Personality and Mood: Is Neuroticism a predictor of negative mood change via serotonergic function?

Mary Elizabeth Stewart

Doctor of Philosophy

University of Edinburgh

2001

Declaration

The research described in this thesis was the unaided work of the author, except where acknowledgement is made by reference. No part of this work has previously been accepted for any other degree, nor is any part of it being concurrently submitted in candidature for another degree.

Mary Elizabeth Stewart

April 2001

Acknowledgements

A great number of people have aided in the completion of this thesis. First and foremost I would like to thank all of those who gave up their time to take part in this study, in particular, those who gave up two days of their lives to drink the unpleasant amino acid drink.

I would like to thank:

My two supervisors, Professor Klaus Ebmeier and Professor Ian Deary, for their support, advice, and encourgement. They have proved to me that happy introverts do exist.

Norma Brearley, for all her help with Endnote and with my questionnaire data, as well as her constant support and encouragement while I was working at the MRC Brain Metabolism Unit and beyond.

Margaret Van Beck, for her help with, spinning the bloods of the volunteers, with scoring the questionnaires, and her constant support. Without these two ladies the time would have gone much slower. I thank them both for making my time at the MRC Brain Metabolism Unit a happy one.

Anne MacIntosh, Sharon Battersby and Carol Swanson for help with spinning my bloods. Polash Shajahan, Alan Doris and Prem Shah, for help with interviewing my volunteers with regard to any possible psychiatric or medical histories, as well as their support throughout my thesis.

Emma Drysdale for her patience when sharing an office. Ronan O'Carroll for his support, advice and ever present wit.

Mike Glabus for his help with setting up and analysing the EEG material.

The lecturers who gave up some of their lecture time for me to make an announcement to recruit volunteers.

The servitors in the psychology department who made that the volunteers picked up their packets up food. Particular thanks goes to George who helped to give me perspective.

The psychiatric department at the University of Newcastle for providing the amino acid drinks and for testing the blood samples. In particular, Eddie Alderson and Mel Leitch.

Katy Smith, from the University of Oxford, and John Hughes, from the University of Newcastle, who gave me important advice before I started testing with regard, to the diet for the volunteers, and with possible problems with the drinking of the amino acid drink.

John "the van", for helping me collect supplies of food from the supermarkets for the volunteers.

Finally, I would like to thank all my friends and family who have supported me with their constant encouragement throughout this time, including Alan Davidson, Livia de Hoz, Bella Starling, Jonathan Pimm, Tara O'Driscoll, Andrew Woodward, Iraide Baxeter, Stephen Eglan and Sue-Ella Holmes to name but a few.

Abstract

The overall aim of this thesis is to establish whether Neuroticism predicts mood change after serotonin depletion. In the process, the association between personality traits and mood states is examined, as well as the structure of personality. Cloninger (1987) suggests that the personality dimension of *Harm Avoidance* is a correlate of brain serotonin activity. *Neuroticism*, closely related to Harm Avoidance (Zuckerman & Cloninger, 1996), is associated with negative mood in healthy volunteers and in patient populations (Costa & McCrae, 1980; Kendler, Neale, Kessler, Heath, & Eaves, 1993; Roy, 1990). Affective disorders and the serotonergic system have been linked through (1) clinical antidepressant trials of specific serotonin re-uptake inhibitors (Boyer & Feighner, 1996); (2) genetic studies, associating the serotonin transporter gene with depressive illness (Ogilvie et al., 1996); and (3) mood change induced by tryptophan depletion (Delgado et al., 1994).

I recruited 1032 university students in Edinburgh to complete the Eysenck Personality Questionnaire Revised, the Tri-Dimensional Questionnaire, the Befindlichskeitskala, the General Health Questionnaire 28, the State and Trait Anxiety Inventory and the Oxford Happiness Inventory. Researchers are in general agreement that three to five factors can be extracted from personality questionnaires and that two factors in particular correspond well - Extraversion and Neuroticism. Factors of Emotionality, Extraversion and

Conscientiousness could be derived from both combined and individual item level analyses of the personality questionnaires (n=897, 347 males and 550 females). An Emotionality factor is suggested at every level of analysis. Neuroticism and Harm Avoidance related highly to mood.

Participants who scored at either end of the Neuroticism scale from the pool of volunteers (n=1032) were selected. This study investigates whether participants who score highly on Neuroticism scales (n=17) are more predisposed to developing depressive mood changes than low Neuroticism scorers (n=15) following tryptophan depletion. Volunteers took part in a controlled double-blind balanced cross-over study of tryptophan depletion. Before and 5 hours after amino-acid drinks a detailed assessment of mood and neuropsychological function was carried out. Scores on Neuroticism scales did not significantly contribute to the prediction of mood change. The effect size, d, for Profile of Mood States depression sub-scale differences between depletion and non-depletion days, for high N scorers was 0.62. This means that 45 high N subjects would be required to achieve a power of 80% with a two-tailed significance of $p<0.05$. Therefore, it would appear that the personality factor of Neuroticism is not an important predictor of mood changes invoked by serotonergic depletion.

Overview

The central hypothesis of this thesis is that the personality trait Neuroticism is positively related to negative mood and depression through serotonin. This may then suggest that Neuroticism is a predictor of clinical depression through serotonin. This is tested by selecting a group of students who score at the extreme ends of the Neuroticism scale and then depleting their brain serotonin by the technique of tryptophan depletion. There are clearly a number of assumptions which need to be justified.

The first question is whether Neuroticism is the best measure by which to select individuals. Any trait measure must be shown to be both stable and reliable. It must be shown that this particular dimension relates highly to both negative mood and depression, and that high scores on this dimension are able to predict these states. That serotonergic hypoactivity is the mechanism by which those with high Neuroticism scores are predisposed to depression must be justified, both by research on affective disorders and on personality. The tryptophan depletion itself must also be justified. It has to be shown to lower mood through lowering central serotonin.

Chapter One: Personality Traits

1.1 General Background

Information about an individual's personality may be collected by a variety of methods. Personality questionnaires are much favoured as a reliable questionnaire can be constructed and norms established quite easily. A questionnaire can have good internal consistency, high test-retest reliability but reliability does not insure validity. Objective tests may also be used where observations of actual behaviour are made. Practically any measure can be taken which can then be related with a particular personality type or trait. Kline (1993) makes the example of asking a subject to clean their shoes. A number of variables can be measured such as how long it takes for the task, whether the tongues are cleaned, whether the laces are removed and so on. But what is being measured? And if we can guess at what is being measured then the subject probably can as well, thereby making the test not objective.

Trait theory of personality suggests there are a number of dimensions, which allow us to characterise people by underlying basic traits. Trait measures prove to be one of the most reliable and stable instruments in psychology (Matthews & Deary, 1998). Indeed Buss (1989) clearly puts traits in the centre stage

"if there is to be a speciality called personality, its unique and therefore defining characteristic is traits": p1378

Traits are in no way new to the study of personality. Galen, a Greek physician, perceived temperament, melancholic, choleric, phlegmatic and sanguine to be based on Hippocrates' four homours, black bile, yellow bile, phlegm and blood respectively. Contemporary theories of traits similar to previous studies attempt to simplify and categorise aspects of the persona by measurement and assessment. Personality questionnaires tend to be the instruments of choice with psychometrics providing statistical techniques to aid with judgements of reliability, validity and stability.

This chapter aims to discuss the main trait theories in personality. Within discussion of personality traits must come discussion of psychometrics. Section 1.2 discusses the psychometric criteria for a single scale and multiple scales, also a number of related issues such as how many traits are relevant to personality are discussed within this framework. Having established these criteria section 1.3 discusses some of the major trait models within personality research.

1.2 Psychometrics and Related Issues

1.2.1 Psychometrics of Single Scales

An individual trait scale must satisfy three criteria: it must be stable, reliable and valid. For a scale to be stable it must have a high test-retest correlation over time. Personality does change slightly as a person gets older, for

instance scores on Extraversion (E) decrease with age (Eysenck, Eysenck, & Barrett, 1985), however, trait measures are stable over at least one year (Conley, 1984; Poguegeile & Rose, 1981).

Secondly, for a scale to be reliable it must show high internal consistency. Meaning the items on the scale are highly correlated, that they are, in essence, measuring the same thing. The Cronbach alpha statistic allows for a measurement to be made on a single scale which gives a value for how the scale correlates with itself (Cronbach, 1990).

Thirdly, for a scale to be valid it must measure what it claims to measure. A scale can be reliable and stable but not be valid. There are a number of different approaches to measuring validity (these are reviewed by (Kline, 1993) and (Anastasi, 1988)). In reference to personality scales I shall concentrate on two: predictive and construct validity. Predictive validity suggests that the scale will predict a certain criterion. The difficulty with this is what would be the criterion. For the scale Neuroticism (N) one may predict low mood (see Chapters 3 and 6) or with an intelligence test one may predict a similar outcome on another intelligence test or academic success. Construct validity, within the realms of validity, is the Holy Grail. This is where a particular concept driven by theory is tested. Construct validity embraces every type of validity. In reality a construct is constantly evolving where a scientific entity is being supported with evidence. This is the situation in personality research where constructs such as Neuroticism and

Extraversion have evolved which are reliable, stable, and predictive, currently construct validity is being tested.

1.2.2 Psychometrics of Multiple Scales

In order to gain a theory of personality more than one trait must be assessed. A theory of personality must incorporate how traits relate to each other. Personality questionnaires assess a number of different traits with items making up a particular scale. Factor analysis simplifies these scales into a number of different factors. These are, in essence, mathematical models. In order to satisfy criteria for factor analysis there are three essential points.

One the data must be suitable. Each scale must have good reliability, and there must be enough items to define the trait sufficiently. There is a pay-off here - as the number of items increases, a greater number of subjects are required. Kline (1993) reviews the discussion on this point and concludes that with a minimum subject group of 100, the minimum subject to item ratio should be 2:1.

Secondly, there a number of different techniques, which can be chosen for factor analysis, differing methods can lead to differing solutions. The various methods may be chosen to fit in with theories of personality or statistical theories. There are three main points: the number of factors extracted, the method chosen to extract the factors and the type of rotation. Theoretically, the same number of factors as items can be extracted. However, the aim is to simplify the data into factors which are meaningful and which explain an

adequate amount of the variance. Therefore if a questionnaire has 100 items, 100 factors could be extracted but this would not simplify the questionnaire. There are a number of guidelines to help choose the best number of factors to be extracted, so that each factor explains a meaningful amount of variance. One method is to use the Scree plot (Cattell, 1996; Kline, 1994). This is a graph of eigen values. The eigen value reflects the amount of variance explained by each factor. When this graph levels off an additional factor adds little to the solution. The choice of how many factors is how many add to the solution. Therefore for instance if the graph smoothes off after 4 factors then 4 factors will be extracted, with the fifth adding little to the explained variance.

There are a number of methods which can be used to extract these factors. These methods vary in the assumptions regarding the amount of variance explained. When factors are extracted using principal components analysis unities are placed in the diagonals of the correlation matrix. This does not allow for error, an assumption is being made that the matrix explains all the variance. A more conservative method is principal axis factoring. Instead of placing unities in the diagonals, communalities are used. The communalities are the amount of variance which can be explained by common factors.

The number of factors has been decided and the way in which they are to be extracted but what of their position in space? These factors can be uncorrelated (orthogonal) or correlated (oblique). If two factors are drawn graphically an orthogonal rotation would place these factors at right angles to

each other. In some cases this decision is arbitrary in others the angle of rotation is derived from the personality theory (e.g. Eysenck's theory see section 1.3.2). Kline (1994) reviews a number of methods and recommends that for orthogonal rotation the technique of Varimax (Kaiser, 1958), while for oblique the technique of Direct Oblimin (Jennrich & Sampson, 1966) are the best available.

Factors can be gained by a number of different methods, can be rotated ad infinitum but are these factors meaningful? Here we return to the quest for the Holy Grail of construct validity. It is by testing these factors and finding construct validity that the factors are shown to have meaning.

1.2.3 Criteria for personality traits

Which criteria are the most important for accepting a particular model of personality or whether a personality trait is basic is a point of debate. Only when we have construct validity will the answers be clear. The criteria in themselves develop as the theory of personality develops. Most would argue that a theory of personality must be replicable, be able to be found in differing cultures, show heritability, show relation to underlying biological or physiological factors, and be stable (Costa & McCrae, 1992a; Eysenck, 1991; Eysenck, 1992).

1.2.4 Number of Traits

Theories of personality also differ on the number of traits or factors. However, researchers are in general agreement that three to five can be

factored from a variety of different questionnaires and a variety of approaches (Digman, 1990; Zuckerman, Kuhlman, Thornquist, & Kiers, 1991). This is the case whether a questionnaire has been structured from a lexical method (Cattell, Eber, & Tatsuoka, 1970; Costa & McCrae, 1992b), from observing psychiatric patients (Eysenck & Eysenck, 1975) or from animal models (Cloninger, 1987). Factors derived from these models are enduring, and are found in a number of personality systems (Costa & McCrae, 1992b; Eysenck et al., 1985). The factors are found in different age, sex, race and language groups (Barrett & Eysenck, 1984; Barrett, Petrides, Eysenck, & Eysenck, 1998; Costa & McCrae, 1992b). The heritability of the factors is high (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990; DiLalla, Gottesman, Carey, & Bouchard, 1999; Eaves, Eysenck, & Martin, 1989; Jang, McCrae, Angleitner, Riemann, & Livesley, 1998).

Two factors in particular correspond well no matter on what premise the questionnaire has been devised. These are most commonly known as Extraversion and Neuroticism (Draycott & Kline, 1995; Zuckerman et al., 1991).

1.2.5 Lower or Higher Order

Implicit within the decision of how many factors should be extracted is that the fewer the factors the broader a dimension they represent. Some theorists argue (Cloninger, 1987; Costa & McCrae, 1992b) that each factor scale can have subscales and that these can in turn be used to relate more

specifically to various criteria. Cattell et al (1970) used a questionnaire to measure sixteen personality factors. However, it is generally agreed that this system is too broad and has at least 11 factors too many (Digman, 1990).

Again we turn back to the psychometrics of a scale - one of the criteria is that they are stable and not just measuring a state. Eysenck (1991) argues that the higher the level, or in this case, the factor, the more it is a measure of a trait, whereas the lower the measure, in this instance, the subscale, the more it is a measure state.

1.2.6 State versus Trait

The boundaries between state and trait and their relationships are complex, and are only touched upon in this thesis. In Chapter Two mood states are discussed, while in Chapter Three the relationships between personality traits and mood states are elaborated.

Trait theory predicts that personality traits are related to states, the effect of traits on behaviour may be mediated by states, and under certain circumstances traits may be predictive of mood states. This argument incorporates the principles of aggregation. Eysenck (1969) and Allport (1961) have argued that a trait may not be able to predict behaviour in one particular situation, but that it is only over a number of situations or when behaviour is aggregated that the trait can be predictive. Epstein (1979; 1980) has shown that if a small number of comparisons are made then correlations are low. He suggests that if two possibly unreliable measures

are taken, correlations cannot help but be low. He observed volunteers' moods and behaviour over a period of thirty days. If he correlated one day with another he found the correlations to be low, however, when he based his correlations on average behaviour the correlations increased to +0.80. Rushton et al (1983) make the point that an aggregate measurement is more stable and representative than any single measurement.

Trait theory as a whole relies on aggregate measures so that a stable trait is captured rather than a transient state. Various personality theories suggest hypotheses about the relationships between a particular state and a particular trait. These theories are elaborated in Section 1.3 and in more detail in relation specifically to mood in Chapter 3.

1.3 Personality Theories

Up to this point I have discussed the psychometric properties which a personality scale must have and mentioned the debate as to whether there are three or five factors. For this thesis it is necessary to use reliable and valid measures of personality. Therefore the main models will be described with reference to their psychometric properties.

The main proponents of a five factor model are Costa and McCrae, while the main proponent of a three factor model is Eysenck. There are other three factor models available such as Cloninger's. Its biological underpinnings have great face validity, however, Cloninger is a relative newcomer to

personality research and more replication is needed for his scale to assume a firm position. Each of these models will be discussed separately.

1.3.1 The Big Five

Costa and McCrae (Costa & McCrae, 1992a; Costa & McCrae, 1992b) propose a five factor model of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. These five factors are not derived from an underlying biological theory but were originally discovered by analysing natural language trait adjectives. Costa and McCrae searched the literature and identified traits and dispositions which appeared to important to other theorists. Through trial and error, item inclusion and exclusion, and extensive factor analysis personality scales were drawn up – the NEO-PI-R and the NEO-FFI. The NEO-PI-R is a 240 item questionnaire with 5 domains and each domain has 6 facets. The facets are depicted in table 1.3.1. The NEO-FFI is a shorter version measuring the same domains (60 item). The scale is based on the idea that personality is hierarchical, that it can have broad dimensions, which can in turn be represented by narrow facets. The Cronbach alphas for the domains are generally high particularly for Neuroticism and Extraversion, however, the alphas for the facets are not as high, ranging as low as 0.56 (Costa & McCrae, 1992b).

The most convincing evidence supporting the Big Five is that these five factors can be found in numerous personality questionnaires (Costa & McCrae, 1992b; Digman, 1990; Ostendorf & Angleitner, 1994) and across

Table 1.3.1: The NEO-PI-R dimensions and facets

NEO-PI-R Dimension	NEO-PI-R Facet
Neuroticism	N1: Anxiety, N2: Angry Hostility, N3: Depression, N4: Self-Consciousness, N5: Impulsiveness, N6: Vulnerability
Extraversion	E1: Warmth, E2: Gregariousness, E3: Assertiveness, E4: Activity, E5: Excitement-Seeking, E6: Positive Emotions
Openness	O1: Fantasy, O2: Aesthetics, O3: Feelings, O4: Actions, O5: Ideas, O6: Values
Agreeableness	A1: Trust, A2: Straightforwardness, A3: Altruism, A4: Compliance, A5: Modesty, A6: Tender-Mindedness
Conscientiousness	C1: Competence, C2: Order, C3: Dutifulness, C4: Achievement Striving, C5: Self-Discipline, C6: Deliberation

cultures (Katigbak, Church, & Akamine, 1996; Yang & Bond, 1990). There are, however, many different big fives, which do not always correspond.

Zuckerman et al (1991) propose an alternative five factor model derived from a wide range of published personality questionnaires including the EPQ (Eysenck & Eysenck, 1975), the Jackson Personality Inventory (Jackson, 1976), the Karolinska Scales of Personality (Schalling, 1978), and the Sensation Seeking Scale (Zuckerman, 1979). Two of the factors Sociability and Neuroticism-Anxiety correspond to Extraversion and Neuroticism respectively. One factor, Impulsive Unsocialized Sensation Seeking (ImpUSS), which includes high loadings from sensation seeking scales, Psychoticism and Autonomy scales, with a negative loading from a socialisation scale seems to correspond to some degree to low Conscientiousness. Another factor, Aggression-Hostility (Agg-Host), which includes high loadings from aggression, hostility, anger and negative loadings from social desirability and responsibility, corresponds approximately to low Agreeableness. Zuckerman's fifth factor Activity (Act)

does not correspond to openness, the fifth factor in Costa and McCrae's five factor model. This model in terms of its biological basis is discussed in section 1.3.4.

Although five factors have been found cross culturally these are not always the same five factors (Yang & Bond, 1990). In some instances the five factor model does not emerge for instance (Han, Weed, & McNeal, 1996).

1.3.2 Eysenck's Big Three

Eysenck's Personality Questionnaire contains three broad factors – Extraversion (E), Neuroticism (N) and Psychoticism (P). Eysenck's three factor model is derived from psychiatric concepts and has been proposed to have a biological basis. Eysenck's questionnaires have also been revised, culminating in the EPQ-R (Eysenck et al., 1985). The traits are slightly different to those of Costa and McCrae. Someone who scored highly on Neuroticism could be described as a worrier, emotional, moody, shy and anxious. Someone who scored high on Extraversion would be described as sociable, friendly, lively, assertive, carefree and active. High scorers on Psychoticism may be described as tough minded, aggressive, cold, egocentric, impulsive, antisocial and unempathetic.

One of Eysenck's Personality Questionnaire (EPQ) greatest strengths is the almost complete separation of the Extraversion, Neuroticism and Psychoticism scales following factor analysis. These factors are common to most of the well known personality questionnaires (Kline & Barrett, 1983) and

can be found across cultures (Barrett & Eysenck, 1984). These scales have been replicated many times. In fact, Kline (1993) comments that if we want a reliable and valid measure of E and N then the Eysenck's questionnaire is about as good as can be desired. One criticism may be that the three factors are broad. Also in the original version of the EPQ the Psychoticism (P) scale was very much skewed towards zero, particularly in females, and had low internal consistency. The revised scale EPQ-R (Eysenck et al., 1985) has improved the P scale but it still has some of the original problems.

Eysenck (1967) bases his biological theory on two neural systems. The first is a cortico-reticular loop which includes the cerebral cortex and the ascending reticular activating system (ARAS). The reticular formation contains several populations of neurons which are involved in sleep, pain, eye movements, alertness, with connections to sensory, motor and autonomic neurons (Barr & Kiernan, 1993). Eysenck (1967) proposed that Introversion/Extraversion differences are based upon levels of activity of the cortico-reticular loop. Introverts having higher levels of activity than extraverts and being chronically more aroused. Due to this over arousal, those that score highly on Introversion will seek out non-stimulating behaviours such as reading in solitude.

Neuroticism, he postulated, is related to the activity of the visceral brain, the second neural system, which incorporates the hippocampus, amygdala, singulum, septum and hypothalamus and has interconnections to the cerebral cortex. Activity of the visceral brain produces autonomic arousal.

Those who score highly on the Neuroticism scale are more likely than low scorers to become autonomically aroused. Thus the high scorers are more likely to become agitated when faced with stressful situations.

This biological theory is attractive in that it is testable. However, one of the problems when testing individuals is the environment in which they are tested. Individuals who are already high on arousal (introverts), or particularly autonomically aroused (high N scorers) will react to a situation differently. Gale finds that if the situation is particularly arousing or particularly stressful this may mediate the results (Gale, 1973).

1.3.3 Gray's conceptual model of personality

Gray (1981; 1987) also suggests a theory of personality derived from a biological basis. He argues that although Eysenck's theory "*bestrides the field of personality like a colossus*", the degree of rotation of these factors in space is a theoretical decision (Gray, 1981). He suggested that Eysenck's factor structure should be rotated to form the dimensions of trait anxiety (Anx) and impulsivity (Imp) (Gray, 1991). The anxiety dimension he suggests is closer to N than to E and is a mix of high N, low E and low P (a rotation of approximately 30 degrees). The impulsive dimension is made up of high N, high E and high P.

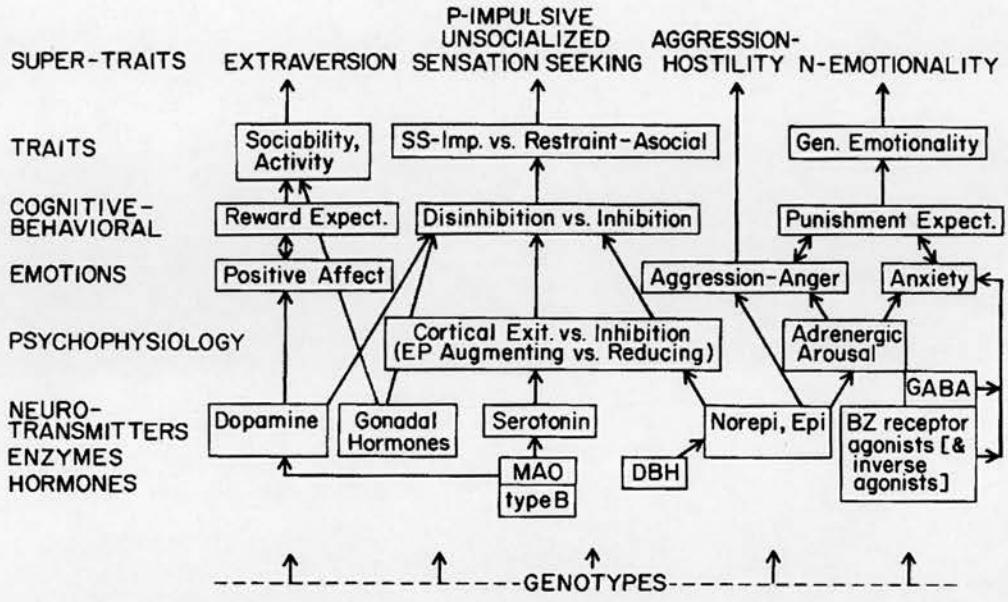
These theoretical dimensions he suggests are related to two conceptual systems: the behavioural inhibition system (BIS) and the behavioural activation system (BAS) respectively. The BIS is activated by fear and

novelty stimuli, and signals of punishment and non-reward. Its function is to inhibit on-going behaviour and increase arousal and attention. This system, according to Gray, is more easily activated in the anxious individual. The BAS is sensitive to signals of reward and non-punishment. It controls approach behaviour and is more active in the impulsive individual. Thus the impulsive person is more likely to show approach behaviour because of their increased sensitivity to reward signals. These conceptual systems are in turn related to neurochemical systems. Gray (1991) suggests that the BIS is particularly sensitive to anxiolytic drugs and that the BAS may be closely related to the dopaminergic system.

1.3.4 Zuckerman's biological theory of personality

A discussion of models of personality would not be complete without Zuckerman. Zuckerman is one of the leading figures researching the biological basis of personality. He would criticise both Gray and Eysenck for assuming isomorphism (a one to one correspondence) between personality traits and brain systems. He suggests that this is too simplified, and that any personality trait may relate to more than one brain system, and that a brain system may be related to more than one personality trait (Zuckerman, 1991). Figure 1.3.1 shows his model where neurophysiological systems have involvement in more than one trait. This is a very complicated picture, however, Zuckerman suggests that various pathways may be related rather than just levels of the monoamines. Furthermore that combinations of biological traits may underlie trait anxiety and emotionality.

Figure 1.3.1: Zuckerman's (1991) psychobiological model of personality



1.3.5 Cloninger's Three Dimensions

Cloninger (1987) proposed a biological model derived from animal research. He suggests that three personality traits: Harm Avoidance (HA); Reward Dependence (RD); and Novelty Seeking (NS) are heritable and that they relate to the monoamine systems: serotonin; noradrenaline; and dopamine respectively. They are genetically independent but the systems are interconnected. The systems act together, for instance Novelty Seeking, or dopaminergic activity will influence approach and initial acquisition of rewarded behaviour, Reward Dependence, or noradrenergic behaviour influences rate of extinction of previously rewarded behaviour. This means that the phenotypes or in other words the factors are allowed to correlate.

This model is attractive in that a trait is directly related to a monamine system. However, Cloninger's "unified biosocial theory of personality (Cloninger, 1987) must yet be shown to be both reliable and valid. In large sample of 1019 subjects the Cronbach alpha's on Cloninger's dimensions were not high (Cloninger, Przybeck, & Svrakic, 1991). Kline (1993) recommends that they should be nearing 0.9 and not fall below 0.7. Cloninger and colleagues splits his data set by gender and by skin colour (black, white). Across these groups the Cronbach alpha statistic ranges for Harm Avoidance, between 0.68 and 0.75, for Novelty Seeking between 0.77 and 0.85 and for Reward Dependence between 0.55 and 0.69. The Reward Dependence scale clearly has low internal consistency and may require revision.

Cloninger's model is not so well established as Eysenck's and the jury is still out on the dimensions that Cloninger proposes and the model itself. There are a few examples where Cloninger's model has been tested in other groups. Using confirmatory factor analysis on both a community based adult population (n=360), and a group of undergraduate students (n=233) (Parker, Bagby, & Joffe, 1996) found a model consistent with Cloninger's. However, the Reward Dependence scales were still problematic. Similarly Bagby and colleagues (1992) suggested from a group of undergraduate students (n=216) that a good fit of Cloninger's model could be found. However, Earleywine, (1993) disagreed with this interpretation, suggesting both from further data (Earleywine, Finn, Peterson, & Pihl, 1992) and from Bagby's

(1992) study that Cloninger's model was not a good fit. The chi-square goodness-of-fit did not support the model while three other indices did (the goodness-of-fit, the adjusted-goodness-of-fit, and the root mean-square residual). Earleywine (1993) suggests that these three indices should not be taken in isolation, that these should be used in comparison to other models to test whether Cloninger's model is the best fit. Support for Earleywine's position comes from Raykov (1993) and Cannon and colleagues (1993), who suggest that these three indices are descriptive and that the chi-square shows that the model is a poor fit.

The model has been tested in other cultures (Aschauer et al., 1994; Le Bon, Staner, Tecco, Pull, & Pelc, 1998; Lepine, Pelissolo, Teodorescu, & Teherani, 1994; Otter, Huber, & Bonner, 1995; Weyers, Krebs, & Janke, 1995) as well as in North America (Bagby et al., 1992; Cannon et al., 1993; Giancola, Zeichner, Newbolt, & Stennett, 1994; Parker et al., 1996; Sher, Wood, Crews, & Vandiver, 1995; Waller, Lilienfeld, Tellegen, & Lykken, 1991). Mixed results have been found. In the French and German samples the questionnaire was a translation. These authors find a somewhat similar model to Cloninger's (Le Bon et al., 1998; Weyers et al., 1995). However, in the English speaking countries, the model was not replicated satisfactorily. In an English sample (Otter et al., 1995), although the Harm Avoidance scale was found to be reliable, Cloninger's model differed significantly (n=413, 106 males and 307 females). In two of the North American samples the sub-

scales of Reward Dependence did not share variance but loaded on different factors (Giancola et al., 1994; Waller et al., 1991).

Two studies, using subjects from the U.S., also assess the TPQ at the item level using exploratory factor analysis (Cannon et al., 1993; Sher et al., 1995). One study tests a Hebrew version of the TPQ at both the item and scale level using exploratory factor analysis (Zohar et al., 2001). Sher et al (1995) found a three factor solution which provided moderate support for Cloninger's model. Factor 1 clearly represented Harm Avoidance and although factors 2 and 3 represented Novelty Seeking and Reward Dependence respectively there was a considerable amount of overlap between these two factors. Cannon et al (1993) reject a 3 factor solution suggesting that one of the factors was overly broad and select a 5 factor solution. Unfortunately this group does not describe the three factor solution at the item level, however, they do find low Cronbach alpha's for the original scales. Sher et al (1995) also describe four and five factor solutions, with the four factor solution explaining more variance than the three.

Giancola et al. (1994) test the validity of the TPQ by comparing each of the three dimensions to established personality measures. In essence they are testing whether the dimensions are predictive which is part of construct validity (see section 1.2.1). Giancola et al. (1994) test Harm Avoidance by comparing it against measures which test anxiety, depression, self-esteem, inwardly directed hostility and sensation seeking. Reward Dependence against measures which test depression and self-esteem, and Novelty

seeking against measures designed to test sensation seeking, outwardly directed anger, behavioural hostility and anxiety. There is clearly some overlap between the measures which they have chosen to test. Their interpretation of Cloninger's three dimensions appears to differ from that which Cloninger (1987) himself proposed, particularly that for Reward Dependence. Cloninger (1987) describes someone who scores high on Reward Dependence but average on the other two dimensions as "highly dependent on emotional supports and intimacy with others; highly sensitive to social cues and responsive to social pressure; highly sentimental, crying very easily; industrious, ambitious overachiever who pushes self to exhaustion; extremely sensitive to rejection from even minor slights, leading to reward-seeking behaviours such as overeating; highly persistent in craving for gratification even when frustrated in attempts to obtain expected recognition or benefits". While someone at the other end of the scale would be described as "socially detached, never sharing intimate dealings with others, content to be alone; independent nonconformist, practical and self-determined; minimal ambition and motivation to please others; cynical, alienated, and insensitive to social cues and pressures; does only what is immediately gratifying, stopping other activities as soon as they cease to be rewarding. In these descriptions it is hard to see how Giancola and colleagues suggest that Reward Dependence should be compared against measures for depression and self-esteem. However, Cloninger gives many different descriptions of possible personality types when the scales interact which may lead to some confusion.

Giancola et al's study however, does test the model against other personality tests in some detail. As there were significant gender differences on many of the questionnaires males and females were analysed separately. The most interesting finding is that Harm Avoidance has an almost one to one relationship with Spielberger's Trait Anxiety scale in both men and women ($r=0.67$ and $r=0.64$ respectively). Reward Dependence does not have the supposed relationship with depression or low self-esteem.

Zohar and colleagues although they do find some support for Cloninger's model this is weak as over 50% of the items do not load on the designated factor (Zohar et al., 2001). When analysed at the scale level the scales lack distinction, loading on more than one factor. Zohar et al. enforce four factors on the model of Harm Avoidance, Reward Dependence, Novelty Seeking and Persistence. Although at both the item and scale level Harm Avoidance is recognisable, only 50% of the HA items load on the HA factor and at the scale level the sub-scale of uncertainty loads also on the Novelty Seeking factor.

The attraction of Cloninger's theory is its face validity for biological underpinnings, however, one must question both the reliability and the validity of the scales. In all cases the scale of Harm Avoidance appeared robust. However, the questionnaire as a whole does not appear to be well replicated across cultures or even in the culture where it was devised. Further, little is yet known about the underlying mechanism by which these traits may predict behaviour.

1.3.6 Comparisons of models and factors

Only a selection of personality models and scales have been reviewed in this chapter but from these it is clear that no model described to date is without fault. In order to gain further insight into the predictive validity of the scales and the amount of variance that each explains, scales and models are compared against each other. This can be done in a number of ways. For instance, individual scales can be correlated, regression analysis may be carried out, or factor analysis may be performed to ascertain which scales or items factor with each other.

Two dimensions, Extraversion-Introversion and Neuroticism (Emotional Stability-Instability, Negative Emotionality) are present in nearly all of the three or five factor models. If a three factor solution is extracted from 46 scales taken from a total of eight personality tests (Zuckerman, Kuhlman, & Camac, 1988) the solution approximates Eysenck's three-factor model. Draycott and Kline (1995) showed that although Costa and McCrae's five-factor model did explain more of the variance than Eysenck's three factor model, three factors explained the variance best. Neuroticism and Extraversion explained much of the shared variance between the NEO-PI and the EPQ-R (Avia et al., 1995; Draycott & Kline, 1995; Saggino, 2000). An Italian replication found similar results however they found that 4 factors, Extraversion, anxiety, tough-mindedness and conscientiousness, best explained the data (Saggino, 2000). In a Spanish sample both three and four-factor models were found (Avia et al., 1995). Eysenck's three factor

model and Costa and McCrae's five factor model can be recovered from using the NEO-PI-R and the NEO-FFI (Caruso & Cliff, 1997) although these questionnaires are designed to recover five factors. Unsurprisingly, if Costa and McCrae's, Eysenck's and Zuckerman's models are compared, there is high correspondence between these models for Extraversion/Sociability and Neuroticism (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993).

Digman (1990) states in his review that there appears to be agreement to the number of personality dimensions but there is less agreement as to their meaning. Digman suggests that there is evidence for five factors of personality from Fiske (1949) to the present day. Again Extraversion and Neuroticism are present in all of the models which Digman suggests are support for the argument of a five factor model of personality.

When Cloninger's model is compared to the Eysenck's direct relationships are not found (Sher et al., 1995; Zuckerman & Cloninger, 1996). Harm Avoidance has been found to correspond highly with both Neuroticism and Extraversion (Sher et al., 1995; Zuckerman & Cloninger, 1996). Novelty Seeking has been found to correlate moderately with both Psychoticism ($r = 0.41$) and Extraversion ($r = 0.44$) and Reward Dependence with Psychoticism ($r = -0.45$).

The interpretation of studies such as these is arbitrary. When scales are compared against each other and factorial analyses carried out at this level, the interpretation of the retrieved factors can be difficult. It is easy to see how what one person may call Conscientiousness another may call Tough

Mindedness and so on. This issue is not necessarily made less arbitrary when analyses are carried out at the item level, however, it is clearer what goes into making a particular factor. However, it is only when these factors are tested against other constructs that they can truly be defined.

1.4 Summary

There are many possible ways of measuring personality however in order to form a science of personality research it is necessary to use measures which can be tested and which are both reliable and valid. Two trait measures stand out - Extraversion and Neuroticism, there is still a debate as to whether there is one further factor or three. Cloninger's 3 factor theory is attractive however, two of the scales are not well replicated, Reward Dependence and Novelty Seeking. However, the third scale of Harm Avoidance appears robust and correlates highly with Eysenck's Neuroticism. The gold standard to date for measuring Extraversion and Neuroticism is Eysenck's revised personality questionnaire.

Chapter Two: Mood

2.1 General Background

Research on mood ranges from describing mood, its structure and its correlates in healthy volunteers, to assessing mood in disorders such as clinical depression. Mood and mood change can be measured directly by, for instance, observer rated or self-report mood scales. It is now well recognised that cognitive impairments accompany symptoms of depression (Murphy, Sahakian, & O'Carroll, 1998) and these can provide indices of depression. These and other measures of mood and mood change are observed in patients with depression, in healthy volunteers undergoing mood induction, and in dysphoric individuals.

This chapter attempts to describe how mood and mood change can be measured with special reference to depression and models of depression. Correlates of mood change shall be discussed such as cognitive function and electrophysiology. Furthermore issues relating to the definition of mood and mood state are discussed.

The main aim of this chapter is to discuss how mood can be measured within normal controls, within patient populations and within models of depression. Therefore well established questionnaires will be discussed as well as correlates of mood change such as cognitive function and electrophysiology. Mood is a general term used to define many different kinds of states. Issues

relating to measurement of mood in general will be touched on, as well as definitions of state and trait. The differences between these two constructs will be discussed.

2.2 Measurement in Healthy Volunteers Vs Clinically Depressed Patients

Mood as measured within clinical depression is different to that within healthy normal controls. Diagnostic categories are used within the affective disorders (American Psychiatric Association, 1994; World Health Organisation, 1992) in which there is a dichotomy of illness versus health. However, mood in the healthy individual is a continuum. Therefore any model of depression in normal volunteers is in truth a model of low mood rather than clinical depression.

In order to gain an understanding of depression and mood disturbance, much work has been conducted in healthy volunteers. This is in order to understand mood without the confounding effects of drug treatments or indeed clinical depression itself. However, there has been very little explanation about how mood in healthy volunteers is comparable to mood in clinical depression. Scales used in healthy volunteers may not capture and reflect the full range or severity of mood change that occurs in clinical depression or indeed vice versa (see section 2.4).

Mood states can be viewed as comparatively short-lived processes (e.g. a momentary surprise, a flash of anger, a brief scare) rather than as a durable

disposition or trait. However, in many cases these mood states are not so short-lived. Anxiety and depression are viewed as states, which are changeable but can be of longer duration. One of the most salient features of depressed individuals is the perservance of low mood (American Psychiatric Association, 1994). For DSM-IV criteria a lowered mood state or loss of interest or pleasure in nearly all things must persist for a minimum of 2 weeks.

There are a number of situations that allow study of the changes that occur with mood change, for instance, onset of depression, recovery from depression, mood induction techniques, and diurnal variation in both patients and controls. The longitudinal study is ideal as assessments can be made prior to illness, however, one cannot always predict who will become depressed. Methods, such as mood induction, allow us to have a window into understanding some of the mechanisms that may produce and maintain a low mood, such as that in clinical depression, without the confounding variables of therapy or having had an illness. Patients, who have recovered from depression, can be compared to either patients with depression or healthy controls, test results from a mood induction study can be compared prior, during or after mood change.

Dysphoric individuals are also used as a model of the mood change which occurs in depression. There are obvious advantages and disadvantages to this model. As with mood induction, there are no confounding factors of illness and dysphoric individuals are much easier to recruit for a study.

However, dysphoria is not depression, nor is a lowering of mood in a mood induction study, and therefore will have characteristics, which differ from those in depression.

The properties of mood, issues relating to the measurement of a state compared to the measurement of a state and the measurement of mood in healthy controls, depressed patients and within mood induction will be discussed. Further the expected differences which are shown in correlates of depression such as cognitive tests and electroencephalogram will be described.

2.3 The Properties of Mood

Scales used in normal volunteers and those used in clinical populations can overlap, however, the definitions and descriptions of mood can vary. This is a very thorny area, as unlike the study of personality traits few researchers have relied on models. The research has been more need than theory driven. Within research on personality traits researchers have been asking questions concerning the number of personality factors, their description and structure within research on mood questionnaires have been derived to assess a particular state, for instance, anxiety.

A structure or model of mood or emotion may help in studying the relationships between personality and mood, may give insights into biological basis and into emotions themselves. Within normal mood there is huge variability. In 1999 a special section in the *Journal of Personality and Social*

Psychology was published discussing the structure of affect. Diener (1999) claims that moods such as joy, affection and pride are usually experienced together just as sadness, anger and anxiety are usually felt together. Watson and Tellegen argued for a two factor model of mood which can be derived from self-report mood scales and is made up of two uncorrelated factors of Positive and Negative Affect (Watson & Tellegen, 1985). In a more recent review they suggest that the two dimensions are not the only "basic" dimensions of affect (Watson, Wiese, Vaidya, & Tellegen, 1999). Matthews and colleagues (1990) would agree with this later review suggesting that two factors are too narrow. They suggest three dimensions of energetic arousal, tense arousal and hedonic tone. Although particular aspects of mood do cluster together and may form dimensions, the structure of mood yet has to be adequately defined.

The second major issue within research on mood is the time frame of mood measures. This may vary from weeks to minutes. In some questionnaires such as the PANAS the time frame can be altered from "right now" to "in general". Each study must make clear the time frame and which aspects of mood are being measured. Where the time frame is over a longer period of time this could represent more of a trait measure rather than a state measure. Only within clinical mood states are there definitive time frames. Within the measurement of normal mood there is no definite cut off between what is a state and what is a trait.

A number of researchers have attempted to clarify these issues. Spielberger (1983) convincingly shows that a trait and a state measure can be reliably assessed at the same time in the same individuals with clear time instructions. He proposes that emotional states are transitory while personality traits can be predicted and are enduring. The higher individuals score on the trait anxiety scale the more likely they will score highly on the state measure. The state form of the scale asks the individual to respond as to how they feel *right now, at this moment.* It produces a score that reflects a transitory state and has been shown to be sensitive to environmental stress. While the trait form asks the individual as to how they feel *generally.* It produces a more enduring trait measure.

Zuckerman (1976) helpfully provides some guidelines by which trait and state measures can be distinguished. These are summarised below:

1. Both trait and state tests should show high internal consistency, but trait tests should show high test-retest reliability while state tests show should low test-retest reliability. Traits should show consistency across time while traits should fluctuate due to the situation.

2. Trait and state measures which measure the same construct (such as anxiety) should correlate to a low level, though if these state measures are averaged they should correlate with the trait measure to a moderate degree.

3. Two trait measures of the same construct should correlate more highly together than they do with a single state measure. For instance Neuroticism from the EPQ should correlate more highly with Neuroticism from the NEO-PI-R than with a state anxiety measure. Conversely two state measures should correlate more highly together than with trait measures.

4. A trait measure should not fluctuate due to a transient change in conditions, for instance from a measure in the morning to a measure in the evening whereas a state measure should be sensitive to transient changes.

These criteria although helpful do not fully clarify issues. Models of mood will aid in producing strict criteria for state measures. From studies that use clear definitions of mood, an understanding of mood, its structure and its variability can be built up. Although the structure of mood is still being debated, there are many measurements available, some of which were discussed in section 2.4, that have been shown to be reliable and valid in the study of mood.

2.4 Mood Induction

Mood induction can be used to measure changes that occur with mood. The technique can be utilised to assess correlates of mood change such as electroencephalogram or cognitive correlates. The technique also allows mood itself to be studied. There are many methods of mood induction - some are used in both healthy volunteers and in patients. Mood induction means

an induction of any type of mood, although typically a low mood is produced some researchers try to also induce positive affect. Mood induction of low mood can act as a model for the low mood that is apparent in clinical depression.

There are numerous different techniques and their effectiveness varies. Methods in healthy volunteers populations include hypnosis (Weiss, Blum, & Gleberman, 1987) music, film clips (Ekman, Friesen, & Davidson, 1990), and the Velten Mood Induction Procedure (VMIP). The VMIP involves the subject reading self-referent statements of a depressing or elating nature and is asked to 'try and feel the mood suggested' (Velten, 1968). Other methods which are derived from the biological basis of mood may also be used. For instance altering levels of serotonin by depleting tryptophan may also induce mood change. The method of tryptophan depletion is discussed in Chapter 5.

Mood induction techniques are not typically effective in all volunteers. For instance Blackburn et al (1990) found that 24 out of 40 responded under the Velten mood induction procedure. They found that this response was positively correlated with Neuroticism as measured by the EPQ.

Mood induction, at least with happy and sad facial expressions, appears to be stable over time (Schneider, Gur, Gur, & Muenz, 1994). Healthy volunteers were shown happy or sad faces and asked to try and feel the emotion the face was expressing. They were shown the same faces a second time after one month. On both occasions volunteers rated

themselves as happier after the happy mood induction and sadder after the sad mood induction. The authors suggest that this method of mood induction could be used as a probe. However, the technique is a model for depression and one may expect the authors to discuss whether the same events prior to a depressive episode would lead to a similar depression in clinical populations - however they do not touch on this issue.

Mood induction is an interesting technique, which allows for correlates of mood change to be studied as well as mood itself. Within this model scales and measurements can be tested and assessed. Furthermore factors which predict mood change can be identified. Although many different types of mood can be induced, the most common is low mood. A lowering of mood is not clinical depression and the relevance of mood induction to the clinical state is still unanswered.

2.5 Rating Scales for Mood and Depression

There are many instruments available to measure mood ranging from diagnostic tools to happiness inventories. Techniques of measurement range observer-rated scales, structured interviews to self-report. A number of these scales will be reviewed which are used in either patient or normal control populations.

2.5.1 Rating scales for depression

There are two main diagnostic tools for depression, the DSM (American Psychiatric Association, 1994) and the ICD (World Health Organisation,

1992). These give criteria for assessing patients, which also categorise severity into mild, moderate and severe. However, within a research study it is not always feasible to interview every individual. There are self-report scales available which are designed to detect psychiatric disorders among community populations.

The General Health Questionnaire 28 is a self-report questionnaire (Goldberg, 1978). Goldberg designed it to screen individuals in the community for psychiatric disorder. The original questionnaire consisted of 60 items but there are now shorter version of 30, 20 and 12 items, and also the GHQ-28, which has 28 items and four sub-scales of somatic, anxiety, social dysfunction and severe depression symptoms. The questionnaire's items can be scored in two ways: as continuous response scales or bimodally (see Table 2.5.1). When scored bimodally there is a cut off for "caseness" or the presence of psychiatric symptoms, which Goldberg suggests is a probability estimate of that person being a psychiatric case. It has been used widely for instance in community samples, in patients with stroke, in women referred to a familial cancer clinic and in sex workers to assess levels of psychiatric morbidity (Cull, Fry, Rush, & Steel, 2001; House, Knapp, Bamford, & Vail, 2001; Romans, Potter, Martin, & Herbison, 2001; Weich, Lewis, & Jenkins, 2001).

The GHQ-28 is not suitable in medical populations (van Hemert, den Heijer, Vorstenbosch, & Bolk, 1995) due to its high somatic content. In a community sample of 17-year-olds the GHQ-28 had better sensitivity and specificity

Table 2.5.1: Scoring of an item from the General Health Questionnaire (From GHQ-28 item number D2)

Have you recently felt that life is entirely hopeless?	Less so than usual	No more than usual	Rather more than usual	Much more than usual
Likert Score	0	1	2	3
GHQ Score	0	0	1	1

values than both the GHQ-30 and GHQ-12 (Banks, 1983). The GHQ-28 has four dimensions somatic symptoms (A), anxiety (B), social dysfunction (C) and depression (D). This factor structure appears to differ depending on the sample in which it is tested (Aderibigbe, Riley, Lewin, & Gureje, 1996; Werneke, Goldberg, Yalcin, & Ustun, 2000). However, the scales C and D appeared robust between a number of different centres (Werneke et al., 2000).

Other measures are available for assessing severity of depression, which give higher levels of measurement rather than a categorical measure, and others which are more sensitive to change over time.

The Hamilton Depression Rating Scale (HDRS) is an observer rated scale for measuring the severity of depression. Hamilton (1960) recommended it should only be used with patients with depression and by psychiatrically trained personnel. It is used widely and generally has high inter-rater reliability (Hedlung & Vieweg, 1979). It correlates highly against psychiatrists' global ratings of severity (Bech et al., 1975; Feinberg, Carroll, Smouse, & Rawson, 1981). The HDRS is not temporally sensitive as many of the questions refer to behaviour over several weeks, however it does give

a sensitive measure of severity of depression. One of the problems when comparing studies which have used the HDRS is that there are many modifications of the scale and the authors do not always make it clear either which modification they have used or indeed how the scale has been modified (Snaith, 1996).

The HDRS is typically used in treatment studies to assess the effect of treatment on clinical depression such as treatment with drug, placebo, transcranial magnetic stimulation, or ECT (Casper, Tollefson, & Nilsson, 2001; Ferreri, Lavergne, Berlin, Payan, & Puech, 2001; Lerer et al., 1995; Maayan et al., 2000; Padberg et al., 1999; Ulrich et al., 2001). Due to its poor temporal sensitivity it has been adapted to test mood change within days or hours for instance within studies on tryptophan depletion or diurnal variation (Delgado et al., 1990; Leibenluft, Noonan, & Wehr, 1992; Moffoot et al., 1994; Porterfield, Cook, Deary, & Ebmeier, 1997; Smith, Fairburn, & Cowen, 1997b). However, reliability and validity of the instrument have not been tested across shorter time spans, although an adapted HDRS has proved to be sensitive to mood change over such a short period of time.

Self-report scales require less manpower and are extremely quick and easy to administer. However, they have their draw backs: patients or volunteers may not use words in the way intended by the experimenter; an individual may interpret a word in a different way and use it in terms of their own experience, some severely ill patients may have difficulties completing a self-report measure. Also it is difficult to measure reliability on many of these

scales. For instance when measuring mood, it is often expected that this will change which makes measuring test-retest reliability difficult.

There are a number of scales, which seem to overcome many of the problems. The Befindlichskeitskala (BFS) (von Zerssen, Strian, & Schwarz, 1974) is a checklist, with two parallel forms, which has items which can discriminate the depressed from the non-depressed state. It correlates highly with global clinical ratings and its parallel forms are highly correlated. The scale has been shown to be sensitive to change in both healthy controls and patient populations. The scale within healthy volunteers has shown the effects of different types of music (rhythmic, meditative and modern) on mental state and physiological responses, with improved mood being shown following the rhythmic music (Mockel et al., 1994). The BFS was used to measure mood in patients with operable breast cancer (Hurny et al., 1992). Serial assessments were performed following surgery, the BFS along with other measures of well being showed improvement with increasing time following surgery. Furthermore, this study was carried out in four major language groups with the results being similar across the groups. Therefore suggesting that not only is the BFS sensitive to change but can also be used across different language groups.

The BFS has also been used in patients with major depressive disorder. For instance it has shown sensitivity to diurnal mood change, where improvement on mood also correlated with neuropsychological function (Moffoot et al., 1994; Porterfield et al., 1997). Along with the HDRS, a visual

analogue scale and the clinicians' global impression, the BFS has measured improved mood following treatment with monamine oxidase inhibitors (Heinze et al., 1993). All of the scales used showed similar improvement in mood.

Although the BFS was primarily designed for use in depressed patients, it is also useful both in healthy controls and patient with medical disorders as well as in patients with psychiatric illness. It is sensitive to change whether this is following treatment with a drug, an operation or mood induction after listening to music.

The scales described in this section have been designed to measure mood in patients with depression however, scales have also been designed to describe "normal" mood.

2.5.2 Rating Scales for "normal" mood

Although mood scales such as the BFS may also be reliable and valid among normal volunteers, and are sensitive to mood change, they may not capture the whole range of mood in the healthy volunteer.

The Profile of Mood States (McNair, Lorr, & Droppleman, 1992) is probably the most widely used measure of mood. McNair et al (1992) recommend its use in both psychiatric outpatients and in healthy volunteers but not in psychiatric in patients. It correlates highly with the Beck Depression Inventory (Jacobs & Boze, 1993). They claim 6 dimensions, which are tension-anxiety, depression-dejection, anger-hostility, vigour, fatigue and

confusion-bewilderment. These factors are derived from an oblique rotation and are therefore correlated. This 6 factor solution does not seem to be ideal as most of the factors correlate with each other to a high degree ($r > 0.5$). The factor structure has been replicated in a group of Australian undergraduates (n=289) (Boyle, 1987). However others do not find all of the factors and suggest that some of the factors therefore may need to be collapsed (Norcross, Guadagnoli, & Prochaska, 1984; Reddon, Marceau, & Holden, 1985). In particular the scales of depression-dejection, confusion-bewilderment and tension-anxiety do not emerge as independent dimensions (Norcross et al., 1984). Reddon and colleagues suggest that the total POMS score may be a better measure of mood (Reddon et al., 1985).

Despite this the questionnaire is sensitive to mood change and is used widely in many different areas of research. For instance, it has been used to monitor changes which occur with altitude (Bolmont, Thullier, & Abraini, 2000), to test mood changes with modafininil (a drug used to relieve daytime sleepiness in narcoleptics) in healthy controls (Caldwell, Caldwell, Smythe, & Hall, 2000). It is used widely within sport psychology to test the effect of exercise on mood (Beedie, Terry, & Lane, 2000; LeUnes & Burger, 2000; Martin, Andersen, & Gates, 2000). It has also been used in mood induction experiments such as tryptophan depletion (Ellenbogen, Young, Dean, Palmour, & Benkelfat, 1996; Klaassen et al., 1999b). The POMS has proved useful in monitoring mood changes intervention programs to reduce stress in cancer patients (Hosaka, Sugiyama, Tokuda, & Okuyama, 2000; Speca,

Carlson, Goodey, & Angen, 2000). Lastly it is also effective in comparing treatment outcome in patients with depression. Lydiard and colleagues (1997) compared the effects of sertraline versus amitriptypline compared to placebo in out patients with major depression.

Watson and Tellegen (1985) propose a two factor model of *positive* and *negative* affect. Although the terms sound oppositional they are in fact orthogonal or uncorrelated dimensions. These factors can be found in a number of mood questionnaires, however some scales provide purer measures of the underlying factors than others (Watson & Clark, 1988). The Positive and Negative Affect Schedule (PANAS) was designed to have items which load substantially on one factor with a near zero loading on the other factor (Watson & Clark, 1988). It maintains this factor structure with different temporal instructions from an individual responding on how they felt "right now" to in "general". Its factor structure is discussed in section 2.3. The factor structure has been replicated in Australian adolescents (Killgore, 2000), however, similar to Watson and colleagues (1999), Killgore found that 3 factors may better explain the data. The scale has been used widely. It does not contain any somatic items and has proved useful in medically ill patients (Kvaal & Patodia, 2000). It has been used to detect an emotional response to music (Roberts, Dimsdale, East, & Friedman, 1998) and the effects of daily events on mood (Kennedymoore, Greenberg, Newman, & Stone, 1992).

Matthews et al (1990) argue that two factors are not broad enough, as arousal and hedonic tone may not load on the same factor. Furthermore they argue that there is no a priori reason why mood factors may be orthogonal. They extract three uncorrelated factors from the UWIST Mood Adjective Checklist (UMACL): energetic arousal, tense arousal and hedonic tone. The questionnaire has been developed largely in healthy volunteers, therefore should be used in that group. It has been used in a wide range of studies, and has been used for instance to test the effect of exercise (Naruse & Hirai, 2000), hypoglycemia (Gold, Macleod, Frier, & Deary, 1995) and caffeine (Watson et al., 2000) on mood, as well as the relationship between mood and performance (Totterdell, 1999).

2.6 Correlates of Depression

"*The essential feature of a Major Depressive Episode is a period of at least 2 weeks during which there is either depressed mood or the loss of interest or pleasure in nearly all things*" (American Psychiatric Association, 1994). However, low mood is not the only correlate of depression. Low mood on mood scales is only one description there are a number of other correlates of low mood which can further describe the change in mood as well as describe the effects of low mood on the individual.

2.6.1 Cognitive Impairments in Depression

Cognitive deficits can be so severe in depression that they resemble deficits observed in organic dementia. This can be to the extent that a test, the

delayed word recall, designed to detect Alzheimer's disease does not successfully differentiate patients with depression and those with Alzheimer's (O'Carroll, Conway, Ryman, & Prentice, 1997). With the return of normal mood cognitive deficits may normalise but in some cases these are long-term (Abas, Sahakian, & Levy, 1990; Shah, Ebmeier, Glabus, & Goodwin, 1998). Abas et al (1990) found that the remaining cognitive impairment was significantly correlated with increased ventricular brain ratio.

Efforts have been made to find a specific deficit or neuropsychological profile. Depression-related deficits have been found in tests assessing executive functioning such as the Wisconsin Card Sorting Test in both patients with depression (Austin, Mitchell, & Goodwin, 2001; Degl'Innocenti, Ågren, & Bäckman, 1998) and in healthy dysphoric students (Channon, 1996; Luu, Collins, & Tucker, 2000). Memory, psychomotor speed and attention have been also found to be impaired (Austin et al., 2001; Austin et al., 1992; Bartolic, Basso, Schefft, Glauser, & Titanic-Schefft, 1999; Moffoot et al., 1994; Schatzberg et al., 2000; Trichard et al., 1995). Austin et al (1992) found the impairment to be correlated with symptom scores on the Hamilton Depression Rating Scale. A similar correspondence of mood with neuropsychological function is found in patients who showed diurnal variation of mood (Moffoot et al., 1994; Porterfield et al., 1997). While Trichard et al (1995) found the verbal fluency test to be sensitive to clinical improvement in a group of severely depressed patients but performance on the Stroop Colour Word Test remained impaired following recovery. Moffoot et al (1994)

go so far to suggest that tests of neuropsychological and psychomotor function may be used as reliable estimates of illness severity.

Patients with depression have been found to be impaired across a wide range rather than specific cognitive domains assessing for instance working memory, recognition memory and executive function (Elliott et al., 1996). This is in contrast to more specific deficits shown by for instance patients with Alzheimer's, Huntingdon's or Parkinson's disease (Elliott et al., 1996). Patient groups are in general heterogeneous, in that they were not matched for instance for age of onset, duration of illness, therapies received or number of admissions to hospital. This is a problem when assessing patients - particularly as the cognitive tests are sensitive to age, drug use and many other factors as well as mood change. Massman et al (1992) using discriminate function analysis found that patients clustered into groups, some showing a subcortical dementia memory profile others a normal profile, while others showed impairments, which were not readily classified.

2.6.2 Cognitive changes following mood induction

Cognitive changes occur also in healthy volunteers during mood induction studies. One benefit in studying healthy volunteers is that correlates of mood change can be observed without the confounders of drugs or a severe illness. Bartolic et al (1999), using the Velten Mood Induction Technique, found that euphoria resulted in better verbal than figural fluency, and that dysphoria resulted in better figural than verbal fluency. That is that low mood versus high mood was related to poor performance on verbal fluency.

Attentional processes change when a low mood is induced in a group of healthy volunteers and become more similar to those shown in a group of previously depressed patients (McCabe, Gotlib, & Martin, 2000). Psychomotor measures are slowed following a lowering of mood in healthy student volunteers (Shah & O'Carroll, 1994).

Other techniques of mood induction such as tryptophan depletion can show cognitive changes. Young et al (1985) found volunteers more easily distracted on a cognitive task when dysphoric. Even when there was not a corresponding self-reported mood change, memory (Klaassen, Riedel, Deutz, van Someren, & van Praag, 1999a; Park et al., 1994; Riedel, Klaassen, Deutz, van Someren, & van Praag, 1999; Schmitt et al., 2000) and attention (Coull et al., 1995; Schmitt et al., 2000), were impaired in healthy volunteers, following depletion. Furthermore impaired performance on a Modified Mini-Mental State was found in patients with Alzheimer's following depletion (Porter et al., 2000). Decision making was altered on executive function tasks which may have been a result of increased impulsivity rather than being a disruption in planning (Rogers et al., 1999a; Rogers et al., 1999b; Schmitt et al., 2000). Interestingly, Park et al (1994) found marked impairments if tryptophan depletion was on the second day and not on the first, on an executive function task perhaps suggesting problems with retrieval. Furthermore, on the same task, if tryptophan depletion was on the first day, speed of responding was enhanced whereas if on the second day performance was slower. From these results Park et al (1994) suggested a

possible role for the serotonergic system specifically in processes of learning and memory but not executive or frontal lobe function. Schmitt et al (2000), suggest that long-term memory is impaired but that frontal lobe function may be enhanced, as improvement was shown on verbal fluency and focused attention tasks.

Although there are cognitive changes apparent in depression these are not specific deficits but the deficit shown does correlate with severity of depression. Changes in cognitive tests and psychomotor performance can also occur when dysphoric mood is induced which in some ways mirrors the cognitive deficits seen in clinical depression. Furthermore when levels of serotonin are altered following tryptophan depletion performance on tests can vary even when there is no concurrent mood change.

2.7 Electroencephalograph Asymmetry and Depression

Considerable evidence supports the proposition that the left hemisphere is specialised for processing positive emotions and the right for negative emotions in those with left hemisphere dominant for language (review see (Heilman, 1997). Also, in those with the left hemisphere dominant for language, there is a left hemisphere advantage in processing verbal tasks and a right hemisphere advantage for processing spatial tasks (Kimura, 1969). This difference can be taken advantage of in experiments where mood is altered. For instance, Miller et al (1995), using carefully matched verbal and spatial tasks so that they had equal psychometric sensitivity,

found that patients with depression show a greater impairment on a right hemisphere spatial task, than on a left hemisphere verbal task.

The asymmetry of mood in the hemispheres can be predicted by resting electroencephalograph (EEG) asymmetry. This has been shown in a range of different subjects and using a range of study designs. For instance infants when spontaneously producing happy faces show greater left frontal activation (less alpha power), and show greater right frontal activation (less alpha power) when spontaneously producing sad faces (Fox & Davidson, 1988; Fox, Henderson, Rubin, Calkins, & Schmidt, 2001). Healthy volunteers who had undergone mood induction with positive and negative emotional clips showed greater left frontal activation with positive mood induction and greater right frontal activation with negative mood induction (Wheeler, Davidson, & Tomarken, 1993). Patients with unipolar depression compared to controls had less left sided activation (more alpha power) in the mid-frontal region (Debener et al., 2000; Henriques & Davidson, 1991). Although the methods have differed and the subject populations are vastly different, the overall picture appears to be the same. Less alpha power in the left hemisphere appears to correspond to positive mood, while more alpha power corresponds to negative mood. Less alpha power in the right hemisphere corresponds to negative mood. The differences in activation could be due to either an increase in hemispheric function in a particular emotional state or could be due to inhibitory processes.

2.8 Summary

Mood can be reliably measured by a number of observer rated or self-report scales in both healthy volunteers and patients with depression. There are other correlates of mood change such as cognitive impairments and asymmetry in alpha power in resting EEG. These can be observed in patients with depression, and in models of depression such as in mood induction experiments. The links between normal mood and clinical depression still have to be established. The structure of mood and issues surrounding the separation between state and trait are still open to debate.

Chapter Three: Personality and Mood

3.1 Overview

Chapter One discusses trait measures of personality, concluding that Extraversion and Neuroticism are the most replicable factors found in the major personality scales. Whether three, five or an alternative number of factors will describe personality adequately, and the precise nature of these factors still has to be resolved and a theory of personality must be validated. Chapter Two discusses how mood is measured both in healthy volunteers and in major depression. This chapter aims to bring together some of these issues discussing how personality and mood are related.

The overall theme of the thesis is that Neuroticism is the best predictor of negative mood and will therefore predict mood change through tryptophan depletion. It must therefore be established that Neuroticism and not another personality trait is predictive of negative mood. Therefore relationships between mood and personality traits in normal volunteers are discussed.

Personality and mood show a number of relationships. These relationships can be complicated to untangle. Personality traits are enduring and long lasting (Costa & McCrae, 1992b; Eysenck et al., 1985). It would be expected that scores on traits be predictive of transitory mood states (Zuckerman, 1976). Mood states may be variations within normal mood or they may be clinical states. Scores on personality scales and scores on mood scales

have been shown to be correlated, groups of volunteers with particular personality characteristics show patterns in their expression of mood, and personality may be predictive of mood change (Blackburn et al., 1990; Costa & McCrae, 1980; McFatter, 1994; Peirson & Heuchert, 2001; Wilson & Gullone, 1999). These various relationships are discussed below. There is an extensive literature relating various personality constructs with mood, emotion, well being and so on. In this chapter I have concentrated on the personality traits proposed by Eysenck and Cloninger. Some difficulties in discriminating state from trait have been discussed in Chapters 1 and 2. Mood is not always well defined, therefore only those studies where the time over which the mood was measured is stated are included.

3.2.1 Neuroticism, Extraversion and Mood in Healthy Volunteers

The relationships between personality and mood can be studied in normal volunteers in a number of ways. Scores on mood and personality inventories may be taken at one particular time point, scores may be taken over a fixed period of time, or at points separated by a defined time period. If a one off measurement is taken, correlations between trait and state measures would be expected but of relatively low effect size. If these are taken and aggregated then the effect should increase. If measures are taken across time then reliability and the predictive power of personality to assess future mood may be tested. Correlations between trait and state scores will differ to an extent between two time points as state scores are not expected to be consistent whereas trait scores are more enduring. Lastly interventions may

take place where scores on personality scales may be used to predict mood change following an experiment.

One major issue that must be remembered (see Chapter Two) is that mood scales can be over varying time periods. An individual may be asked to respond as to how they are feeling at that particular instant or over a longer period of time. This, just as multiple measures over time act as aggregate measures, can change the relationships between personality and mood.

However, it has been found consistently that Neuroticism correlates positively with negative mood and that Extraversion correlates with positively with positive mood irrespective of time scale. Table 3.2.1 depicts some of these relationships. Costa and McCrae (1980) found that these relationships were stable across time (four periods of three months). The individual was asked to reflect, in respect to mood, over a period of one to two weeks. Neuroticism correlated to a moderate level with negative affect (r = 0.35 to 0.43) and Extraversion correlated to a small level with positive affect (r = 0.16 to 0.27). Neuroticism also had small to negligible negative correlations with positive affect (r = -0.08 to –0.17). The minimum number of subjects for any one time equalled 566 as not all subjects completed the questionnaires at all four time periods. Kardum and Hudek-Knezevic (1996) find similar results though with larger effect sizes when individuals are asked to reflect over a period of one week (n=177). Their study revealed that Neuroticism correlated with negative mood to a high level (r = 0.66) and negatively with positive mood to a moderate extent (r = -0.38). Extraversion correlated

Table 3.2.1: Summary of correlations between Neuroticism and Extraversion and positive and negative mood

Authors	*Time period*	*Mood scale*	*N*	*Neuroticism*	*Extraversion*
(Costa & McCrae, 1980)	1-2 weeks	PAS +ve	566	-0.08 to –0.17	0.16 to 0.27
		NAS -ve		0.35 to 0.43	negligible
(Kardum & Hudek-Knezevic, 1996)	1 week	+ve	177	-0.38	0.52
		-ve		0.66	-0.38
(Wilson & Gullone, 1999)	in general	PANAS +ve	228 children	negligible	0.44
		-ve		0.32	negligible
		+ve	167 young adults	negligible	0.48
		-ve		0.62	-0.25
		+ve	142 >30 yrs old	-0.30	0.54
		-ve		0.64	-0.12
(Williams, 1990)	now	POMS-bi +ve	172	-0.20 to –0.30	0.23 to 0.38
		-ve		0.29 to 0.45	-0.08 to –0.31
(Furnham & Brewin, 1990)	1 week	OHI +ve	101	-0.43	0.55
(Furnham & Cheng, 1999)	1 week	OHI +ve	348	-0.01 to –0.56	0.41 to 0.56

PAS positive affect scale, NAS negative affect scale Bradburn (1969); PANAS positive and negative affectivity schedule (Watson & Clark, 1988); POMS-bi Profile of mood states-bipolar form (McNair et al., 1992); OHI Oxford Happiness Inventory (Argyle, Martin, & Lu, 1995)

positively with positive mood to a large extent (r = 0.52) and moderately with negative mood (r = -0.38). The mood scale was not named in the paper, but was a Croatian questionnaire, which had shown high reliability and good validity.

Costa and McCrae (1980) were also able to assess the predictive power of the personality variables over a period of 10 years. Neuroticism scores were

predictive of negative affect (r = 0.39) but not of positive affect (r = -0.08), while Extraversion was predictive of positive affect (r = 0.23) but not of negative affect (r = 0.03). Again individuals were asked to recall their mood over the past two weeks. These relationships have been found to hold true across the lifespan. Wilson & Gullone (1999) using the EPQ and the PANAS (Watson & Clark, 1988), found that Neuroticism correlated with negative affect and Extraversion with positive affect to a moderate extent in children and adolescents (r=0.32 and 0.44 respectively, n=228). Subjects were asked to respond to how they felt in general. In this age group a significant relationship between Neuroticism and positive affect or Extraversion and negative affect was not found. Using the same instruments but a slightly older population, late adolescents or young adults a stronger effect was found between Neuroticism and negative mood (r=0.62) though again there was no relationship with positive mood (n=167). This is a similar age group to most studies as this is the age of most undergraduate students. Extraversion, had a similar moderate effect with positive mood (r = 0.48) but in this older group also showed a small negative correlation with negative mood (r = -0.25). In adults over thirty the relationship between Neuroticism and negative affect was similar (r = 0.64), but in this group a medium sized negative correlation was found with positive mood (r = -0.30, n=142). Extraversion showed a large correlation with positive mood (r = 0.54) and a small almost negligible correlation with negative mood (r = -0.12).

Williams (1990) addresses very clearly the difficulties of measuring mood. Definitions of mood can range from states of arousal to a more long term emotional state. Williams brings together six different studies which assess the relationships between Eysenck's personality questionnaires and mood 'right here and now' in a combined total of 172 subjects. In all of the studies mood was recorded on a number of occasions. The scales did not all fall neatly into positive and negative mood categories, however, a number could be generally described along these lines. Broadly negative mood scales were Depression, Confusion-Bewilderment, Fatigue-Inertia, Tension-Anxiety and broadly positive mood scales were Elation, General Activation, Euphoria. When averages were taken across the studies Neuroticism was found to correlate positively to a small to medium extent with negative mood ($r = 0.45$, 0.42, 0.29, 0.43 respectively) and negatively with positive mood to a lesser extent ($r = -0.20$, -0.21, -0.30 respectively). Extraversion showed almost an opposite pattern correlating positively with positive mood ($r = 0.30$, 0.23, 0.38 respectively) and negatively with negative mood ($r = -0.31$, -0.24, -0.26, -0.08). Williams suggests that the relationship between mood and personality may have more of a pattern. Those who score high on Neuroticism and low on Extraversion are likely to be associated with more negative and less positive mood. While those who score low on Neuroticism and high on Extraversion are likely to be associated with more positive and less negative mood. This broad pattern was replicated by McFatter (1994), however, he also suggested that only in subjects with high scores on Neuroticism did

Extraversion have any appreciable relationship with either positive or negative affectivity.

Further evidence on the influence of Neuroticism and Extraversion on positive affect comes from research on well being and happiness scales (Furnham & Brewin, 1990; Hotard, McFatter, McWhirter, & Stegall, 1989). Extraversion was found to be a significant predictor of subjective well-being scales ($n=291$, $p<0.001$) (Hotard et al., 1989) and of happiness ($n=101$, $r = 0.55$; $n=348$, $r = 0.41$ to 0.56 respectively) (Furnham & Brewin, 1990; Furnham & Cheng, 1999). Remarkably consistent β weights were found across Japanese, Chinese and British cultures for the relationship between Extraversion and Happiness (Furnham & Cheng, 1999), which the authors propose suggests a genetic basis to this relationship. However, a separate study found that Extraversion was only a significant predictor among those who had high scores on the Neuroticism scale or who had poor social relationships (Hotard et al., 1989). Neuroticism was found to negatively correlate with happiness in UK ($n=101$, $r = - 0.43$; $n=120$, $r = -0.42$) and Chinese populations ($n=100$, $r = -0.56$) but not Japanese ($n=128$, $r = -0.01$) (Furnham & Brewin, 1990; Furnham & Cheng, 1999).

Effect sizes may differ due to many factors. For instance the age of participants in these groups varied and Wilson & Gullone (1999) did find differences in effect sizes with age. Further the mood questionnaires themselves differ and the time period across which they are measured. The cultural groups are also different in these studies. While there has been a

discussion within trait psychology concerning the structure of personality this discussion is only opening up within mood. Williams (1990) comments that Watson and Tellegen (1985) label two factors of mood positive and negative affect where others may call these energetic and tense arousal. However, with these caveats aside, it must be accepted that the relationships between Neuroticism and negative mood and Extraversion and positive mood are found consistently. However, these two scales may interact with perhaps Neuroticism being a more stable predictor of negative mood than Extraversion of positive mood.

Neuroticism and Extraversion have also been shown to predict response on mood induction experiments. Blackburn et al (1990) (as discussed in section 2.3) found that Neuroticism predicted mood response in a Velten Mood Induction experiment. In a study using both a positive and a negative feedback induction procedure Larsen and Ketelaar (1989) found that Neuroticism predicted negative affect ($r = -0.30$) but not positive affect ($r = 0.01$) and Extraversion predicted positive affect ($r = 0.25$) but not negative affect ($r = -0.03$).

The studies reported in this section have used different questionnaires, different age groups of subjects, different cultural groups and have measured mood over different time periods. However the most consistent finding is that Neuroticism correlates with negative mood. It also seems to correlate to a lesser extent with positive mood. Extraversion correlates negatively with positive mood and positively with negative mood, however, some

researchers suggest that this relationship may be mediated by Neuroticism (McFatter, 1994). Measures of mood do vary a great deal not only across the time scale which they measure but also in their content. Therefore it is not surprising that effect sizes vary from study to study. Measures of mood need to be standardised, or indeed the relationships between mood questionnaires explored before relationships between personality and mood can be described adequately. However, the consensus from the range of questionnaires is that Neuroticism is highly related to negative mood.

3.2.2 Cloninger's scales and Mood in Healthy Volunteers

The TPQ has also been correlated with mood scales. Unfortunately very little research has assessed the relationships between the TPQ scales and the full range of mood but has targeted more on mood scales that are related in some way to depressed mood. From the research investigating the relationships between mood and Neuroticism and Extraversion and between these personality dimensions and Harm Avoidance, it may be expected that Harm Avoidance would show correlations with both positive and negative mood. The scale of Harm Avoidance has consistently been shown to correlate highly with mood while Reward Dependence and Novelty Seeking have in general shown small to negligible correlations (for instance (Giancola et al., 1994; Krebs, Weyers, & Janke, 1998; Naito, Kijima, & Kitamura, 2000; Peirson & Heuchert, 2001; Svrakic, Przybeck, & Cloninger, 1992) see table 3.2.2 for a summary of these results).

Table 3.2.2: Examples of correlations between Cloninger's scales and mood

Authors	Time Scale	Mood Scale	N	Harm Avoidance	Reward Dependence	Novelty Seeking
(Svrakic et al., 1992)	1 week	POMS-bi	86	-0.39 to –0.58	-0.07 to –0.34	-0.04 to –0.28
(Peirson & Heuchert, 2001)	1 week	BDI	471	0.44	-0.14	0.06
(Giancola et al., 1994)	1 week	BDI	807	0.38 to 0.48	0.01	0.05
(Krebs et al., 1998)	in general	BSKE	200			
		Positive mood		-0.40	0.05	0.06
		Negative Mood		0.37	0.18	0.15
(Naito et al., 2000)	not given	SDS	220	0.52	-0.16	-0.04

POMS-bi Profile of mood states bi-polar form (McNair et al., 1992); BDI Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961); BSKE Befindlichkeitsskalierung (Janke et al., 1995); SDS Self-rating Depression Scale (Zung, 1965)

Svrakic et al (1992) asked individuals to respond on the Profile of Mood States bi-polar form (POMS-bi, (McNair et al., 1992)) on how they had felt over the previous week (n=86). The POMS-bi is similar to the POMS in that it has six dimensions in this case it is proposed to be a better measure for bipolar rather than unipolar mood. The dimensions are, composed versus anxious, agreeable versus hostile, elated versus depressed, confident versus unsure, energetic versus tired and clearheaded versus confused. Of the TPQ scales Harm Avoidance showed the highest and most consistent correlations with mood. Medium to large negative correlations (r = -0.39 to -0.58) were found between all of the POMS-bi scales and Harm Avoidance. Reward Dependence correlated with composed versus anxious to a moderate level (r = -0.34) and showed small to negligible correlations with

the other POMS-bi dimensions while Novelty Seeking showed small to negligible correlations with all of the POMS-bi dimensions.

When questioned as to how they generally felt on the Befindlichkeitsskalierung (Janke, Debus, Erdmann, & Huppe, 1995), a German questionnaire which can be classified into two broad categories of Positive General Mood and Negative General Mood, again the trait of Harm Avoidance explained the most variance (Krebs et al., 1998).

Two studies assessed the relationship between Cloninger's scales and the Beck Depression Inventory (BDI) (Beck et al., 1961) in undergraduate students ((Giancola et al., 1994; Peirson & Heuchert, 2001) the TCI and TPQ respectively). The Beck Depression Inventory is a measure of depressed mood and asks participants how they have felt over a period of one week. In both cases Harm Avoidance correlated positively with the measure of depressed mood to a moderate level, Reward Dependence to a small or negligible level and Novelty Seeking negligibly.

Correlations between Harm Avoidance and mood were shown to be relatively stable across a three month period by Naito et al (2000). They correlated the Japanese versions of the TCI and the Self-rating Depression Scale (SDS) (Zung, 1965). Both of these questionnaires were given twice approximately three months apart. Harm Avoidance and depressed mood correlated to a large degree ($r = 0.52$) on the first occasion while on the second to moderate degree ($r = 0.39$). The other scales had small to negligible correlations.

3.3 Summary

Research within normal volunteer populations shows that Neuroticism consistently correlates with low or negative mood and may predict a drop in mood following a mood induction, while Extraversion correlates with positive mood. In some cases Neuroticism may also correlate negatively with positive mood and Extraversion negatively with negative mood.

The relationships between mood and the TPQ have not been investigated to the same extent that with the EPQ. The TPQ perhaps because of its proposed relationships with the monoamine system has been tested against negative mood scales more than positive mood scales. Similar to the research with the TPQ mood has been measured using a range of different questionnaires over different time frames and in different age and cultural groups. However, Harm Avoidance consistently correlates with positively with negative mood measures. In only one study was there a clear positive mood scale used and here Harm Avoidance correlated negatively with positive mood.

In sum, personality traits therefore do seem to be highly related to mood and in some way predictive of mood. How mood in normal volunteers relates to that measured in depression is not established. Indeed the relationships between normal mood and personality need to be explored further using models of mood. Personality traits may be predictive of normal mood but the question still remains - are they predictive of depressive disorder?

Costa and McCrae (1980) suggest that introverts are not more prone to anxiety and depression than extraverts suggesting that:

"We may all be on hedonic treadmills, ... the treadmills of adjusted extraverts are much happier places to be."

However Neuroticism is a better predictor of negative mood and it is this variable that predicts a drop in mood following mood induction. The relationships between personality and mood in the depressed state are discussed in Chapter Six.

Chapter Four: The Biological Basis of Mood

4.1 Overview

Mood and its measurement have been discussed in Chapter Two where some of the problems of measurement in healthy volunteers versus patients have been discussed. Mood as measured in healthy volunteers has not in general been conceptualised as a biological process different to that of the mood disorders. It is assumed that the biological processes causing mood changes in normal healthy volunteers are similar to those in mood disorder. However, this comparison has not in many cases been made explicit. Mood change in healthy volunteers is conceptually different from clinical depression. Normal variation in mood may be extreme but this does not in itself constitute clinical depression. There are degrees of clinical depression but the term in itself is categorical, an individual is either depressed or is not (American Psychiatric Association, 1994; World Health Organisation, 1992). The severity of depression can be measured on continuous scales such as the Hamilton Depression Rating Scale but this scale is recommended only within depressive illness (Hamilton, 1960). In healthy volunteers, mood and mood change are more frequently measured on continuous scales.

This chapter therefore restricts its review to evidence derived from clinical depression and discusses the biological basis of mood disorder. The main aim of this chapter is to show that serotonin plays a major role in clinical depression although there are many neurochemicals and agents implicated.

Tryptophan depletion, the method used to test whether Neuroticism is related to serotonergic function, will be focused on in Chapter 5.

4.2 The Biological Basis of Mood Disorder

There are numerous factors involved in the onset and maintenance of depression. It is hypothesised that there is a biological basis to depression. It is not expected that only one factor is involved but that both onset and maintenance of the affective disorders are multifactorial. Many neurochemicals and agents have been implicated such as: a) serotonin; b) noradrenaline; c) dopamine; d) acetylcholine and e) neuropeptides.

4.3 Acetylcholine

There is some evidence that abnormalities in the levels of acetylcholine results in depression. Raising CNS cholinergic activity causes behavioural depression in some healthy humans and patients with affective disorders (Gershon & Shaw, 1961; Janowski & Risch, 1987) and conversely some anticholinergic drugs can cause euphoria. However, there is very little evidence from treatment studies to link the cholinergic system to depression.

4.4 Noradrenaline

Clinical trials of antidepressants, abnormalities of noradrenergic function found in depressed patients and catecholamine depletion have all given evidence towards noradrenaline's role in depression. Catecholamine depletion occurs after giving alpha-methylparatryosine (AMPT), a tryosine

hydroxylase inhibitor, the enzyme critical for the synthesis of both noradrenaline and dopamine or by giving a tyrosine free amino acid drink (McTavish, Cowen, & Sharp, 1999). Patients with a history of depression, after having received AMPT, had increased scores on the Hamilton Depression Rating Scale (HDRS) (Berman et al., 1999). Similarly patients on noradrenaline or dopamine reuptake inhibitors showed an increase in HDRS scores compared to only 1/9 patients on SSRI's following catecholamine depletion (Delgado et al., 1993).

Catecholamine depletion is not specific to noradrenaline as dopamine is also depleted, therefore any resulting mood changes may be due to dopamine depletion rather than by noradrenaline alone. More selective evidence may be drawn from abnormalities of noradrenergic function. These include increased α_2-adrenergic receptor number in platelets (Garcia-Sevilla, Zis, Hollingsworth, Greden, & Smith, 1981); blunting of the growth hormone response to: clonidine (Checkley, Slade, & Shur, 1981), amphetamine (Langer, Heinze, Reim, & Matussek, 1976) and desipramine (Laakmann et al., 1986); decreased cortisol response to methylamphetamine (Checkley & Crammer, 1977), decreased night time melatonin secretion (Frazer et al., 1986) in patients with affective disorder, and increased cAMP response to beta-adrenergic receptor agonists in platelets in suicide victims (Ebstein et al., 1988).

Thus there is some evidence that noradrenaline plays a role in depression and that some drugs may alleviate depression due to acting on

noradrenaline. There are very few drugs which act exclusively on this agent and other neurotransmitters are implicated.

4.5 Dopamine

Dopamine, another monoamine, is also implicated in depression. In Parkinsonism, where there is an imbalance of dopamine, there is a high rate of depression (for a review (Cummings, 1992)). Levels of the metabolite of dopamine, CSF-HVA, are altered in those with depression. It is increased in those with psychotic (Diehl & Gershon, 1992) and decreased in those with retardation (van Pragg & Korf, 1975). Abnormal receptor binding in patients with depression compared to controls is shown by methods such as SPECT scannning (D'Haenen & Bossuyt, 1994). Mood can also be altered by changing the levels of dopamine, for instance, rapid but transient mood improvement is shown in depressed patients following administration of the D2 agonist, amphetamine (Joyce, 1985). Lastly, some antidepressants such as nomifensine and amoxapine act on dopamine (typically D2) receptors (for a review (Diehl & Gershon, 1992). However, there are no neuroendocrine abnormalities of the dopamine system in depression.

4.6 Neuropeptides

Many neuropeptides are co-released or co-localised with a classical neurotransmitter and may have an impact on depressive disorder for instance corticotrophin releasing hormone (CRH) stimulates the hormone ACTH which in turn stimulates the production of cortisol. CRH secretion is

itself stimulated by 5-HT, noradrenaline and acetylcholine. In depressed patients the ACTH response to CRH is blunted (Holsboer, Von Bardeleben, Gerken, Stalla, & Muller, 1984) and levels of CRH in CSF have been found to be increased in depressed patients as compared to controls (Nemeroff et al., 1984). Conversely, CSF levels of somatostatin and neuropeptide Y have been found to be decreased in depressed patients as compared to healthy controls (Rubinow et al., 1983). However, as with many of the neuropeptides these findings may not be specific to depression (Rubinow, Davis, & Post, 1988; Taylor & Fishman, 1988).

4.7 Serotonin

Serotonin's role in the affective disorders is evidenced by a number of mechanisms for instance (1) selective serotonin reuptake inhibitors used in the treatment of depression in clinical trials (Boyer & Feighner, 1996); (2) genetic studies identifying an association of certain serotonin transporter gene alleles with depression (Ogilvie et al., 1996; Collier et al., 1996); (3) observing mood changes following manipulataion of levels of 5-HT by for instance l-tryptophan depletion (Benkelfat, Ellenbogen, Dean, Palmour, & Young, 1994; Delgado et al., 1990; Smith et al., 1997b); (4) relating abnormalities in levels of 5-HT, it's precursor l-tryptophan (Coppen, Eccleston, & Peet, 1973) and its metabolites, 5-hydroxyindoleacetic acid (5-HIAA), (eg (Asberg, Schalling, Traskman-Bendz, & Wagner, 1987) and (5) observing differences in receptor number and binding in patients with

depression. These mechanisms and abnormalities are summarised in Table 4.7.1.

4.7.1 Receptors

5-HT_2 receptors are located on postsynaptic neurones innervated by 5-HT containing nerve terminals in the CNS. 5-HT receptor binding is increased in the brains of depressed patients (McKeith et al., 1987) and suicide victims (Stanley & Mann, 1983). However, differences in 5-HT_2 receptor binding in the brains of depressed patients and suicide victims has not always been found (Owen et al., 1983). These are post-mortem studies and there are many factors which may affect the results: drug use through-out the lifetime of the patients; duration of depression, severity of the depression; cause of death; age and the number of episodes of depression are just a few. Receptors are found on blood platelet membranes and these may be tested during life. Platelet 5-HT_2 receptors are increased in patients with (Arora & Meltzer, 1989) which returned to normal levels after successful treatment with an antidepressant (Biegon et al., 1987), while binding with radiolabelled 5-HT is decreased in some patients (Coppen et al., 1978; Healy & Leonard, 1987). These results are difficult to interpret as receptors are increased but binding is decreased, and it is not known how they may be related but they do show some abnormality in the 5-HT system in patients with depression.

Imaging techniques have also been utilised to assess receptors in patients. One of the major limitiations is the number of radiotracers which have been

Table 4.7.1 Serotonin and affective disorder

Link between 5-HT and affective disorders	Major finding	Reference
Clinical effectiveness of SSRI's	Remittance of depression after 2 weeks	(Boyer & Feighner, 1996)
Action of other antidepressants on 5-HT - MAOI's - tricyclics	Remittance of depression	British National Formula
Abnormalities in the levels of - 5-HT	Blood 5-HT inversely correlated with depression scores in suicide attempters Low level of platelet 5-HT correlated with response to SSRI's	(Verkes, Hengeveld, van der Mast, Fekkes, & van Kempen, 1998)
	Low level of platelet 5-HT correlated with response to SSRI's	(Pérez et al., 1998)
- 5-HIAA	Reduced in the CSF of patients with depression	(Agren, 1980; Asberg, Thoren, Traskman, Bertilsson, & Ringberger, 1976)
- TRP	Decreased TRP/LNAA ratios, plasma free and/or total TRP in drug-free depressed patients	(Coppen, Swade, & Wood, 1978; Lucca, Lucini, Piatti, Ronchi, & Smeraldi, 1992; Shaw et al., 1978)
Abnormalities in 5-HT binding - imaging	β-CIT uptake reduced Ketanserin uptake increased	(D'Haenen et al., 1992; Kuikka et al., 1995; Malison et al., 1998)
- 5-HT_2 receptor binding in brain from PM studies	increased in depressed patients & suicide victims	(McKeith et al., 1987; Stanley & Mann, 1983)
- platelet 5-HT_2 receptors	increased in patients with depression	(Biegon et al., 1987)
- platelet binding	Decreased uptake of radiolabelled 5-HT in depressed drug-free patients	(Coppen et al., 1978; Ellis & Salmond, 1994; Healy & Leonard, 1987)
Neuroendocrine response to - d-fenfluramine	Prolactin reponse blunted in depressed patients	(Cleare, Murray, & O'Keane, 1996)
- TRP infusion	Growth hormone reponse blunted in depressed patients	(Power & Cowen, 1992)
- ipsapirone	Blunted temperature, cortisol and ACTH responses in depressed patients	(Lesch, Aulakh, & Murphy, 1992; Lesch et al., 1990)
- 5-HTP	Cortisol response increased in depressed patients	(Meltzer et al., 1984)
Number of Dorsal Raphe Nucleus Serotonin Neurons	Increased number and density in suicide victims	(Underwood et al., 1999)
Depletion of 5-HT - by PCPA	Transient relapse in patients treated with imipramine or MAOI no relapse with AMPT	(Shopsin, Friedman, & Gershon, 1976; Shopsin, Gershon, Goldstein, Friedman, & Wilk, 1975)
- TRP depletion		see tables 5.4.1 - 5.6.9
Genetic studies	Association of serotonin transporter genes with depression	(Collier et al., 1996; Ogilvie et al., 1996)

SSRI serotonin re-uptake inhibitors; MAOI's monamine oxidase inhibitors; TRP tryptophan; LNAA large neutral amino acids; β-CIT 2-β-carbomethoxy-3-β-(4-iodophenyl)-tropane; PM post-mortem; 5-HTP 5-hydroxytryptophan ; PCPA para-chlorophenylalanin

developed for both PET and SPET. At present there are tracers for 5-HT1A, 5-HT2A and the 5-HT transporter. β-CIT uptake, which attaches to the serotonin transporter, is reduced in the mid-brain of patients with depression (Kuikka et al., 1995; Malison et al., 1998). Ketanserin (a SPECT tracer) has been used to examine 5-HT2 receptors with higher uptake observed in the parietal cortex in depressed patients (D'Haenen et al., 1992). However, criticisms of this tracer have been made as ketanserin has high nonspecific uptake. Although the use of imaging may greatly increase our knowledge of 5-HT receptors and serotonin synthesis (using for instance a-methyl tryptophan) there is still much development to take place (for a review see (Staley, Malison, & Innis, 1998).

In sum there seems to be evidence to suggest that there are abnormalities in receptor binding and number in patients with depression.

4.7.2 Abnormalities in the levels of 5-HT, its precursors and metabolites

Differing levels of these substances have been found in patients with depression. However, these findings may not be specific. For instance they may vary due to diet (Wurtman & Wurtman, 1988) or in other disorders such as generalized anxiety disorder where levels of 5-HIAA are correlated with anxiety symptoms (Garvey, Noyes, Woodman, & Laukes, 1995) increased in women who had recovered from bulimia nervosa (Kaye et al., 1998). The best replicated finding is that the metabolite of 5-HT, 5-HIAA is decreased in the CSF of patients (Agren, 1980; Asberg et al., 1976).

4.7.3 Neuroendocrine response

Increased 5-HT activity can lead to an enhanced release of several hormones, including the pituitary hormones prolactin, adrenocoricotrophic hormone (ACTH) and growth hormone, as well as the peripherally released hormones cortisol and renin. In many cases (see table 4.7.1) these responses are decreased or blunted in patients with depression. Studies have increased 5-HT activity with tryptophan infusion or such agents as the 5-HT releasing and 5-HT reuptake blocking drug fenfluramine; a drug of the azaspirodecanedione family, which have high partial agonist affinity for 5-HT1a receptor. These responses allow another method for measuring abnormalities in the serotonin system.

4.7.4 5-HT Depletion

Levels of 5-HT can be manipulated in humans in a number of different ways including: (1) depletion of tryptophan by an amino acid drink (see Chapter 5) (2) diet manipulation e.g. eating only carbohydrates (Wurtman & Wurtman, 1988); (3) para-chlorophenylaline (PCPA) (Shopsin et al., 1976; Shopsin et al., 1975).

4.7.4.a PCPA

Para-chlorophenylalanine (PCPA), the tryptophan hydroxylase inhibitor, prevents tryptophan from being converted into serotonin and depletes brain serotonin. Two imipramine treated patients who were given PCPA relapsed after a maximum of 72 hours, two treated patients who received AMPT did

not relapse, furthermore the one patient who was given AMPT before being given imipramine responded to the imipramine even though AMPT was being given concurrently. Although the numbers are small these findings would suggest that reduction of 5-HT but not noradrenaline is associated with relapse in imipramine treated patients or in those patients who respond to imipramine (Shopsin et al., 1975). PCPA was also given to patients who had a treatment response to tranylctpromine monoamine oxidase inhibitors (Shopsin et al., 1976). Patients experienced a relapse to the severity of pretreatment within one to four days of PCPA administration. The results from these studies support the idea of serotonin being important in mood, however, they were not adequately controlled and the side effects from giving this intervention may have caused the dip in mood alone. Due to the side effects, this method has not been used extensively and tryptophan depletion has been utilised to reduce 5-HT levels.

4.8 Summary

Although it is unlikely that only one mechanism or only one type of abnormality is responsible for the spectrum of affective disorders, in order to test a hypothesis the effects of changing only one agent must be assessed. It is possible to test the serotonergic system by the method of tryptophan depletion. This method will be reviewed in Chapter 5 in both patient populations and healthy controls.

Chapter Five: Tryptophan Depletion

5.1 Overview

This chapter will review the method of tryptophan depletion in patients and healthy control populations. Tryptophan depletion alters serotonergic functioning temporarily. It produces a transient change in levels of serotonin in the brain. By lowering serotonin levels in this way, transient changes have been found in mood (Delgado et al., 1990), aggression (Cleare & Bond, 1995) and cognition (Park et al., 1994). The mood change found in patients who have recovered from a major depressive episode can be similar to that found in depression. However, it is a transient change and would therefore not be expected to mirror the depressed state but may be linked to major depressive disorder.

Not all of those who become depressed respond to SSRIs, and serotonin is only one of the many agents that are implicated in the affective disorders (see Chapter 4). Therefore it would not be expected that everyone who has recovered from a major affective disorder would respond to tryptophan depletion. In turn, it would not be expected that all healthy volunteers would respond to tryptophan depletion. It is possible that there is a vulnerability to tryptophan depletion, which is likely to be a susceptibility to alterations in levels of serotonin. The method of tryptophan depletion is reviewed.

5.2 Biological Theory of Tryptophan Depletion

The basic premise, of tryptophan depletion, is that serotonin (5-HT) transmission in the brain is reduced by a single administration of an amino acid mixture without tryptophan (Miller et al., 1992; Moja, Cipolla, Castoldi, & Tofanetti, 1989; Young, Ervin, Pihl, & Finn, 1989; Young et al., 1985). In humans this is difficult to study, but it can be assessed in rat brain where it has been shown that overall there is a reduction of 5-HT synthesis and release (Bel & Artigas, 1996; Stancampiano et al., 1997). A number of mechanisms are involved in this process of lowering serotonin.

One step in the biosynthesis of serotonin is the conversion of l-tryptophan to 5-hydroxytryptophan. Tryptophan must cross into brain competitively against other large neutral amino acids (LNAAs). These competing amino acids include l-leucine, l-isoleucine; l-valine; l-phenylalanine; and l-tryosine. These LNAAs take up the transport sites in preference to l-tryptophan so that in their presence almost no tryptophan can get across into the brain. Thus tryptophan's rate of transport into the brain is determined by its availability compared to the other LNAAs - the tryptophan/LNAA ratio.

The conversion of tryptophan to 5-hydroxytryptophan is catalysed by the rate limiting enzyme tryptophan hydroxylase. Under normal circumstances tryptophan hydoxylase is only half saturated with its substrate tryptophan (Young & Gauthier, 1981). The Michaelis constant for tryptophan hydroxylase is higher than tryptophan concentration in the brain, suggesting

that under normal physiological circumstances the activity of this enzyme is limited by the availability of substrate.

Lastly, a third factor affects the availability of tryptophan. Protein synthesis is enhanced by the administration of the amino acid mixture and the resulting incorporation of tryptophan into protein in the liver leads to a rapid (5 hours) and substantial (approximately 90%) reduction of free tryptophan in plasma (Delgado et al., 1990; Moja et al., 1989). Thus much of the available tryptophan in the blood is converted into protein leaving very little to cross the blood brain barrier to be converted by tryptophan hydroxylase into serotonin.

In summary, tryptophan depletion works by a number of methods: 1) by enhancing protein synthesis thus available tryptophan is turned into protein leaving little to be synthesised into 5-HT; 2) as the levels of tryptophan drop less tryptophan is converted into 5-HT by tryptophan hydroxylase; 3) tryptophan competes to cross the blood brain barrier against the 5 other large neutral amino acids. These three mechanisms working together mean that very little serotonin can be synthesised.

Tryptophan depletion thus appears to reduce central 5-HT function (Carpenter et al., 1998; Moreno et al., 2000) (these two studies are summarised in table 5.6.9). These results must be interpreted with some reservation as tryptophan is also hydroxylated to 5HTP and then to 5HT outside, for example in the gut, in mast cells, and to provide 5HT in platelets. Therefore CSF and plasma 5HIAA cannot be assumed to come entirely from

the brain, however these studies give an indication of central changes following tryptophan depletion.

CSF could be tested by lumbar puncture, however, this is very invasive and painful and is not a method which is always acceptable in volunteers. Plasma levels of tryptophan can be measured by taking a blood sample. Serum levels are in turn related to brain 5-HT levels (Fernstrom, 1977), Fernstrom and Wurtman (1971) have shown the synthesis and content of 5-HT in rat brain vary in parallel with brain tryptophan concentration. Tryptophan alone among the amino acids is largely bound to albumin, thus restricting its transport across the blood brain barrier (Knott & Curzon, 1972). Plasma free tryptophan or unbound tryptophan is a better predictor of brain tryptophan concentrations than plasma total (for a review see (Curzon, 1979)).

5.3 Tryptophan Depletion the Method

This method generally involves giving a test drink and a *placebo* drink. The test drink is a mixture of amino acids (the typical amino acids included are listed in table 9.2.1) without tryptophan whereas the *placebo* drink contains the same amino acids but also with tryptophan. This can vary from study to study but typically involves giving a 100g amino acid drink on Day 2, with a special diet either low protein or low tryptophan on Day 1, and the volunteers fasting from 12 midnight on the evening before the test day. On the tryptophan day, 2.3g of tryptophan is given, and some researchers add tryptophan to the standardised diet. There is generally at least one week

between test days to allow for tryptophan to be metabolised and for the body to return to its natural levels.

This amount of tryptophan raises plasma tryptophan by approximately a factor of 3 but drops the tryptophan/LNAA ratio (Weltzin, Fernstrom, McConaha, & Kaye, 1994). However, when 4.3g of tryptophan are given in the 100g drink or 2.3g in a 50g drink the tryptophan/LNAA ratio is maintained (Weltzin et al., 1994). The test drink causes a reduction of both total and free tryptophan in plasma in 5 hours (Delgado et al., 1990).

One of the main problems with the drink is that it can make the recipients nauseated. Different drinks have been given in order to combat this problem, for instance: a half dose drink, a drink containing just the other LNAAs, a drink containing the other essential amino acids. Women, due to a generally lower body weight, have been given a slightly decreased drink (approximately 80%) and this appears to result in a similar drop in plasma total and free tryptophan as a 100g drink (Smith et al., 1997b). A control drink without tryptophan was used also due to the eosynophilia-myalgia syndrome. The tryptophan that was produced was contaminated and could not be given. Generally a quarter strength drink was given however in some cases it did not act as an inert control and reduced plasma tryptophan to an adequate degree to produce mood changes (Moreno et al., 1999).

5.4 Changes with Tryptophan Depletion in Patient Groups

One of the main outcome measures of tryptophan depletion is mood. Mood changes have been found in volunteers undergoing tryptophan depletion however, the results have not always been consistent, either in patient groups or healthy controls.

This chapter contains a review of all of the published studies on tryptophan depletion. Studies included in this review are those which were found using searches on Medline, Bids and the more recent Web of Science up to February 2001, as well as those found by personal communications from authors and those which have been cited in any papers found by the methods described. Abstracts presented at conferences were not included nor were letters. At times authors have reported on the same group of subjects more than once. This may have been done due to an increase in the subject numbers, where a separate finding is reported or where a different analysis was undertaken. Within the tables this overlap of subjects has been made clear whenever the authors have made it explicit or when I have received personal communications from the authors. This is the most comprehensive review of tryptophan depletion that has taken place. Reilly and colleagues reviewed the literature several years ago but did not produce such comprehensive tables and furthermore there have been many more studies which have used this method in the interim years (Reilly, McTavish, & Young, 1997). A recent reviewer has focused on the studies within patient populations but not within healthy controls (Moore et al., 2000). Furthermore,

the focus of the current review was on mood while that of Moore and colleagues was on clinical consequences in clinical groups. Therefore the review of papers described in this chapter is unique.

Tables 5.4.1-5.4.6 summarise the results, methods and subjects used among patient groups, table 5.5.1 summarise the results among healthy volunteers with a family history of major affective disorder and tables 5.6.1-5.6.9 among healthy controls. The outcome variable that is most interest to this thesis is depressed mood. Although other outcome variables are described each table is presented with this as the key outcome measure. The method and design of the study is only described in the tables if it differs from the standard drink or if it is not a double blind cross over study.

5.4.1 Patients with Depression

Tables 5.4.1 describe all the studies reported which show a mood change in patients who are remitted from a depressive episode and table 5.4.2 shows all the studies which do not show the predicted mood change. One of the first studies to use tryptophan depletion in patients was that by Delgado and colleagues in 1990 (Delgado et al., 1990). Therefore this study will be discussed in depth. They found a significant relapse (14/21) in patients who were in remission from a major depressive episode following tryptophan depletion but not following sham depletion (0/21). Total and free l-tryptophan levels were reduced 87 and 91 percent respectively following the tryptophan free drink. The patients had recently responded to a range of antidepressant medication. Patients treated with a catecholamine reuptake inhibitor were

least sensitive to relapse while those treated with SSRIs or MAOIs were more sensitive. The patients who did not relapse and who were on a noradrenaline reuptake inhibitor were found to show a depression in mood following catecholamine depletion using AMPT (Miller et al., 1996; Salomon, Miller, Delgado, & Charney, 1993).

Delgado and colleagues tested this possible link with SSRIs and depressive relapse following depletion (Delgado et al., 1999). They recruited patients who had never failed to respond to an adequate trial of either desipramine (a tricyclic with more specific action on noradrenergic receptors) or fluoxetine (a SSRI) and ran a tryptophan depletion trial on the responders to these antidepressants. Following depletion only 1 out of 15 patients who responded to desipramine relapsed whereas 8 of the 15 fluoxetine responders relapsed. These two studies would suggest that those patients who respond to SSRIs are more sensitive to tryptophan depletion.

The link with SSRIs, and possible serotonergic function has not been tested further, however a number of studies have supported Delgado and colleagues' findings (see table 5.4.1). They have found depressive relapse in patients with a history of a major depressive episode where the principal treatment was an agent acting on the serotonergic system (Barr et al., 1994; Bremner et al., 1997; Moreno et al., 1999; Smith et al., 1997b; Smith, Morris, Friston, Cowen, & Dolan, 1999b; Weltzin et al., 1994). Interestingly, some patients reported feelings similar to those, which they had experienced during their depression (Smith et al., 1997b).

Not only have changes in mood been found post tryptophan depletion but also changes in brain metabolism using positron emission tomography (PET). Decreased brain metabolism has been found in the dorsal lateral prefrontal cortex, thalamus and orbitofrontal cortex in those patients with depressive relapse following tryptophan depletion but not in those without depressive relapse (Bremner et al., 1997). Further in those with no mood change there are no changes observed using this method (Agren & Reibring, 1994).

Not all studies have found a significant mood change after depletion in those who had recovered from a major depressive episode (see table 5.4.2 (Cassidy, Murry, Weiner, & Carroll, 1997; Leyton et al., 1997; Price, Malison, McDougle, Pelton, & Heninger, 1998)). The patients in the study by Cassidy and colleagues had responded to ECT. Delgado and colleagues (Delgado et al., 1990; Delgado et al., 1999) found that those patients who had responded to SSRIs were more likely to suffer a mood dip following tryptophan depletion. There are a number of reasons why Cassidy and colleagues' study did not show an effect. There may not have been enough power, as there were only five subjects. Only the MADRS was used to assess mood change where other researchers have tended to find differences using instruments such either an adapted HDRS or the POMS. Finally the volunteers were not given a standardised diet and this may have affected the response to tryptophan depletion.

Table 5.4.1: Tryptophan depletion in patients with major depressive disorder: studies which showed predicted mood change
(this table only reports data concerning the patient group not control comparison groups if used)

Patient Group	Male female ratio	Experimental Conditions	Mood Change	Major Findings	Reference
21 MDE responded to a range of drug types, heterogeneous group	8:13	On medication	Yes *a*	14/21 mood change when depleted; 0/21 on control day	(Delgado et al., 1990)
21 MDE responded to SSRIs	11:10	19/21 on fluoxetine 2/21 on paroxetine. PET 6hrs after depletion	Yes *a*	7/21 depressive relapse. PET: decrease in brain metabolism in dorsal prefrontal gyrus, thalamus and orbitofrontal cortex	(Bremner et al., 1997)
15 MDE recovered.	0:15	Drug free Test drinks 20% of standard	Yes *a*	HDRS significantly increased, feelings similar as to previous depression. Increased scores on VAS	(Smith et al., 1997b)
8 MDE responded to antidepressants	8:0	Symptom free >/= 6mths. 2/8 drug free. PET at 5 hrs	Yes *a*	6/8 depressive relapse	(Smith et al., 1999b)
12 MDE in remission Vs 12 age and sex matched controls[1]	4:8	Drug free. Tested with 100g or 1/4 strength drink	Yes *a*	Increase on HDRS with both drinks but no difference on POMS for patients	(Moreno et al., 1999)
30 MDE responded in drug trial	Fl 7:8 Ds 9:6	15 responded fluoxetine (Fl) and 15 to desipramine (Ds)	Yes *a*	1/15 on Ds relapsed, 8/15 on fl	(Delgado et al., 1999)
10 MDE in remission	10:0	Current treatment SSRI. Drinks consumed at 1500, EEG recording at 2330. Tested with 100g or 1/4 strength drink.	Yes *a*	Mood change on HDRS. Changes on POMS. Reversed the REM inhibition associated with SSRIs.	(Moore et al., 1998)
20 MDE responded to SSRI. 12 in test group, 8 in control	T-: 6:6 T+: 5:3	Responded to citralopram. Tested with drink containing 5 competitive LNAAs +/- 2.3g TRP. Between subjects.	Observ-ation	5/12 worsening of symptoms on MADRS	(Åberg-Wistedt et al., 1998)
8 MDD summer remitted (3 met criteria for SAD and were reported in (Leyton et al., 1997)	1:7	Assessed family history. 3/7 FH+ for mood disorders, 4/7 substance abuse disorders, 3/7 personality disorders. 3/7 no FH	Yes *a*	Significant lowering of mood on both HDRS and POMS FH+ greater effect.	(Leyton et al., 2000)

mood change refers to a mood change on a depression rating scale; MDE major depressive episode; MDD major depressive disorder; SSRI serotonin re-uptake inhibitor; PET positron emission tomography; LNAA large neutral amino acids; VAS visual analogue scale; POMS Profile of mood states; [1] healthy normal control population is reported in table 5.6.7; *a* measured by an adapted HDRS;T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; MADRS Montgomery-Asberg Depression Rating scale; REM rapid eye movement

Table 5.4.2: Tryptophan depletion in patients with major depressive disorder: studies which did not show predicted mood change

Patient Group	Male female ratio	Experimental Conditions	Mood Change	Major Findings	Reference
14 MDE in remission	6:8	Drug free.	No	No mood change on HDRS, POMS-bi, VAS	(Leyton et al., 1997)
22 MDE in placebo treatment period prior to drug trial,	6:16	mCPP infusion 5 hrs post drink	No	mCPP - reduced cortisol response Following T- increase in HARS, VAS anxious, decrease in energy.	(Price et al., 1997)
38 MDE in placebo treatment period prior to drug trial, currently depressed	17:21	Drug free. 5 hours post drink - iv. TRP	No	Cortisol response to iv. TRP greater during T- than T+. No significant mood change either after T- or due to infusion	(Price et al., 1998)
5 MDE responded to ECT	2:3	Drug free. Tested with 100g or 1/4 strength drink	No	Only used MADRS	(Cassidy et al., 1997)
22 MDE responded to sleep deprivation	T- 3:8 T+ 2:9	Not cross-over	N/A	Depletion prevented relapse after 1 night of recovery sleep	(Neumeister et al., 1998b)
43 MDE untreated	21:22	HDRS score>/= 21	-	No change on test day. Bimodal mood change on day after related to treatment response	(Delgado et al., 1994)

mood change refers to a mood change on a depression rating scale N/A not applicable a dash is not appropriate; MDE major depressive episode T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; TRP L-tryptophan; HARS - Hamilton Anxiety Rating Scale (Hamilton 1959); Montgomery-Asberg Depression Rating scale; VAS visual analogue scale; POMS-bi profile of mood states bipolar form; mCPP m-chlorophenylpiperazine

Price and colleagues assessed cortisol response to intravenous tryptophan and to m-chlorophenylpiperazine in patients who had not been treated for their current major depressive episode (Price et al., 1997; Price et al., 1998). The response was consistent with the hypothesis that tryptophan depletion induces an upregulation of postsynaptic 5-HT receptors. A mood change was not found, however, the patients were depressed at the time of testing. This finding is consistent to that of Delgado and colleagues who also tested depressed patients (Delgado et al., 1994).

Delgado et al (1994) depleted patients with scores of a minimum of 21 on a 25-item modified HDRS (table 5.4.2). After having participated in the testing phase of the study the patients were given antidepressant treatment (of either a therapeutic blood level or an adequate dose (> or = 300mg/d of imipramine hydrochloride or its equivalent). The patients fell into three groups: antidepressant non-responders (n=10); partial responders (n=12); and antidepressant responders (n=20). The interesting part of the study is that during the tryptophan depletion phase of the study, although there was no significant mood change on the depletion day, on the day after testing when tryptophan was being repleted there were mood changes, which followed a bi-modal pattern. Some patients felt much better and some much worse. This pattern is related to treatment response. Those who felt better tended to be treatment responders and those who felt worse treatment non-responders. This pattern was not mirrored on the placebo day when both groups showed gradual mild improvement.

Neumeister and colleagues also tested patients during a depressive episode finding that depletion had an effect on relapse (Neumeister et al., 1998b). However, this group was not followed but this finding may also relate to response to treatment similarly to that of Delgado and colleagues (1994).

The overwhelming evidence therefore is that tryptophan depletion in those who are recovered from depression results in a lowering of mood particularly if the patients responded to an SSRI. Having a history of depression does not appear to be a sufficient predictor of depressive relapse following depletion but rather having a history of depression and responding to SSRIs. There could be a number of factors, or one factor which predicted the depression and the response to tryptophan depletion. The outstanding question is therefore which factors predict response to tryptophan depletion?

5.4.2 Patients with Seasonal Affective Disorder

The predicted mood dip following tryptophan depletion also occurred in four of five studies in those remitted from Seasonal Affective Disorder (SAD, see table 5.4.3) (Lam et al., 2000; Lam et al., 1996; Neumeister et al., 1997a; Neumeister et al., 1998a). Patients had responded to light therapy or were summer remitted. All of these studies were small involving a maximum of 13 patients. Tryptophan depletion is not expected to have an effect on all subjects. Therefore it may be that there was simply not a large enough effect to find a mood change in Lam and colleagues (2000) group or that the individuals recruited differed in some way to those in the other studies.

Neumeister (1997b) (see table 5.4.3) did not find a mood change in a group of patients who were symptomatic which is consistent with the three studies where mood was reported in symptomatic patients with major depressive disorder (Delgado et al., 1994; Price et al., 1997; Price et al., 1998) (the latter 3 studies are reported in table 5.4.2).

The treatment for the patients who responded to tryptophan depletion was not SSRIs. The individuals had responded to light therapy (Lam et al., 1996; Neumeister et al., 1997a; Neumeister et al., 1998c) or were summer remitted (Neumeister et al., 1998a). However, all of the individuals who responded had suffered from seasonal affective disorder. Again the question must be asked what are the predictors for depressive relapse following tryptophan depletion. Could there be a serotonergic vulnerability?

5.4.3 Patients with Bulimia

Mood was lowered following tryptophan depletion in a group of women with a previous history of bulimia (Kaye et al., 2000; Smith, Fairburn, & Cowen, 1999a; Weltzin et al., 1994; Weltzin, Fernstrom, Fernstrom, Neuberger, & Kaye, 1995) (see table 5.4.4). In those with a history of MDE significant mood dips were found on the HDRS (Smith et al., 1999a; Weltzin et al., 1994). Therefore it is uncertain whether the history of bulimia or the past history of a major depressive episode was predictive in the depressive relapse. Those with a history of a major depressive episode alone had a depressive relapse following tryptophan depletion (Barr et al., 1994;

Table 5.4.3: Tryptophan depletion in patients with seasonal affective disorder (this table only reports data concerning the patient group not control comparison groups if used)

Patient Group	Male female ratio	Experimental Conditions	Mood Change	Major Findings	Reference
10 SAD responded to light therapy	3:7	Drug free	Yes *a*	6/10 depressive relapse	(Lam et al., 1996)
11 SAD summer remitted	2:9	Drug free	Yes *b*	8/11 depressive relapse	(Neumeister et al., 1998a)
13 SAD responded to light therapy	4:9	3 treatment cross-over: T-, CD and sham of diphenhydramine hydrochloride	Yes *b*	T- increased depression scores on test day. CD increased depression scores on day after.	(Neumeister et al., 1998c)
12 SAD responded to light therapy	2:10	Drug free	Yes *a*	6/12 depressive relapse. Effect on POMS.	(Neumeister et al., 1997a)
11 SAD symptomatic	1:10	Drug free. HDRS>14.	No	None	(Neumeister et al., 1997b)
12 SAD summer remitted compared to 10 healthy volunteers[2]	1:12	Drug free	No	None	(Lam et al., 2000)
18 SAD reported mood change (Neumeister et al., 1997a)	2:16	Assessed SERT gene	-	SERT did not predict mood change	(Lenzinger et al., 1999)

mood change refers to a mood change on a depression rating scale a dash is not appropriate SAD seasonal affective disorder; SERT serotonin transporter gene; CD catecholamine depletion [2] healthy volunteers reported in table 5.6.6; *a* measured by an adapted HDRS; *b* as measured by Structured Interview Guide for the Hamilton Depression Rating Scale, Seasonal Affective Disorder Version; POMS profile of mood states.

Bremner et al., 1997; Delgado et al., 1999; Delgado et al., 1994; Moreno et al., 1999; Smith et al., 1997b; Smith et al., 1999b) (see table 5.4.1).

Kaye et al (2000) did not find a depressive relapse following tryptophan depletion in a group of bulimic women but did find a mood change in that the women were more irritable following the depleting drink compared to the placebo drink (see table 5.4.4). There could be a number of reasons for the difference in results between this study and those by Weltzin and colleagues and Smith and colleagues (Smith et al., 1999a; Weltzin et al., 1994). The group of subjects in Kaye et al's group did not have a history of a major depressive episode, which may have made the group less susceptible to a depressive mood change. Furthermore Kaye et al used a different range of mood measures, which may have been less sensitive.

Not only mood has been altered by tryptophan depletion but also food choice has been affected after depletion (Weltzin et al., 1995), but this appeared to be idiosyncratic as when a larger group was tested intake of food did not differ either between bulimic women and control women or on the depletion or non-depletion day. However, cognitions about body image and other eating disorder cognitions were increased post depletion (e.g. (Smith et al., 1999a; Weltzin et al., 1994) see table 5.4.4).

One study did not find any changes following tryptophan depletion (Oldman, Walsh, Salkovskis, Fairburn, & Cowen, 1995). This could be for a number of reasons. They used a less effective drink which contained only 51g of amino acids. This drink may not have lowered tryptophan either to a low enough

Table 5.4.4 Tryptophan depletion in patients with bulimia and late luteal phase disorder (this table only reports data concerning the patient group not control comparison groups if used)

Patient Group	Male female ratio	Experimental Conditions	Mood Change	Major Findings	Reference
13 BN women Vs 9 healthy women[3]; 2nd study of 6 healthy males[4]	0:13	Drug free. 8/10 currently MDE	Yes *a*	BN women more anxious, over reactive, more body image distortion, greater indecision	(Weltzin et al., 1994)
10 BN recovered compared to 12 controls[5]	0:10	All had history of MDE	Yes *a*	Increased HDRS 6/10 eating disorder cognitions	(Smith et al., 1999a)
10 BN women Vs 10 healthy women[6]	0:10	Drug free. T+ drink contained 4.6g TRP. 7 hrs post drink subjects chose their own food	other	6/10 BN women ingested more calories post T- Vs control day. More irritable.	(Weltzin et al., 1995)
22 BN Vs 16 healthy female controls** (10 Vs 10 reported (Weltzin et al., 1995))	0:22	Drug free. Tested during follicular phase T+ contained 4.6g TRP.	other	Increased levels of mood lability, irritability and desire to purge on T- day Vs T+ day. No difference in intake of food between days or groups	(Kaye et al., 2000)
8 BN recovered vs 12 healthy controls[6]	0:8	Tested in follicular or luteal phase. Three test days: water, 51g drink +/- 1.15 g TRP	No	No specific effect of TRP depletion	(Oldman et al., 1995)
16 late luteal phase disorder	0:16	13 drug free, 3 on fluoxetine. Tested x4, sham vs depletion; luteal vs follicular phase	other	14/16 increase in pre-menstrual symptoms during late luteal phase	(Menkes et al., 1994)

mood change refers to a mood change on a depression rating scale N/A not applicable a dash is not appropriate *a* measured by an adapted HDRS other is other mood change; POMS profile of mood states; VAAS; visual analogue anxiety scale; BN bulimia nervosa; [3] healthy volunteers reported in table 5.6.2, [4] reported in table 5.6.5, [5] reported in table 5.6.6, [6] reported in table 5.6.6

level or rapidly enough to induce a lowering of mood. Secondly there were only 8 bulimic women in the study. There simply may not have been a large enough effect within this small group of women to produce a significant change.

An effect was also found among a group of volunteers with late luteal phase disorder (Menkes, Coates, & Fawcett, 1994) (n=16, see table 5.4.4). During the luteal phase, all but 2 of the women had an increase in pre-menstrual symptoms following the depletion drink but not following the control drink.

Tryptophan depletion produces a depressive relapse in women with bulimia who also have a history of major depression. Mood and food choice can also be altered in these groups. Women with late luteal phase disorder had an increase in pre-menstrual symptoms during the late luteal phase following depletion. These studies show that tryptophan depletion can have a wide range of effects in a number of different populations. That women with bulimia have altered mood following depletion shows that a history of a major depressive episode is not necessary for mood change following depletion. The mood change shown in those without a history of major depression is not as severe as those who have a history of depression. Although these studies add to the body of evidence showing the effects of tryptophan depletion, they do not directly test the predictors and they do not bring us any closer to answering what are the predictors of tryptophan depletion.

5.4.4 Patients with Obsessive Compulsive and Panic Disorder

Tryptophan depletion has also been used within obsessive compulsive disorder and panic disorder. Mood changes such as those found among those with a history of affective disorder have not in general been found among patients with obsessive compulsive disorder or panic disorder (see table 5.4.5). Of the seven studies reported only Barr et al (1994) found a mood dip following tryptophan depletion. However, 10 out of the 15 patients with obsessive compulsive disorder that they studied also had a history of major depressive disorder.

However tryptophan depletion has had an effect on different outcome measures in these groups. OCD patients showed a more pronounced disturbance in sleep continuity (Huwig-Poppe et al., 1999). Patients with panic disorder were more anxious following a CO_2 challenge test when they had received the depleted drink than the placebo (Miller, Deakin, & Anderson, 2000; Schruers et al., 2000). Kent et al (1996) used a different outcome measure in only 5 patients with panic disorder. Although they did not find any mood changes they did find that the patients significantly increased their ventilation when tryptophan depleted suggesting that serotonergic manipulation may be associated with the respiratory hyperactivity seen in panic disorder.

Table 5.4.5: Tryptophan depletion in patients with obsessive compulsive and panic disorder (this table only reports data concerning the patient group not control comparison groups if used)

Patient Group	Male female ratio	Experimental Conditions	Mood Change	Major Findings	Reference
15 OCD	8:7	On medication. 10/15 lifetime history of MDE	Yes *a*	Lowered mood, impaired concentration, decrease energy	(Barr et al., 1994)
12 OCD	4:8	Drug free. Drink contained only the essential amino acids +/- 1.5g TRP	No	No specific effects of TRP depletion	(Smeraldi et al., 1996)
12 OCD compared to 12 controls reported in (Voderholzer et al., 1998)	6:6	Drug free. Drink given at 1800	No	Following T- OCD patients more pronounced disturbance of sleep continuity. Decrease in stage 2 sleep in both groups. No difference in REM sleep in OCD patients, but differences shown in controls	(Huwig-Poppe et al., 1999)
8 Panic disorder		Drug free	No	No change	(Goddard et al., 1994)
20 Panic disorder Vs 19 controls[7]	10:10	Test days separated by only 4 days. CO_2 challenge 270 minutes after drink.	No	No effect of T- on mood scores. CO_2 challenge increase in anxiety ratings on both occasions, patients increased significantly more than controls. Greater increase for patients on T- day than T+ day. Increased rate of panic attacks on T- day.	(Miller et al., 2000)
5 Panic disorder Vs 7 healthy controls[8]	3:2	Tested with depleted drink Vs nothing. Comparison with controls	N/A	Increased ventilation	(Kent et al., 1996)
24 Panic disorder 12 T- 12 T+	 5:7 4:8	Drug free. Not cross-over 12 T-, 12 T+. T+ drink 3g T. Both drinks also contained 33g fatty acids and 63g carbohydrates. CO_2 challenge 5hrs post drink.	N/A	No change on VAAS post T-. But post CO_2 challenge T- group more anxious and more panic symptoms than T+ group on VAAS and PSL.	(Schruers et al., 2000)

mood change refers to a mood change on a depression rating scale N/A not applicable a dash is not appropriate *a* measured by an adapted HDRS other is other mood change; POMS profile of mood states; VAAS; visual analogue anxiety scale; PSL panic symptom list; OCD obsessive compulsive disorder, [7] healthy volunteers reported in table 5.6.2, [8] reported in table 5.6.7

5.4.5 Patients with other disorders

Tryptophan depletion had also been carried out in other disorders where an alteration in serotonin metabolism and function has been implicated. A number of different outcome measures have been assessed (see table 5.4.6).

Mood was not found to be altered by tryptophan depletion in patients with bipolar disorder. Two out of the three studies reported on this group were very small, one study involving only 4 individuals (Cassidy, Murry, & Carroll, 1998) and the other 7 (Cappiello et al., 1997) (see table 5.4.6). Not perhaps surprisingly the study with only four individuals did not find any differences when tryptophan depleted compared to the placebo drink. While Cappiello and colleagues found an exacerbation in manic symptoms. In the one larger study on this group (n=15) no such change in symptoms was found but changes were found in the amplitudes of N_1P_2 and P_{300} (Young, Hughes, & Ashton, 2000). It is perhaps surprising that mood was not found to be altered. However two of the three studies in those who had responded from bipolar disorder were very small. Furthermore none of the subjects had recently responded to an SSRI.

Serotonin is also thought to play a role in schizophrenia. In a large group (n=25) performance was found to be worse on the Wisconsin card sorting test following depletion than following placebo (Golightly et al., 2001) (see table 5.4.6). Porter and colleagues (Porter et al., 2000) found that patients with dementia of the Alzheimer type performed worse on the Modified Mini-

Table 5.4.6: Tryptophan depletion in patients with other disorders (this table only reports data concerning the patient group not control comparison groups if used)

Patient Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
4 Bipolar responded to lithium	2:2	Current treatment lithium. Tested with 100g vs 1/4 strength drink.	No	None	(Cassidy et al., 1998)
15 Bipolar in remission,	9:6	Stable on lithium Tests effect on AEP and EEG activity	No	None. Fall in the amplitude of N_1, P_2 and P_{300} but no change in the power spectrum.	(Hughes et al., 2000b) (Young et al., 2000)
7 Bipolar responded to lithium.	3:4	Current treatment lorazepam, 5/7 on neuroleptics. Tested with 100g drink vs 1/4 strength drink. Measure taken - Young Mania Rating Scale	N/A	Exacerbated manic symptoms	(Cappiello et al., 1997)
16 Schizophrenic	6:10	On medication but no drugs with significant 5-HT effects. T- Vs T+ levels and carbohydrate levels.	No	None	(Sharma et al., 1997)
25 Schizophrenic	21:4	On medication and stable but no drugs with significant 5-HT effects.	No	Worse performance on Wisconsin Card Sorting Test following T- compared to T+	(Golightly et al., 2001)
6 Gilles de Tourette	4:2	Drug free. All with OCD or OCD features.	other	Urge to tic, more anxious and increased POMS score	(Rasmusson et al., 1997)
16 dementia of Alzheimer type Vs 16 controls[9]	6:10	52g drink +/- 1.15gTRP	None	Worse performance on Modified Min-Mental State following T-	(Porter et al., 2000)
1 autistic disorder	0:1	Drug free	Yes a	More anxious, depressed, angry, irritable, agitated and perservation increased scores on HDRS, HARS, VAS	(McDougle et al., 1993)
17 autistic disorder	15:2	Drug free. Clinician rated scales for symptoms and clinician rated VAS	No	11/17 increase in behavioural symptoms, 0/17 during sham	(McDougle et al., 1996)
25 cocaine dependent	25:0	Cue of cocaine use shown after 7 hrs. Mood measured by bipolar likert scale or clinician rated VAS	No	Reduced cue induced cocaine craving following T-	(Satel et al., 1995)
12 cocaine dependent	10:2	Administration of cocaine after 5hrs. Mood Measured by POMS	No	Cocaine VAS "high" decreased after T-	(Aronson et al., 1995)
14 Intermittent Explosive Disorder	13:1	Drug Free. Buss Durkee Hostility inventory used	-	No change in hostility	(Salomon et al., 1994)

mood change refers to a mood change on a depression rating scale N/A not applicable a dash is not appropriate *a* measured by an adapted HDRS other is other mood change; OCD obsessive compulsive disorder; VAS visual analogue scale; HDRS adapted Hamilton Depression Rating Scale; HARS adapted Hamilton Anxiety Rating scale; POMS profile of mood states; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; [9] reported in table 5.6.7

Mental State exam following depletion compared to placebo. Tryptophan depletion although does not affect mood in these groups does appear to effect cognitive function. Behavioural symptoms were increased following tryptophan depletion in a group of individuals with autism and in a group of individuals with Gilles de Tourettes (McDougle et al., 1996; Rasmusson et al., 1997) (see table 5.4.6).

Evidence linking addiction and serotonin was supported as the cocaine "high" decreases following depletion in a group of men and women who were cocaine dependent (Aronson et al., 1995), as does the craving induced from cues (Satel, Krystal, Delgado, Kosten, & Charney, 1995) (see table 5.4.6).

The group of studies presented in table 5.4.6 show the range of effects that can occur with tryptophan depletion in a range of different patient groups. The main aim of many of these studies was not to induce a mood change but to suggest that serotonin plays a role in a particular disorder.

5.4.6 Summary of tryptophan depletion in patient populations

Serotonin appears to be implicated in a number of disorders. Tryptophan depletion has been shown to bring about changes in a wide range of disorders thereby giving further evidence to the role that serotonin may play within that disorder.

The most well replicated finding from tryptophan depletion studies is a dip in mood in patients who were either currently depressed or had a history of major depressive disorder. This mood dip is irrespective of whether the

patients had suffered or were suffering from another psychiatric disorder for instance, (Barr et al., 1994; Bremner et al., 1997; Delgado et al., 1990; Delgado et al., 1999; Delgado et al., 1994; Moreno et al., 1999; Smith et al., 1997b; Smith et al., 1999a; Weltzin et al., 1994). A history of major depressive disorder would appear to be a predisposing factor. However, this is not a necessary or sufficient factor. Patients treated on medication other than SSRIs did not suffer from such a mood dip following tryptophan depletion (Delgado et al., 1999) and in some cases individuals who never had a history of major depressive disorder may suffer from a mood change for instance (Kaye et al., 2000; Weltzin et al., 1995).

5.5 Healthy Volunteers with a Family History of Depression

Family history of major depressive disorder is a predisposing factor for mood change during tryptophan depletion (Benkelfat et al., 1994; Klaassen et al., 1999b) (see table 5.5.1). However this factor is not sufficient to cause a mood change. Ellenbogen et al (1999) did not find any significant mood change in a group of female volunteers with a positive family history for major affective disorder. However, this study only involved 12 volunteers which may not have been enough to gain an effect (see table 5.5.1). Riedel (1999) did not assess mood but did find cognitive changes in a similar group specifically in long-term memory but not in short term memory or perceptual or psychomotor performance (see table 5.5.1).

5.6 Healthy Volunteers

Often healthy volunteers have been used as a comparison group as any mood change with tryptophan depletion is not expected. However, this is not always the case. Tables 5.6.1-5.6.7 describe studies that have involved healthy normal controls. The focus of these tables is change on a negative mood questionnaire. Tables 5.6.1 and 5.6.2 describe studies where changes in mood have been observed.

5.6.1 Mood changes in healthy normal volunteers

Findings of lowered mood among healthy normal volunteers have not been consistent. Lowered mood has been found following tryptophan depletion in both studies which tested all males, all females or mixed gender groups (see tables 5.6.1 and 5.6.2). Young et al (1985), depleted a group of 12, 18-25 year old men, which resulted in significantly lowered mood and in them being more easily distracted by dysphoric themes, than the non-depleted groups, while performing on an attention task (see table 5.6.1). Smith and colleagues found that tryptophan depletion lowered mood irrespective of environment in 40 males who were depleted compared to 40 who received the control drink (Smith, Pihl, Young, & Ervin, 1987) (see table 5.6.1). More recent studies have supported these findings with mood changes on the POMS (Bhatti et al., 1998; LeMarquand, Benkelfat, Pihl, Palmour, & Young, 1999). An increase on the POMS was found even when the drink only contained 50g of amino acids in a group of 14 males (Knott, Howson, Perugini, Ravindran, & Young, 1999) (see table 5.6.1).

Table 5.5.1: Tryptophan depletion in healthy controls with a family history of major affective disorder (this table only reports data concerning the patient group not control comparison groups if used)

Subject Group and age	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
19 male FH- (22.3+/-3.4 yrs), 20 male FH+ (24.1+/-2.8 yrs)	39:0		Yes	6/20 FH+ had 10 point change on POMS, 0/19 FH-. No change on clinical scales (HDRS)	(Benkelfat et al., 1994)
16 FH+(29+/-11 yrs), 11 FH- (33+/- 10 yrs)	FH+ 7:9; FH- 5:6	Test days separated by min 4 days. Tested with 100g drink +/- 3g TRP, gave an additional 10g after 7, 11 and 14hrs.	Yes	Increase on POMS in FH+ following T-.	(Klaassen et al., 1999b)
12 female, (22.4+/- 0.7 yrs) FH+	0:12	TRP depleted twice and one balanced drink	No	None only used self-report measures POMS, VAS.	(Ellenbogen et al., 1999)
16 FH+; 11FH- (31+/-11yrs)	FH+ 7:9; FH- 5:6	Tested with 100g drink +/- 3g TRP, gave an additional 10g after 7, 11 and 13 hrs. Drinks contained carbohydrate and fat.	N/A	Impaired long-term memory in both groups but no impairment to short-term memory, perceptual or psychomotor performance	(Riedel et al., 1999)

mood change refers to a mood change on a negative mood rating scale N/A not applicable; HDRS Hamilton Depression Rating Scale; POMS profile of mood states; VAS visual analogue scale; FH family history

Similar changes in mood have been found in women (Ellenbogen et al., 1996; Kaye et al., 2000; Weltzin et al., 1994) and in mixed gender groups (Klaassen et al., 1999a; Leyton et al., 1999) (see table 5.6.2). Interestingly two studies repeated the procedure and these mood changes only occurred on the first depletion but not the second. There is no obvious explanation for depletion to cause a mood change on the first case but not the second, however, there could be a number of reasons. For instance, by knowing what to expect from the drink the subjects reacted to it in a different way on the second time around, or an adaptation in serotonergic transmission may have occurred to make the individuals lack in sensitivity the second time around.

However, a number of studies did not show mood changes in either single or mixed gender groups (see tables 5.6.3, 5.6.6 and 5.6.7). Some of these studies used the 50g drink (Hughes, Ashton, Matthews, & Young, 2000; Oldman et al., 1995; Oldman, Walsh, Salkovskis, Laver, & Cowen, 1994; Park et al., 1994; Porter et al., 2000) or a different drink (Abbott et al., 1992; Wolfe, Metzger, & Jimerson, 1995) which may explain the lack of mood change. While some studies only included a small group of subjects therefore it is possible that these studies may have fallen foul to a type II error. Indeed in many of the studies which have included normal controls mood change has not been expected and therefore not directly tested. However, mood change has been reported in a number of studies and the

Table 5.6.1: Tryptophan depletion in healthy male controls: studies which showed a mood change

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
36 (18-25 yrs)	36:0	Not cross-over. 3 groups of 12: T- Vs 2.3g T+ vs 10.3g T+. False negative feedback given after a task to induce dysphoric mood.	Yes	Lowered mood on MAACL. Performed less well on a cognitive task. More easily distracted when dysphoric	(Young et al., 1985)
80 (18-25 yrs)	80:0	Not cross-over. 8 groups of 10 each. 40 T-, 40 T+. Positive Vs negative environment. Informed Vs not informed about peripheral effects of drink.	Yes	Lowered mood on MAACL independent of environment	(Smith et al., 1987)
11 (21-53 yrs)	11:0	Drinks given at 6pm with 48hrs between drinks. Tested with either 100g drink or 25g drink.	Yes	Both drinks decreased REM latency and increased REM time. Less elated, less vigour, less friendliness on POMS	(Bhatti et al., 1998)
28 (18-35 yrs)	28:0	Not cross-over. Tested with 50g drink +/- 1.15g. After 5hrs gave d-fenfluramine.	Yes	Increase on POMS. Slowing of EEG - increases in delta amplitude. Post d-fen increase in fast wave (beta) activity after T- not T+.	(Knott et al., 1999)
13 FH+ for alcoholism T- 11 FH+ for alcoholism T+ 15 FH- for alcoholism T- 18 FH- for alcoholism T+ (all 18-25 yrs)	13:0 11:0 15:0 18:0	Not cross-over. 4 FH+ T-, 1 FH+ T+ vomited, 1 FH- T- vomited but were included in the analysis. Tested on Taylor aggression task (12 did not complete task) and on go/no-go discrimination task	Yes	Lowering of mood on POMS, VAS and increase in anxiety on state scores on STAI. No differentiation of aggressive responding due to depletion. FH+ T- made more commission errors, errors in response to punishment or reward. May be related to impulsivity.	(LeMarquand et al., 1999)

mood change refers to a mood change on a negative mood rating scale N/A not applicable; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; FH family history; MAACL multiple affect adjective check list (Zuckerman & Lubin, 1965); POMS profile of mood states; REM rapid eye movement.

Table 5.6.2: Tryptophan depletion in healthy controls all female or mixed gender: studies which showed a mood change

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
20 FH- (18-30 yrs)	0:20	T- twice and one T+. Drink 16.7% less than standard drink.	Yes 1st depletion No 2nd depletion	T-1 lowered mood on POMS and VAS but not on T-2. Only self-report mood measures used.	(Ellenbogen et al., 1996)
9 (21+/- 2 yrs) (BN reported in table 5.4.4)	0:9		Yes	More depressed, more over reactive. Used an adapted 6-point scale.	(Weltzin et al., 1994)
16 (24.5 +/-5.6 yrs) (10 reported in (Weltzin et al., 1995))	0:16	100g +/- 4.6g 7 hrs post drink subjects chose their own food	Yes	More irritable post T- than T+. No differences in food intake on either day	(Kaye et al., 2000)
paper does not give details of numbers (19-39 yrs)	all women	Between groups: T+, T- or deficient in phenylaline and tryosine. Underwent a stressful procedure, a speech	Yes	Mood lowered after stress challenge test following both types of depletion but not for controls.	(Leyton et al., 1999)
6 FH- (24-40 yrs)	4:2	Cross-over T - Vs T+ before and after 6 weeks treatment with fluoxetine	Yes 1st depletion No 2nd depletion	VAS happy ratings lower during T-1. No effect on POMS or HDRS.	(Barr, Heninger, Goodman, Charney, & Price, 1997)
13 (27 +/- 7yrs)	3:10	Compared T- Vs lyseine depletion. Tested with 100g drink, 3g TRP or Lyseine – or a balanced drink. Drink also contained carbohydrate and fat. Gave a further 10g of drink after 7, 11 & 14 hrs.	Yes	Following T- increase on POMS and on von Zerssen –ve mood scale. Less recall of words from word list. LYS-Depletion - no change.	(Klaassen et al., 1999a)

mood change refers to a mood change on a negative mood rating scale; POMS profile of mood states; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink

reasons why some volunteers show a mood change and some do not needs to be explored.

One could hypothesise that those who showed a mood change are susceptible to serotonin change, in the same way that those who responded to SSRIs are susceptible to change in serotonin. The question is therefore could personality predict change following tryptophan depletion.

5.6.2 Changes in aggressive responding in healthy normal volunteers

Although lowered mood has not always been tested directly in healthy volunteers aggressive responding has been (see table 5.6.4). Aggression has been directly tested in random groups of male volunteers or in those selected as high or low on aggression or hostility. In those with high trait hostility aggression was found to be increased following tryptophan depletion compared to a control drink (Bjork, Dougherty, Moeller, & Swann, 2000; Dougherty, Bjork, Marsh, & Moeller, 1999; Wingrove, Bond, & Cleare, 1999). One study did not find an effect of tryptophan depletion of stable aggressive men, however on the test employed in this study the aggressive men reached ceiling, therefore an effect could not be detected.

In men who were not selected for aggression, aggressive responding was found to be increased on the depletion day compared to the depletion day (Bjork, Dougherty, Moeller, Cherek, & Swann, 1999; Cleare & Bond, 1995; Pihl et al., 1995). However one study found aggression to be increased following both drinks (Moeller et al., 1996).

In sum, tryptophan depletion does increase aggressive responding in men, thereby adding weight to the hypothesis that aggression and serotonin are connected. Whether this is connected to the more general concept of negative mood has not been resolved. However, aggression is similar to irritability which is a facet of negative mood. Furthermore these studies show that response to tryptophan depletion may be predicted by a particular aspect of an individuals personality, in this case aggression or hostility.

5.6.3 Summary of studies in healthy volunteers

A number of measures other than mood and aggression have been assessed following tryptophan depletion. Cognitive change has been discussed in section 2.6.1. Methods and subject groups have varied from study to study. Tryptophan depletion does appear to have an effect in healthy volunteers whether this is on mood, aggression, cognition or sleep. The overriding question must be why does tryptophan affect some volunteers but not others.

5.9 Summary

Tryptophan depletion produces a mood change in those who have had a previous history of depressive disorder, a history of bulimia, and can exacerbate symptoms in other disorders. A mood dip may be induced in those with a family history of depressive disorder and in some volunteers. The effect does not appear to be specific of gender. Performance on tests of memory, attention or executive function may be affected following tryptophan

depletion. However, a past history of depression, or a family history of depression are not sufficient criteria to predict a mood dip following tryptophan depletion. Aggression of high trait hostility can predict response to tryptophan depletion. A predictive criterion may be a susceptibility to serotonergic change. The next chapter will discuss whether Neuroticism is related to serotonergic function, and therefore whether this personality variable may be a possible predictor of mood change following tryptophan depletion.

Table 5.6.3: Tryptophan depletion in healthy male controls: studies which did not show a mood change on a depression scale

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
12 (21-31 yrs)	12:0	5 volunteers were FH+, 1 had personal history of MDE Tested mood, memory, attention and anxiety.	No	None	(Shansis et al., 2000)
12 (21-39 yrs)	12:0	Tested with 52 g drink +/- 1.15g T	No	Cognitive performance affected on tests of learning and executive function.	(Park et al., 1994)
20 (23.5 yrs)	20:0	Tested with 52 g drink +/- 1.15g T Auditory evoked potentials (AEP) using oddball task and EEG recorded	No	No difference in AEP's or EEG's	(Hughes et al., 2000a)
15 (29 +/- 4 yrs)	15:0	Tested with 100g drink +/- 3g T, after 5hrs gave a CO_2 challenge	No	9/15 increase in state form of STAI. Increase on panic symptom list. No change on POMS or VAS and CO_2 challenge effects not specific to T-	(Klaassen et al., 1998)
60 (18-30 yrs)	60:0	Tested with a different drink, gelatine fortified with amino acids but gained 80% free TRP depletion. Not cross-over 4 groups of 15. T- Vs T+, morphine Vs placebo	No	T- abolished the analgesic effect of morphine	(Abbott et al., 1992)
13 (21-52 yrs)	13:0	T+ 4.6g T Tested the acoustic startle response	No	Only used visual analogue scales for mood. No difference on Stroop or reaction times tasks. Suppression of prepulse inhibition of the acoustic startle response.	(Phillips, Oxtoby, Langley, Bradshaw, & Szabadi, 2000)

FH family history; T- L-tryptophan depletion; T+ l-tryptophan enhanced; TRP tryptophan; EEG electroencephalogram; STAI state and trait anxiety inventory, VAS visual analogue scale; POMS profile of mood states

Table 5.6.4: Tryptophan depletion in healthy male controls: studies which did not show a mood change on a depression scale and aggression was tested

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
48 (32 +/-9 yrs)	24:0	Volunteers were in two groups - high or low in aggression. 24 in each group	No	Increased aggression both on a behavioural test and in a self-report questionnaire	(Cleare & Bond, 1995)
10 (25.0 +/-4.9 yrs)	10:0	Tested with 100g or 25g drink. Assessed aggressive responding	N/A	Increased aggressive responding with both drinks compared to baseline	(Moeller et al., 1996)
90 (18-34 yrs)	90:0	In 6 groups of 15: drink Vs alcohol. Tested with 100g drink T-, 2.3gTRP or 10.3g TRP. Given alcohol or cola after 260 mins	N/A	Increased aggressive responding post TRP depletion and alcohol consumption	(Pihl et al., 1995)
8 (32.6 +/- 8.6)	8:0	Tested over 4 days. Day 1 baseline days 2 & 3 T+ or T-, day 4 hunger condition Split into hostile Vs non-hostile groups	N/A	More aggressive when depleted than other two conditions High hostile group more aggression following depletion	(Bjork et al., 1999) (Dougherty et al., 1999)
28 high trait hostility (18-44 yrs)	28:0	Not cross-over, 14 depleted, 14 placebo. 100g +/-10.3 g Played a tank game which involved steering a tank through a mine field with instructions from a fictitious "partner"	N/A	Depleted group reported increased feelings of restlessness and incompetence, whether they lost due to instructions or by running out of time	(Wingrove et al., 1999a)
27 high trait hostility (18-44 yrs); 13 T-, 14 T+	28:0	Not cross-over. 13 depleted, 14 placebo. Assessed relationship between prolactin response and hostility	N/A	The higher the hostility score at baseline, the smaller the change in prolactin for both T+ and T-.	(Wingrove, Bond, Cleare, & Sherwood, 1999b)
38 18 stable aggressive (17.2 +/- 0.4 yrs) 20 non-aggressive (17 +/- 0.6 yrs)	38:0	Two groups: stable aggressive (18) Vs non-aggressive (20)	N/A	No effect of T-.	(LeMarquand et al., 1998)
12 aggressive (27.9 +/-8.3 yrs) Vs 12 nonaggressive (31.1 +/-7.1)	24:0	T+ drink 10.3g TRP Tested aggressive responding during high and low provoking occasions	N/A	When provoked high aggressive group showed more aggressive responding following T-	(Bjork et al., 2000)

T- L-tryptophan depletion; T+ l-tryptophan enhanced; TRP tryptophan; AEP averaged evoked potental; EEG electroencephalogram

Table 5.6.5: Tryptophan depletion in healthy male controls: studies which did not test for a mood change on a depression scale

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
6 (26 +/- 6 yrs)	6:0	Aim to maintain TRP:LNAA ratio, gave 4 test mixtures 100g no TRP 100g 2.3g TRP 100g 4.6g TRP 50g 2.3g TRP	N/A	plas TRP 66%; T:LNAA 87% plas TRP x3 ; T:LNAA 54% plas TRP x5 ; T:LNAA plas TRP x3 ; T:LNAA (% etc compared to baseline measures)	(Weltzin et al., 1994)
8 (34.1 +/-8.8 yrs)	8:0	Some had personal histories of drug or alcohol, personality disorders or both. Low monoamine diet for 3 days prior to testing. Full cross-over, 4 test days: T+ or T- and d-fen or sham.	N/A	Prolactin response to d-fen decreased post T-	(Coccaro, Kavoussi, Cooper, & Hauger, 1998)
40 (18-35 yrs)	40:0	CCK-4 given 5hrs post aa drink Between subjects design 20 T-, 20 T+	N/A	T- did not modify effect of CCK-4	(Koszycki, Zacharko, Le Melledo, Young, & Bradwejn, 1996)
26 (18-35 yrs reported in (Knott et al., 1999))	26:0	Assessed immune activity	reported in (Knott et al., 1999)	Increase in POMS did not correlate with immune activity	(Ravindran, Griffiths, Merali, Knott, & Anisman, 1999)

mood change refers to a mood change on a negative mood rating scale; POMS profile of mood states; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; TRP tryptophan

Table 5.6.6: Tryptophan depletion in healthy female controls: studies which did not show a mood change on a depression scale

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
6 (18-35 yrs)	0:6	Tested with a reduced aa drink Vs lactose	N/A	Total TRP 79% decrease T/LNAA ratio 94% decrease Placebo total TRP 21% decrease T/LNAA ratio 12% decrease	(Wolfe et al., 1995)
10 (25 +/- 6 yrs Vs 10 BN women reported in table 5.4.4)	0:10	7 hrs post drink subjects chose their own food	No	8/10 ingested less calories on depletion day versus control day	(Weltzin et al., 1995)
12 (19-27 yrs)	0:12	Tested with water, 52g drink +/- 1.15g T. Water always first. Tested appetite by providing a free-choice buffet	No	None	(Oldman et al., 1994)
12 (19-28 yrs vs 8 BN women reported in table 5.4.4)	0:12	Tested in follicular or luteal phase. Three test days water, T-, or T+. Tested with 51g drink +/- 1.15 g T	No	None	(Oldman et al., 1995)
10 (31.4 +/-11.4 yrs vs 12 SAD patients reported in table 5.4.3)	0:10		No	None	(Lam et al., 2000)
12 (28.2 +/- 5.5 yrs vs 10 BN women reported in table 5.4.4)	0:12	Tested with 85.8 g drink	No	None	(Smith et al., 1999a)

mood change refers to a mood change on a negative mood rating scale; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink

Table 5.6.7: Tryptophan depletion in mixed gender controls: studies which did not show a mood change on a depression scale

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
11 (27 +/- 2 yrs)	10:1	Full cross-over, 4 test days: T+ or T- and yohimbine or saline. Yohimbine or saline administered 5hrs after amino acid drink	No	T- alone - 5/11 increased nervousness, light headed, more piloerection. Post yohimbine & T- increased nervousness. No effect on cortisol or MHPG.	(Goddard et al., 1995)
14 T- (28.1 +/-0.9 yrs) Vs 15 T+ (27.9 +/-1.3 yrs)	7:7 8:7	Asked volunteers to talk about the "most anxiety-provoking episodes in their lives"	No	None	(Monteiro-dos-Santos et al., 2000)
12 (23-75 yrs Vs MDE patients reported in table 5.4.1)	4:8	100g Vs 25g drink	No	None	(Moreno et al., 1999)
11 (21-41 yrs)	5:6	Tested with 100g drink for men 20% less for women	No	No specific mood changes	(Smith, Clifford, Hockney, Clark, & Cowen, 1997a)
7 (27.2 +/- 7.7 yrs)	5:2	Tested with T- Vs nothing	No	None	(Kent et al., 1996)
12 (34 +/- 9 yrs)	6:6	Drinks were given at 1800	No	Decrease of Stage 2, non-REM sleep; increase in % of time awake during sleep time; increase in REM density.	(Voderholzer et al., 1998)
17 (23.3 +/-2.3 yrs)	9:8	100g drink +/- 4.6g TRP. At lunch added a maltodextrin/fat mixture. 90g of drink at T0 and 10g at T6. Cognitive test batter at baseline, 5 and 9 hours after drink	No	No effect of order of depletion. Impaired long-term memory, improved frontal activation – perhaps focused attention improvement on Stroop, a dichotic listening task and verbal fluency	(Schmitt et al., 2000)
19 (29.1 +/- 8.4 yrs Vs 20 Panic disorder reported in table 5.4.5)	11:8	Test days separated by only 4 days. CO_2 challenge 270 minutes after drink.	No	Prior to CO_2 challenge increase in anxiety but no difference between T+ and T- days.	(Miller et al., 2000)
16 (73.1 +/-4.9)	8:8	52g drink +/-1.15g TRP	No	None	(Porter et al., 2000)

mood change refers to a mood change on a negative mood rating scale; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; TRP tryptophan; CSF cerebrospinal fluid; REM rapid eye movement

Table 5.6.8: Tryptophan depletion in mixed gender controls: studies which did not show a mood change on a depression scale

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
7 (25.6 +/- 2.8 yrs)	4:3	Tested with 100g or 25g drink. Given at 3pm	N/A	Plasma total TRP lowered slightly after 1/4 strength drink, returned to baseline after a few hours	(Krahn et al., 1996)
15 (27.8 +/- 1.6 yrs) Vs 16 non-depleted (27.1 +/-1.2 yrs)	7:8 8:8	Tested on intra-dimensional extra-dimensional shift discrimination task Between subjects design Tested on a decision making task	N/A	Ability to learn changed stimulus-reward associations decreased. Those depleted chose the more likely outcome significantly less than their controls	(Rogers et al., 1999a; Rogers et al., 1999b)
12 (29.0 +/- 1.8 yrs)	Not given	Tested with 52 g drink +/- 1.15g TRP	N/A	Enhanced response times to incompatible stimuli in an attentional task	(Coull et al., 1995)
12 (24-32 yrs)	6:6	Two different T- drinks. Both essential amino acids only. Placebo drink – orange juice, oat flakes and table salt. Tested AEP and EP	N/A	None	(Dierks et al., 1999)
18 patients with cirrhotic liver disease 5 healthy controls (39-60 yrs)		Tested with the essential amino acids	N/A	In cirrhotics plasma TRP dropped later than in controls the delay being proportional to the disease process	(Moja et al., 1991)
11 (28.5 +/-2.3 yrs)	5:6	Drink given at 1500.	N/A	Nocturnal 6-SM significantly decreased and highly correlated with decreases in plasma melatonin.	(Zimmermann et al., 1993a)
8 (32 +/- 8.5 yrs)	4:4	Drinks given at 1500	N/A	Melatonin secretion decreased	(Zimmermann et al., 1993b)

mood change refers to a mood change on a negative mood rating scale; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; TRP tryptophan; 6-SM - 6-hydroxymelatonin sulphate, a metabolite of melatonin; CSF cerebrospinal fluid, 5-HIAA 5-hydroxyindoleacetic acid

Table 5.6.9: Tryptophan depletion and CSF measures

Subject Group	Male: female	Experimental Conditions	Mood Change	Major Findings	Reference
5 (33.6 +/-4.5)	2:3	Drinks given at 12pm. Plasma compared to CSF levels of T. CSF 5-HIAA taken through out day	No	Plasma and CSF levels of tryptophan correlated highly. CSF nadirs reached several hours after plasma nadirs. CSF 5-HIAA levels decreased (mean 31%)	(Carpenter et al., 1998)
5 (29.4 +/- 6.27 yrs)	4:0	Blood and CSF levels taken. Only one CSF sample taken 7 hours after drink to test for monoamine metabolites	No	Free and total plasma TRP and CSF 5-HIAA significantly reduced following T-. No change in CSF levels of HVA, MHPG, NPY, CRF and CGRP.	(Moreno et al., 2000)
6 (44.8 +/- 11.9)	4:2	51.49 g drink no T+ drink. 3 days of low monamine diet, 6 days of low TRP diet. Day 9 drink. Plasma compared to CSF levels of T. CSF 5-HIAA taken through out day.	N/A	Concentration profiles of total and free TRP and CSF TRP were similar (statistical analysis could not be carried out due to missing data)	(Williams, Shoaf, Hommer, Rawlings, & Linnoila, 1999)

mood change refers to a mood change on a negative mood rating scale; T- L-tryptophan depletion; T+ L- tryptophan enhanced drink; TRP tryptophan; CSF cerebrospinal fluid; REM rapid eye movement; MHPG 3-methoxy-4-hydroxyphenylglycol; HVA homovanillic acid, NPY neuropeptide Y, CRF corticotrophin releasing factor, CGRP calcitonin gene-related protein

Chapter Six: Personality Traits and Mood: a Shared Biological Basis?

6.1 Overview

Personality traits and models of personality have been discussed in Chapter One. Relationships between personality and mood have been related in Chapter Three. Biological theories of depression have been discussed in Chapter 4. The question is now - what connects these concepts together? Is personality related to depression and if it is by what mechanism? This chapter discusses the shared biological basis between personality and depression. This chapter is divided into 3 main sections. The first discusses research which has linked personality to depression. The second section discusses personality and antidepressant treatment. These two sections bring together overlapping issues. Although in essence many of the studies are similar and show similar results the approach is different. The third discusses evidence for the biological basis of personality traits. The main aim of this chapter is to suggest that Neuroticism and clinical depression have a shared biological basis. What will be proposed within this chapter is that serotonin links together Neuroticism and clinical depression.

6.2 Personality and mood in patients with depression

Enns and Cox (1997) propose four kinds of relationship which exist between personality and depression. These are firstly the vulnerability model, where

personality factors predispose an individual to onset of depression. The second is the pathoplasty model where personality factors affect the expression of depression. The third is the scar model where personality factors are altered by depression. Lastly, the fourth is a continuity or spectrum model, where another factor or process is responsible for both the personality factors and depression. These relationships are not mutually exclusive as will be revealed with examples described below.

6.2.1 Neuroticism, Harm Avoidance and Depression

Cross-sectional studies find increased Neuroticism scores (as measured by the EPQ, and the Munich Personality Test) in patients with depression, compared to controls with no personal or family history of psychiatric disorder (e.g. (Roy, 1990) patients n=42, controls n=42, $p<0.001$,$d=1.7$; (Hecht, van Calker, Berger, & von Zerssen, 1998) patients n=48, controls n=29, $r=0.4$ respectively). Harm Avoidance scores were also found to be increased in patients with depression compared to healthy controls ((Hansenne, Pitchot, Moreno, Machurot, & Ansseau, 1998), patients n=53, controls=33 (Hansenne et al., 1999) patients n=40, controls n=40, $d=2.1$). Furthermore patients in remission from a major depressive episode have both increased Neuroticism and Harm Avoidance scores compared to controls with no personal or family history of psychiatric disorder (e.g. (Roy, 1990), patients n=18, controls n=24, $p<0.001$,$d=1.5$; (Young et al., 1995) patients n=62, controls n=100, $d=0.7$ respectively).

If patients with depression are followed from the time of treatment, scores on Neuroticism and Harm Avoidance decrease in responders but not in non-responders ((Chien & Dunner, 1996) n=35 versus n=28 respectively; (Bagby, Joffe, Parker, Kalemba, & Harkness, 1995) n=41 versus n=16 respectively; (Hirschfeld et al., 1983b) n=25 versus n=32 respectively). Patients in remission have Neuroticism scores which were one standard deviation above normative samples (Bagby et al., 1995). Harm Avoidance scores correlated with change scores following treatment on the Hamilton Depression Rating Scale (Strakowski, Faedda, Tohen, Goodwin, & Stoll, 1992).

Increased Neuroticism scores were also found to be predictive of chronicity (Scott, Eccleston, & Boys, 1992) n=55; (Duggan, Lee, & Murray, 1990) n=50; (Weissman, Prusoff, & Klerman, 1978) and poor outcome (Duggan et al., 1990) n=89, (Kerr, Schapira, Roth, & Garside, 1970) n=42).

These findings could be interpreted in a number of ways. The decrease in scores in patients following remission suggest a state related change, however, remitted patients appear to still have increased scores compared to controls which may suggest a vulnerability or that the depression has had an effect on personality which would fit with the scar hypothesis. Increased Neuroticism scores predict chronicity (Duggan et al., 1990; Scott et al., 1992). However, this does not answer whether N predicts onset of depression but merely that it may predict a failure to recover.

6.2.2 Prospective Longitudinal Studies

The ideal design is the longitudinal study where individuals are assessed before they suffer from a depressive illness. This is very labour intensive as it is not known who will or will not suffer from an illness. There are however a number of longitudinal studies assessing personality and depression.

The Clinical Studies of the National Institute of Mental Health - Clinical Research Branch Collaborative Program on the Psychobiology of Depression has offered an opportunity to study the relationships between personality and depression both cross-sectionally and longitudinally. The participants are patients who had suffered from moderate to severe depression or mania. At various stages personality variables of this group have been reported (Hirschfeld, Klerman, Clayton, & Keller, 1983a) and also in comparison to, first degree relatives of the probands, and, control subjects matched to a subset of the relatives (Hirschfeld et al., 1983a; Hirschfeld et al., 1989). After 6 years 29 of the control group had a first episode of major depression. This group had lower emotional strength than the never ill group (n=370) which includes an increased Neuroticism score (Hirschfeld et al., 1989). This increased N score was not as great as those patients who had previously had major depressive episodes, suggesting that not only is N predictive of depressive illness but that there is an effect of the illness on N. A further finding is that the **never** ill first degree relatives, had high emotional strength which included a **low** value for N (Hirschfeld et al., 1989). This evidence

therefore suggests that a high N predisposes to depressive illness and also that a low N score is protective against depressive illness.

A group of Swiss men going for military service were followed between 1972 and 1988. Personality data was collected when these young men applied for military service (n=2842). On follow-up it was discovered that high Neuroticism scores predicted onset of unipolar (n=99) but not bipolar (n=26) depression (Clayton, Ernst, & Angst, 1994).

Block and colleagues followed a group of children from age 3 onwards and reported on them at age 18 (Block, Gjerde, & Block, 1991) n=88. They did not gain a psychiatric diagnosis but they relate personality profiles to an increased risk of depressive disorder as measured by the Center for Epidemiological Studies-Depression Scale (CES-D; (Radloff, 1977). Those showing depressive tendencies at age 18 had distinguishing personality profiles and behaviour as early as age 7. In order to ascertain a personality profile they used the California Q Set both the child and adult versions (CCQ and CAQ respectively; (Block, 1978; Block & Block, 1980) respectively). This measure assesses personality, cognitive and social characteristics of the person. Girls were oversocialised meaning that they were too compliant to other's wishes and emphasised close relationships while boys had a desire for attention, and attempted to go beyond social restraints placed on them such as being too aggressive, and also did not feel adequate in themselves. These personality measures are not directly comparable to the trait measures, with which we are now familar, however, this study is interesting

in that it shows that from a very early age an individual is predisposed to a mood disorder by their personality characteristics.

Twin studies have given further insights into the relationships between personality and depression. Female-female twin pairs (n=1733) were selected from a larger cohort of twins (Kendler, Neale, Kessler, Heath, & Eaves, 1993). Again the personality factor Neuroticism is implicated as a factor towards depressive mood. Neuroticism was found to be highly related to lifetime prevalence of major depression. The twin pairs were followed for one year. In those who had not previously had a depressive episode Neuroticism predicted one-year prevalence of major depression (the vulnerability or continuity/spectrum model). Those who had suffered from a major depressive episode had increased Neuroticism scores (the scar effect). Furthermore, within the year of assessment, those who were suffering from an episode had increased Neuroticism scores (the state effect).

Neuroticism appears to be related to clinical depression in a number of ways which will be summarised in section 6.2.4, however others have argued that Extraversion is a predictor of depression.

6.2.3 Extraversion as a Predictor of Depression

Extraversion scores increase following recovery of depression (e.g. (Bagby et al., 1995; Hirschfeld et al., 1983b). However, Extraversion does not differentiate between patients who are asymptomatic, have moderate or

fluctuating symptoms, or who have chronic symptoms, while Neuroticism scores increase across the three groups (Weissman et al., 1978). Extraversion was also not found to be predictive of chronicity (Duggan et al., 1990; Radloff, 1977; Weissman et al., 1978) nor predispose to a depressive illness in twins (Kendler et al., 1993) in high risk relatives of patients with major depression (Hirschfeld et al., 1989).

6.2.4 Summary of mood and personality in patients with depression

Personality and in particular Harm Avoidance and Neuroticism appear to be related to clinical depression in a number of ways. From the range of studies reviewed where methods have varied it would seem that Neuroticism scores increase during a depressive episode and decrease following an episode (state effect). That scores are higher in those who have suffered from episode of depression compared to those who have not (scar effect). Higher Neuroticism scores in previously well individuals predispose them to depressive disorder (a vulnerability). Also higher scores predispose to a poor outcome and a longer duration of illness (pathoplasty). And low N scores are protective against clinical depression. Others have argued that Extraversion is a predictor of depression and although Extraversion scores increase following Extraversion does not appear to be predictive of depression.

Although there is convincing evidence associating Neuroticism with depression, this personality trait is not selective to depression. Neuroticism or Harm Avoidance may not differentiate between disorders. Higher scores

on these personality dimensions are not restricted to depressive disorder but are also seen in panic disorder, generalised anxiety disorder, obsessive-compulsive disorder and eating disorders (Kleifield, Sunday, Hurt, & Halmi, 1994; Reich, Noyes, Hirschfeld, Coryell, & O'Gorman, 1987; Richter, Summerfeldt, Joffe, & Swinson, 1996; Starcevic, Uhlenhuth, Fallon, & Pathak, 1996).

Neuroticism appears to be strongly related to clinical depression. The personality trait of Harm Avoidance is also related to depression. However, the body of evidence linking HA and depression is not as strong, because there have not been any longitudinal studies implicating HA as a predictor of depression. It could be hypothesised that Neuroticism (and possibly HA), from this convincing though circumstantial evidence, have a shared a biological basis with depression.

6.3 Personality and Antidepressant Treatment

Antidepressant treatment and its effect on personality have been assessed in both patients and controls. This is line of questioning changes of focus from whether personality is correlated with depression to more causal issues. For instance there is the implicit suggestion that personality variables are biologically based and that these may act on the same mechanisms as antidepressant drugs and therefore affective disorders. Before embarking on this section two points must be remembered. Firstly that personality traits are meant to be enduring and stable over time. Secondly, from sections 6.1 and 6.2 it is clear that Neuroticism and Harm Avoidance scores may increase

during a depressive episode (Hansenne et al., 1998; Roy, 1990) and in some cases stay raised following a depressive episode (Roy, 1990; Young et al., 1995). Any interpretation of results suggesting that personality predicts response due to a particular antidepressant must be dealt with caution.

Studies reported to date suggesting that personality variables are predictors of particular antidepressant drug response do not have adequate controls. These studies are immediately appealing. A quick short measure such as a personality inventory may be able to predict response. However, so far the results from these studies may just be a result of changes in trait dimensions which were reported in sections 6.1 and 6.2. Studies suggesting that personality predicts antidepressant response are now reviewed.

6.3.1 Personality as a predictor of antidepressant treatment in patients

Tome et al (1997) suggest that temperament factors may influence outcome of antidepressant treatment in patients with depression. They find that those patients who have high Harm Avoidance scores also score highly on the Montgomery-Asberg Depression Rating Scale (MADRS: (Montgomery & Asberg, 1979)) following six weeks of treatment on paroxetine and pindolol ($n=21$, $r = -0.38$). This result suggests that those with lower scores have a better outcome and those with higher scores may predict poor outcome. However, this is not a new finding and may have nothing to do with a particular treatment. Neuroticism and Harm Avoidance scores are highly correlated. High Neuroticism scores are also related to poor outcome (Duggan et al., 1990; Kerr et al., 1970). The suggestion is that HA is

predictive of treatment with drugs that act specifically on the serotonergic system. However, there are no controls within this study. Firstly, there is only a one off measure of personality. Although personality and mood are expected to correlate the correlation with outcome may be due to the state effects on the trait measures. Secondly, only one therapy is included, there is no control therapy. If there is a relationship with antidepressant treatment is it with any particular treatment?

A second study suggests that those patients with high Harm Avoidance and high Reward Dependence scores have a good outcome following treatment with a tricyclic antidepressant (clomipramine or desipramine, n=84) (Joyce, Mulder, & Cloninger, 1994). This group of patients was slightly different as most had not previously been treated for a psychiatric disorder and over half had never received an antidepressant drug. This alone could explain the difference in prediction from HA scores. Patients in remission following a psychiatric episode can have inflated Neuroticism scores (possibly also HA scores), this may be especially true for those that have had recurrent illnesses. High scores in Tome and colleagues' (1997) study may reflect chronicity and poor outcome, while the results in the study by Joyce and colleagues (1994) may reflect a state change. The problem with these two studies is that there is no way to tell which explanation fits best as personality measures were not taken on follow-up.

In a large study (n=199) Newman et al (2000) found that although Harm Avoidance scores decreased with treatment, and HA scores correlated with

baseline depression scores on the Hamilton Depression Rating Scale-17 none of the personality scales predicted response to fluoxetine. Nelson and Cloninger (1997) found similar results using nefazodone.

Using the Karolinska Scales of Personality Ekselius and von Knorring (1999) found significant changes on all of the personality measures except for the impulsiveness scale in patients treated for major depressive disorder. The changes were in the direction of normality for treatment with either sertaline or citralopram.

Other studies found that trait dimensions did not predict response. A Japanese study found that Cloninger's character dimensions were predictive of response rather than temperament dimensions when a trial of maprotiline (a noradrenergic heterocyclic) was used (n=86) (Sato et al., 1999). What is noticeable about this study is the extremely high HA scores throughout the study for both responders and non-responders (HA mean equals approximately mean 27). These scores are significantly higher than controls within the study (HA mean equals approximately 18) and do not decrease with treatment. Further there is no difference between responders and non-responders on these scores.

A second study, which also did not find personality traits to predict response found similar results (Kocsis et al., 1989). Personality scores taken at baseline did not differentiate between responders and non-responders irrespective of treatment (n=53). On this occasion scales were the Maudsley Personality Inventory and the Cattell 16-Personality Factor Scale, and

treatment was imipramine (a tricyclic with mixed action on noradrenergic and serotonergic receptors) or placebo.

Bagby et al (1999) highlight the lack of specificity of studies such as these in a group of patients with major depression (n=76). They found personality changes on the NEO-PI-R following treatment with desipramine (a tricyclic with more specific action on noradrenergic receptors), paroxetine and sertraline (both SSRIs) over a period of 8-14 weeks. A significant increase in Extraversion and decrease in Neuroticism was found which significantly correlated with change in depression severity. Bagby et al (1999) found that a decrease in anger-hostility, a subscale of the Neuroticism dimension and an increase in gregariousness, a subscale of the Extraversion dimension were independent of depression scores. Changes on these scores could be a reflection of recovery, however, with no placebo condition conclusions must be cautious.

A control group was included in a study assessing compulsive personality as a predictor of response (Ansseau, Troisfontaines, Papart, & von Frenckell, 1991). This study compared two groups of patients both of whom had suffered from a major depressive episode, one group with an underlying compulsive personality (n=19) and one without (n=17). The groups were treated with fluovoxamine. The compulsive personality group improved significantly more than the other group over the test period. This study seems to suggest that personality variables are predictors of serotonergic treatment. However, again there are inadequate controls. Although the

patients appeared relatively well matched they could have differed on other factors. However, the main criticism is that there was no control treatment of any sort. The compulsive patients may have got better with placebo or with another drug.

The group of studies described open up new discussions within the biological basis of personality and the relationships between personality and depression. However, the research to date has not really given any new information. The studies need adequate controls, both in terms of treatment with both placebo and alternate drugs that act on different systems and in terms of adequate group controls. A more interesting approach would be to test a particular personality trait or group of traits where a control group is also employed. For instance a group of depressed patients who are high on Harm Avoidance or Neuroticism versus a group which are not high on this scale.

6.3.2 Personality and antidepressants in healthy volunteers

The mechanism of action of antidepressant can also be addressed by studies within normal healthy volunteers. This line of research suggests that there is a direct link between normal personality, mood and antidepressant action.

A group of 15 healthy volunteers were given fluoxetine (an SSRI) for 6 weeks (10mg/day for the first week and 20mg/day for the following 5 weeks with placebo prior and post treatment with fluoxetine) no changes were found on

mood or personality variables (Gelfin, Gorfine, & Lerer, 1998). This is indeed what would be expected. No target variable was chosen. Harm Avoidance is hypothesised to be related to serotonin, and there is some evidence that this may be true of Neuroticism, therefore if subjects were high on these dimensions, changes might be expected but not in a random group of volunteers. However, Knutson and colleagues did find that measures of hostility and negative affect decreased in a group of healthy volunteers following administration of paroxetine (n=25) compared to a group receiving placebo (n=26) (Knutson et al., 1998).

When a group of healthy volunteers who had emotional states that they themselves considered undesirable were treated with clomipramine (a tricyclic), mood did improve compared to placebo (Gorenstein, Gentil, Melo, Lotufo-Nego, & Lauriano, 1998). Unfortunately this study was in a small group of subjects (n=9) and a standard personality test was not given.

Although there is some evidence of personality traits predicting mood improvement in normal healthy volunteers (Gorenstein et al., 1998), and that state changes occur within a random group of volunteers (Knutson et al., 1998), conclusions can not be drawn from these studies. As with the research on personality as a predictor of antidepressant response in patient populations adequate controls must be employed.

6.4 Biological Basis of Personality Theories

Chapter Three reviewed studies where mood was correlated with personality traits, and where personality was predictive of mood states. Section 6.2 reviewed research where personality traits are predictive of major depressive episodes. It has been established that affective disorders have a biological basis (Chapter 4). It may then be supposed that personality traits that predispose to affective disorders share a biological basis with clinical depression. However, in order for these theories of personality traits and their biological basis to be validated they must stand up to experimentation. Methods testing for a biological basis have ranged from twin studies, which show that genes account for approximately 50% of the variance in most normally distributed personality traits, such as Neuroticism or Extraversion (Loehlin, 1992), to drawing parallels between behaviour in animals to human personality traits (for reviews see (Cloninger, 1987; Depue & Collins, 1999)). In some cases researchers have concentrated on particular traits such as Extraversion, others such as Gray have attempted to evaluate a particular model (for reviews see (Depue & Collins, 1999; Gray, 1981; Gray, 1987; Matthews & Gilliland, 1999)). Investigating into the biological basis of personality has involved a broad range of studies. These will be described and commented upon below in relation to those personality traits which have been shown to have a relationship with mood.

6.4.1 Extraversion

Psychophysiological measures, such as EEG and electrodermal response, have traditionally been applied as they give indices of arousal. The other main area of research on Extraversion is neurochemical. This area is based predominantly on animal studies and Extraversion's correlates with dopamine.

6.4.2 Extraversion and the Psychophysiological Arousal

Eysenck (1967) proposed that introversion/extraversion differences are based upon levels of activity of the cortico-reticular loop with introverts having higher levels of activity than extraverts. Introverts therefore being chronically more aroused than extraverts. EEG is one method by which to measure this proposed difference in arousal. EEG is relatively quick and easy to measure and has a very rapid response. When an individual is more alert the frequency of the EEG becomes faster. The level of arousal of the testing situation is crucial in this area, as different levels of arousal in the situation will react differently in individuals with varying levels of introversion and extraversion (for a review see (Matthews & Gilliland, 1999)). Aside from the face validity of studies in this area, personality traits are only weakly predictive of spontaneous EEG (about 0.20) (Matthews & Amelang, 1993). Indeed, across three environment types placing the volunteers in differing levels of arousal, only weak positive correlations were found between, extraversion and impulsivity, and slow-wave activity (but not more alpha) (Matthews & Amelang, 1993). While Gale (1992) showed that at moderate

arousal levels, introverts exhibit greater evidence of alpha activity as compared to extraverts. The increased alpha reflects lower levels of arousal as would be predicted by Eysenck's theory.

A further measure of psychophysiological arousal is electrodermal activity (EDA). This is measured by placing electrodes on the skin and measuring skin conductance level and skin conductance response. Phasic rather than tonic electrodermal activity show consistent differences between introverts and extraverts. Higher levels of EDA are shown in introverts as compared to extraverts at low levels of arousal but not when arousal level is high (reviewed by (Matthews & Gilliland, 1999)).

Brain imaging allows measurement of functional differences which may be associated with personality variables. Using the ^{133}Xe-inhalation method, Mathew et al (1984) found decreased blood flow to be correlated with Extraversion. Using the same method, but with more detectors, Stenberg et al (1990; 1993) found higher blood flow in the temporal lobes for introverts as compared to extraverts, in healthy volunteers at rest. The results of this study must be interpreted with caution for two reasons. Firstly the resolution is only to a superficial level. Secondly, Drevets and colleagues (1992) suggest that this may reflect temporalis muscle activity rather than intracranial activity. Ebmeier et al (1994) found Extraversion to be significantly correlated with uptake of 99mTc-Exametazime (a tracer which has monotonic relationship with regional cerebral blood flow) in the anterior and posterior cingulate areas bilaterally using SPET. A PET study (with 15O

labelled H2O) also found increased blood flow in the anterior cingulate to be correlated with Extraversion, as well as regions in the temporal lobes, and the posterior thalamus, while Introversion was associated with increased blood flow in the frontal lobes and anterior thalamus (Johnson et al., 1999).

The psychophysiological data is equivocal with Extraversion having little predictive value for spontaneous EEG. Imagining techniques have revealed some interesting findings, however, the ^{133}Xe-inhalation method, as with EEG has only superficial resolution. The major problem in this area is the testing environment, and any result must be interpreted with caution as it may have more to do with the environment than with the trait itself.

6.4.3 Extraversion, Novelty Seeking and Dopamine

A neurochemical basis to personality traits has been postulated (Cloninger, 1987). Much of the theoretical basis has been derived from work in animals, where researchers have attempted to find correlates of human personality traits in animal behaviour. Cloninger suggests the dimension Novelty Seeking is the heritable tendency toward intense exhilaration where the individual will explore actively in pursuit of potential rewards as well as active avoidance of monotonous behaviour or punishment (Cloninger, 1987). This he terms behavioural activation. Those high on Extraversion also avoid monotonous tasks and may be said to be sensitive to signals of reward. In fact, Depue and Collins (1999) characterise Extraversion as having two central characteristics: interpersonal engagement and impulsivity. They relate these characteristics to the mammalian behavioural approach system.

Thus in many ways Extraversion and Novelty Seeking are perceived to be similar behaviourally. Research into the neurobiology basis of both has implicated similar brain systems, dopamine being the principal neuromodulator.

Cloninger (1987) proposed that dopamine is the major neuromodulator of Novelty Seeking (NS) because of dopamine's role in exploratory behaviour in animals and due to its role in the stimulation of euphoria in humans. A similar argument would be true for Extraversion. Furthermore dopamine blockade reduces the reinforcement for exploration of novelty stimuli (Cowdry & Gardner, 1988; Soloff et al., 1986). Further evidence of the relationship between dopamine and personality comes from associations between both Novelty Seeking and Extraversion with the 7 repeat allele in the locus for the D4 dopamine receptor gene, for instance (Benjamin et al., 1996; Ebstein et al., 1996).

However, Depue and Collins (1999), in a recent review of evidence relating dopamine (DA) to Extraversion, concede that

" There is a paucity of work on individual differences in DA functioning in normal humans".

Theories relating to the biological basis of Extraversion or Novelty Seeking need further validation. Electrophysiological work can be criticised because of the testing environment and the interaction of the trait with this environment, while neurochemical investigations have relied too heavily on

work with animals and have not yet been substantiated in humans. Research into the biological basis of Extraversion has not yet revealed its relationship with mood, nor has this association been tested directly.

6.4.4 Neuroticism

Neuroticism has been shown to be correlated with depression, and has been shown to predictive of onset of depression. The question now is, are there psychophysiological, neuropharmacological or molecular genetic correlates which may reveal the mechanism of this relationship.

6.4.5 Neuroticism and Psychophysiology

Psychophysiological data has not been particularly revealing. During resting EEG those who score highly on Neuroticism show more beta activity (Matthews & Amelang, 1993) which would symbolise increased cortical arousal as would be predicted by Eysenck's theory. Also faster P300 latency has been reported for high N individuals (Stelmack & Houlihan, 1995). However, electrodermal responses tend to be insensitive to both N and trait anxiety (Zuckerman, 1991). Furthermore, Fahrenberg and colleagues (1986; 1983) failed to find emotional lability as a reliable predictor of activation processes (for instance EEG relative power in the alpha band, eye blink activity, EMG, electrodermal activity).

6.4.6 Neuroticism and Neurochemistry

Neuroticism has been linked directly to mood and indeed in investigating Neuroticism and its biological basis studies have taken the opportunity to assess personality traits and neurochemistry in patient groups.

Platelet monoamine oxidase (MAO) activity can be seen as a marker for vulnerability to some forms of psychopathology, deviant MAO activity is found in several psychiatric disorders and in relatives of patients (Oreland, von Knorring, & Schalling, 1984). Low MAO activity is found in suicide attempters (Gottfries, von Knorring, & Oreland, 1980). Low MAO activity is correlated with Neuroticism (Schalling, Asberg, Edman, & Oreland, 1987). This is obviously not a direct test of any theory but merely suggests that there are similar mechanisms occurring in both Neuroticism and those vulnerable to a psychiatric disorder.

Decreased cerebrospinal fluid concentrations of the serotonin metabolite 5-HIAA have been reported in patients with depression (Agren, 1980; Asberg et al., 1976) and in those with suicidal and aggressive behaviour (reviewed by (Asberg & Wagner, 1986)). In a group of patients with depressive disorder this metabolite was found to be significantly correlated with Neuroticism scores (Roy, 1999). Again this research suggests that there are similar mechanisms involved in depression and Neuroticism.

Polymorphisms have been associated with personality traits and in particular an association between the short variant of a polymorphism in the upstream

regulatory region of the serotonin transporter (SERT) gene has been found with Neuroticism (Lesch et al., 1996). The short form of a polymorphic region (a variable-number-tandem-repeat region) of the serotonin transporter gene was also found to be associated with depression (Ogilvie et al., 1996).

6.4.7 Harm Avoidance

Harm Avoidance is highly correlated with Neuroticism (Zuckerman & Cloninger, 1996). Cloninger (1987) proposed that Harm Avoidance is related to serotonergic activity, thus this has been the focus of much research dealing with this trait. Indeed he posits that high Harm Avoidance is associated with high 5-HT function.

Linkage analysis is where particular loci are associated with a particular behaviour. Linkage has been found in sibpair analysis between the SERT promoter with the personality trait Harm Avoidance (Mazzanti et al., 1998).

The functional responsivity of central serotonergic systems can be assessed by such methods as the clomiprimine challenge test. By intravenously administering clomiprimine prolactin and cortisol responses can be measured. A positive trend towards a moderate correlation was found between Harm Avoidance and cortisol release following administration of clomiprimine, which supports Cloninger's theory, however, no parallel prolactin release was discovered (Ruegg et al., 1997). Unfortunately it is not clear whether the cortisol release is due to peripheral or central responses

and may be a result of greater anxiety in those who score highly on HA. Again testing conditions may interact with the personality type.

HA can predict response to 5-HT agonists. Flesinoxan is a selective 5-HT1A agonist which induces a dose-dependent release of prolactin in normal subjects. In depressed patients this response is blunted (Pitchot et al., 1995). HA and prolactin response to flesinoxan are positively correlated (Hansenne et al., 1997). Both prolactin and cortisol release correlated with HA scores following administration of D-fenfluramine also a 5-HT agonist (Gerra et al., 2000). Both of these results support the relationship predicted by Cloninger.

Harm Avoidance has also been positively associated with increased 5-HT2 receptor sensitivity (Peirson et al., 1999). The authors imply that high scores on the Harm Avoidance scale may be related to low central basal levels of serotonin.

However a number of studies have failed to find this relationship between serotonin and Harm Avoidance. For instance, Pfohl and colleagues failed to find an association between this Harm Avoidance and platelet imipramine binding in a sample of patients with obsessive compulsive disorder and controls (Pfohl, Black, Noyes, Kelley, & Blum, 1990). And Waller et al failed to find a relationship between whole blood serotonin and TPQ scores in patients with bulimia nervosa (Waller et al., 1993).

6.5 Summary

Research into the biological basis of personality using psychophysiological measures has lead into circular arguments concerning arousal. Animal studies have given some insight into possible mechanisms. However, transferring animal research into research on human personality is a difficult transition. Cloninger's model has sparked increased interest in psychological, psychiatric and neuroscience research into the possibility of personality traits been associated with neurochemistry.

Personality traits do appear to have biological correlates. Neuroticism and Harm Avoidance are highly related to mood in normal controls, Neuroticism and Harm Avoidance are related to clinical depression and Neuroticism is predictive of major depressive episodes. There is a large body of evidence suggesting that depression is associated with reduced 5HT function (see section 4.7), however, it has been posited by Cloninger (1987) that high Harm Avoidance, which is highly correlated to Neuroticism, is associated with high 5HT function. Nevertheless these personality traits and mood appear to have some similar biological correlates. However, to date these are not clearly defined. This area of research is only starting to develop. Many techniques available use indirect methods to assess neurochemical systems. For instance the serotonergic system is commonly assessed by measuring indices in blood or urine or by assessing platelets. Although there are more direct methods available these tend to be expensive and intrusive. Indirect methods can lead to a convincing body of evidence however, direct and

systematic testing must take place before a clear and compelling argument is reached to discover any shared biological basis between mood and personality.

Chapter Seven: Aims and Hypotheses

The overall aim of this thesis is to determine whether the personality trait of Neuroticism is related to mood via serotonin. The rationale for this hypothesis has been described in chapters 1-6. In brief, Neuroticism, as measured by the EPQ-R is reliable and stable, and can be factored from the EPQ across many different cultures (Barrett & Eysenck, 1984; Barrett et al., 1998; Kline, 2000) (see Chapter 1). Neuroticism is related to negative mood in healthy volunteers (Costa & McCrae, 1980; Kardum & Hudek-Knezevic, 1996; Williams, 1990; Wilson & Gullone, 1999) (see Chapter 2) and Neuroticism scores are related to depression (see Chapter 6). Neuroticism scores increase during a depressive episode, are higher in those who have suffered from episode of depression compared to those who have not, and are predictive of a depressive episode (Hirschfeld et al., 1989; Kendler et al., 1993; Roy, 1990). In Chapter 6 it is proposed that Neuroticism and clinical depression have a shared biological basis and that serotonin is the agent that they have in common. However, Cloninger (1987) proposes that Harm Avoidance is related to serotonergic function. Neuroticism corelates highly with Harm Avoidance (Zuckerman & Cloninger, 1996). Tryptophan depletion produces a transient change in levels of serotonin in the brain. By lowering serotonin levels in this way, transient changes have been found in mood in patients with a history of depression (Delgado et al., 1990), in healthy volunteers with a family history of depression (Benkelfat et al., 1994) and in healthy volunteers (Young et al., 1985) (see Chapter 5).

Although the main aim of the thesis is to establish whether Neuroticism will be a predictor of mood change via tryptophan depletion, the thesis also aims to test whether:

1. Neuroticism factors clearly from the EPQ-R in this group of healthy student volunteers
2. Neuroticism shares a high proportion of variance with Harm Avoidance
3. Neuroticism is a relatively strong predcitor of negative mood in healthy volunteers

The rationale and expected outcomes for these aims are described below.

7.1 Personality Traits

There are many theories of personality. Eysenck's (1985) model has been well established with the three factors of Neuroticism, Extraversion and Psychoticism being common to many personality questionnaires and the model has been reproduced across cultures (Barrett & Eysenck, 1984; Kline, 1993; Kline & Barrett, 1983). Cloninger (1987) proposed a three factor model of personality, with the dimensions Harm Avoidance, Reward Dependence and Novelty Seeking. However, three dimensions have not always been apparent and only the scale of Harm Avoidance has consistently been found to be robust (Giancola et al., 1994; Otter et al., 1995; Waller et al., 1991). Although the model has been tested in other countries few studies have included an item analysis of Cloninger's questionnaire.

Only one of these has been within a British sample and in only 413 individuals ((Otter et al., 1995) see section 1.3.5 for a review).

The first aim of this thesis therefore is to test in a large group of student volunteers whether Cloninger's three factors can be extracted satisfactorily from his measurement instrument. Secondly, although Eysenck's model is well established, it is important to confirm that Eysenck's factors can be extracted from his questionnaire within this group of volunteers.

In order to carry out these aims exploratory factor analysis will determine whether the factors can be extracted as hypothesised by Eysenck and Cloninger. The question is how the items are distributed across each of the factors rather than whether the models are the best fit for the data. Exploratory factor analysis gives a clearer picture as to how the items load on each factor whereas confirmatory factor analysis gives a better picture as to the fit of the model. Therefore exploratory rather than confirmatory factor analyses will be performed.

The hypothesis is that from the TPQ, Harm Avoidance is the only factor that will be robust. From the EPQ-R, the expectation is that three factors will be extracted, Neuroticism, Extraversion and Psychoticism. However, Psychoticism will not be robust.

7.2 Shared Variance between Eysenck's and Cloninger's models

Cloninger's model proposes that individual differences in each of the dimensions of Harm Avoidance, Reward Dependence and Novelty Seeking

are related to individual differences in the function of serotonin, noradrenaline and dopamine respectively. This model has good face validity. The overall hypothesis of this thesis is that Neuroticism is related to depression through serotonin. However it is Cloninger's Harm Avoidance that is proposed to be directly related to serotonin, although the evidence is not substantial (see Chapter 6). Therefore it is important to explore the relationships between Neuroticism and Harm Avoidance. This will be carried out by correlation, stepwise linear regression and by factor analysis both at the scale and the item level. This allows for comparison with previous studies as well as exploring in depth the relationship between the two scales. The main aim is to establish the shared variance between Harm Avoidance and Neuroticism, as these are the personality traits that have been related to mood states.

Furthermore although the two scales may overlap there may be variance in one that is not explained by the other. For instance Waller et al (1991) found that, although the TPQ and the MPQ (the Multidimensional Personality Questionnaire; Tellegen (1982)) shared considerable variance, each questionnaire contained variance that was unexplained by the other. Similarly, Zuckerman & Cloninger (1996) found the scales of Cloninger's TCI, Eysenck's EPQ-R and Zuckerman and Kuhlman's Personality Questionnaire (Zuckerman et al, 1993) to show considerable correspondence, however, variance in one questionnaire was left unexplained by another. Therefore, exploratory factor analysis at the item level may reveal factors that can be discussed in relation to personality structure. Solutions from the combined

item analysis of both the TPQ and EPQ-R will be described and their relationships to personality structure discussed.

The hypotheses from these analyses are that, Harm Avoidance will correlate highly with Neuroticism, that Harm Avoidance will be the best predictor, from the TPQ, of Neuroticism and that these two scales will factor together at both the item and scale level. Further it is hypothesised that Neuroticism and Extraversion will both correlate with Harm Avoidance and that these two scales together will predict the variance in Harm Avoidance. The scales of Psychoticism, Reward Dependence and Novelty Seeking are not as robust as the scales of Neuroticism, Extraversion and Harm Avoidance therefore no specific predictions are made of these scales.

7.3 Personality Traits and Mood States

The scales of Harm Avoidance, Extraversion and Neuroticism have been shown in previous studies to correlate with mood. In healthy volunteers, Neuroticism correlates positively with negative mood and negatively with positive mood, and Extraversion correlates positively with positive mood and, in some cases, negatively with negative mood (Costa & McCrae, 1980; Furnham & Brewin, 1990; Furnham & Cheng, 1999; Kardum & Hudek-Knezevic, 1996; Williams, 1990; Wilson & Gullone, 1999). Harm Avoidance has not been adequately tested against positive mood, but does correlate positively with negative mood and negatively with positive mood (Giancola et al., 1994; Krebs et al., 1998; Naito et al., 2000; Peirson & Heuchert, 2001; Svrakic et al., 1992).

The hypotheses are that Neuroticism and Harm Avoidance will correlate highly and positively with negative mood measures and both will correlate negatively with positive mood measures. It is proposed that Neuroticism will be the best predictor of negative mood and that Harm Avoidance is a good predictor of mood but that this scale predicts both positive and negative mood. This will be shown by both correlation, and regression analyses.

7.4 Neuroticism and mood: a shared biological basis. Is Neuroticism a predictor of mood change via tryptophan depletion?

Having established that Neuroticism can be extracted from the EPQ-R in this sample, that it relates highly to Cloninger's Harm Avoidance, and is related to negative mood in healthy volunteers, the question remains: by which mechanism? It is hypothesised that Neuroticism and serotonergic function are related, and that those who score at the high end of the Neuroticism scale are more sensitive to change in the serotonergic system. This is tested by rapidly depleting volunteers of tryptophan, which in turn depletes serotonin. It is hypothesised that high Neuroticism scorers will have larger negative mood changes than low Neuroticism scorers following tryptophan depletion.

Tryptophan depletion produces a mood change in those who have had a previous history of depressive disorder and in those with a family history of depressive disorder (Benkelfat et al., 1994; Delgado et al., 1994; Klaassen et al., 1999b; Moreno et al., 1999). Self-report mood scales test whether there is the proposed increase in negative mood and decrease in positive mood.

Cognitive deficits and psychomotor retardation have been observed in clinical depression, and are sensitive both to diurnal changes in mood and to negative mood induction (Austin et al., 2001; Austin et al., 1992; Bartolic et al., 1999; Channon, 1996; Degl'Innocenti et al., 1998; Luu et al., 2000; Moffoot et al., 1994; Schatzberg et al., 2000; Trichard et al., 1995). Altered performance on cognitive tests have been found following tryptophan depletion in healthy volunteers in memory (Klaassen et al., 1999a; Park et al., 1994; Riedel et al., 1999; Schmitt et al., 2000) and attention (Coull et al., 1995; Schmitt et al., 2000) even when there was not a corresponding mood change. Therefore it would be expected that performance on cognitive tests would be worse on the depletion day compared to the placebo day and that there would be psychomotor slowing.

Non-specific EEG changes, such as slowing, have been used to track the effects of psychotropic drugs in patients and controls (Saletu, Saletu, Grunberger, Mader, & Karobath, 1983) and are predicted to occur following tryptophan depletion. More specific changes are predicted to occur during depressive mood induction, such as a shift in brain asymmetry during resting EEG. Relative unilateral slowing over left frontal sites may be expected (Debener et al., 2000; Henriques & Davidson, 1991) in those with high Neuroticism scores, after tryptophan depletion.

Chapter Eight Methods I: The questionnaire study

The thesis is divided into two main studies, the first a questionnaire based study and the second the tryptophan depletion study. The questionnaire based study involved recruiting a large number of individuals to complete personality and mood questionnaires. This section describes the methods for the first study.

8.1 Subjects

Subjects were recruited by three methods: firstly by advertisements placed on university notice boards; secondly by requesting for volunteers in a lecture theatre or class; thirdly by approaching students directly in communal areas such as Open Days, computer laboratories and cafeterias and asking them to participate. Students attending the University of Edinburgh, Heriot Watt, Queen Margaret College and Napier were contacted. Subjects were asked only to take part if English was their first language and if they were over 18 years of age. Unfortunately an accurate record could not be taken of compliance rates as lecturers occasionally asked for questionnaires to be left behind in case other students would wish to participate and some students wished to take questionnaire packs for their friends. It is not known whether students received these questionnaires. However, an estimate can be calculated. Approximately 2000 questionnaires were handed out and out of these 1032 were completed and returned.

8.2 Methods and Measures

Volunteers were asked to complete the Eysenck Personality Questionnaire-Revised (EPQ-R; (Eysenck et al., 1985)), the Tri-dimensional Personality Questionnaire (TPQ; (Cloninger, 1987)), a measure of state anxiety (State and Trait Anxiety Inventory (STAI, (Spielberger et al., 1983)), a mood measure (Befindlichskeitskala (BFS, (von Zerssen et al., 1974), a depression rating and screening scale (General Health Questionnaire 28, (GHQ-28); (Goldberg, 1978)) and a happiness measure the Oxford Happiness Inventory (OHI), (Argyle et al., 1995)). The TPQ and the OHI were kindly provided by the authors. The questionnaire pack took approximately 1 hour to complete.

The personality questionnaires consisted of forced choice responses. The EPQ-R is a 100 item questionnaire consisting of scales scoring for Extraversion-Introversion, Neuroticism, Psychoticism and Lie. The Lie scale is not a dimension of personality but is used as a way of ascertaining whether an individual is faking their responses. The response is YES/NO. For example:

3.	Does your mood often go up and down?	YES	NO
6.	Are you a talkative person?	YES	NO

The TPQ is a 100 item questionnaire with scales for Novelty Seeking, Harm Avoidance and Reward Dependence. Each of these scales has four subscales. The response is TRUE/FALSE. For example:

10. I often have to stop what I am doing because I start worrying about what might go wrong.	True	False
21. Even when most people feel it is not important, I often insist on things being done in a strict and orderly way.	True	False

The STAI has two forms each of 40 items on a likert scale of 1-4 asking the subject to respond either how they are feeling right now (state anxiety) or in form 2 asking how the subject feels in general (trait anxiety). Only the state form is included within this thesis. Examples of items are:

1.	I feel calm	1	2	3	4
11.	I feel self-confident	1	2	3	4

The BFS is a self-rating mood scale. Subjects are presented with 28 pairs of words and are asked to decide which of the two corresponds more closely to their *present* state of mind. If they are unable to answer they can opt for a neutral box. Scores are assigned 2,1 or 0 corresponding to the negative, neutral or positive response, with a maximum score of 56. It has a total score, and fatigue and depression subscales. Examples of items are:

	more		more		neither - nor
1		alert		listless	
2		indifferent towards others		interested in others	

The GHQ-28 is a 28 item self-report questionnaire with four sub-scales of somatic, anxiety, social dysfunction and severe depression symptoms. The questionnaire can be scored in two ways: as a continuous scale or bimodally. Respondents are asked to respond as to how they have felt over the previous few weeks. An example of an item with both types of scoring is given:

Have you recently felt that life is entirely hopeless?	Less so than usual	No more than usual	Rather more than usual	Much more than usual
Likert Score	0	1	2	3
GHQ Score	0	0	1	1

The OHI is also a self-rating mood scale of 29 items assessing happiness. Subjects are asked to respond as to how they have been feeling over the previous week and are given four statements from which to choose. For example:

a	I feel that the future is overflowing with hope and promise
b	I feel I have so much to look forward to
c	I feel optimistic about the future
d	I am not particularly optimistic about the future

Participants were given a stamped and addressed envelope to return the questionnaire, and were asked only to take part if they are willing to be considered for the second stage of the study. Therefore any volunteers that may have wished to participate but who would not be able to give up two

days were asked not to take a questionnaire. Further any individuals who made it know to me at this stage that they had a medical disorder such as diabetes were asked not to take a questionnaire as they would not be able to follow the strict diet for the two day tryptophan depletion study.

Volunteers were excluded if more than five items had been omitted on any personality questionnaire, or if they had omitted to fill in their contact details. When items were missed on the mood scales the subject was eliminated for analysis involving this questionnaire only. Therefore the numbers vary for each analysis.

The GHQ-28 was scored as a continuous scale and bimodally. For comparisons between mood and personality it was scored on a continuous scale. In order to ascertain those who may have been depressed at the time of completing the questionnaire pack the GHQ-28 was scored bimodally. Those who scored above the recommended threshold score for caseness of 5 were contacted by telephone (Goldberg, 1978). After 120 questionnaires were scored it became clear that this cut-off was far too low, therefore only those who scored in the D section were contacted. Aderibigbe et al (1996) found that the factor structure of the GHQ changed depending on cultural background of the sample, therefore it could be possible that the scales were not measuring the factors which were originally intended. However, Werneke and colleagues (2000) found that scales C and D were robust. Thereby justifying our using scale D as a means of measuring caseness. A letter was sent to the individual recommending that they see their general

practitioner as soon as possible. Consent to send this letter had to be gained from the subject and upon instruction from the subject a copy of their GHQ-28 could then be sent to the general practitioner. This was not done until consent was gained from the subject, but none refused to give consent. Examples of the letters sent to the volunteer and to the GP are included in Appendix I.

The analyses of the data gained from the questionnaire study are described in Chapters 10, 11 and 12.

Chapter Nine Method II: The tryptophan depletion study

This chapter describes the methods for the tryptophan depletion part of the study. It includes a description of the selection of volunteers, the mood rating scales, the cognitive tests, physical measures and EEG techniques used within the study.

9.1 Subjects

From study one, initially subjects who scored either above the top or below the bottom 10% EPQ N scale population norms were selected. After scoring 100 questionnaires this was thought to be an over selection and would not select extremes adequately. Individuals who scored above the top or bottom 5% EPQ N scale population norms were then selected. Norms were taken from Eysenck et al (1985). Volunteers with any significant medical or psychiatric history were excluded. Any subjects who had dyslexia were also excluded. Subjects who did not have English as their first language were excluded. This data is presented in Chapter 13.

9.2 Procedure

Volunteers were asked to follow a low tryptophan diet from 2pm on the day prior to testing (Day 1), followed by a second day on which either an amino acid drink with tryptophan or a drink without tryptophan was given (Day 2). The experiment was carried out in a double-blind cross-over fashion. These days were a minimum of a week apart. A light low tryptophan lunch was

given on the day of the assessment approximately 120 minutes post ingestion of the drink (approximately at 12pm).

The low tryptophan diet (evening meal day 1 and lunch day 2) consisted of food chosen in consultation with researchers from Oxford who had employed a similar methodology (Smith, Clifford, Hockney, Clark, & Cowen, 1997a; Smith et al., 1997b; Smith et al., 1999a; Smith et al., 1999b; Smith, Williams, & Cowen, 2000). This diet was low in protein and therefore low in tryptophan. Day 1's diet consisted of a prepacked meal (either vegetable ratatouille or mushroom dopiaza), brown rice, a carrot, one quarter of a medium onion, one tomato, one quarter of either a red or green pepper, a tin of peaches in syrup and tea or coffee. This meal was delivered to a campus nearest to where the volunteer resided. The volunteers were requested not to eat anything other than the food provided from 2pm on the day prior to testing.

The lunch (day 2) consisted of soup, cream cheese, low protein crackers, salad, and jelly. Although all these foods are low in tryptophan they still contain a small amount, therefore quantities were weighed to ensure that tryptophan consumption was kept to a minimum.

Volunteers were instructed that they did not have to eat everything on the diet, but could not eat anything that was not on the list. They could not drink any alcohol on the day prior to testing, nor on the day of testing. They were instructed not to eat anything after 12am (midnight) on the morning prior to testing, but could drink as much water as they liked. They were allowed to

take tea or coffee with milk to whiten, but no fruit juice or other drinks apart from water.

All women who took part were in their follicular phase of the menstrual cycle, as serotonin concentrations are more stable during this period (Hindberg & Naesh, 1992) and tryptophan metabolism is more stable (Brien, Martin, & Bonner, 1997). Furthermore women in the premenstual phase are more likely to suffer from mood changes (Van Goozen, Frijda, Wiegant, Endert, & Van de Poll, 1996).

All volunteers were requested to arrive at the department just before 9am on the test day. Before and after amino-acid drinks, assessments of mood and neuropsychological function were carried out, including EEG. Also before and after amino-acid drinks blood samples were taken. All morning measures were repeated in the afternoon. However some measures were only given in the afternoon. Therefore all measures were given both on the placebo and the depletion days, however some measures were given on the morning **and** afternoon of the test days. Those measures, which were repeated throughout the course of one test day (given both in the morning and afternoon), will be known throughout as repeated measures.

A further screening was carried out in the morning of the test day to insure that the volunteer had not omitted any medical or psychiatric history. Individuals were excluded from taking part if any significant medical or psychiatric history was revealed during this interview.

Screening took place at approximately 9am. Blood samples were taken immediately after the subject was screened. Measurements taken before the drink took place between 9am and 10am (details of these measurements are given in sections 9.2.1 and 9.2.2). The drink was consumed at approximately 10am. A light lunch was served at approximately 12pm. Afternoon measurements were taken between approximately 2pm and 4pm (these measurements are detailed in section 9.2.3-9.2.4). At 4pm the second blood sample was taken.

All volunteers who completed up to the second test day were given £40 to cover their expenses. If they were excluded in the morning interview of the first day they were given £10.

9.2.1 Mood Measures which were given both prior and post consumption of the amino acid drink

Assessments were given both prior to consumption of the drink (baseline measures) and post consumption of the drink. These (repeated) mood assessments were an adapted Hamilton Depression Rating Scale (HDRS; (Hamilton, 1960)); the BFS (parallel forms were randomised; (von Zerssen et al., 1974) the Profile of Mood States (POMS; (McNair et al., 1992)); and the positive and negative affectivity scale (PANAS; (Watson & Clark, 1988)). A brief description of the questionnaire is given below. The mood scales are reviewed in Chapter 2.

The HDRS although unsuitable for this population was used to give an indication if mood change was comparable to the mood dip observed in other studies of tryptophan depletion where the population was a psychiatric one (e.g (Delgado et al., 1990; Smith et al., 1997b)). The questionnaire was also used as an ethical consideration as no volunteer should leave if there were thinking suicidal thoughts. It was adapted to measure transient mood changes (the adapted Hamilton Depression Rating Scale is presented in Appendix II).

The POMS is a self-rated mood scale. Subjects are presented with 65 words and asked to rate on a likert scale of 1-4 of how they are feeling at that moment. There are six dimensions of tension-anxiety (T), depression-dejection (D), anger-hostility (A), vigour (V), fatigue (F) and confusion-bewilderment (C). A total score can be calculated by summing the subscales with vigour scored negatively.

The PANAS is a self-report mood scale. It has ten words relating to positive affectivity and ten words relating to negative affectivity on a likert scale of 1-5. The questionnaire can be used over a number of time frames, in this case subjects are asked to rate how they are feeling at the present moment.

9.2.2 Physical Measures which were given both prior and post consumption of the amino acid drink

Reaction time, maximum voluntary contraction; blood pressure and pulse were assessed both in the morning and afternoon sessions. Reaction time

was measured using the CANTAB computerised psychometric testing battery (Sahakian & Owen, 1992). The subject must touch the screen within a circle following the appearance of a yellow dot, as quickly as possible. The test can be broken down into reaction time, response initiation time and movement time.

Blood pressure and pulse measures were taken. Mean arterial pressure was calculated from diastolic and systolic pressure.

Mean arterial pressure=[systolic + 2(diastolic)]/3

Each subject was also required to squeeze a dynamometer as hard as they could to gain a measure of maximum voluntary contraction. Volunteers were given three attempts and the average was recorded. Cohen et al (1982) found deficits in motor performance of patients with affective disorder proportionate to their level of depression.

9.2.3 Afternoon Mood Measures

The afternoon mood assessment, or post consumption of the drink, was a repeat of the morning but also included the UWIST mood adjective checklist (Matthews et al., 1990). This questionnaire is divided into three scales or dimensions: stress, hedonic tone and arousal. The scale asks the volunteer to respond as to how they are feeling right now. It has 24 adjectives divided equally between the three scales and are to be endorsed definitely, slightly, slightly or slightly not.

The Alderley Park State Anxiety questionnaire (APSAQ; (Walker, 1990)) assessed state anxiety before and after the PASAT. Respondents were required to answer as to how they were feeling right then and there. This questionnaire consists of twelve items such as *"I feel I can cope"* and the volunteer has five choices: not at all, slightly, moderately, considerably, extremely. An example some items are:

1. I feel I can cope
4. I feel afraid
10. I feel sweaty

An adapted HDRS and a BFS were given on day two after the volunteer had returned home, and at mid-day on day three.

9.2.4 Psychometric Tests

Cognitive tests included the Digit Symbol Substition Test (DSST; (Wechsler, 1981); Digits Forwards and Digits Backwards (DIGF & DIGB; (Wechsler, 1981)); Verbal Fluency (Benton & Hamsher, 1978) the Paced auditory serial addition task (PASAT) (Gronwall & Wrightson, 1981; Gronwall, 1977) and a visual discrimination task.

The DSST is a time limited test (90 seconds) which tests psychomotor speed and coding. Subjects are presented with rows of digits ranging from 0 to 9 in random order (a total of 93) and asked to draw a corresponding symbol.

DIGF and DIGB are tests of concentration and working memory. Subjects are read a range of numbers (the numbers are between 1 and 9 inclusive) and asked to repeat them to the experimenter. In the case of DIGF the volunteer repeats them as they heard them, and in the case of DIGB the volunteer repeats them in the reverse order.

Verbal Fluency is a sensitive indicator of brain dysfunction. This test has been extensively reported to be highly sensitive to frontal lobe lesions (Miceli, Caltagirone, Gainotti, Masullo, & Silveri, 1981). Pachana (1996) reports that it may be regarded as an index of executive abilities. The subject is required to produce as many words as possible that begin with a particular letter, excluding proper nouns and the same word with a different suffix. Parallel versions of T, R, W and C, F, L were administered, the letters being matched for relative frequency.

The PASAT is a test of working memory, attention and planning. Three sets of 61 numbers between 1 and 9 inclusively are given at regular intervals (4 seconds, 2 seconds and 1.4 seconds) and the subject is asked to add the second number to the preceding one. The 4 second interval was included so that the volunteers would become familiar with the test. When the test was piloted among students some managed to gain scores either at ceiling or close to ceiling on the 2 second interval test, therefore a 1.4 second interval was also included. Volunteers did not gain maximum scores on the 2 second test following the depletion or placebo days, whereas some did have

difficulties with the 1.4 second test, therefore only the 2 second interval test was analysed.

The last test was a visual change detection task (Deary, McCrimmon, & Bradshaw, 1997; McCrimmon, Deary, Huntly, MacLeod, & Frier, 1996). This is a speed of processing task which also tests attention and concentration. The subject was asked to indicate which one of 50 dots which appear on a screen comes up at a slight delay compared to the other 49. The time interval of delay was in 6 randomly presented blocks (14, 29, 43, 57, 71, 86 ms), with 20 trails to each block. This is the time that is fixed. It is inspection time that is assessed and not the time to react.

9.2.5 The amino acid drink

The amino acid drink was composed of 16 amino acids (see table 9.2.1) with or without tryptophan. The composition of the amino acid drink is similar to that employed by Young and colleagues (1985). This composition is in the same proportion as in a food meant for human consumption, human milk, except that aspartic acid and glutamic acid were omitted due to their possible toxicity at high doses. The "placebo" drink contained 2.3g l-tryptophan. This amount of l-tryptophan in a 100g drink has not caused any mood or cognitive changes (see chapter 5). It raises plasma tryptophan but drops the tryptophan/LNAA ratio (see chapter 5, Weltzin et al, 1994).

The drinks were flavoured with a blackcurrant flavouring to make them more

Table 9.2.1 Composition of the amino acid drink

Amino Acid	Amount (g) Males	Females
L-Alanine	5.5	4.58
L-Arginine	4.9	4.08
L-Cysteine	2.7	2.25
Glycine	3.2	2.67
L-Histidine	3.2	2.67
L-Isoleucine	8.0	6.67
L-Leucine	13.5	11.25
L-Lysine monohydrochloride	11.0	9.17
L-Methionine	3.0	2.5
L-Phenylalanine	5.7	4.75
L-Proline	12.2	10.17
L-Serine	6.9	5.75
L-Threonine	6.5	5.42
L-Tryptophan	2.3	1.92
L-Tryosine	6.9	5.75
L-Valine	8.9	7.42

palatable. The amino acids were suspended in water. The amino acids are not fully soluble but remain in suspension. In order to decrease the odour from the drinks the water was chilled. Volunteers consumed an extra-strong mint after ingestion of the drink to mask the unpleasant flavour. The volunteer, upon leaving on day two was given a number to contact the experimenter if they felt unwell up to mid-day on day three. They were advised not to consume illicit drugs or alcohol on the evening following testing. Before leaving the test room on day two, the volunteer was given a meal to raise their tryptophan levels before returning home and were advised to eat again on returning home. The meal provided consisted of a sandwich, a bag of crisps and a chocolate bar.

9.2.6 Blood Tests

Plasma total and plasma free tryptophan levels were assessed prior to ingestion and 6 hours post ingestion. The blood samples were collected in 10ml EDTA tubes. These were spun and 3 x 0.5ml of plasma was taken off into eppendorfs and frozen at –20 °C. Plasma total tryptophan was assessed from these samples. A further 2 x 0.5ml of plasma was taken off and spun for 5 minutes at 13000 rpm. From each of these two samples 400 μl (0.4ml) was taken off and spun in an ultrafiltrate tube at 13 000 rpm until 200 μl of filtrate was available (aprroximately 1hour). This method of ultrafiltration is derived from that by Joseph et al (1981). These were then stored on site at –20 °C. At the end of the study they were transported on dry ice to the University of Newcastle, by myself on the train, where tryptophan levels were assessed by high pressure liquid chromatograhy with electrochemical detection (Marshall, Kennedy, & Eccleston, 1987). In order to assess the ultrafiltrate the method was the same as that detailed by Marshall et al (1987) except the dilution step. For plasma total tryptophan 10 microliters of plasma were mixed with water to 1ml and 60 microliters of the ultrafiltrate were mixed with water to make 1ml.

9.2.7 EEG Recording

Sixty seconds of EEG data were continuously recorded at a sampling rate of 90 Hz per channel. Unipolar scalp recordings were made at F3, F4, Cz, P3 and P4 with a linked ear reference using the 10-20 system. The amplifier

ground was derived from a forehead electrode. EOG was recorded using bipolar electrodes sited subraorbitally to and at the outer canthus of the left eye. EEG data were amplified with a gain of 10,000, at a gain of 1,000, using a Digitimer D160 amplifier (bandwidth 0.16 - 30 Hz (-3dB) all channels) system and digitally sampled into an IBM PS/2 using a Metrabyte DAS-16 A/D converter with 12-bit resolution. Data sampling was controlled by software, custom-written in Borland Turbo-PASCAL.

Three separate EEG recordings were made: eyes open, eyes closed and with the subjects instructed to blink every 10 seconds. The blink exercise was conducted to assess the effect of blinking on the EEG spectra.

Following careful examination of the data it was decided to use the "eyes open" recordings as it was more EOG artefact free than the "eyes closed" data.

EOG artefact was removed by visually editing the data. This was performed blind to condition and group. The method adopted was as follows: A program was written in the PC-MATLAB (The Mathworks) to interactively edit the data. The F3, F4 and EOG channel were displayed in 10 second strips. The data were visually inspected to assess where EOG artefact was corrupting the EEG data at these two frontal recording sites. The onset and offset of EOG artefact was then marked and data from all channels automatically removed between these points. The program automatically removed offsets between the joined sections. The result of the editing process was then

superimposed on the original data to asses the success of the operation and repeated if unsatisfactory.

9.2.8 EEG Spectral Analysis

A program was written in the PC-MATLAB to perform spectral analysis using the "SPECTRUM" function available in the Signal Processing Toolbox. Dr Mike Glabus wrote this program. Firstly, the blink-edited data had offsets removed to give a mean of zero for all channels. The data were the normalised to give each channel the same total power by dividing by its root-mean-square (rms) value.

The Welch Method (Welch, 1970) of spectral analysis was then applied using the SPECTRUM procedure defining a 512-point FFT window overlapping by 75%. The SPECTRUM procedure automatically pre-processes each raw data set with a Hanning window. The FFT output spectra were then normalised to give a total power of 1 for every channel for the complete spectrum (0 - 45 Hz). The data were then split into 5 frequency bands corresponding to those most commonly used in EEG spectral analysis. These frequencies are multiples of the fundamental of 0.176 Hz:

Delta = 0.53 - 4.22 Hz

Theta = 4.4 - 7.9 Hz

Alpha = 8.1 - 13.01 Hz

Beta1 = 13.2 - 17.9 Hz

Beta2 = 18.1 - 29.9 Hz

The power in each band was expressed as a percentage of the total normalised power for the calculated spectrum (=1). These data were automatically calculated then saved in text files for statistical analysis. To derive a measure of asymmetry the left-sided alpha power was divided by the right-sided alpha power.

9.3 Normalisation of Data

When the reaction time data was skewed it was natural log transformed in order to normalise the distribution. If log transforming did not normalise the data, the data was not then transformed.

All the EEG data was log (base 10) transformed.

Chapter Ten Results I: A test of Eysenck's and Cloninger's 3 Factor Models of Personality

The aim of this chapter is to determine whether the personality dimensions described by Eysenck and Cloninger can be described satisfactorily in this data set. The chapter is divided into 3 sections.

The first section (section 10.1) describes the scales of Eysenck's Personality Questionnaire-Revised (EPQ-R) and the Tri-dimensional Personality Questionnaire (TPQ), assessing reliabilities and distributions.

The second section describes exploratory factor analysis at the item level of the EPQ-R and the TPQ separately. This is carried out to ascertain whether the three factor solution of Extraversion, Neuroticism and Psychoticism from the EPQ-R, and the three factor solution of Harm Avoidance, Novelty Seeking and Reward Dependence from the TPQ are justified in this sample. Specifically the question asked was whether the items from each questionnaire could be summarised into the three factors as presented by Eysenck and Cloninger.

The third section explores the TPQ at the scale level. This examines the groupings of the items into sub scales. Thereby asking at the scale level whether Cloninger's 3-factor structure can be achieved in this data sample.

Descriptions of this type for the EPQ-R are not novel, however, the aim of this chapter is to show that the scales from the EPQ-R can be found in this data set. Of particular interest in the scale of Neuroticism.

However there have been few item analysis reported in the literature on the TPQ. This chapter reports the largest exploratory item analysis in a British sample of this questionnaire. Chapter 1 reviews the literature on these questionnaires.

10.1 Personality Scales

10.1.1 Subjects

1032 subjects completed and returned the personality and mood questionnaires subject recruitment is described in section 8.1. Those who missed one or more items on the EPQ-R or the TPQ were excluded leaving 897 (347 males and 550 females) subjects. Subjects were all recruited from university campuses with majority being undergraduate students. Age was calculated by subtracting dates of birth from the middle of the recruitment period. This date rather than the date when the questionnaires were returned was chosen because at times there was a delay between scoring the questionnaires and entering the data (due to the volume of questionnaires returned) and also there was also at times a delay between the questionnaire being completed and it being returned. When recruiting it was asked that only those over 18 years of age would apply, and this was checked when the questionnaires were received. However, by choosing this

date, some subjects may have been over 18 when they were recruited and filled in the questionnaire but not at the middle of recruitment. Male ages ranged from 17.4 to 50.4 (mean = 21.1, standard deviation = 4.7). Six males omitted their dates of birth from the questionnaire pack. Female ages ranged from 17.1 to 48.9 (mean = 20.7, standard deviation = 4.0). Five females omitted their dates of birth from the questionnaire pack.

10.1.2 Basic psychometric properties of the two personality scales

Taking a measure of internal consistency can assess reliability of each of the scales within each questionnaire. This is measured by Cronbach's coefficient alpha. This is a statistic which calculates the ratio of the inter-item covariance (or the degree to which the items vary together) to the average item variance, based on the number of items in the scale. Alphas are therefore likely to be higher if there are more items, if the items have a normally distributed response pattern and if the items measure the same construct. However, if the Cronbach alpha statistic is high this does not necessarily mean that the correct construct is being measured. Alpha values can be artificially inflated by having items in the questionnaire which are almost identical. Conventionally a satisfactory reliability is defined as being above 0.7 with any above 0.8 being good (Kline, 1993). Alphas for the scales from the EPQ-R and the TPQ are presented separately.

10.1.3 Psychometric properties of the EPQ-R

Table 10.1.1 shows the number of items, the number of subjects, internal

consistency (Cronbach alpha reliability) for the EPQ-R scales of Extraversion, Neuroticism and Psychoticism, for the whole population and for males and females separately. The alpha reliabilities for the EPQ-R range from .68 to .88 (mean = 0.78). The EPQ-R Psychoticism scale is the only scale, which has a reliability, which does not reach 0.7. In females the Cronbach alpha is 0.68, which is below the level conventionally defined as being satisfactory. Alphas for both the Neuroticism and Extraversion scales in both males and females are high, ranging between 0.86 and 0.88.

The lower reliabilities for the Psychoticism scale may be a reflection of a skewed response pattern. This may partly be due to the poor item content in the Psychoticism scale. Ideally there should be an equivalent or near equivalent number of positive responses as negative for an item. The cut-off for an acceptable item is taken to be 80% in one direction (Kline, 2000). In women only 12 out of the 32 items fulfilled these requirements, while for men 18 items were within the acceptable range. Appendix III shows the response pattern for the Psychoticism items. Although the response pattern for a number of items is skewed scores on the Psychoticism scale, scores on this scale are not skewed, in the whole population or in males or females separately. Similar to the other scales the Psychoticism scale follows a normal distribution in the population.

Gender had a significant effect on scores. Although scores on the Psychoticism scale were not skewed, males and females did not show homogeneity of variance, therefore a non-parametric test was used. On the

Psychoticism scale males have significantly higher scores (Mann-Whitney U-test, Z=7.64, n=897, p<0.0001). Females scored significantly higher on the Neuroticism scale (t=5.50, df=895, p<0.0001; d=0.4), and the Lie scale (t=3.92, df=895, p<0.0001; d=0.3).

10.1.4 Psychometric properties of the TPQ

Table 10.1.2 shows the number of items, the number of subjects and internal consistency (Cronbach alpha reliability) for the TPQ for the whole population and for males and females separately. The alpha reliabilities for the TPQ range from .72 to .90 (mean = .81) and are all within the satisfactory range. The TPQ Harm Avoidance scale has the highest reliabilities of .90 and .89 for males and females respectively and Reward Dependence has the lowest 0.72 in both males and females. All the TPQ scales are normally distributed. Females scored higher on the TPQ HA scale (t=5.35, df=895, p<0.0001; d=0.4) and on the TPQ RD scale (t=8.53, df=895, p<0.0001; d=0.6).

10.1.5 Scale Intercorrelations

This section deals with correlations between scales from each questionnaire. Theoretically the scales from the EPQ-R are orthogonal, therefore it is expected that the correlations would be small if not negligible. Traditionally small correlations range from 0.10 to <0.30, moderate from 0.30 to <0.50 and large 0.50 to 1 (Cohen, 1988). Scales from the TPQ are allowed to correlate, however, one would not expect high correlations as the personality dimensions should measure a separate entity. If the correlations are high

Table 10.1.1: Eysenck Personality Questionnaire-Revised scale means, standard deviations and alphas

Scale	No. of items	Alpha (males)	Mean (males)	SD (males)	Alpha (females)	Mean (females)	SD (females)
Extraversion	23	.87	14.8	5.8	.86	15.0	5.0
Neuroticism	24	.88	12.6	5.9	.86	14.7	5.3
Psychoticism	32	.73	8.3	4.2	.68	6.2	3.5
Lie	21	.75	5.6	3.5	.72	6.5	3.5

Table 10.1.2: Tri-dimensional Personality Questionnaire scale means, standard deviations and alphas

Scale	No. of items	Alpha (males)	Mean (males)	SD (males)	Alpha (females)	Mean (females)	SD (females)
Novelty Seeking	34	.81	18.4	5.9	.79	17.9	5.6
Harm Avoidance	34	.90	13.2	7.6	.89	15.9	7.1
Reward Dependence	30	.72	17.6	4.7	.72	20.3	4.4

then the scales could be measuring the same construct and therefore be substantially redundant.

10.1.6 Correlations between the scales of the EPQ-R

Table 10.1.3 shows the correlations between the scales of the EPQ-R for both men and women. The pattern of correlations is slightly different in males compared to females. In males Extraversion and Neuroticism correlate negatively (r = -.30), a moderate correlation, while in females the correlation is small (r = -.20). Higher scores on Extraversion tend to go with lower scores on Neuroticism.

The Lie scale has small negative correlations with both Extraversion and Neuroticism (r = -.21 and r = -.13 in males and in females r= -.13 and r= -.20 respectively). Psychoticism and Lie correlate negatively to a moderate degree (r = -.39) in males and to a smaller degree in females (r = -.29). In females Psychoticism has a small positive correlation with Neuroticism (r = .12).

In order to fulfil the theoretical and statistical requirements of orthogonality all correlations between scales should be small at worst. In females correlations are small but not negligible with the correlation of the Lie scale and the Psychoticism scale verging on moderate. In males, there are two moderate correlations one between Extraversion and Neuroticism and one between Psychoticism and Lie. The highest correlation is in males between Psychoticism and Lie. However, the Lie scale in not a trait measure of

Table 10.1.3: Correlations among the EPQ-R scales for men (above diagonal, n=347) and women (below diagonal, n=550) (correlations are Spearman's rho) (p<.01, *p<.05)**

	Extraversion	Neuroticism	Psychoticism	Lie
Extraversion	-	-.30**	.08	-.21**
Neuroticism	-.20**	-	.04	-.13 *
Psychoticism	.07 *	.11**	-	-.37**
Lie	-.13**	-.20**	-.31**	-

personality.

10.1.7 Correlations between the scales of the TPQ

The TPQ does not have the same assumptions of orthogonality as the EPQ-R. The scales can be factored obliquely and are therefore allowed to correlate. The pattern of correlations (shown in table 10.1.4) is very similar between males and females. In both males and females there is a moderate negative correlation between Harm Avoidance and Novelty Seeking (r = -.22). In males other correlations are below 0.1. In females there is a further small positive correlation between Novelty Seeking and Reward Dependence (r = .12).

10.2 Item level analysis of the EPQ-R and the TPQ

The second section of this chapter assess the two questionnaires at the item level using exploratory factor analysis to ascertain whether the personality dimensions proposed by Eysenck and Cloninger can be found in this data set.

Table 10.1.4: Correlations among the TPQ scales for men (above diagonal, n=347) and women (below diagonal, n=550) (p<.01, *p<.05)**

	Novelty Seeking	Harm Avoidance	Reward Dependence
Novelty Seeking	-	-.22**	.04
Harm Avoidance	-.22**	-	-.09
Reward Dependence	.12**	-.03	-

10.2.1 Item Level Analysis of the EPQ-R

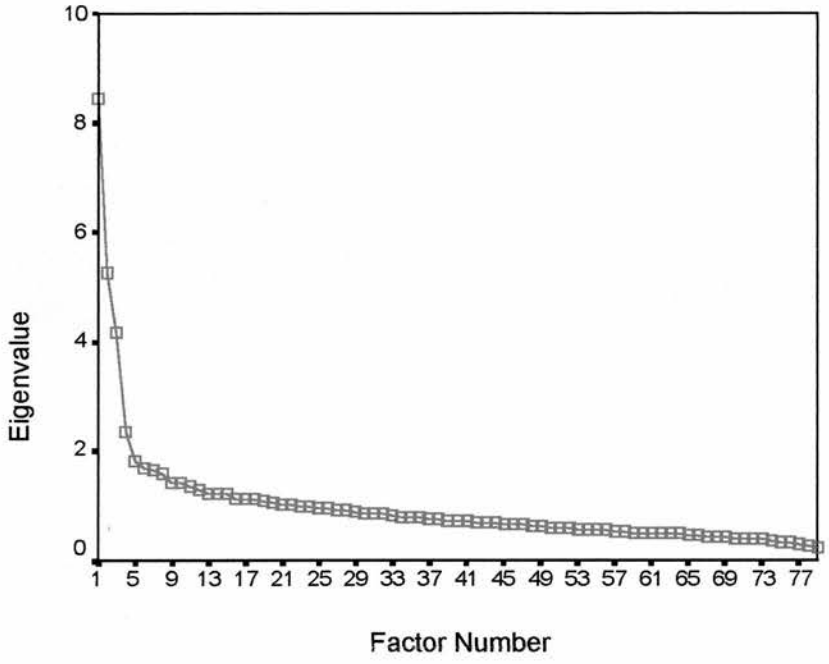
An item level analysis or exploratory factor analysis of the EPQ-R was carried out to ascertain whether the three-factor solution of Extraversion, Neuroticism and Psychoticism is justified in this sample. The exploratory factor analysis shows the number of factors, which may be extracted and the loadings of the items across the personality dimensions. The factor structure for males and females was very similar therefore data presented is an exploratory factor analysis with the two genders combined. Principal axis factoring of the items relating to Extraversion, Neuroticism and Psychoticism was carried out. Factors were extracted using principal axis factoring rather than principal components analysis as this method of extraction does not assume that all the variance is explained by the matrix. In a correlation matrix a measure is normally said to correlate with itself perfectly, therefore in the diagonal there are unities. Principal axis factoring replaces these unities with communalites, the amount of variance that can be explained by common factors, (in this case squared multiple correlations). If unities are in the diagonal no account is made for error whereas by using communalities error

in measurement is accounted for. In this group as it is so large, the factors will not differ greatly from those extracted by PCA, however, the variance explained will be less. Therefore the item factor loadings will be less that those gained by using principal components analysis.

Figure 10.2.1 shows the Scree plot of eigen-values derived from the correlation matrix of all the items from the EPQ-R Extraversion, Neuroticism and Psychoticism scales. The Extraversion scales contains 23 items, the Neuroticism scale 24 items and the Psychoticism scales 32. Items relating to the Lie scale were omitted (number of items = 21), as these are not relevant to Eysenck's three-factor theory. Therefore the analysis concerned a total of 79 items. The graph of the eigen-values and the size of the eigen-value give an indication to how many factors should be extracted. The eigen-value reflects the amount of variance explained by each factor, therefore the solution selected or the number of factors selected is directly related to how much variance is explained. The first unrotated factor always explains the most variance, followed by the second and so on. As these being to level offon the graph the addition of a further factor adds very little to the solution. In figure 10.2.1 the eigen-values begin to level off after 4 factors with a jump after the first three. A fifth factor would therefore add very little to the solution. Factor solutions with both 3 and 4 factors will be presented.

The factors from the EPQ-R are thought to be orthogonal or uncorrelated with each other, therefore Varimax rotation was used. With orthogonal

Figure 10.2.1: Scree plot of a Principal Axis Factoring for the EPQ-R Extraversion, Neuroticism and Psychoticism items



rotations the rotated factor matrix is presented. The factors extracted are made up of items which load on the factor. In orthogonal rotations, loadings are the correlations of the item with the factor; this is not the case in an oblique rotation. (Oblique rotations will be discussed in section 10.2.6). Conventionally in large samples, all loadings greater than or equal to 0.3 are taken to be significant loadings.

The results of a 3 and a 4-factor solution are shown in Table 10.2.1. These factor solutions are named in the analysis according to the factors that they represent. The 3-factor solution is called the ENC, representing the three factors of Extraversion, Neuroticism and Conscientiousness. The 4-factor solution is called ENAC representing the four factors of Extraversion,

Neuroticism, Antisocialness and Conscientiousness. The loadings presented are in bold colour with Extraversion in green, Neuroticism in blue and Psychoticism in red. It would be expected in terms of Eysenck's theory that exploratory factor analysis would reveal three factors relating to these scales.

Items are given as examples throughout the factor analysis. However, when a factor is being described indications of whether these where scored True or False, Yes or No or negative or positive loading are not always given in the text. The scoring and direction of loading should be clear from the theme of the factor. Directions of loadings are given in the tables.

10.2.2 EPQ-R Three-Factor Solution – Neuroticism, Extraversion and Conscientiousness (ENC)

Factors 1 and 2 are clearly Extraversion and Neuroticism respectively. These will therefore be called Extraversion-3FS and Neuroticism-3FS throughout. Factor 3 seems to represent a Conscientiousness factor is will therefore be called Conscientiousness-3FS. The 3FS is to distinguish the solutions gained in this analysis from other analyses. The Extraversion scale is made up of 23 items. 18 of these load on Factor 1 with loadings ranging between .348 and .695. One item from the Neuroticism scale loads negatively on Extraversion-3FS (N35 - *Have you often felt listless and tired for no reason?*). Four Extraversion items do not load on any Extraversion-3FS (E1 - *Do you have many different hobbies?;* E55 - *Do you like telling jokes and funny stories to your friends?*; E63 – *Do you nearly always have a 'ready answer' when people talk to you?* and E72- *Do you often take on more*

Table 10.2.1: Three and Four Factor orthogonally rotated solutions of an item level analysis of the EPQ-R

Item	Question	3- Factor Solution			4-Factor Solution				Comm-unality
		Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 4	
E1	Do you have many different hobbies?	.293	-.079	-.127	.285	-.072	-.123	-.078	.258
E6	Are you a talkative person?	**.614**	.033	.021	**.644**	-.001	.110	-.128	.498
E11	Are you rather lively?	**.626**	-.055	-.103	**.622**	-.056	-.108	-.080	.462
E16	Can you usually let yourself go and enjoy yourself at a lively party?	**.489**	-.137	.020	**.471**	-.117	-.129	.126	.327
E20	Do you enjoy meeting new people?	**.518**	-.090	-.070	**.482**	-.034	**-.321**	.199	.507
E24	Do you tend to keep in the background on social occasions?	**.695**	-.103	.016	**.700**	-.115	-.014	-.015	.558
E28	Do you like going out a lot?	**.464**	-.096	-.012	**.427**	-.041	-.283	.250	.373
E33	Do you prefer reading to meeting people?	**.488**	-.099	-.047	**.453**	-.047	-.291	.204	.412
E36	Do you have many friends?	**.489**	.077	-.107	**.467**	-.051	-.210	.031	.330
E40	Would you call yourself happy-go-lucky?	**.392**	-.224	.124	**.388**	-.222	-.001	.139	.322
E45	Do you usually take the initiative in making new friends?	**.521**	-.083	-.062	**.515**	-.081	-.092	-.031	.362
E47	Are you mostly quiet when you are with other people?	**.627**	-.109	-.017	**.635**	-.123	-.005	-.030	.552
E51	Can you easily get some life into a rather dull party?	**.501**	-.020	.142	**.536**	-.054	.174	-.013	.585
E55	Do you like telling jokes and funny stories to your friends?	.299	-.021	-.022	**.305**	-.031	.003	-.057	.191
E58	Do you like mixing with people?	**.608**	-.088	-.117	**.571**	-.032	**-.353**	.158	.572
E61	Have people said that you sometimes act too rashly?	.252	.203	**.384**	.286	.162	**.365**	.169	.366
E63	Do you nearly always have a 'ready answer' when people talk to you?	.200	.022	.154	.242	-.029	.282	-.088	.188
E67	Do you like doing things in which you have to act quickly?	**.348**	-.205	.197	**.354**	-.215	.095	.146	.315
E69	Do you often make decisions on the spur of the moment?	**.370**	-.041	**.317**	**.381**	-.057	.190	.230	.323
E72	Do you often take on more activities than you have time for?	.271	.046	.056	.279	.033	.063	0	.230
E78	Can you get a party going?	**.540**	-.094	.154	**.563**	-.124	.152	.021	.610
E90	Do you like plenty of bustle and excitement around you?	**.569**	-.004	-.048	**.541**	.036	-.239	.150	.408
E94	Do other people think of you as being very lively?	**.618**	.033	-.025	**.639**	.007	.050	-.130	.463
N3	Does your mood often go up and down?	-.053	**.512**	.098	-.045	**.507**	.123	.054	.331
N8	Do you ever feel 'just miserable' for no reason?	-.063	**.501**	.026	-.055	**.493**	.093	-.019	.347
N13	Do you often worry about things you should not have done or said?	-.017	**.464**	-.133	-.026	**.477**	-.081	-.070	.313
N17	Are you an irritable person?	-.093	**.466**	.131	-.063	**.431**	.264	-.051	.309
N22	Are your feelings easily hurt?	-.031	**.578**	-.220	-.042	**.594**	-.125	-.140	.446

Item	Question	3- Factor Solution			4-Factor Solution				Comm-unality
		Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 4	
N26	Do you often feel 'fed-up'?	-.122	**.558**	.135	-.108	**.545**	.183	-.051	.438
N31	Are you often troubled about feelings of guilt?	-.018	**.528**	.018	-.016	**.529**	.054	.011	.347
N35	Would you call yourself a nervous person?	**-.305**	**.471**	-.051	**-.313**	**.486**	-.018	.001	.433
N38	Are you a worrier?	-.146	**.623**	-.184	-.160	**.645**	-.112	-.090	.480
N43	Do you worry about awful things that might happen?	-.027	**.520**	-.094	-.026	**.521**	-.007	-.087	.345
N46	Would you call yourself tense or 'highly-strung'?	-.124	**.475**	.089	-.105	**.454**	.188	-.028	.368
N52	Do you worry about your health?	.090	**.309**	-.076	.090	**.310**	-.023	-.069	.222
N60	Do you suffer from sleeplessness?	-.162	**.386**	.190	-.142	**.364**	.232	.067	.257
N65	Have you often felt listless and tired for no reason?	-.064	**.493**	.138	-.057	**.489**	.136	.097	.371
N70	Do you often feel life is very dull?	-.189	**.419**	**.303**	-.165	**.393**	**.314**	.149	.364
N74	Do you worry a lot about your looks?	.031	**.423**	-.009	.029	**.428**	.011	.006	.278
N76	Have you ever wished that you were dead?	-.178	**.410**	.202	-.152	**.382**	.272	.045	.316
N80	Do you worry too long after an embarrassing experience?	-.146	**.483**	-.178	-.153	**.495**	-.087	-.119	.358
N83	Do you suffer from 'nerves'?	-.128	**.436**	-.043	-.138	**.454**	-.043	.027	.335
N84	Do you often feel lonely?	-.204	**.539**	.132	-.190	**.527**	.182	.052	.400
N87	Are you easily hurt when people find fault with you or the work you do?	-.007	**.504**	-.230	-.018	**.518**	-.132	-.154	.428
N92	Are you sometimes bubbling over with energy and sometimes very sluggish?	.160	**.370**	.120	.169	**.358**	.126	.058	.307
N97	Are you touchy about some things?	.005	**.430**	-.043	.012	**.422**	.047	-.081	.246
N100	When your temper rises, do you find it difficult to control?	.039	**.344**	.168	.067	**.311**	.255	-.005	.238
P2	Do you stop to think things over before doing anything?	.158	-.020	**.336**	.168	-.032	.204	.259	.320
P5	Do you take much notice of what people think?	-.004	-.238	.224	.019	-.268	.219	.075	.220
P7	Would being in debt worry you?	.053	-.289	.298	.056	-.293	.136	.264	.224
P9	Do you give money to charities?	-.155	-.065	.216	-.147	-.073	.152	.157	.160
P12	Would it upset you a lot to see a child or an animal suffer?	-.106	-.080	.190	-.086	-.104	.202	.061	.257
P14	Do you dislike people who don't know how to behave themselves?	.038	-.133	.108	.003	-.090	-.148	**.312**	.201
P18	Should people always respect the law?	-.033	.056	**.409**	-.045	.076	.138	**.472**	.317
P21	Are good manners very important?	-.066	-.060	.299	-.010	-.023	-.006	**.465**	.354
P25	Would you take drugs which may have strange or dangerous effects?	.027	.031	**.409**	.020	.044	.159	**.438**	.266

Item	Question	3-Factor Solution			4-Factor Solution				Comm-unality
		Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 4	
P29	Do you prefer to go your own way rather than act by the rules?	.068	-.014	**.441**	.074	-.020	.240	**.384**	.313
P30	Do you enjoy hurting people you love?	-.017	.038	.213	.004	.012	.220	.080	.149
P34	Do you have enemies who want to harm you?	.031	.161	.266	.061	.124	**.300**	.076	.217
P37	Do you enjoy practical jokes that can sometimes really hurt people?	.069	.002	**.329**	.084	-.017	.239	.218	.211
P41	Do good manners and cleanliness matter much to you?	-.010	-.038	.296	-.129	-.002	-.001	**.457**	.347
P42	Have you often gone against your parents' wishes?	.010	.126	**.327**	.112	.108	.245	.216	.223
P48	Do you think marriage is old-fashioned and should be done away with?	-.094	.048	.227	-.089	.045	.140	.192	.158
P50	Are you more easy-going about right and wrong than most people?	.051	-.090	**.365**	.043	-.078	.125	**.397**	.265
P54	Do you enjoy co-operating with others?	-.235	.065	.202	-.201	.022	**.309**	-.016	.212
P56	Do most things taste the same to you?	-.052	.051	.137	-.039	.036	.142	.055	.129
P59	Does it worry you if you know that there are mistakes in your work?	.040	-.139	.275	.036	-.133	.102	.281	.199
P64	Do you like to arrive at appointments in plenty of time?	.091	-.087	.181	.078	-.070	.004	.251	.163
P68	Is (or was) your mother a good woman?	-.064	.069	.205	-.046	.047	.206	.087	.159
P73	Are there several people who keep trying to avoid you?	-.041	.154	.196	-.019	.129	.221	.061	.202
P75	Do you think people spend too much time safeguarding their future with savings and insurance?	.047	.016	.236	.045	.021	.098	.239	.133
P79	Do you try not to be rude to people?	.019	-.072	**.347**	.044	-.104	**.301**	.177	.222
P81	Do you generally 'look before you leap'?	.215	.097	**.395**	.238	.068	**.310**	.236	.388
P85	Can you on the whole trust people to tell the truth?	-.153	.223	.224	-.129	.195	.264	.070	.250
P88	Is it better to follow society's rules than go your own way?	.009	-.043	.269	.001	-.030	.079	**.309**	.230
P91	Would you like other people to be afraid of you?	-.070	.133	.253	-.038	.095	**.310**	.053	.215
P95	Do people tell you a lot of lies?	-.013	.207	.199	.012	.178	.243	.044	.237
P96	Do you believe one has special duties to one's family?	.174	-.024	.209	-.156	-.045	.207	.092	.171
P99	Would you feel sorry for an animal caught in a trap?	-.055	-.072	.150	-.036	-.095	.173	.030	.205

activities than you have time for?). One Extraversion item loads positively on Conscientiousness-3FS (E61 - *Have people said that you sometimes act too rashly?*) and one on Extraversion-3FS and Conscientiousness-3FS with its highest loading (.370) being on Extraversion-3FS (E69 - *Do you often make decisions on the spur of the moment?).*

Factor 1 therefore clearly represents Extraversion as it is almost purely made up of Extraversion items, which load almost exclusively on this factor. When the items are read from the highest to the lowest loading there does not appear to be a great deal of variation from the theme of sociability. However, the first five items with the highest loadings relate to the liveliness of the individual, for instance: E24 – *Do you tend to keep in the background on social occasions?* and E47 – *Are you mostly quiet when you are with other people?* Following this the items tend to relate to mixing with other people: E58 – *Do you like mixing with people?* and E45 – *Do you usually take the initiative in making new friends?* Lastly there are a few questions which seem to relate to how carefree the individual may be described : E40 - *Would you call yourself happy-go-lucky?* and E69 - *Do you often make decisions on the spur of the moment?*

Factor 2 is made up of all of the 24 Neuroticism items with loadings ranging from .309 to .623. One of the Neuroticism items also loads negatively on factor 1 as described above and one item loads on factor 3 (shown in table 10.2.1). Factor 2 clearly represents Neuroticism. The highest loading item, N38 – *Are you a worrier?* is related to worry which is the overall theme of

this trait. The next few items relate more specifically to emotional sensitivity, for example, N22 - *Are your feelings easily hurt?* and N31 - *Are you often troubled about feelings of guilt?* The next group of items deals almost purely with anxiousness, for instance: N46 - *Would you call yourself tense or 'highly-strung'?* N13 - *Do you often worry about things you should not have done or said?* The third theme relates to fatigue and health, for instance: N60 - *Do you suffer from sleeplessness?* and N92 - *Are you sometimes bubbling over with energy and sometimes very sluggish?*

Factor 3 has mainly Psychoticism loadings; however, the highest loading is only .441 and only incorporates 9 of the 32 Psychoticism items. Table 10.2.2 shows the items which load on factor 3 (Concientiousness-3FS). The values of the loadings are shown in table 10.2.1. Many of the Psychoticism items do not load on any of the factors. The wording of the 12 items which load on Concientiousness-3FS appear to reflect impulsiveness. There would appear to be two main themes within these questions the first being law or rule abiding and the second a rashness or impulsivity. Factor 3 having so few Psychoticism items could not therefore be described as being representative of Psychoticism but may be closer to a factor for impulsivity or conscientiousness. This third factor of Concientiousness-3FS does not explain a great deal of variance. The communalites for the items range between .211 and .388. This is the variance which item explains without the unique variance (or specific variance and the error variance). This is in

Table 10.2.2: Items which load on Factor 3 of a three-factor solution of the EPQ-R

(direction of loading is positive if not reported and negative if – appears after the item)

Item number	Scoring	Question
E61	Yes	Have people said that you sometimes act too rashly?
E69	Yes	Do you often make decisions on the spur of the moment?
N70	Yes	Do you often feel life is very dull?
P2	No	Do you stop to think things over before doing anything?
P18	No	Should people always respect the law?
P25	Yes	Would you take drugs which may have strange or dangerous effects?
P29	Yes	Do you prefer to go your own way rather than act by the rules?
P37	Yes	Do you enjoy practical jokes that can sometimes really hurt people?
P42	Yes	Have you often gone against your parents' wishes?
P50	Yes	Are you more easy-going about right and wrong than most people?
P79	No	Do you try not to be rude to people?
P81	No	Do you generally 'look before you leap'?

contrast to the items which load on Extraversion-3FS which range between .315 and .610, and those which load on Neuroticism-3FS which range between .222 and .480.

10.2.3 Summary of EPQ-R – 3 factor solution

Extraversion and Neuroticism were extracted as the first and second factors which is similar to that found in Eysenck's model. These two factors are particularly strong as the items relating to these dimensions had high loadings, the majority of the items loaded on these factors, and the items relating to each scale either did not load on other factors or if they did so the loadings were small. Extraversion-3FS and Neuroticism-3FS were therefore distinct from other factors as well as being clear. However, Psychoticism did not emerge clearly as a third factor. The loadings were small if not negligible. The third factor related more to conscientiousness rather than a general psychoticism dimension.

10.2.4 Four Factor Solution of the EPQ-R – Extraversion, Neuroticism, Antisocialness and Conscientiousness (ENAC)

In the four-factor solution factors 1 and 2 are clearly Extraversion and Neuroticism. Factor 3 appears to represent Antisocialness, and factor 4 Conscientiousness. Throughout the analysis these will be known as Extraversion-4FS, Neuroticism-4FS, Antisocialness-4FS and Conscientiousness-4FS.

Factor 1 (Extraversion-4FS) contains loadings from 19 of the 23 Extraversion items, with loadings ranging from .305 to .700. Only one item from other scales loads on Extraversion-4FS. Similarly to the 3 factor solution this is item N35 which loads negatively (*Have you often felt listless and tired for no reason?*). Four Extraversion items did not load on Extraversion-4FS, with 3 of these not loading on any factor (E1 - *Do you have many different hobbies?*, E63 – *Do you nearly always have a 'ready answer' when people talk to you?* and E72- *Do you often take on more activities than you have time for?)* and one loading positively on Antisocialness-4FS (E61 - *Have people said that you sometimes act too rashly?*). One Extraversion item loads positively on Extraversion-4FS and negatively on Antisocialness-4FS (E55 - *Do you like telling jokes and funny stories to your friends?*). This Extraversion factor is very similar to that extracted in the three factor solution with the same themes making up the factor. Examples of items are given in section 10.2.3.

Factor 2 is clearly Neuroticism with all of the 24 Neuroticism items loading on this factor, and none of the items from other scales. Loadings range between

.310 and .645. Only two of items from the Neuroticism scale load on other factors as well. N35 as mentioned above also loads on Extraversion-4FS and *N70 (Do you often feel life is very dull?*) loads positively on Antisocialness-4FS. Again this factor is similar to that extracted in the three factor model, a description of the factor is given in section 10.2.3.

Factor 3 (Antisocialness-4FS) is made up of mainly 5 Psychoticism items with small loadings, 3 Extraversion items and 1 Neuroticism item with loadings ranging between .300 and .365. The highest loading (-.365) is an Extraversion item (E61). Due to the small loadings this factor should not be over-interpreted. However, the items do seem to relate to a general antisocial theme where individuals who scored highly on this factor would prefer to be on their own, feel that they have enemies and in fact would like people to be scared of them. Table 10.2.3 lists the items which load on this factor.

Factor 4 (Conscientiousness-4FS) is made up of solely Psychoticism items. The loadings are again small and range between .309 and .372. The items are shown in table 10.2.4. They all relate to following society's rules. They do appear to tap a true factor. The items seem to ask the same question. This is called a bloated specific where it appears that a factor is being extracted but is merely relating to one question (Cattell, 1973). Factors 1 and 2 are quite clearly Extraversion and Neuroticism, however loadings on both factors 3 and 4 are low and consist of very few items.

Table 10.2.3: Items which load on Factor 3 of a four factor solution of the EPQ-R (direction of loading is positive if not reported and negative if – appears after the item)

Item number	Scoring	Question
E20 -	Yes	Do you enjoy meeting new people?
E58 -	Yes	Do you like mixing with people?
E61	Yes	Have people said that you sometimes act too rashly?
N70	Yes	Do you often feel life is very dull?
P34	Yes	Do you have enemies who want to harm you?
P54	No	Do you enjoy co-operating with others?
P79	No	Do you try not to be rude to people?
P81	No	Do you generally 'look before you leap'?
P91	Yes	Would you like other people to be afraid of you?

Table 10.2.4: Items which load on Factor 4 of a four factor solution of the EPQ-R (direction of loading is positive if not reported and negative if – appears after the item)

Item number	Scoring	Question
P14	No	Do you dislike people who don't know how to behave themselves?
P18	No	Should people always respect the law?
P21	No	Are good manners very important?
P25	Yes	Would you take drugs which may have strange or dangerous effects?
P29	Yes	Do you prefer to go your own way rather than act by the rules?
P41	No	Do good manners and cleanliness matter much to you?
P50	Yes	Are you more easy-going about right and wrong than most people?
P88	No	Is it better to follow society's rules than go your own way?

10.2.5 Summary of analysis of the EPQ-R

Theoretically the scales of the EPQ-R should not correlate and from an item level analysis it should be possible to extract three factors using an orthogonal rotation. In section 1 it was shown that the scales did show some level of correlation although not high. In section 2 three clear factors could not be extracted. Extraversion and Neuroticism come out clearly in both a three and four factor solution, however, it would be difficult to describe a third or fourth factor. This may partly be due to the poor item content in the Psychoticism scale. There should be an equivalent or near equivalent number of positive responses as negative to an item. The cut-off for an

acceptable item is taken to be 80% in one direction. Only 13 out of 32 items fulfilled these requirements. Appendix III shows the response pattern for the Psychoticism items. In sum, Extraversion and Neuroticism are clear factors. Extraversion and Neuroticism can be extracted orthogonally, however, the scales from the EPQ-R correlate negatively to a moderate level in men and to a small level in women. Neuroticism is the scale which has the most relevance to the overall theme of this thesis and it can be extracted from the EPQ-R with either a 3 or a 4-factor solution.

10.2.6 Item Analysis of the TPQ

A Scree plot of eigen-values derived from the correlation matrix of the items from the TPQ is shown in Figure 10.2.2. The graph starts to flatten off after four factors. Cloninger predicts three factors Harm Avoidance, Novelty Seeking and Reward Dependence from his model of personality. Therefore both 3 and 4 factor solutions are extracted. To extract the factors as with the EPQ-R principal axis factoring is used, putting multiple squared correlations in the diagonals of the correlation matrix.

In Cloninger's model the factors are allowed to correlate. However, the correlations between the scales are low and if the factor correlation matrix is examined (table 10.2.5), the factors are shown to have very small correlations between them suggesting that an orthogonal solution may be more appropriate. When the matrices from the two types of rotation are compared, the results are very similar. The decision of choosing between an orthogonal and an oblique rotation in this situation is arbitrary. The main aim

Figure 10.2.2: Scree plot of a factor analysis for the TPQ

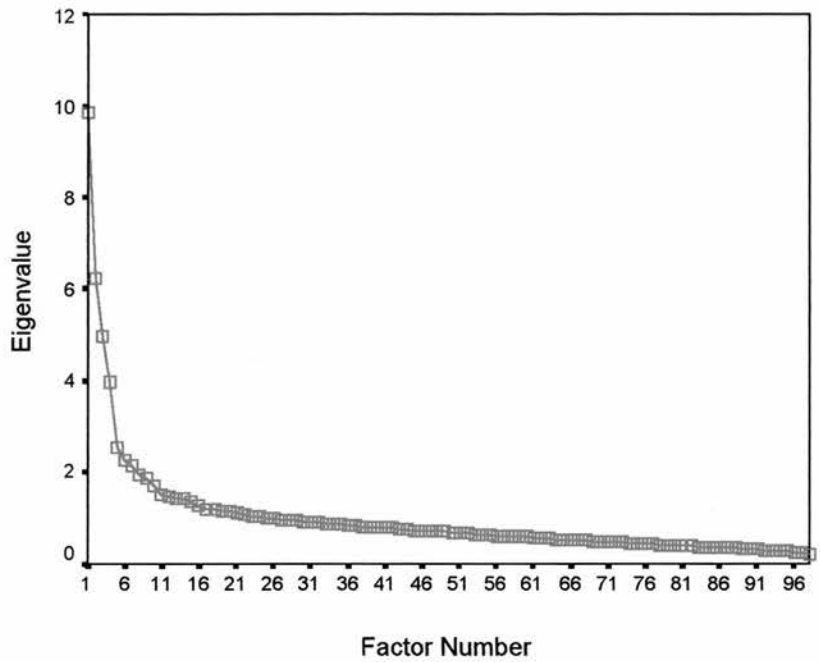


Table 10.2.5: TPQ Factor correlation matrix for 3 factor obliquely rotated solution

Factor	1	2	3
1	1.00		
2	-.063	1.00	
3	-.003	.054	1.00

of this section is to compare the factors with those derived by Cloninger; therefore, following extraction an oblique rotation (Direct Oblimin) is reported and discussed. However, as the correlations are minimal between the factors, and the decision is an arbitrary one, an orthogonal rotation is also presented to show the similarity between the two solutions.

In oblique rotations, correlations or loadings can be reported in the form of the structure or the pattern matrix respectively. Correlations provide the structure of the matrix whereas loadings show the pattern of item

interrelations, hence the names of the matrices. In the case of an orthogonal rotation the loadings and the correlations are identical. The structure provides the correlations of the items with the test factors, which have values between 0 and 1. The pattern matrix provides the loadings on the factors and these values can exceed one where structure matrix values (the correlations) are very high. In oblique rotations the structure matrix better explains the factors, which are being described, while the pattern matrix gives a better idea of how items contribute across factors. The terms loadings and correlations tend to be used interchangeably and in reality there is actually very little difference between the matrices, particularly in this data set. However, in this case the structure matrix from a Direct Oblimin rotation will be reported, as the question being asked about the three-factor model is whether the structure is similar to that of the one reported by Cloninger. The matrix from the orthogonal rotation is also reported (Table 10.2.6).

Table 10.2.6 shows the correlations of the items with the factors on an obliquely rotated 3-factor solution. Values greater than 0.3 are in colour, Harm Avoidance in dark blue, Novelty Seeking in bright green and Reward Dependence in violet.

10.2.7 Three factor solution of the TPQ – Harm Avoidance, Conscientiousness and Socialness (HCS)

Cloninger proposed that the three factors from the TPQ would be Harm Avoidance, Reward Dependence and Novelty Seeking. The 3-factor analysis presented here does not replicate these factors. The three factors found are

Table 10.2.6: Three Factor solutions of the TPQ using both an oblique and an orthogonal rotation

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
1	HA1	I usually am confident that everything will go well, even in situations that worry most people.	**.603**	-.119	.109	**.600**	-.103	.112	.513
5	HA1	Usually I am more worried than most people that something might go wrong in the future.	**.576**	-.146	.064	**.573**	-.130	.067	.477
8	HA1	I nearly always stay relaxed and carefree, even when nearly everyone else is fearful.	**.541**	-.108	.162	**.538**	-.096	.164	.446
10	HA1	I often have to stop what I am doing because I start worrying about what might go wrong.	**.476**	.003	.002	**.476**	.012	-.003	.548
14	HA1	I often stop what I am doing because I get worried, even when my friends tell me everything will go well.	**.436**	.008	-.021	**.437**	.022	-.023	.498
18	HA2	I usually feel tense and worried when I have to do something new and unfamiliar.	**.626**	-.100	.011	**.624**	-.081	-.009	.504
19	HA2	I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about.	**.673**	.083	-.050	**.672**	-.062	-.049	.677
23	HA2	I often feel tense and worried in unfamiliar situations, even when other's feel there is no danger at all.	**.663**	-.085	-.011	**.661**	-.065	-.010	.657
26	HA2	I usually stay calm and secure in situations that most people would find physically dangerous.	**.454**	-.107	.233	**.452**	-.099	.235	.378
29	HA2	I am usually confident that I can easily do things that most people would consider dangerous (such as driving an automobile fast on a wet or icy road).	.249	-.210	.159	.243	-.207	.164	.305
33	HA3	When I have to meet a group of strangers, I am more shy than most people.	**.446**	.067	**-.334**	**.444**	-.045	**-.334**	.495
37	HA3	I often avoid meeting strangers because I lack confidence with people I do not know.	**.484**	-.093	**-.314**	**.481**	-.071	**-.312**	.545
38	HA3	I usually stay away from social situations where I would have to meet strangers, even if I am assured that they will be friendly.	**.380**	-.041	-.289	**.379**	-.022	-.289	.438
42	HA3	I would probably stay relaxed and outgoing when meeting a group of strangers, even if I were told they are unfriendly.	**.455**	-.117	-.139	**.451**	-.100	-.137	.442

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
44	HA3	I think I would stay confident and relaxed when meeting strangers, even if I were told they are angry at me.	**.386**	-.101	.025	**.383**	-.090	.027	.327
47	HA2	Most of the time I would prefer to do something a little risky (like riding in a fast automobile over steep hills and sharp turns) – rather than having to stay quiet and inactive for a few hours.	.280	-.255	.108	.273	-.249	.115	.496
49	HA4	I try to do as little work as possible, even when other people expect more of me.	.113	**.442**	-.141	.128	**.450**	-.154	.360
51	HA2	Most of the time I would prefer to do something risky (like hand-gliding or parachute jumping) – rather than having to stay quiet and inactive for a few hours.	**.347**	-.188	.067	**.341**	-.180	.072	.509
54	HA4	I have less energy and get tired more quickly than most people.	**.430**	.074	-.065	**.433**	.090	-.068	.477
57	HA4	I often need naps or extra rest periods because I get tired so easily.	**.326**	.078	.070	**.329**	.087	.065	.435
59	HA4	I am more energetic and tire less quickly than most people.	**.466**	.070	.057	**.469**	.083	.054	.474
63	HA4	I usually can stay "on the go" all day without having to push myself.	**.420**	.048	.029	**.422**	.061	.027	.391
68	HA4	I recover more slowly than most people from minor illnesses or stress.	.250	.075	.018	.253	.083	.015	.330
69	HA4	I need much extra rest, support, or reassurance to recover from minor illnesses or stress.	**.356**	.028	.025	**.357**	.039	.023	.435
73	HA4	It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense, tired or worried.	**.535**	-.056	-.052	**.534**	-.039	-.051	.441
75	HA4	I usually feel much more confident and energetic than most people, even after minor illnesses or stress.	**.534**	.041	.032	**.536**	.057	.029	.523
80	HA4	I recover more quickly than most people from minor illnesses or stress.	**.473**	.092	.117	**.477**	.103	.114	.444
82	HA1	I think I will have very good luck in the future.	**.418**	.007	-.066	**.419**	.022	-.067	.432

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
84	HA1	If I am embarrassed or humiliated, I get over it very quickly.	**.522**	-.127	.079	**.519**	-.113	.082	.360
89	HA3	I feel very confident and sure of myself in almost all social situations.	**.595**	-.116	-.145	**.592**	-.094	-.143	.484
91	HA1	I never worry about terrible things that might happen in the future.	**.411**	-.035	.218	**.411**	-.028	.219	.320
95	HA1	Regardless of any temporary problem that I have to overcome, I always think it will turn out well.	**.533**	-.010	.029	**.533**	.006	.028	.487
98	HA1	I usually have good luck in whatever I try to do.	**.395**	.073	-.028	**.397**	.087	-.031	.401
100	HA3	It is easy for me to organise my thoughts while talking to someone.	**.310**	.011	-.145	**.311**	.024	-.146	.270
2	NS1	I often try new things just for fun or thrills, even if most people think it is a waste of time.	**-.403**	.212	.021	**-.397**	.200	.016	.393
4	NS1	When nothing new is happening, I usually start looking for something that is thrilling or exciting.	**-.316**	.153	.131	**-.311**	.140	.128	.344
9	NS1	I usually demand very good practical reasons before I am willing to change my old ways of doing things.	-.097	.225	.066	-.090	.221	.059	.263
11	NS1	I hate to change the way I do things, even if many people tell me there is a new and better way to do it.	-.243	.065	.039	-.242	.056	.038	.367
13	NS4	I like it when people can do whatever they want without strict rules and regulations.	-.139	**.317**	.032	-.129	**.312**	.024	.254
16	NS4	I like to be very organised and set up rules for people whenever I can.	-.074	.281	.044	-.065	.278	.036	.339
21	NS4	Even when most people feel it is not important, I often insist on things being done in a strict and orderly way.	-.045	.265	.081	-.036	.262	.073	.298
22	NS4	I often do things based on how I feel at the moment without thinking about how they were done in the past.	-.109	**.427**	.007	-.095	**.425**	-.005	.338
24	NS4	I often break rules and regulations when I think I can get away with it.	-.059	**.393**	-.125	-.046	**.396**	-.136	.287
28	NS4	I lose my temper more quickly than most people.	.183	.108	.036	.186	.113	.033	.242

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
30	NS2	I often react so strongly to unexpected news that I say or do things that I regret.	.248	.120	.102	.253	.125	.098	.301
32	NS3	I am much more reserved and controlled than most people.	-.054	.246	**.424**	-.045	.234	**.417**	.358
35	NS4	I almost never get so excited that I lose control of myself.	-.011	.200	.283	-.004	.193	.278	.276
40	NS1	I am slower than most people to get excited about new ideas and activities.	-.263	.083	**.353**	-.260	.066	.352	.313
43	NS1	It is difficult for me to keep the same interests for a long time because my attention often shifts to something else.	.191	**.338**	-.018	.202	**.345**	-.028	.270
46	NS2	I like to think about things for a long time before I make a decision.	**-.308**	**.365**	.056	-.297	**.355**	.046	.394
48	NS2	I often follow my instincts, hunches, or intuition without thinking through all the details.	-.184	**.455**	.060	-.170	**.449**	.048	.425
50	NS2	I often have to change my decisions because I had a wrong hunch or mistaken first impression.	.148	.272	.020	.157	.277	.012	.293
55	NS2	I usually think about all the facts in detail before I make a decision.	-.120	**.539**	.066	-.102	**.535**	.051	.484
56	NS2	I nearly always think about all the facts in detail before I make a decision, even when other people demand a quick decision.	-.145	**.390**	.097	-.133	**.384**	.086	.336
60	NS4	I am usually able to get other people to believe me, even when I know that what I am saying is exaggerated or untrue.	-.092	.161	-.022	-.087	.160	-.027	.321
62	NS4	I can usually do a good job of stretching the truth to tell a funnier story or to play a joke on someone.	-.171	.210	.026	-.164	.204	.020	.314
65	NS4	I have trouble telling a lie, even when it is meant to spare someone else's feelings.	-.037	.231	-.013	-.030	.231	-.019	.226
66	NS3	I am better at saving money than most people.	.107	**.517**	.129	.124	**.519**	.115	.472

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
70	NS3	I often spend money until I run out of cash or get into debt from using too much credit.	.091	**.501**	.072	.107	**.504**	.058	.478
72	NS3	Because I so often spend too much money on impulse, it is hard for me to save money – even for special plans like a holiday.	.165	**.510**	.063	.182	**.515**	.049	.539
76	NS3	Some people think I am too stingy or tight with my money.	-.092	.269	.202	-.083	.261	.195	.326
78	NS3	It is hard for me to enjoy spending money on myself, even when I have saved plenty of money.	-.149	**.320**	.161	-.139	**.312**	.153	.335
81	NS2	I hate to make decisions based only on my first impressions.	-.112	**.372**	.073	-.100	**.368**	.063	.281
85	NS1	I like old "tried and true" ways of doing things much better than trying "new and improved" ways.	-.245	.143	.129	-.241	.133	.125	.297
87	NS3	I enjoy saving money more than spending it on entertainment or thrills.	-.099	**.390**	.190	-.086	**.383**	.180	.361
93	NS1	In conversations I am much better as a listener than as a talker.	-.199	.152	.252	-.194	.139	.249	.300
96	NS1	I like to stay at home better than to travel or explore new places.	-.244	.036	.181	-.242	.024	.181	.213
99	NS2	I like to pay close attention to details in everything I do.	.048	**.441**	.013	.062	**.444**	.001	.308
3	RD3	I like to discuss my experiences and feelings openly with friends instead of keeping them to myself.	-.138	.077	**.604**	-.135	.057	**.603**	.539
6	RD3	I don't mind discussing my personal problems with people whom I have known briefly or slightly.	-.029	.126	.200	-.025	.120	.197	.279
7	RD3	I would like to have warm and close friends with me most of the time.	.107	.016	**.311**	.108	.011	**.311**	.247
12	RD3	My friends find it hard to know my feelings because I seldom tell them about my private thoughts.	-.010	.085	**.630**	-.096	.066	**.629**	.580
15	RD3	It wouldn't bother me to be alone all the time.	.026	.051	**.339**	.028	.044	**.338**	.251
17	RD4	I usually do things my own way, rather than giving in to the wishes of other people.	.127	-.027	.198	.127	-.028	.199	.258

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
20	RD4	Other people often think that I am too independent because I won't do what they want.	.053	.015	.163	.054	.013	.162	.249
25	RD4	I don't care very much whether other people like me or the way I do things.	.196	-.033	.249	.195	-.033	.249	.262
27	RD1	I feel it is more important to be sympathetic and understanding of other people then to be practical and tough-minded.	.098	.030	.259	.100	.027	.258	.222
31	RD1	People find it easy to come to be for help, sympathy, and warm understanding.	-.089	-.068	**.436**	-.090	-.082	**.438**	.305
34	RD1	I am strongly moved by sentimental appeals (like when asked to help crippled children).	.084	-.049	**.300**	.083	-.054	**.302**	.221
36	RD4	I have a reputation as someone who is very practical and does not act on emotion.	.110	**.352**	**.367**	.122	**.346**	**.357**	.357
39	RD2	I usually push myself harder than most people do because I want to do as well as I possibly can.	-.156	**-.481**	.044	-.171	**-.488**	.058	.536
41	RD2	I often push myself to the point of exhaustion or try to do more than I really can.	-.086	-.158	.070	-.091	-.163	.075	.319
45	RD2	I could probably accomplish more than I do, but I don't see the point in pushing myself harder than is necessary to get by.	-.097	**-.445**	.140	-.111	**-.452**	.153	.464
52	RD2	I am satisfied with my accomplishments, and have little desire to do better.	.072	-.079	.100	.070	-.080	.102	.128
53	RD2	I see no point in continuing to work on something unless there is a good chance of success.	-.34	-.161	.160	-.139	-.170	.165	.226
58	RD4	I don't go out of my way to please other people.	.123	-.128	**.323**	.120	-.133	**.327**	.332
64	RD3	I am usually more upset than most people by the loss of a close friend.	.258	-.034	.244	.258	-.032	.245	.290
67	RD3	Even after there are problems in a friendship, I nearly always try to keep it going anyway.	-.092	-.059	.157	-.093	-.066	.159	.188
74	RD3	If I am feeling upset, I usually feel better around friends than when left alone.	-.058	.082	**.351**	-.055	.072	**.349**	.253

No.	Item	Question	Oblique Solution			Orthogonal Rotation			Comm-unality
			Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	
77	RD2	I often keep trying the same thing over and over again, even when I have not had much success in a long time.	-.162	-.176	-.048	-.165	-.080	-.045	.228
79	RD2	I seldom let myself get upset or frustrated: when things don't work out, I simply move on to other activities.	**.477**	-.101	.195	**.475**	-.092	.197	.382
83	RD1	I am often moved deeply by a fine speech or poetry.	.029	.003	.285	.030	-.003	.285	.242
86	RD3	I like to keep my problems to myself.	-.053	.101	**.640**	-.049	.083	**.638**	.562
88	RD3	Even when I am with friends, I prefer not to "open up" very much.	-.151	.094	**.697**	-.146	.071	**.696**	.635
90	RD3	I usually like to stay cool and detached from other people.	-.047	.124	**.657**	-.042	.106	**.655**	.475
92	RD2	I am more hard-working than most people.	-.101	**-.556**	-.038	-.119	**-.560**	-.022	.497
94	RD1	I like to please other people as much as I can.	.110	-.067	.228	.108	-.070	.230	.278
97	RD2	I am usually so determined that I continue to work long after other people have given up.	-.237	**-.401**	-.070	-.251	**-.407**	-.058	.477

Harm Avoidance, Conscientiousness and Socialness. These will be called Harm Avoidance-3FS-TPQ, Conscientiousness-3FS-TPQ and Socialness-3FS-TPQ.

Factor 1 is clearly Harm Avoidance. Thirty of the 34 HA items load predominantly on Harm Avoidance-3FS-TPQ with loadings ranging between .310 and .673. Only four items from other scales load on Harm Avoidance-3FS-TPQ. Three Novelty Seeking items load negatively and one Reward Dependence item loads positively. Table 10.2.7 describes these items. These items could be described as Harm Avoidance. It is unlikely for someone high on HA to seek out new thrills and although making a spontaneous decision may be highly related to novelty seeking, being indecisive and not wishing to step out is related to Harm Avoidance. These items are ambiguous.

Three of the HA items do not load on any factor (HA 29 *I am usually confident that I can easily do things that most people would consider dangerous (such as driving an automobile fast on a wet or icy road*); HA 47 *Most of the time I would prefer to do something a little risky (like riding in a fast automobile over steep hills and sharp turns) - rather than having to stay quiet and inactive for a few hours;* HA 68 *I recover more slowly than most people from minor illnesses or stress*). Two items load on both Harm Avoidance-3FS-TPQ and factor 3 (HA 33, HA 37), however, their loadings are higher on Harm Avoidance-3FS-TPQ than on Socialness-3FS-TPQ. One item loads on Conscientiousness-3FS-TPQ only (HA 49 *I try to do as little*

Table 10.2.7: Items which load on factor 1 of a 3-factor solution of the TPQ (excluding HA items) (direction of loading is positive if not reported and negative if – appears after the item)

Item	Number	Scoring	Question
NS1 -	2	True	I often try new things just for fun or thrills, even if most people think it is a waste of time.
NS1 -	4	True	When nothing new is happening, I usually start looking for something that is thrilling or exciting
NS2 -	46	False	I like to think about things for a long time before I make a decision
RD2	79	False	I seldom let myself get upset or frustrated: when things don't work out, I simply move on to other activities

work as possible, even when other people expect more of me). Factor 1 is therefore clearly Harm Avoidance and the items relating to Harm Avoidance describe this factor well.

There are a number of themes within this factor. The first group of questions with the highest loadings relate to feelings of worry and anxiety for unfamiliar and future experiences, for instance: HA2 19 *I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about* and HA1 5 - *Usually I am more worried than most people that something might go wrong in the future.* The second theme seems to relate to fatigue for instance: HA4 73 - *It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense, tired or worried* and HA4 84 - *I recover more quickly than most people from minor illnesses or stress.* The third theme could be said to relate to confidence and anxiousness in social situations, for example: HA3 37 - *I often avoid meeting strangers because I lack confidence with people I do not know* and HA3 33 - *When I have to meet a group of strangers, I am more shy than most people.* Lastly

there are a few questions relating to a search for excitement and inability to settle which load negatively on this factor: NS1 4 - *When nothing new is happening, I usually start looking for something that is thrilling or exciting* and HA3 100 - *It is easy for me to organise my thoughts while talking to someone.*

Factors 2 and 3 are not quite so clear. Factor 2 (Conscientiousness-3FS-TPQ) consists of 15 loadings from Novelty Seeking items, 5 from Reward Dependence with four of these five loading negatively (as marked in table 10.2.8) and one from Harm Avoidance. Loadings ranged between .317 and .556. Therefore it would seem that factor 2 is clearly Novelty Seeking. However only four items are above 0.5 and as many as 15 NS items do not load on any factor while 3 load on Harm Avoidance-3FS-TPQ (one of these also on factor 2) and 2 load on Socialness-3FS-TPQ. The sub-scales are not equally well represented in this factor. There is a range from NS2, 3 and 4 sub scales but there is only one question from NS1. This sub-scale is not a good measure of Factor 2. Although Factor 2 could be described as Novelty Seeking it is not a particularly convincing factor. Over 50% of the items included in the questionnaire do not load on this factor, perhaps suggesting that better items should be included. Furthermore, only 4 of the loadings are high reaching above 0.5, with the majority in the 0.3's.

By reading through all the questions relating to factor two there is a feeling that these together relate to a conscienciousness factor - or in fact in this case a lack of conscienciousness. There are a few themes running through

Table 10.2.8: Items which load on factor 2 of a 3-factor solution of the TPQ (direction of loading is positive if not reported and negative if – appears after the item)

Item	Number	Scoring	Question
HA	49	True	I try to do as little work as possible, even when other people expect more of me.
NS4	13	True	I like it when people can do whatever they want without strict rules and regulations
NS4	22	True	I often do things based on how I feel at the moment without thinking about how they were done in the past
NS4	24	True	I often break rules and regulations when I think I can get away with it
NS1	43	True	It is difficult for me to keep the same interests for a long time because my attention often shifts to something else
NS2	46	False	I like to think about things for a long time before I make a decision
NS2	48	True	I often follow my instincts, hunches, or intuition without thinking through all the details
NS2	55	False	I usually think about all the facts in detail before I make a decision
NS2	56	False	I nearly always think about all the facts in detail before I make a decision, even when other people demand a quick decision
NS3	66	False	I am better at saving money than most people
NS3	70	True	I often spend money until I run out of cash or get into debt from using too much credit
NS3	72	True	Because I so often spend too much money on impulse, it is hard for me to save money - even for special plans like a holiday
NS3	78	False	It is hard for me to enjoy spending money on myself, even when I have saved plenty of money
NS2	81	False	I hate to make decisions based only on my first impressions
NS3	87	False	I enjoy saving money more than spending it on entertainment or thrills
NS2	99	False	I like to pay close attention to details in everything I do
RD4	36	False	I have a reputation as someone who is very practical and does not act on emotion
RD2 -	39	True	I usually push myself harder than most people do because I want to do as well as I possibly can
RD2 -	45	False	I could probably accomplish more than I do, but I don't see the point in pushing myself harder than is necessary to get by
RD2 -	92	True	I am more hard-working than most people
RD2 -	97	True	I am usually so determined that I continue to work long after other people have given up

the questions, with relevance to a preference in spending rather than saving money, an unwillingness to push hard at work and a willingness to make rash decisions rather than think over consequences.

Factor 3 (Socialness-3FS-TPQ) is predominantly Reward Dependence, with 11 RD, two NS items and two HA items loading negatively (see table 10.2.9). The loadings on this factor ranged between .300 and .697.

The highest loadings (in the 0.6's) are all from Reward Dependence 3 sub-scale (in italics). These questions relate to openness with other people and discussing problems with others. The Reward Dependence items are not representative of the factor as 14 RD items do not load on any factor, 5 load on Conscientiousness-3FS-TPQ, 1 loads on factor 1. The factor seems to have two main themes. The first relating to a willingness to open up and listen to others and the second main theme would be a preference to be around others than being alone. The factor itself could be described as openness to social relations. There is not a theme relating to other experiences and therefore it is quite a narrow factor relating only to social relations.

10.2.8 Summary of the TPQ – 3 factor solution

Factor 1 is the only clear factor to emerge from this data set. The majority of the items from the Harm Avoidance scale load on factor 1, with few loadings from other scales. Factors 2 and 3 are less clear. Although three factors can be extracted which are related to the three personality dimensions the most convincing is factor 1. The loadings on factors 2 and 3 are mixed with items from other scales and many items do not load on these factors. When the orthogonal and the oblique rotations are compared the loadings are almost identical. In only one case is there an item which loads in one solution but

Table 10.2.9: Items relating to factor 3 of a 3-factor solution of the TPQ (direction of loading is positive if not reported and negative if – appears after the item)

Item	Number	Scoring	Question
RD3	*3*	*True*	*I like to discuss my experiences and feelings openly with friends instead of keeping them to myself*
RD3	7	True	I would like to have warm and close friends with me most of the time.
RD3	*12*	*False*	*My friends find it hard to know my feelings because I seldom tell them about my private thoughts*
RD3	15	False	It wouldn't bother me to be alone all the time
RD1	31	True	People find it easy to come to be for help, sympathy, and warm understanding
RD1	34	True	I am strongly moved by sentimental appeals (like when asked to help crippled children)
RD4	36	False	I have a reputation as someone who is very practical and does not act on emotion
RD4	58	False	I don't go out of my way to please other people
RD3	74	True	If I am feeling upset, I usually feel better around friends than when left alone
RD3	*86*	*False*	*I like to keep my problems to myself*
RD3	*88*	*False*	*Even when I am with friends, I prefer not to "open up" very much*
RD3	*90*	*False*	*I usually like to stay cool and detached from other people*
HA3 -	33	True	When I have to meet a group of strangers, I am more shy than most people
HA3 -	37	True	I often avoid meeting strangers because I lack confidence with people I do not know
NS3	32	False	I am much more reserved and controlled than most people
NS1	40	False	I am slower than most people to get excited about new ideas and activities

does not load in the other. Item number 46 (NS2) loads at -.308 on factor 1 in the oblique rotation but is below the 0.3 mark (-.297) in the orthogonal rotation. The factor loadings are all extremely similar throughout. Cloninger's three factor model of Novelty Seeking, Harm Avoidance and Reward Dependence was not clearly evident from this data set. However, Harm Avoidance could be extracted satisfactorily.

10.2.9 Four factor solution of the TPQ – Harm Avoidance, Conscientiousness, Tough Mindedness and Impulsiveness (HCTI)

The factors were extracted similarly to the three-factor model. When factors were rotated obliquely the four factors had small correlations between them (see table 10.2.10) thereby suggesting that an orthogonal rotation would be a more appropriate solution. This solution is presented in Table 10.2.11. The items are presented in order of size relating first to factor 1, then to 2 and so on. The items that do not load on any factor greater than 0.3 are presented at the bottom of the table.

Four factors were extracted which were Harm Avoidance, Conscientiousness, Tough Mindedness and Impulsiveness. These are called Harm Avoidance-4FS-TPQ, Conscientiousness-4FS-TPQ, Tough Mindedness-4FS-TPQ and Impulsiveness-4FS-TPQ.

Factor 1 (Harm Avoidance-4FS-TPQ) is clearly Harm Avoidance, as with the 3-factor solution HCS solution. In this case 26 of the HA items load on Factor 1, with 24 of these having their highest loadings on factor 1. The loadings range between .317 and .679. Harm Avoidance-4FS-TPQ also has moderate loadings from 2 Reward Dependence items and 2 Novelty Seeking items, one loading positively and one loading negatively. The factor seems to be describing emotionality. The themes are similar to that of Harm Avoidance-3FS-TPQ in the three factor HCS solution, with a theme relating to worry, a theme relating to confidence in social situations and a theme relating to fatigue. However, this factor is slightly less broad than the one

Table 10.2.10: TPQ Factor correlation matrix for 4 factor obliquely rotated solution

Factor	1	2	3	4
1	1.00			
2	-.024	1.00		
3	-.031	.061	1.00	
4	-.133	.051	.037	1.00

described in the three factor HCS solution and does not contain a theme relating to a search for excitement and inability to settle.

Factor 2 (Conscientiousness-4FS-TPQ) is a mix of Reward Dependence and Novelty Seeking items. The Reward Dependence items are all from the sub-scale Persistence and these all load negatively on the factor. The loadings range between .308 and .616. Conscientiousness-4FS-TPQ is also made up of the Novelty Seeking sub-scales of Impulsiveness, Extravagance and Disorderliness. It is very similar to the Conscientiousness-3FS-TPQ found in the 3-factor HCS solution. The first items with the highest loadings relate to work attitudes. Someone scoring high on this factor would not work late or push themselves harder than others. They would break regulations and be more slapdash. The individual would also be willing to spend money and not worry about saving. Again this factor seems to relate to a lack of conscienciousness or to a broad description of impulsiveness.

Factor 3 (Tough Mindedness-4FS-TPQ) is mainly made up of Reward Dependence items with the highest loadings being five items from the Reward Dependence sub-scale Attachment (RD3). The highest loading items are similar to that in Socialness-3FS-TPQ of the 3-factor HCS solution.

Table 10.2.11: Four Factor solution of the TPQ orthogonally rotated

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
23	HA2	I often feel tense and worried in unfamiliar situations, even when other's feel there is no danger at all.	**.679**	-.068	-.029	.140
19	HA2	I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about.	**.667**	-.056	-.075	.176
73	HA4	It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense, tired or worried.	**.617**	-.072	-.050	-.013
5	HA1	Usually I am more worried than most people that something might go wrong in the future.	**.602**	-.138	.054	.118
18	HA2	I usually feel tense and worried when I have to do something new and unfamiliar.	**.590**	-.062	-.041	.224
10	HA1	I often have to stop what I am doing because I start worrying about what might go wrong.	**.545**	-.015	-.002	-.005
14	HA1	I often stop what I am doing because I get worried, even when my friends tell me everything will go well.	**.495**	-.001	-.023	-.002
1	HA1	I usually am confident that everything will go well, even in situations that worry most people.	**.488**	-.047	.058	**.382**
89	HA3	I feel very confident and sure of myself in almost all social situations.	**.463**	-.035	-.198	.373
84	HA1	If I am embarrassed or humiliated, I get over it very quickly.	**.462**	-.083	-.047	.256
79	RD2	I seldom let myself get upset or frustrated: when things don't work out, I simply move on to other activities.	**.458**	-.078	.174	.186
8	HA1	I nearly always stay relaxed and carefree, even when nearly everyone else is fearful.	**.456**	-.053	.121	**.317**
37	HA3	I often avoid meeting strangers because I lack confidence with people I do not know.	**.451**	-.060	**-.335**	.137
95	HA1	Regardless of any temporary problem that I have to overcome, I always think it will turn out well.	**.439**	.051	-.017	.305
54	HA4	I have less energy and get tired more quickly than most people.	**.435**	.090	-.082	.082
69	HA4	I need much extra rest, support, or reassurance to recover from minor illnesses or stress.	**.425**	.011	.029	-.036
91	HA1	I never worry about terrible things that might happen in the future.	**.400**	-.018	.199	.154
30	NS2	I often react so strongly to unexpected news that I say or do things that I regret.	**.395**	.068	.128	-.193
33	HA3	When I have to meet a group of strangers, I am more shy than most people.	**.384**	-.022	**-.362**	.174
80	HA4	I recover more quickly than most people from minor illnesses or stress.	**.377**	.153	.069	**.303**
38	HA3	I usually stay away from social situations where I would have to meet strangers, even if I am assured that they will be friendly.	**.374**	-.023	**-.301**	.062
42	HA3	I would probably stay relaxed and outgoing when meeting a group of strangers, even if I were told they are unfriendly.	**.368**	-.062	-.174	.256
11	NS1	I hate to change the way I do things, even if many people tell me there is a new and better way to do it.	**-.364**	.111	.014	.159
64	RD3	I am usually more upset than most people by the loss of a close friend.	**.358**	-.072	.264	-.077

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
57	HA4	I often need naps or extra rest periods because I get tired so easily.	**.350**	.080	.059	.042
63	HA4	I usually can stay "on the go" all day without having to push myself.	**.341**	.100	-.011	.247
68	HA4	I recover more slowly than most people from minor illnesses or stress.	**.317**	.055	.023	-.063
92	RD2	I am more hard-working than most people.	-.013	**-.616**	.013	-.159
39	RD2	I usually push myself harder than most people do because I want to do as well as I possibly can.	-.039	**-.557**	.103	-.218
66	NS3	I am better at saving money than most people.	.103	**.527**	.104	.019
97	RD2	I am usually so determined that I continue to work long after other people have given up.	-.082	**-.498**	-.001	**-.336**
55	NS2	I usually think about all the facts in detail before I make a decision.	-.020	**.495**	.077	-.237
72	NS3	Because I so often spend too much money on impulse, it is hard for me to save money - even for special plans like a holiday.	.254	**.482**	.062	-.146
70	NS3	I often spend money until I run out of cash or get into debt from using too much credit.	.154	**.480**	.067	-.116
45	RD2	I could probably accomplish more than I do, but I don't see the point in pushing myself harder than is necessary to get by.	-.068	**-.469**	.167	-.027
99	NS2	I like to pay close attention to details in everything I do.	.017	**.463**	-.014	.041
49	HA4	I try to do as little work as possible, even when other people expect more of me.	.133	**.433**	-.155	-.058
87	NS3	I enjoy saving money more than spending it on entertainment or thrills.	-.109	**.393**	.176	-.003
56	NS2	I nearly always think about all the facts in detail before I make a decision, even when other people demand a quick decision.	-.133	**.382**	.090	-.068
22	NS4	I often do things based on how I feel at the moment without thinking about how they were done in the past.	.031	**.368**	.033	**-.310**
24	NS4	I often break rules and regulations when I think I can get away with it.	.037	**.354**	-.111	-.235
81	NS2	I hate to make decisions based only on my first impressions.	-.045	**.341**	.081	-.164
78	NS3	It is hard for me to enjoy spending money on myself, even when I have saved plenty of money.	-.186	**.335**	.144	.034
16	NS4	I like to be very organised and set up rules for people whenever I can.	-.181	**.334**	.007	.167
46	NS2	I like to think about things for a long time before I make a decision.	-.241	**.326**	.072	-.213
21	NS4	Even when most people feel it is not important, I often insist on things being done in a strict and orderly way.	-.154	**.319**	.043	.183
43	NS1	It is difficult for me to keep the same interests for a long time because my attention often shifts to something else.	.286	**.308**	-.012	-.151
88	RD3	Even when I am with friends, I prefer not to "open up" very much.	-.143	.082	**.694**	.049
90	RD3	I usually like to stay cool and detached from other people.	-.047	.119	**.647**	.080
86	RD3	I like to keep my problems to myself.	-.038	.089	**.635**	.048

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
12	RD3	My friends find it hard to know my feelings because I seldom tell them about my private thoughts.	-.106	.081	**.622**	.078
3	RD3	I like to discuss my experiences and feelings openly with friends instead of keeping them to myself.	-.102	.052	**.609**	-.015
31	RD1	People find it easy to come to be for help, sympathy, and warm understanding.	-.061	-.087	**.445**	-.002
32	NS3	I am much more reserved and controlled than most people.	-.039	.237	**.416**	.008
40	NS1	I am slower than most people to get excited about new ideas and activities.	-.223	.054	**.367**	-.089
36	RD4	I have a reputation as someone who is very practical and does not act on emotion.	.148	**.339**	**.356**	-.011
74	RD3	If I am feeling upset, I usually feel better around friends than when left alone.	-.055	.078	**.347**	.028
58	RD4	I don't go out of my way to please other people.	.138	-.134	**.324**	.058
15	RD3	It wouldn't bother me to be alone all the time.	-.014	.069	**.322**	.127
7	RD3	I would like to have warm and close friends with me most of the time.	.147	.000	**.314**	-.001
34	RD1	I am strongly moved by sentimental appeals (like when asked to help crippled children).	.132	-.071	**.310**	-.019
83	RD1	I am often moved deeply by a fine speech or poetry.	.116	-.037	**.307**	-.110
35	NS4	I almost never get so excited that I lose control of myself.	.091	.155	**.303**	-.160
2	NS1	I often try new things just for fun or thrills, even if most people think it is a waste of time.	-.209	.113	.082	**-.473**
75	HA4	I usually feel much more confident and energetic than most people, even after minor illnesses or stress.	**.361**	.142	-.039	**.457**
60	NS4	I am usually able to get other people to believe me, even when I know that what I am saying is exaggerated or untrue.	.110	.072	.030	**-.411**
47	HA2	Most of the time I would prefer to do something a little risky (like riding in a fast automobile over steep hills and sharp turns) - rather than having to stay quiet and inactive for a few hours.	.116	-.175	.062	**.407**
4	NS1	When nothing new is happening, I usually start looking for something that is thrilling or exciting.	-.134	.060	.189	**-.406**
48	NS2	I often follow my instincts, hunches, or intuition without thinking through all the details.	-.005	**.377**	.099	**-.398**
26	HA2	I usually stay calm and secure in situations that most people would find physically dangerous.	**.326**	-.035	.183	**.391**
29	HA2	I am usually confident that I can easily do things that most people would consider dangerous (such as driving an automobile fast on a wet or icy road).	.096	-.136	.115	**.384**
51	HA2	Most of the time I would prefer to do something risky (like hand-gliding or parachute jumping) - rather than having to stay quiet and inactive for a few hours.	.199	-.112	.021	**.381**
59	HA4	I am more energetic and tire less quickly than most people.	**.333**	.149	.000	**.365**
62	NS4	I can usually do a good job of stretching the truth to tell a funnier story or to play a joke on someone.	-.005	.133	.069	**-.358**

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
82	HA1	I think I will have very good luck in the future.	.279	.088	-.121	**.350**
20	RD4	Other people often think that I am too independent because I won't do what they want.	-.108	.091	.117	**.336**
17	RD4	I usually do things my own way, rather than giving in to the wishes of other people.	-.018	.043	.155	**.333**
41	RD2	I often push myself to the point of exhaustion or try to do more than I really can.	.078	-.244	.127	**-.303**
44	HA3	I think I would stay confident and relaxed when meeting strangers, even if I were told they are angry at me.	.281	-.041	-.015	.297
98	HA1	I usually have good luck in whatever I try to do.	.287	.139	-.075	.286
100	HA3	It is easy for me to organise my thoughts while talking to someone.	.227	.061	-.179	.206
9	NS1	I usually demand very good practical reasons before I am willing to change my old ways of doing things.	-.166	.256	.042	.098
13	NS4	I like it when people can do whatever they want without strict rules and regulations.	-.078	.287	.042	-.161
28	NS4	I lose my temper more quickly than most people.	.268	-.077	.048	-.113
50	NS2	I often have to change my decisions because I had a wrong hunch or mistaken first impression.	.272	.228	.037	-.203
65	NS4	I have trouble telling a lie, even when it is meant to spare someone else's feelings.	.018	.207	-.005	-.128
76	NS3	Some people think I am too stingy or tight with my money.	-.116	.278	.188	.035
85	NS1	I like old "tried and true" ways of doing things much better than trying "new and improved" ways.	-.269	.146	.126	-.007
93	NS1	In conversations I am much better as a listener than as a talker.	-.121	.109	.273	-.164
96	NS1	I like to stay at home better than to travel or explore new places.	-.242	.026	.188	-.037
6	RD3	I don't mind discussing my personal problems with people whom I have known briefly or slightly.	.105	.065	.233	-.230
25	RD4	I don't care very much whether other people like me or the way I do things.	.124	.005	.221	.219
27	RD1	I feel it is more important to be sympathetic and understanding of other people then to be practical and tough-minded.	.071	.045	.244	.110
52	RD2	I am satisfied with my accomplishments, and have little desire to do better.	.031	-.060	.088	.114
53	RD2	I see no point in continuing to work on something unless there is a good chance of success.	-.137	-.167	.168	.008
67	RD3	Even after there are problems in a friendship, I nearly always try to keep it going anyway.	-.045	-.086	.174	-.081
77	RD2	I often keep trying the same thing over and over again, even when I have not had much success in a long time.	-.035	-.142	-.003	-.278
94	RD1	I like to please other people as much as I can.	.152	-.085	.236	-.012

The range of loadings is between .301 and .694. There are a number of themes. The first with the highest loadings relates to openness with friends: RD3 88 - *Even when I am with friends, I prefer not to "open up" very much* and RD1 31- *People find it easy to come to be for help, sympathy, and warm understanding.* The second theme, although there are questions as in factor 3 in the 3-factor solution relating to a preference to be around others for instance: RD3 15 - *It wouldn't bother me to be alone all the time,* could be described as tough mindedness. This latter theme could be characterised by the following items: RD4 36 - *I have a reputation as someone who is very practical and does not act on emotion*; RD4 58 – *I don't go out of my way to please other people*; and RD1 34 - *I am strongly moved by sentimental appeals (like when asked to help crippled children).* The factor overall therefore seems to correspond to the individuals response to others. About being able to understand how others feel and be responsive to this and about feeling and acting on emotion. Overall it could be called tough mindedness.

Factor 4 (Impulsiveness-4FS-TPQ) has a mix of predominantly Novelty Seeking and Harm Avoidance with 3 Reward Dependence items. Although the items are again from a range of scales they seem to tap into a similar theme. The loadings range between .303 and .473. The items appear to relate to searching for new ideas and thrills: NS1 2 - *I often try new things just for fun or thrills, even if most people think it is a waste of time* and NS2 48 - *I often follow my instincts, hunches, or intuition without thinking through all the details.* Also the person does not seem to tire or wish to rest: HA4 75 -

I usually feel much more confident and energetic than most people, even after minor illnesses or stress and HA4 59 - *I am more energetic and tire less quickly than most people.* The overall factor could be described as risk taking or impulsiveness.

10.2.10 Summary of the TPQ – 4 factor solution

The four-factor solution does not produce the personality traits which Cloninger proposed. In fact the only factor that comes through is Factor one which resembles Harm Avoidance, although in this case it may be better described as emotionality. The further three factors are a mix between the proposed scales. There do seem to be four factors emerging. Of particular interest is that Extraversion is not extracted as a single factor from the TPQ, although facets of this trait can be identified in factors 1, 2, 3 and 4. Unlike therefore the analysis from the EPQ-R there is not a single Extraversion factor. (This will be discussed in chapter 14 in more detail). In sum if a four factor solution is extracted from Cloninger's TPQ the strongest factor emerging is Emotionality.

10.3 The TPQ at the scale level

The TPQ has three higher order dimensions consisting of 12 sub scales divided equally between the second order factors. This section assesses these scales and describes an exploratory analysis of the sub scales to determine whether they do adequately represent the higher order factors presented by Cloninger.

Table 10.3.1 shows the internal consistency for each of these scales. The alphas are also given as a comparison for the whole scale. It would, of course, be expected that the reliabilities be higher for the total scales than for the sub scales. This is true with all of the reliabilities being lower than those of the total scales. All of the Harm Avoidance scales have alphas above 0.7. These are all satisfactory. However, the reliabilities for both the Novelty Seeking and Reward Dependence scales are poor. The internal consistency is so low that is unlikely that that these scales are measuring the same construct. Only the Harm Avoidance scales appear to be reliable in the sense of being internally consistent.

10.3.1 Factor analysis of the TPQ at the scale level

The Scree plot shown in figure 10.3.1 smooths off after three factors. The fourth value is below 1 therefore adding very little to the solution. Three factors were extracted using principal axis factoring of the sub scales of Harm Avoidance, Novelty Seeking and Reward Dependence. Again the distinction between an orthogonal and an oblique rotation is arbitrary. From the tables displayed above, when factors are extracted at the item level, it is clear that there is little difference between the orthogonal and the oblique rotation when the factors have small correlations between them. Table 10.3.2 displays the correlations between the three factors if rotated using Direct Oblimin. Due to these small correlations and the small number of factors an orthogonal solution would be chosen. However, in order to illustrate in Cloninger's solution and compare it to the orthogonal solution

Table 10.3.1 Internal consistencies of TPQ sub scales

Scale	Description	Males	Females
HA1 (10)	Anticipatory worry	.81	.81
HA2 (7)	Fear of uncertainty	.76	.72
HA3 (7)	Shyness with strangers	.80	.72
HA4 (10)	Fatigability	.78	.77
Total HA		.90	.89
NS1 (9)	Exploratory excitability	.51	.53
NS2 (8)	Impulsiveness	.66	.68
NS3 (7)	Extravagance	.74	.71
NS4 (10)	Disorderliness	.54	.47
Total NS		.81	.79
RD1 (5)	Sentimentality	.47	.44
RD2 (9)	Persistence	.64	.64
RD3 (11)	Attachment	.75	.76
RD4 (5)	Dependence	.39	.47
Total RD		.72	.72

Figure 10.3.1: Scree plot of factor analysis of the sub scales of the TPQ

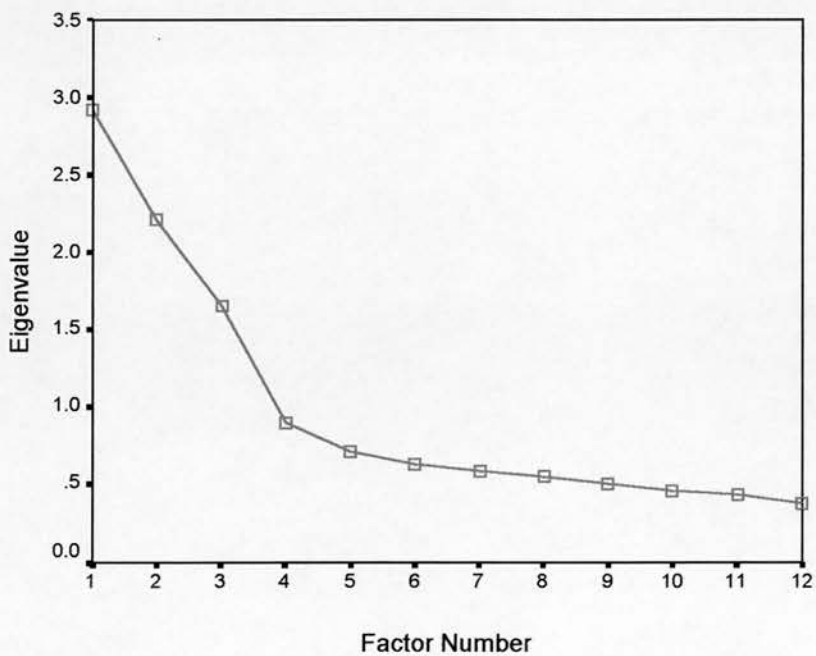


Table 10.3.2: TPQ Factor correlation matrix for a 3-factor obliquely rotated solution at the scale level

Factor	1	2	3
1	1.00		
2	-.091	1.00	
3	-.001	.134	1.00

both rotations are presented in table 10.3.3.

Factor 1 is evidently Harm Avoidance factor, with high loadings from all four of the sub scales. However, Novelty Seeking 1 does load negatively to a high degree on this factor. Cloninger (1991) suggests that this sub scale represents "exploratory excitability versus stoic rigidity". The Harm Avoidance sub scales do not load on any of the other factors.

Factor 2 is made up mainly of Novelty Seeking with all four of the sub scales having loadings greater than 0.3 on this factor. However, Novelty Seeking 1, loads more highly on factor 1 than on factor 2. Also Persistence (RD2) loads negatively to a moderate degree on factor 2.

Factor 3 is Reward Dependence being made up of 3 of the Reward Dependence sub scales and none of the other sub scales. In sum, Cloninger's structure is fairly well represented when exploratory factor analysis is carried out at the scale level. Three factors emerge with the highest loadings coming from the hypothesised sub scales.

10.4 Summary of Results I

In this chapter Eysenck's Personality Questionnaire-Revised and Cloninger's Tri-Dimensional Personality Questionnaire have been assessed.

Extraversion and Neuroticism from the EPQ-R both had satisfactory reliabilities (Cronbach's alpha) and were both normally distributed. They also could be extracted using exploratory factor analysis in either a 3 or 4 factor

Table 10.3.3: Structure matrix for three factor solution of the TPQ at the scale level

		Oblique Rotation			Orthogonal Rotation			Comm unality
Scale	**Description**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 1**	**Factor 2**	**Factor 3**	
HA1	Anticipatory worry	**.719**	-.028	.135	**.719**	-.008	.141	.448
HA2	Fear of uncertainty	**.748**	-.189	.146	**.740**	-.170	.164	.463
HA3	Shyness with strangers	**.680**	-.105	-.201	**.678**	-.067	-.192	.396
HA4	Fatigability	**.604**	.135	.072	**.613**	.156	.065	.334
NS1	Exploratory excitability	**-.501**	**.379**	.237	**-.484**	**.349**	.208	.341
NS2	Impulsiveness	-.136	**.646**	.091	-.106	**.641**	.042	.297
NS3	Extravagance	-.047	**.616**	.285	-.016	**.603**	.240	.293
NS4	Disorderliness	-.189	**.655**	.078	-.156	**.649**	.029	.323
RD1	Sentimentality	.007	-.019	**.645**	-.003	-.058	**.651**	.261
RD2	Persistence	-.010	**-.372**	.056	.119	**-.382**	.084	.176
RD3	Attachment	-.115	.159	**.664**	.111	.115	**.657**	.284
RD4	Dependence	.175	.102	**.518**	.179	.079	**.515**	.246

solution. These two personality dimensions seem robust and replicable in this data set. However, Eysenck's third factor Psychoticism falls short of the statistical demands placed on a trait measure of personality. The Cronbach alpha value in women falls short of satisfactory with a value of 0.68. If the items are scrutinised further it is found that the response profile for many of the Psychoticism items were skewed. Subjects were not scoring on specific items. Thus meaning that the scale itself had many poor items. Finally Psychoticism could not be extracted satisfactorily either using a 3-factor solution as originally suggested by Eysenck or a 4-factor solution. One of Eysenck's other assumptions was that the scales were orthogonal and would therefore not correlate. This was not the case with small to moderate correlations occurring between the scales and notably small to moderate negative correlations between Extraversion and Neuroticism.

The scales of the TPQ all had satisfactory alpha reliabilities, were normally distributed and there were only small correlations between the scales. At the scale level it was clear that three factors could be extracted and loadings were high from the proposed scales. However, on closer scrutiny problems arose when extracting the dimensions at the item level as proposed by Cloninger. The Scree plot (figure 10.2.2) distinctly shows a four-factor solution – however a both 3 factor and 4 factor were extracted in order to gauge Cloninger's model. One factor was robust. This was Harm Avoidance. Although, in the 3-factor solution, Novelty Seeking and Reward Dependence did come out as the second and third factors the loadings were not as high as may have been expected and many of the proposed items did not load on the proposed scales.

When a four-factor model was extracted at the item level again only Harm Avoidance could be extracted, which may be better described in this analysis as emotionality. Cloninger's proposed traits of Novelty Seeking and Reward Dependence did not emerge. Three further factors emerged from the four-factor analysis. These factors could represent traits such as Impulsivity, Openness and Risk Taking. Chapter 11 will investigate further factors which may emerge when both Cloninger's and Eysenck's questionnaires are analysed together.

In sum, in this data set, three of the scales appear to be robust, Extraversion, Neuroticism and Harm Avoidance.

The overall aim of the thesis is to show that Neuroticism is a predictor of mood change via tryptophan depletion. It was essential to establish that Neuroticism could be extracted satisfactorily in this data set from the EPQ-R. Furthermore as Extraversion also shows correlations with mood (see Chapter 3) it was also necessary to show the robustness of this scale. Cloninger (1987) proposed that Harm Avoidance is related to serotonergic function therefore it was also important to establish that this scale could be extracted from the TPQ. Although the evidence relating Harm Avoidance and serotonin is not convincing (see Chapter 6), it is necessary to compare Neuroticism with this scale. The next chapter assesses the relationships between the EPQ-R and the TPQ.

Chapter Eleven Results II: Correspondence between Eysenck's EPQ-R and Cloninger's TPQ

There are a number of aims of this chapter. One aim is to illustrate the degree to which Eysenck's and Cloninger's scales interrelate. Of particular interest is in the correspondence between Harm Avoidance and Neuroticism. This is of importance to this thesis as volunteers were chosen for the tryptophan depletion part of the project by their Neuroticism scores. However, it is Cloninger who proposes that the personality trait of Harm Avoidance is directly related to the monoamine system. Therefore, one of the main aims of this chapter is to ascertain how these two scales correspond. A further aim is to identify which factors summarise the questionnaires at both an item and a scale level. This will give further insight into the structure of personality and how the two questionnaires correspond.

An expectation therefore is that Harm Avoidance and Neuroticism will correlate highly and that that they will explain much of the same variance. This can be assessed firstly by simple correlation (section 11.1) and secondly by stepwise regression (section 11.2).

The relationships between the personality scales can be investigated further by describing the factors, which arise when the TPQ and EPQ-R are combined in a factor analysis. The hypothesis is that an emotionality factor highly related to Neuroticism will be able to be extracted at every level of

analysis. Factor analysis can be performed at both the scale level and at the item level (sections 11.3 and 11.4).

The factor analyses: assess correspondence between the proposed scales of Eysenck and Cloninger (analysis at the scale level); explore which factors best describe the questionnaires when combined (analysis at both the scale and item level); and assess correspondence between the scales at the item level by identifying which items load together (analysis at the item level only).

11.1 Correlations between the scales of the EPQ-R and TPQ

The pattern of correlations between the two questionnaires is roughly similar between males and females (see tables 11.1.1 and 11.1.2). The pattern of intercorrelations is not a simple one with nearly every scale from one questionnaire being explained by two scales from the other questionnaire. The largest correlations are between Neuroticism and Harm Avoidance, in both males and females (r=.68 and .64 respectively). These are high correlations and suggest a great deal of overlap between the two scales. The two scales of Neuroticism and Harm Avoidance, although not equivalent, will explain much of the same variance.

Harm Avoidance also seems to be explained by Extraversion, as there are large negative correlations between these two scales. Novelty Seeking positively correlates to a high degree with Extraversion (r=.41, r=.53), Psychoticism (r=.51, r=.40) and negatively with the Lie scale (r=-.40, r=-.34). Reward Dependence positively correlates with Extraversion (r=.38, r=.34)

Table 11.1.1: Correlations between the EPQ-R and TPQ scales for men (n=347)

(correlations are Spearman's rho)

	Novelty Seeking	Harm Avoidance	Reward Dependence
Extraversion	.41**	-.60**	.38**
Neuroticism	-.05	.68**	.11 *
Psychoticism	.51**	-.03	-.23**
Lie	-.40**	-.03	.11 *

* p<.05; **p<.01

Table 11.1.2: Correlations between the EPQ-R and TPQ and women (n=550)

(correlations are Spearman's rho)

	Novelty Seeking	Harm Avoidance	Reward Dependence
Extraversion	.53**	-.56**	.34**
Neuroticism	.03	.64**	.15**
Psychoticism	.40**	-.04	-.27**
Lie	-.34**	-.07	-.01

* p<.05; **p<.01

and negatively with Psychoticism (r=-.23, r=-.27). All of Cloninger's scales appear to have substantial amounts of variance accounted for by at least two of Eysenck's scales.

Neuroticism has one large correlation with Harm Avoidance, a small positive correlation with Reward Dependence and does not correlate highly with other scales. Extraversion correlates with all three of Cloninger's scales, positively with Novelty Seeking and Reward Dependence but negatively with Harm Avoidance. Psychoticism correlates positively with Novelty Seeking and negatively with Reward Dependence.

Correlations alone do not seem to explain adequately the correspondence between the scales of the questionnaires. All three of the TPQ scales have

substantial amounts of variance explained by more than one of the EPQ-R scales. Harm Avoidance has high correlations with both Neuroticism and Extraversion. These scales (Neuroticism and Extraversion) correlate between themselves. The question is how do these scales interrelate. The next section describes stepwise regression between the EPQ-R and TPQ scales.

11.2 Stepwise regression of the EPQ-R and TPQ scales

Correlations have allowed us to look at the relationships between two variables. The purpose of multiple regression is to determine if a particular scale, for instance, Harm Avoidance, can be better predicted by a combination of other scales, for instance, Neuroticism and Extraversion. The question in this section is how do the two questionnaires interrelate – therefore, for instance how a scale from the TPQ can be predicted by a scale or scales from the EPQ-R.

There are numerous different selection methods for multiple regression. In this case stepwise was chosen. At each "step" a variable is entered and then the next and the next and so on. The first step involves the variable with the highest correlation with the criterion. The next variable is added and the equation is tested to ascertain whether the addition of a second variable adds significantly. This is continued until the addition of further variables produces no significant improvement. If two variables (a and b) are highly correlated it is likely that they will explain the same variance (this is shown in relation to

mood in chapter 12). Therefore if variable a is entered much of the variance that variable b explains is also entered.

A stumbling block may be which variables to enter. Common sense takes over at this point. Only scales of a theoretical interest should be included as independent variables. Those scales that have negligible correlations with the dependent variable would be of no interest. Often one of the criticisms of stepwise regression is precisely this point concerning the independent variables. However, it must be made clear at this point, the main aim of this analysis is to determine how much of one scale can be predicted by another without other variables being entered into the equation. A second aim is determine the predictive power of, for instance, the EPQ-R scales in predicting Harm Avoidance. Therefore the main outcome which is gained from this analysis is how predictive one scale is of another. A second outcome is to determine the relationships between the scales. For instance tables 11.1.1 and 11.1.2 describe the correlations between Extraversion, Neuroticism and Harm Avoidance. Stepwise regression analysis will allow for the relationships between these three scales to be explored.

Although of key interest are the relationships between Harm Avoidance and Neuroticism all the scales will be investigated at this point, in order to illuminate the relationships between the personality scales.

11.2.1 TPQ scales as the dependent variables in multiple linear stepwise regression

Harm Avoidance correlates highly with Neuroticism and Extraversion with almost negligible correlations with Psychotism and Lie. Table 10.1 shows that Neuroticism and Extraversion also correlate with each other. The question here is how much do these scales play a role in describing Harm Avoidance. In multiple stepwise linear regression analysis Harm Avoidance is entered as the dependent variable with Neuroticism and Extraversion as the independents.

Both of these variables significantly predicted Harm Avoidance in both males and females. Neuroticism explains most of the variance (approximately 46% in males and 42% in females), with Extraversion significantly adding to the model when Neuroticism was removed from the equation ($F_{(1, 344)}$=163.67, $p<.001$ in men, $F_{(1, 548)}$=263.33, $p<.001$ in women). The regression equation describes how much of the variance both variables explain together and how much variance Extraversion explains on its own when Neuroticism is factored out. In males the two variables predict approximately 63% of the variance and in females 61% (tables 11.2.1 and 11.2.2). Extraversion explains a further 18% of the variance in males and 19% in females when Neuroticism is partialled out.

The standardised β weights are the slope coefficients for standardised data. These weights give an indication of the relative influence of each of the

variables in the equation. These indicate in men and for standardised data that a unit change in Neuroticism will lead to a 0.546 increase in Harm Avoidance and that unit change in Extraversion would lead to a 0.438 decrease in Harm Avoidance. This pattern is similar in women.

Part correlations or also called semi-partial correlations can be calculated, these show the correlation between the criterion and a partialled predictor variable. The relationships are described in figures 11.2.1 and 11.2.2 and in table 11.2.3. The part correlations in table 11.2.3 are the correlation that Neuroticism has with Harm Avoidance with Extraversion partialled out, and the correlation that Extraversion has with Harm Avoidance with Neuroticism partialled out.

The figures (11.2.1 and 11.2.2) show the percentage of variance of Harm Avoidance that Neuroticism explains alone, that Extraversion explains alone, and the percentage explained by the overlap between the Neuroticism and Extraversion. This pattern is roughly is similar in men and women, however in women there is less overlap between Neuroticism and Extraversion with Harm Avoidance (18.9% Vs 11.9%).

In sum, Neuroticism and Extraversion can explain approximately 60% of the variance in Harm Avoidance. The best predictor of Harm Avoidance is Neuroticism, explaining over 40% of the variance.

Table 11.2.1 Stepwise linear regression of Neuroticism and Extraversion on Harm Avoidance in males (n=347) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.456	.454	.456	<.001	.546
EPQE	.631	.629	.175	<.001	-.438

Table 11.2.2 Stepwise linear regression of Neuroticism and Extraversion on Harm Avoidance in females (n=550) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.415	.414	.415	<.001	.555
EPQE	.605	.603	.190	<.001	-.445

Table 11.2.3 Zero order and part correlations of Neuroticism and Extraversion with Harm Avoidance

	Men		Women	
	Correlation with HA	Part Correlation	Correlation with HA	Part Correlation
Neuroticism	.675	.521	.644	.544
Extraversion	-.600	-.419	-.556	-.436

Figure 11.2.1 Percentage variance explained of Harm Avoidance by Neuroticism and Extraversion in men (n=347)

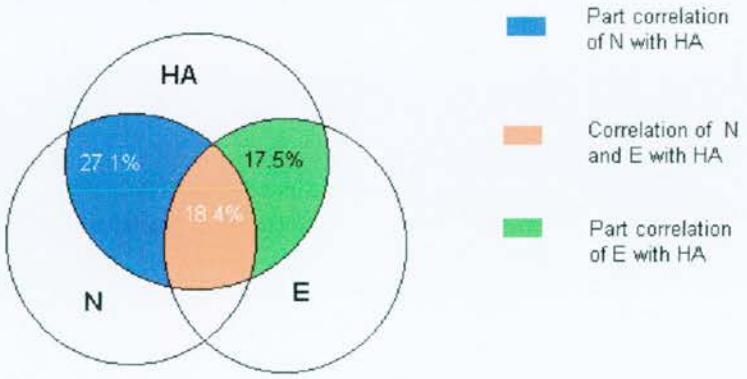
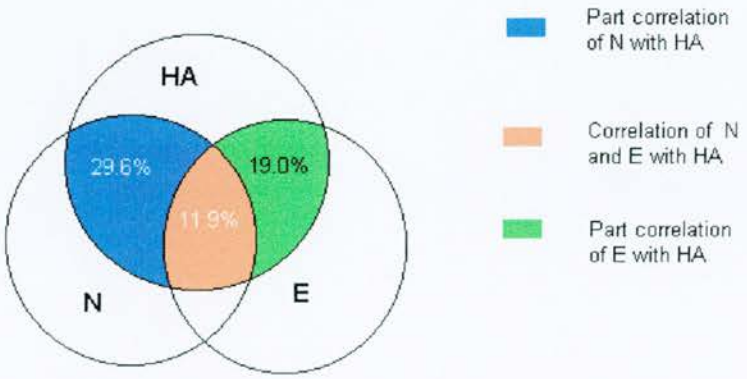


Figure 11.2.2 Percentage variance explained of Harm Avoidance by Neuroticism and Extraversion in women (n=550)



Novelty Seeking correlates significantly with two of the scales from the EPQ-R, namely, Extraversion (0.41 in men, 0.53 in women) and Psychoticism (0.51 in men, 0.40 in women). Although the correlations themselves do not

differ to a great extent the pattern is different in males and females, with the highest correlation being with Psychoticism in men, and with Extraversion in women. This pattern is mirrored in the regression equations with Psychoticism being the best predictor of Novelty Seeking in men and Extraversion being the best predictor of Novelty Seeking in women (Tables 11.2.4 and 11.2.5 respectively). The two scales together explain approximately 40% of the variance in Novelty Seeking in both males and females.

The standardised β weights show these relationships clearly with the standardised equation in men reading:

TPQNS = .482 EPQP + .372 EPQE + c

and in women:

TPQNS = .362 EPQP + .509 EPQE + c

c is the constant

In men a standardised unit change in Extraversion has a corresponding 0.372 change in Novelty Seeking in women there would be a 0.509 change in Novelty Seeking.

This relationship can be seen more clearly when the part correlations are examined (see Table 11.2.6). In men Psychoticism with Extraversion partialled out explains 23.1% of the variance. Extraversion with Psychoticism partialled out explains 13.8%. Although both Extraversion and Psychoticism

Table 11.2.4 Stepwise linear regression of Psychoticism and Extraversion on Novelty Seeking in males (n=347) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQP	.263	.261	.263	<.001	.482
EPQE	.401	.397	.137	<.001	.372

Table 11.2.5 Stepwise linear regression of Extraversion and Psychoticism on Novelty Seeking in females (n=550) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQE	.286	.284	.286	<.001	.509
EPQP	.416	.414	.131	<.001	.362

Table 11.2.6 Zero order and part correlations of Psychoticism and Extraversion with Novelty Seeking

	Men		Women	
	Correlation with NS	Part Correlation	Correlation with NS	Part Correlation
Psychoticism	.513	.481	.397	.362
Extraversion	.412	.371	.534	.508

add significantly to the model explaining Novelty Seeking there is very little overlap between the two scales, approximately 3% (see Figures 11.2.3 and 11.2.4).

In women Extraversion with Psychoticism partialled out explains 25.8% of the variance, while Psychoticism with Extraversion partialled out explains 15.8%.

Figure 11.2.3 Percentage variance explained of Novelty Seeking by Psychoticism and Extraversion in men (n=347)

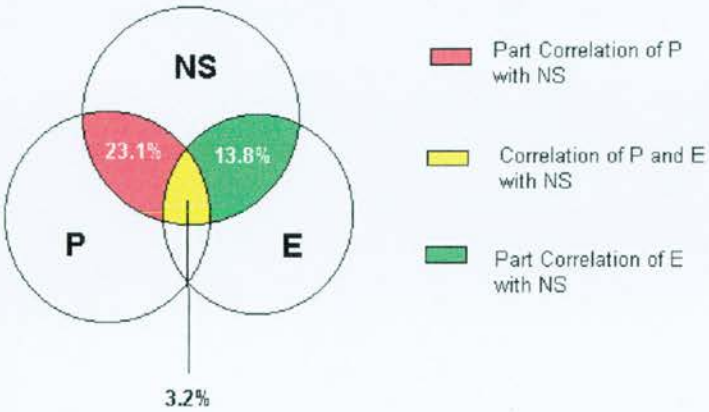
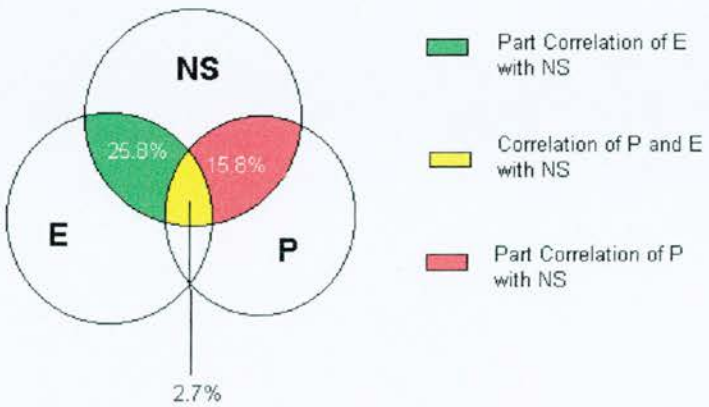


Figure 11.2.3 Percentage variance explained of Novelty Seeking by Psychoticism and Extraversion in women (n=550)



In men the best predictor of Novelty Seeking is Psychoticism explaining approximately 26% of the variance, while in women the best predictor is Extraversion explaining approximately 29% of the variance.

Reward Dependence has small to medium correlations with all three of the EPQ-R scales in both men and women, with Extraversion having a medium sized correlation in both genders. Therefore all three of these scales were entered as predictors in the stepwise regression equation. In both males and females all three scales add significantly to the regression equation explaining approximately 28% of the variance in men and 27% in women (see Tables 11.2.7 and 11.2.8). In both males and females Extraversion is the highest predictor followed by Psychoticism and then Neuroticism. In males Psychoticism with Extraversion extracted explains approximately a further 7% of the variance, and Neuroticism with both Extraversion and Psychoticism extracted explains a further 6% of the variance. In females Psychoticism with Extraversion extracted explains approximately a further 9% of the variance, and Neuroticism with both Extraversion and Psychoticism extracted explains a further 7% of the variance.

The complexity of these relationships is shown when the part correlations are examined. The part correlations are higher than those at zero order (see Table 11.2.9). The part correlation is the correlation of, for instance, Reward Dependence and Extraversion with Psychoticism and Neuroticism partialled out. Therefore it would be expected that the part correlation would have a lower value than the correlation at zero order.

Table 11.2.7 Stepwise linear regression of Extraversion, Psychoticism and Neuroticism on Reward Dependence in males (n=347) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQE	.147	.145	.147	<.001	.484
EPQP	.215	.210	.068	<.001	-.279
EPQN	.278	.272	.063	<.001	.263

Table 11.2.8 Stepwise linear regression of Extraversion, Psychoticism and Neuroticism on Reward Dependence in females (n=550) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQE	.116	114	.116	<.001	.415
EPQP	.200	.197	.085	<.001	-.325
EPQN	.267	.263	.066	<.001	.265

Table 11.2.9 Zero order and part correlations of Extraversion Psychoticism and Neuroticism with Reward Dependence

	Men		Women	
	Correlation with RD	Part Correlation	Correlation with RD	Part Correlation
Extraversion	.383	.460	.340	.405
Psychoticism	-.228	-.278	-.267	-.322
Neuroticism	.108	.251	.146	.258

This is not the case. Psychoticism and/or Neuroticism must therefore be acting as a suppressor variable or suppressor variables, where they obscure the relationship between HA and N. This is difficult to conceptualise in terms of personality dimensions and is easier in terms of performance. Howell (1997) uses the example of speed of reading, knowledge of history and performance on a speed history test. In this example speed of reading can

act as a suppressor variable, where the true relationship between knowledge of history and performance on the test is being suppressed by reading speed.

In the case above the relationships are very complicated. RD has positive correlations with both E and N; however, these two scales are negatively correlated. Reward Dependence has negative correlations with Psychoticism while both Extraversion and Neuroticism correlate positively with Psychoticism. Neuroticism and Psychoticism therefore act as suppressor variables in the relationship of Extraversion with Reward Dependence in a similar manner to speed of reading on the relationship of knowledge of history and performance on test. Further, Extraversion and Neuroticism act as suppressor variables in the relationship of Psychoticism with Reward Dependence and Extraversion and Psychoticism act as suppressor variables in the relationship of Neuroticism with Reward Dependence.

In sum, the EPQ-R scales of Neuroticism and Extraversion are good predictors of Harm Avoidance, Psychoticism and Extraversion are moderate predictors of Novelty Seeking but Reward Dependence is not well predicted by the EPQ-R scales.

11.2.2 EPQ-R scales as the dependent variables in multiple linear stepwise regression

If Neuroticism is entered as the dependent variable in the regression equation the outcome is slightly different. Again variables to enter into the equation were chosen by their correlations with the target variable. Only

Harm Avoidance and Reward Dependence had significant correlations with Neuroticism.

Tables 11.2.10 and 11.2.11 describe the linear stepwise regression of Harm Avoidance and Reward Dependence on Neuroticism in men and women respectively. Both of these personality factors play a significant role in describing Neuroticism. The two variables explain approximately 48% of Neuroticism in men and approximately 44% of the variance in women. Harm Avoidance clearly explains most of the variance (46% in men, 42% in women). The standardised β weights also support that Harm Avoidance is by far the better predictor of Neuroticism. With a unit change in Harm Avoidance being reflected by a 0.69 change on standardised Neuroticism scores in men and a 0.648 change in women.

If the part or semi-partial correlations are examined, an interesting pattern arises (see table 11.2.12). The part correlations are higher than the correlations at zero order. The part correlation is the correlation of, for instance, Harm Avoidance with Neuroticism with Reward Dependence partialled out. Therefore it would be expected that the part correlation would have a lower value than the correlation at zero order.

This is not the case. Reward Dependence must therefore be acting as a suppressor variable, where it obscures the relationship between HA and N. RD has a small positive correlation with N (0.108 and 0.146 in men and women respectively) and a very small negative correlation with HA (-0.086

Table 11.2.10 Stepwise linear regression of Harm Avoidance and Reward Dependence on Neuroticism in males (n=347) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.456	.454	.456	<.001	.690
TPQRD	.484	.484	.028	<.001	.168

Table 11.2.11 Stepwise linear regression of Harm Avoidance and Reward Dependence on Neuroticism in females (n=550) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.415	.414	.415	<.001	.648
TPQRD	.441	.439	.027	<.001	.163

Table 11.2.12 Zero order and part correlations of Harm Avoidance and Reward Dependence with Neuroticism

	Men		Women	
	Correlation with N	Part Correlation	Correlation with N	Part Correlation
Harm Avoidance	.675	.687	.644	.648
Reward Dependence	.108	.167	.146	.163

and -0.027 in men and women respectively). RD therefore acts as a suppressor variable in the relationship of HA with N.

Although RD acts as a suppressor variable it is still clear that HA is far and away the best predictor of Neuroticism explaining 46% and 42% of the variance in men and women respectively.

Extraversion correlates significantly with all three of the scales from the TPQ therefore all 3 were entered as independent variables. Interestingly, Harm Avoidance is the best predictor of Extraversion, explaining approximately 36% of the variance in Extraversion in males and approximately 31% in females (this is shown in tables 11.2.13 and 11.2.14). Further an increase in standardised Harm Avoidance scores would lead to approximately a 0.5 decline on standardised Extraversion scores in both males and females. Harm Avoidance is therefore the best predictor for both Neuroticism and Extraversion.

In males the best predictor is Harm Avoidance, followed by Reward Dependence followed by Novelty Seeking. In females the latter two switch around with Novelty Seeking taking the second position and Reward Dependence the third. However the three together in both males and females explain approximately 55% of the variance in Extraversion. Harm Avoidance explains over 30% of that variance in both males and females.

Table 11.2.15 shows the zero order and part correlations of the TPQ scales with Extraversion. This table shows more clearly the overlapping relationships between the 4 questionnaire scales. In women, but not in men Novelty Seeking is a close second in predicting the variance in Extraversion.

Psychoticism has significant correlations with Novelty Seeking and Reward Dependence. These two scales were therefore entered as independent variables in the regression equation. The two scales only predict 32% of the

Table 11.2.13 Stepwise linear regression of Harm Avoidance, Reward Dependence and

Novelty Seeking on Extraversion in males (n=347) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.359	.358	.359	<.001	-.508
TPQRD	.470	.467	.111	<.001	.330
TPQNS	.551	.547	.080	<.001	.290

Table 11.2.14 Stepwise linear regression of Harm Avoidance, Novelty Seeking and Reward Dependence on Extraversion in females (n=550) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.309	.308	.309	<.001	-.459
TPQNS	.489	.484	.177	<.001	.398
TPQRD	.563	.561	.077	<.001	.279

Table 11.2.15 Zero order and part correlations of Harm Avoidance, Reward Dependence and Novelty Seeking with Extraversion

	Men		Women	
	Correlation with E	Part Correlation	Correlation with E	Part Correlation
Harm Avoidance	-.600	-.494	-.556	-.448
Reward Dependence	.383	.328	.340	.277
Novelty Seeking	.412	.283	.534	.385

variance in Psychoticism in men and in women only 26% of the variance, with Novelty Seeking being the better predictor (tables 11.2.16 and 11.2.17).

Table 11.2.16 Stepwise linear regression of Novelty Seeking and Reward Dependence on Psychoticism in males (n=347) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQNS	.263	.261	263	<.001	.522
TPQRD	.324	.320	.061	<.001	-.246

Table 11.2.17 Stepwise linear regression of Novelty Seeking and Reward Dependence on Psychoticism in females (n=550) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQNS	.158	.156	.158	<.001	.436
TPQRD	.259	.256	.101	<.001	-.320

Table 11.2.18 Zero order and part correlations of Harm Avoidance, Reward Dependence and Novelty Seeking with Neuroticism

	Men		Women	
	Correlation with P	Part Correlation	Correlation with P	Part Correlation
Novelty Seeking	.513	-.522	.397	.433
Reward Dependence	-.228	-.246	-.267	-.318

The relationships between these scales are also not simple with the part correlations exceeding the zero correlations. Again Reward Dependence must be acting as a suppressor variable in the relationship of Novelty Seeking with Psychoticism, and indeed, Novelty Seeking as a suppressor in the relationship of Psychoticism with Reward Dependence.

11.2.3 Summary of regression analysis

Although regression analysis gives a clearer picture of the relationships between the two sets of personality scales, these are not simple. Neuroticism is the best predictor of Harm Avoidance explaining 46% of the variance in men and 42% in women. However, a substantial part of this scale is also explained by Extraversion. The two scales together explain over 60% of the variance. Neuroticism, on the other hand, is almost solely predicted by Harm Avoidance with Reward Dependence only adding 3% in men and 2% in women.

Extraversion is well predicted by the TPQ scales. All three scales together predict 55% of the variance in men and 56% of the variance in women. Unsurprisingly, it is Harm Avoidance that explains the most variance, 36% in men and 31% in women.

Novelty Seeking is well predicted by Psychoticism and Extraversion with the two scales together explaining approximately 40% of the variance. Reward Dependence and Psychoticism do not seem to correspond as highly with other scales with approximately 30% of their variance being explained.

The regression analysis shows which scales are the most predictive. The correlation analysis shows some of this picture but the regression analysis gives the weights of each variable. Furthermore from the part correlations pictures can be drawn to show the more complex relationships between the variables. From the correlation analysis it would appear that Extraversion

and Neuroticism almost equally predict Harm Avoidance. However it is Neuroticism which is the best predictor of Harm Avoidance with Extraversion playing a large role. The part correlations show how these three scales overlap. In sum, Harm Avoidance appears to be made up of principally Neuroticism with some Extraversion and Neuroticism has a high relationship solely with Harm Avoidance.

11.3 Factor analysis of the EPQ-R and TPQ combined at the scale level

The third way to ascertain the correspondence between the EPQ-R and the TPQ is by factor analysis. This can be performed at both the scale and the item level. The aim of this analysis it to investigate which factors emerge and in particular whether Neuroticism and Harm Avoidance factor together. The Lie scale was omitted, as also was the case in the analysis in chapter 10. Lie items were originally included as a control and are not theoretically related to the factors of the EPQ-R.

A Scree plot of eigen-values is shown in Figure 11.3.1. There is a clear jump after 3 factors following which the plot straightens out. These three factors also all have eigen-values above 1.

Principal axis factoring of Extraversion, Neuroticism and Psychoticism from the EPQ-R, and Harm Avoidance, Novelty Seeking and Reward Dependence from the TPQ was carried out. Again the decision of orthogonal or oblique is an arbitrary one. In order to aid with this decision an oblique rotation was carried out and the factor correlation matrix examined. This is presented in

Figure 11.3.1: Scree plot of EPQ-R and TPQ scales

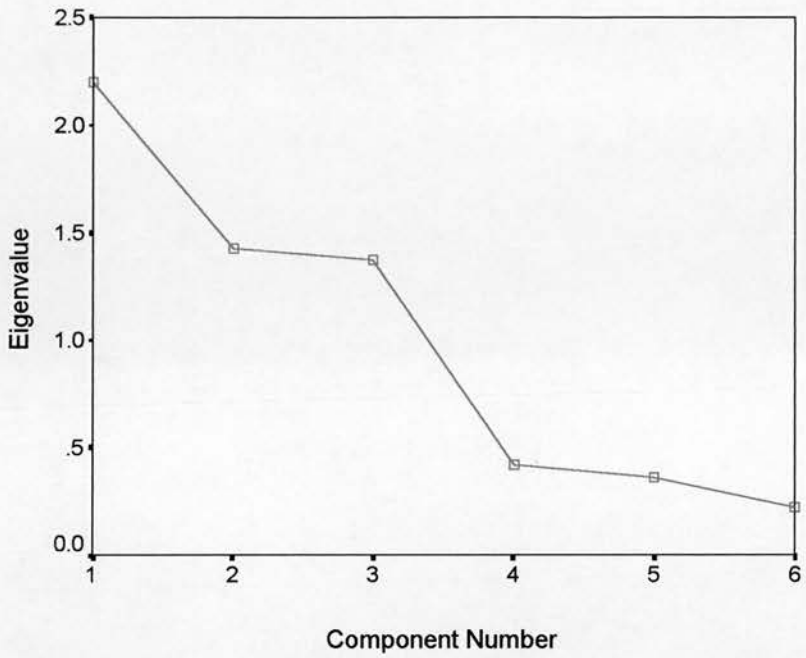


table 11.3.1. The correlations between the factors are small to negligible, thereby suggesting that an orthogonal rotation is more suitable. Only an orthogonal rotation will be discussed but in order to show the similarity between the solutions the oblique solution is presented in Appendix IV.

An orthogonal 3 factor solution is presented in table 11.3.2. The loadings at the scale level are obviously much higher than loadings seen in the previous chapter at the item level. This is because the scales are aggregate measures. The table shows a range of significant loadings where each factor is explained by a number of different scales.

Table 11.3.1: Factor correlation matrix for 3 factor obliquely rotated solution for the EPQ and TPQ scales combined

Factor	1	2	3
1	1.00		
2	.184	1.00	
3	.095	.061	1.00

Table 11.3.2: Three Factor orthogonally rotated solution of a scale level analysis of the EPQ-R and TPQ combined

Scale	Factor 1	Factor 2	Factor 3	Communality
Extraversion	**-.443**	**.414**	**.643**	.558
Neuroticism	**.794**	.066	.134	.505
Psychoticism	.018	**.720**	**-.337**	.322
Novelty Seeking	-.092	**.718**	.218	.411
Harm Avoidance	**.881**	-.178	-.146	.627
Reward Dependence	.102	-.100	**.687**	.308

High Harm Avoidance, high Neuroticism and low Extraversion comprise factor 1. Both Harm Avoidance and Neuroticism load very highly on this factor and do not load on either factor 2 or factor 3. Extraversion loads to a lesser degree. This may be described as an emotionality factor.

Factor 2 is made up of Psychoticism and Novelty Seeking with some Extraversion. It has a high loading from Psychoticism (.720), a high loading from Novelty Seeking (.718) and a moderate loading from Extraversion (.414). All of these loadings are positive. It is a difficult factor to interpret. It could represent an Openness factor. This would incorporate openness to new experiences and ideas, as well as to social relations.

Factor 3 has a high loading from Reward Dependence (.687), a high loading from Extraversion (.643), and a moderate negative loading from Psychoticism

(-.363). This would appear to represent relationships with other people. The need to be around others and the wish to be accepted by them. It could be called Socialness.

Interestingly Extraversion loads on all three factors but the TPQ scales only load on one factor each, and all have high loadings. The Harm Avoidance scale on factor 1, Novelty Seeking on factor 2, and Reward Dependence on factor 3.

The matrix is approaching Thurstone's simple structure ((Thurstone, 1931), the essentials of which are simplified by (Child, 1990)). There are a number of requirements for a matrix to reach simple structure. Simple structure in essence maximises the number of high and low loadings while minimising the number of moderate loadings. There are a number of criteria to reach simple structure such as:

1) Each variable should contain at least one zero loading. A zero loading is one which is not statistically significant. Loadings are in this case correlations, therefore a small loading is 0.1 and above and a negligible loading is below 0.1. A significant loading is taken to be one above 0.3. Only Extraversion has loadings above 0.3 on all three factors, and only Reward Dependence has small loadings or above on the factors. RD has one large loading on factor 3 and 2 small loadings. Therefore only Extraversion does not satisfy this requirement.

2) There should be the same number of zero loadings in each factor as the number of factors. There are 3 factors and each factor has three loadings less than 0.3.

3) Factors should not show the same pattern of loadings, meaning that if variables have a significant loading in for instance factor 1, there should be zero loadings in factor 2. This is mainly true of this solution, only Extraversion loads on all three factors and Psychoticism has a high loading on factor 2 and a moderate loading on factor 3.

Simple structure makes a matrix easier to interpret as a factor has high loadings from some variables and low loadings from others. Each factor seems to consist of two major variables with a third factor loading to a moderate extent.

At the scale level a combined analysis of the scales from the EPQ-R and the TPQ produces a solution with three factors. The first, an Emotionality factor, consists of Harm Avoidance, Neuroticism and some Extraversion. Neuroticism and Harm Avoidance do not show significant loadings on any other factor. This analysis therefore shows the correspondence between these two scales. Furthermore that they both relate solely to Emotionality. The second factor appears to represent Openness. This factor mainly comprises Psychoticism and Novelty Seeking with a moderate loading from Extraversion. The third appears to relate to Socialness, involving loadings from Extraversion, Reward Dependence and Psychoticism. Interestingly Extraversion loads on all three factors. Further description of the

correspondence between the EPQ-R and the TPQ is available at the item level of analysis.

11.4 Item Analysis of the TPQ and EPQ-R

Three factors can be extracted at the scale level with Harm Avoidance and Neuroticism both loading highly on the same factor. An item level analysis of the two scales was carried out to further gain insight into the correspondence between the questionnaires. Furthermore investigation into the structure of personality can also be carried out. There are a number of personality models which propose different numbers of factors (see Chapter 1). For instance Eysenck proposed 3 factors, Costa and McCrae proposed 5 factors. It is interesting therefore to also assess the number of factors as well as their description from this item analysis.

A Scree slope was drawn to determine the number of factors to extract (see figure 11.4.1). There are a number of natural breaks in the slope. In order to aid with the decision of the number of factor to extract the percentage variance explained by the first 6 components is shown in Table 11.4.1. As always the first factor explains the most variance, the second factor the second most and so on. The first two factors clearly explain most of the variance with factor 3 adding very little. However, factor 4 and factor 5 add approximately the same amount of variance each with factor 6 adding a negligible amount. The values may seem very small, this is because each item has an amount of error variance attached thereby decreasing the

Figure 11.4.1: Scree plot of EPQ-R and TPQ items

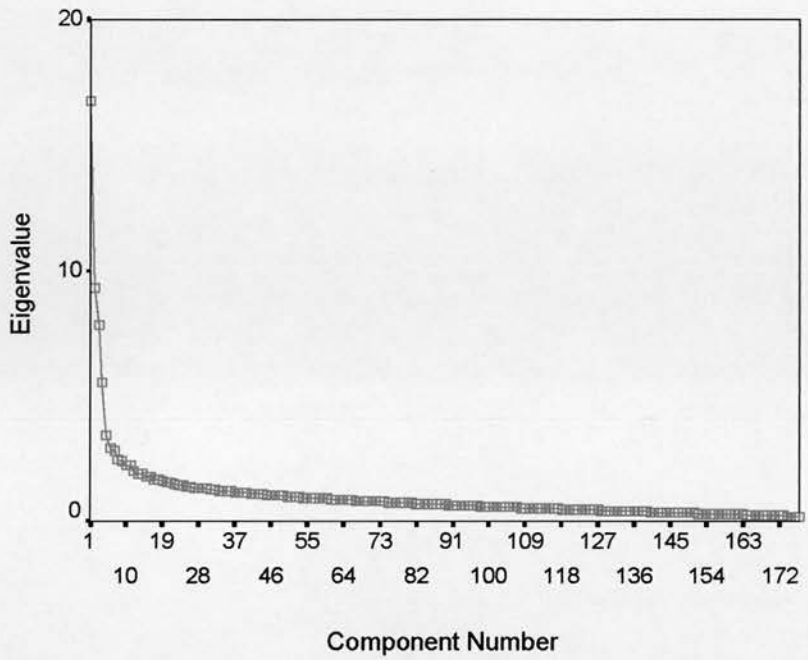


Table 11.4.1: Percentage variance explained by the first 6 components from an analysis of the EPQ-R and TPQ items

Component	% variance	Difference in Variance
1	9.46	
2	5.26	4.16
3	4.43	0.84
4	3.13	1.3
5	1.94	1.19
6	1.65	0.29

explained variance. When these are aggregated into factors the values increase greatly. There is a definite break after the fourth factor, however, the number of factors to be extracted can be an arbitrary decision therefore 3, 4 and 5 factor solutions will be tested. If all factors with an eigen-value greater than 1 were extracted, the solution would contain 15 factors. However, if 15 factors are extracted, four of the factors contain less than 5

items with loadings above 0.3. A factor such as this is unlikely to be robust.

Furthermore it is unlikely that it will meaningfully summarise the data. The decision of how many factors to extract must result in a sensible solution. The solution should contain factors which adequately summarise the data and which will fulfil psychometric criteria. Therefore as personality models have been proposed which contain 3, 4 or 5 factors, it is interesting to assess a three factor, a four factor and a five factor solution.

When a five factor solution is assessed, the fifth factor has only 5 loadings at 0.3 and above with the highest loading at 0.334 and one of the items loading on another factor. This is clearly not a true factor, therefore a 5 factor solution will not be presented. The fifth factor is where the slope straightens out therefore perhaps it is no surprise that the fifth factor is not a true factor.

The second question is which rotation to use - whether an oblique or orthogonal. Again the correlations between the factors are small, therefore in all cases an orthogonal rotation is presented. Also principal axis factoring rather than principal component analysis will be used to extract the factors in order to take into account error variance.

Tables 11.4.2 and 11.4.3 show a 4 and 3 factor solution respectively. In order to make the factors clearer, the loadings are presented in order of size. Only items which had loadings greater than 0.3 are presented. The initial communalities are available in Appendix IV.

11.4.1 Four Factor Solution of the EPQ-R and TPQ combined

Four factors can be extracted and each factor has a range of loadings from different items (see Table 11.4.2). The table shows the items which load significantly on the factors in order of loading, from the highest loading to the lowest. A total of 177 items were analysed, this consists of 23 Extraversion, 24 Neuroticism, 32 Psychoticism, 34 Novelty Seeking, 34 Harm Avoidance and 30 Reward Dependence items. Any items which do not achieve a loading of 0.3 or above on any factor were not included in the table. A total of 119 items are included within the table and a total of 58 items do not load above 0.3 on any of the factors.

The four factors seemed to represent Emotionality, Sociability, Conscientiousness and Risk Taking. As a number of these factors have been extracted in earlier analyses they will be called represent Emotionality-4C, Sociability-4C, Conscientiousness-4C and Risk Taking-4C.

Factor 1 is predominantly made up from Neuroticism and Harm Avoidance items. 23 of the 24 Neuroticism items load on this Emotionality factor. None of the Neuroticism items load on any other factor and only one does not load, N52 (*Do you worry about your health?*). 18 out of the 34 Harm Avoidance items have their highest loadings on Emotionality-4C, 16 of these having significant loadings solely on this factor. One of the items also loads on Risk Taking-4C. The highest loadings from this scale are from the sub-scales of "anticipatory worry" and "fear of uncertainty". Emotionality-4C also consists of two Reward Dependence items and two Novelty Seeking item.

Table 11.4.2: Orthogonal rotation of a 4-factor solution for the EPQ-R and TPQ combined

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
38	N	Are you a worrier?	**.627**	-.014	-.146	-.158
23	HA2	I often feel tense and worried in unfamiliar situations, even when others feel there is no danger at all.	**.620**	-.192	-.059	-.115
19	HA2	I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about.	**.601**	-.239	-.047	-.152
5	HA1	Usually I am more worried than most people that something might go wrong in the future.	**.598**	-.098	-.141	-.090
18	HA2	I usually feel tense and worried when I have to do something new and unfamiliar.	**.559**	-.200	-.071	-.209
22	N	Are your feelings easily hurt?	**.554**	.111	-.125	-.109
73	HA4	It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense, tired or worried.	**.536**	-.175	-.079	-.009
79	RD2	I seldom let myself get upset or frustrated: when things don't work out, I simply move on to other activities.	**.532**	.032	-.089	-.144
43	N	Do you worry about awful things that might happen?	**.526**	.044	-.084	-.044
26	N	Do you often feel 'fed-up'?	**.521**	-.121	.074	.069
84	N	Do you often feel lonely?	**.520**	-.196	.007	.080
35	N	Would you call yourself a nervous person?	**.517**	-.208	-.073	-.147
8	HA1	I nearly always stay relaxed and carefree, even when nearly everyone else is fearful.	**.512**	-.044	-.041	-.259
84	HA1	If I am embarrassed or humiliated, I get over it very quickly.	**.511**	-.093	-.097	-.239
46	N	Would you call yourself tense or 'highly-strung'?	**.501**	-.090	-.031	.052
1	HA1	I usually am confident that everything will go well, even in situations that worry most people.	**.496**	-.108	-.040	**-.328**
31	N	Are you often troubled about feelings of guilt?	**.493**	.014	.015	.072
91	HA1	I never worry about terrible things that might happen in the future.	**.492**	.108	-.046	-.125
65	N	Have you often felt listless and tired for no reason?	**.486**	-.042	.119	.025
3	N	Does your mood often go up and down?	**.483**	-.027	.028	.112
10	HA1	I often have to stop what I am doing because I start worrying about what might go wrong.	**.473**	-.111	-.017	.002
80	N	Do you worry too long after an embarrassing experience?	**.466**	-.044	-.092	-.143
8	N	Do you ever feel 'just miserable' for no reason?	**.465**	-.018	.015	.009
87	N	Are you easily hurt when people find fault with you or the work you do?	**.465**	.086	-.196	-.064
83	N	Do you suffer from 'nerves'?	**.461**	-.047	-.002	-.111
95	HA1	Regardless of any temporary problem that I have to overcome, I always think it will turn out well.	**.456**	-.131	.057	-.218
17	N	Are you an irritable person?	**.445**	-.072	.017	.100
70	N	Do you often feel life is very dull?	**.428**	-.261	.130	.189

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
76	N	Have you ever wished that you were dead?	**.425**	-.159	.113	.082
89	HA3	I feel very confident and sure of myself in almost all social situations.	**.422**	-.367	-.006	-.328
13	N	Do you often worry about things you should not have done or said?	**.415**	.068	-.039	-.079
30	NS2	I often react so strongly to unexpected news that I say or do things that I regret.	**.412**	.075	.052	.208
14	HA1	I often stop what I am doing because I get worried, even when my friends tell me everything will go well.	**.411**	-.137	.002	-.003
74	N	Do you worry a lot about your looks?	**.401**	.088	-.004	.033
80	HA4	I recover more quickly than most people from minor illnesses or stress.	**.392**	-.043	.150	-.268
97	N	Are you touchy about some things?	**.390**	.035	-.049	.029
60	N	Do you suffer from sleeplessness?	**.389**	-.185	.070	.103
64	RD3	I am usually more upset than most people by the loss of a close friend.	**.387**	.155	-.064	.037
54	HA4	I have less energy and get tired more quickly than most people.	**.376**	-.201	.114	-.056
69	HA4	I need much extra rest, support, or reassurance to recover from minor illnesses or stress.	**.370**	-.052	.008	.027
100	N	When your temper rises, do you find it difficult to control?	**.365**	.022	.067	.189
92	N	Are you sometimes bubbling over with energy and sometimes very sluggish?	**.326**	.145	.090	.169
57	HA4	I often need naps or extra rest periods because I get tired so easily.	**.326**	-.019	.094	-.028
28	NS4	I lose my temper more quickly than most people.	**.317**	-.006	.060	.176
63	HA4	I usually can stay "on the go" all day without having to push myself.	**.305**	-.132	.129	-.226
24	E	Do you tend to keep in the background on social occasions?	-.179	**.617**	.072	.215
90	RD3	I usually like to stay cool and detached from other people.	.079	**.603**	.106	-.189
88	RD3	Even when I am with friends, I prefer not to "open up" very much.	-.011	**.590**	.102	-.135
58	E	Do you like mixing with people?	-.150	**.580**	.005	.042
47	E	Are you mostly quiet when you are with other people?	-.160	**.576**	.094	.116
6	E	Are you a talkative person?	-.004	**.573**	.056	.191
11	E	Are you rather lively?	-.128	**.538**	-.051	.186
3	RD3	I like to discuss my experiences and feelings openly with friends instead of keeping them to myself.	.016	**.529**	.067	-.073
12	RD3	My friends find it hard to know my feelings because I seldom tell them about my private thoughts.	.014	**.523**	.010	-.166
94	E	Do other people think of you as being very lively?	-.038	**.521**	-.079	**.310**
86	RD3	I like to keep my problems to myself.	.083	**.515**	.010	-.136
90	E	Do you like plenty of bustle and excitement around you?	-.100	**.503**	.022	.166
33	HA3	When I have to meet a group of strangers, I am more shy than most people.	.271	**-.498**	.002	-.155
20	E	Do you enjoy meeting new people?	-.163	**.497**	.017	.058

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
37	HA3	I often avoid meeting strangers because I lack confidence with people I do not know.	.323	**-.493**	-.041	-.114
45	E	Do you usually take the initiative in making new friends?	-.151	**.493**	-.061	.176
36	E	Do you have many friends?	-.112	**.466**	.017	.052
33	E	Do you prefer reading to meeting people?	-.155	**.450**	.058	.050
40	NS1	I am slower than most people to get excited about new ideas and activities.	-.117	**.444**	.017	.041
38	HA3	I usually stay away from social situations where I would have to meet strangers, even if I am assured that they will be friendly.	.261	**-.439**	-.005	-.037
31	RD1	People find it easy to come to be for help, sympathy, and warm understanding.	.025	**.429**	-.103	-.081
16	E	Can you usually let yourself go and enjoy yourself at a lively party?	-.178	**.428**	.069	.147
78	E	Can you get a party going?	-.159	**.421**	.068	**.335**
28	E	Do you like going out a lot?	-.162	**.414**	.132	.060
32	NS3	I am much more reserved and controlled than most people.	.065	**.407**	.221	-.017
51	E	Can you easily get some life into a rather dull party?	-.074	**.392**	.040	**.347**
93	NS1	In conversations I am much better as a listener than as a talker.	-.037	**.356**	.079	.171
74	RD3	If I am feeling upset, I usually feel better around friends than when left alone.	.041	**.341**	.062	-.095
15	RD3	It wouldn't bother me to be alone all the time.	.063	**.318**	.059	-.188
42	HA3	I would probably stay relaxed and outgoing when meeting a group of strangers, even if I were told they are unfriendly.	**.311**	**-.315**	-.054	-.221
92	RD2	I am more hard-working than most people.	-.014	-.018	**-.595**	.151
39	RD2	I usually push myself harder than most people do because I want to do as well as I possibly can.	-.015	.092	**-.539**	.211
66	NS3	I am better at saving money than most people.	.135	.098	**.486**	-.026
97	RD2	I am usually so determined that I continue to work long after other people have given up.	-.090	.003	**-.479**	**.307**
99	NS2	I like to pay close attention to details in everything I do.	.024	.002	**.478**	-.027
45	RD2	I could probably accomplish more than I do, but I don't see the point in pushing myself harder than is necessary to get by.	-.007	.146	**-.474**	.022
55	NS2	I usually think about all the facts in detail before I make a decision.	.007	.125	**.470**	.223
70	NS3	I often spend money until I run out of cash or get into debt from using too much credit.	.166	.069	**.453**	.113
72	NS3	Because I so often spend too much money on impulse, it is hard for me to save money - even for special plans like a holiday.	.247	.061	**.449**	.125
49	HA4	I try to do as little work as possible, even when other people expect more of me.	.073	-.136	**.441**	.056
24	NS4	I often break rules and regulations when I think I can get away with it.	.024	-.096	**.396**	.288
18	P	Should people always respect the law?	.066	-.079	**.392**	.130
81	P	Do you generally 'look before you leap'?	.095	.103	**.380**	**.301**

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
56	NS2	I nearly always think about all the facts in detail before I make a decision, even when other people demand a quick decision.	-.102	.140	**.377**	.059
25	P	Would you take drugs which may have strange or dangerous effects?	.037	-.052	**.366**	.182
87	NS3	I enjoy saving money more than spending it on entertainment or thrills.	-.049	.217	**.360**	-.024
59	P	Does it worry you if you know that there are mistakes in your work?	-.121	-.029	**.360**	.046
16	NS4	I like to be very organised and set up rules for people whenever I can.	-.151	.043	**.346**	-.161
22	NS4	I often do things based on how I feel at the moment without thinking about how they were done in the past.	.032	.104	**.346**	.298
21	NS4	Even when most people feel it is not important, I often insist on things being done in a strict and orderly way.	-.111	.045	**.338**	-.170
2	P	Do you stop to think things over before doing anything?	-.018	.066	**.337**	.222
36	RD4	I have a reputation as someone who is very practical and does not act on emotion.	.234	**.307**	**.333**	-.017
81	NS2	I hate to make decisions based only on my first impressions.	-.032	.115	**.322**	.159
13	NS4	I like it when people can do whatever they want without strict rules and regulations.	-.045	.075	**.308**	.178
7	P	Would being in debt worry you?	.279	-.070	**.307**	.116
46	NS2	I like to think about things for a long time before I make a decision.	-.206	.148	**.307**	.201
2	NS1	I often try new things just for fun or thrills, even if most people think it is a waste of time.	-.189	.215	.091	**.435**
75	HA4	I usually feel much more confident and energetic than most people, even after minor illnesses or stress.	**.343**	-.181	.164	**-.411**
61	E	Have people said that you sometimes act too rashly?	.188	.110	.256	**.402**
20	RD4	Other people often think that I am too independent because I won't do what they want.	-.090	.109	.078	**-.392**
47	HA2	Most of the time I would prefer to do something a little risky (like riding in a fast automobile over steep hills and sharp turns) - rather than having to stay quiet and inactive for a few hours.	.127	-.040	-.153	**-.391**
48	NS2	I often follow my instincts, hunches, or intuition without thinking through all the details.	.019	.155	**.361**	**.388**
26	HA2	I usually stay calm and secure in situations that most people would find physically dangerous.	**.374**	.052	-.021	**-.376**
60	NS4	I am usually able to get other people to believe me, even when I know that what I am saying is exaggerated or untrue.	.082	.069	.036	**.373**
29	P	Do you prefer to go your own way rather than act by the rules?	-.054	-.062	.235	**.373**
69	E	Do you often make decisions on the spur of the moment?	-.102	.236	**.346**	**.370**
29	HA2	I am usually confident that I can easily do things that most people would consider dangerous (such as driving an automobile fast on a wet or icy road).	.118	.031	-.117	**-.369**
67	E	Do you like doing things in which you have to act quickly?	-.277	.188	.073	**.369**
17	RD4	I usually do things my own way, rather than giving in to the wishes of other people.	.027	.125	.035	**-.365**

No.	Item	Question	Factor 1	Factor 2	Factor 3	Factor 4
4	NS1	When nothing new is happening, I usually start looking for something that is thrilling or exciting.	-.078	.280	.031	**.362**
51	HA2	Most of the time I would prefer to do something risky (like hand-gliding or parachute jumping) - rather than having to stay quiet and inactive for a few hours.	.191	-.101	-.092	**-.353**
59	HA4	I am more energetic and tire less quickly than most people.	**.316**	-.143	.169	**-.347**
62	NS4	I can usually do a good job of stretching the truth to tell a funnier story or to play a joke on someone.	-.018	.121	.113	**.343**
41	RD2	I often push myself to the point of exhaustion or try to do more than I really can.	.096	.106	-.246	**.300**

The items which load on this factor, all seem to relate to emotionality. However, there are a number of themes running through the items. These themes give a better feel of the factor examples will now be described. The first five items are directly related to worry, for example N38 - *Are you a worrier?,* HA2 23 – *I often feel tense and worried in unfamiliar situations, even when others feel there is no danger at all.* The next group of questions could be categorised as relating to an emotional sensitivity towards negative emotion. For instance, N22 – *Are your feelings easily hurt?*, N26 – *Do you often feel 'fed-up?,* and HA1 84 - *If I am embarrassed or humiliated, I get over it quickly?* The third theme could be described as rumination over social situations versus carefree. For instance HA3 89 – *I feel very confident and sure of myself in almost all social situations;* N13 – *Do you often worry about things you should not have done or said;* N74 – *Do you worry about your looks?* The final group are related to energy and fatigue for instance HA4 54 – *I have less energy and get tired more quickly than most people;* N92 – *Are you sometimes bubbling over with energy and sometimes very sluggish?;* and HA4 63 - *I usually can stay "on the go" all day without having to push myself.*

Factor 1 is made up of the majority of both the Neuroticism and Harm Avoidance items. It combines items from both of these scales into one large factor which reflects an underlying theme of anxiety and emotionality. Therefore this factor could be described as emotionality.

Factor 2 seems to relate mainly to Extraversion items with 15 out of 23 of these loading predominantly on this factor. 7 of the 11 Reward Dependence sub-scale of Attachment load primarily on factor 2. The factor is also made up of 4 negative loadings from HA3, the sub-scale titled "shyness with strangers", 3 items from the Novelty Seeking scale and one from the Reward Dependence sub-scale of sentimentality versus insensitiveness. It appears to reflect sociability and is called Sociability-4C.

These items can be broken up into three themes. The first group of items would appear to relate to openness with others without reserve. Items include RD3 90 - *I usually like to stay cool and detached from other people;* E6 – *Are you a talkative person?;* RD3 86 – *I like to keep my problems to myself.* The second theme relates to meeting new people and the ease of this experience. For instance E20 – *Do you enjoy meeting new people?;* E45 – *Do you usually take the initiative in making new friends?;* HA3 38 – *I usually stay away from social situations where I would have to meet strangers, even if I am assured that they will be friendly.* The last theme concerns the sociability of the individual. Some items are: E16 – *Can you usually let yourself go and enjoy yourself at lively party?;* and E28 – *Do you like going out a lot?* This factor seems to relate to sociability.

Factor 3 includes a range of items from, Novelty Seeking, Psychoticism, Reward Dependence and Harm Avoidance. The mix of these items read like a factor representing conscientiousness. There are 14 Novelty Seeking, 6

Psychoticism, 5 Reward Dependence and 1 Harm Avoidance items. These questions appear to break up into four themes.

The first concerns attitudes to work. For instance RD2 92 – *I am more hard-working than most people.;* RD2 97 – *I am usually so determined that I continue to work long after other people have given up.* The second theme appears to focus on attitudes towards money. NS3 66 – I am better at saving money than most people. and NS3 70 - *I often spend money until I run out of cash or get into debt from using too much credit.* A few questions relate to abiding the law: NS4 24 – *I often break rules and regulations when I think I can get away with it.* P25 - *Would you take drugs which may have strange or dangerous effects?* The last theme contains items concerning decision making and rigidity. For instance NS2 21 – *Even when most people feel it is not important, I often insist on things being done in a strict and orderly way.* and NS2 81 – *I hate to make decisions based only on my first impression.* This factor is very similar to a factor from Costa and McCrae NEO five-factor inventory (Costa & McCrae, 1992).

The last factor, factor 4 is again a mix of items from different scales. In this case it is comprised of items from every scale except for Neuroticism. It contains 6 Harm Avoidance, 5 Novelty Seeking, 3 Extraversion, 3 Reward Dependence and 1 Psychoticism items. This final factor seems to relate to living life at the edge and taking risks. Some of the items are: E61 – *Have people said that you sometimes act too rashly?* and E69 – *Do you often make decisions on the spur of the moment?* There are other aspects to this

factor, such as independence, NS1 2 – *I often try new things just for fun or thrills, even if most people think it is a waste of time,* RD4 20 - *Other people often think that I am too independent because I won't do what they want,* and perseverance HA4 75 - *I usually feel much more confident and energetic than most people, even after minor illnesses or stress*, RD2 41 - *I often push myself to the point of exhaustion or try to do more than I really can.* Also some items relate to decision making, NS2 48 - *I often follow my instincts, hunches, or intuition without thinking through all the details* E69 - *Do you often make decisions on the spur of the moment?*

The fourth factor has themes in it, which relate to taking risks, being independent and taking decisions quickly. The overall theme could be called risk taking.

Interestingly in the four-factor solution Neuroticism is the only scale, which loads purely on one factor and does not load on any other. Harm Avoidance although it loads chiefly on Emotionality-4C it is not as distinct as Neuroticism with items also loading on the other three factors of Sociability-4C, Conscientiousness-4C and Risk Taking-4C. Its items therefore span more areas of personality than Emotionality alone. Extraversion does not factor as cleanly as may have been expected. Although Factor 2 is clearly a sociability factor a number of Extraversion items also load on Factor 4.

11.4.2 Three Factor Solution of the EPQ-R and TPQ combined

Again only those items which load on any factor above 0.3 were included within the table 11.4.3. 177 items were included within the analysis, 74 did not load on any factor above 0.3 leaving a total of 113 items presented in table 11.4.3. The three factor solutions provides factors which appear to resemble an Emotionality factor, an Extraversion factor and a Conscientiousness factor, factors 1, 2 and 3 respectively. These will be called Emotionality-3C, Extraversion-3C and Conscientiousness-3C.

Factor 1 is similar to the four factor solution is again an emotionality factor with high loadings chiefly from Neuroticism and Harm Avoidance. 21 Neuroticism items and 25 Harm Avoidance load on this factor. Only 3 items from other scales load on Emotionality-3C, 2 from Reward Dependence and 1 from Extraversion. Only one item loads both on Emotionality-3C and another factor. The item is a Harm Avoidance item, number 43. It has a negative loading on Extraversion-3C. This factor is clearly very similar to the first factor in the four factor solution with the general themes being very similar, therefore for a better feel of the factor see section 11.4.1.

Factor 2 consists predominantly of loadings from Extraversion items with 15 items out of 23 from this scale. 8 items from Reward Dependence have significant loadings on factor 2, 2 items from Novelty Seeking and one from Harm Avoidance. Only one item loads on factor 2 and on another factor – the Harm Avoidance item, which has it's highest loading on Emotionality-3C (item number 43 - HA3). The themes running through the items are again

Table 11.4.3: Orthogonal rotation of a 3-factor solution for the EPQ-R and TPQ combined

No.	Item	Question	Factor 1	Factor 2	Factor 3
38	N	Are you a worrier?	**.640**	-.017	-.163
23	HA2	I often feel tense and worried in unfamiliar situations, even when other's feel there is no danger at all.	**.629**	-.189	-.056
19	HA2	I often feel tense and worried in unfamiliar situations, even when others feel there is little to worry about.	**.618**	-.241	-.065
5	HA1	Usually I am more worried than most people that something might go wrong in the future.	**.600**	-.092	-.116
18	HA2	I usually feel tense and worried when I have to do something new and unfamiliar.	**.585**	-.210	-.124
22	N	Are your feelings easily hurt?	**.560**	.111	-.132
8	HA1	I nearly always stay relaxed and carefree, even when nearly everyone else is fearful.	**.547**	-.063	-.142
79	RD2	I seldom let myself get upset or frustrated: when things don't work out, I simply move on to other activities.	**.546**	.027	-.118
1	HA1	I usually am confident that everything will go well, even in situations that worry most people.	**.544**	-.134	-.177
84	HA1	If I am embarrassed or humiliated, I get over it very quickly.	**.542**	-.108	-.173
35	N	Would you call yourself a nervous person?	**.532**	-.212	-.092
43	N	Do you worry about awful things that might happen?	**.523**	.052	-.059
73	HA4	It is extremely difficult for me to adjust to changes in my usual way of doing things because I get so tense, tired or worried.	**.522**	-.159	-.008
91	HA1	I never worry about terrible things that might happen in the future.	**.505**	.104	-.080
26	N	Do you often feel 'fed-up'?	**.504**	-.099	.146
84	N	Do you often feel lonely?	**.498**	-.172	.103
95	HA1	Regardless of any temporary problem that I have to overcome, I always think it will turn out well.	**.489**	-.146	-.037
46	N	Would you call yourself tense or 'highly-strung'?	**.482**	-.071	.047
80	N	Do you worry too long after an embarrassing experience?	**.481**	.049	-.121
65	N	Have you often felt listless and tired for no reason?	**.478**	-.027	.150
83	N	Do you suffer from 'nerves'?	**.474**	-.049	-.029
31	N	Are you often troubled about feelings of guilt?	**.473**	.034	.089
89	HA3	I feel very confident and sure of myself in almost all social situations.	**.473**	**-.393**	-.138
10	HA1	I often have to stop what I am doing because I start worrying about what might go wrong.	**.464**	-.098	.029
87	N	Are you easily hurt when people find fault with you or the work you do?	**.461**	.090	-.168
8	N	Do you ever feel 'just miserable' for no reason?	**.457**	-.006	.053
3	N	Does your mood often go up and down?	**.456**	-.002	.124
80	HA4	I recover more quickly than most people from minor illnesses or stress.	**.436**	-.067	-.001

No.	Item	Question	Factor 1	Factor 2	Factor 3
26	HA2	I usually stay calm and secure in situations that most people would find physically dangerous.	**.431**	.014	-.208
13	N	Do you often worry about things you should not have done or said?	**.421**	.069	-.052
17	N	Are you an irritable person?	**.421**	-.049	.108
75	HA4	I usually feel much more confident and energetic than most people, even after minor illnesses or stress.	**.412**	-.221	-.065
76	N	Have you ever wished that you were dead?	**.408**	-.138	.181
14	HA1	I often stop what I am doing because I get worried, even when my friends tell me everything will go well.	**.406**	-.127	.039
70	N	Do you often feel life is very dull?	**.392**	-.227	.262
74	N	Do you worry a lot about your looks?	**.389**	.101	.039
54	HA4	I have less energy and get tired more quickly than most people.	**.385**	-.198	.102
97	N	Are you touchy about some things?	**.376**	.048	.003
59	HA4	I am more energetic and tire less quickly than most people.	**.375**	-.177	-.029
64	RD3	I am usually more upset than most people by the loss of a close friend.	**.372**	.168	-.013
30	NS2	I often react so strongly to unexpected news that I say or do things that I regret.	**.370**	.109	.186
60	N	Do you suffer from sleeplessness?	**.367**	-.162	.157
69	HA4	I need much extra rest, support, or reassurance to recover from minor illnesses or stress.	**.360**	-.040	.053
63	HA4	I usually can stay "on the go" all day without having to push myself.	**.343**	-.152	.006
42	HA3	I would probably stay relaxed and outgoing when meeting a group of strangers, even if I were told they are unfriendly.	**.343**	**-.332**	-.127
67	E	Do you like doing things in which you have to act quickly?	**-.334**	.224	.238
57	HA4	I often need naps or extra rest periods because I get tired so easily.	**.329**	-.015	.086
100	N	When your temper rises, do you find it difficult to control?	**.327**	.053	.188
44	HA3	I think I would stay confident and relaxed when meeting strangers, even if I were told they are angry at me.	**.327**	-.160	-.129
98	HA1	I usually have good luck in whatever I try to do.	**.322**	-.177	.045
82	HA1	I think I will have very good luck in the future.	**.320**	-.225	-.044
24	E	Do you tend to keep in the background on social occasions?	-.212	**.634**	.128
6	E	Are you a talkative person?	-.036	**.592**	.117
47	E	Are you mostly quiet when you are with other people?	-.176	**.582**	.093
58	E	Do you like mixing with people?	-.156	**.577**	-.021
90	RD3	I usually like to stay cool and detached from other people.	.111	**.572**	-.055
88	RD3	Even when I am with friends, I prefer not to "open up" very much.	.015	**.565**	-.034
11	E	Are you rather lively?	-.161	**.554**	.020

No.	Item	Question	Factor 1	Factor 2	Factor 3
94	E	Do other people think of you as being very lively?	-.095	**.552**	.076
90	E	Do you like plenty of bustle and excitement around you?	.127	**.518**	.073
3	RD3	I like to discuss my experiences and feelings openly with friends instead of keeping them to myself.	.029	**.515**	-.021
33	HA3	When I have to meet a group of strangers, I am more shy than most people.	.295	**-.507**	-.034
45	E	Do you usually take the initiative in making new friends?	-.183	**.507**	.008
20	E	Do you enjoy meeting new people?	-.171	**.497**	.002
12	RD3	My friends find it hard to know my feelings because I seldom tell them about my private thoughts.	.044	**.496**	-.047
37	HA3	I often avoid meeting strangers because I lack confidence with people I do not know.	.337	**-.495**	-.042
86	RD3	I like to keep my problems to myself.	.107	**.493**	-.025
36	E	Do you have many friends?	-.120	**.467**	.004
78	E	Can you get a party going?	-.213	**.453**	.208
33	E	Do you prefer reading to meeting people?	-.160	**.449**	.034
40	NS1	I am slower than most people to get excited about new ideas and activities.	-.122	**.443**	-.001
16	E	Can you usually let yourself go and enjoy yourself at a lively party?	-.199	**.438**	.099
38	HA3	I usually stay away from social situations where I would have to meet strangers, even if I am assured that they will be friendly.	.264	**-.434**	.023
51	E	Can you easily get some life into a rather dull party?	-.133	**.428**	.199
31	RD1	People find it easy to come to be for help, sympathy, and warm understanding.	.034	**.417**	-.157
28	E	Do you like going out a lot?	-.166	**.414**	.102
32	NS3	I am much more reserved and controlled than most people.	.073	**.401**	.147
93	NS1	In conversations I am much better as a listener than as a talker.	-.064	**.373**	.136
74	RD3	If I am feeling upset, I usually feel better around friends than when left alone.	.058	**.327**	-.024
4	NS1	When nothing new is happening I usually start looking for something that is thrilling or exciting	-.139	**.319**	.208
36	RD4	I have a reputation as someone who is very practical and does not act on emotion.	.243	**.304**	.257
35	NS4	I almost never get so excited that I lose control of myself.	.124	**.301**	.197
48	NS2	I often follow my instincts, hunches, or intuition without thinking through all the details.	-.036	.199	**.508**
55	NS2	I usually think about all the facts in detail before I make a decision.	-.016	.148	**.503**
24	NS4	I often break rules and regulations when I think I can get away with it.	-.013	-.062	**.497**
81	P	Do you generally 'look before you leap'?	.054	.138	**.483**
69	E	Do you often make decisions on the spur of the moment?	-.154	.274	**.471**
72	NS3	Because I so often spend too much money on impulse, it is hard for me to save money - even for special plans like a holiday.	.237	.078	**.450**

No.	Item	Question	Factor 1	Factor 2	Factor 3
22	NS4	I often do things based on how I feel at the moment without thinking about how they were done in the past.	-.009	.138	**.449**
61	E	Have people said that you sometimes act too rashly?	.123	.160	**.444**
70	NS3	I often spend money until I run out of cash or get into debt from using too much credit.	.159	.083	**.440**
25	P	Would you take drugs which may have strange or dangerous effects?	.018	-.032	**.408**
29	P	Do you prefer to go your own way rather than act by the rules?	-.110	-.019	**.405**
18	P	Should people always respect the law?	.056	-.064	**.404**
49	HA4	I try to do as little work as possible, even when other people expect more of me.	.078	-.129	**.404**
2	P	Do you stop to think things over before doing anything?	-.045	.090	**.397**
92	RD2	I am more hard-working than most people.	-.060	.003	**-.385**
66	NS3	I am better at saving money than most people.	.153	.093	**.380**
45	RD2	I could probably accomplish more than I do, but I don't see the point in pushing myself harder than is necessary to get by.	-.028	.149	**-.379**
99	NS2	I like to pay close attention to details in everything I do.	.045	-.004	**.371**
42	P	Have you often gone against your parents' wishes?	.095	.029	**.353**
13	NS4	I like it when people can do whatever they want without strict rules and regulations.	-.064	.093	**.345**
43	NS1	It is difficult for me to keep the same interests for a long time because my attention often shifts to something else.	.241	-.007	**.345**
81	NS2	I hate to make decisions based only on my first impressions.	-.048	.131	**.344**
46	NS2	I like to think about things for a long time before I make a decision.	-.228	.164	**.340**
50	P	Are you more easy-going about right and wrong than most people?	-.115	-.030	**.338**
47	HA2	Most of the time I would prefer to do something a little risky (like riding in a fast automobile over steep hills and sharp turns) - rather than having to stay quiet and inactive for a few hours	.188	-.084	**-.336**
37	P	Do you enjoy practical jokes that can sometimes really hurt people?	-.044	.034	**.332**
56	NS2	I nearly always think about all the facts in detail before I make a decision, even when other people demand a quick decision.	-.097	.141	**.323**
50	NS2	I often have to change my decisions because I had a wrong hunch or mistaken first impression.	.231	.056	**.319**
39	RD2	I usually push myself harder than most people do because I want to do as well as I possibly can.	-.069	.117	**-.314**
59	P	Does it worry you if you know that there are mistakes in your work?	-.114	-.029	**.311**
7	P	Would being in debt worry you?	-.284	-.064	**.300**

very similar to those described in the four factor solution. However, there are several items which relate to a fourth theme of excitability. For instance: NS1 4 – *When nothing new is happening I usually start looking for something that is thrilling or exciting* and NS4 35 – *I almost never get so excited that I lose control of myself.* These themes taken together are similar to an Extraversion factor. This factor seems to combine elements from Sociability-4C and Risk Taking-4C in the four factor solution therefore forming a factor which is more similar to Extraversion.

Factor 3 contains loadings from all the scales except for Neuroticism. It consists in the main of Novelty Seeking and Psychoticism items containing 14 significant loadings from the former scale and 10 from the latter. There are also 2 significant loadings from Extraversion, 1 from Harm Avoidance and 3 from Reward Dependence. Again none of these items load above 0.3 on other factors and no items which load on other factors load on Factor 3 (Conscientiousness-3C). A number of questions relate to following of rules, work attitudes and decision making. The wording of these items seems to reflect an overall conscientiousness factor. The first few items that band together are related to decision making and taking decisions on the spur of the moment. These decision can be in relation to money, work or just general decision making. For instance: NS2 48 – *I often follow my instincts, hunches, or intuition without thinking through all the details.;* P81 – *Do you generally 'look before you leap'?* and NS3 72 – *Because I so often spend too much money on impulse, it is hard for me to save money – even for special*

plans like a holiday. The second theme appears to be concerned with rules and the law. Examples of this theme are given in section 11.4.1. The third theme would be concerned with the work ethic and being able to stick with a particular project or idea without giving up. For instance: instance RD2 92 – *I am more hard-working than most people.;* NS2 99 – *I like to pay close attention to details in everything I do;* and RD2 39 – *I usually push myself harder than most people do because I want to do as well as I possibly can.* These themes together of decision making, rules and the law and work ethic seem to represent an overall theme of Conscientiousness.

In sum the 3-factor model produces again an emotionality factor, an extraversion type factor and the third factor seems to be conscientiousness.

11.4.3 Summary of Combined item analysis

An interesting point to note is that both of the solutions verge on Thurstone's simple structure. Few items load significantly on more than one factor this being particularly true of the 3 factor model and there are three or four clear factors with significant loadings from a range of items. Thus fulfilling, in the main, Thurstone's requirement for simple structure.

An emotionality factor is the first factor in both the solutions. Items from the Neuroticism scale load significantly in both factors and Harm Avoidance is equally well represented in the 3-factor solution. Either of these factors could be a larger factor for Neuroticism or Emotionality. However, at this stage they are merely statistical entities. No tests of reliability or validity have been

carried out. These factors of emotionality would need to be tested to a greater degree before it could be determined whether they were true factors of personality.

A number of other factors have been revealed form both the three and four factor models. The three and four factor solutions are similar in that they both produce an Emotionality factor and a Conscientiousness factor. The thrid factor in the three factor solution is of Extraversion. In the four factor solution Extraversion appears to be represented in both Sociability and Risk Taking.

11.5 Summary of analysis of the correspondence between the EPQ-R and TPQ personality scales

One of the aims of this chapter was to assess the correspondence between Cloninger's scales of Novelty Seeking, Harm Avoidance and Reward Dependence with Eysenck's scales of Extraversion, Neuroticism and Psychoticism.

Harm Avoidance and Neuroticism do overlap to a great extent. There is a large positive correlation between these scales (in both males and females) to a degree that suggests near equivalence. Neuroticism is best predicted by Harm Avoidance in stepwise multiple linear regression with no other scale predicting a substantial proportion. Harm Avoidance correlates highly with both Neuroticism and Extraversion, however, the best predictor of Harm

Avoidance is Neuroticism although Extraversion does also explain a large proportion of the variance.

Correspondence between the scales was examined in further detail by carrying out factor analysis (principal axis factoring). At both the scale and the item level Harm Avoidance and Neuroticism factor together. The two scales seem to be nearing equivalence. However, when these scales were correlated Harm Avoidance also correlates negatively to a high degree with Extraversion. Furthermore, if the 4 factor solution at the item level is examined, Neuroticism items load on only Emotionality-4C (factor 1), but some Harm Avoidance items load on Sociability, Conscientiousness and Risk Taking (factors 2, 3 and 4). This would suggest the Harm Avoidance scale is broader than Neuroticism and may measure more than "emotionality" alone.

The other scales do not show such a high correspondence to just one scale. This is clear at every level of analysis. The other scales show moderate to large correlations with at least two other scales. When 3 factors are extracted at the scale level Extraversion loads moderately on three factors, Psychoticism on two, and Reward Dependence and Novelty Seeking on one each. Each factor has significant loadings from three scales. However, if the highest loadings are examined for each of the scales and factors, Psychoticism and Novelty Seeking explain most of Openness (Factor 2), and Extraversion and Reward Dependence most of Socialness (Factor 3), with of course Neuroticism and Harm Avoidance explaining Emotionality (Factor 1). If the 3-factor solution is examined at the item level, the pattern is the same.

HA and N make up Emotionality-3C (Factor 1), E and RD explain Extraversion-3C (Factor 2), and P and NS explain Conscientiousness-3C (Factor 3).

Interestingly in the four factor solution the pattern although not followed as strictly is similar for three factors with Extraversion and Reward Dependence overlapping on Sociability (Factor 2), Novelty Seeking and Psychoticism on Conscientiousness-4C and of course Harm Avoidance and Neuroticism on Emotionality-4C (Factor 1). The fourth factor is Risk Taking which if combined with Sociability-4C may go to make up Extraversion-3C.

The analysis described gives a picture regarding personality's structure. Clearly from this analysis there is an emotionality factor. This has emerged as a factor at the scale level and in both a 3 and a 4 factor solution. This is the first factor to emerge in all the analyses. A second factor does seem to be some kind of sociability factor involving Extraversion and Reward Dependence, however, correlations between Extraversion and Harm Avoidance are higher than between Extraversion and Reward Dependence. Whether there should be 3, 4 or more factors is a question beyond the scope of this thesis, however, both a 3 and a 4-factor solution could be found in this data set.

Harm Avoidance and Neuroticism correspond to a high degree. When factored together almost all of the Neuroticism items factor with Harm Avoidance. The aim of the thesis is to relate the Neuroticism with mood via serotonin. Therefore the next chapter will address the relationships between

mood and personality and ask whether Neuroticism is the best predictor of negative mood.

Chapter Twelve Results III: The relationships between self-report personality scales and mood scales

This chapter aims to describe the relationships between mood and personality with regard to scores on personality and mood questionnaires. The personality questionnaires included in the pack were designed for trait measures whereas the mood questionnaires were designed to capture a specific state. This chapter aims to explore the state/trait relationships.

These associations can be examined in a number of ways. Simple correlations will allow the relationships between individual scales to be examined. However, in many cases more than one scale will relate to another. In order to examine this in more detail, multiple regression will be used to determine the relationships. The first section of this chapter will report on simple correlation, the second on multiple regression. Although many relationships will be explored the main focus of the chapter is to determine the relationships between Neuroticism and Harm Avoidance with positive and negative mood.

Chapter 11 describes the relationships between the two personality questionnaires, the EPQ-R and the TPQ. It is clear that the associations between these scales are complex. When assessing the relationships between these scales and mood the situation will become more complicated, therefore it is imperative to make clear the objectives of this section.

Although all relationships between the personality questionnaires and mood are of interest, the key question is whether Neuroticism is a good predictor of negative mood. This relates to the main hypothesis of the whole thesis. Secondary to this is whether Harm Avoidance is a good predictor of negative mood. Harm Avoidance has been hypothesised to be related to mood through serotonin (see section 1.3.4) but it is the scale of Neuroticism that was chosen to select subjects for the experimental stage of the thesis. Thirdly are the relationships between these two scales and positive mood. Of interest is whether these scales can also predict positive mood and whether they are a better predictor of positive mood than negative mood. Fourthly, of interest is how good a predictor Extraversion is of both negative and positive mood. This is of concern as Extraversion has been shown to be related to mood (see section 3.2.1) therefore it is important to show in this data set that Neuroticism and Harm Avoidance are better predictors of negative mood than Extraversion.

Other scales are also of interest. This study is of an unusually large scale therefore evidence relating the relatively little studied TPQ scales and mood is of particular interest.

12.1 Methods specific to analysis involving mood questionnaires

A number of state measures were included in the questionnaire pack. These included a measure of state anxiety (State and Trait Anxiety Inventory, STAI, (Spielberger, Gorsuch, Luschene, Vagg, & Jacobs, 1983)), a mood measure (Befindlichskeitskala, BFS, (von Zerssen, Strian, & Schwarz, 1974)), a

depression rating scale (General Health Questionnaire 28, GHQ-28, (Goldberg, 1978)) and a happiness measure (Oxford Happiness Inventory OHI, (Argyle & Crossland, 1987)). All fulfilled criteria for parametric statistics.

All of those who did not have a score for each and every questionnaire were excluded, that is those who had scores on for instance the OHI but did not complete the BFS were at this point excluded. There have been a number of exclusions within the data set up to this point. In the analysis for chapters 10 and 11 only those who completed both of the personality questionnaires were included in the analysis. Out of the remaining 347 males and 550 females, 1 female did not gain a score for the STAIS, 2 males and 1 female did not gain scores for the OHI and 6 males and 17 females did not gain scores for the BFS. This comes to a total of 8 males and 19 females. Approximately 2% of the male group and 3.5% of the female group who had completed the personality questionnaires failed to complete the mood questionnaires. This is a relatively low percentage of the total group, therefore these individuals' data on the other questionnaires was not included in any further analysis. A total of 339 males and 531 females remained in the data set.

12.2 Simple Correlations between Mood and Personality Scales

Tables 12.2.1 and 12.2.2 show correlations of the personality measures of the EPQ-R and TPQ with the OHI, the BFS total score, the Spielberger state inventory and the GHQ total score for men and women respectively. Also included within these tables are the correlations between the mood measures themselves. The correlations are discussed in terms of effect sizes. **Table**

12.2.1: Correlations between the EPQ-R and TPQ scales with mood measures for men (n=339)

	OHI	BFS	GHQ-28	STAIS
Extraversion	.52**	-.39**	-.26**	-.34**
Neuroticism	-.57**	.55**	.54**	.63**
Psychoticism	-.17**	.21**	.12**	.10**
Lie	.04	-.07	-.05	.02
Novelty seeking	.08	-.05	-.01	-.07
Harm Avoidance	-.69**	.55**	.48**	.60**
Reward Dependence	.25**	-.15**	.01	-.03
OHI	-			
BFS	-.65**	-		
GHQ-28	-.60**	.57**	-	
STAIS	-.62**	.76**	.60**	-

OHI – Oxford Happiness Inventory; BFS – Befindlichskeitskala; GHQ-28 – General Health Questionnaire 28; STAIS – State and Trait Anxiety Inventory state version

* p<.05; **p<.01

Table 12.2.2: Correlations between the EPQ-R and TPQ scales with mood measures for women (n=531)

	OHI	BFS	GHQ	STAIS
Extraversion	.48**	-.23**	-.21**	-.27**
Neuroticism	-.50**	.42**	.52**	.52**
Psychoticism	-.20**	.26**	.17**	.19**
Lie	.07	-.01 *	-.12**	-.05
Novelty seeking	.12**	.03	-.00	-.07
Harm Avoidance	-.67**	.46**	.54**	.52**
Reward Dependence	.25**	-.10**	.01	-.05
BFS	-.60**			
GHQ-28	-.64**	.59**		
STAIS	-.63**	.73**	.64**	

OHI – Oxford Happiness Inventory; BFS – Befindlichskeitskala; GHQ-28 – General Health Questionnaire 28; STAIS – State and Trait Anxiety Inventory state version

* p<.05; **p<.01

Irrespective of sign, a correlation of between 0 and 0.1 is negligible, from 0.1 up to 0.3 the effect is small, from 0.3 to 0.5 the effect is medium and above 0.5 the effect is large.

A number of the personality scales correlate highly with the mood scales particularly Harm Avoidance, Neuroticism and Extraversion. Furthermore the mood measures themselves are all highly correlated. The STAIS and the BFS correspond very highly.

Happiness as measured by the Oxford Happiness Inventory has a large positive correlation with Extraversion and large negative correlations with Harm Avoidance and Neuroticism. These correlations have large effect sizes. The OHI also has a small positive correlation with Reward Dependence and a small negative correlation with Psychoticism. Both of these are small effects. Further, in females only, the OHI has a further small correlation with Novelty Seeking. This is a small effect, just over 0.1. In men the correlation is just below 0.1 and has therefore a negligible effect size. Males and females have very similar pattern of correlations for the OHI.

The BFS, which measures negative mood, has a similar but opposite pattern. This scale correlates highly with both Neuroticism and Harm Avoidance with a large effect size in men (0.55 for both N and HA) and a moderate effect size in women (0.42 and 0.46 respectively, which is just below the level traditionally classed as large). Extraversion correlates negatively from a small to moderate extent in women and men respectively. There are also small negative correlations with Reward Dependence.

The GHQ-28 is another measure of negative mood. Again the highest correlations in both men and women are with Neuroticism and Harm Avoidance. There are large effects between Neuroticism and the GHQ-28 in

both men and women, and with Harm Avoidance in women. In men this latter correlation has a medium effect size just falling below 0.5 at 0.47. There are also small negative correlations with Extraversion and positive correlations with Psychoticism with small effect sizes.

The state anxiety scale, the STAIS, unsurprisingly has high positive correlations with both Neuroticism and Harm Avoidance. Extraversion also plays a role and there are small to moderate negative correlations with this scale in women and men respectively. STAIS also has small positive correlations with Psychoticism.

There do not appear to be simple one to one relationships between the mood and personality scales. However, Neuroticism and Harm Avoidance have large positive correlations with all of the negative mood scales, large positive correlations with the positive mood scale and in the main large effect sizes. Extraversion correlates positively with positive mood and negatively with negative mood, although the size of the effect varies according to the scale. Psychoticism also seems to play a role having positive correlations with negative mood and negative correlation with positive mood, though all the effects are small. Lastly, the role of Reward Dependence appears to be more specific to the particular mood questionnaire. It has small positive correlations with the OHI and small negative correlations with the BFS but negligible correlations with both the GHQ-28 and the STAIS.

In sum, Neuroticism and Harm Avoidance correlate positively with negative mood and negatively with positive mood, while Extraversion correlates

positively with positive mood and negatively with negative mood. These relationships can be studied in more depth using regression analysis.

12.3 Stepwise regression of the mood and personality scales

The main aim of this section is to show how well Neuroticism can predict mood compared to other scales. Section 12.1 describes clearly the correlations between mood scales. This section will assess these relationships in more depth. There are a number of ways the analysis could be done but in order to show relationships clearly, analyses will be carried out in the following manner.

Firstly proposed scales from either the EPQ-R or the TPQ will be entered into multiple linear stepwise regression equations with a mood scale. This will make clearer the predictive power of a scale from a particular questionnaire. In order to determine which single scale is the best predictor, a regression analysis with all the personality scales which correlate to a small or higher degree with the mood questionnaire will be entered into a regression equation.

12.3.1 The BFS as the dependent variable with the EPQ-R scales as independent variables

The BFS is a measure of negative mood. It has a negative correlation with Extraversion, a positive correlation with Neuroticism and a positive correlation with Psychoticism in both men and women. These three scales were therefore entered as independent variables in the regression equation.

Tables 12.3.1 and 12.3.2 show the results for men and women respectively. In both men and women Neuroticism is the best predictor. An increase in Neuroticism leads to an increase in BFS scores. Neuroticism in men explains 30% of the variance. The second best predictor in men is Extraversion. This is as expected, with an increase in Extraversion scores reflecting a decrease in BFS scores. Extraversion, in men adds a further 6% of the variance. The third predictor in men is Psychoticism adding a further 4%. The standardised beta weights show the influence of each of the variables in the regression equation. With Extraversion and Psychoticism having almost equal but yet opposite effects and Neuroticism having by far the largest influence on standardised BFS scores. The zero order and the part correlations in table 12.3.3 show how much overlap there is between the scales and how much variance each scale explains when the others are partialled out. Psychoticism clearly has very little overlap with the other two scales having a zero order correlation of .205 and a part correlation of .199. While Neuroticism and Extraversion clearly have some degree of overlap. This is as expected as these two scales correlate to a moderate degree in men. The EPQ-R scales together explain approximately 40% of the variance in the BFS scores in men. In women, the pattern is very similar. The three EPQ-R scales also significantly predict scores on the BFS in women as in men.

In women, Neuroticism explains approximately 18% of the variance. However, in women Psychoticism is the second best predictor of the BFS, adding a further 4% after Neuroticism, rather than Extraversion, which adds a

Table 12.3.1 Stepwise linear regression of Neuroticism, Extraversion and Psychoticism on the BFS in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.300	.298	.300	<.001	.459
EPQE	.356	.352	.056	<.001	-.267
EPQP	.395	.390	.039	<.001	.200

Table 12.3.2 Stepwise linear regression Neuroticism, Extraversion and Psychoticism on the BFS in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.179	.177	.179	<.001	.361
EPQP	.222	.220	.044	<.001	.228
EPQE	.252	.248	.029	<.001	-.176

Table 12.3.3 Zero order and part correlations of Neuroticism, Extraversion and Psychoticism with the BFS

	Men		Women	
	Correlation with the BFS	Part Correlation	Correlation with the BFS	Part Correlation
Neuroticism	.548	.437	.423	.350
Extraversion	-.386	-.254	-.234	-.172
Psychoticism	.205	.199	.255	.225

further 3%. The three scales of Neuroticism, Extraversion and Psychoticism, together explain approximately 25% of the variance in the BFS scores in women. When the beta weights are examined the pattern is similar to that in

men, Neuroticism having the largest weight with Extraversion and Psychoticism having similar though opposite weights.

In both men and women Neuroticism was the best predictor of the BFS, however, in men the EPQ-R scales were slightly better predictors of the BFS than in women.

12.3.2 The BFS as the dependent variable with the TPQ scales as independent variables

Scales from the TPQ were entered as the independent variables BFS. The BFS has a large positive correlation with Harm Avoidance and a small negative correlation with Reward Dependence. In women the correlations are slightly smaller than in men with the correlation with Harm Avoidance reaching a medium effect size (r=0.46). These two scales were therefore entered as the independent variables in a regression equation. These results are presented in tables 12.3.4 and 12.3.5 for men and women respectively.

In men Harm Avoidance explains 30% of the variance, the same percentage that Neuroticism explained when regressed with the EPQ-R scales. Reward Dependence explains only a further 1%. If the part and zero order correlations are examined, (table 12.3.6) these scales overlap by approximately only 1%. The two scales together explain 31% of the variance in the BFS. The standardised β weights reflect the influence of two variables in the regression equation. A standardised unit increase in Harm Avoidance reflects a 0.54 increase in standardised BFS scores, which reflects a very

Table 12.3.4 Stepwise linear regression of Harm Avoidance and Reward Dependence on the BFS in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.302	.300	.302	<.001	.540
TPQRD	.312	.308	.011	<.001	-.104

Table 12.3.5 Stepwise linear regression of Harm Avoidance and Reward Dependence on the BFS in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.214	.213	.214	<.001	.460
TPQRD	.221	.218	.007	<.001	-.083

Table 12.3.6 Zero order and part correlations of Harm Avoidance and Reward Dependence on the BFS

	Men		Women	
	Correlation with the BFS	Part Correlation	Correlation with the BFS	Part Correlation
TPQHA	.549	.538	.463	.460
TPQRD	-.152	-.103	-.097	-.083

close relationship. A standardised unit increase in Reward Dependence reflects a 0.1 decrease in standardised BFS scores. In men, the EPQ-R is a better predictor of negative mood as measured by the BFS than the TPQ.

In women, as with the EPQ-R the percentage of variance explained by the personality scales is less than in men, though the pattern is very similar with

Harm Avoidance being far and away the best predictor from the TPQ scales. Table 12.3.5 shows the results in women only. Harm Avoidance predicts 21% with Reward Dependence adding less than 1%. Again there is very little overlap (approximately 0.3%) between these two scales as can be seen in table 12.3.6. Further the standardised β weights are of similar proportions in women as in men. In women Harm Avoidance therefore explains slightly more of the variance than Neuroticism did when regressed with the EPQ-R scales, but the EPQ-R predicts slightly more of the variance in the BFS than the TPQ (25% versus 22%).

12.3.3 The BFS as the dependent variable with the EPQ-R and TPQ scales as independent variables

The question asked now is which scale from both the questionnaires explains the most variance when the scales are regressed together. All three of the EPQ-R scales were entered into the regression equation as was Harm Avoidance and Reward Dependence. It must be remembered at this point that some of these scales have high correlations with each other and will therefore mask each other's relationships with the mood questionnaire.

Reward Dependence when entered with the variables from the EPQ-R scale no longer fulfilled the requirements for stepwise regression in either men or women. Furthermore in women Extraversion also did not reach the criteria. Therefore in men Neuroticism, Psychoticism, Extraversion and Harm Avoidance were entered as the independent variables and in women

Neuroticism, Psychoticism and Harm Avoidance were entered. The results are reported in table 12.3.7 for men and 12.3.8 for women, and table 12.3.9 reports the part correlations.

In men, Harm Avoidance comes out as the highest predictor, explaining as before approximately 30% of the variance. Neuroticism adds a further 6%, followed by Psychoticism (4%) and Extraversion (2%). All together these scales explain approximately 42% of the variance in the BFS scores. When the standardised β weights are examined it is clear that the relationships are complex. Although Harm Avoidance predicts the most variance in the regression equation, Neuroticism has a higher standardised β weight and a higher part correlation. When the other scales are partialled out of the equation Neuroticism explains more of the variance than Harm Avoidance. The reason why Harm Avoidance comes out first in the stepwise regression equation will probably be due to its high correlations with both Neuroticism and Extraversion. It is therefore a broader variable than Neuroticism alone.

In women the picture is slightly different. Both Reward Dependence and Extraversion do not fulfil the requirements to be entered in the equation for stepwise regression. Therefore only Harm Avoidance, Neuroticism and Psychoticism were regressed. These three scales together explain approximately 30% of the variance. Harm Avoidance being the best predictor and Neuroticism the poorest. When the standardised β weights and the zero and part correlations are examined it would seem that although Neuroticism has a high zero correlation with the BFS its part correlation is

Table 12.3.7 Stepwise linear regression of Harm Avoidance, Neuroticism, Psychoticism and Extraversion on the BFS in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.302	.300	.302	<.001	.233
EPQN	.360	.356	.058	<.001	.332
EPQP	.398	.393	.039	<.001	.205
EPQE	.415	.408	.017	<.001	-.165

Table 12.3.8 Stepwise linear Harm Avoidance, Psychoticism and Neuroticism on the BFS in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.214	.213	.214	<.001	.372
EPQP	.287	.285	.073	<.001	.250
EPQN	.300	.296	.013	<.001	.153

Table 12.3.9 Zero order and part correlations of Harm Avoidance, Neuroticism, Psychoticism and Extraversion with the BFS

	Men		Women	
	Correlation with the BFS	Part Correlation	Correlation with the BFS	Part Correlation
Harm Avoidance	.549	.142	.463	.279
Neuroticism	.548	.240	.423	.114
Psychoticism	.205	.204	.255	.246
Extraversion	.386	-.129	-	-

relatively small and the standardised β weight is smaller than that for Harm Avoidance or Psychoticism. However, all three of these variables add significantly to the model, with all three adding to the regression equation.

The broader measure of Harm Avoidance is clearly a better predictor of BFS scores in women.

12.3.4 The GHQ-28 as the dependent variable with the EPQ-R scales as independent variables

The GHQ-28 is also a measure of negative mood (this scales are described in section 2.5). All three of the EPQ-R scales correlated with the GHQ-28. In both men and women, Neuroticism had a large positive correlation with the GHQ-28, Extraversion a small negative correlation and Psychoticism a small positive correlation.

All three of the EPQ-R scales add significantly to a stepwise linear regression model, with the pattern being similar between men and women (see tables 12.3.10 and 12.3.11). In men Neuroticism is the best predictor of the GHQ-28 explaining 29% of the variance. Extraversion adds significantly to the model ($p=0.027$) predicting an additional 1% of the variance, with Psychoticism being the third predictor ($p=0.024$) also adding 1% of the variance. Extraversion and Psychoticism have similar (though opposite in sign) standardised β weights adding approximately the same amount of variance to the model.

In women, Neuroticism predicts 27% of the variance, and again is the best predictor of the GHQ-28. Extraversion and Psychoticism change positions with Psychoticism being the second predictor ($p=.003$) and Extraversion the

Table 12.3.10 Stepwise linear regression of Neuroticism, Extraversion and Psychoticism on the GHQ-28 in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.294	.292	.294	<.001	.503
EPQE	.305	.300	.010	.027	-.116
EPQP	.315	.309	.010	.024	.103

Table 12.3.11 Stepwise linear regression Neuroticism, Extraversion and Psychoticism on the GHQ-28 in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.267	.266	.267	<.001	.480
EPQP	.280	.277	.012	.003	.124
EPQE	.293	.289	.013	.002	-.116

Table 12.3.12 Zero order and part correlations of Neuroticism, Extraversion and Psychoticism with the GHQ-28

	Men		Women	
	Correlation with the GHQ-28	Part Correlation	Correlation with the GHQ-28	Part Correlation
Neuroticism	.543	.479	.517	.465
Extraversion	-.256	-.111	-.206	-.113
Psychoticism	.122	.102	.168	.122

third (p=.002). Again in the regression equation both of these scales have similar (though opposite in sign) standardised β weights.

When the zero-order correlations (table 12.3.12 or 12.1 and 12.2) are examined Extraversion has a higher correlation with the GHQ-28 than

Psychoticism in both men and women. However, the part correlations show that Extraversion with the other scales partialled out explains much less of the variance. This is probably due to the overlap between Neuroticism and Extraversion.

It is clearly Neuroticism that adds the most to this model and is far and away the best predictor of the GHQ-28. The regression equations are very similar in both men and women with the EPQ-R scales predicting approximately the same amount of variance in both sexes and the standardised β weights being very similar for all of the variables. The EPQ-R scales explain approximately 30% of the variance of the GHQ-28 in both men and women.

12.3.5 The GHQ-28 as the dependent variable with the TPQ scales as independent variables

The second stage of the regression analysis is to assess the predictive power of the scales from the TPQ on the GHQ-28. When the correlations between these scales were examined (tables 12.1 and 12.2) only Harm Avoidance was found to correlate significantly with this mood questionnaire. Therefore clearly, out of the TPQ scales Harm Avoidance is the best predictor of the GHQ-28.

12.3.6 The GHQ-28 as the dependent variable with the EPQ-R and TPQ scales as independent variables

In order to ascertain which scale is the best predictor of negative mood as assessed by the GHQ-28, the EPQ-R scales and Harm Avoidance were

entered into regression analyses. Extraversion following the addition of Harm Avoidance to the equation no longer had added significantly to the model and was therefore not included in the analyses. Tables 12.3.13 and 12.3.14 show the results of Neuroticism, Harm Avoidance and Psychoticism being regressed on the GHQ-28 in men and women respectively.

In men, Neuroticism is the best predictor explaining 29% of the variance ($p<.001$), with Harm Avoidance adding a further 3% ($p<.001$) and Psychoticism adding 1% ($p=.018$). However, this model is different in women. Harm Avoidance is the best predictor explaining 29% of the variance ($p<.001$), Neuroticism adding a further 5% ($p<.001$) and Psychoticism adding 2% ($p<.001$). These relationships are confusing, but are made slightly clearer by the part correlations (table 12.1.15). In men Neuroticism has the highest zero order correlation with the GHQ-28, followed by Harm Avoidance followed by Psychoticism. There is some overlap between Neuroticism and Harm Avoidance, but Neuroticism still explains the most variance on its own when the other scales are partialled out (8%). In women the zero order correlations are very similar between Neuroticism and Harm Avoidance with Harm Avoidance having the slightly larger correlation. However, in women Neuroticism explains less of the variance in the GHQ-28 on its own than Harm Avoidance. Although there are slight differences between men and women in the amount of variance each of the variables predict the pattern is reasonably similar.

Table 12.3.13 Stepwise linear regression of Neuroticism, Harm Avoidance and Psychoticism on the GHQ-28 in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.294	.292	.294	<.001	.382
TPQHA	.320	.316	.026	<.001	.230
EPQP	.332	.326	.011	.018	.107

Table 12.3.14 Stepwise linear of Harm Avoidance, Neuroticism and Psychoticism on the GHQ-28 in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.288	.287	.288	<.001	.375
EPQN	.337	.334	.048	<.001	.255
EPQP	.359	.356	.022	<.001	.152

Table 12.3.15 Zero order and part correlations of Neuroticism, Harm Avoidance and Psychoticism with the GHQ-28

	Men		Women	
	Correlation with the GHQ-28	Part Correlation	Correlation with the GHQ-28	Part Correlation
EQPN	.543	.282	.517	.191
TPQHA	.484	.169	.537	.282
EPQP	.122	.106	.168	.150

Harm Avoidance, Neuroticism and Psychoticism together predict approximately, in men, 33% of the variance and in women 36% of the variance. Again Harm Avoidance would seem to be the slightly broader variable explaining some of the variance which Neuroticism does not.

In sum, Neuroticism is a good predictor of the negative mood scale of the GHQ-28 predicting 27% of the variance in women and 29% of the variance in men. Extraversion is not a good predictor adding only 1% to the model. Neuroticism, in men, is the best predictor of all the personality scales entered into the regression equation. In women, Harm Avoidance explains more of the variance than Neuroticism suggesting that it may be a broader scale than Neuroticism.

12.3.7 The OHI as the dependent variable with the EPQ-R scales as independent variables

The OHI measures happiness. It has a large negative correlation with Neuroticism, a large positive correlation with Extraversion and a small negative correlation with Psychoticism in both men and women. These three scales were entered into the regression equation (see tables 12.3.16 and 12.3.17).

Neuroticism is the best predictor from the EPQ-R scales, Extraversion the second and Psychoticism the third in both men and women. All three scales in men predict approximately 50% of the variance, and in women 43%. In men, Neuroticism predicts more of the variance of the OHI than in women 33% versus 25%. The standardised β weights reflect the influence of Neuroticism and Extraversion on the regression equation more accurately. These are very similar in value although of opposite sign, with Extraversion adding positively to OHI scores and Neuroticism negatively. In women the

Table 12.3.16 Stepwise linear regression of Neuroticism, Extraversion and Psychoticism on the OHI in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.330	.328	.330	<.001	-.446
EPQE	.467	.464	.137	<.001	.405
EPQP	.499	.494	.032	<.001	-.180

Table 12.3.17 Stepwise linear regression Neuroticism, Extraversion and Psychoticism on the OHI in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.249	.247	.249	<.001	-.393
EPQE	.395	.393	.146	<.001	.411
EPQP	.430	.427	.035	<.001	-.189

Table 12.3.18 Zero order and part correlations of Neuroticism, Extraversion and Psychoticism with the OHI

	Men		Women	
	Correlation with the OHI	Part Correlation	Correlation with the OHI	Part Correlation
Neuroticism	-.574	-.425	-.499	-.381
Extraversion	.522	.386	.478	.400
Psychoticism	-.174	-.179	-.202	-.187

standardised β weight of Extraversion is marginally higher than that of Neuroticism, although Neuroticism has come out as the best predictor. When the part correlations are examined it is clear that when other scales are partialled out Extraversion explains slightly more of the variance in the

OHI on its own than Neuroticism (Table 12.3.18). Therefore a standardised unit increase in Extraversion would reflect a slightly greater increase in standardised OHI scores than a standardised unit increase in Neuroticism. The part correlations are slightly obscured in men. The part correlation of Psychoticism with the OHI is slightly higher than the zero order correlation, suggesting that Neuroticism or Extraversion act as suppressor variables. In sum, the OHI a measure of positive mood is predicted almost equally well by Neuroticism and Extraversion.

12.3.8 The OHI as the dependent variable with the TPQ scales as independent variables

The second stage of this analysis is to assess the TPQ scales. The OHI has a small correlation with Reward Dependence, a large correlation with Harm Avoidance but a negligible correlation with Novelty Seeking in men, therefore only the former two scales were entered into the regression analysis. In women the OHI correlated with all three scales, therefore all three were entered into the regression equation, however, Novelty Seeking did not add to the model when entered into a regression equation therefore only Harm Avoidance and Reward Dependence were entered. Tables 12.3.19 and 12.3.20 show the regression results.

The results are very similar in both men and women, with Harm Avoidance being the best predictor, explaining 47% of the variance in men and 45% of the variance in women. Both scales together predict approximately 50% of the variance. The standardised beta weights show the influence of Harm

Table 12.3.19 Stepwise linear regression of Harm Avoidance and Reward Dependence on the OHI in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.474	.472	.474	<.001	-.672
TPQRD	.509	.506	.035	<.001	.189

Table 12.3.20 Stepwise linear regression of Harm Avoidance and Reward Dependence on the OHI in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.450	.449	.450	<.001	-.664
TPQRD	.502	.500	.052	<.001	.228

Table 12.3.21 Zero order and part correlations of Harm Avoidance and Reward Dependence on the OHI

	Men		Women	
	Correlation with the OHI	Part Correlation	Correlation with the OHI	Part Correlation
TPQHA	-.688	-.669	-.671	-.664
TPQRD	.248	.188	.248	.228

Avoidance in the regression equation. The pattern is very similar in men and women. One standardised unit change in Harm Avoidance scores would lead to approximately a 0.67 decrease in OHI scores. These scales have a very close relationship. Reward Dependence does also have a significant influence on the OHI scores with the standardised beta weight being 0.189 in

men and 0.228 in women. The part and zero order correlations show that there is not much overlap between these scales (table 12.3.21).

12.3.9 The OHI as the dependent variable with the EPQ-R and the TPQ scales as independent variables

In order to investigate the relationships between all these scales further analyses with the EPQ-R scales and the two TPQ scales was carried out. Results are presented in tables 12.3.22 and 12.3.23. The results are quite complicated due to the interactions between all of the scales. A discussion of all the possible interrelationships of the questionnaires is not appropriate here.

However, to summarise, the personality scales together predict approximately, in men, 58% of the variance, and in women, 55% of the variance. The scales of Harm Avoidance, Reward Dependence, Neuroticism, Extraversion and Psychoticism all add significantly to the regression equation in both men and women. The best predictor in both men and women is Harm Avoidance. This scale predicts 47% of the variance in men, with a standardised β weight of –0.414, and in women it predicts 45% of the variance, with a standardised β weight of –0.509. In sum, the relationships between happiness as measured by the OHI and personality are complicated and involve more than one narrow personality measure. However, out of all the EPQ-R and the TPQ scales Harm Avoidance is the best predictor of the OHI.

Table 12.3.22 Stepwise linear regression of Harm Avoidance, Neuroticism, Extraversion, Psychoticism and Reward Dependence on the OHI in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.474	.472	.474	<.001	-.414
EPQP	.511	.508	.037	<.001	-.150
EPQE	.534	.530	.023	<.001	.155
EPQN	.560	.555	.026	<.001	-.257
TPQRD	.575	.569	.015	.001	.144

Table 12.3.23 Stepwise linear of Harm Avoidance, Reward Dependence, Psychoticism, Neuroticism and Extraversion on the OHI in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.450	.449	.450	<.001	-.509
TPQRD	.502	.500	.052	<.001	.169
EPQP	.531	.528	.028	<.001	-.166
EPQN	.540	.536	.009	.002	-.148
EPQE	.547	.543	.008	.003	.118

Table 12.3.24 Zero order and part correlations of Neuroticism, Harm Avoidance and Psychoticism with the OHI

	Men		Women	
	Correlation with the OHI	Part Correlation	Correlation with the OHI	Part Correlation
TPQHA	-.688	-.252	-.671	-.315
EPQP	-.174	-.142	-.202	-.152
EPQE	.522	.111	.478	.087
EQPN	-.574	-.183	-.499	-.105
TPQRD	.248	.123	.248	.144

12.3.10 The STAIS as the dependent variable with the EPQ-R scales as independent variables

The STAIS measures state anxiety. One could say that Neuroticism measures or is related to trait anxiety, therefore it is expected that Neuroticism will be a significant predictor of the STAIS.

The three scales from the EPQ-R all correlated significantly with the STAIS. In males there was a large correlation with Neuroticism and the STAIS (0.63), a moderate negative correlation with Extraversion (-0.34) and a small correlation with Psychoticism (0.10). In females there was a large correlation with Neuroticism (0.52), slightly smaller than in males, a small negative correlation with Extraversion (-0.27) and a small positive correlation with Psychoticism (0.19). These three were entered into the regression equation. Tables 12.3.25 and 12.3.26 display the results.

Neuroticism is clearly the best predictor of the STAIS in both males and females. More variance is predicted in men than in women (40% versus 26% respectively). In men Extraversion adds a further 3% and Psychoticism 0.7%. In women, Extraversion is also the second best predictor adding a further 3% also and Psychoticism adding in this case 2%. In women Psychoticism is a slightly better predictor than in men. The pattern is very similar in men and women. Neuroticism has a higher correlation with the STAIS in men than in women and this is reflected in the regression equation and the part correlations (see table 12.3.27). A unit increase in standardised Neuroticism scores leads to a 0.575 increase in standardised STAIS scores

12.3.25 Stepwise linear regression of Neuroticism, Extraversion and Psychoticism on the STAIS in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.401	.400	.401	<.001	.575
EPQE	.429	.425	.027	<.001	-.182
EPQP	.436	.431	.007	.038	.086

Table 12.3.26 Stepwise linear regression Neuroticism, Extraversion and Psychoticism on the STAIS in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.266	.264	.266	<.001	.461
EPQE	.293	.290	.027	<.001	-.183
EPQP	.314	.310	.021	<.001	.148

Table 12.3.27 Zero order and part correlations of Neuroticism, Extraversion and Psychoticism with the STAIS

	Men		Women	
	Correlation with the STAIS	Part Correlation	Correlation with the STAIS	Part Correlation
Neuroticism	.634	.548	.515	.447
Extraversion	-.344	-.173	-.267	-.178
Psychoticism	-.104	.085	.186	.147

in men, and a 0.461 increase in women. Extraversion in men and women are equivalent with the standardised beta weight being slightly higher in women than men for Psychoticism (0.148 and 0.086 respectively).

12.3.11 The STAIS as the dependent variable with the TPQ scales as independent variables

The second part of the analysis is to assess the predictive power of the scales from the TPQ scales. From the TPQ only Harm Avoidance significantly correlates with the STAIS, therefore out of these scales Harm Avoidance is clearly the best predictor. In men the Pearson's r=0.60 and in women 0.52.

12.3.12 The STAIS as the dependent variable with the EPQ-R and TPQ scales as independent variables

The Harm Avoidance scale was therefore entered into a regression equation with the EPQ-R scales. In males and females Extraversion no longer added to the regression equation at a significant level and was therefore dropped from any further analyses. Tables 12.3.28 and 12.3.29 show the results of stepwise linear regression of Harm Avoidance, Neuroticism and Psychoticism with the STAIS in males and females respectively.

In males Neuroticism is the best predictor explaining 40% of the variance, with Harm Avoidance adding 6% and Psychoticism adding only a further 0.8%.

Again the standardised β weights show a truer reflection of the influence of each of these variables with the equation reading:

STAIS = 0.405 EPQN + 0.332 TPQHA + 0.09 EPQP

Table 12.3.28 Stepwise linear regression of Neuroticism, Harm Avoidance and Psychoticism on the STAIS in males (n=339) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
EPQN	.401	.400	.401	<.001	.405
TPQHA	.458	.455	.057	<.001	.332
EPQP	.466	.461	.008	.026	.090

Table 12.3.29 Stepwise linear of Harm Avoidance, Neuroticism and Psychoticism on the STAIS in females (n=531) (significance represents the level of significance of adding the variable to the model)

Predictor Variable	R square	Adjusted R square	R square change	Significance	Standardised β weight
TPQHA	.275	.273	.275	<.001	.358
EPQN	.327	.325	.052	<.001	.263
EPQP	.355	.351	.027	<.001	.168

Table 12.3.30 Zero order and part correlations of Neuroticism, Harm Avoidance and Psychoticism with the STAIS

	Men		Women	
	Correlation with the STAIS	Part Correlation	Correlation with the STAIS	Part Correlation
EQPN	.634	.299	.515	.196
TPQHA	.602	.245	.524	.269
EPQP	.104	.089	.186	.166

The part correlations give an indication to how these variables overlap. Although both Neuroticism and Harm Avoidance have high zero order correlations, the correlations of these scales with the other scales partialled

out are much smaller showing that there is indeed a great deal of overlap between the two.

In women, Harm Avoidance is the highest predictor explaining 28% of the variance, with Neuroticism adding 5% and Psychoticism adding 3%. Again the standardised β weights show a truer reflection of the influence of each of these variables with the equation reading:

STAIS = 0.358 TPQHA + 0.263 EPQN + 0.168 EPQP

Overall these scales together predict less of the variance in women than in men of the STAIS and that in each case the regression coefficients are smaller in women than in men. However, in both genders Neuroticism and Harm Avoidance explain approximately the same amount of variance with Psychoticism coming in as the third predictor.

12.4 Summary

Four different mood questionnaires were assessed. Two of which measured negative mood – the BFS and the GHQ-28, one which measured positive mood – the OHI and one which measured anxiety.

As expected Neuroticism and Harm Avoidance were positive predictors for negative mood and anxiety, and were negative predictors for positive mood. Also Extraversion was a negative predictor of negative mood and a positive predictor of positive mood. However, relationships were not always simple.

When the EPQ-R scales were assessed in isolation, Neuroticism always was the highest predictor and in all case but one had also the highest standardised β weight. In women, with the OHI as the dependent variable, Extraversion had more influence in the regression equation than Neuroticism, although in the stepwise linear regression, Neuroticism explained the most variance. Neuroticism had a high predictive power for mood particularly negative mood. Likewise when the TPQ was examined in isolation with the mood scales in all cases the scale of Harm Avoidance was the highest predictor with the highest standardised β weights. In sum, Neuroticism and Harm Avoidance were the best predictors of mood with Harm Avoidance being a slightly broader variable at times coming out as the best predictor. Therefore in this population it is justified to say that Neuroticism is a good predictor of negative mood.

Neuroticism therefore can be extracted from the EPQ-R in this sample, it corresponds very highly with Harm Avoidance, and it is a good predictor of negative mood. Harm Avoidance is also a good predictor of negative mood but it appears to relate more broadly to mood. HA was the best predictor of the OHI (positive mood) when both the TPQ and EPQ-R scales whereas for the negative mood scales HA and N were roughly equivalent. Neuroticism may be a more distinct predictor of negative mood. The next step in this thesis is to examine whether Neuroticism is a good predictor of mood change via serotonin depletion.

Chapter Thirteen Results IV: Neuroticism as a predictor of mood change by tryptophan depletion

This chapter describes the results from the tryptophan depletion study. Chapter twelve related mood and personality questionnaires and showed that Neuroticism was a predictor of negative mood. The main aim of this chapter is to test whether Neuroticism can predict a dip in mood following tryptophan depletion. The main hypothesis being tested is whether Neuroticism and low mood are related via serotonin. Changes are measured by a number of different measures including self-report mood scales, cognitive tests, electroencephalogram, and physical measures such as pulse.

Two groups are tested within this hypothesis, those who score at the high end of the Neuroticism scale compared to those who score at the low end of the Neuroticism scale. Those who scored at the high end were expected to have a mood change following tryptophan depletion.

A number of measures were tested at baseline (prior to consumption of the amino acid drink) and then again during the "depletion window", four to six hours following consumption of the drink. These measures were compared at baseline in order to ascertain whether Neuroticism had any affect on these scores. Not all measures or tests were given both in the morning and afternoon. Therefore the analysis is laid out in the following fashion so that in each section the analysis used is the same.

Baseline measures are compared, followed by main effects of tryptophan depletion for each type of test (for instance mood, physical measures or psychometric tests). Order effects are reported at the end of the section for those tests where order may have had an effect.

The data were analysed in the following way. Parametric statistics were used if the data were normally distributed, had homogeneity of variance and were of at least interval level. Normality of the data was tested by inspection of frequency histograms and the skewness statistic. Homogeneity of variance was assumed if Levene's test for equality of variance was not statistically significant. Data were analysed using repeated measures MANOVA. At the start of each set of analyses a table is given describing the within and between subjects factors. This test was used in the first instance whether data met parametric criteria or not, as there is no non-parametric equivalent. Post-hoc tests were either t-tests when the data met parametric criteria or when the data was non-parametric Mann-Whitney U-tests or Wilcoxon signed ranks tests. All results reported are two-tailed unless indicated otherwise. Significance was set at $p<0.05$. Significance levels were rounded to two decimal places unless between 0.045 and 0.05, which are reported to three decimal places.

13.1 Selection of the High and Low Scorers on the Neuroticism Scale

Volunteers were selected from a group who had completed or had missed less than 5 items (not including the N scale) on the Eysenck Personality Scale – Revised (n=1031). Out of this large group those scoring above the

top or below the bottom 5% EPQ-R N scale population norms were selected (n=181). The norms were taken from Eysenck et al (1985). These norms were used rather than selecting from the total population gathered in this study as the recruitment and selection were performed on an ongoing basis. All of these individuals (n=181) were then requested to take part in the tryptophan depletion study. Individuals were sent a questionnaire asking about their personal medical and psychiatric history. If necessary a further interview took place by telephone to clarify any issues brought up on the questionnaire. A number of individuals were excluded at this point. A psychiatrist in order to confirm and expand on the information on the medical questionnaire interviewed all of the volunteers who came into the department for the test days. Individuals were also excluded at this point. Out of the 181 individuals selected for the study 149 did not complete the test days. Table 13.1 describes by Neuroticism score a summary of the reasons why 149 did not complete the test days.

It is clear from the table that many more individuals who scored at the upper end of the EPQ-R N scale were contacted, than those who scored at the lower end of the scale. This may have been due to a number of reasons. Firstly the study was titled "Personality, Mood and Diet" which may have attracted those more interested or worried about their own moods. Not all the students recruited were undergraduates where one may expect the full range of Neuroticism score, some were postgraduate students. Although there is no direct evidence of this one could hypothesise that there may be

Table 13.1: High and low N scorers who were selected for the tryptophan depletion study

Reason for exclusion	Low Scorers	High Scorers	Total
Total Contacted	**57**	**124**	**181**
Did not reply to initial request	21	33	54
Dropped out	9	17	26
Depression	3	18	21
Bulimia	0	1	1
Panic attacks	0	1	1
Bipolar	0	1	1
Chronic fatigue	0	1	1
Migraine	2	4	6
Asthma	2	9	11
Head injury	1	2	3
Dyslexic	1	0	1
Abnormal menstrual cycle	0	2	2
Drug use	0	3	3
Miscellaneous illnesses	1	7	8
Fainted after blood sampling	0	2	2
Vomited after ingestion of drink	2	6	8
Total Excluded	**42**	**107**	**149**
Total Completed Test Days	**15**	**17**	**32**

few individuals who score at the low end of the Neuroticism scale who take up a postgraduate degree. Unfortunately a question asking which course or degree was not included in the questionnaire pack therefore this hypothesis can not be tested. Only anecdotal evidence can be included where following recruitment from postgraduate areas there appeared to be very few individuals returning questionnaires who scored at the low end of the scale.

Lastly, as noted in the methods a large percentage of the recruiting was performed within the lecture halls. Again this has not been tested within this study but one could propose that those individuals who have higher N scores may turn up to their lectures whereas those with lower N scores may not. These latter two possible reasons for more high N scores being recruited are

merely conjecture and the most likely reason is that those who score high on N were more interested in finding out about their own moods.

However, in the final group who completed the test days there were an equivalent number of high N and low N scorers. The high scorers had much more illness whether this was psychiatric such as depression, bipolar, bulimia, panic attacks or chronic fatigue, or physical illness such asthma, migraine, and within the miscellaneous category ulcers, allergies, or colds and flus.

Some had agreed to participate and then later dropped out, this was due to a number of reasons such as moving, having exams, work pressure or no longer wishing to spend two days doing a study.

Those who took part and those who dropped out were compared on personality scores (see table 13.2.1). The high and low scorers were compared separately. There were no differences on any of the personality measures in the low N scorers between those who took part and those who dropped out. The high N scorers did differ on one measure. Those who dropped out had significantly higher N scorers (Mann-Whitney U-test, $Z=2.95$, $n=123$, $p<.005$).

13.2 Comparison of the two groups

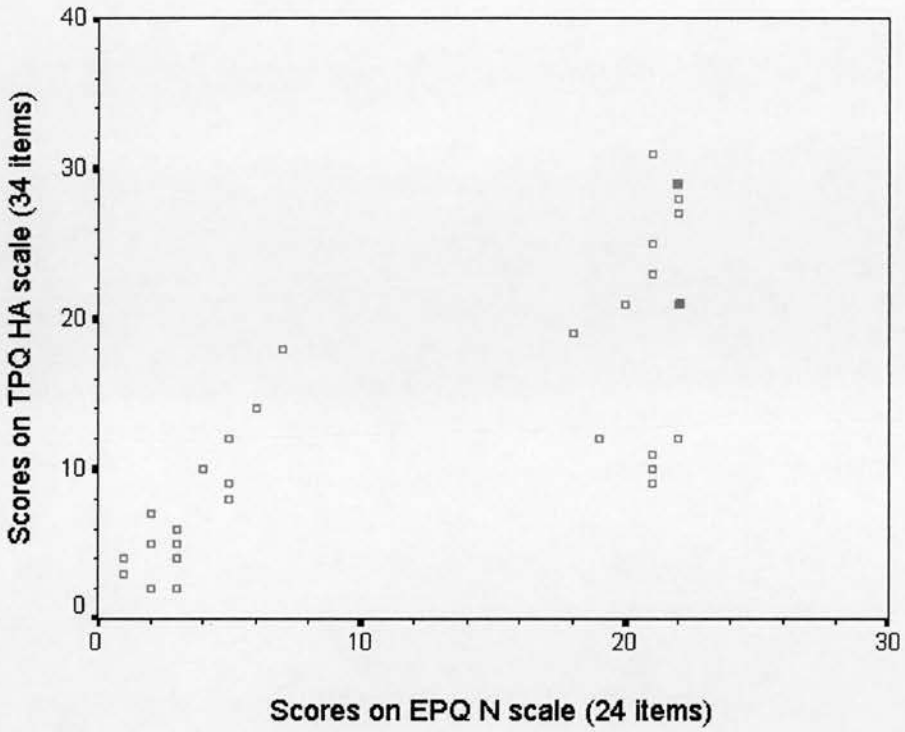
The groups, high and low EPQ Neuroticism scorers, were selected solely on their EPQN scores, and as noted in section 13.1 a large number dropped out.

Table 13.2.1: High and low N Scorers personality, depression, IQ and age scores

	Low N (SD) Completers		Low N Dropouts		High N (SD) Completers		High N Dropouts	
N	3.5	(1.8)	3.6	(2.0)	21.1	(1.2)	22.1	(1.2)
E	17.5	(3.3)	15.9	(5.0)	13.6	(5.4)	13.1	(5.8)
L	5.6	(3.8)	8.2	(3.6)	4.8	(3.3)	5.3	(3.4)
P	6.9	(3.5)	6.4	(3.5)	6.9	(3.7)	8.1	(4.1)
HA	7.3	(4.6)	9.3	(5.5)	20.5	(7.3)	23.1	(6.2)
RD	18.6	(5.0)	18.1	(5.4)	20.5	(4.7)	19.8	(4.2)
NS	20.4	(5.7)	17.1	(5.6)	17.5	(7.5)	18.6	(6.4)
Age	20.6	(2.8)	20.8	(3.0)	23.0	(7.3)	21.6	(4.5)
HDRS	0.7	(1.0)	-		0.7	(1.7)	-	
NART	108.5	(8.7)	-		111.4	(8.5)	-	

The high versus low scorers are compared on other personality and mood measures in table 13.2.1. They are well matched for personality on the EPQ Lie scale, EPQ Psychoticism, TPQ Reward Dependence and TPQ Novelty Seeking. However, Extraversion does significantly differ between high and low N scorers (Mann-Whitney U-test, $Z=1.97$, $n=32$, $p=0.049$), with the low N's having higher extraversion scores. As expected the TPQ Harm Avoidance scores and the EPQ Neuroticism scores differ significantly between the two groups (Mann-Whitney U-test, $Z=4.22$, $n=32$, $p<0.001$; Mann-Whitney U-test, $Z=4.88$, $n=32$, $p<0.001$). Figure 13.2.1 displays Neuroticism and Harm Avoidance scores in a scatter plot. For the low N scorers, Neuroticism and Harm Avoidance correlated highly (Spearman's $rho=0.809$, $n=15$, $p<0.001$), however the Neuroticism and Harm Avoidance did not correlate significantly or to a large degree in the high N scorers

Figure 13.2.1: Scatter plot showing the distribution of scores on HA and N



A different coloured box represents no. of cases,
empty red box = 1 case
filled in red box = 2 cases
blue box = 3 cases

(Spearman's rho=0.402, n=17 ns). This may be due to an attenuation in variance. The low **N** scores range between 1 and 7 whereas the high scores range between 18 and 22. There may simply not be enough variance within this sample to gain a large correlation. Further, correlations between Harm Avoidance were high among the whole unselected sample (r = 0.68 males n= 347 and r = 0.64 females n=550).

The two groups are well matched for IQ as measured by the National Adult Reading Test and well matched for age. Both groups' scores are nearing the floor on the adapted Hamilton Depression Rating Scale. There were more

women (n=20) in the group than men (n=12) but this is not statistically significant (χ^2 =2.0 df=1 ns). Men and women were fairly evenly split between the two groups (χ^2 = 0.65 df=1 ns). Table 13.2.2 exhibits group by gender.

All other baseline measures are presented in the relevant sections.

13.3.1 Mood Measures given both prior and post amino acid drink: Comparison of Baseline Scores

An adapted Hamilton Depression Rating Scale (HDRS), the Profile for Mood States (POMS), the Befindlichskeitskala (BFS) and the Positive and Negative Affectivity Scale (PANAS) were given both in the morning and in the afternoon. The adapted Hamilton Depression Rating Scale, in this case, was used to measure a putative dip in mood which may have been comparable to a mood dip seen in other studies of tryptophan depletion using patients with a previous history of depression e.g. (Smith, Fairburn, & Cowen, 1997). However, both before and after drinks, scores were close to zero. The rating scale as described in section 2.4 is a tool designed for use in patients with aprevious history of depression, whereas in this case all the subjects were healthy volunteers with no history of psychiatric illness. This questionnaire will therefore not be analysed further.

Figures 13.3.1-13.3.12 show baseline scores for the other mood measures on both test days. Scores were analysed using two-way repeated measures MANOVA, table 13.3.1 describes the analysis.

Table 13.2.2: High and low N scorers by gender

Gender	High N Scorer	Low N Scorer	Totals
Male	5	7	12
Female	10	10	20
Totals	15	17	32

Table 13.3.1: MANOVA table describing within and between subject factors for analysis of baseline scores

Analysis	Within Subjects Factor	Between Subjects Factor
2-way repeated measures MANOVA	Day: Baseline scores on morning of depletion vs non-depletion day	Group: High vs Low Scorers on the EPQ N scale

Key for Figures 13.3.1 – 13.8.6

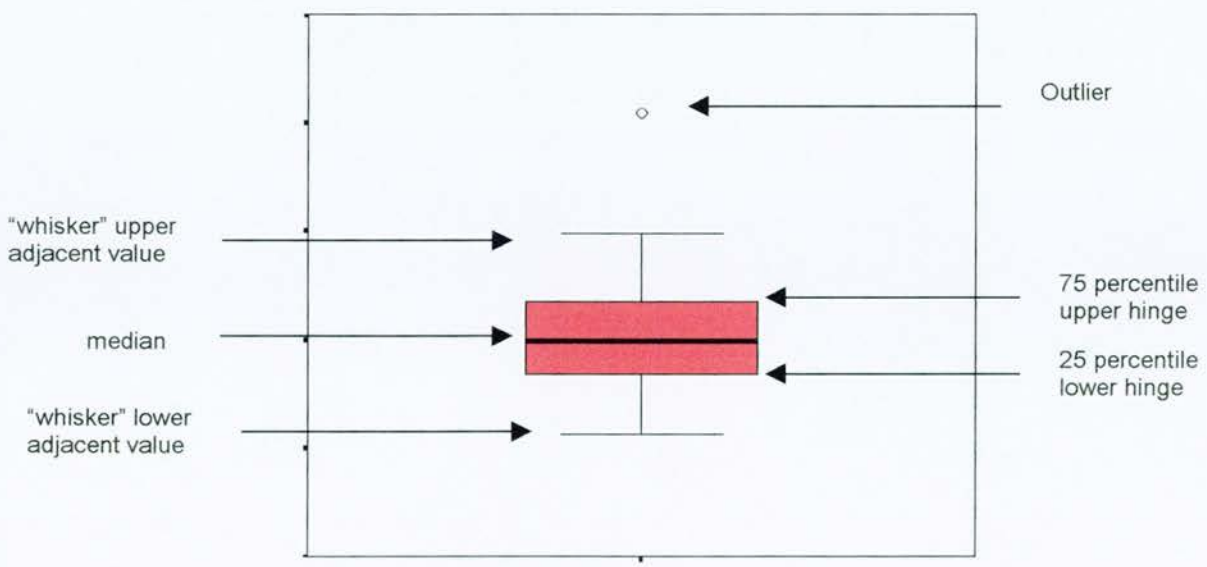
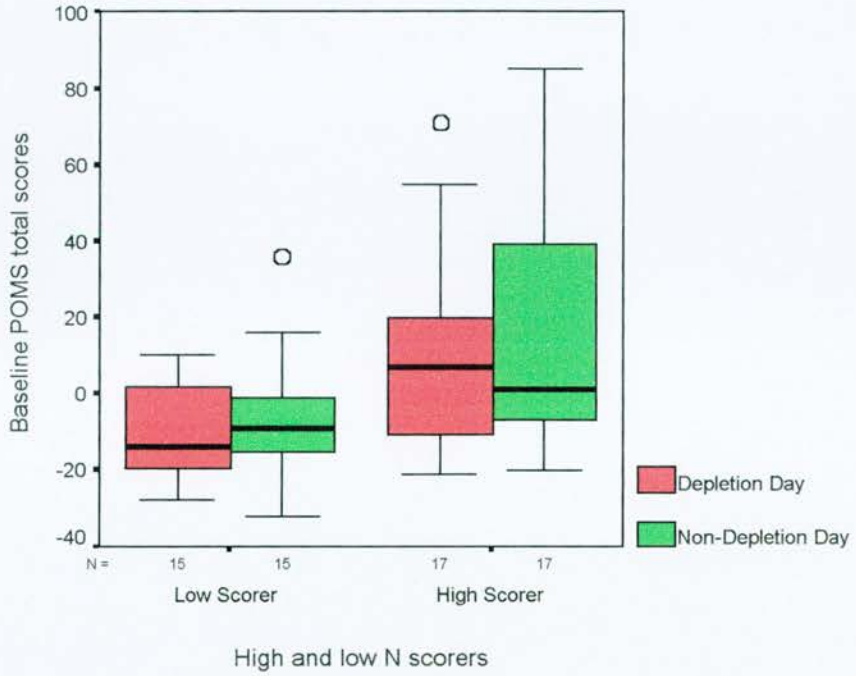


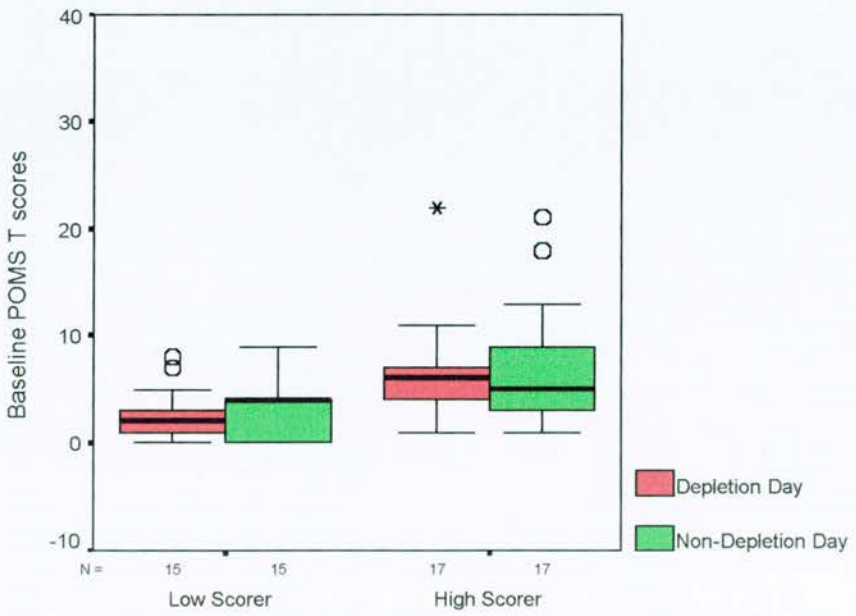
Figure 13.3.1: Scores at baseline on the total POMS



High and low N scorers

POMS total = tension-anxiety (T) + depression-dejection (D) + anger-hostility (A) + fatigue (F) + confusion-bewilderment (C) - vigour (V)

Figure 13.3.2: Scores at baseline on the POMS T (tension-anxiety) sub scale



High and Low N Scorers

Figure 13.3.3: Scores at baseline on the POMS D (depression-dejection) sub scale

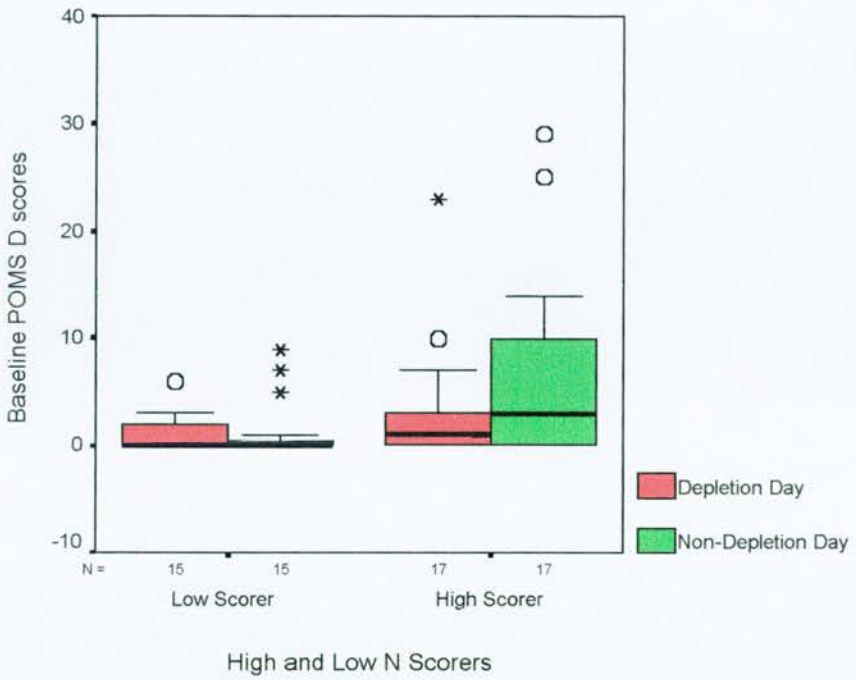


Figure 13.3.4: Scores at baseline on the POMS A (anger-hostility) sub scale

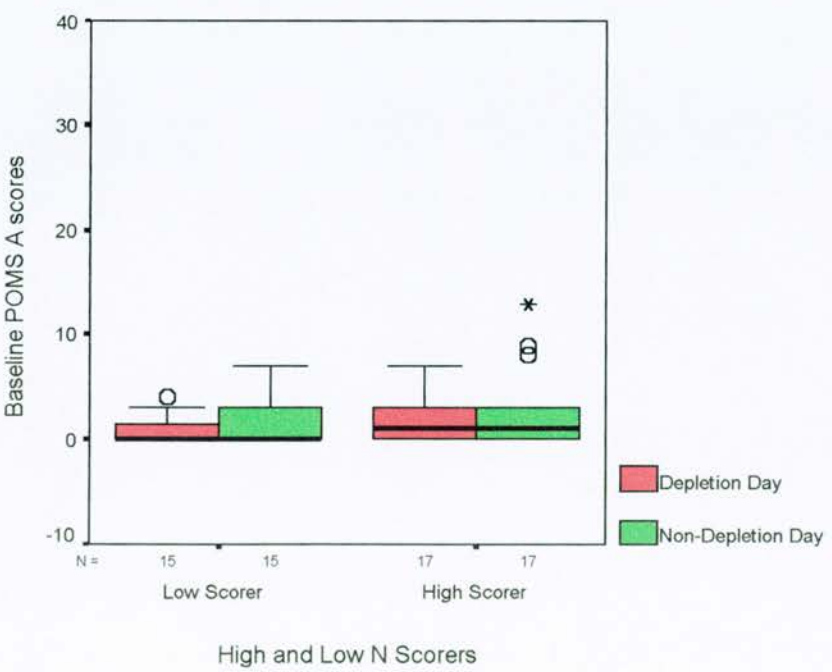


Figure 13.3.5: Scores at baseline on the POMS V (vigour) sub scale

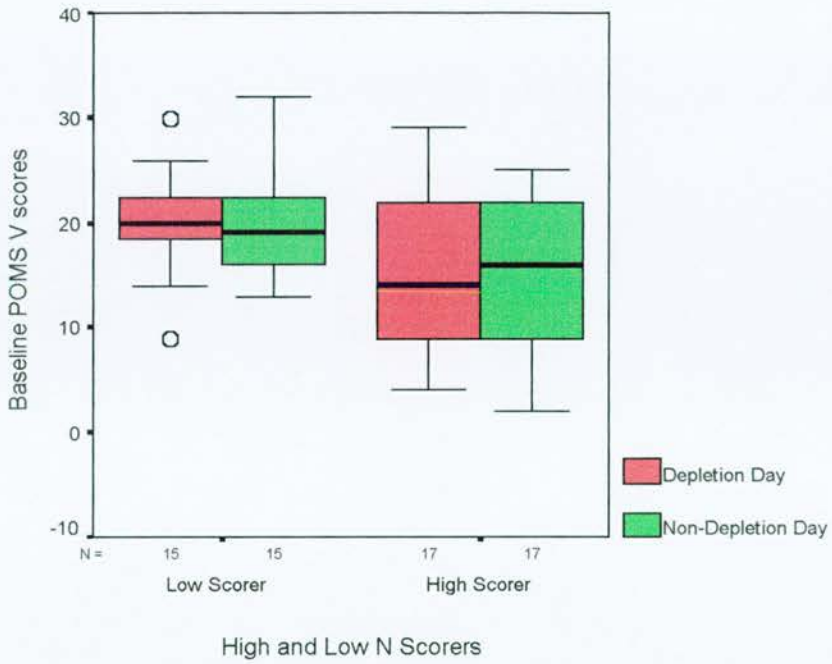


Figure 13.3.6: Scores at baseline on the POMS F (fatigue) sub scale

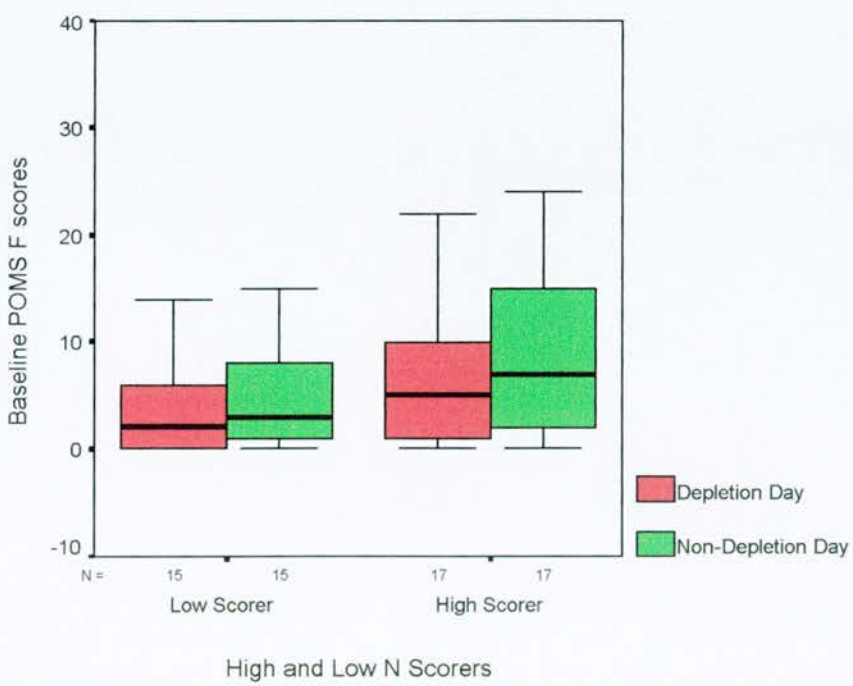


Figure 13.3.7: Scores at baseline on the POMS C (confusion-bewilderment) sub scale

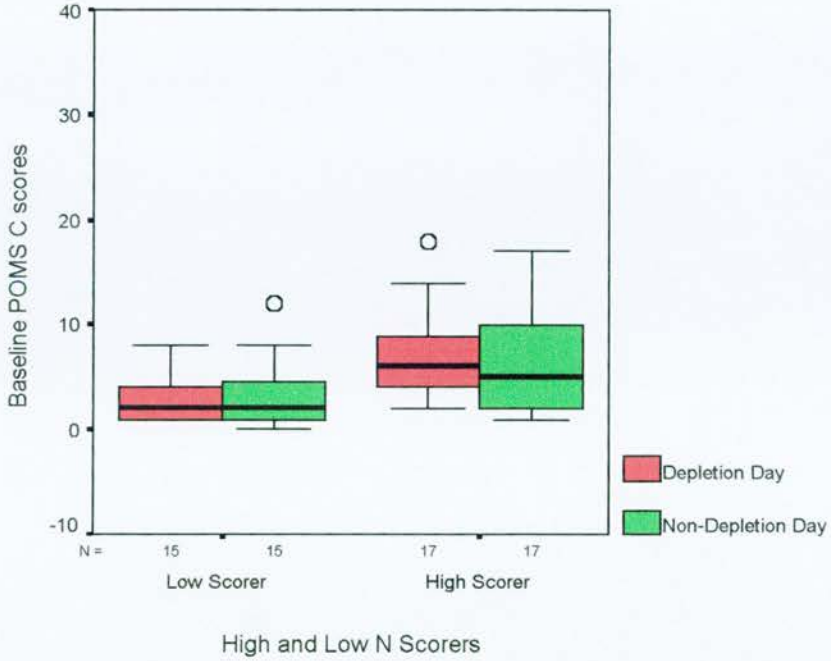


Figure 13.3.8: Scores at baseline on the BFS (total score)

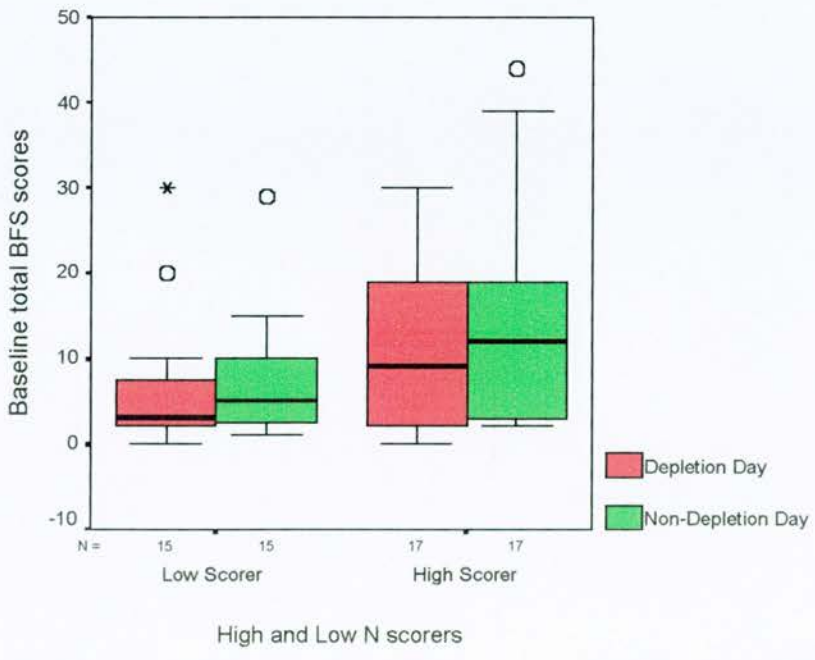


Figure 13.3.9: Scores at baseline on the BFS D sub scale

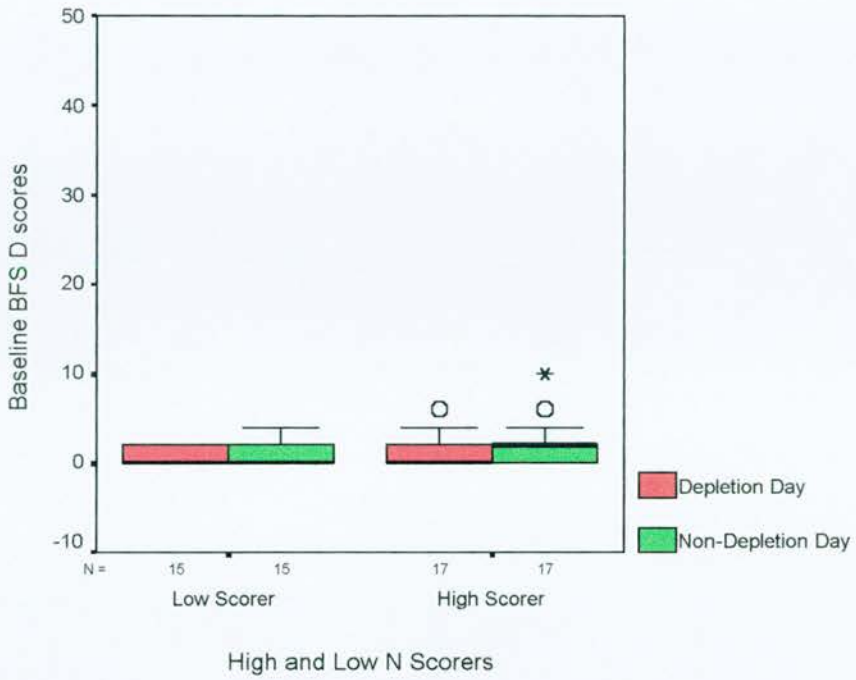


Figure 13.3.10 Scores at baseline on the BFS F sub scale

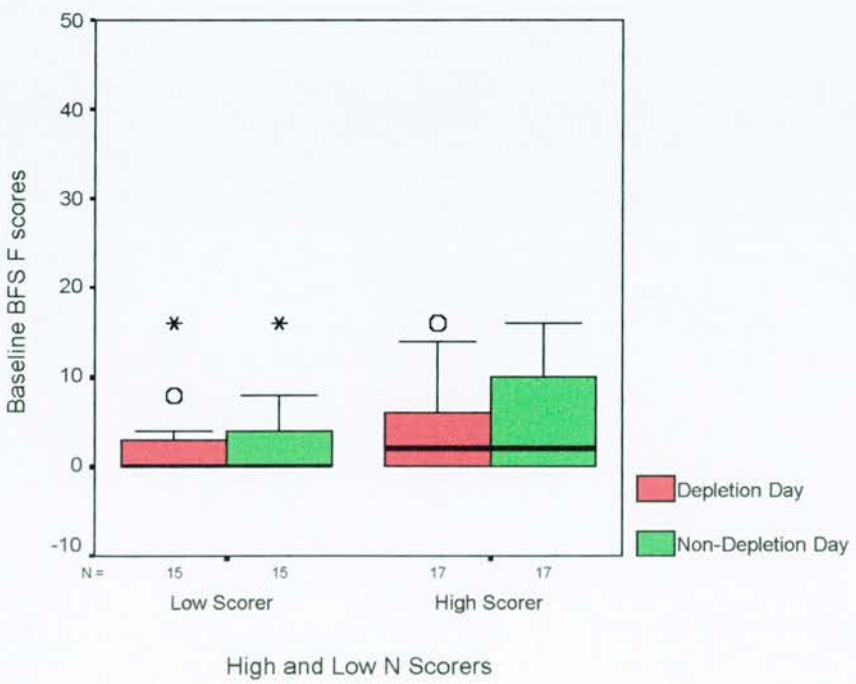


Figure 13.3.11: Scores at baseline for positive affectivity

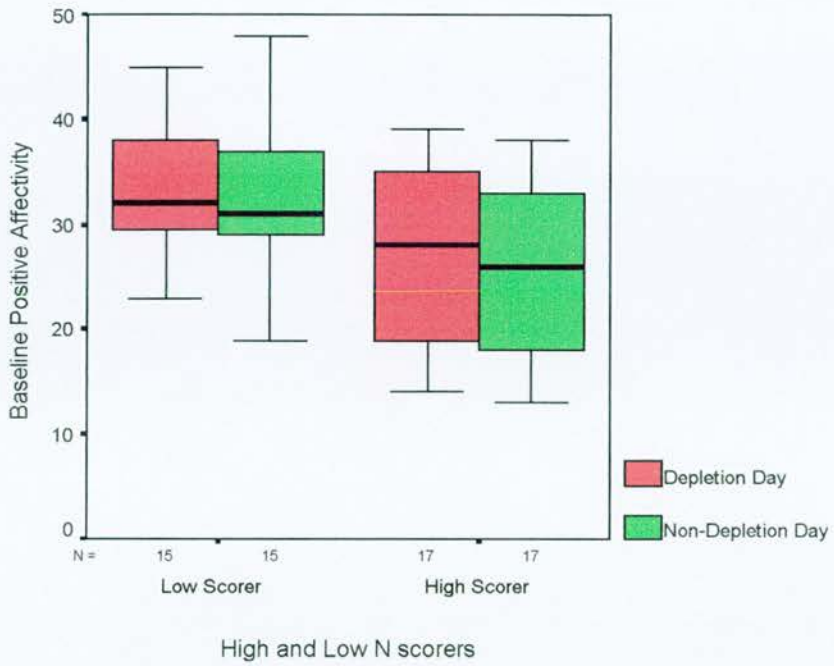
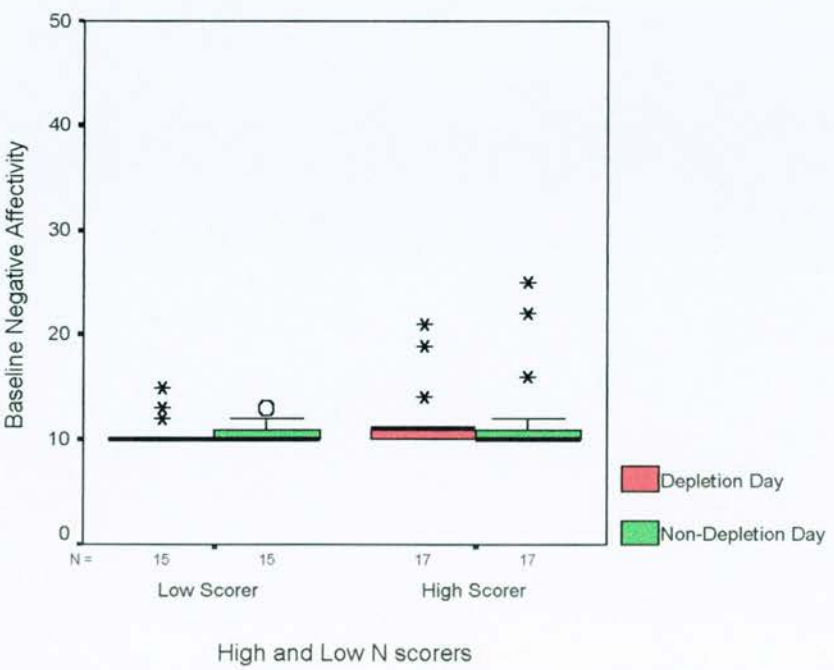


Figure 13.3.12: Scores at baseline for negative affectivity



The groups are divided into high and low scorers on the Neuroticism scale. It has been established that Neuroticism is highly related to mood, particularly negative mood. Therefore it would be expected that there might be some differences at baseline between two groups on scales which measure negative mood. Baseline scores are the scores in the morning prior to testing. Placebo versus depletion days were compared to assess the variability in the mood measures.

At baseline there were no significant differences between scores on BFS total scores, or on its sub-scales, on the POMS Fatigue scale, POMS Aggression scale, POMS Vigour, POMS Depression or on negative affectivity as measured by the PANAS.

Examination of POMS total scores showed a significant main effect of subject group ($F_{1,30}$=5.92, p=0.02) and a significant effect of day ($F_{1,30}$=4.26, p=0.048). The effect of day is which day the person is to be depleted on. The high N scorers had higher scores on both days.

High N scorers scored higher on POMS Tension ($F_{1,30}$=9.18, p=0.005), on both depletion and non-depletion days (Mann-Whitney U-test, Z=2.95, n=32, p=0.003, Mann-Whitney U-test, Z=2.14, n=32, p=0.03 respectively). The high N scorers had higher scores on POMS Confusion scale ($F_{1,30}$=7.83, p=0.01) the groups differing significantly from each other on the depletion day (Mann-Whitney U-test, Z=3.36, n=32, p=0.001).

There were group effects on positive affectivity on the PANAS with the High N scorers having lower scores ($F_{1,30}$=5.97, p=0.02), on both days (t=2.38, df=30, p=0.02; t=2.2, df=30, p=0.04 respectively).

The high and low N scorers were similar on most of the scales at baseline. However, those who scored at the high end of the scale had higher scores on the POMS total, POMS tension, and POMS confusion scales. This group also had lower scores on positive affectivity from the PANAS. There was also an effect of day on these scores. The effect was for both the depletion and non-depletion day for all of these scales except for the POMS Confusion scale where the effect was solely on the depletion day.

13.4 The Effect of Tryptophan Depletion Versus Placebo Drink On Repeated Mood Scores

In order to compare the effect of the low tryptophan drink with the placebo drink, in the two groups, change scores were calculated. High and low N scorers differed from each other on a number of scales (detailed in section 13.3.1, also there were differences on some of the mood scales between the two test days. The change score should control for some of these differences in baseline scores.

Change score = Afternoon score - Morning score

In all cases a positive score means that the volunteer feels worse in the afternoon, that is feels more depressed, more fatigued, more tense and so on, **except** for the sub-scale vigour on the POMS and positive affectivity on

the PANAS. An increase on these scales would mean that the individual feels more vigorous or has more positive affectivity following the drink rather than prior to the drink. If tryptophan depletion does produce a lowering of mood, it would be expected that for the latter two scales the change score would be negative, while on the other mood scales the change score would be positive. Table 13.4.1 describes the two-way repeated measures MANOVA.

The means and standard deviations for the changes in mood on the depletion and non-depletion days are shown in table 13.4.2 and the spread of data is shown in box plots in figures 13.4.1-13.4.12.

The drinks had **no significant effect** on **any** of the mood scales described in this section. Therefore there was not a significant change in mood from morning to afternoon due to either the tryptophan depleting drink or the placebo drink for either the high or low N scorers.

Table 13.4.1: Repeated measures MANOVA for analysing the effect of tryptophan depletion on change scores

Analysis	Within Subjects Factor	Between Subjects Factor
2-way repeated measures MANOVA	Day: Change scores on depletion vs non-depletion day	Group: High or Low Scorers on the EPQ N scale

Table 13.4.2: The effect of tryptophan depletion and placebo on afternoon-morning mood measures

		Mean (SD)	
Test	**Group**	**Depleted**	**Non-depleted**
BFS Total	**High N**	**2.4 (8.5)**	**-0.8 (9.3)**
	Low N	**-1.3 (10.5)**	**-1.5 (8.9)**
BFS DM	**High N**	**1.0 (2.2)**	**0.8 (2.7)**
	Low N	**0.1 (1.9)**	**-0.3 (2.3)**
BFS Fatigue	**High N**	**0.4 (5.2)**	**-1.4 (6.0)**
	Low N	**-0.7 (5.3)**	**-1.2 (4.1)**
POMS Total	**High N**	**0.4 (20.0)**	**-5.3 (17.8)**
	Low N	**-2.6 (8.5)**	**-0.1 (14.9)**
POMS D	**High N**	**-0.2 (2.4)**	**-2.2 (5.9)**
	Low N	**-0.8 (1.4)**	**0.0 (2.4)**
POMS F	**High N**	**0.2 (6.6)**	**-2.0 (4.8)**
	Low N	**-0.9 (3.8)**	**-0.2 (3.6)**
POMS V	**High N**	**-0.8 (6.9)**	**0.1 (6.5)**
	Low N	**-0.8 (4.1)**	**-0.6 (5.4)**
POMS A	**High N**	**0.1 (1.4)**	**-0.7 (2.8)**
	Low N	**-0.2 (0.7)**	**0.2 (2.4)**
POMS T	**High N**	**-0.7 (3.7)**	**-0.7 (3.0)**
	Low N	**-1.1 (1.8)**	**-0.8 (3.2)**
POMS C	**High N**	**0.2 (4.9)**	**0.4 (3.3)**
	Low N	**-0.4 (1.7)**	**0.3 (3.3)**
Positive affectivity	**High N**	**-3.2 (6.0)**	**-1.5 (8.0)**
	Low N	**-3.9 (3.5)**	**-4.5 (5.6)**
Negative Affectivity	**High N**	**-1.1 (2.7)**	**-1.6 (2.9)**
	Low N	**-0.5 (1.4)**	**-0.3 (0.7)**

Figure 13.4.1: The effect of tryptophan depletion on POMS total scores

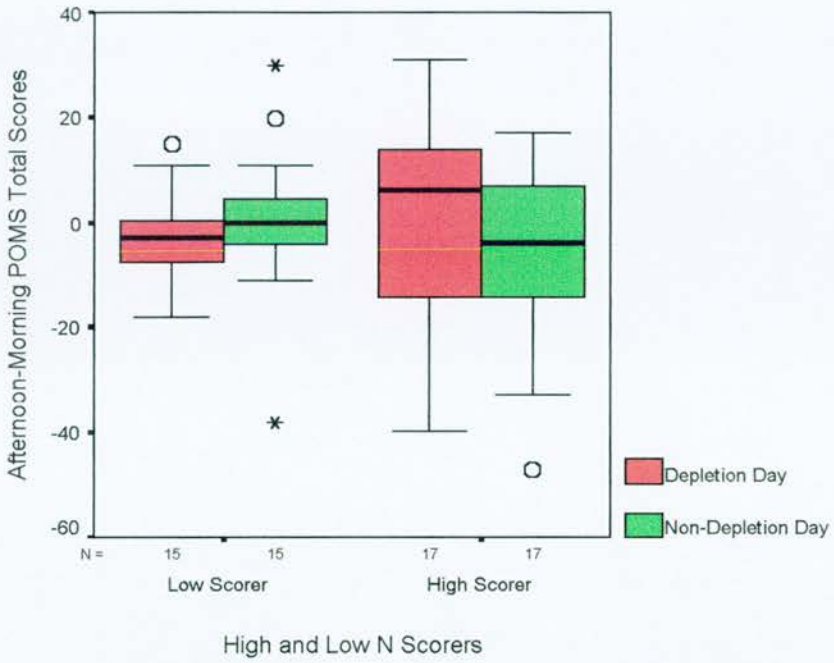


Figure 13.4.2: The effect of tryptophan depletion on POMS T scores

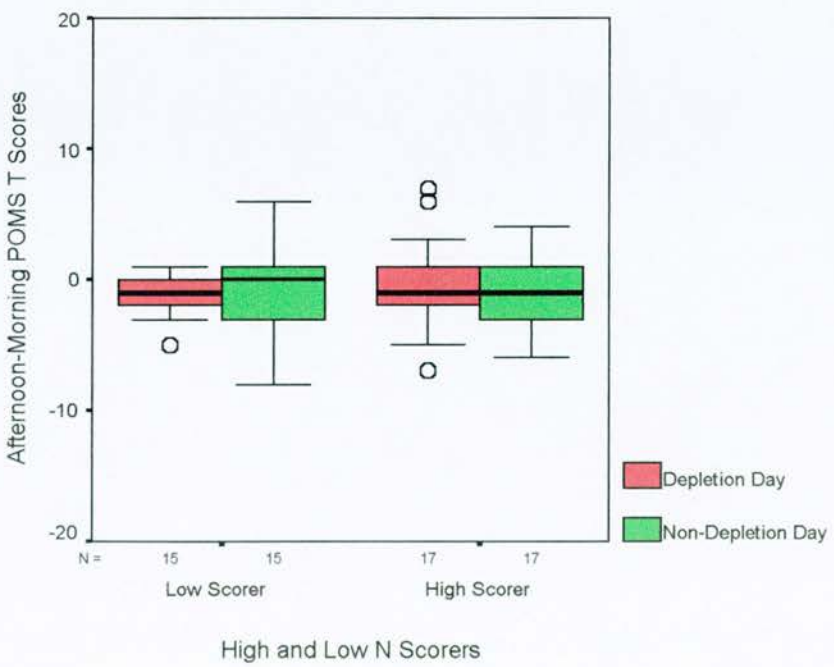


Figure 13.4.3: The effect of tryptophan depletion on POMS D scores

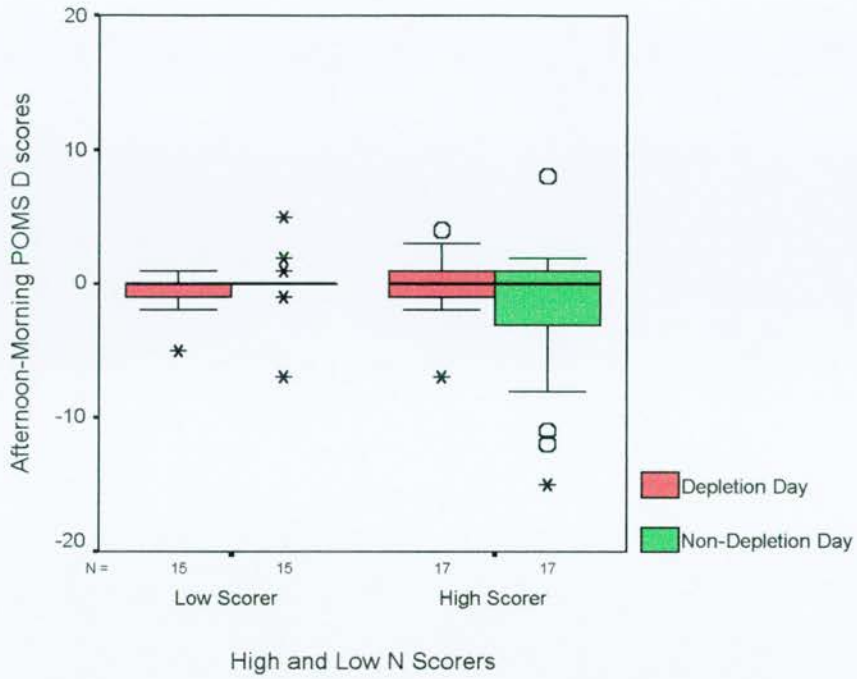


Figure 13.4.4: The effect of tryptophan depletion on POMS A scores

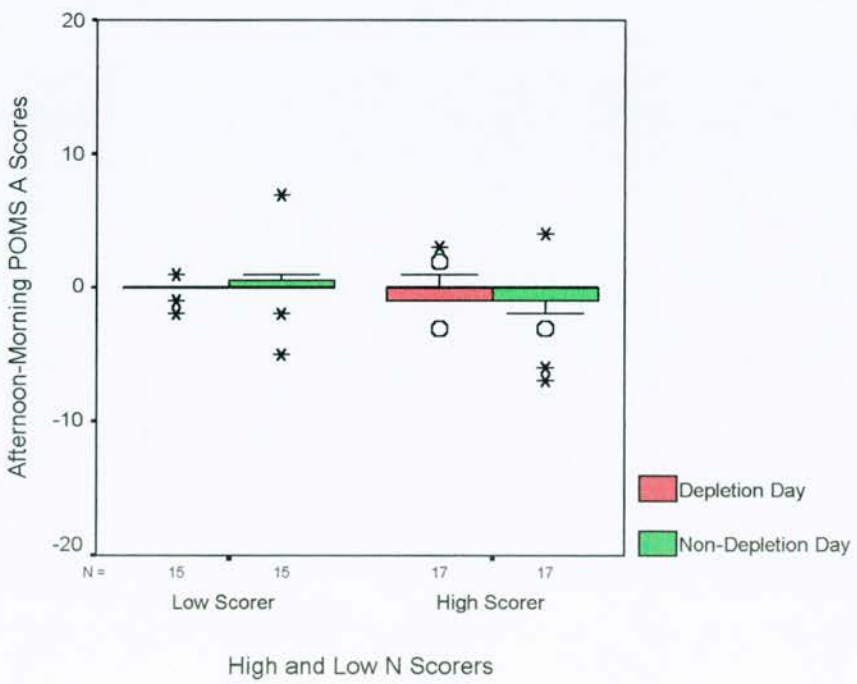


Figure 13.4.5: The effect of tryptophan depletion on POMS V scores

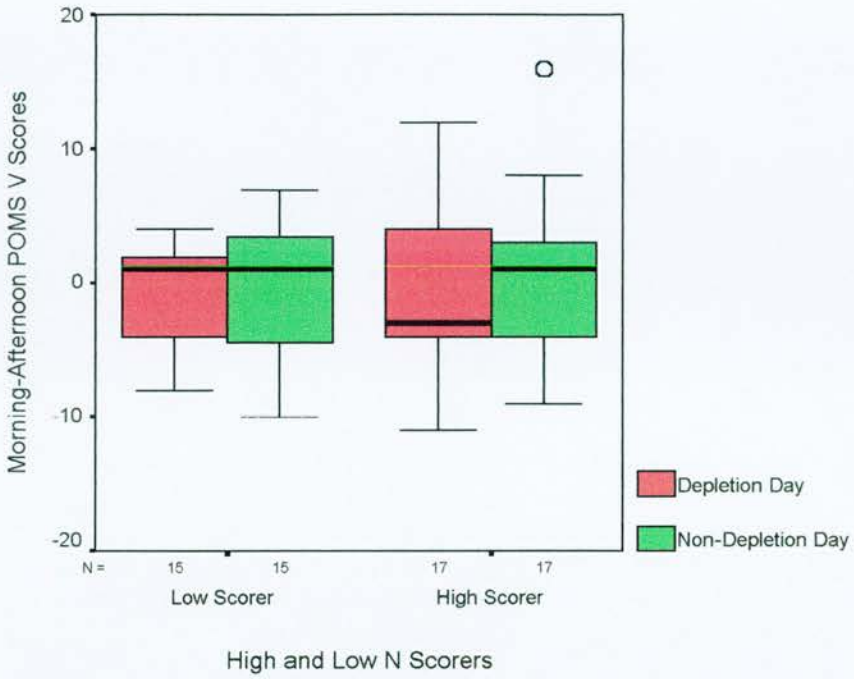


Figure 13.4.6: The effect of tryptophan depletion on POMS F scores

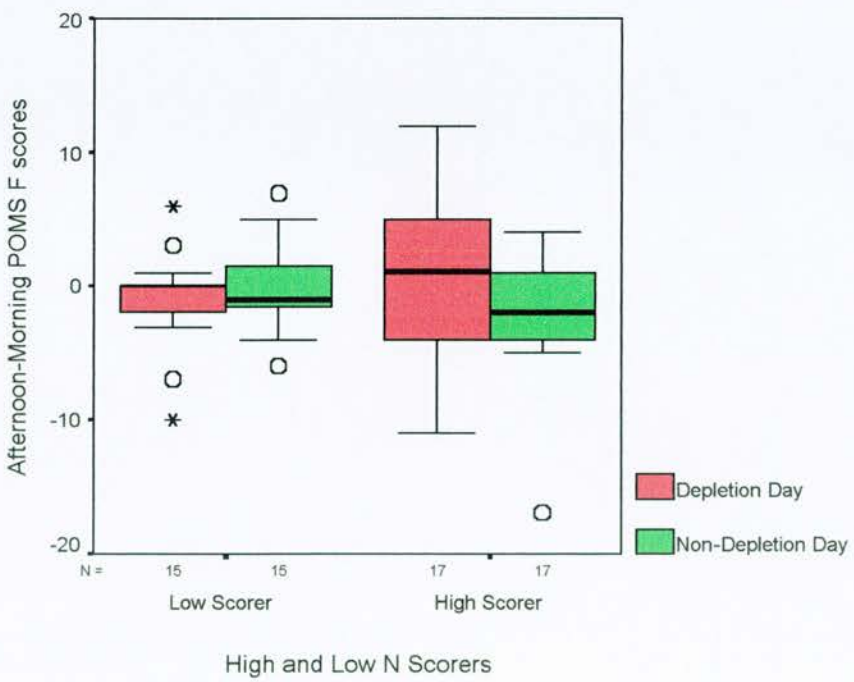


Figure 13.4.7: The effect of tryptophan depletion on POMS C scores

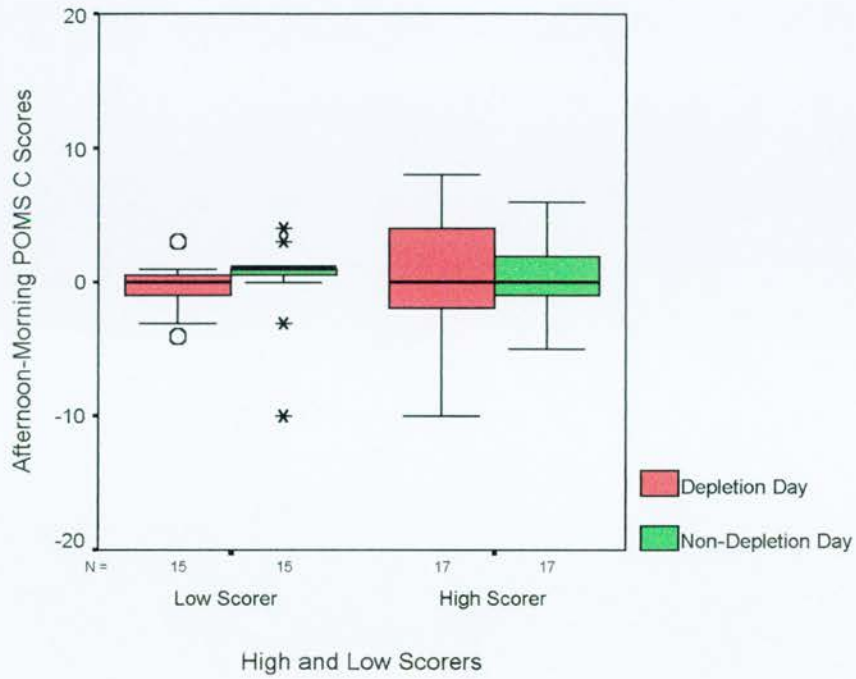


Figure 13.4.8: The effect of tryptophan depletion on BFS total scores

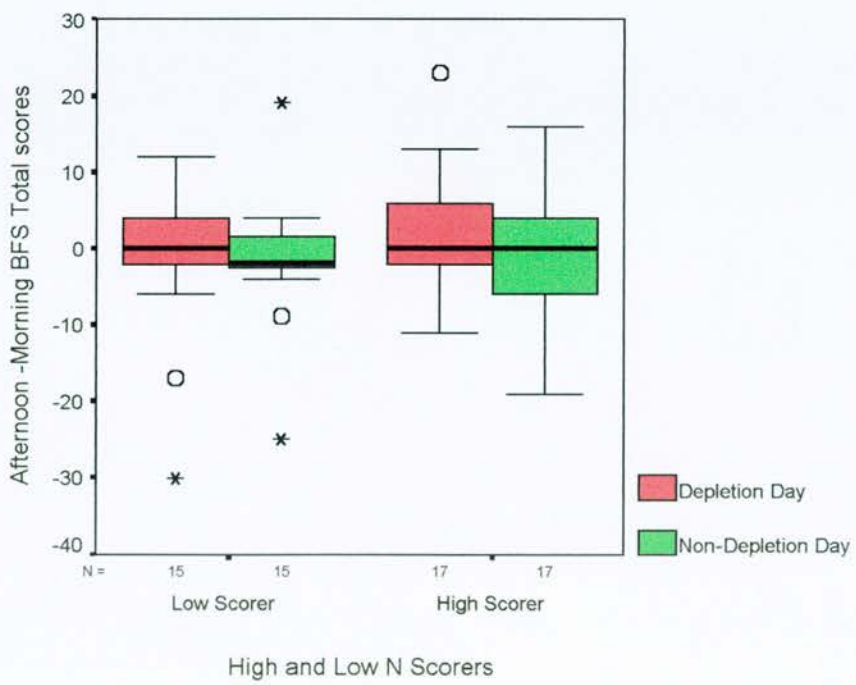


Figure 13.4.9: The effect of tryptophan depletion on BFS D scores

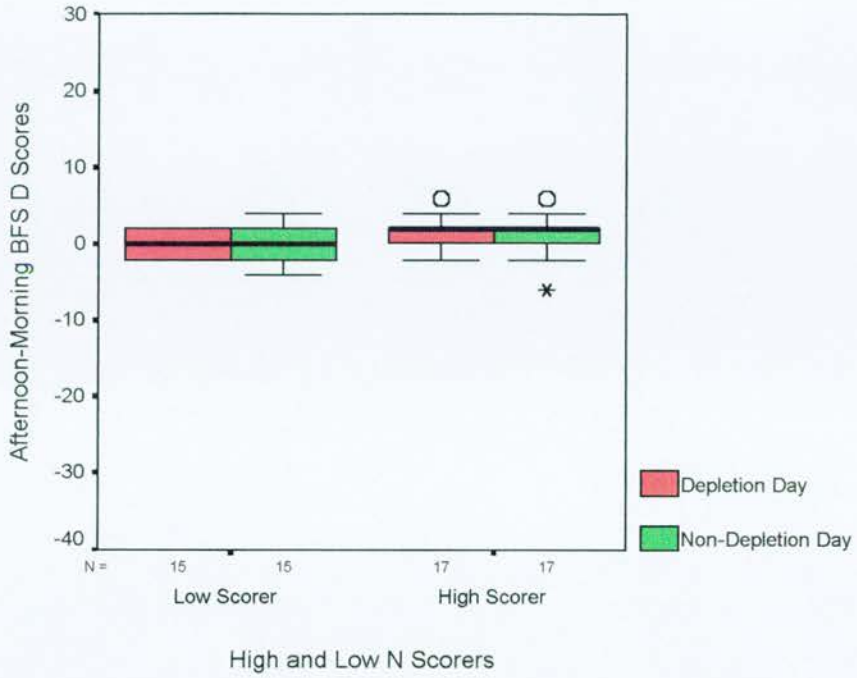


Figure 13.4.10: The effect of tryptophan depletion on BFS F scores

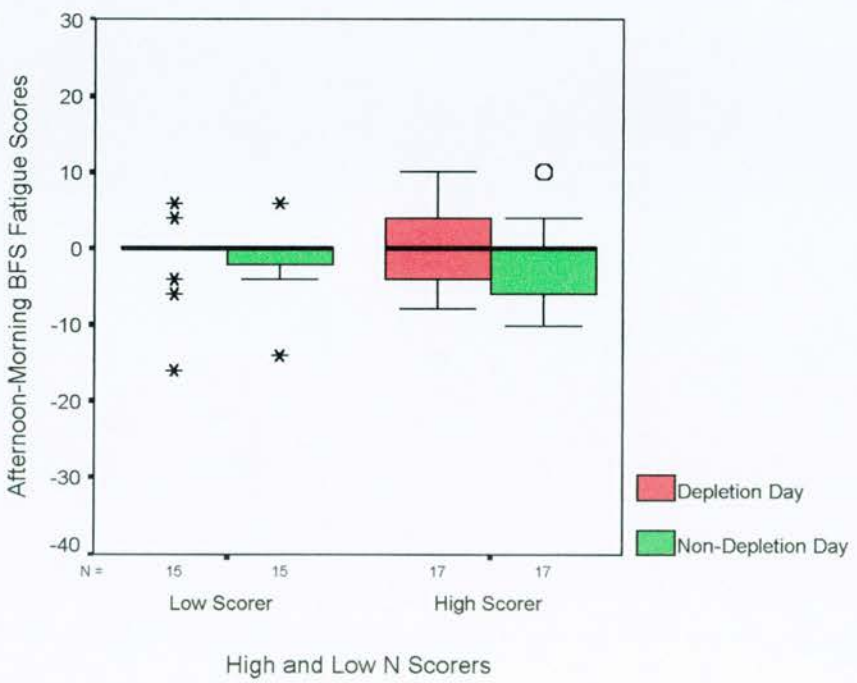


Figure 13.4.11: The effect of tryptophan depletion on Positive affectivity

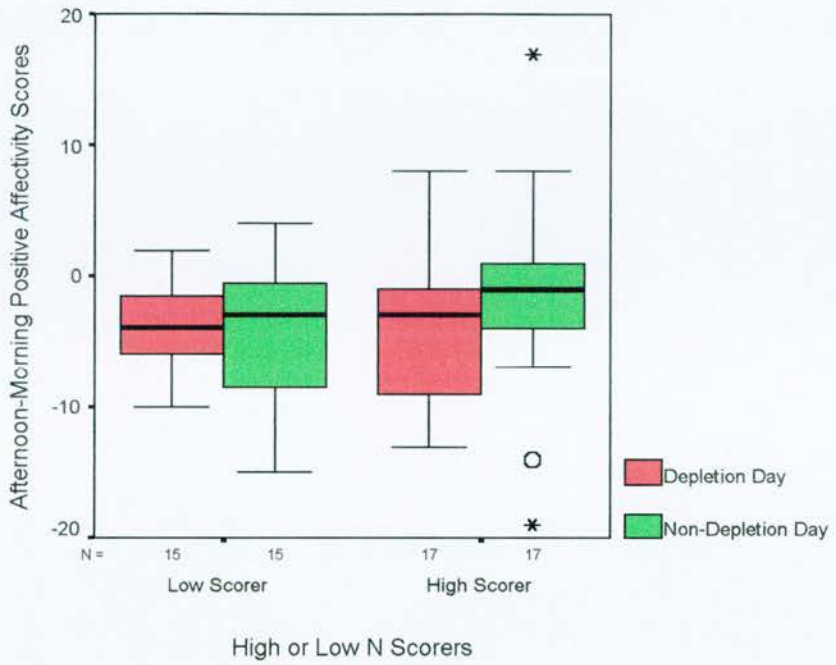
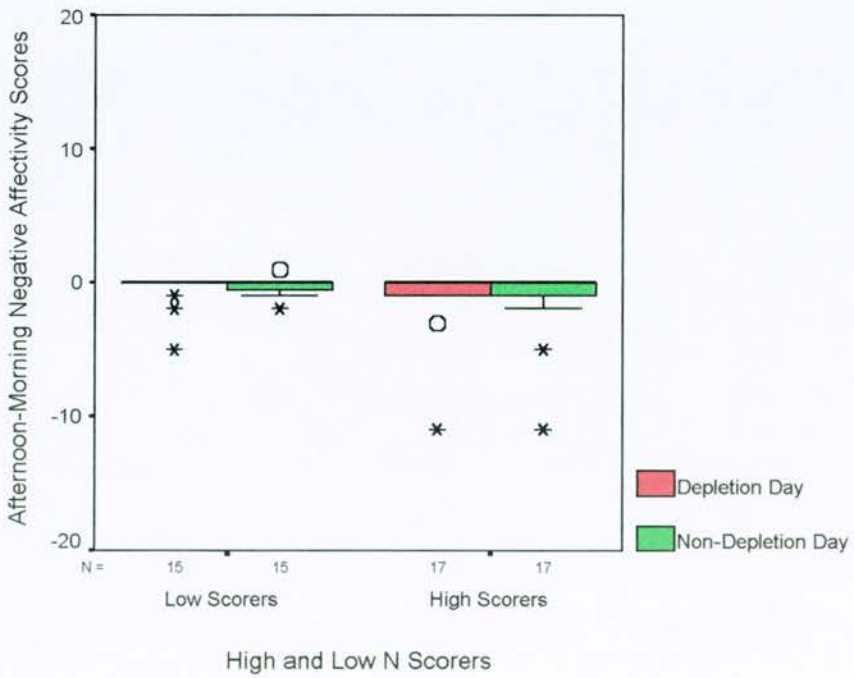


Figure 13.4.12: The effect of tryptophan depletion on Negative affectivity



13.5 Comparison of Physical Measures at Baseline

Four physical measures were repeated in the morning and the afternoon. These were mean arterial pressure, pulse, maximum voluntary contraction (MVC) and reaction time. The reaction time was broken down into three separate measures: reaction time, response initiation time and movement time. The MVC and the reaction time measures were performed with both the right and the left hand. Table 13.5.1 describes the two-way repeated measures MANOVA. There were 3 volunteers who were left-handed within the group. Two low N scorers (1 male and 1 female) and one high N scorer (male). These individuals were excluded from the analysis for the MVC and reaction time measures in order to keep the sample as homogeneous as possible. Therefore the sample remaining for these measures contained a total of 29 individuals, 4 high N male scorers, 10 high N female scorers, 6 low N male scorers and 9 low N female scorers.

Table 13.5.2 shows the means and standard deviations and figures 13.5.1-13.5 display box plots for each of these measures by group. There were no significant differences, at baseline, between groups for mean arterial pressure, pulse, maximum voluntary contraction with the right or left hand, reaction time with the right or left hand, response initiation times (RIT) when using the right or left hand, or movement time with the right hand. However, movement time with the left hand showed a significant interaction of group by day ($F_{1,27}$=8.02, p=0.009), the low scorers had significantly faster movement

Table 13.5.1: Repeated measures MANOVA to compare physical measures at baseline

Analysis	Within Subjects Factor	Between Subjects Factor
2-way repeated measures MANOVA	Day: Baseline scores on morning of depletion Vs non-depletion day	Group: High Vs Low Scorers on the EPQ N scale

Table 13.5.2: Means and standard deviations of physical measures at baseline for high and low Neuroticism scorers

Measurement	Means for Low N (SD)		Means for High N (SD)	
Mean arterial pressure (units)	85.8	(10.8)	89.3	(5.9)
Pulse	61.7	(7.9)	60.1	(9.3)
MVC right hand	104.5	(31.7)	99.9	(25.8)
MVC left hand	99.6	(31.7)	94.0	(25.2)
Reaction time RH (ms)	637.1	(59.5)	675.1	(86.4)
Reaction time LH (ms)	646.1	(81.0)	667.1	(81.0)
RIT RH (ms)	310.8	(30.1)	323.3	(37.1)
RIT LH (ms)	308.5	(38.0)	316.5	(36.4)
Movement time RH (ms)	361.2	(89.0)	389.0	(57.6)
Movement time LH (ms)	364.4	(73.3)	408.1	(93.6)

times on the morning when they were to receive the balanced (placebo) drink ($t=2.60$, $df=27$, $p=0.02$).

Figure 13.5.1: Average arterial blood pressure at baseline

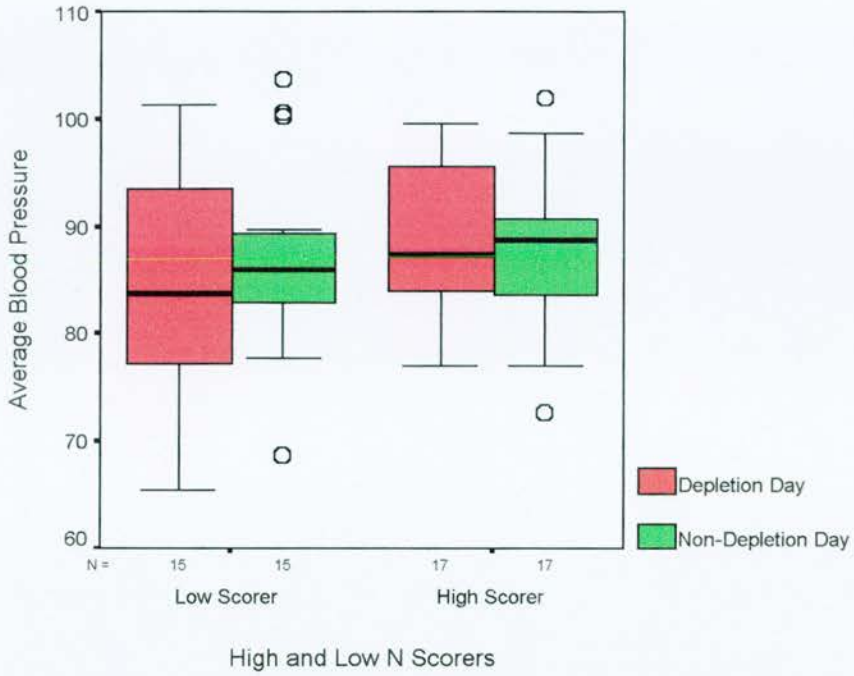


Figure 13.5.2: Pulse at baseline

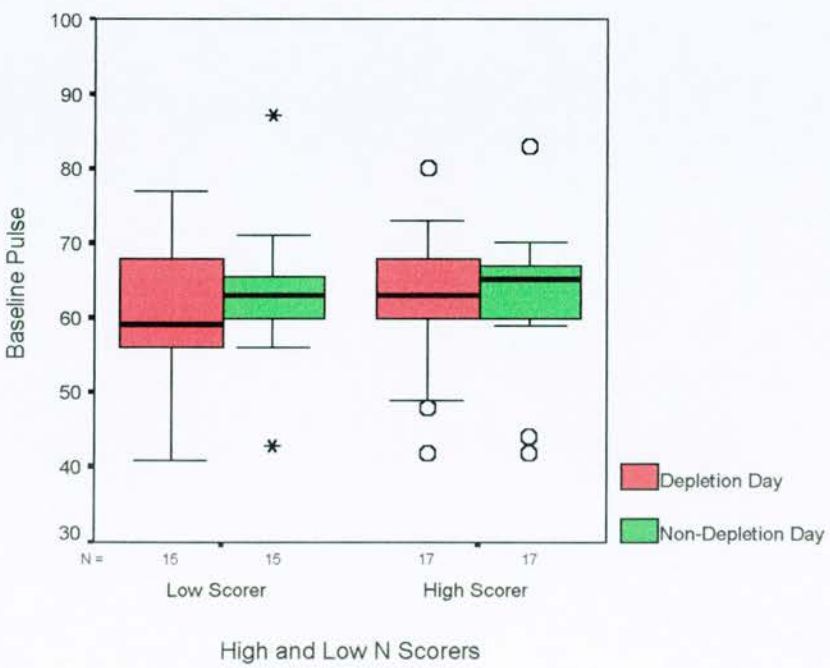


Figure 13.5.3: Maximum voluntary contraction with the right hand at baseline

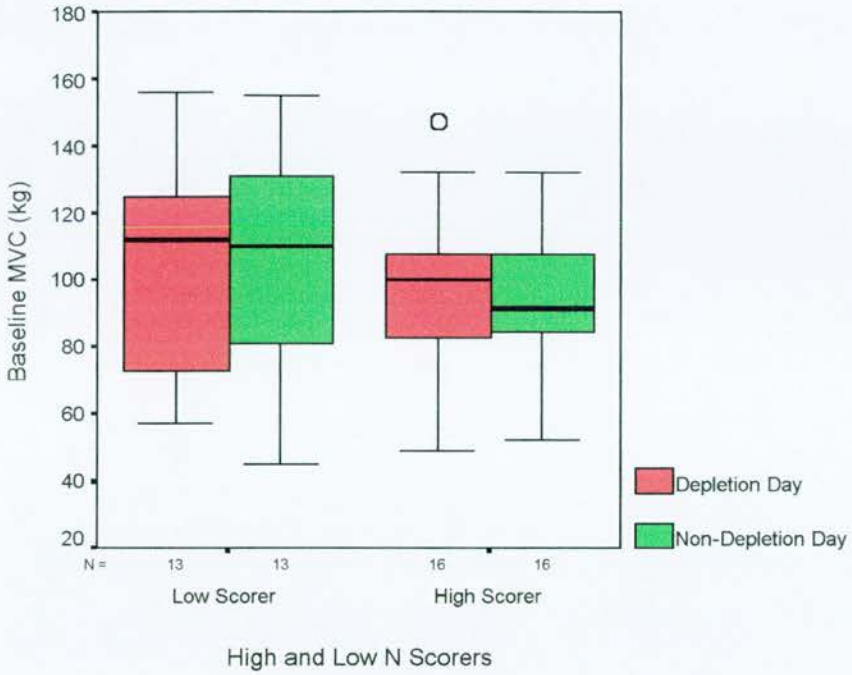


Figure 13.5.4: Maximum voluntary contraction with the left hand at baseline

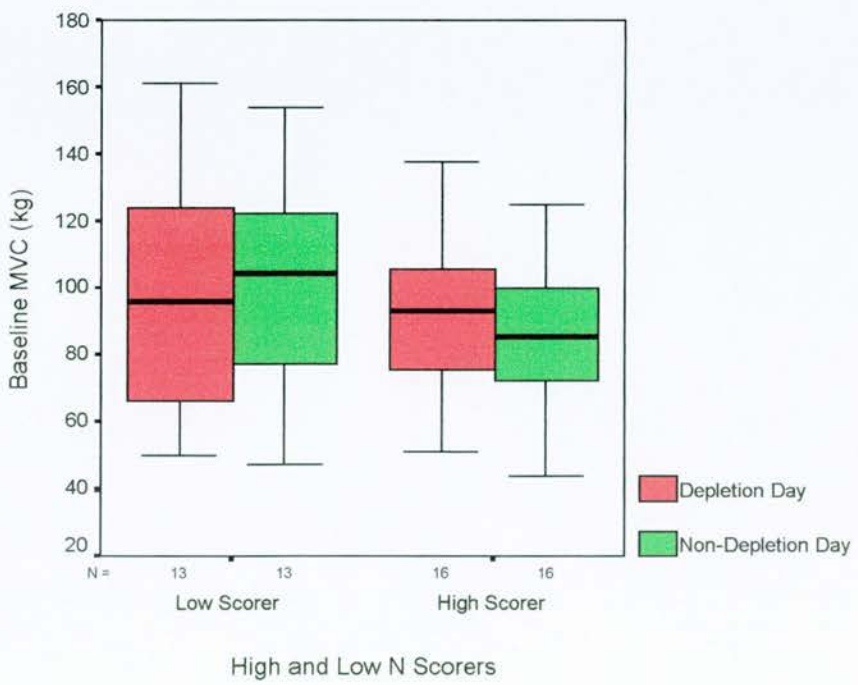


Figure 13.5.5: Reaction time using the right hand at baseline

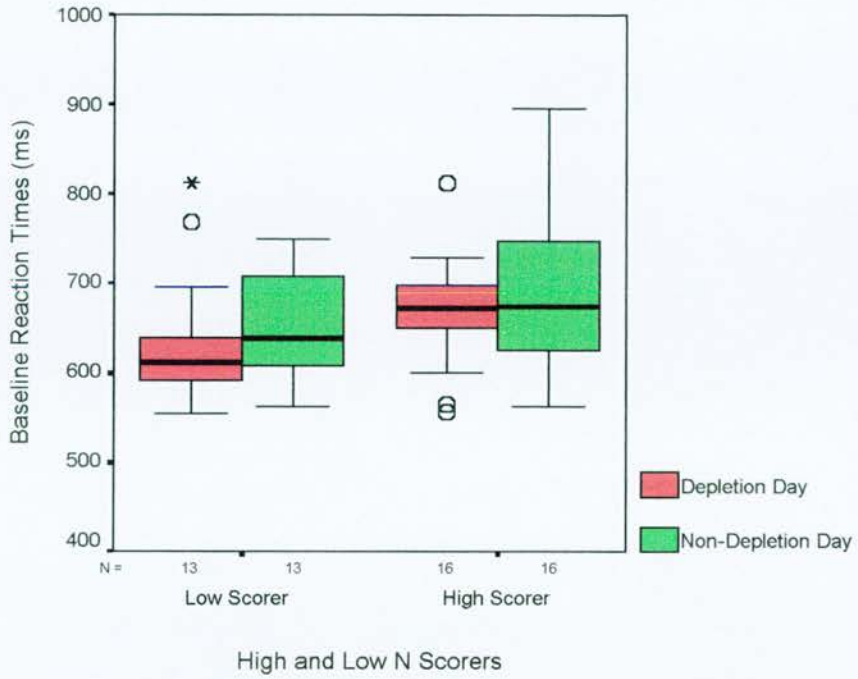


Figure 13.5.6: Reaction time using the left hand at baseline

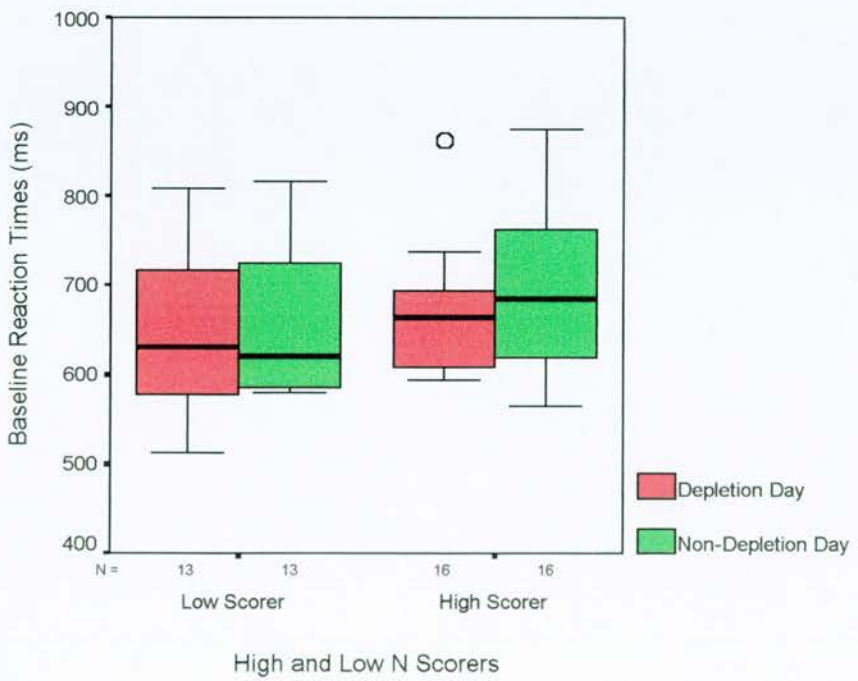


Figure 13.5.7: Response initiation time when using the right hand at baseline

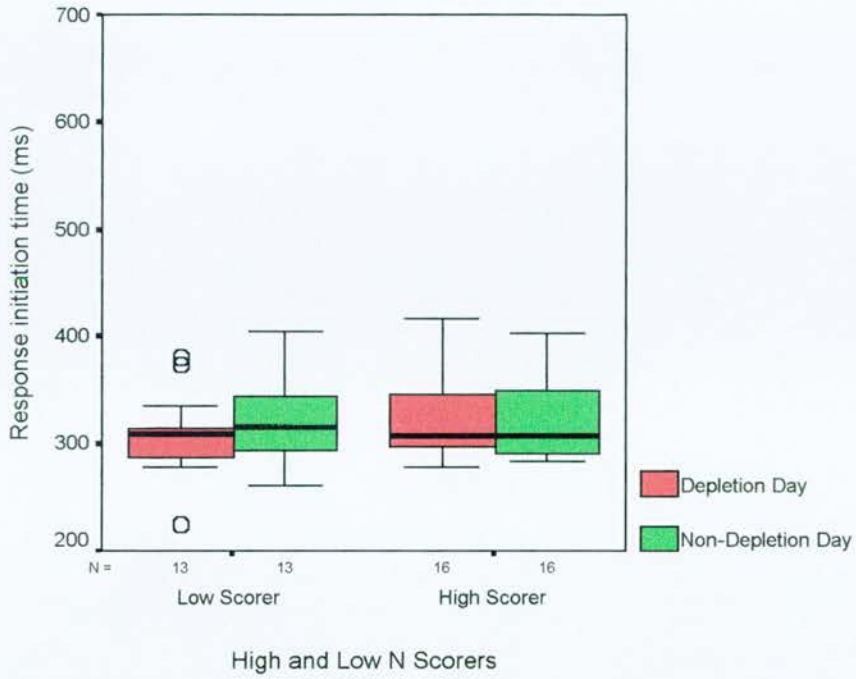


Figure 13.5.8: Response initiation time when using the left hand at baseline

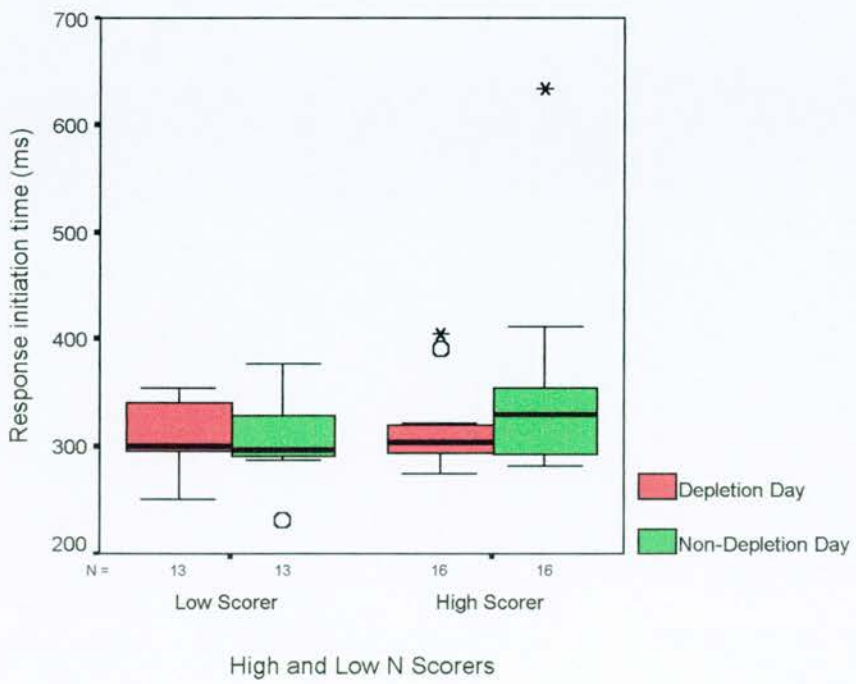


Figure 13.5.9: Movement time using the right hand at baseline

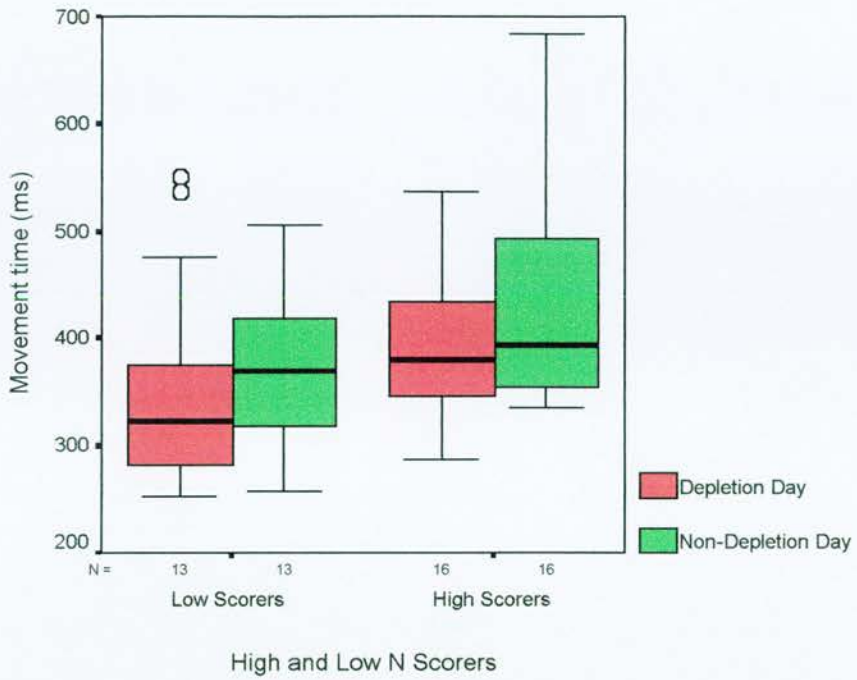
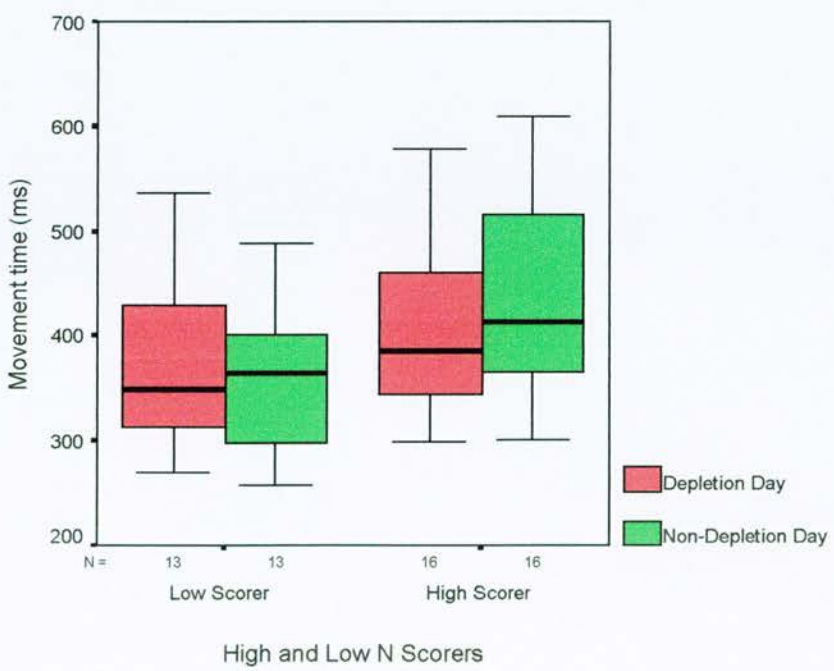


Figure 13.5.10: Movement time when using the left hand at baseline



13.6 The Effect of Tryptophan Depletion Versus Placebo Drink On Repeated Physical Measures

As with the repeated mood measures in order to compare the effect of the drinks on the physical measures a change score was calculated.

Change score = Afternoon score - Morning score

A positive score reflects an increase for mean arterial pressure and pulse and in physical strength for the MVC. An increase would mean a slowing of reactions for the three timed measures of reaction time, response initiation time and movement time. If tryptophan depletion does affect mood then a slowing of these reactions would be expected, as would a decrease in MVC. Table 13.6.1 describes the two-way repeated measures MANOVA used to test the effects of tryptophan depletion.

The means and standard deviations for each of the physical measures are shown in table 13.6.2. And box plots display the data in Figures 13.6.1-13.6.10.

There is an interaction of drink and group on the mean arterial pressure, ($F_{1,28}$=4.74, p=0.04). However, when each day is analysed separately there is only a trend on the depletion day (t=1.90, df=26, p=0.07) with high N's showing decreased mean arterial pressure, and low N's showing increased mean arterial pressure following depletion. There is no effect on the non-depletion day (t=1.19, df=26, p=0.24).

Table 13.6.1: Repeated measures MANOVA to test the effect of tryptophan depletion

Analysis	Within Subjects Factor	Between Subjects Factor
2-way repeated measures MANOVA	Day: Change scores on depletion vs non-depletion day	Group: High vs Low Scorers on the EPQ N scale

Table 13.6.2: Changes in mean scores on physical measures before and after tryptophan depletion in high and low Neuroticism scorers

		Mean (SD)	
Test	**Group**	**Depleted**	**Non-depleted**
Mean Arterial	**High N**	**-2.7 (5.8)**	**1.1 (5.6)**
Pressure	**Low N**	**1.5 (7.0)**	**0.9 (4.9)**
Pulse	**High N**	**1.7 (11.8)**	**-0.3 (8.1)**
	Low N	**4.4 (7.7)**	**-0.3 (7.6)**
MVC RH	**High N**	**3.7 (11.8)**	**6.3 (7.1)**
	Low N	**1.8 (6.6)**	**0.4 (6.9)**
MVC LH	**High N**	**1.9 (7.5)**	**4.6 (7.9)**
	Low N	**0.2 (8.3)**	**-1.5 (5.0)**
Reaction time	**High N**	**-8.2 (56.8)**	**-41.9 (109.3)**
RH	**Low N**	**13.5 (85.5)**	**-7.3 (82.0)**
Reaction time	**High N**	**4.0 (30.9)**	**-5.4 (39.8)**
LH	**Low N**	**27.2 (127.7)**	**5.2 (81.2)**
RIT RH	**High N**	**-0.5 (25.0)**	**-0.6 (16.8)**
	Low N	**20.1 (41.2)**	**-4.5 (32.0)**
RIT LH	**High N**	**-1.3 (14.2)**	**-26.9 (90.7)**
	Low N	**15.1 (53.4)**	**16.0 (36.5)**
Movement time	**High N**	**15.3 (52.8)**	**-8.3 (45.2)**
RH	**Low N**	**29.0 (88.4)**	**12.2 (112.7)**
Movement time	**High N**	**4.7 (33.9)**	**-4.3 (28.6)**
LH	**Low N**	**20.9 (86.2)**	**29.5 (95.7)**

Neither the placebo nor the depletion drink had any significant effect on change scores for pulse, maximum voluntary contraction or on any of the reaction time measures, in either the high or low N scorers.

The only effect found was that on mean arterial pressure where high N scorers showed decreased mean arterial pressure and low N scorers showed increased mean arterial pressure following depletion.

Figure 13.6.1: The effect of tryptophan depletion on mean arterial pressure

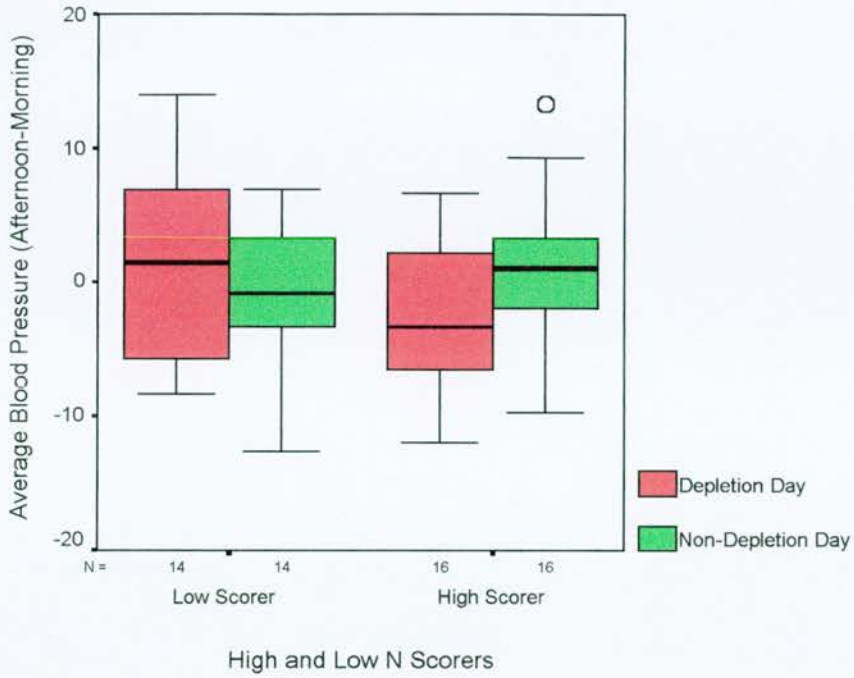


Figure 13.6.2: The effect of tryptophan depletion on pulse

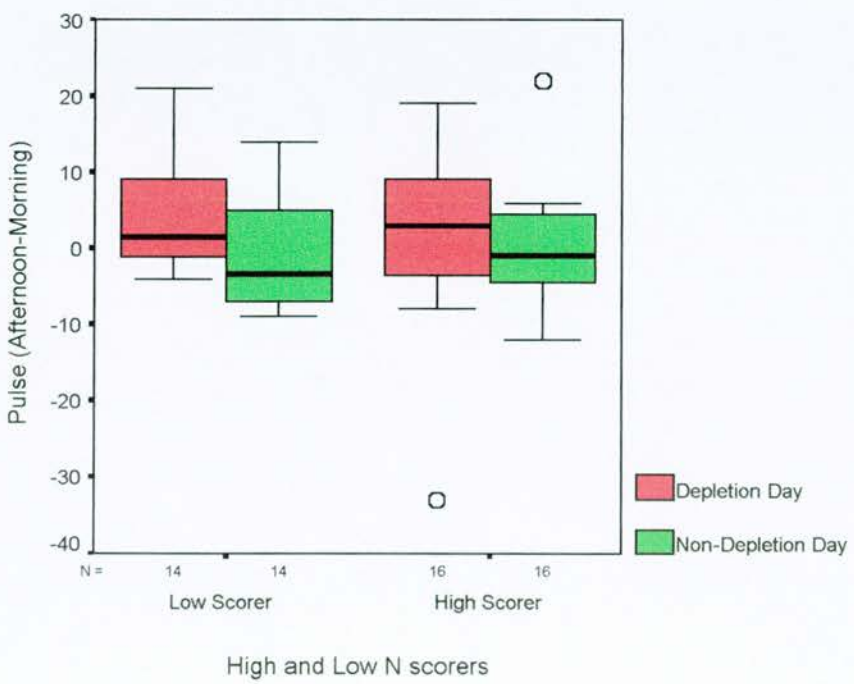
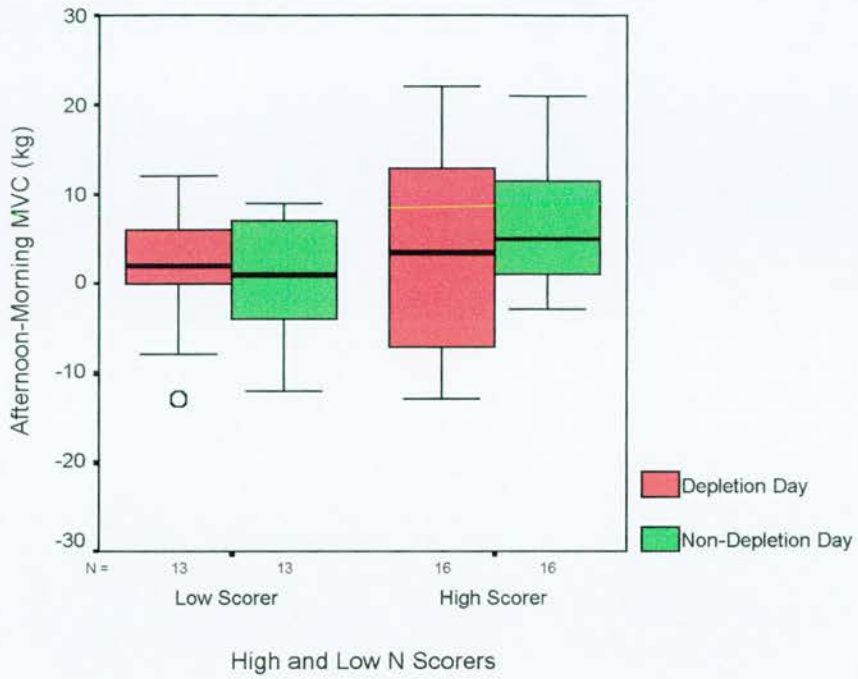
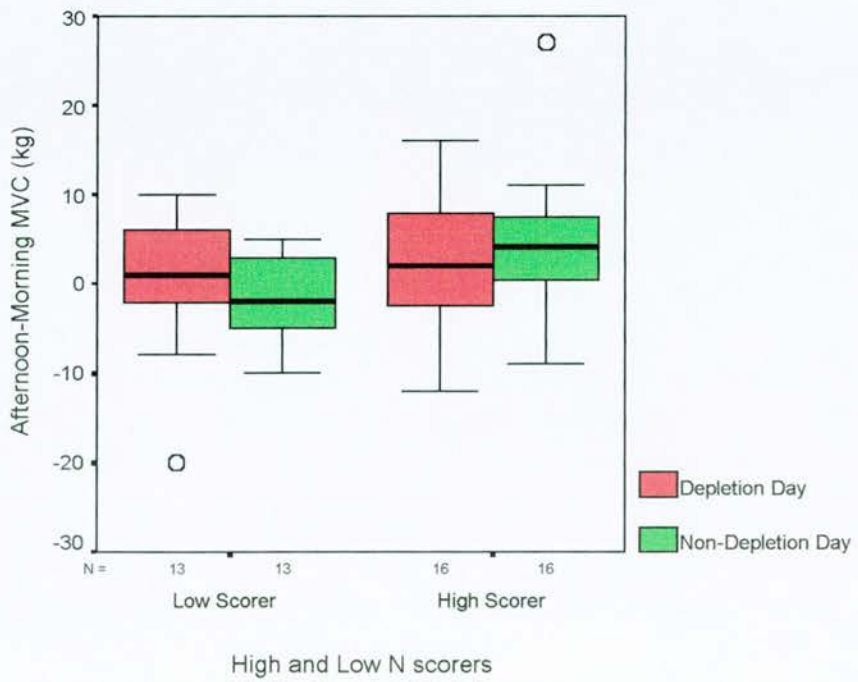


Figure 13.6.3: The effect of tryptophan depletion on maximum voluntary contraction when using the right hand



High and Low N Scorers

Figure 13.6.4: The effect of tryptophan depletion on maximum voluntary contraction when using the left hand



High and Low N scorers

Figure 13.6.5: The effect of tryptophan depletion on reaction time using the right hand

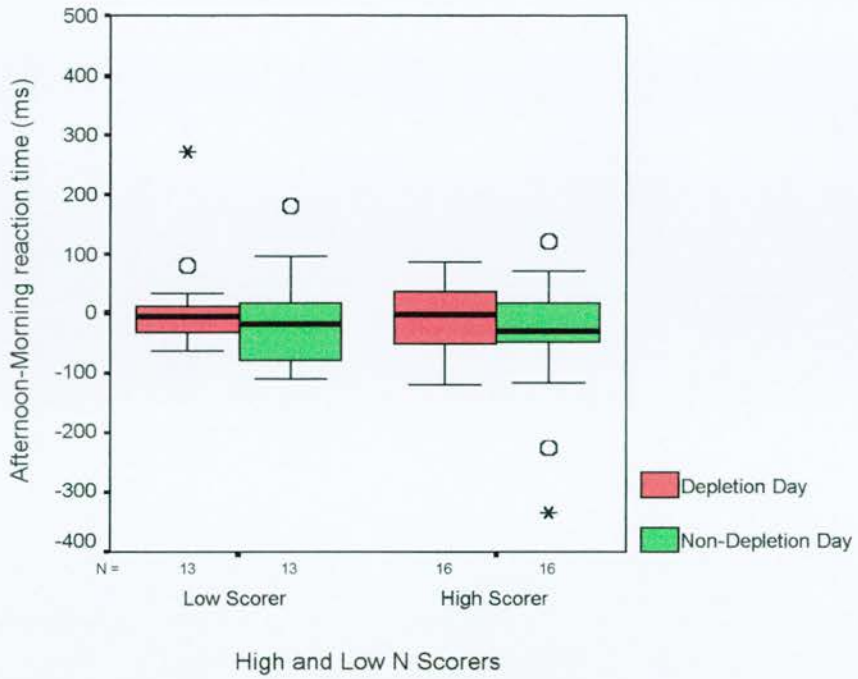


Figure 13.6.6: The effect of tryptophan depletion on reaction time using the left hand

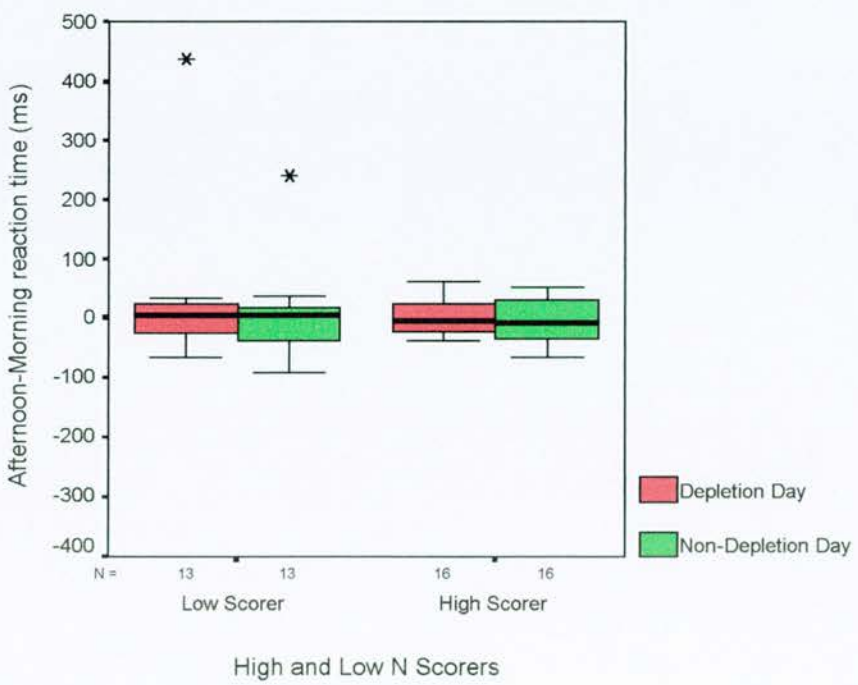


Figure 13.6.7: The effect of tryptophan depletion on response initiation time when using the right hand

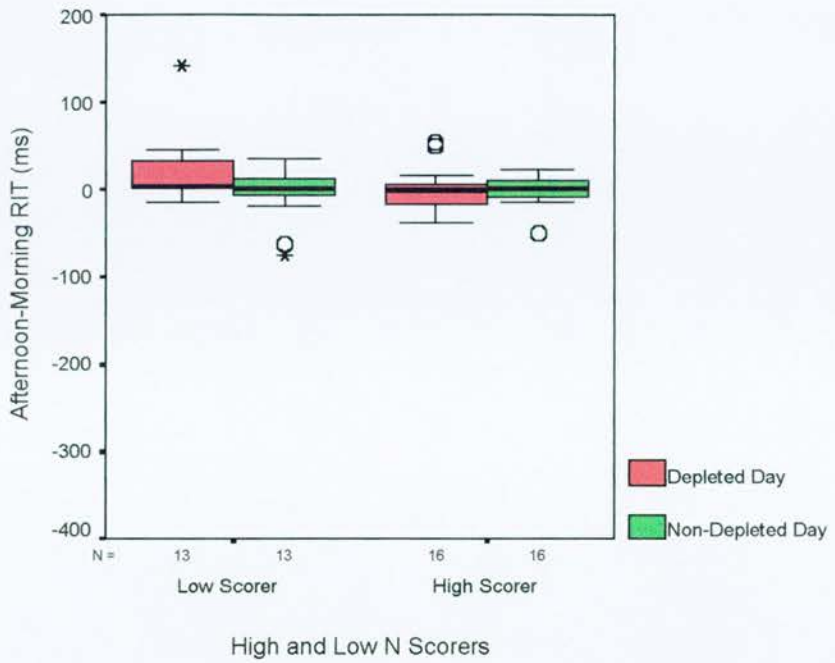


Figure 13.6.8: The effect of tryptophan depletion on response initiation time when using the left hand

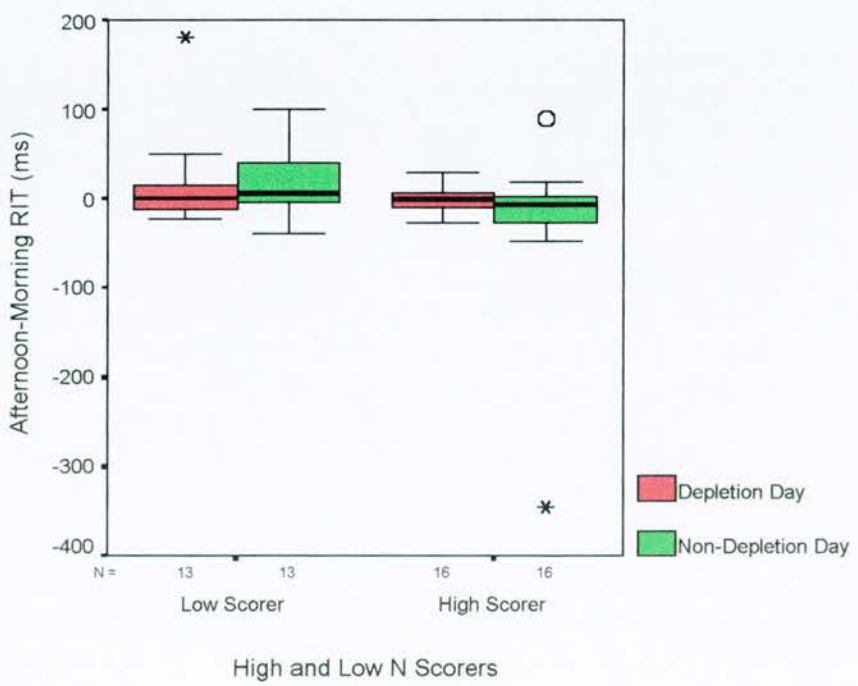


Figure 13.6.9: The effect of tryptophan depletion on movement time when using the right hand

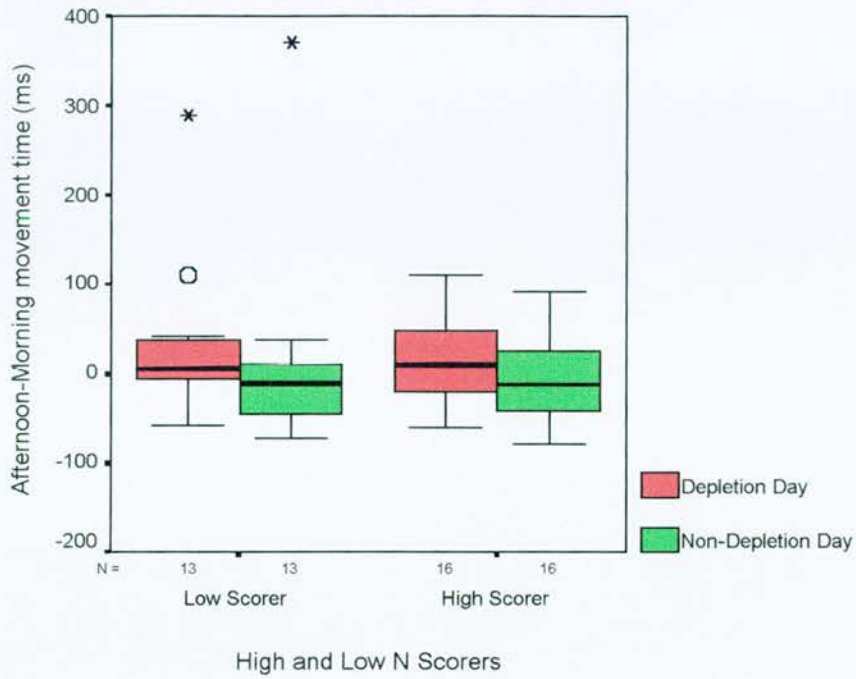
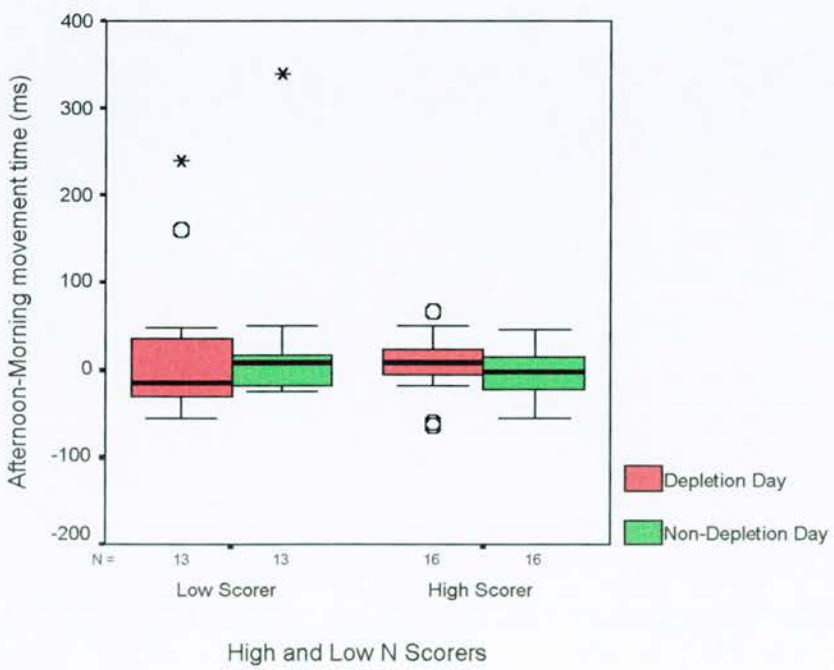


Figure 13.6.10: The effect of tryptophan depletion on movement time when using the left hand



13.7 The effect of tryptophan depletion on afternoon mood measures

The UWIST Mood Adjective Checklist was presented in the afternoon only. The Alderley Park State Anxiety Questionnaire (APSAQ; (Walker, 1990)) was given before and after a psychometric test thus it will be presented separately. Table 13.7.1 shows the two-way repeated measures MANOVA for scales given in the afternoon only.

The means and standard deviations on the UWIST are given in table 13.7.2. and box plots show the spread of the data for each group and day in figures 13.7.1-13.7.3

As would be expected, on examination the high N scorers had significantly higher UWIST stress scores ($F_{1,30}$=11.18, p=0.002), on both the depletion and non-depletion days (Mann-Whitney U-test, Z=2.63, n=32, p=0.008, Mann-Whitney U-test, Z=3.4, n=32, p=0.001 respectively). The groups also significantly differed on hedonic tone N ($F_{1,30}$=8.52, p=0.007), with a trend for a group by treatment interaction ($F_{1,30}$=3.43, p=0.07). The high N scorers had significantly lower scores on the depletion day (Mann-Whitney U-test, Z=3.30, n=32, p=0.001), which is in accordance with the hypothesis that tryptophan depletion will lower mood in a vulnerable population. There were no significant differences between the two groups on arousal.

Table 13.7.1: Repeated measures MANOVA used to test the effect of tryptophan depletion on mood measures given in the afternoon only

Analysis	Within Subjects Factor	Between Subjects Factor
2-way repeated measures MANOVA	Day: scores on depletion Vs non-depletion day	Group: High Vs Low Scorers on the EPQ N scale

Table 13.7.2: The effect of tryptophan depletion on means and standard deviations for the UWIST mood adjective checklist

		Mean (SD)	
Test	**Group**	**Depleted**	**Non-depleted**
UWIST S	**High N**	**15.1 (4.2)**	**16.2 (5.3)**
	Low N	**11.1 (3.4)**	**10.8 (3.5)**
UWIST H	**High N**	**26.4 (5.0)**	**28.0 (3.3)**
	Low N	**30.7 (2.2)**	**29.5 (3.1)**
UWIST A	**High N**	**21.3 (3.9)**	**20.5 (5.4)**
	Low N	**23.3 (3.7)**	**23.4 (4.6)**

Figure 13.7.1: The effect of tryptophan depletion on UMACL stress scores

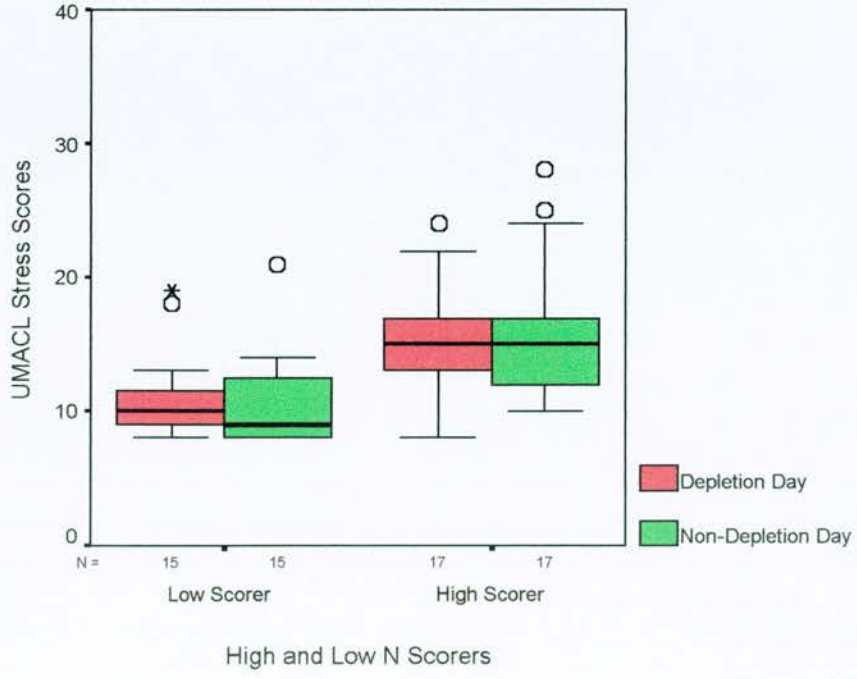


Figure 13.7.2: The effect of tryptophan depletion on UMACL hedonic tone scores

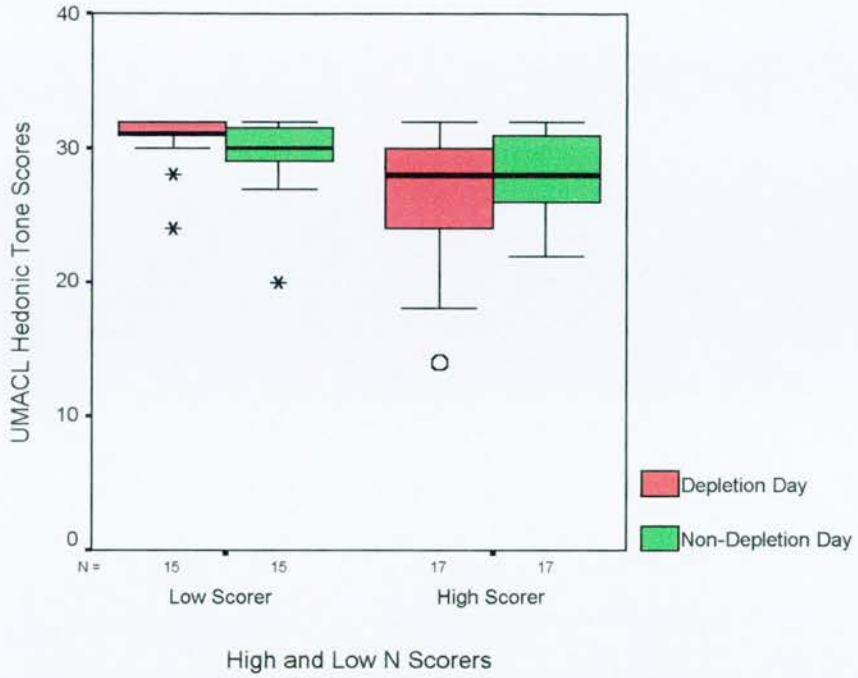
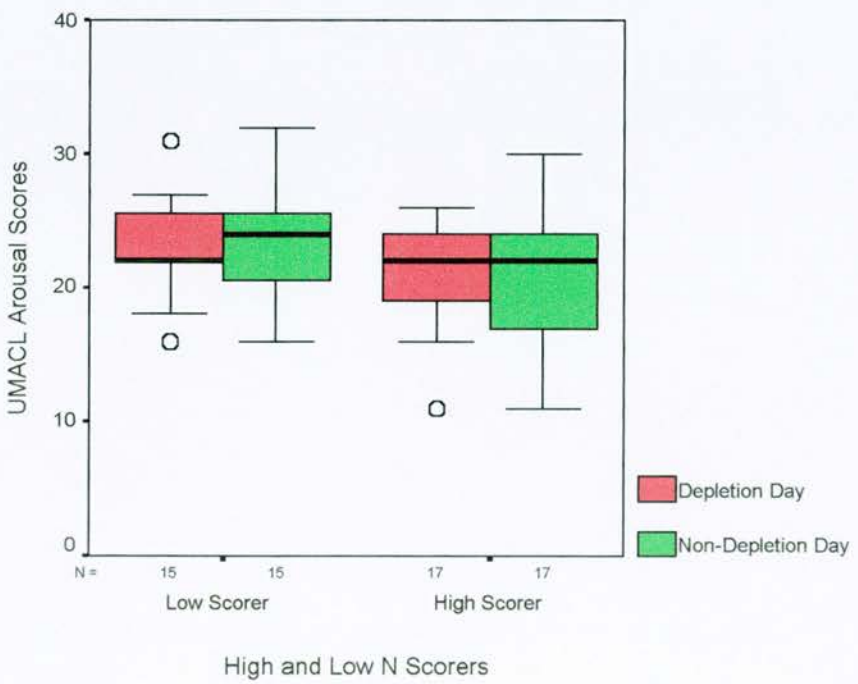


Figure 13.7.3: The effect of tryptophan depletion on UMACL arousal scores



13.8 The effect of tryptophan depletion on psychometric tests

Volunteers were tested on the digit symbol substitution test (DSST), digit span, the paced auditory serial addition task (PASAT), verbal fluency, and visual discrimination in the afternoons only. It would be expected, according to the hypotheses, that those who scored on the high end of the Neuroticism scale would show a decreased performance on these tests on the depletion day as compared to the placebo day. Table 13.8.1 displays the means and standard deviations for the two test days. Figures 13.8.1-13.8.5 present box plots showing the spread of the data. Table 13.8.2 describes the two way MANOVA used to analyse the between day effects.

In the main the hypothesis was not supported. There were no effects of drink or group on digit span, on the paced auditory serial addition task or on the visual discrimination task. There was a main effect of treatment on the DSST ($F_{1,30}$=7.60, p=0.01), both groups performed slightly better on the depletion day compared to the placebo day (t=2.74, df=31, p=0.10).

Differences were found on the verbal fluency task. There was an interaction of groups and treatment ($F_{1,30}$=9.71, p=0.004). The low N scorers performed better following depletion while the high scorers performed better following placebo. However, there was no main effect of tryptophan depletion. Further when the high and low N scorers were assessed separately, it was the low scorers who showed a significantly different performance between the two days (Wilcoxon signed rank test, z = -2.8, n=15, p=0.005) rather than the high scorers (Wilcoxon signed rank test, z = -1.2, n=17, ns).

Table 13.8.1: The effect of tryptophan depletion on psychometric tests

		Mean (SD)	
Test	**Group**	**Depleted**	**Non-depleted**
DSST	**High N**	**75.6 (11.8)**	**73.4 (12.9)**
	Low N	**76.2 (6.0)**	**72.4 (8.9)**
Digit Span	**High N**	**18.1 (5.1)**	**19.1 (4.5)**
	Low N	**19.0 (4.3)**	**18.7 (4.2)**
PASAT	**High N**	**47.4 (9.5)**	**47.5 (8.1)**
	Low N	**45.1 (8.1)**	**43.4 (9.2)**
Visual Discrimination	**High N**	**73.5 (11.3)**	**73.2 (11.6)**
	Low N	**79.7 (12.3)**	**79.1 (7.6)**
Verbal Fluency	**High N**	**39.6 (8.9)**	**41.4 (9.9)**
	Low N	**44.9 (10.0)**	**40.9 (12.4)**

Figure 13.8.1: The effect of tryptophan depletion on the DSST

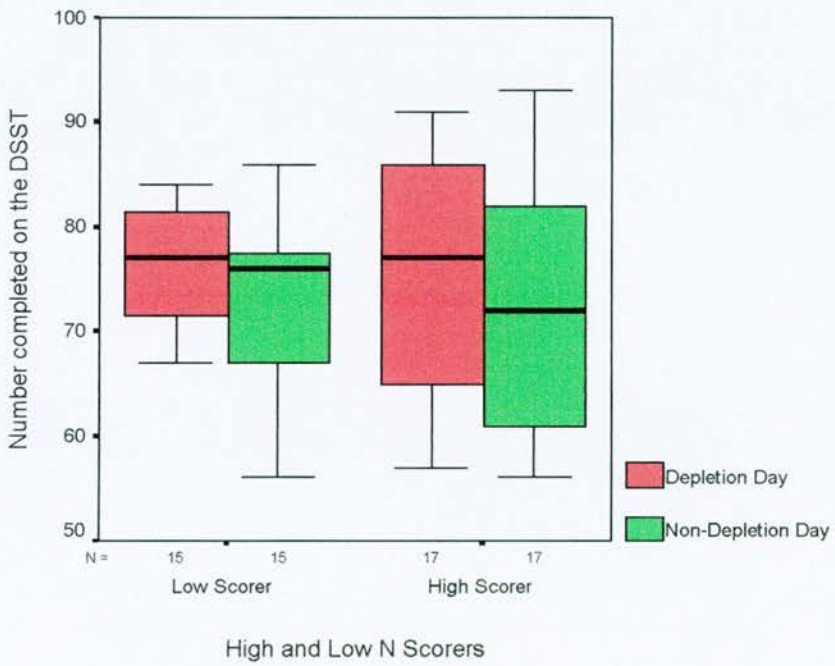


Figure 13.8.2: The effect of tryptophan depletion on digit span

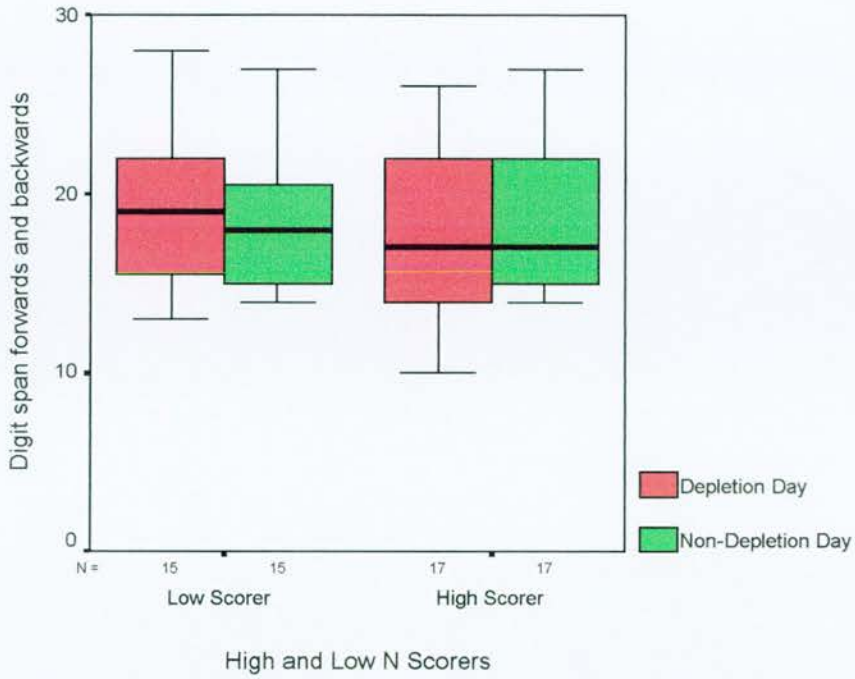


Figure 13.8.3: The effect of tryptophan depletion on the PASAT

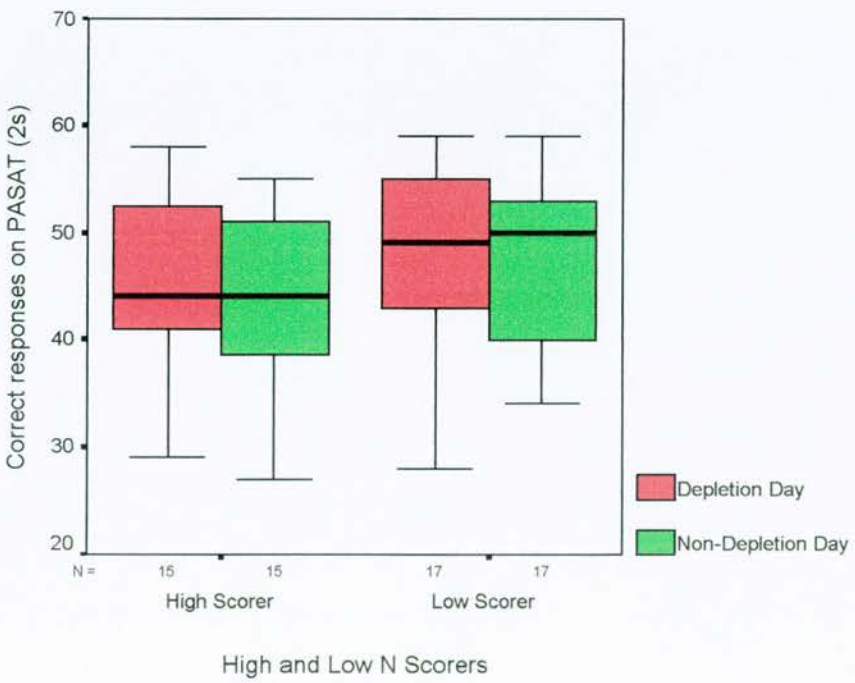


Figure 13.8.4: The effect of tryptophan depletion on visual discrimination

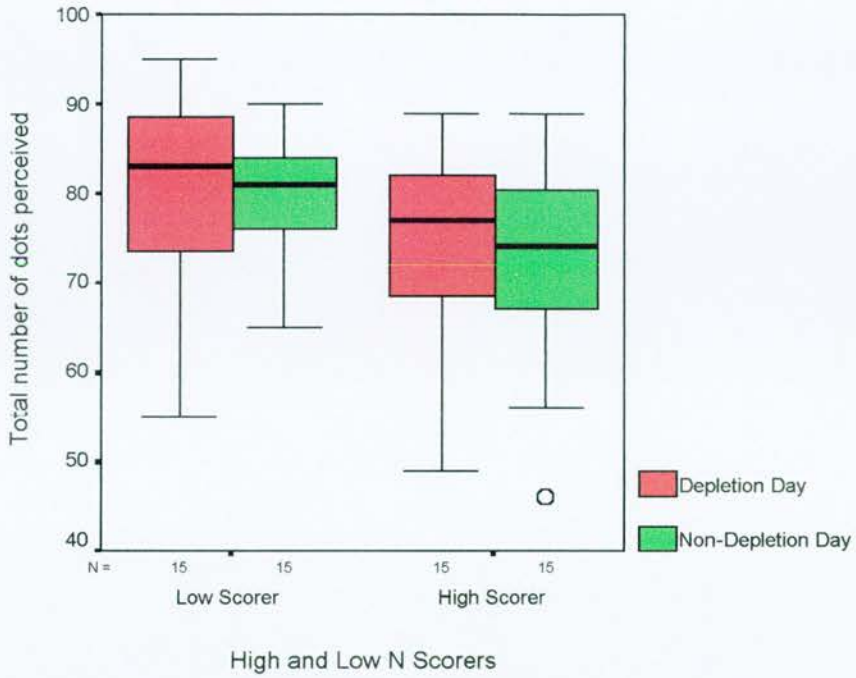
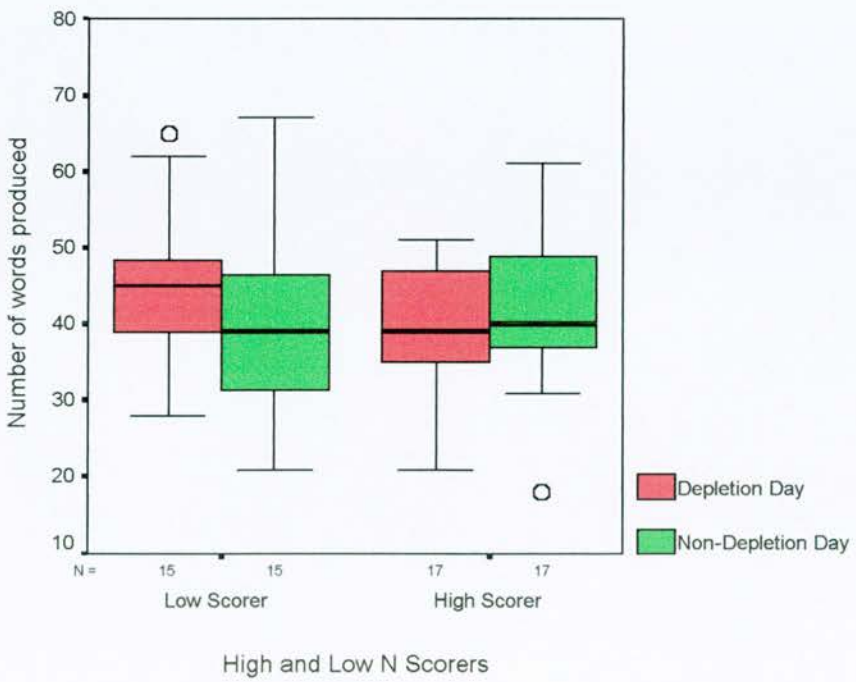


Figure 13.8.5: The effect of tryptophan depletion on verbal fluency



13.8.1 The APSAQ

This questionnaire which assesses state anxiety is given both before and after the paced auditory serial addition task. Change scores were therefore calculated for this measure.

Change Scores (APSAQ) = score post PASAT-score prior to PASAT

Table 13.8.3 and figure 13.8.6 displays these change scores.

A positive score would indicate an increase in anxiety following the PASAT, while a negative score would indicate a decrease in anxiety. On examination, a significant effect of group was found ($F_{1,30}$=4.34, p=0.046), this was restricted to the placebo day (t=2.19, df=30, p=0.04). Both groups had an increase in anxiety following the PASAT however, the low N group did not show as great an increase in anxiety as the high N group, on the placebo day.

13.9 Effects of order for the depletion or placebo days

The National Adult Reading Test (NART) was presented only once, this was in the morning of the first day of testing. It was therefore important to show whether depletion or placebo had an effect on the group scores. There were no significant differences on the NART between those who had tryptophan first or second (t=0.933, df=30, ns), nor between high or low scorers on the N scale on each day (t=0.71, df=16, ns; t=0.88, df=12, ns respectively). Table 13.9.1 describes the three-way repeated measures MANOVA that is

Table 13.8.3: The effect of tryptophan depletion on anxiety before and after the PASAT

		Mean (SD)	
Test	**Group**	**Depleted**	**Non-depleted**
APSAQ	**High N**	**4.0 (4.1)**	**3.2 (2.2)**
	Low N	**3.0 (2.4)**	**1.5 (2.2)**

Figure 13.8.6: The effect of tryptophan depletion on anxiety scores as measured by the APSAQ

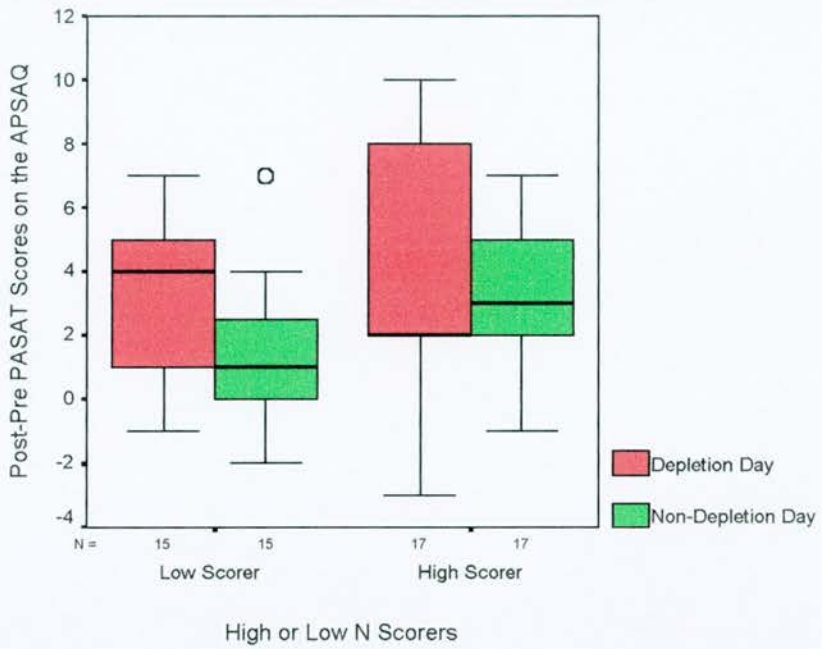


Table 13.9.1: Repeated measures MANOVA to test the effect of day (depletion versus placebo) on test scores

Analysis	Within Subjects Factor	Between Subjects Factor 1	Between Subjects Factor 2
Three-way repeated measures MANOVA	Day: Scores on test day one vs test day two	Order: tryptophan depletion on day one or day two	Group: High or Low N Scorer

used to analyse differences due to order for the psychometric tests given in the afternoon. Only those tests were order of test day was hypothesised to have an effect were tested in this manner. That is the psychometric tests and the reaction time measures.

In this section only those tests which showed a significant order effect are included. Means by day and N score for the all the psychometric tests are presented in Appendix V.

On inspection there was a significant order effect on DSST scores ($F_{1,28}$=31.78, $p<0.001$) and a significant interaction of order and treatment ($F_{1,28}$=9.04, $p=0.006$), though no effect of Neuroticism. If given tryptophan on the first day the volunteers improved significantly on the second day ($t=7.57$, $df=17$, $p<0.001$) whereas if depleted on the first day the volunteers did not show significant improvement on the second day ($t=1.67$, $df=13$, ns). Means and standard deviations are shown in table 13.9.2 and are displayed graphically in figure 13.9.1.

There was a significant interaction of order, treatment and Neuroticism ($F_{1,28}$=6.80, $p=0.01$) on the verbal fluency task. This is a much more complex relationship. The low scorers do not improve following tryptophan depletion, but do perform significantly better when depleted on the second day ($t=6.5$, $df=9$, $p<0.001$). Whereas the high N's perform worse when depleted irrespective whether this is on the first or second day (although these differences are not statistically significant). These results are exhibited in tabular form in table 13.9.3 and graphically in figures 13.9.2 and 13.9.3.

Table 13.9.2: Order effects on the DSST

	Means (SD)	
	Test day one	**Test day two**
Depletion first	74.6 (10.0)	76.6 (12.2)
Placebo first	70.1 (9.4)	76.9 (9.0)

Figure 13.9.1: The effect of order on correct responses on the DSST when tryptophan depletion is on the second day

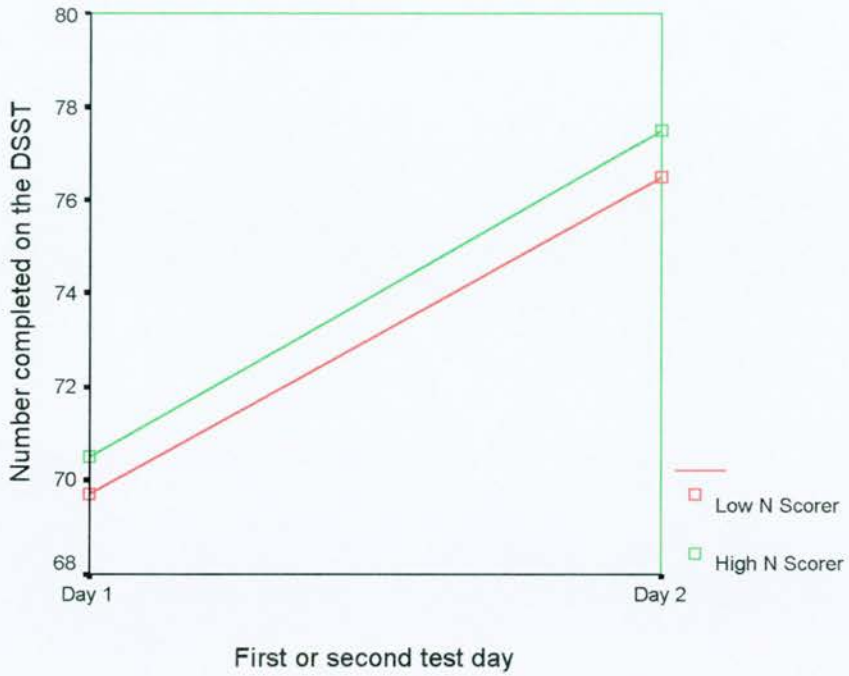


Table 13.9.3: Order effects on verbal fluency

Order	**High or Low N Scorer**	**Mean (SD)**	
		Test day one	**Test day two**
Depletion First	High Scorer	36.7 (9.4)	39.2 (9.9)
	Low Scorer	47.2 (10.7)	47.0 (13.3)
Placebo First	High Scorer	44.0 (10.0)	42.9 (7.5)
	Low Scorer	37.9 (11.4)	43.7 (10.0)

Figure 13.9.2: The effect of order on verbal fluency when tryptophan depletion is on the first test day

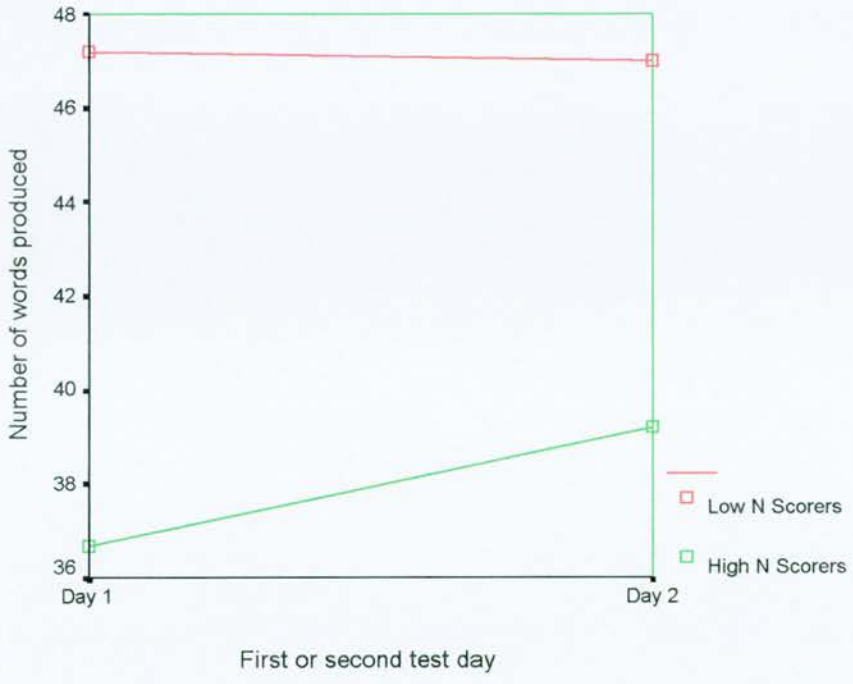
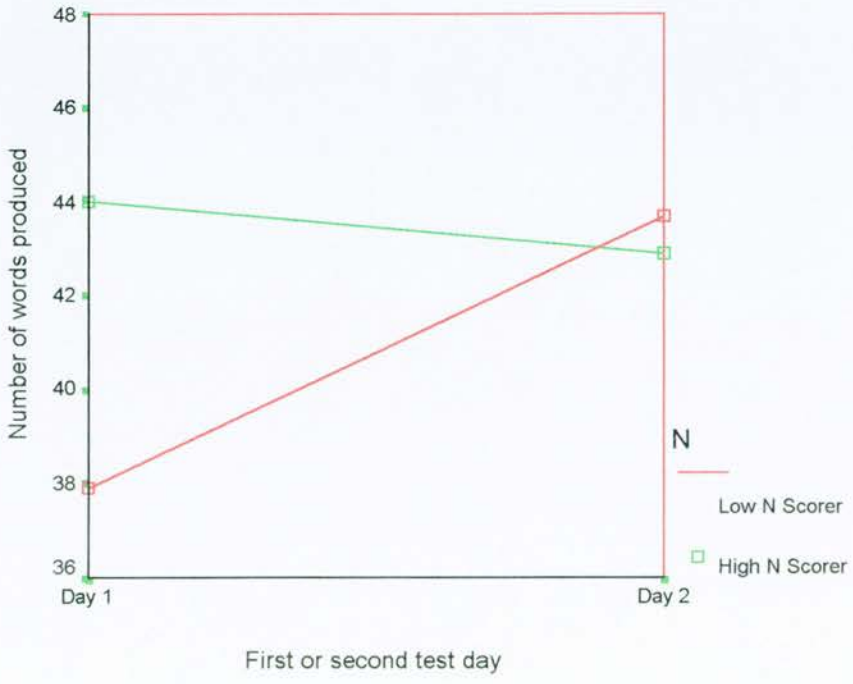


Figure 13.9.3: The effect of order on verbal fluency when tryptophan depletion is on the second test day



There was a significant effect of order on digit span ($F_{1,28}$=13.17, p=0.001), for the paced auditory serial addition task ($F_{1,28}$=32.89, p<0.001) and visual discrimination ($F_{1,28}$=26.27, p<0.001). Whether depleted or not the volunteers improved on the second day. Table 13.9.4 displays the means and standard errors for these tests by order.

In sum, the order of depletion did have an effect all of the psychometric tests in some way. This however, varied from tests to test. For digit span, the PASAT and visual discrimination performance improved on the second day regardless of N score and regardless of whether the person had the depletion drink or the placebo drink. The DSST and the verbal fluency tests showed interaction effects. On the DSST if given the placebo drink on the first occasion showed improvement on the second occasion however, if they were depleted on the first occasion no improvement was shown on this test on the second test day. On the verbal fluency there was an interaction of order, treatment and Neuroticism. The low N scorers if given the placebo drink on the first day improved on the second day, but if depleted on the first day did not show improvement on the second day, thereby showing a similar pattern to that on the DSST. However, the high N scorers performed worse when depleted irrespective of whether they were depleted on the first or second occasion.

13.9.1 Reaction Time

Although most of the reaction time measures were normally distributed some of the measures were skewed, in order to normalise the data they were

Table 13.9.4: Effect of order on digit span, the PASAT and visual discrimination

	Means (SD)	
	Test day one	**Test day two**
Digit span	17.9 (4.9)	19.4 (4.7)
PASAT	42.7 (10.0)	48.9 (7.3)
Visual discrimination	71.0 (12.5)	79.7 (8.1)

natural log transformed. These measures were assessed both in the morning and the afternoon. Table 13.9.5 describes the four-way repeated measures MANOVA used to analyse these data. Again all left handed individuals were excluded from this analysis.

There were no order effects for reaction time using the right hand, however, when the left hand was used there was a main effect of day ($F_{1,25}$=5.11, p=0.03), with reaction times, counter intuitively, being, slower on the second day. Table 13.9.6 displays this data.

Order did not affect the other measurements significantly.

13.10 The effect of tryptophan depletion on EEG measures

EEG measurements were made in the morning and the afternoon. This data was converted so that a ratio of EEG power was obtained. The power over the left frontal lobe (F3) was divided by the power over the right frontal lobe. This calculation was performed as a differential between the left and right side was expected. Only right-handed subjects were included within this analysis. One subject from each group was left-handed. Data from two

Table 13.9.5: Repeated measures MANOVA to assess the effect of order on reaction time measures

Analysis	Within Subjects Factor I	Within Subjects Factor II	Between Subjects Factor I	Between Subjects Factor II
Four way repeated measures MANOVA	Drink: Scores on morning of test day Vs scores on afternoon of test day	Day: Scores on test day one Vs test day two	Order: tryptophan depletion on day one or day two	Group: High Vs Low N Scorer

Table 13.9.6: Order effects on the reaction time with the left hand

Test	**Means (SD)**	
	Test day one	**Test day two**
Reaction time	6.48 (0.14)	6.52 (0.16)

subjects from the low N scorers group was lost due to technical difficulties thereby leaving 12 low scorers and 16 high scorers.

Baseline EEG was assessed by day and by Neuroticism. There were no significant differences between day (day one mean=0.025 sd=0.012, day two mean=0.019 sd=0.017; $F_{1,26}$=0.713, ns) or between subjects (high N scorers mean=0.019 sd=0.014, low N scorers mean=0.023 sd=0.016; $F_{1,25}$=0.609, ns).

Further a change score was calculated

Change score = afternoon F3/F4 - morning F3/F4

The analysis used is presented in table 13.10.1. Means and standard deviations of the transformed data are presented in table 13.10.2. If the

Table 13.10.1: Repeated measures MANOVA used to test the effect of depletion on EEG frontal power

Analysis	Within Subjects Factor	Between Subjects Factor
2-way repeated measures MANOVA	Day: Change scores on depletion Vs non-depletion day	Group: High Vs Low Scorers on the EPQ N scale

Table 13.10.2: The effect of tryptophan depletion on frontal alpha power

Frontal alpha power					
		Depleted		Non-depleted	
Eyes open	High N	0.01	(0.10)	-0.05	(0.10)
	Low N	-0.004	(0.07)	-0.001	(0.06)

change scores are positive they represent an increase in power in the left frontal region compared to the right frontal region following the drinks, which corresponds to an increase in negative mood.

From the table it is clear that there is more variability in the recordings due to individual variability than due to the drinks. There was no effect of drink ($F_{1,26}$=2.645, ns), no effect of group ($F_{1,26}$=0.416, ns) and no interaction effect ($F_{1,26}$=3.174, ns). In sum, the drinks had no effect on the asymmetry of alpha power.

13.11 The effect of tryptophan depletion on biochemical measures

Blood could not be gained from all of the volunteers. If after the second attempt not enough blood could be gained, or if the volunteer showed any signs of undue discomfort the procedure was terminated. Blood samples

were collected on all four occasions from 14 low N scorers and 15 high N scorers.

Plasma free and total tryptophan levels were not significantly different at baseline on the day of the depletion drink compared to the day of the placebo drink (plasma free tryptophan: depletion day mean=4.5 nMol/ml sd=1.1 placebo day mean=4.7 nMol/ml sd=0.8 $F_{1,25}$=0.374 ns; total tryptophan: mean=63.5 nMol/ml sd=8.25 placebo day mean=61.0 nMol/ml sd=8.1 $F_{1,25}$= ns). There were also no group differences at baseline by group (plasma free: high N scores mean=4.4 nMol/ml sd=0.8 low N scorers mean=4.8 nMol/ml sd=1.0 $F_{1,25}$=2.739 ns; total tryptophan: high N scorer mean=61.2 nMol/ml sd=7.3 low N scorer mean=63.3 nMol/ml sd=9.3 $F_{1,25}$=0.734 ns).

The degree of change between morning and afternoon samples was analysed.

Change score = afternoon – morning

Table 13.11.1 displays the means and standard deviations for both the plasma free and total tryptophan levels. After the low tryptophan drink both plasma total and free tryptophan levels fell significantly (free t=13.52 df=28, p<.001; total t=17.62 df=28, p<.001). Free tryptophan was depleted by 82.9% (16.6 nMol/ml , and total by 87.7% (5.1 nMol/ml). Although this is adequate depletion, and the majority (21/29) was depleted of free tryptophan by greater than 84%, one individual only achieved 5.8% depletion. The other

Table 13.11.1: The effect of depletion and placebo drinks on plasma free and total tryptophan

	Plasma Free (nMol/ml)	Plasma total (nMol/ml)
Depletion day	**-3.81 (1.0)**	**-56.56 (8.3)**
Placebo day	**2.38 (2.5)**	**36.45 (27.9)**

8 individuals were between 64% and 80%. There was no significant effect of Neuroticism on change levels of tryptophan (free $F_{1,27}$=2.12 df=27, ns; total $F_{1,27}$=0.132 df=27, ns).

In the placebo condition, tryptophan levels were on average increased to 156.1% (58.5) for plasma free and 162.0% (49.1) for plasma total tryptophan of the baseline values.

Blood levels of tryptophan, mood and personality scores for each individual are shown in the appendix VI. There does not appear to be a relationship between the percentage of depletion (of tryptophan) and mood however, the levels of depletion are skewed, and there may not be enough variance in these scores to allow for a correlation.

Chapter Fourteen Discussion 1: Eysenck's and Cloninger's Personality Models

The EPQ-R has been reproduced many times; the three factors of Neuroticism, Extraversion and Psychoticism are common to many personality questionnaires and the model has been reproduced across different cultures (Barrett & Eysenck, 1984; Kline, 1993; Kline & Barrett, 1983). The evidence discussed in this chapter adds to this body of knowledge.

The three dimensions from the TPQ have not always been apparent and only the scale of Harm Avoidance has consistently been found to be robust (Giancola et al., 1994; Otter et al., 1995; Waller et al., 1991). This is the largest item level analysis in of this questionnaire in the English language.

The chapter is divided into sections: the first addresses the EPQ-R and the second section the TPQ. The scale of Neuroticism is the main focus of this chapter: whether Neuroticism was shown to be a reliable scale; and whether it could be extracted satisfactorily from the data set. Neuroticism is the focus as it is by this scale that volunteers were selected for the tryptophan depletion study. It was therefore important to show that the scale was robust in the current population. A second question was whether the same could be said of Harm Avoidance. Of interest also were whether the models of Eysenck and Cloninger could be reproduced satisfactorily in the data set and whether the scales they suggested were internally consistent. In addition, throughout the analysis other questions arose which will be discussed.

Furthermore the factors which are suggested from exploratory factor analysis from the items of the EPQ-R and TPQ will be discussed.

14.1 Eysenck's model

The questions were whether: three factors could be extracted from the EPQ-R in this data set and whether Eysenck's model could be reproduced. There were a number of issues relating to these questions. The first issue was whether the scales of Extraversion, Neuroticism and Psychoticism showed high internal consistency, the second was whether three factors could be extracted. The third issue was whether the factors extracted from the EPQ-R in this group would reproduce the model shown by Eysenck. The last issue was whether the factors extracted were uncorrelated.

14.1.1 Scales of the EPQ-R

The Cronbach alphas of the Extraversion and Neuroticism scales were high in both men and women. These were comparable to those reported by Eysenck (1985). However, internal consistency for both the Psychoticism scale and the Lie scale were lower. Internal consistency in females did not reach a satisfactory value. The Lie scale is not a trait measure of personality therefore it is of no particular consequence that the internal consistency of this scale is low. It is at times used for selection in order to ascertain whether individuals are attempting to "fake good" their responses.

14.1.2 The Psychoticism Scale

There could be a number of reasons for the poor reliability of the Psychoticism scale. When the items are examined more closely they show a skewed response pattern (see section 10.1.3). Furthermore when a three factor solution (ENC) was assessed only 9 of the 32 Psychoticism items load together, with relatively low loadings. The third factor did not seem to represent Psychoticism but rather was more similar to Conscientiousness. If the four factor solution (ENAC) was assessed, factor three - Antisocialness - contains loadings from only 9 items, 5 of which are from the Psychoticism scale. Factor 4 - Conscientiousness - contains loadings from 8 Psychoticism items, however, these all ask essentially the same question. All these loadings are low. The items from the Psychoticism scale therefore do not appear to load on a Psychoticism construct, they load across different factors, the loadings are low, and only some of the items load on any factor. Therefore it is not surprising that internal consistency is low, as it does not appear that the same construct is being measured by the items.

Scores on the P scale have typically showed a skewed distribution with scores tending towards zero (Eysenck et al., 1985). Eysenck et al (1985) suggest that this scale is more appropriate for a clinical population and that some of the items are too " 'way out' for most people". The model of personality, although derived from clinical models, is meant to refer to normal populations. Therefore the third scale should ideally show a normal distribution within a normal population. However, unusually in this population,

the total scores on the Psychoticism scale were not skewed but followed a normal distribution. A recent study in a group of Spanish volunteers specifically tested the P scale. They similarly also found a more normal distribution of Psychoticism (Ortet, Ibanez, Moro, Silva, & Boyle, 1999). The mean for males is 8.3 (s.d. 4.2) and for females is 6.2 (s.d 3.5), which are slightly higher than those found previously 7.2 (s.d 4.6) for males and 5.7 (s.d 3.9) for females (Eysenck et al., 1985). The slightly higher scores in this group may be due to age. Eysenck et al (1985) found that P scores decreased slightly in older age groups.

However, the P scale still appears to suffer serious psychometric shortcomings in the current population. Internal consistency is unsatisfactory, the P scale has a skewed response set at the item level, and few items load together. Scores are different between men and women, with men scoring higher on this scale. The P scale items do not seem in the current student population to be representative of a monolithic Psychoticism construct. However, in a less homogeneous population, Ortet and colleagues found that 23 Psychoticism items contributed to scale reliability, had adequate loadings on a Psychoticism factor, and did not load on other factors substantially (Ortet et al., 1999). This Spanish study provides good support for Eysenck et al's Psychoticism factor.

14.1.3 The EPQ-R Model – the factors

Eysenck's model was not supported in this data set. Both a three (ENC) and a four factor solution (ENAC) were extracted. An Extraversion and a

Neuroticism factor were apparent in both solutions (see sections 10.2.2 and 10.2.4).

Lucas et al (2000) suggest that a higher order Extraversion factor may split into facets which are linked by reward sensitivity and facets which are linked by sociability. However in both the ENC and the ENAC (3 and 4 factor) solutions the higher order Extraversion factor appears to be more representative of sociability. This finding concurs with previous research, which suggests that Extraversion from the EPQ scales measures sociability alone (Roger & Morris, 1991).

Digman (1990) suggested that Eysenck's Psychoticism should be split into two factors. One of which related to impulsivity while the other related to agreeableness. The four factor ENAC solution does appear to agree with Digman's suggestion to a degree, with the third factor relating to Antisocialness (the opposite of Agreeableness) and the fourth factor relating to Conscientiousness or Impulsivity. Both of these factors consist mainly of Psychoticism items. However, the Antisocialness factor is made up of only 9 items in total with loadings ranging between .300 and .365 and the fourth factor consists of equally low loadings and the items may not tap a true factor. (The P scale and items are discussed in section 14.1.2). The third factor in the three factor (ENC) solution appears to relate more to impulsiveness or conscientiousness. Therefore the solutions found here can only give partial support to Digman (1990).

Both Extraversion and Neuroticism have high loadings and are made up of almost purely relevant items. In both of the three and four factor solutions the Psychoticism factor is not apparent. Zuckerman's (1988) question of "What lies beyond E and N?" is particularly apt. Both of the solutions produce a factor which appears to represent Conscientiousness. The three factor solution (ENC) may well produce factors which are more representative of personality, as Conscientiousness-4FS may be a bloated specific. That is where items correlate highly because they all ask essentially the same question. The items are therefore not tapping into a true factor. Digman (1990) reviews many personality models, and makes a case for five personality dimensions (these are presented in table 15.3.2). These are broadly: Extraversion, Neuroticism, Agreeableness, Conscientiousness and Openness. The question therefore is whether the EPQ scales can measure these factors. Ng and colleagues, including the Lie scale in their prinicipal components exploratory analysis, propose five factors which they label Neuroticism, Conscientiousness, Sociability, Excitement Seeking and Agreeableness (Ng, Cooper, & Chandler, 1998). Indeed within the current analysis it may be suggested that the current ENC model gives three of the big five, where the three factors are Extraversion, Neuroticism and Conscientiousness. The four factor ENAC model could perhaps represent four of these five with Antisocialness being related to Agreeableness. However, in the ENAC model the Antisocialness factor and the Conscientiousness factor are not particularly convincing as both of these factors consist of items with low loadings (neither factor contains an item with

a loading exceeding 0.38) and both contain only a few items. Whether either the factors here or those proposed by Ng et al correspond to those in the Big Five is a question open to debate. The factors derived from the exploratory factor analysis would need to be tested against those from the Big Five model. However, it does appear from both the current study and the Hong Kong study (Ng et al., 1998), that Psychoticism is not the third factor in the EPQ scales.

14.1.3 The EPQ-R Model – orthogonal or oblique

Embedded within Eysenck's model is that the dimensions are orthogonal. The factors should be at 90 degrees to one another. Therefore these scales should not correlate to a significant level. It would have been expected that correlations between the three personality dimensions would be negligible. The highest correlation is a negative one between Psychoticism and Lie ($r = -0.37$ in men and $r = -0.31$ in women). This is not surprising. The Lie scale is not a personality scale as such but was originally included as a device to exclude those who provided false answers. It does appear to reflect social desirability, which is a description that may contrast to those who score high on Psychoticism. The Lie scale also had small negative correlations with Extraversion and Neuroticism in both men and women. These correlations do not affect Eysenck's model as the Lie scale is not part of the theory but is merely included in the questionnaire to prevent individuals faking positive responses. Eysenck et al (1985) found similar correlations with the Lie scale.

In the same large data set (men n=408, women n=494) which Eysenck et al (1985) present, Neuroticism and Psychoticism correlate to a small degree in men and other than the correlations with the Lie scale all other correlations are of negligible size. This is not the case in the present data set. Neuroticism and Extraversion correlate to a significant degree, negatively to a moderate level in men (r = -0.30) and to a small level in women (r = -0.20). This would suggest that the factors are not entirely independent of each other.

Further there is a small correlation between Psychoticism and Neuroticism in women (r = .11). Differing from Eysenck's model, Psychoticism does not come out as a third factor during exploratory factor analysis. Therefore, scores on the scale in this data set are not expected to act in the fashion as predicted by Eysenck. The items do not load well together and the internal consistency is low. Psychoticism is not a robust third factor in this data set.

However, both Neuroticism and Extraversion factor extremely well with very few items from either scale loading on other factors, as well as most of the items relating to these scales loading onto the relevant factors. One possible explanation of the correlation between these scales may be due to the sample. The project was advertised as one assessing "Personality, Mood and Diet". It is possible that those who volunteered were suffering from low mood and were using this project as a means of investigating their own mood. Whether depression has an influence on personality scores can not be examined within this thesis (discussed in section 17.1.2). Scores on

personality measures such as Neuroticism and Extraversion are known to be affected by low mood and depression, in that scores on Neuroticism are increased and scores on Extraversion are decreased (Kendler et al., 1993; McFatter, 1994; Williams, 1990). It is also thought that the relationship between Neuroticism and Extraversion may change, as if N scores are increased and E scores are decreased. This may alter their position and they then may correlate (McFatter, 1994). This is certainly an area which needs examined as although there is a wealth of studies examining mood and personality (see chapter 3 for examples) few have questioned whether the factor structure of a personality model is upheld during clinical depression or low mood.

Replications of personality models have been found across different countries and cultures (Barrett et al., 1998), however, Twenge suggests that scores on scales may change due to the socio-cultural environment (Twenge, 2000; Twenge, 2001). Twenge found that both Neuroticism (Twenge, 2000) and Extraversion (Twenge, 2001) scores are changing through the decades. Between 1952-1993 both adult and child scores on anxiety increased by approximately one standard deviation. A similar increase in American college students scores on Extraversion was found between 1996 and 1993. The change (increase) in scores may account for the increased correlations between Extraversion and Neuroticism. If the scores are changing the relationships between Extraversion and Neuroticism could also be changing therefore affecting their factor structure.

Neuroticism and Extraversion are suggested from both a three and a four factor solution in this data set. The main aim of this section was to show that Neuroticism could be extracted from the EPQ-R in this student population. Despite the moderate correlation between N and E in men and the small correlation in women, which does not support Eysenck's hypothesis that these would be orthogonal, these scales are shown to be robust.

14.1.3 Gender Differences on the EPQ-R

Both Extraversion and Neuroticism have high reliabilities and items from their scales factor together with high loadings. The reliabilities are very similar for both men and women, however, mean scores on the Neuroticism scale are higher for women. This finding is consistent with many previous studies, these are reviewed by Francis (1993). There are a number of reasons why women may score higher on the Neuroticism scale. Firstly there may be a genuine gender bias, or this may be due to the scale itself. There may be a gender bias in the questions. For instance Jorm (1987) suggests that some of the questions might be weighted to contain more items which are more appropriate for females rather than males. A male might be more likely to show anger than cry. Francis (1993) found two components of the Neuroticism scale, one that was influenced by gender, and one that was not. Furthermore Francis and Wilcox (1998) found that scores of masculinity were correlated with high Extraversion and low Neuroticism, while scores of femininity were correlated with low Psychoticism. Personality or at least the

measurement of it does appear to be affected by gender. This may affect relationships with other variables that are related to gender such as mood.

Scores on the Psychoticism scale also showed differentiation between men and women with men scoring higher on this scale. Again these differences on scores may be due to question type and gender specific responding.

14.1.4 Summary of Eysenk's EPQ-R

Eysenck and colleagues' model of Extraversion, Neuroticism and Psychoticism has been replicated many times therefore the findings in this thesis regarding this model are far from unique. However, it was important to show that both Neuroticism and Extraversion could be extracted satisfactorily from the EPQ-R scales in the current student population. Neuroticism and Extraversion factor from the EPQ-R well with high loadings. There is however, some correlation between these scales which would not be expected in Eysenck's theory. Further, Eysenck's model as a whole does not appear robust as the P scale shows psychometric shortcomings. Neither a three factor (ENC) nor a four factor (ENAC) solution found a factor representing Psychoticism, but rather a factor, Conscientiousness, which appeared to be more similar to one from the Big Five. In sum, Neuroticism and Extraversion appear as robust scales though Eysenck's model of Psychoticism, Extraversion and Neuroticism is not wholly supported.

14.2 Cloninger's Model

The scale of most interest in regard to this thesis from Cloninger's model is Harm Avoidance. Cloninger (1987) proposed that Harm Avoidance is related to serotonergic function. In this thesis it is proposed that Neuroticism may be related to serotonergic function (see Chapter 6). Harm Avoidance and Neuroticism have been shown to be highly related (Zuckerman & Cloninger, 1996). As Harm Avoidance has been proposed to be related to serotonergic function, rather than Neuroticism it is important to assess this dimension. Although this one scale is the focus of this section, other questions relating to the other scales and to the model itself were also asked. These relate to whether the questionnaire showed good reliability, whether three factors could be extracted and whether the factors fit with the model's factors. Cloninger also proposed 4 sub-scales for each of the dimensions, these were also assessed.

Although the focus of the chapter is on Neuroticism from the EPQ-R, the analysis of the TPQ adds more to the current literature. There have been relatively few replications of Cloninger's model. Only eight studies which have used the TPQ to test Cloninger's model have been published in English (Bagby et al., 1992; Cannon et al., 1993; Giancola et al., 1994; Otter et al., 1995; Parker et al., 1996; Sher et al., 1995; Waller et al., 1991; Zohar et al., 2001). Two have been published in French (Le Bon et al., 1998; Lepine et al., 1994) and two in German (Aschauer et al., 1994; Weyers et al., 1995). Only three of studies have assessed Cloninger's model at the item level

using exploratory factor analysis. Two of these were in samples from the US (Cannon et al., 1993; Sher et al., 1995) and one in a Hebrew speaking population from Israel (Zohar et al., 2001). However, only one of these samples was in a group totally composed of normal controls (n=1139) (Zohar et al., 2001). Sher et al recruited a mixed group of volunteers some who had a family history of alcoholism (n=490) (Sher et al., 1995), while the group that Cannon and colleagues recruited were all alcoholics (Cannon et al., 1993). Of the remaining five studies published which test the TPQ's structure three studies use exploratory factor analysis at the sub-scale level as well as confirmatory factor analysis (Giancola et al., 1994; Otter et al., 1995; Waller et al., 1991), while the remaining two studies only use confirmatory factor analysis (Bagby et al., 1992; Parker et al., 1996). Only one study has tested Cloninger's model in a British sample (Otter et al., 1995). In this study exploratory analysis at the scale level and confirmatory factor analysis were used. Otter et al's sample contained only 413 subjects. Therefore this thesis produces the only exploratory analysis at the item level in a British sample and the largest exploratory analysis at the item level of the English language version of the TPQ in the world (excepting Cloninger's original sample n=1019 (Cloninger et al., 1991)). Although a test of the model is beyond the scope of this thesis, whether three factors could be extracted in a manner such as Cloninger's will be commented upon. The factors that are extracted will be described.

14.2.1 Scales of the TPQ

Some of the scales and sub-scales showed low internal consistency suggesting that the items are not measuring the same construct. Only the sub-scales from Harm Avoidance show satisfactory reliabilities with the total scale showing high alphas for both males and females. Table 14.2.1 shows the reliabilities of the sample from this study in comparison to Cloninger's normative samples (Cloninger et al., 1991) and Otter's English sample (Otter et al., 1995). The alphas for the present sample for the total scales are all satisfactory with Harm Avoidance showing high internal consistency. Values for all the scales are higher in the present sample than in Cloninger's normative sample or in Otter's English sample. However, in all of the three groups, Cloninger's, Otter's and the present one, the reliabilities are low on some of the sub-scales from both Novelty Seeking and Reward Dependence. There would appear to be an error in Otter et al's Reward Dependence reliabilities (the error has been confirmed by personal communication with the authors, however corrected values have not yet been made available). The error would appear to be in the totals (these are in italics in table 14.2.1). Cronbach's alpha for the total Reward Dependence scale is much lower than the alphas of the sub-scales. These values therefore seem to be in error, as the total scale usually has a higher alpha value than the sub-scale. However, the reliabilities for the scales are still low. Only the scale of Harm Avoidance contains satisfactory values for both the entire scale and the sub-scales. The

Table 14.2.1: Cronbach alpha's for the current student sample, an English sample (Otter et al., 1995) and Cloninger's normative data for males and females (Cloninger et al., 1991)

	Cloninger's white sample		Cloninger's black sample		Otter's English sample		Present sample	
	Males (n=326)	Females (n=350)	Males (n=136)	Females (n=207)	Males (n=106)	Females (n=307)	Males (n=347)	Females (n=550)
HA1	.67	.65	.45	.62	.71	.76	.81	.81
HA2	.65	.65	.61	.52	.71	.74	.76	.72
HA3	.75	.74	.51	.67	.72	.76	.80	.72
HA4	.75	.74	.71	.73	.73	.77	.78	.77
Total HA	**.85**	**.85**	**.77**	**.80**	**.72**	**.72**	**.90**	**.89**
NS1	.53	.54	.46	.36	.51	.61	.51	.53
NS2	.56	.55	.38	.44	.70	.65	.66	.68
NS3	.64	.63	.47	.63	.74	.70	.74	.71
NS4	.48	.47	.57	.44	.58	.59	.54	.47
Total NS	**.75**	**.73**	**.68**	**.71**	**.68**	**.73**	**.81**	**.79**
RD1	.45	.39	.46	.46	.49	.37	.47	.44
RD2	.58	.57	.38	.35	.54	.61	.64	.64
RD3	.67	.64	.55	.59	.74	.74	.75	.76
RD4	.44	.38	.37	.42	.54	.57	.39	.47
Total RD	**.69**	**.61**	**.63**	**.55**	***.39***	***.40***	**.72**	**.72**

low values on the other scales may suggest that revision of some items is necessary to ensure that the items are measuring the same construct.

The present sample showed slightly higher means for Harm Avoidance compared to the other samples, higher Novelty Seeking values than Cloninger's (1991) samples though similar to Otter et al's (1995) sample, but similar Reward Dependence values (see table 14.2.2). There could be a number of reasons for the difference in scores. When the subjects were recruited they were asked to only volunteer if they would be willing to take part in the two day study. Perhaps those higher in Novelty Seeking would be more likely to apply. As noted in section 14.1.2 the study was advertised as investigating "Personality, Mood and Diet", there might be a possibility that those who scored high on Harm Avoidance would be more likely to volunteer for such a project in order to investigate their own moods. However, those high on Harm Avoidance may not wish to drink a foul tasting drink, be tested for two days and possibly suffer from a mood change. A further reason for a difference in scores may because of age. In comparison to the other two studies, the present group was younger and all were recruited from the student population. Novelty Seeking is likely to decrease with age therefore it is likely that the younger group would have higher scores. Cloninger et al (1991) found a negative correlation (r = -.36 to -.42) between age and Novelty Seeking.

Table 14.2.2: Means and standard deviations for the current student sample, an English sample (Otter et al., 1995) and Cloninger's normative data for males and females (Cloninger et al., 1991)

	Cloninger's white sample		Cloninger's black sample		Otter's English sample		Present sample	
	Males (n=326)	Females (n=350)	Males (n=136)	Females (n=207)	Males (n=106)	Females (n=307)	Males (n=347)	Females (n=550)
HA1	2.3 (2.0)	2.6 (2.1)	2.5 (1.7)	2.8 (2.1)	2.6 (2.2)	4.2 (2.7)	3.7 (2.8)	4.6 (2.8)
HA2	3.7 (1.9)	4.7 (1.7)	4.2 (1.8)	4.8 (1.6)	3.2 (2.0)	4.1 (2.1)	3.1 (2.2)	4.3 (2.0)
HA3	2.5 (2.0)	3.0 (2.1)	2.2 (1.6)	2.4 (1.9)	2.7 (2.0)	3.1 (2.1)	3.1 (2.2)	3.2 (1.9)
HA4	2.1 (2.2)	2.5 (2.4)	2.7 (2.3)	3.1 (2.5)	2.2 (2.2)	3.6 (2.6)	3.3 (2.5)	3.8 (2.5)
Total HA	10.6 (6.0)	12.9 (6.1)	11.6 (5.1)	13.2 (5.5)	10.7 (6.2)	15.0 (7.0)	13.2 (7.6)	15.9 (7.1)
NS1	4.2 (1.9)	4.4 (2.0)	4.0 (1.9)	4.4 (2.0)	5.2 (1.9)	5.2 (2.1)	5.4 (1.9)	5.2 (1.9)
NS2	2.5 (1.8)	2.2 (1.7)	2.3 (1.5)	2.2 (1.7)	3.1 (2.2)	3.5 (2.1)	3.7 (2.1)	3.4 (2.2)
NS3	3.1 (1.8)	3.2 (1.7)	3.0 (1.6)	3.2 (1.7)	3.8 (2.0)	4.1 (1.9)	3.8 (2.0)	4.0 (1.9)
NS4	3.8 (2.0)	3.2 (1.8)	3.7 (2.1)	3.2 (1.8)	5.0 (2.2)	5.4 (2.2)	5.6 (2.0)	5.2 (2.0)
Total NS	13.7 (5.2)	13.0 (4.9)	13.0 (4.6)	13.0 (4.9)	17.0 (5.9)	18.2 (6.1)	18.4 (5.9)	17.9 (5.6)
RD1	3.8 (1.2)	4.3 (0.9)	4.2 (1.0)	4.3 (0.9)	3.1 (1.4)	3.8 (1.1)	3.2 (1.3)	3.8 (1.2)
RD2	5.6 (2.0)	5.6 (2.0)	5.2 (1.7)	5.6 (2.0)	4.8 (2.0)	5.0 (2.2)	4.6 (2.2)	5.3 (2.1)
RD3	6.6 (2.4)	7.2 (2.2)	6.2 (2.1)	7.2 (2.2)	5.5 (2.8)	7.4 (2.6)	6.6 (2.7)	7.7 (2.6)
RD4	2.6 (1.3)	3.0 (1.2)	2.1 (1.2)	3.0 (1.2)	2.5 (1.5)	3.0 (1.5)	3.2 (1.3)	3.4 (1.3)
Total RD	18.5 (4.3)	20.1 (3.8)	17.7 (3.9)	20.1 (3.8)	15.8 (4.7)	19.2 (4.6)	17.6 (4.7)	20.2 (4.4)

14.2.2 The TPQ Model – in this sample

Cloninger's model appears to be relatively well replicated when exploratory analysis is carried out at the scale level. Three factors did emerge which are similar to the model which Cloninger had proposed. The three factors were Harm Avoidance, Novelty Seeking and Reward Dependence. The three factors do in the main contain loadings from the hypothesised sub-scales with only a few exceptions. However the sub-scale of Persistence (RD2) did not load highly on any factor but had a small negative loading on the Novelty Seeking factor (-.372). When analysis is carried out at the sub-scale level there appears to be quite strong support for Cloninger's three factor model. However, this is the most positive evidence supporting Cloninger's model from this sample.

At the item level the only scale which factored from the TPQ satisfactorily was Harm Avoidance. The three factor model as proposed by Cloninger was not found, however both three and four factor solutions were found with only Harm Avoidance from Cloninger's model being extracted as a single factor. In both cases this was the first factor. The three factor solution (HCS) suggested factors resembling Harm Avoidance, Conscientiousness and Socialness. The four factor solution (HCTI) suggesting factors representing Harm Avoidance, Conscientiousness, Tough Mindedness and Impulsiveness.

In this analysis exploratory factor analysis was used instead of confirmatory. Confirmatory factor analysis is the preferred technique for testing the fit of a

particular model. However, the model could not be extracted at the item level of analysis and one would expect that exploratory factor analysis would find an approximation of Cloninger's three factors rather than just one. Therefore it would be unlikely that confirmatory would justify Cloninger's model in this sample.

Although the sample used in this study is not a completely random sample, one may have expected more support for the Cloninger's model. Items from Reward Dependence and Novelty Seeking did not load as hypothesised and internal consistency for these scales was low. Both three and four factor solutions were suggested using exploratory factor analysis. These factors were not the same as Cloninger's factors. The only scale in the either solution which is similar to one in Cloninger's solution is Harm Avoidance.

14.2.3 The TPQ solutions in comparison to the EPQ-R solutions

Interestingly the three factor (ENC) solution which is suggested in this sample from the TPQ seems similar (at least) semantically to the three factor solution derived from the EPQ-R. Harm Avoidance correlates highly with Neuroticism therefore both these factors seem to relate to an emotionality factor. Both the TPQ and EPQ-R solutions contain a Conscientiousness factor. Furthermore both solutions contain a factor relating to Sociability. The TPQ HCS solution suggests a factor relating to socialness and the EPQ-R ENC solution, one relating to Extraversion. Section 14.1.3 notes that the Extraversion factor appears to be representative of sociability. Therefore the three factor solution of HCS and ENC appear to be remarkably similar.

The four factor HCTI solution suggested from the TPQ contains factors representing themes relating to Harm Avoidance, Conscientiousness, Tough Mindedness and Impulsitivity. The four factor solution (ENAC) from the EPQ-R represents factors which represent Extraversion, Neuroticism, Antisocialness and Conscientiousness. The TPQ HCTI solution does not contain a factor representing Extraversion. However, both solutions do contain a factor relating to emotionality, Harm Avoidance and Neuroticism. Furthermore, Conscientiousness is again present in both the HCTI and the ENAC solutions.

Comparisons between the suggested three and four factor solutions can be made with the Big Five as has been done in section 14.1.3. The three factor solution (HCS) could be said to extract three of the big five. The four factor is more confusing because there is no Extraversion factor. In nearly all questionnaires a factor resembling Extraversion has been extracted (Digman, 1990). However, Harm Avoidance, Conscientiousness would appear to directly related to Neuroticism and Conscientiousness from the Big Five. Tough Mindedness as the opposite of the Big Five's Agreeableness and Impulsivity may represent part of Extraversion and part of Conscientiousness.

14.2.4 Item level analysis of the TPQ in this sample compared to those in the literature

There were three studies published in the English language which analysed the TPQ at the item level (Cannon et al., 1993; Sher et al., 1995; Zohar et al.,

2001). The factors suggested in these studies will be discussed in relation to the factors found at the item level analysis in the current study. The level of information given regarding the factor solutions differs from study to study and solution to solution. Therefore when the factors are described by the researchers these are summarised in table 14.2.3. However, some researchers have not included descriptions but have compared their model to Cloninger's or another model in the literature. Table 14.2.3 also suggests a comparison between the solutions.

Cannon and colleagues suggested a five factor solution from the TPQ in a group of 303 male in-patients in an Alcohol Dependence Treatment Program (Cannon et al., 1993). They suggested that both a three and a four factor solution produced factors which were too broad. Their three factor solution contained items whose content ranged from difficulty in recovering from minor illnesses or stress to keeping problems to oneself and preferring to stay at home rather than travel to new places. Their four factor solution suffered from a similar problem with a factor with content ranging from persistence, social reserve and optimism. The five factor solution is shown in table 14.2.3. Factor 1 represents Subjective Distress which appears to relate to an emotionality factor. Factor 2 represents Detachment which appears to contain a theme of antisocialness where the individual is shy and has a reluctance to self-disclosure. The third factor represents Disinhibition which contains themes of impulsiveness, rule breaking and thrill seeking. The fourth factor, Relaxed Confidence, suggests self-confidence, optimism and a

Table 14.2.3: Exploratory item analysis of the TPQ

Author	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
(Cannon et al., 1993)	Subjective Distress	Detachment	Disinhibition	Relaxed Confidence	Orderliness
(Sher et al., 1995)	Harm Avoidance	Reward Dependence	Novelty Seeking		
(Sher et al., 1995)	Harm Avoidance	Reward Dependence	Novelty Seeking		Persistence
HCS this study	Harm Avoidance		Socialness		Conscientiousness
HCTI	Harm Avoidance	Tough Mindedness	Impulsiveness		Conscientiousness

HCS H Harm Avoidance, C Conscientiousness, S Socialness; HCTI H Harm Avoidance, C Conscientiousness T Tough Mindedness I Impulsivity

comfortableness around others. The fifth, Orderliness, contains items relating to being well-orgainsed, working hard and saving money.

However, it must be borne in mind that the population which Cannon and colleagues (1993) study is an unusual one. All of the subjects within their study were attending an alcohol dependency unit, therefore it would be likely that their scores would be skewed in some way. Their scores may therefore alter the model which is produced.

Sher et al (1995) suggest a three, a four and a five factor solution. However, they do not report the five factor solution but merely note that it does not support the model proposed by Cannon et al (1993). Their three factor solution resembled the three factor solution proposed by Cloninger of Harm Avoidance, Novelty Seeking and Reward Dependence. However, Sher et al (1995) note that there was a great deal of overlap between the Novelty Seeking and the Reward Dependence factors.

Their four factor solution, they suggest, contains the same three factors that are in the three factor solution Harm Avoidance, Novelty Seeking and Reward Dependence, as well as a factor which could broadly be described as Persistence. Unfortunately the items for each factor are not described in the paper. The Persistence factor contains 12 out of the 34 HA items, 6 RD items and 4 NS items. It would be interesting to know the themes within this factor. The Harm Avoidance factor only contains 14 out of the 34 HA items and also contains 4 NS and 3 RD items. The Novelty Seeking factor appears to be more representative of Novelty Seeking containing 23 out of the 34 NS items, and only containing 3 HA and 2 RD items. The Reward Dependence factor contains 19 of the RD items and only 3 HA and 2 NS.

Zohar et al (2001) restricted their analysis to a four factor solution. They do not describe the factors nor do they give the item loadings for the items. They do note that less than half of the items loaded on the factors suggested by Cloninger.

All of the solutions presented consistently find an Emotionality factor whether a three, four or five factor solution is extracted. Interestingly also a Conscientiousness factor is also extracted in all but Sher et al's three factor solution. If table 14.2.3 is compared to table 15.3.2 a factor which relates to conformity, socialness and agreeableness can be seen in all the solutions.

In sum, none of the published exploratory item level analyses of the TPQ or the current study could reproduce Cloninger's three factors to a satisfactory level. However, there are similarities between these models. All of the

analyses suggested an Emotionality factor and a Conscientiousness factor, with a possible third factor of agreeableness. Although the dimensions found appear to some degree to relate to current research on personality these factors are not supportive of the model from which the questionnaire was derived. They do not add weight to Cloninger's theory of personality.

14.2.5 The TPQ and its revisions

It therefore would appear that the TPQ as it stands can not be replicated satisfactorily in either the current population or in other populations (Cannon et al., 1993; Giancola et al., 1994; Otter et al., 1995; Sher et al., 1995; Waller et al., 1991; Zohar et al., 2001). Cloninger originally suggested a three factor solution but later suggested that one of the sub-scales from Reward Dependence may be an independent factor which was called Persistence (Cloninger et al., 1991; Cloninger, Svrakic, & Przybeck, 1993). Noting the failings of these models he later reinvented the questionnaire to include three Character dimensions (Cloninger et al., 1993), though including the Temperament dimensions. The revised model contains four Temperament dimensions: Harm Avoidance, Novelty Seeking, Reward Dependence and Persistence; and three Character dimensions: Self-Directedness, Cooperativeness and Self-Transcendence (Cloninger et al., 1993). The Temperament and Character Inventory (TCI) was developed to test these dimensions.

De Fruyt and colleagues (De Fruyt, Van de Wiele, & Van Heeringen, 2000) find by regression analysis that the dimensions of the new model can

substantially predict all of the domains from Costa and McCrae's Five Factor Model (Costa & McCrae, 1992b). There have been a number of studies which have assessed the TCI and published in the English language (Brandstrom et al., 1998; Gutierrez et al., 2001; Kozeny & Hoschl, 1999; Pelissolo & Lepine, 2000; Richter, Brandstrom, & Przybeck, 1999; Tomita et al., 2000). The dimensions of Reward Dependence, Novelty Seeking and Harm Avoidance remain largely unchanged and therefore suffer the same psychometric problems with the new model as within the old model. Furthermore, the domain of Persistence could not be extracted satisfactorily and revision of this domain was suggested (Gutierrez et al., 2001; Kozeny & Hoschl, 1999; Pelissolo & Lepine, 2000; Richter et al., 1999).

14.2.6 Gender differences on the TPQ

Females scored higher on the Harm Avoidance scale and on the Reward Dependence scale. Similar differences in these scales have been found on these scales (Cloninger et al., 1991; Giancola et al., 1994; Otter et al., 1995) but Cloninger also found males to have higher Novelty Seeking scores. These differences are not surprising as similar differences have been found and replicated many times with Eysenck's scales. The reasons for gender differences in the TPQ are likely to be similar to those discussed above in section 14.1.3.

14.3 Summary

The focus of this chapter was to ascertain whether Neuroticism could be extracted satisfactorily from the EPQ-R in the current population. Both Neuroticism and Extraversion showed high Cronbach alphas therefore showing good internal consistency. When the EPQ-R was analysed at the item level both a three and a four factor solution suggested a Neuroticism and an Extraversion factor. However, these two factors correlated which was not as expected in regard to Eysenck's model. Furthermore the third factor did not appear to be a Psychoticism factor but rather a Conscientiousness factor.

When the TPQ was analysed support was given to Cloninger's model when exploratory factor analysis was carried out at the scale level. The three factors of Harm Avoidance, Novelty Seeking and Reward Dependence were suggested. However, this did not prove to be the case at the item level. From the results found in this data set, caution should perhaps be adopted when comparing models at the scale level rather than the item level. At the item level only Harm Avoidance from Cloninger's model could be supported. This is in contrast to the exploratory factor analysis at the scale level. Harm Avoidance was extracted both in a three and a four factor solution and in both solutions Harm Avoidance was both distinct and clear.

The data has given some interesting evidence regarding personality models. Cloninger's appears to be flawed with the exception of the scale of Harm Avoidance. Eysenck's Psychoticism dimension has again been found to be

weak. Interestingly when a three factor solution is extracted both analysis of the EPQ-R and the TPQ suggest very similar solutions containing an Emotionality factor (Neuroticism or Harm Avoidance), a Socialness factor (Extraversion or Socialness) and a Conscientiousness. Neuroticism and Harm Avoidance correlate highly in this sample and Extraversion appears to consist almost completely of items relating to sociability. The correspondence (at least semantically) between these factors is interest especially as both of these questionnaires are developed from diverse theoretical backgrounds. However, it is beyond the scope of this thesis to investigate possible models of personality and the correspondence between these solutions.

In sum, three factors of the proposed factors can be extracted satisfactorily from the data set: Neuroticism, Harm Avoidance and Extraversion.

Chapter Fifteen Discussion II: Correspondence between the EPQ-R and TPQ scales

This chapter discusses the relationships between Cloninger's and Eysenck's scales. Although Cloninger proposed that Harm Avoidance is related to serotonin, this thesis proposes that those who score at the high end of the Neuroticism scale may be sensitive to serotonin change via tryptophan depletion. It was also hypothesised that Neuroticism would be a better predictor of negative mood and therefore a better predictor of mood change via tryptophan depletion than Harm Avoidance. It was therefore important to assess the relationship between these Harm Avoidance and Neuroticism. Measures of personality from different questionnaires do have high correspondence, for instance, scales from Cloninger's and Zuckerman and Kuhlman's scales questionnaires (Zuckerman & Cloninger, 1996). It is therefore important to assess how much Eysenck's EPQ-R and the TPQ overlap in this sample. Furthermore the combined analysis of both of the questionnaires will be discussed regarding the structure of personality (the results are presented in Chapter 11).

15.1 Correlation and regression analysis of the EPQ-R and TPQ scales

At this point a note of caution must be made. Any results, with regarding the total scale scores of Reward Dependence and Novelty Seeking must be interpreted with some caution, these two scales might not be measuring the constructs that they were proposed to be measuring (as discussed in chapter

14, the Cronbach alpha values were low and very few items loaded on the relevant factor). This is particularly true of Reward Dependence. However the Harm Avoidance scale was shown to be robust.

Harm Avoidance and Neuroticism show a very close relationship (tables 11.1.1 and 11.1.2) with the correlations being r = 0.68 in men and r = 0.64 in women. However, the scales are not equivalent. Extraversion also explains a substantial part of the variance in Harm Avoidance (r = -0.60 and r = –0.56 in men and women respectively). This is where the dimensions from the two personality scales overlap the most with two scales from the EPQ-R explaining approximately 60% of the variance in one of the scales from the TPQ (see section 11.2).

Less than 50% of Neuroticism's variance was explained by Harm Avoidance and Reward Dependence (48% in men, 44% in women). The majority of this variance is explained by the relationship with Harm Avoidance. The scale of Harm Avoidance appears to contain facets which are not contained within Neuroticism. Neuroticism only has a high correlation with Harm Avoidance and is predicted almost purely by Harm Avoidance. However, both Neuroticism and Extraversion predict Harm Avoidance.

Extraversion correlates with and is a significant predictor of all three of the TPQ scales. Extraversion and Psychoticism can predict approximately 40% of the variance in Novelty Seeking. All three EPQ-R personality scales predict less than 30% of Reward Dependence. Extraversion correlates with all three of the TPQ scales and these explain approximately 55% of the

variance in Extraversion. These three scales of Harm Avoidance, Neuroticism and Extraversion explain the most variance in the personality models. The relationships that are shown would appear to suggest that although both questionnaires propose that they measure personality neither questionnaire explain the full breadth of the other. These models overlap but neither gives the full picture and each explains different aspects of personality (see section 11.2).

A similar picture was found by Waller and colleagues (1991) and Zuckerman and Cloninger (1996). Zuckerman and Cloninger compared the EPQ-R, the Temperament and Character Inventory (TCI) and the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ). The TCI contains both temperament and character scales. The three temperament dimensions of Harm Avoidance, Reward Dependence and Novelty Seeking remained basically unchanged in the TCI. Zuckerman and Cloninger correlated the scales from each of these inventories. A single scale from one inventory did not fully explain a single scale from the other inventory. Thus, there was no direct one to one relationship between any of the EPQ-R scales and the TCI temperament scales. Notably there were very high correlations between Harm Avoidance and ZKPQ N-anxiety ($r = 0.66$) and the EPQ-R Neuroticism ($r = 0.59$) scales. Further the Harm Avoidance scale similar to the present study also showed an equivalently large though negative correlation with EPQ-R Extraversion ($r = -0.53$). EPQ-R Extraversion also showed a small but significant correlation with Reward Dependence, thereby playing a role in all three of the TCI

scales. Novelty Seeking had moderate positive correlations with both Psychoticism and Extraversion. The correlations between the EPQ-R dimensions and Cloninger's dimensions are very similar to those found in the current study. HA correlated highly with both E and N, also Extraversion correlated significantly with all three of Cloninger's scales.

Interestingly, Novelty Seeking in Zuckerman and Cloninger's study showed an almost one to one correspondence with ZKPQ Impulsive Sensation (r = 0.68). Similarly to the present study Reward Dependence did not show high correlations with any scale either from the EPQ-R or from the ZKPQ. Further Waller et al (1991) found that the TPQ only explained a proportion of the variance in the Multidimensional Personality Questionnaire adequately (MPQ) (Tellegen, 1982). Although each of these models proposes to describe the basic traits of personality, none of the models fully encompass the other, and there is a large proportion of variance left unexplained.

The scale of Reward Dependence does not show high correlations with any other scale. This may be for a number of reasons. The scale itself does not reach a satisfactory reliability and does not factor particularly well. It may not, in fact, measure what it is meant to measure and may indeed not fit with a model of personality. This would be the most convincing argument. Less than 30% of the scale was explained by the EPQ-R scales, and only small correlations were found with any of the scales from the ZKPQ (r ranges between –0.27 and 0.16). This may suggest that this scale explains part of personality which other scales have not tapped.

15.2 Factor analysis at the scale level

A three-factor solution was extracted from analysis at the scale level of the EPQ-R and the TPQ combined (see section 11.3). The analysis suggested factors representing Emotionality, Openness and Socialness. This matrix approached Thurstone's simple structure ((Thurstone, 1931), the essentials of which are simplified by (Child, 1990)). Extraversion loaded on all three factors, which is against simple structure. It was not, however, spread equally amongst the three factors but had a much higher loading on factor 3.

The first factor (Emotionality) contained high positive loadings from both Harm Avoidance and Neuroticism with a smaller negative loading from Extraversion. This factor is pretty much as expected as Harm Avoidance correlated highly with both Neuroticism and Extraversion and would appear to capture individual differences in emotionality. Correspondence between Harm Avoidance and an emotionality factor has been found in other studies (e.g. (Sher et al., 1995; Waller et al., 1991; Zuckerman & Cloninger, 1996)). Zuckerman and Cloninger (1965), as noted in section 15.1 found that Harm Avoidance correlated highly with both the N-Anxiety dimension from the Zuckerman-Kuhlman Personality Questionnaire and Neuroticism from the EPQ-R. Waller and colleagues (1991) found from correlational, regression and factor analysis with the Multidimensional Personality Questionnaire that Harm Avoidance appeared to tap a Negative Emotionality factor.

Furthermore when the TPQ scale was explored at the item level every solution suggested an emotionality factor (see table 14.2.3). The

Emotionality factor (Factor 1) also appears to be very similar to trait anxiety as proposed by Gray (1981; 1987). This in fact would be supported by Cloninger himself who suggested that Gray's dimension may be better called Harm Avoidance and that Harm Avoidance "*involves a heritable neurobiological tendency to learn to avoid punishment, non-reward, and novelty*" (Cloninger, 1986) page 176). Gray's Anxiety dimension is a mix of high N, low E and low P but factor 1 contained a negligible loading from P. The dimension is a good approximation to this factor although not perfect. Gray's impulsive dimension, which is made up of high N, high E and high P, did not appear. Neither Harm Avoidance nor Neuroticism had significant loadings on other factors. Again the correspondence at the scale level shows the closeness of their relationship.

The second factor in the three factor solution suggested from the analysis at the scale level of the EPQ-R and TPQ combined was called Openness (to experience) (see section 11.3). This factor contained a very high loading from Psychotism, a high loading from Novelty Seeking and a moderate loading from Extraversion. This factor could relate to impulsivity and taking risks. Indeed Novelty Seeking, Psychoticism and Extraversion are all purported to assess some characteristics of impulsivity. Zuckerman (1993) proposes an alternative biological five factor model, where one of the factors is P-Impulsive Sensation Seeking. The factor found in this analysis seems to be similar to the factor proposed by Zuckerman. P-Impulsive Sensation Seeking relates to impulsiveness and attention to reward stimuli. It is highly

related to Eysenck's Psychoticism and Costa and McCrae's Conscientiousness (Zuckerman, 1993). Factor 2 in this analysis therefore may be related to Zuckerman's P-Impulsive Sensation Seeking.

The third factor is made up of a very high loading from Extraversion, a high loading from Reward Dependence and a smaller negative loading from Psychoticism. These could well represent a factor which relates to Agreeableness. The extravert, the person who is dependent on other people's approval and the person who is tender minded all point to this interpretation.

The EPQ-R E does not load purely on one factor in this analysis, although this scale is suggested to be the best maker for Extraversion (Kline, 1993). However, its highest loading, of 0.643, is on what could be called an agreeableness factor (factor 3). It must be held in mind that these are interpretations of factors. It is very plain that any interpretation at this level is fraught with difficulty and it is only when these factors are tested against hypotheses that their meanings become clear.

Sher et al (1995) use exploratory factor analysis to determine the relationships between Eysenck's and Cloninger's scales. They compare Cloninger's sub-scales rather than the total scales, with the total scales from the EPQ-R. They are therefore comparing factors of a different order. The EPQ-R factors are broad, as are the three factors from the TPQ. It is these factors which should be compared.

Sher et al (1995) found an emotionality factor with loadings from Harm Avoidance, Neuroticism and Extraversion, which is similar to factor 1 in the present study. Their third factor contained loadings from Reward Dependence, a low positive loading from Extraversion (0.35) and a low negative loading from Psychoticism (-0.35). This is similar to the present study's factor 3, or agreeableness factor, which contains loadings from Extraversion, Reward Dependence and Psychoticism. Factor 1 in their model contains loadings from Novelty Seeking, Psychoticism and a low loading (0.30) from Neuroticism. This appears to be roughly comparable to factor 2 in the current study, which consists of high loadings from Psychoticism and Novelty Seeking and also a moderate loading from Extraversion. Interestingly RD2 Persistence does not load on any factor in Sher et al's data set.

The two models, that in Sher et al's study and the current study, are broadly similar. However, differences would be expected as analysis was carried out at different levels. Sher et al (1995) compared the EPQ-R at the higher order level, the total scale, with the lower order TPQ sub-scales, while model in the current study assessed all the scales at the higher order level. The aggregate measures of Reward Dependence and Novelty Seeking include all the sub-scales however, when these are explored at the sub-scale level in this sample the Persistence sub-scale (RD2) does not factor with Reward Dependence. Furthermore the Exploratory Excitability sub-scale (NS1) factors with both Novelty Seeking and Harm Avoidance. Loadings of the

sub-scales on other factors than the proposed one is a finding which is not exclusive to this study. Others have found that the sub-scales do not load exclusively on the proposed factor (Cannon et al., 1993; Cloninger et al., 1991; Giancola et al., 1994; Otter et al., 1995; Sher et al., 1995; Waller et al., 1991).

The EPQ-R and the TPQ if factored together at the scale level suggest three factors. Both in this study and in one by Sher and colleagues (1995) three quite similar factors are suggested. One is an Emotionality factor, one factor seems to be similar to Zuckerman's P-Impulsive Sensation Seeking and the third is suggestive of Agreeableness. Extraversion was not suggested as a single factor but loaded on all three factors in the current study and on two in Sher et al's study.

15.3 Item level factor analysis

The item level analysis is interesting from two perspectives. It gives an insight into how the TPQ and EPQ-R relate and also opens up a discussion concerning the structure of personality. Some researchers would argue that a five-factor model of personality should be recoverable from any data set, others argue for three factors. In fact the number of personality factors suggested ranges from 3 to 13 (Brand, 1994; Cattell et al., 1970; Costa & McCrae, 1992b; Eysenck, 1991; Gray, 1987; Zuckerman, 1991). The best way to test a particular model is by using confirmatory factor analysis. However, the current analysis is more interested in how the items from the EPQ-R and TPQ inter-relate, the solutions that arise are a by-product. It

must be remembered at this point that the aim of this thesis is not to suggest models of personality but to suggest which trait is the most related to mood. However, an item level analysis of both of these scales in such a large population will add to the literature regarding the structure of personality and regarding the comparability of these two scales.

15.3.1 Item level analysis of the TPQ and EPQ-R combined in this sample

The four factor solution suggested factors which represent Emotionality, Sociability, Conscientiousness and Risk Taking (see section 11.4.1). These are called Emotionality-4C, Sociability-4C, Conscientiousness-4C and Risk Taking-4C. The three factor solution suggested factors which represent Emotionality, Extraversion and Conscientiousness (see section 11.4.2). These are called Emotionality-3C, Extraversion-3C and Conscientiousness-3C.

In both the three and four factor solutions an emotionality factor was extracted as the first factor. This was made up of mainly Neuroticism and Harm Avoidance items. In all of the other analyses, correlation, regression analysis, and factor analysis at the scale level Extraversion corresponded with Harm Avoidance. At the scale level Extraversion also loaded on this emotionality factor. This is therefore a striking difference that at the item level Extraversion does not load with Harm Avoidance. In the four factor solution items from Harm Avoidance load on each of the other factors,

whereas in the three factor solution, 2 items load on other factors. Neuroticism in both cases loads only on factor 1.

The three-factor solution contains an Emotionality factor, an Extraversion factor and a Conscientiousness factor. The four-factor solution contains a very similar Emotionality factor, a Sociability factor, a Conscientiousness factor and a factor which seems to relate to impulsiveness or risk-taking. The Extraversion factor from the three-factor solution is very similar to the one in the four factor except Extraversion-3C also includes an excitability or impulsiveness theme. For instance some items relate to looking for something exciting or thrilling. Extraversion as measured by the EPQ-R almost totally relates to Sociability, however within its predecessor the EPI it also related to impulsiveness (Roger & Morris, 1991). Extraversion-3C therefore appears to be more similar to the original scale of Extraversion from the EPI.

This first factor of emotionality appears to be fairly robust across the different types of analysis with the two scales of Harm Avoidance and Neuroticism showing high correspondence. Furthermore a sociability factor is in both solutions. Neuroticism and Harm Avoidance are highly related shown by correlation, regression and factor analysis at both the scale and the item level. The relationships between the other scales are less clear. Part of this may be due to the poor item content and scales particularly of Reward Dependence and Psychoticism. When factor analysed at the item level, both

three and four factor solutions produced an emotionality factor, a sociability factor and a conscientiousness factor.

Of particular interest to this thesis is that Harm Avoidance and Neuroticism factor together in both solutions. In both cases an Emotionality factor is suggested.

15.3.2 Factors suggested from the combined analysis compared to the individual questionnaire analysis

The individual questionnaire analysis is presented in Chapter 10. Both a three (ENC; see section 10.2.2) and a four factor solution (ENAC; see section 10.2.4) was suggested from the EPQ-R. The factors from the three factor solution are called Extraversion-3FS, Neuroticism-3FS Conscientiousness-3FS. The factors from the four factor solution from the EPQ-R are known as Extraversion-4FS, Neuroticism-4FS, Antisocialness-4FS and Conscientiousness-4FS.

Both a three (HCS; see section 10.2.7) and a four factor solution (HCTI; see section 10.2.9) were also suggested from the TPQ. The factors from the three factor solution are called Harm Avoidance-3FS-TPQ, Conscientiousness-3FS-TPQ and Socialness-3FS-TPQ. The factors from the four factor solution from the TPQ are known as Harm Avoidance-4FS-TPQ, Conscientiousness-4FS-TPQ, Tough Mindedness-4FS-TPQ and Impulsiveness-4FS-TPQ.

The three and four factor solutions from the combined analysis are summarised in section 15.3.1 and described in section 11.4.

The three factor solutions from each analysis show remarkable similarity. The analysis of the EPQ-R suggested factors resembling Extraversion, Neuroticism and Conscientiousness, and the three factor solution from the TPQ suggested factors resembling Harm Avoidance, Conscientiousness and Socialness. The combined analysis suggested Emotionality-3C, Extraversion-3C and Conscientiousness-3C. There does seem to be a similar three factor solution across all the item level analysis of the EPQ-R, the TPQ and these two questionnaires combined, particularly in regard to an Emotionality factor. However, the factors are not the same and no statistical comparison shall be made of them here (this is beyond the scope of this thesis). Extraversion-3C encompasses sociability and some elements that resemble impulsiveness which are not present in the other solutions (Extraversion-3FS from the EPQ-R or Socialness-3FS from the TPQ). Conscientiousness-3FS from the EPQ-R only relates to a few items, therefore caution must be taken in interpreting this factor. However the broad themes relating to rule abiding and decision-making appear to be in all of the Conscientiousness factors.

The four factor solutions from each analysis do not show such a high correspondence. However, an Emotionality factor is present in all of the solutions: Emotionality-4C (from the combined analysis), Neuroticism-4FS (from the EPQ-R analysis), and Harm Avoidance-4FS (from the TPQ

analysis). A Conscientiousness factor is also present: Conscientiousness-4C Conscientiousness-4FS (from the EPQ-R analysis), and Conscientiousness-4FS (from the TPQ analysis). However although the remaining factors contain facets of each other there are only very broad comparisons to be drawn. One could perhaps suggest that there is an Agreeableness type factor present in all of the solution represented by Sociability-4C from the combined analysis, Antisocialness-4FS from the EPQ-R analysis and Tough Mindedness from the TPQ analysis. However Sociability from the combined analysis is more similar to Extraversion-4FS from the EPQ-R analysis.

From both the combined and the individual analysis it would appear that an Emotionality factor is always suggested. Furthermore a factor which relates to Conscientiousness is extracted from all of the solutions also. The three factor solutions from each of the analyses appear to be the most comparable.

Of particular interest to this thesis however, is the correspondence shown between Harm Avoidance and Neuroticism in both the three and four factor solutions. Furthermore that an Emotionality factor is suggested from the combined and individual exploratory analyses.

15.3.3 Factor solutions from this sample in comparison to those in the literature

Zuckerman and colleagues (1991) have analysed a number of different questionnaires and explored which factors are revealed in different solutions (see section 1.3.1). Zuckerman's solutions and the combined solutions found

in the current study are summarised in the table 15.3.1 (Zuckerman et al., 1991).

The three factor solution at the scale level from the combined analysis appears to agree with Zuckerman's three factor analysis. The first factor suggested in both is Emotionality, and the third a Socialness factor. In the current analysis the second factor was called an Openness factor however, this as discussed in section 15.2 appears to correspond with Zuckerman's Impulsive Sensation Seeking factor.

The item level analyses do not show such good correspondence between the factors with those of Zuckerman. However, the level of analysis is different. The items from the Psychoticism scale of the EPQ-R did not appear to relate to a Psychoticism factor. Similarly the items of Reward Dependence and Novelty Seeking did not appear to relate to these scales. However there are similarities. Two factors are present in all of the analyses, one relating to Emotionality and one relating to Extraversion.

The three factor item analysis solution seems to agree at least in part with Zuckerman's 3 factor solution. The first factor in Zuckerman's solution is a broad emotionality factor with high loadings from EPQ Neuroticism and anxiety scales this seems to correspond well with the Emotionality-3C. The third factor of Sociability would correspond well to Extraversion-3C, however, Extraversion-3C also contains items relating to impulsiveness. Zuckerman's second factor of P-ImpUSS incorporates items from the EPQ Psychoticism scale, loadings from impulsivity, sensation seeking scales and responsibility

Table 15.3.1: Solutions from Zuckerman et al's (1991) analysis of 33 personality scales and from the current study

Solutions	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
5 factor	P-ImpUSS	N-Anxiety	Aggression-Hostility	Sociability	Activity
4 factor	Aggression-Hostility	P-ImpUSS	N-Anxiety	Sociability	
3 factor	N-Emotionality	P-ImpUSS	Sociability		
Scale level analysis combined	Emotionality	Openness (P-ImpUSS)	Socialness		
Combined 4 factor	Emotionality	Sociability	Conscient-iousness	Risk taking	
Combined 3 factor	Emotionality	Extraversion	Conscient-iousness		

P-ImpUSS: Impulsive-Unsocialized-Sensation Seeking, Combined combined analysis of the EPQ-R and TPQ at the item level

scales. This in some way corresponds to the Conscientiousness factor which contains loadings in the main from Novelty Seeking and Psychoticism. However, the themes of this factor appear to relate more to Conscientiousness rather than Impulsiveness and Sensation Seeking.

Zuckerman presents a five factor solution which is not present in the current analysis. Both this solution and the Zuckerman's four factor solution contain a factor relating to Aggression-Hostility. This may be a facet which is missing from both Cloninger's and Eysenck's personality models. Neither questionnaire taps into this behaviour. The Psychoticism scale is meant to relate to this perhaps more negative side but the scale has been shown to be poor in this population. Furthermore the scale does not appear to have items which relate to aggression or hostility.

Also perhaps worthy of comparison are the dimensions, which Digman (1990) presents as support for a five factor model as well as other five factor models proposed in the literature. Digman's table is copied in table 15.3.2. He suggests that although there is support for a five factor model that the meaning of the five factors is variable. This is clear from the table. Therefore although there is support for a five factor model of personality, the five factors described may vary from study to study. For instance Goldberg (1992) found that correlations between factors derived from the NEO-PI-R which were supposedly equivalent, correlated between 0.46 and 0.69. Furthermore that when the Big-Five structures were assessed in Dutch, American English and German, although similar factors were found, these terms did not have the same meanings across the three languages (Hofstee, Kiers, DeRaad, Goldberg, & Ostendorf, 1997). Therefore the labels used to describe a particular factor may not mean the same. However, Digman suggests that a broad consensus of five factors are Extraversion or sociability, Neuroticism or emotionality, Conscientiousness or will to achieve, Agreeableness or conformity and Openness or Intellect.

If a wide interpretation is taken of this five factor model then the three factor solution from the current analysis appears to correspond with three of these five: Neuroticism or Emotionality, Extraversion and Conscientiousness. The four factor solution, however, does not seem to add to this with again only three factors broadly concurring with the model: Emotionality, Sociability,

Table 15.3.2: Five possible dimensions of personality (taken from (Digman, 1990) page 423)

Author	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Fiske (1949)	social adaptability	conformity	will to achieve	emotional control	inquiring intellect
Eysenck (1970)	extraversion	Psychoticism		neuroticism	
Tupes & Christal (1961)	surgency	agreeable-ness	dependend-ability	emotionality	culture
Norman (1963)	surgency	agreeable-ness	conscientiou sness	emotional	culture
Borgatta (1964)	assertivenes s	likeability	task interest	emotionality	intelligence
Cattell (1957)	exvia	cortertia	superego strength	anxiety	intelligence
Guilford (1975)	social activity	paranoid disposition	thinking introversion	emotional stability	
Digman (1988)	extraversion	friendly compliance	will to achieve	neuroticism	intellect
Hogan (1986)	sociability & ambition	likeability	prudence	adjustment	intellectance
Costa & McCrae (1985)	extraversion	agreeable-ness	conscientiou sness	neuroticism	openness
Peabody & Goldberg (1989)	power	love	work	affect	intellect
Buss & Plomin (1984)	activity	sociability	impulsivity	emotionality	
Tellegen (1985)	positive emotionality		constraint	negative emotionality	
Lorr (1986)	interpersonal involvement	level of socialization	self-control	emotional stability	independent

Conscientiousness and Risk Taking. The fourth factor of impulsivity or risk taking behaviour according to Digman would also be the third factor. However, if Openness or Intellect are regarded as Costa and McCrae's (Costa & McCrae, 1992b) Openness to Experience then the factor of Risk Taking may be said to correspond with this factor.

Within personality research there has been a great deal of discussion as to whether there are three, four or five factors of personality. This research

does support three of the factors however, the questionnaires included in this analysis may not explain the full range of personality traits. For instance Zuckerman found an Aggression-Hostility factor in both a four and a five factor solution which is not apparent in the current data set.

From Digman's table it is clear that all models of personality do not produce a five factor model and that the five factor model differ from solution to solution. Costa and McCrae (1992a; 1992b) argue for a five factor model from their questionnaires the NEO Personality Inventory (NEO PI-R) and the shorter version the NEO Five Factor Inventory (NEO FFI). However, when their model is reanalysed five factors are not always apparent. Egan and colleagues (2000) in a sample of 1025 subjects find that out of the five factors of Neuroticism, Extraversion, Conscientiousness, Agreeableness and Openness only three could be represented from both item level principal components analysis and confirmatory factor analysis. The three factors being Neuroticism, Agreeableness and Conscientiousness. Surprisingly in Egan and colleagues' study an Extraversion factor was not clearly represented. However, two of these factors relate to two from the three factor solutions found in the current study.

Costa's and McCrae's five factor model was originally derived by lexical analysis, by analysing natural language trait adjectives. Achieving five factors which are in agreement with the big five has been supported in both German and English (Saucier & Ostendorf, 1999), however, others argue

from the same data set that there are more than five dimensions of personality (Paunonen & Jackson, 2000).

Clearly the structure of personality and the number of factors which describe personality are discussions which will occupy differential psychology for some time. This study adds to the literature by suggesting three factors from analysis of the EPQ-R, the TPQ and these questionnaires combined. However, these factors are statistical constructs and need to be validated. It is only when these factors are tested against theories and construct validity is established will we have a clearer picture of the traits which make up the human persona.

15.4 Summary

For the purposes of the present study, Neuroticism was a good marker of the emotionality factor at the scale or item level and for both the three and four factor solutions with 84% or more of the items loading on this factor. Extraversion from the EPQ-R was also the best marker for the sociability factor in both the three and four factor solutions at the item level. Harm Avoidance shows high correlations with both Extraversion and Neuroticism and is clearly a broader factor than Neuroticism alone. The two inventories, EPQ-R and TPQ, do not show full correspondence and it would appear that variance is left unexplained. It may be that neither fully explain personality. However, two factors are clearly replicable, Emotionality and Sociability, with perhaps a further factor of conscientiousness.

Chapter Sixteen: Discussion III Personality and mood

This chapter aims to discuss which personality measures are the best predictors of mood. Within this discussion various issues relating to state and trait will become apparent. These will be discussed further where appropriate. However, the main aim is to establish which trait measure is the best predictor of negative mood, and which may be best to select individuals who have a predisposition towards low mood and possibly depression. Four state tests were used, two which measured mood at that moment (the BFS and the STAIS) and two which measured mood over the previous week (the GHQ-28 and the OHI). The BFS is a measure of depressed mood and the GHQ-28 is a measure of depressed mood and general well-being. The STAIS is a measure of anxiety and the OHI a measure of Happiness (see Chapter Two for discussions of these scales). 1032 volunteers took part in the study. A number of individuals were excluded from the analysis as they had not completed all of the mood and personality questionnaires (n=162, exclusion criteria are detailed in chapters 10 and 12). A total of 339 males and 531 females (n=870) completed remained in the data set.

16.1 The EPQ-R scales and mood

The best two predictors of mood from the EPQ-R scales have been shown to be Extraversion and Neuroticism, with Neuroticism consistently correlating positively with negative mood and Extraversion with positive mood (as

discussed in chapter 3). This section will discuss these relationships in the current data set.

16.1.1 Neuroticism and mood

In both men and women, in the current sample, Neuroticism correlated positively with negative mood r = 0.42 to 0.63 (as measured by the BFS, and the STAIS measures assessing mood right now) and r = 0.52 to r = 0.54 (as measured by the GHQ-28 which measures over the past two weeks). Neuroticism correlated negatively with Happiness r = –0.50 to –0.57 (as measured by the OHI). The length of time over which the individual reflected did not seem to affect the correlation with mood as these were all roughly equivalent. Previous research showed effects ranging from 0.29 to 0.45 for Neuroticism and negative mood measured "right now" (Williams, 1990), whereas if this measure was correlated with a scale where the subject was asked to reflect over the whole week, effects rose to as high as 0.66 (Kardum & Hudek-Knezevic, 1996).

16.1.2 Extraversion and Mood

Extraversion, in the current sample, correlated positively with Happiness (OHI) r = 0.48 to 0.52 and negatively with negative mood r = -0.21 to –0.39. The correlations between Neuroticism and negative mood are clearly much higher with moderate to large effects whereas Extraversion and negative mood correlated to a small or moderate effect. Surprisingly, in this study, the association between Extraversion and Happiness is not higher than those

between Neuroticism and positive mood, being of a roughly equivalent effect size.

Previous research showed broadly this same pattern between Extraversion and mood. Extraversion consistently showed a positive correlation with positive mood r = 0.16 to 0.56 (see table 3.2.1). In some cases Extraversion did not show a negative correlation with negative mood but in those samples where a negative correlation was found this was always of a smaller size than the positive correlation with positive mood (Costa & McCrae, 1980; Kardum & Hudek-Knezevic, 1996; Williams, 1990; Wilson & Gullone, 1999).

16.1.3 Psychoticism and mood

Psychoticism, in the current data set, showed small positive correlations with negative mood as measured here and now (BFS r = 0.21 and r = 0.26; STAIS r = 0.10 and r = 0.19 in men and women respectively) and with mood measured over a couple of weeks (GHQ-28 r = 0.12 and r = 0.17 in men and women respectively). Small negative correlations occurred with Happiness (OHI r = -0.17 and r = -0.20).

Unlike Extraversion and Neuroticism the relationships between Psychoticism and mood have not been found consistently. Small positive correlations have been found previously between Psychoticism and negative mood. Williams (1990) found small positive correlations with Tension-Anxiety (r = 0.249) and with Confusion-Bewilderment (r = 0.232) but not with scales measuring other aspects of low mood such as depression (n=172). Kardum (1996) found a

moderate correlation with negative mood (r = 0.30; as measured by a Croatian inventory as described in section 3.2.1). The findings have been equally as erratic for positive mood, for instance, Williams (1990) found no correlations with any positive mood scales while Kardum and Hudek-Knezevic (1996) found a moderate negative correlation with their Croatian positive mood scale. One may argue that the differences in the results are due to using different mood scales. The same broad general pattern was found for Extraversion and Neuroticism no matter which scale was used. Even when the same scale is used, different results are found for correlations with Psychoticism. For instance, Furnham and Brewin (1990) found no correlation with the OHI (r = 0.01, n=101) but a later study using the same mood questionnaire found small negative correlations in a UK population (r = -0.25, n=120) and in a Japanese population (r = -0.11, n=128) but not in a Chinese population (r = -0.08, n=100) (Furnham & Cheng, 1999).

In the current study, Psychoticism, by using stepwise linear regression was shown to explain a proportion of the variance of mood (approximately between 1 and 7 percent). Psychoticism is not consistently associated with mood but in this population it does play a small though significant role.

The variability within past studies may be due to the variability within the Psychoticism scale itself. As has been shown both in this study and in previous studies the internal consistency of this scale is low and many of the items do not load on a Psychoticism factor (Ortet et al., 1999; SanMartini, Mazzotti, & Setaro, 1996). In previous studies the scores on the

Psychoticism scale are skewed (for instance (Eysenck et al., 1985; Ortet et al., 1999)) but within this study the scores were normally distributed. It is therefore not internally consistent, items from the scale do not factor particularly well and scores on the scale tend to be skewed. It would not be expected that consistent results would be found with this scale.

16.2 The TPQ scales and mood

The best predictor of mood from the TPQ scales is Harm Avoidance, both in this current study and in previous studies (Giancola et al., 1994; Krebs et al., 1998; Naito et al., 2000; Peirson & Heuchert, 2001; Svrakic et al., 1992). This scale correlates positively with negative mood and negatively with positive mood while Reward Dependence and Novelty Seeking do not correlate with mood to a significant level. This section will discuss the correlations found between the TPQ scales and mood questionnaires.

16.2.1 Harm Avoidance and Mood

Harm Avoidance from Cloninger's TPQ showed the highest correlations with mood. In fact the highest correlations for this scale were with Happiness as measured by the OHI ($r = -0.67$ to -0.69). While for negative mood, as measured by the BFS, the GHQ-28 and the STAIS, these ranged between 0.46 to 0.60. Harm Avoidance may be a broader variable than either Neuroticism or Extraversion. It correlates highly with both of these scales, and both of these scales predict up to 63% of its variance in a stepwise linear regression. In contrast, Neuroticism is almost solely predicted by Harm

Avoidance with this scale predicting over 40% of the variance and Reward Dependence only adding a further 3%.

There has been very little work associating Harm Avoidance with positive mood in the past. This is probably because Cloninger's scales have more appeal to clinical investigators and therefore are used more within that setting. A German group have tested the scales against both positive and negative mood and found that HA correlated to roughly the same extent with both extremes ($r = -0.40$ and $r = 0.37$ respectively, (Krebs et al., 1998)). Harm Avoidance has been shown previously to correlate significantly with a number of other measures of negative mood (the POMS-bi, the BDI, SDS; (Giancola et al., 1994; Naito et al., 2000; Peirson & Heuchert, 2001; Svrakic et al., 1992)).

Harm Avoidance, therefore, is a good predictor of mood in general. This has been shown both in the current study and in previous research. It would appear to be general emotionality factor rather than a scale that is only related to negative mood.

16.2.2 Reward Dependence, Novelty Seeking and mood

In previous research Reward Dependence and Novelty Seeking were shown to have negligible correlations with mood questionnaires. In the current study, although low correlations between Novelty Seeking and mood questionnaires supported these findings, small significant correlations were found with Reward Dependence. In the current study this scale had a small

positive correlation with Happiness (r = 0.25) and a small negative correlation with the BFS (r = -0.15). Any interpretations from these findings should be viewed with caution. Many of the items from these scales did not load on the correct factor. Therefore any predictions between these scores and mood may not be replicable, furthermore the traits may not be measuring what they are proposed to be measuring.

16.3 The best personality predictor of mood ....?

The regression analysis gives more insight as to which measure predicts the most variance for the mood scales. When the EPQ-R scales are analysed separately all three scales predict a significant proportion of the variance for all three negative mood scales (the BFS, the GHQ-28 and the STAIS). In all three cases Neuroticism predicts the most variance. The same is true when Happiness (OHI) is examined. In the case of Happiness, when Neuroticism and Extraversion are placed in a stepwise linear regression equation they have almost equivalent β weights. Neuroticism clearly plays a much larger role in the case of negative mood. Extraversion correlated significantly with positive mood across a range of cultures whereas Neuroticism did not provide such consistent correlations (Costa & McCrae, 1980; Kardum & Hudek-Knezevic, 1996; Williams, 1990; Wilson & Gullone, 1999). In a UK population, the same scale (the OHI) was used, correlations were roughly equivalent between E or N (Furnham & Brewin, 1990; Furnham & Cheng, 1999). This is similar to the results found in the present research. Although

Neuroticism was the best predictor of the OHI, Extraversion played an almost equal role.

Hills and Argyle (2001) argue that the mechanism by which Extraversion affects mood and happiness may be different from that of Neuroticism. Extraversion as measured by the EPQ-R relates almost purely to sociability (Roger & Morris, 1991). Therefore, the main characteristic of someone who scores at the high end of this scale may be regarded as social activity. The relationships between sociability and tendency for solitude are more closely associated with Extraversion than to Happiness (Hills & Argyle, 2001). The authors suggest that unlike other variables, Extraversion, may be instrumental in creating conditions for positive mood rather than directly influencing mood.

Of the TPQ scales only Harm Avoidance correlated with the GHQ-28 and the STAIS. The BFS was predicted significantly by both HA and RD with Harm Avoidance being the best predictor. The same was true for the OHI. Although the three personality scales are meant to interact in relation to mood, Harm Avoidance was the best predictor. Previous research (see table 3.2.2) showed a similar pattern for mood scales that related to the individual's state over the previous week, Harm Avoidance showed the highest correlations with both positive and negative mood (Giancola et al., 1994; Krebs et al., 1998; Naito et al., 2000; Peirson & Heuchert, 2001; Svrakic et al., 1992).

In this sample, correlations between Harm Avoidance and the negative mood scales (the BFS, the GHQ-28 and the STAIS), in men, ranged between 0.48 and 0.60, and in women, ranged between 0.46 and 0.54. Correlations between Neuroticism and the negative mood scales, in men, ranged between 0.54 and 0.63, and in women, ranged between 0.42 and 0.52. The correlations are roughly equivalent. When scales from both the TPQ and EPQ-R were regressed together, Neuroticism and Harm Avoidance were equally the best predictors of negative mood as measured by the BFS, the GHQ-28 and the STAIS. There was very little between these two scales as to which was the better predictor. Their beta weights were very similar. However, when it came to the OHI and happiness Harm Avoidance was clearly the best predictor.

For mood overall, Harm Avoidance was the best overall predictor. Harm Avoidance appears to be a general measure for emotionality. Neuroticism was also a good predictor for Happiness and the negative mood measures, however, for Happiness Harm Avoidance predicted the most variance.

16.4 Trait versus state issues

These results bring to the foreground issues relating to criteria of what is a state measure and what is a trait measure (see Chapter 2). Following Zuckerman's (1976) criteria the state scales should correlate to a higher degree with each other than with any trait measure. Two state scales, included in the questionnaire pack, purportedly measure depressed mood – the BFS and the GHQ-28. In both men and women these two scales

correlate together higher than with any trait scale, but only just. In men and women, respectively, the correlations are 0.57 and 0.59, but the correlations with Neuroticism and the BFS are 0.55 and 0.42 and with the GHQ-28 are 0.54 and 0.52, respectively. Harm Avoidance also has large correlations with these scales (BFS 0.55 and 0.46; GHQ 0.48 and 0.54 respectively). In order to fulfil Zuckerman's (1976) criteria one may expect the correlations between the state scales to be substantially higher than between the state and trait scales. This is clearly not the case.

It could be argued that the correlations between the GHQ and the BFS are not as large as may be expected as they are measuring mood over a different time scale. The BFS is questioning about mood right here and now while the GHQ-28 is over the past week. Furthermore they may be tapping into different aspects of "depressed" mood. The highest correlations between either state and state measures or state and trait measures are between the STAIS and the BFS, two state measures (r = .76 and .73 in men and women respectively). The STAIS is a measure of anxiety while the BFS is of depression. It would be expected that these questionnaires correlate but perhaps not to a higher degree than the BFS and the GHQ. However, both of these questionnaires (the STAIS and the BFS) are referring to mood right here and now rather than a general mood.

A second of Zuckerman's (1976) criteria is not met. The correlations between trait and state measures should be of a low level whereas if tables

12.2.1 and 12.2.2 are examined it is clear that there are large correlations between the trait and state measures.

A criticism may be that individuals did not answer the questionnaires in the way intended, however, this criticism could be made of all such research. Spielberger (1983) has successfully shown that individuals can and do respond differently when asked as to how they feel generally, as to how they feel right now in the State and Trait Anxiety Inventory (STAI). Watson and colleagues (1988) found that volunteers would respond on a mood questionnaire differently across a number of time points ranging from that moment to in general.

Correlations between state and trait measures appear to show the same broad picture of Neuroticism being the best predictor of negative mood and Extraversion of positive mood but the size of the effect varies. This variation may be due to the wide range of questionnaires being employed and the differing time scales of the questionnaires. Perhaps more exacting criteria of state measures need to be formulated. There are a wide variety of state measures available which purportedly measuring states across a wide variety of time frames. The time frame can range from this instant to across months or even years. The longer the time frame the more the state would appear to resemble a trait. Trait measures of personality are enduring (Costa & McCrae, 1992b; Eysenck et al., 1985) and are stable over at least one year (Conley, 1984; Poguegeile & Rose, 1981). However, mood states can affect trait measures and traits do appear to fluctuate when a person is clinically

depressed (Hirschfeld et al., 1989; Kendler et al., 1993; Roy, 1990). For instance, Neuroticism scores appear to rise and Extraversion scores decrease during an episode of depression (see Chapter 6). In order to set out clear criteria for the differences between state and trait, a clear definition of what is a state must be established. Indeed there could be a number of definitions regarding states. There are states that refer to brief flashes or instants, in contrast to states that are more long lasting. Do these states, which are measured over different time frames, have the same factor structure? Do they relate to personality in a similar way? Watson and colleagues (1988) suggest that the Positive and Negative Affectivity Schedule (PANAS) retains its two dimensional factor structure whether mood is measured at that instant or over years. However, this two dimensional structure has not always been supported (Killgore, 2000; Matthews et al., 1990; Watson et al., 1999). By further investigating the structure of mood over different time frames and in different circumstances, it may be possible to compare mood in normal healthy controls to those with clinical depression.

16.5 Limitations

The analyses are obviously limited. The scales all relate to normal non-pathological variations in mood, there are on a one-off basis, the only follow-up is for a very small sample who carried on to take part in the tryptophan depletion study. Whether Neuroticism or Harm Avoidance is a better predictor for depression can not be answered as the mood questionnaires

(BFS, GHQ-28, STAI and OHI) used within this study relate to normal mood. How scores on these scales relate to mood in depression is not known.

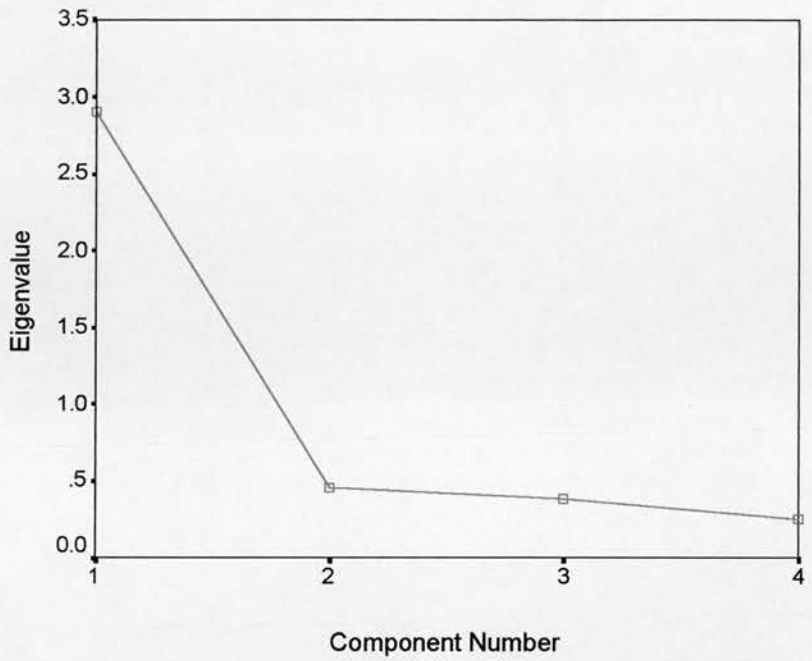
The emphasis of this study was to select individuals for the tryptophan depletion study and to be able to identify those individuals who may have been clinically depressed at the time of filling in the questionnaires. The structure of mood was not assessed in these questionnaires. If a mood structure can be identified and questionnaires developed which assess this, then relationships between mood and personality may be further explored. Further insight may also be gained between mood in normal healthy volunteers and in major affective disorder. Unfortunately neither the PANAS (Watson & Clark, 1988) nor the UWIST (Matthews et al., 1990), two questionnaires which assess mood structure, were included in the questionnaire pack.

The underlying structure of mood is an area of research that is developing (Diener, 1999; Remington, Fabrigar, & Visser, 2000; Russell & Barrett, 1999; Watson et al., 1999). Proponents of a circumplex model of affect, (for instance (Remington et al., 2000; Watson, 1999; Watson & Tellegen, 1985)), suggest that positive and negative mood are uncorrelated to each other. However, the definitions of negative and positive mood are confusing. For instance happiness which could be thought of as a positive mood and sadness which could be thought of as a negative mood are in fact allowed to correlate and commonly predicted to be at 180° to one another (Remington et al., 2000).

All the mood questionnaires in this study correlated together highly. Happiness correlated at -.60 or above with all of the negative mood measures. If positive mood, as measured by the OHI, and negative mood, as measured by the BFS, the GHQ-28 and the STAIS, are separate factors then it would be expected that these scales would not correlate to such a high extent. Therefore these mood questionnaires may be tapping the same underlying factor rather than aspects of positive and negative mood. If this is true then it is not surprising that there are such high correlations between Neuroticism and positive mood, and Extraversion and negative mood. As well as the high correlations between Harm Avoidance and both positive and negative mood.

In order to test whether the mood scales used within this study tested different components of mood, a principal components analysis was carried out on the mood questionnaires, at the scale level (the BFS, the GHQ-28, the STAIS and the OHI). If the questionnaires measure positive and negative mood as two separate entities then two components should be apparent. Figure 16.5.1 shows the Scree plot of these scales. Only one component has an eigen-value greater than one and the slope smoothes off after this first component. Therefore the mood scales used in this study appear to tap into only one factor "mood" which does not appear to have two distinct dimensions of positive and negative mood. This may explain in part the large correlations between Neuroticism and the OHI and between Extraversion and the BFS, GHQ-28 and the STAIS.

Figure 16.5.1: Scree plot of the BFS, GHQ-28, OHI and STAIS



16.6 Summary

Three personality measures predict mood in healthy volunteers consistently – Neuroticism, Extraversion and Harm Avoidance. The correlations between the mood questionnaires are high (OHI, BFS, GHQ-28 and STAIS). When a principal components analysis is carried out at the scale level only one component is apparent. Thereby suggesting that the mood questionnaires all tap into the same mood factor rather than positive and negative mood.

Neuroticism and Harm Avoidance are the both good predictors of mood with Harm Avoidance being a better predictor of Happiness as measured by the OHI than Neuroticism. Neuroticism is clearly highly related to mood in

healthy volunteers and is a good predictor of negative mood. The use of this scale as a selection variable for those who may be more susceptible to negative mood is very clearly indicated.

Chapter Seventeen Discussion IV: Neuroticism as a predictor of mood change by tryptophan depletion

The aim of this study was to examine whether the personality trait of Neuroticism was related to mood and mood dip following serotonin depletion by the method of tryptophan depletion. The effects of tryptophan depletion were measured by self-report mood scales, cognitive tests, electroencephalogaphic variables, and physical measures. Both free and total plasma tryptophan were significantly reduced, consistent with levels found previously in the literature (Benkelfat et al., 1994; Delgado et al., 1990; Reillyet al., 1997). Acute tryptophan depletion showed selective effects on certain neuropsychological tests and on certain measures of arousal and anxiety. Acute tryptophan depletion did not cause a significant drop in mood in these healthy volunteers. Neuroticism was not a strong predictor of individual differences in mood changes following tryptophan depletion.

Bearing the weakness of the predictive power of Neuroticism in mind, there were a number of interesting findings within the study. These will now be discussed. A number of issues as to why Neuroticism was not a strong predictor must also be brought to the fore.

17.1 Selection of volunteers

Although Neuroticism was not a strong predictor of mood change by tryptophan depletion, there was a large effect of Neuroticism on recruitment

shown in table 13.1. 124 high N compared to 57 low N scorers were selected for the tryptophan depletion study (χ^2=24.80, df=1, p<0.001). One would expect this number to be equal because personality is normally distributed. However, clearly more high N scorers were selected than low N scorers. For some reason there were more high N scorers who returned the personality and mood questionnaires than low N scorers.

Unfortunately there is no way of knowing for certain why this may be, and there could be any number of reasons. Firstly the study was titled "Personality, Mood and Diet", those who scored on the high end of the Neuroticism scale may have been more inclined to take part than low N scorers. The high N scorers may have been more interested in finding out about their own personalities and mood.

17.1.1 Comparison of this samples' Neuroticism scores with published Neuroticism scores

One possible factor which may play a part in the unequal numbers of high and low N scorers recruited is that there may be an overall increase in Neuroticism scores. Twenge suggests that scores on scales may change due to the socio-cultural environment (Twenge, 2000; Twenge, 2001). Twenge found that both Neuroticism (Twenge, 2000) and Extraversion (Twenge, 2001) scores are changing through the decades. Between 1952-1993 both adult and child scores on anxiety increased by approximately one standard deviation. Therefore by using norms that were published in 1985

more than the top 5% could have been selected as individuals may be scoring higher on the Neuroticism scale, therefore the normal curve could have moved to the right.

In order to ascertain whether the individuals in the current sample had higher N scores that those in the published data set these are compared in table 17.1. The current sample contained a total of 347 males and 550 females who completed the two personality questionnaires. Male ages ranged from 17.4 to 50.4 (mean = 21.1, standard deviation = 4.7). Six males omitted their dates of birth from the questionnaire pack. Female ages ranged from 17.1 to 48.9 (mean = 20.7, standard deviation = 4.0). Five females omitted their dates of birth from the questionnaire pack.

The means are compared by one sample t-tests using Eysenck's and colleagues published N scores as the test value (Eysenck et al., 1985). Only the two youngest age groups were compared in this way, as the majority of the current sample was less than 30 years old. The Neuroticism scores in the present sample were higher than the Neuroticism scores in Eysenck's sample across all the age groups. Males between 16 and 20 years old ($t=4.34$, $df=254$, $p<.001$), females between 16 and 20 years old ($t=2.33$, $df=415$, $p=.02$), and females between 21 and 30 years old ($t=6.40$, $df=111$, $p<.001$) had significantly higher N scores than those in Eysenck's sample.

One may then argue that the selection criteria that were used to choose high and low N scorers are no longer appropriate and a higher cut-off for the high N scorers should have been chosen. However, this study cannot be taken in

Table 17.1: A comparison of the current sample's Neuroticism scores with Eysenck and colleagues' (Eysenck et al., 1985) published Neuroticism scores

	Eysenck et al.'s (1995) sample			The current sample		
Age Group	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
Males						
16-20	108	11.12	5.68	255	12.26	5.76
21-30	64	11.08	5.37	70	12.09	6.39
31-40	53	11.92	5.70	10	12.30	5.38
41-50	55	11.22	5.95	6	19.67	1.51
51-60	69	9.43	6.27	0		
61-70	59	8.32	5.07	0		
sub-total	408	10.54	5.81	341		
Females						
16-20	161	14.03	4.85	416	14.64	5.36
21-30	159	12.53	4.78	112	15.54	4.97
31-40	38	11.71	4.94	10	12.80	5.83
41-50	50	10.94	5.92	7	12.86	5.37
51-60	45	11.31	5.36			
61-70	41	9.98	5.51			
sub-total	494	12.47	5.22	545		
Total	**902**			**886**		

support of Twenge (2000) as the volunteers were not selected randomly but were asked only to participate if they were interested in taking part in the two day study. Although the mean Neuroticism scores in this sample are higher than those published in 1985 that does not necessarily suggest that Neuroticism scores are increasing across the generations. More high N scorers may have volunteered for this study than low N scorers.

17.1.2 Exclusion of volunteers

Although more than twice as many high N scorers were selected than low N scorers (124 high N compared to 57 low N scorers), many more high N scorers were excluded than low N scorers. Neuroticism scores have been shown to be related to depression (see Chapter 6 for a review). Briefly,

Neuroticism scores increase during a depressive episode, are higher in those who have suffered from episode of depression compared to those who have not and are predictive of a depressive episode (Hirschfeld et al., 1989; Kendler et al., 1993; Roy, 1990). It was therefore possible that in this sample those who scored at the high end of the Neuroticism scale were more likely to either be suffering from, or have a history of, a major depressive episode.

Unfortunately there was no way of discerning whether individuals in the group who completed the questionnaire packs were clinically depressed. A depression screening inventory was included within the questionnaire pack (the GHQ-28), but due to ethical reasons it was not possible to follow all of those who scored on the GHQ-28 further and discover whether they had been diagnosed with clinical depression.

A number of individuals were identified who were currently suffering from or had a personal history of clinical depression. Of those people selected for the tryptophan depletion study (the high or low N scorers), more high N scorers (n=18) either were currently suffering from clinical depression or had a history of depression than low N scorers (n=3). However, these numbers were not significantly different (χ^2=2.67, df=1, ns). Among those selected there could have been many more with clinical depression that were not identified. These figures are only a rough guide to the level of clinical depression in this sample. Many of those with depression may simply have dropped out of the study or not filled in the medical questionnaire.

Although there were many more high scorers selected to take part (n=124) in the tryptophan depletion study this was not true of the number who completed the two test days. These numbers were almost equal, with 15 low N scorers and 17 high N scorers. It is clear that many more high N scorers (n=107) dropped out of the study than low N scorers (n=42). There were a number of reasons for individuals dropping out, however, significantly more high N scorers (46%, n=57 out of a total of 124) compared to low N scorers (21%, n=12 out of a total of 57) were excluded for medical or psychiatric reasons (χ^2=3.86, df=1, p<0.05). Therefore it could be that those who finally completed the two days were an unusually healthy high N group.

It is thus possible that this group who completed the two days would not be susceptible to serotonergic change. It was predicted that those who scored on the high end of the Neuroticism scale would be more susceptible to depression than those who scored at the low end of the scale. This susceptibility may be due to an abnormality in the serotonergic system. Similar to those with a family history of depression this group may have a mood dip following the tryptophan depletion challenge (Benkelfat et al., 1994; Ellenbogen et al., 1999; Klaassen et al., 1999b). However, the most susceptible individuals may have already been excluded.

17.2 Percentage depletion of free and total plasma tryptophan

A potential criticism of tryptophan depletion studies is that adequate depletion of tryptophan was not achieved, but this does **not** appear to be the case in

this study. In this group both free or unbound tryptophan and total plasma tryptophan were decreased by over 80%. Plasma free tryptophan or unbound tryptophan is a better predictor of brain tryptophan concentrations than plasma total (Curzon, 1979) and this reached an acceptable level.

A variety of methods have been used to achieve acute depletion of plasma tryptophan (Reilly et al., 1997). In this study a low tryptophan meal was provided on the evening prior to consumption of the amino acid drink (see Chapter 9). The volunteers were requested to consume nothing except for the foods on the low tryptophan diet from 2pm onwards on the day before the test day. Also they were asked not to consume anything except for water from midnight until they were given food on the test day. Some protocols have asked individuals to have a low tryptophan diet for the whole day proceeding the test day. Unfortunately it would have been very difficult for this population to comply, as their routines would have been very much altered to deal with this request. Therefore in order to gain full compliance only the evening meal on the day prior to testing was altered. The lack of a preceding low tryptophan diet for a longer period might produce greater variability in baseline tryptophan levels. However the baseline levels of plasma free and plasma total tryptophan were similar on both test days suggesting that the diet the night before was adequate in ensuring no differences at baseline.

One individual only achieved 5.8% depletion while 8 were between 64 and 80%. All of the volunteers were watched while they consumed the drink and

all had agreed to comply with the diet on the evening prior to the test day. It was therefore unlikely that these factors affected the reduced percentage of depletion in this sub-set of volunteers. It may be necessary to have the full 24 hour low tryptophan diet to achieve adequate depletion on the test day in all of the volunteers. However, adequate depletion was achieved in the majority of the volunteers.

It would therefore appear that the experimental paradigm did produce a significant reduction in plasma tryptophan. This technique has been shown to have central effects in man (Carpenter et al., 1998; Moreno et al., 2000; Williams, Shoaf, Hommer, Rawlings, & Linnoila, 1999). Further reduction of brain tryptophan availability has been shown to produce a decrease in brain serotonin synthesis in man by using positron emission tomography (Nishizawa et al., 1997). Therefore by extrapolation it may be concluded that in this group of volunteers this experimental paradigm produced an effect on brain 5-HT function.

17.3 Comparison of baseline mood scores

Neuroticism in the unselected population (n=847) was shown to correlate positively with negative mood and negatively with positive mood (see Chapter 12), in that N correlated positively to a large extent with the BFS, the GHQ-28 and the STAI and negatively with the OHI. Therefore, it would be expected that the high N group would differ from the low N group on baseline scores of mood (see section 13.3.1).

The groups were interviewed using an adapted Hamilton Depression Rating scale. This questionnaire was designed for use in a population with a previous or current history of depression. Both groups in this study scored close to zero. This would be as expected as all of those volunteers with depression or a history of depression were excluded from the study.

However other measures of mood were employed at baseline, the BFS, the POMS and the PANAS. The BFS is sensitive to negative mood change in depression (Moffoot et al., 1994; Porterfield, Cook, Deary, & Ebmeier, 1997). This scale is highly correlated with Neuroticism. It is therefore perhaps surprising that the groups do not differ at baseline either on this scale or its sub-scales. The groups also did not differ on negative affectivity as measured by the PANAS. Again this is surprising as Neuroticism correlated negatively with the negative mood scales used in the questionnaire pack and Williams and Gullone (1999) found Neuroticism to correlate with this scale ($r = 0.32$ to $r = 0.64$). The groups did not vary on the POMS Fatigue scale, POMS Aggression scale or POMS Vigour scale however, there would be no specific predictions of the effect of Neuroticism on these scales.

The high and low N scorers did differ significantly on both test days on POMS Tension and positive affectivity as measured by the PANAS (see section 13.3.1), thereby, supporting earlier findings that those high on Neuroticism are more anxious and are lower on positive affectivity (see Chapter Three) (Costa & McCrae, 1980; Kardum & Hudek-Knezevic, 1996; Williams, 1990; Wilson & Gullone, 1999).

The high N scorers had higher POMS Confusion scores on the depletion day only. This could be due to the way that the individuals reacted differently to the environment. Some high N scorers may have felt more confused on the first test day than the second test day, while others may have been more confused on the second day. It is probably a chance finding that the high N scorers had higher Confusion scores on the depletion day, as there was no significant effect of day on the POMS Confusion scores ($F_{1,30}$=0.01, ns).

The high and low N scorers therefore differed on POMS Tension and positive affectivity as would be expected. However, they did not differ on the BFS, negative affectivity or the POMS D scale. The BFS measure was originally developed for research in patients with depression, therefore a valid criticism may be that it is not suitable in normal healthy volunteers. However, the scale has been used in a wide range of subjects including healthy volunteers (Mockel et al., 1994) and in patients with operable breast cancer (Hurny et al., 1992). In these populations it has been used to monitor mood change. The scale has been shown to be sensitive to change in healthy volunteers, patient and psychiatric patient populations and there was not a floor effect in this sample, the scores at baseline ranged between 0 and 44. It is surprising that the high and low N groups do not differ at baseline, particularly as there is a high correlation between N and the BFS in the unselected group. From figure 13.6.6 it is clear that the high N scorers do have slightly higher BFS total scores on both days, however this difference was not statistically significant.

The groups did not differ on negative affectivity on the PANAS but did differ on positive affectivity on the PANAS. Although the two factor mood structure has been brought into question (Killgore, 2000; Matthews et al., 1990; Watson et al., 1999), the questionnaire is still sensitive to mood measurement (Kennedymoore et al., 1992; Kvaal & Patodia, 2000; Roberts et al., 1998).

There also were no differences on the POMS D scale. The factor structure of this questionnaire has been brought into question, with some suggesting that the scales be collapsed, in particular the scales of depression-dejection, confusion-bewilderment and tension-anxiety (Lindgren et al., 1999; Norcross et al., 1984; Reddon et al.,, 1985). The total POMS score may be more reliable (Reddon et al., 1985). The scale has detected mood change in normal healthy controls (Caldwel et al., 2000; Martin et al., 2000), patient controls (Speca et al., 2000), healthy controls with a family history of major depressive disorder (Klaassen et al., 1999b) and in patients with depression (Lydiard et al., 1997).

This group of selected subjects may well be unusual. An explanation may be that the low N scorers in this group are not true low N scorers but may have faked their responses. Eysenck and colleagues suggest that a proportion of low N scorers are "repressors" (Derakshan & Eysenck, 1997; Eysenck, 2000). Repressors are literally repress their scores and score at the opposite end of the Neuroticism scale thereby, scoring as low scorers. Therefore a possible explanation for the high and low N scorers, in this study, having

similar baseline mood scores is that, the low N scorers in fact have higher negative affectivity scores, BFS or POMS D scores, than that expected of such a group. This will not be assessed. The minimum score on the negative affectivity scale is 10. The majority of the low N scorers scored 10 on both days with the maximum score being 15 on either day. The minimum score on POMS D is 0 and the maximum 60. The majority of the low N scorers scored 0 on both days with the maximum score being 9 on either day. Lastly the BFS has a minimum score of 0 and a maximum score of 56. The low N scorers on both days scored between 0 and 30. These scores are comparable to those found in other studies with normal controls (Mockel et al., 1994). Therefore the explanation that the low N group show more negative mood than expected is unlikely.

Within the large unselected group Neuroticism correlates highly with measures of negative mood including the BFS (n=870). However the selected group of high N scorers (n=17) do not differ from low N scorers (n=15) on the BFS, negative affectivity or on the POMS D. The lack of differentiation, between the high and low N scorers, who are selected for the tryptophan depletion study, on these scales, may be due to the particular individuals involved. The high Neuroticism group are not representative of high Neuroticism scorers. Although speculative, it may be that, this particularly healthy high N group has developed coping styles to deal with their predisposition to negative affectivity and therefore they do not differ from

their low Neuroticism scoring counterparts. Indeed, it may be that those who are susceptible to lower mood have already been excluded.

17.4 The effect of tryptophan depletion on mood measures

The POMS depression scale has been shown to be sensitive to mood change following tryptophan depletion (Benkelfat et al., 1994 d=1.4; Klaassen et al., 1999b d=0.87; Leyton et al., 2000 d=1.5), the effect size d for between depletion and non-depletion days in the test population is high. The effect size, d, for Profile of Mood States depression sub-scale differences between depletion and non-depletion days for the high N scorers, was 0.62. This means that 45 high N subjects would be required to achieve a power of 80% with a two-tailed significance of $p<0.05$. Neuroticism is, therefore, not an important predictor of individual serotonergic function in healthy volunteers, as assessed by tryptophan depletion.

The power of the current study was not enough to gain an effect. The power analysis suggests that 45 subjects would be necessary to gain an effect. Therefore there were not enough volunteers recruited into the tryptophan depletion part of the study to find a mood change in this group. This means that approximately 90 (45 high N subjects and 45 low N subjects) would have been needed to show that high N compared to low N scorers would suffer a lowering of mood.

The weak predictive power of Neuroticism is perhaps surprising. Family history of depression was found to be a good predictor of both mood and

cognitive change following tryptophan depletion (Benkelfat et al., 1994; Klaassen et al., 1999b; Riedel et al., 1999). At the time of planning the study, only Benkelfat et al's (1994) study had been published were the effect size was shown to be 1.4. There was therefore an expectation of an effect of that order in this group who have a vulnerability to depression. However, Ellenbogen and colleagues (1999) did not find a mood change in a group of 12 women with a family history of depression. The authors suggest that the women who took part in their study may have been resistant to depression, and that they may have excluded those who were vulnerable. Family history of major depressive disorder predisposes to an early onset of depression (McMahon et al., 1994). All of those who had previously had an episode of depression were excluded. Therefore those included in the study may have been resistant.

Healthy volunteers, following tryptophan depletion, have shown a mood change in both males and females (Bhatti et al., 1998; Ellenbogen et al., 1996; Kaye et al., 2000; Klaassen et al., 1999a; Knott et al., 1999; LeMarquand et al., 1999; Leyton et al., 1999; Smith et al., 1987; Weltzin et al., 1994; Young et al., 1985), although this result has been inconsistent (see tables 5.6.1-5.6.9). There is not yet an explanation as to why some individuals are susceptible and some are not. However, a personal history of major depressive disorder is not sufficient to predict a mood change (Cassidy et al., 1997; Leyton et al., 1997; Price et al., 1998).

There are a number of speculative reasons why the current sample did not show the predicted mood change. An explanation may be that it is only individuals who have a vulnerable serotonergic system that tryptophan depletion produces a mood change. For instance Delgado and colleagues (1990) found that patients who responded to SSRIs or MAOIs were more sensitive to tryptophan depletion than those who responded to a catecholamine reuptake inhibitor. Therefore it was not a depressive episode itself which predicted the effect to tryptophan depletion but response to SSRIs or MAOIs. The effect of tryptophan depletion may be due to a vulnerable serotonergic system, or one that is susceptible to changing levels of serotonin. Those who show an effect from this method show it due to this serotonergic vulnerability.

However, the question remains how can a "vulnerable" serotonergic system be identified? Although previous history of a major depressive episode is not necessary or sufficient it is a fairly good predictor.

However, it may be that although serotonin is implicated in depression, changes in this neurotransmitter alone may not be sufficient to cause a mood change. In fact the effects of tryptophan depletion (shown in previous studies) may be due to changes in other systems or compounds. 5-HT is thought to have a neuromodulatory effect and indeed 5-HT neurones extend across much of the CNS. A sudden reduction of 5-HT may result in changes in other systems. Tryptophan is an important agent in many other neuroactive compounds such as somatostatin and the delta-sleep inducing

peptide (DSIP). The sudden reduction in available tryptophan may therefore also affect these compounds.

Lowered mood following tryptophan depletion has been found in those with a personal history of a major depressive episode, seasonal affective disorder (SAD), bulimia, a family history of major depressive disorder and in normal controls (see Chapter 5). The reasons why some individuals and not others suffer a mood change have not been answered. Perhaps it is also time to ask why are some individuals not susceptible to change from this method.

17.5 The effect of tryptophan depletion on physical measures

Blood pressure, pulse, reaction time measures and maximum voluntary contraction were compared between the groups at baseline and following tryptophan depletion. It was hypothesised that with a lowering of mood there would be psychomotor slowing in the high N group. The reaction time measures were hypothesised to become slower and the maximum voluntary contraction lower in the high N group following the depleting drink compared to placebo, with no change in the low N group.

Differences were found between the high and low N scorers on one of the reaction time measures at baseline. Movement time with the non-dominant hand was slower for those who scored at the high end of the N scale compared to those at the low end on the morning of the placebo day. There is no obvious explanation for this finding other than it is likely to be a chance difference.

Following tryptophan depletion the only effect found was that mean arterial pressure was decreased in the high N scorers and that low N scorers showed increased mean arterial pressure. There were no differences found on reaction time measures, maximum voluntary contraction or pulse.

There was one effect of order on reaction time. When using the left hand reaction times were slower on the second day however there were no effects of group or treatment. There were no order effects on any of the other reaction time measures. Slowing on the second day is counter intuitive, as one would expect that with practice that reaction times would become faster. Therefore one may expect that reaction times would be quicker on the second day compared to the first. However as there were no other effects this one significant finding may simply have been due to chance.

As there were no mood changes, in the high or low N groups following tryptophan depletion, it would be unlikely that there would be associated psychomotor retardation. Perhaps a mood change is required for psychomotor retardation to occur. Indeed psychomotor retardation and anhedonia correlate (Lemke, Puhl, Koethe, & Winkler, 1999). Dantchev and Widlocher (1998) pose that psychomotor retardation is central to depression and that it is a good criterion for prediction of therapeutic effect. However thinking times were slowed following depletion of tryptophan in a group of normal subjects with no concurrent mood change (Park et al., 1994).

Interpretation of the changes in mean arterial pressure following tryptophan depletion must be speculative. Depressed patients compared to controls

have similar blood pressure and pulse, however in response to orthostatic (standing upright) challenge depressed patients show a reduced increase in blood pressure variability indicating reduced sympathetic activation (Tulen et al., 1996). The decrease in arterial pressure in the high N scorers may reflect reduced sympathetic activation similar to that found in patients with depression. Indeed, Lechin and colleagues find a similar reduction in sympathetic activation in a group of dysthymic depressed patients who have altered levels of platelet serotonin (Lechin et al., 1995). Serotonin is implicated in many other areas as well as mood. It is present in many cells outside the brain for instance within blood platelets, mast cells, and within the digestive tract. Therefore changes in blood pressure may have no connection with mood but may be due to the change in levels of serotonin. The connection between blood pressure, heart rate and depression is an important one as depression following myocardial infarction reduces life expectancy (Frasure-Smith, Lesperance, & Talajic, 1995; House, Knapp, Bamford, & Vail, 2001; Leng, 1994).

17.6 The effect of tryptophan depletion on EEG

EEG measures were taken both in the morning and the afternoon of the test days. EEG power or activity has been found to differ over the left and right hemispheres with mood (Debener et al., 2000; Fox et al., 2001; Henriques & Davidson, 1991; Wheeler et al., 1993). The overall pattern is that less alpha power (or more activation) in the left hemisphere appears to correspond to positive mood, while more alpha power (or less activation) corresponds to

negative mood. Less alpha power (more activation) in the right hemisphere corresponds to negative mood. In this group of high and low Neuroticism scorers there was no change in mood. Although there were some changes in anxiety and on cognitive function tests, asymmetry of EEG alpha power did not change following tryptophan depletion. Other tryptophan depletion studies have not assessed EEG power in this manner. A lack of change in asymmetry of EEG alpha power is probably due to the lack of substantial mood change in the volunteers and lack of statistical power in this study.

17.7 The effect of tryptophan depletion on psychometric tests

Volunteers were tested on a number of psychometric tests. The digit symbol substitution test (DSST), digit span, the paced auditory serial addition task (PASAT), verbal fluency, and visual discrimination. Volunteers were tested in the afternoons only, therefore comparisons were between the two days and the two groups. Chapter Thirteen lays out the results for these analyses discussing first the main effect of tryptophan depletion and group, followed by order. This section aims to bring together these analyses and discuss the relevant positive and negative findings.

The psychometric tests were counterbalanced to reduce effects due to practice. However, where a technique to aid performance can be learned, rather than details of the test itself, it would surprising if there was not a marginal improvement on the second day. Indeed it would be expected with most psychometric tests that unless extensive practice had taken place

before testing that there would be some improvement over time. Therefore effects of order on the psychometric tests are important.

The two groups were well matched on the National Adult Reading Test (NART), a measure of IQ. There were also no differences between the group who were depleted first compared to the group who were depleted second on this measure. Therefore it is unlikely that IQ would play a role in any differences found on the psychometric tests.

In line with practice effects, performance was better on the second day, irrespective of whether the individual was given the depletion drink or the placebo, on digit span, the paced auditory serial addition task and visual discrimination. For all three of these tasks a technique could be learned in order to improve performance therefore it is expected that these two tests improve on the second day. However, there were no other effects of drink or group on these tasks. Only two tasks showed effects of depletion: the DSST and verbal fluency. The reason why only the DSST and the verbal fluency were influenced by tryptophan depletion may be that the PASAT, visual discrimination and digit span were simply not sensitive enough to detect any change and there was not enough statistical power within this study.

There was a main effect of treatment on the DSST where both the high and low N scorers performed better on the depletion rather than the placebo day. There was also a significant effect of order which related to the order of the amino acid drinks. If given tryptophan on the first day the volunteers improved significantly on the second day (i.e. the depletion day) whereas if

depleted on the first day the volunteers did not show significant improvement on the second day (i.e. the placebo day).

The effect on the DSST is an interesting one. The volunteers performed better on the DSST when depleted irrespective of order. There was no improvement on the second day if they were given the depleting drink on the first day. One would expect an improvement on this test with practice. Therefore it is surprising that in these conditions there was no improvement. However if given the depleting drink second performance got better.

It must be noted that the placebo drink is not a true placebo but actually enhances the levels of tryptophan in the blood, although the ratio with LNAAs is reduced (Weltzin et al, 1994). The placebo drink may therefore have an effect on the tests. The drink used in this study contained 2.3g of tryptophan. When larger doses are given the subjects are more sedated (Cleare and Bond, 1995). The subjects in this group did not appear to be more sedated on the any of the mood measures following the placebo compared to the depleting drink. Furthermore the DSST tests psychomotor speed and coding. Reaction time measures were largely unaffected by tryptophan depletion as was maximum voluntary contraction, therefore suggesting that psychomotor speed was unaffected. The DSST has also been used as a measure for speed of processing (Bryan & Luszcz, 1999; Bryan, Luszcz, & Pointer, 1999; Crawford, Bryan, Luszcz, Obonsawin, & Stewart, 2000). However if only speed of processing was affected then surely tryptophan depletion would show an effect on the visual discrimination task which tests

speed of information processing. The DSST also requires some coding or planning. It could be that the drinks affected these parts of the test. Or it could be because the test requires a number of processes that it is more sensitive to change.

The second test to show an effect was verbal fluency. There was an interaction of group and treatment, where the low N scorers performed better on the depletion day and the high scorers performed better on the placebo day. When the high and low N scorers were assessed separately, it was the low scorers who showed a significantly different performance between the two days, in that the low scorers performed better on the depletion day. There was also a significant effect of order on this test. The low scorers do not improve following tryptophan depletion therefore if depleted on the first day performance did not improve on the placebo day, but if given the placebo on the first day they did perform significantly better when depleted on the second day. This would reflect in the overall better performance of the low N group on the depletion day. This pattern of responding is similar to that shown on the DSST, where irrespective of order performance was better when depleted of tryptophan.

This improvement following depletion was also found by Schmitt et al (2000) in a group of healthy volunteers. Furthermore the overall pattern was similar to that found by Hughes et al (2001). Hughes and colleagues gave a reduced drink (50g rather than 100g). The volunteers performed better on the task if depleted first. Performance did improve on the depletion day if

given placebo first, however, performance was better across the two test days if depleted first. The lack of main effect in the Hughes et al (2001) study may be due to the decreased drink. However, the pattern of results in normal controls is roughly the same. Performance is better when depleted.

This pattern in not reflected in the high N scorers. The high N scorers performed worse when depleted irrespective whether this is on the first or second day. If depleted on the first day the high N scorers perform better on the second day, however, if given placebo on the first day they perform slightly worse on the second day. This finding would mirror that found in depression, where performance is worse on *frontal* tasks (Austin et al., 2001; Degl'Innocenti et al., 1998; Trichard et al., 1995) and in healthy volunteers following mood induction (Bartolic et al., 1999).

Although there was no main effect on the mood measures given both in the morning and the afternoon there were effects on those measures given only in the afternoon. Two measures were used, the Alderley Park State Anxiety questionnaire (APSAQ; (Walker, 1990)) and the UWIST mood adjective checklist (Matthews et al., 1990). Indeed when the UWIST scores are assessed the high N scorers have lower scores on hedonic tone on the depletion day compared to the placebo day, suggesting a lowering of mood. However, it must be borne in mind that the mood change shown is a small one as no mood change was found on the BFS, the POMS or the PANAS.

The APSAQ was given directly before and directly after one of the psychometric tests, the PASAT. The PASAT has been claimed to be a

stressful task altering mood following testing (Holdwick & Wingenfeld, 1999; Mielke & Hall, 1998). On both days there was an increase in scores on the APSAQ following the PASAT, particularly on the depletion day. On the placebo day the low N group did not have as great an increase in anxiety scores either compared to the high N scorers or compared to the depletion day.

The low N scorers showed more anxiety following the PASAT on the depletion day than the placebo day and performed better on the depletion day on the DSST and the verbal fluency. Although it was expected that the volunteers would find the PASAT a stressful test it is possible that following any of the tests the volunteers would be more anxious. Indeed, some of the volunteers mentioned that they quite enjoyed the PASAT. Therefore it could be that performing on any psychometric test is a stressful experience. The low N scorers were more anxious on the depletion day, which may have improved their performance, while the high N scorers were more anxious and this may have decreased their performance on the depletion day. This is consistent with reports of stress on performance. Test anxiety is mediated by personality factors (McIlroy, Bunting, & Adamson, 2000). Increased levels of stress can lead to improved performance due to increased cognitive effort in the low anxious individual or conversely in the anxious individual increased anxiety can lead to a decrement in performance (Hardy, 1999).

A possible explanation, for the improvement in the low N scorers and healthy volunteers (Hughes et al., 2001; Schmitt et al., 2000), and the worsening of

performance in the high N scorers on the psychometric tasks, is that serotonin has a dampening effect on the noradrenergic and dopaminergic arousal systems. Tryptophan depletion decreases the level of serotonin, which will affect serotonin's effect on the noradrenergic and dopaminergic arousal systems. The decrease in levels of serotonin may increase cortical arousal with behavioural activation due to release of the noradrenergic and dopaminergic systems. This may have a differential effect on high and low Neuroticism scorers. In the low N group this may improve performance, while in the already highly aroused high N group this decreases performance.

As with depression the cognitive changes that occur with tryptophan depletion do not seem to fit a neuropsychological profile. Previous studies have found impairments in memory (Klaassen et al., 1999a; Park et al., 1994; Riedel et al., 1999; Schmitt et al., 2000) and attention (Coull et al., 1995; Schmitt et al., 2000) with no changes on executive function tasks (Park et al., 1994). Others have suggested a disruption in planning (which may be due to a change in impulsivity (Rogers et al., 1999a; Rogers et al., 1999b)), while some have found improvement on *frontal* tasks (Hughes et al., 2001; Schmitt et al., 2000). The only clear message is that changes do occur and this may be more specific to the difficulty of the task where capacity may be stretched than due to the type of task.

17.8 The pattern of the results

The data from the whole tryptophan depletion study is shown in Table 17.2 in order to assess whether there is a pattern across the study: whether

Neuroticism predicted performance and mood on the depletion day compared to the placebo day. Table 17.2 shows the means and standard deviations for the differences (depletion day score minus placebo day score) between the two test days by group. The scores on the tests have been inverted where necessary so that a negative score means that they feel or perform worse on the depletion day and a positive that they feel or perform better. The column, outcome, in table 17.2, indicates whether the individuals felt better or worse on the depletion day compared to the placebo by group (+ indicates better, - indicates worse). Not all of the tests included within the study are included within table 17.2. The tests included are only those tests where a direction was hypothesised. Only the total scores of the BFS and the POMS were included. The BFS contains a Depression sub-scale and a Fatigue sub-scale which both measure different aspects depressed mood. The sub-scales of the POMS correlate highly. Total scores therefore were used so that the same construct from one questionnaire would not be entered into the table more than once. There were no direct hypotheses concerning blood pressure or pulse therefore these were not included. For reaction time and maximum voluntary contraction only the right handed measures are presented in this table as the results were the same for both hands. Therefore only right-handed subjects were included in this analysis. EEG is included. Asymmetry of EEG alpha power may reflect mood changes. The high N scorers feel or perform worse following tryptophan depletion compared to placebo in 12 out of the 14 tests presented. A

Table 17.2: Outcome for high and low N scorers on mood, cognitive, physical and EEG measures, following tryptophan depletion

Test	*Group*	*Depleted-Placebo*		*Outcome*
BFS Total	High N	-2.4	(13.1)	-
	Low N	0.6	(11.6)	+
POMS Total	High N	-3.4	(19.7)	-
	Low N	4.2	(14.3)	+
Positive	High N	-1.4	(7.7)	-
Affectivity	Low N	0.4	(6.8)	+
Negative	High N	-0.6	(3.1)	-
Affectivity	Low N	0.3	(1.9)	+
MVC	High N	-1.8	(12.9)	-
	Low N	1.4	(7.2)	+
Reaction Time	High N	-16.0	(117.1)	-
	Low N	-20.8	(52.6)	-
RIT	High N	-2.4	(32.7)	-
	Low N	-24.6	(41.1)	-
Movement Time	High N	-23.9	(79.1)	-
	Low N	-16.8	(61.2)	+
DSST	High N	1.2	(6.5)	+
	Low N	3.5	(6.3)	+
Digit Span	High N	-1.1	(3.3)	-
	Low N	0.2	(2.2)	+
PASAT	High N	-0.2	(8.3)	-
	Low N	0.6	(8.1)	+
Visual	High N	1.6	(14.5)	+
Discrimination	Low N	0.2	(10.1)	+
Verbal Fluency	High N	-0.4	(5.5)	-
	Low N	3.3	(3.8)	+
EEG	High N	-0.2	(0.4)	-
	Low N	0.0	(0.2)	+

MVC maximum voluntary contraction; RIT response initiation time; DSST digit symbol substitution test; PASAT paced auditory serial addition task

Hotelling's T^2 was carried out to test whether the data fitted a pattern, whether the high N group felt worse across the tests on the depletion day compared to the low N scorers ($F_{(14,12)} = 0.754$ ns). This was not significant even though the high N group felt or performed worse in 12 of the 14 tests. This may be because Hotelling's T^2 is not very powerful. It tests whether the pattern goes in both directions where in this case the prediction was for one direction. There is almost a one to one ratio of subjects to number of

variables, there should be more variables than subjects. Furthermore the data does not fit the assumptions for this test. The data is skewed, has a number of outliers, does not show homogeneity of the variance-covariance matrices among the two groups.

17.9 Summary

Neuroticism did not prove to be a strong predictor of mood change following tryptophan depletion in this group of volunteers. This may have been because the high N group who took part in the study was an unusual high N group. They did not differ from the low N group on negative affectivity, POMS D or the BFS even though Neuroticism in the whole group of student volunteers was highly correlated to negative mood. It is possible that those individuals who are susceptible were excluded. The power analysis showed that 45 high N scorers would be required to find an effect of mood change on the POMS D sub-scale following tryptophan depletion as compared to placebo. This study did not contain sufficient power to detect an effect.

However, within the sample there were a number of interesting changes on the psychometric tests and the mood and anxiety questionnaires given in the afternoon. The volunteers performed better on the depletion day than on the placebo day on the DSST. There were no significant group differences on this test. On the verbal fluency test the low N group performed better on the depletion than the placebo day also, whereas the high N group performed worse on the placebo day. The low N scorers showed more anxiety on the Alderley Park State Anxiety Questionnaire (APSAQ) on the depletion day

than the placebo day following one of the psychometric tests, the PASAT. The better performance of the low N scorers and the worse performance of the high N scorers on the depletion day may be due to an interaction between anxiety and performance. Increased stress levels in the low N group may have lead to an improved performance due to increased cognitive effort and conversely increased anxiety in the high N group may have lead to a decrement in performance (Hardy, 1999).

In sum, although Neuroticism was not a predictor of mood change following tryptophan depletion, those who scored at the high end of the Neuroticism scale felt and performed worse, following tryptophan depletion compared to placebo.

Chapter Eighteen General Discussion and Conclusions

The main aims of this thesis were to test whether Neuroticism is related to mood and whether Neuroticism would be predictive of mood change via tryptophan depletion. This has been tested by selecting two extreme groups on the Neuroticism scale from a large sample of volunteers (n=1032) who completed questionnaires on personality and mood. It was proposed that those who scored at the high end of the Neuroticism scale (n=17) would be predisposed to developing a depressive mood change following tryptophan depletion compared to the low Neuroticism scorers (n=15). Tryptophan depletion has been shown to have central effects in man (Carpenter et al., 1998; Moreno et al., 2000; Williams et al., 1999) and to produce a decrease in brain serotonin synthesis (Nishizawa et al., 1997). By lowering serotonin levels in this way, transient changes have been found in mood in patients with a history of depression (Delgado et al., 1990), in healthy volunteers with a family history of depression (Benkelfat et al., 1994) and in healthy volunteers (Young et al., 1985). The aim was therefore to show that Neuroticism would be a predictor of negative mood change via tryptophan depletion and therefore by extrapolation via brain serotonin.

Within this general aim, the relationships between personality traits and mood have also been examined as well as the structure of personality. The main findings of this thesis are that Neuroticism is not a predictor of mood

change via serotonin change and that three factors of Emotionality, Extraversion and Conscientiousness may be basic to personality.

The first section of the thesis assessed the personality measures of the EPQ-R and the TPQ. The first aim was to establish whether the personality dimensions proposed by Eysenck (Eysenck, 1991; Eysenck et al., 1985) and Cloninger (Cloninger, 1987; Cloninger et al., 1991) could be extracted from these questionnaires. From the EPQ-R both Neuroticism and Extraversion showed high internal consistency (as measured by Cronbach alphas) and both factors could be extracted from the questionnaire. The three factor solution of Extraversion, Neuroticism and Psychoticism could not be extracted. Items from the Psychoticism scale did not load onto a factor that appeared to represent Psychoticism either in a three or a four factor solution. A three factor solution with factors representing Extraversion, Neuroticism and Conscientiousness was suggested as well as a four factor solution with factors representing Extraversion, Neuroticism, Antisocialness and Conscientiousness.

From the TPQ only the dimension of Harm Avoidance appeared robust. When the TPQ was analysed using principal axis factoring at the sub-scale level, support was given to Cloninger's factors of Harm Avoidance, Reward Dependence and Novelty Seeking, this was not the case at the item level. A three factor solution of Harm Avoidance, Conscientiousness and Socialness was suggested as well as a four factor solution of Harm Avoidance, Conscientiousness, Tough Mindedness and Impulsiveness.

When a combined item level analysis of the TPQ and EPQ-R was carried out, again a three factor solution of Emotionality, Extraversion and Conscientiousness was suggested as well as a four factor solution with suggested factors of Emotionality, Sociability, Conscientiousness and Risk Taking.

With respect to the main aim of the thesis, it is interesting to note that in all of the solutions, whether three or four factor, and whether derived from the EPQ-R or the TPQ or both, an Emotionality factor was suggested. The Emotionality factor consisted of loadings mainly from Neuroticism or Harm Avoidance or both. Neuroticism was shown to be robust from the EPQ-R and Harm Avoidance from the TPQ. These two factors showed high correspondence throughout and when the two questionnaires (EPQ-R and TPQ) were analysed together nearly all of the Harm Avoidance and the Neuroticism items were extracted on the same factor. This is particularly pertinent as Cloninger (1987) proposed that Harm Avoidance is related to serotonergic function.

Comment can be made within this thesis on personality structure. There is still much debate concerning which factors and how many form the structure of personality (Costa & McCrae, 1992a; Eysenck, 1991; Eysenck, 1992; Zuckerman et al., 1988; Zuckerman et al., 1991). Numbers of the personality factors suggested range between 3 and 13 (Brand, 1994; Cattell et al., 1970; Costa & McCrae, 1992b; Eysenck, 1991; Gray, 1987; Zuckerman, 1991). However a broad consensus of five factors has been gained which are

Extraversion or sociability, Neuroticism or emotionality, Conscientiousness or will to achieve, Agreeableness or conformity, and Openness or Intellect (Digman, 1990). Two main proponents of a five factor model are Costa and McCrae (1992a; 1992b) whose five factors are Extraversion, Neuroticism, Conscientiousness, Agreeableness and Openness. An important point is that although the same five factors can be derived, these five factors may vary from study to study. For instance, a supposedly equivalent factor from one study may not correlate highly with a factor from another study, thereby suggesting that the factors are not measuring the same thing, or factors from one study may not have the same meaning in another study (Goldberg, 1992; Hofstee et al., 1997).

In respect to the three factors found in this study, they may be similar to three of the big five but they may not correlate highly nor may they have the same meaning. Furthermore it is only through testing these factors and finding construct validity can they be established as being basic to personality.

Although many studies have shown that Neuroticism is related to negative mood both in healthy controls and in patient populations (Chien & Dunner, 1996; Costa & McCrae, 1980; Hirschfeld et al., 1989; Kardum & Hudek-Knezevic, 1996; Kendler et al., 1993; Roy, 1990; Williams, 1990; Wilson & Gullone, 1999), it was important to establish that both Neuroticism and Harm Avoidance were related to mood in this sample. Indeed, in this sample both Neuroticism and Harm Avoidance related highly to mood shown by both correlation and regression analysis. However, both traits correlated highly

with mood measures designed to measure low mood and with a mood measure designed to measure Happiness. It is suggested that in order to gain a further understanding of mood in both normal controls and within patient populations that models of mood should be employed in both groups. Unfortunately separate mood components could not be extracted from the questionnaires used within this study (when the mood questionnaires were analysed at the scale level using prinicipal components analysis).

In this study it was those who scored at either end of the Neuroticism scale who were selected for the tryptophan depletion part of the study, however, Cloninger proposed that Harm Avoidance relates to serotonergic function. Neuroticism was shown to be only a weak predictor of mood change via tryptophan depletion. Those who scored at the high end of the Neuroticism scale did not develop depressive mood changes shown by self-report mood scales, by cognitive correlates, psychomotor retardation or alpha wave asymmetry in EEG. However, if a sign test is carried out and all of these tests are compared as to which day the volunteer performed or felt worse on, there is an effect. Those who score at the high end of the N scale feel and perform worse on psychometric and psychomotor tasks following the depleting drink compared to the placebo drink. Furthermore there is a trend for the low N scorers to feel better and perform better following the depleting drink compared to the placebo drink. Neuroticism was not a predictor of mood change via tryptophan depletion but if all the tests are brought together

in a sign test, Neuroticism did predict a worsening of mood and performance following tryptophan depletion compared to placebo.

A further finding from the study was that although norms were used to select individuals (Eysenck et al., 1985), over twice as many high N scorers were recruited than low N scorers (124 high N compared to 57 low N scorers). A number of possible reasons for this over selection of high N scorers are discussed in Chapter 17. One possible reason may be that Neuroticism scores have increased in the general population across age generations due to the socio-cultural environment (Twenge, 2000). For instance a person of age 20 in the 1960's would have lower Neuroticism score than someone of age 20 in the 1980's (Twenge, 2000). Indeed the group studied had higher Neuroticism scores than those published by Eysenck and colleagues (Eysenck et al., 1985). An argument may be that the selection criteria that were used are no longer appropriate and a higher cut-off for the high N scorers should have been chosen. This may well be the case but the volunteers in this study were not recruited completely randomly. They were asked only to participate if they were interested in taking part in the two day study which may have led to more high Neuroticism scorers volunteering which in turn could lead to higher Neuroticism scores in the group as a whole.

The majority of the high Neuroticism scorers were excluded from the study. More high N scorers than low N scorers were excluded for medical or psychiatric reasons. It is possible that the high N group who took part in the

study was an unusual group of high N scorers. Indeed this group did not differ from the low N group on measures of mood, the Befindlichskeitskala (BFS), negative affectivity or the Profile of Mood States D scale on the morning of the test days. This would appear to be unusual, particularly because Neuroticism correlated highly with scores on the BFS in the whole unselected sample (n=870). It is therefore possible that individuals who may have been susceptible to depressive mood change were excluded due to health reasons.

In sum, a three factor solution of personality has been suggested of an Emotionality factor, an Extraversion factor and a Conscientiousness factor. Emotionality whether Neuroticism or Harm Avoidance, relates highly to mood. The relationship between Neuroticism and mood does not appear to be directly mediated by serotonin. Neuroticism is not a good predictor of mood change following tryptophan depletion, and therefore by extrapolation, following depletion of brain serotonin.

Appendix I: Letters sent when the subject scored on the D scale of the GHQ-28

AI.1: Letter sent to subject when the individual scored mildly on the D section of the GHQ-28

MRC

Medical Research Council

MRC Brain Metabolism Unit
Royal Edinburgh Hospital
Morningside Park
Edinburgh
EH10 5HF

telephone 0131 537 6534

telefax (Natl) 0131 537 6110
(Intl) 4431 537 6110

electronic mail mary.stewart@ed.ac.uk

Your reference
Our reference

Dear

Re: Personality, Mood and Diet

Thank you for filling out all my questionnaires. I have just recently scored yours. You may remember one of them which asks about your general health and how you have been feeling both physically and emotionally over the past few weeks. On this questionnaire you did indicate that you were not feeling at your best. Our ethics board requires us to get in touch with everyone who scores above a certain level. Our routine advice to those who score above this level is to consult their GP.

We have found that a number of people who do score above this level do not feel unwell at all, but if you are not feeling well then we would advise you to see your G.P. If you have any questions, please feel free to contact me on 0131 537 6534.

Thanks very much indeed for your time.

Mary Stewart

AI.2 Letter sent to subject when the individual scored severely on the D section of the GHQ-28

MRC

Medical Research Council

MRC Brain Metabolism Unit
Royal Edinburgh Hospital
Morningside Park
Edinburgh
EH10 5HF

telephone 0131 537 6535

telefax (Natl) 0131 537 6110
(Intl) 4431 537 6110

electronic mail mary.stewart@ed.ac.uk

Your reference
Our reference

Dear

Re: Personality, Mood and Diet

Thank you for filling out all my questionnaires. I have just recently scored yours. You may remember one of them which asks about your general health and how you have been feeling both physically and emotionally over the past few weeks. On this questionnaire you scored quite highly. Our ethics board requires us to get in touch with everyone who scores above a certain level. Our advice to those who score highly is to consult their GP. Thus if you still feel the same way as you did when you completed the questionnaire we recommend that you do this. I do not have your GP's address at present, but it may be helpful for me to send a copy of the questionnaire to your GP. If you wish for me to do this please get in touch. Please feel free to contact me on 0131 537 6535, if you have any questions.

Thanks very much indeed for your time.

Mary Stewart

AI.3: Example of a letter of the General Practitioner of a subject who scored on the D section of the GHQ-28

MRC
Medical Research Council

Your reference
Our reference

MRC Brain Metabolism Unit
Royal Edinburgh Hospital
Morningside Park
Edinburgh
EH10 5HF

telephone 0131 537 6535

telefax (Natl) 0131 537 6110
(Intl) 4431 537 6110

electronic mail mary.stewart@ed.ac

Dear Dr ,

Re:

I am writing with S's consent and complying with the ethics committee's guidelines, to inform you about some abnormal study results. He has participated in a study on personality and mood, which involves healthy volunteers filling in questionnaires on mood and personality. One of the questionnaires is the General Health Questionnaire. S scored quite highly on this - over the threshold level, and specifically on the 'D' (depression) section. I have enclosed a copy of his responses. The caseness score for this questionnaire is 4/5, i.e. an individual scoring over 5 may require medical assistance. S, as you can see, scored 20 - he comes across on the questionnaire as being anxious and as having a low mood. For a psychiatric assessment, referral to your local community psychiatric team may be indicated.

I hope that this is of help to you.

Yours sincerely,

Mary Stewart
PhD Student
(Clinical Supervisor Prof K Ebmeier)

Appendix II: The Adapted Hamilton Depression Rating Scale

The original Hamilton has been adapted to reflect changes throughout the day. The original wording and original items which have been altered or omitted are in square brackets and underlined.

RNO ..... ID ..... Date ..... Interviewer .....

1. What's your mood like at the moment [What's your mood like this past week]

Are you feeling down or depressed?

Sad? Hopeless?

Do you feel like crying at all?

DEPRESSED MOOD (sadness, hopeless, helpless, worthless):

0 - absent
1 - indicated only on questioning
2 - spontaneously reported verbally
3 - communicated non-verbally, i.e., facial expression, posture, voice, tendency to weep
4 - this in spontaneous verbal and non-verbal communication

1 _____

2. Do you feel especially critical of yourself at the moment [this past week], feel you've done things wrong, or let others down? If YES: What are your thoughts?

Are you feeling guilty about anything that you've done or not done?

FEELINGS OF GUILT:

0 - Absent
1 - self-reproach, feels he has let people down
2 - ideas of guilt or rumination over past errors or sinful deeds
3 - present illness is a punishment. Delusions of guilt
4 - hears accusatory or denunciatory voices and/or experiences threatening visual hallucinations

2 _____

3. [This past week, have you had] Do you have any thoughts that life is not worth living, or that you'd be better off dead. What about thoughts of hurting or even killing yourself?

If YES: What are you thinking?

SUICIDE:

0 - absent
1 - feels life is not worth living
2 - wishes he were dead or any thoughts of possible death to self
3 - suicidal ideas or gesture
4 - attempts at suicide

3 _____

[4. How have you been sleeping over the last week?
Have you any trouble falling asleep at the beginning of the night? (Right after you go to bed, how long has it been taking you to fall asleep?
How many nights this week have you had trouble falling asleep?)]

[INSOMNIA EARLY:

0 - no difficulty falling asleep
1 - complains of occasional difficulty falling asleep - i.e., more than 1/2 hour
2 - complains of nightly difficulty falling asleep

_____ 4 _____]

[5. During the past week, have you been waking up in the middle of the night? If YES: Do you get out of bed? What do you do? (Only go to the bathroom)?

When you get back in bed, are you able to fall right back asleep?

Have you felt your sleeping has been restless or disturbed some nights?

INSOMNIA MIDDLE:

0 - no difficulty
1 - complains of being restless and disturbed during the night
2 - waking during the night - any getting out of bed (except to void)

5]

[6. What time have you been waking up in the morning for the last time, this past week?

IF EARLY: Is that with an alarm clock, or do you just wake up yourself? What time do you usually wake up (that is, before you get depressed)?

INSOMNIA LATE:

0 - no difficulty
1 - waking in early hours of morning but goes back to sleep
2 - unable to fall asleep again if gets out of bed

6]

4. At the moment do you feel that you could still enjoy the activities which you normally find pleasurable?

[How have you been spending your time this past week (when not at work)
Have you felt interested in doing (those things) or do you feel you have to push yourself to do them?]

0 - no difficulty
1 - thoughts and feelings of incapacity, fatigue or weakness related to activities, work or hobbies
2 - loss of interest in activity, hobbies or work - by direct report of the patient or indirect in listlessness, indecision and vacillation (feels he has to push self to work or activities)
[3 - decrease in actual time spent in activities or decrease in productivity. In-hosp pat. spends less than 3 hrs/day in activities (hospital job or hobbies) exclusive of ward chores
4 - stopped working because of present illness. In hospital, no activities except ward chores, or fails to perform ward chores unassisted]

4 _____

5. RATING BASED ON OBSERVATION DURING INTERVIEW

RETARDATION: (slowness of thought and speech; impaired ability to concentrate; decreased motor activity):

0 - normal speech and thought
1 - slight retardation at interview
2 - obvious retardation at interview
3 - interview difficult
4 - complete stupor

5 _____

6. RATING BASED ON OBSERVATION DURING INTERVIEW

AGITATION:

0 - none
1 - fidgetiness
2 - playing with hands, hair etc.
3 - moving about, can't sit still
4 - hand-wringing, nail biting, hair-pulling, biting of lips

6 _____

7. Do you feel especially tense or irritable at the moment [this past week]

Are you worrying a lot about little unimportant things, things you wouldn't ordinarily worry about. If YES: Like what, for example??

ANXIETY PSYCHIC:

0 - no difficulty
1 - subjective tension and irritability
2 - worrying about minor matters
3 - apprehensive attitude apparent in face or speech
4 - fears expressed without questioning

7 _____

8. [In this past week] Do you have any physical symptoms such as:

ANXIETY SOMATIC (physiologic concomitants of anxiety, such as GI - dry mouth, gas, indigestion, diarrhoea, cramps, belching
C-V - heart palpitations, headaches
Resp - hyperventilating, sighing
Having to urinate frequently
Sweating):

0 - absent
1 - mild
2 - moderate
3 - severe
4 - incapacitating

8 _____

[12. How has your appetite been this past week? (What about compared to your usual appetite?)

Have you had to force yourself to eat?

Have other people had to urge you to eat?

SOMATIC SYMPTOMS GASTROINTESTINAL:

0 - none
1 - loss of appetite but eating without encouragement
2 - difficulty eating without urging

12 _____]

9. How is your energy at the moment? [been this past week]

Are you feeling any heaviness in your limbs, back or head?

Have you any backaches, headaches, or muscle aches?

SOMATIC SYMPTOMS GENERAL:

0 - none
1 - heaviness in limbs, back or head. Backaches, headache, muscle aches. Loss of energy and fatiguability.
2 - any clear-cut symptom

9 _____

[14. How has your interest in sex been this week? (I'm not asking about performance, but about your interest in sex - how much you think about it).

Has there been any change in your interest in sex (from when you were not depressed)?

Is it something you've thought much about? If No: is that unusual for you?

GENITAL SYMPTOMS (such as loss of libido, menstrual disturbances):

0 - absent
1 - mild
1 - severe

14]

10. [In the last week, how much have your thoughts] At the moment are your thoughts focused on your physical health or how your body is working (compared to your normal thinking)?

HYPOCHONDRIASIS:

0 - not present
1 - self-absorption (bodily)
2 - preoccupation with health
3 - frequent complaints, requests for help etc.
4 - hypochondriacal delusions

10

[16. Have you lost any weight since this (DEPRESSION) began? If YES: how much?

IF NOT SURE: Do you think your clothes are any looser on you?

AT FOLLOW-UP: Have you gained any of the weight back?

LOSS OF WEIGHT (Rate either A or B):

A. When rating by history:

0 - no weight loss
1 - probable weight loss associated with present illness
2 - definite (according to patient) weight loss
3 - not assessed

B. On weekly ratings by ward staff, when actual weight changes are measured:

0 - less than 1lb loss in week
1 - more than 1lb loss in week
2 - more than 2lb loss in week
3 - not assessed

16]

[17. RATING BASED ON OBSERVATION

INSIGHT

0 - Acknowledges being depressed and ill OR not currently depressed
1 - acknowledges illness but attributes cause to bad food, climate, over-work, virus, need for rest, etc.
2 - denies being ill at all

17]

[18. This past week, have you been better or worse at any particular time of day - morning or evening?

IF VARIATION: How much worse do you feel in the (MORNING or EVENING)

IF UNSURE: A little bit worse or a lot worse?

DIURNAL VARIATION:

A - Note whether symptoms are worse in morning or evening. If NO diurnal variation, mark none:

0 - no variation or not currently depressed
1 - worse in a.m.
2 - worse in p.m.

B - When present, mark the severity of the variation:

0 - none
1 - mild
2 - severe

18]

[19. In the past week, have you ever suddenly had the feeling that everything is unreal, or you're in a dream or cut off from other people in some strange way? Any spacey feelings? IF YES: How bad has that been? How often this week has that happened?

DEPERSONALISATION AND DEREALISATION (such as feelings of unreality and nihilistic ideas):

0 - absent
1 - mild
2 - moderate
3 - severe
4 - incapacitating

19]

[20. This past week, have you felt that anyone was trying to give you a hard time or hurt you?

IF NO: What about talking about you behind your back?

IF YES: Tell me about that

PARANOID SYMPTOMS:

0 - none
1 - suspicious
2 - ideas of reference
3 - delusions of reference and persecution

20]

11. [In the past week, have there been things] At the moment, do you have the urge to do certain things over and over again, like checking the locks on the doors several times?
If YES: Can you give me an example?

Do you have any thoughts that don't make any sense to you, but that keep running over and over in your mind?

If YES: Can you give me an example?

OBSESSIONAL AND COMPULSIVE SYMPTOMS:

0 - absent
1 - mild
2 - severe

11 _____

Total 11-item ...../38

Appendix III: Response profiles on the EPQ-R Psychoticism Scale

Table AIII:1: Items from the EPQ-R Psychoticism scale which show an acceptable response profile in men

Item Number	% did not score on item	% scored on item
P2	78.7	21.3
P7	68.3	31.7
P9	63.1	36.9
P14	64.3	35.7
P18	45.0	55.0
P21	70.6	29.4
P25	55.0	45.0
P29	28.0	72.0
P37	79.8	20.2
P41	78.1	21.9
P42	41.8	58.2
P50	49.0	51.0
P59	76.7	23.3
P64	75.2	24.8
P75	69.7	30.3
P81	70.0	30.0
P85	71.8	28.2
P88	34.6	65.4

Table AIII:2: Items from the EPQ-R Psychoticism scale which do not show an acceptable response profile in men

Item Number	% did not score on item	% scored on item
P5	82.4	17.6
P12	92.8	7.2
P30	97.1	2.9
P34	85.3	14.7
P48	86.2	13.8
P54	93.1	6.9
P56	96.0	4.0
P68	96.8	3.2
P73	86.7	13.3
P79	86.7	13.3
P91	84.4	15.6
P95	88.5	11.5
P96	85.0	15.0
P99	92.5	7.5

Table AIII:3: Items from the EPQ-R Psychoticism scale which show an acceptable response profile in women

Item Number	% did not score on item	% scored on item
P9	78.2	21.8
P14	65.3	34.7
P18	57.6	42.4
P25	74.0	26.0
P29	49.5	50.5
P42	55.8	44.2
P50	60.9	39.1
P64	76.7	23.3
P75	74.2	25.8
P81	70.2	29.8
P85	71.8	28.2
P88	37.8	62.2

Table AIII:2: Items from the EPQ-R Psychoticism scale which do not show an acceptable response profile in women

Item Number	% did not score on item	% scored on item
P2	82.5	17.5
P5	85.1	14.9
P7	89.5	10.5
P12	97.8	2.2
P21	84.2	15.8
P30	96.7	3.3
P34	93.5	6.5
P37	91.3	8.7
P41	85.8	14.2
P48	88.5	11.5
P54	92.4	7.6
P56	95.1	4.9
P59	87.5	12.5
P68	97.8	2.2
P73	93.3	6.7
P79	90.9	9.1
P91	90.4	9.6
P95	88.4	11.6
P96	85.1	14.9
P99	95.5	4.5

Appendix IV: Combined analysis of the EPQ-R and TPQ scales

Table AIV:1: Structure matrix of the three Factor obliquely rotated solution of a scale level analysis of the EPQ-R and TPQ combined

Scale	Factor 1	Factor 2	Factor 3	Communality
Extraversion	**.502**	**.459**	**.680**	.558
Neuroticism	**-.779**	-.004	-.092	.505
Psychoticism	.035	**.712**	**-.312**	.322
Novelty Seeking	.165	**.725**	.248	.411
Harm Avoidance	**-.898**	-.258	-.200	.627
Reward Dependence	-.085	-.102	**.677**	.308

Table AIV:2: Communalties of items of the EPQ-R and TPQ for extraction using principal axis factoring

Number	Scale	Value	Number	Scale	Value
1	HA1	.563	1	E	.380
2	NS1	.459	2	P	.401
3	RD3	.576	3	N	.399
4	NS1	.443	5	P	.359
5	HA1	.545	6	E	.591
6	RD3	.353	7	P	.344
7	RD3	.349	8	N	.439
8	HA1	.528	9	P	.268
9	NS1	.333	11	E	.519
10	HA1	.595	12	P	.358
11	NS1	.437	13	N	.387
12	RD3	.618	14	P	.326
13	NS4	.403	16	E	.442
14	HA1	.555	17	N	.450
15	RD3	.368	18	P	.442
16	NS4	.437	20	E	.573
17	RD4	.342	21	P	.431
18	HA2	.583	22	N	.529
19	HA2	.711	24	E	.634
20	RD4	.350	25	P	.394
21	NS4	.379	26	N	.509
22	NS4	.435	28	E	.470
23	HA2	.696	29	P	.475
24	NS4	.451	30	P	.250
25	RD4	.407	31	N	.426
26	HA2	.448	33	E	.504
27	RD1	.311	34	P	.300
28	NS4	.487	35	N	.540
29	HA2	.362	36	E	.424
30	NS2	.377	37	P	.314
31	RD1	.400	38	N	.583
32	NS3	.421	40	E	.434
33	HA3	.593	41	P	.445
34	RD1	.342	42	P	.340
35	NS4	.340	43	N	.542
36	RD4	.446	45	E	.492
37	HA3	.609	46	N	.445
38	HA3	.552	47	E	.623
39	RD2	.589	48	P	.252
40	NS1	.413	50	P	.363
41	RD2	.417	51	E	.633
42	HA3	.498	52	N	.331
43	NS1	.353	54	P	.330
44	HA3	.398	55	E	.320
45	RD2	.521	56	P	.234
46	NS2	.465	58	E	.639
47	HA2	.545	59	P	.366
48	NS2	.526	60	N	.359
49	HA4	.428	61	E	.460
50	NS2	.379	63	E	.348
51	HA2	.561	64	P	.288

Number	Scale	Value	Number	Scale	Value
52	RD2	.212	65	N	.477
53	RD2	.312	67	E	.437
54	HA4	.530	68	P	.270
55	NS2	.546	69	E	.492
56	NS2	.403	70	N	.466
57	HA4	.489	72	E	.380
58	RD4	.411	73	P	.331
59	HA4	.535	74	N	.369
60	NS4	.394	75	P	.268
62	NS4	.425	76	N	.402
63	HA4	.445	78	E	.652
64	RD3	.359	79	P	.327
65	NS4	.304	80	N	.533
66	NS3	.530	81	P	.493
67	RD3	.281	83	N	.439
68	HA4	.407	84	N	.458
69	HA4	.497	85	P	.401
70	NS3	.534	87	N	.517
72	NS3	.595	88	P	.332
73	HA4	.510	90	E	.500
74	RD3	.326	91	P	.336
75	HA4	.566	92	N	.387
76	NS3	.372	94	E	.559
77	RD2	.317	95	P	.344
78	NS3	.422	96	P	.273
79	RD2	.474	97	N	.340
80	HA4	.495	99	P	.312
81	NS2	.361	100	N	.436
82	HA1	.481			
83	RD1	.349			
84	HA1	.548			
85	NS1	.385			
86	RD3	.600			
87	NS3	.432			
88	RD3	.676			
89	HA3	.556			
90	RD3	.539			
91	HA1	.505			
92	RD2	.552			
93	NS1	.424			
94	RD1	.363			
95	HA1	.551			
96	NS1	.297			
97	RD2	.541			
98	HA1	.455			
99	NS2	.417			
100	HA3	.370			

Appendix V: Effects of order on psychometric tests

Table AV:1: The effect of order of tryptophan depletion on psychometric tests

Test and Order	High or Low N Scorer	Mean (SD)	
		Test day one	Test day two
DSST Depletion First	High Scorer	74.0 (12.0)	76.0 (14.4)
	Low Scorer	75.6 (5.6)	77.8 (7.9)
DSST Placebo First	High Scorer	70.5 (11.1)	77.5 (12.0)
	Low Scorer	69.7 (8.4)	76.5 (6.5)
Digit Span Depletion First	High Scorer	17.3 (5.6)	19.9 (5.0)
	Low Scorer	17.4 (4.0)	19.0 (3.2)
Digit Span Placebo First	High Scorer	18.1 (3.9)	19.0 (4.8)
	Low Scorer	18.6 (4.8)	19.8 (4.3)
PASAT Depletion First	High Scorer	44.6 (11.1)	50.6 (7.8)
	Low Scorer	41.0 (9.5)	47.4 (7.1)
PASAT Placebo First	High Scorer	44.0 (7.3)	50.6 (6.5)
	Low Scorer	41.4 (9.8)	47.2 (6.8)
Visual Discrimination Depletion First	High Scorer	70.2 (13.0)	78.0 (7.4)
	Low Scorer	68.6 (14.3)	77.2 (10.4)
Visual Discrimination Placebo First	High Scorer	67.0 (13.6)	78.3 (6.3)
	Low Scorer	80.0 (6.2)	85.2 (6.6)

Appendix VI: Mood and Personality Scores and Tryptophan Levels For each Individual in the Tryptophan Depletion study

Table AVI:1 Baseline and post drink levels of plasma free and total tryptophan levels in each individual subject

ID	Sex	N	HA	Free am depletion day	Free am placebo day	Free pm depletion day	Free pm placebo day	Total am depletion day	Total am placebo day	Total pm depletion day	Total pm placebo day
1	M	1	4	5.59	6.09	.35	4.98	74.19	66.02	5.38	74.46
2	M	1	3	5.05	5.76	.36	5.24	85.54	65.60	7.69	67.07
3	M	2	2	4.24	4.90	.60	5.01	65.80	50.59	10.09	83.57
4	M	2	5	4.93	5.75	.49	4.24	70.03	43.74	11.31	55.37
5	M	2	7	.	.	.	.	.	.	.	.
6	F	3	4	4.01	2.99	.37	3.62	54.44	49.53	6.36	65.05
7	F	3	5	4.35	3.77	.42	7.42	70.14	64.86	8.01	108.54
8	F	3	6	4.04	3.82	.48	9.37	55.12	62.83	6.06	125.34
9	F	3	2	4.19	5.20	1.52	6.69	58.58	57.19	5.97	82.56
10	F	4	10	5.23	5.76	.59	6.08	59.02	62.95	6.89	90.28
11	F	5	8	5.03	7.07	.49	8.80	65.52	81.07	9.43	114.73
12	F	5	12	7.49	3.86	1.81	8.09	67.91	58.70	24.02	99.22
13	F	5	9	4.09	4.01	.87	5.57	62.41	57.19	9.46	80.84
14	F	6	14	4.47	4.14	.58	8.76	53.80	73.55	8.74	114.76
15	F	7	18	4.93	5.92	.58	12.18	73.19	63.87	10.13	155.12
16	M	18	19	4.09	4.44	.91	4.82	79.49	66.93	9.27	76.52
17	M	19	12	4.58	5.19	.45	13.64	77.58	65.07	6.53	159.29
18	F	20	21	5.24	4.15	.48	4.86	59.76	60.44	5.45	73.53
19	F	21	23	3.43	3.68	3.23	9.39	61.32	65.19	7.79	146.28
20	M	21	31	4.28	4.22	.46	5.23	60.88	59.30	7.91	81.44
21	M	21	9	3.95	4.18	.54	4.98	62.91	60.99	7.47	78.56
22	M	21	25	3.62	3.57	.57	10.85	55.65	60.28	6.50	155.86
23	M	21	10	4.13	3.97	.84	4.82	52.34	62.69	5.67	55.98
24	M	21	11	5.90	4.50	1.29	7.99	68.77	56.01	5.54	92.57
25	F	22	21	3.87	4.39	.40	6.62	61.70	60.36	6.64	96.65
26	F	22	21	6.48	5.47	2.20	8.10	67.69	64.19	8.17	80.53

ID	Sex	N	HA	Free am depletion day	Free am placebo day	Free pm depletion day	Free pm placebo day	Total am depletion day	Total am placebo day	Total pm depletion day	Total pm placebo day
27	F	22	28	.	.	.	.	.	.	.	.
28	F	22	12	3.20	3.96	.40	6.01	55.13	51.77	5.99	88.20
29	F	22	27	3.69	3.80	.43	5.90	64.76	58.76	5.43	89.25
30	F	22	29	4.27	5.38	.25	6.47	68.00	55.57	5.17	93.98
31	F	22	29	4.46	4.39	.41	7.62	58.54	39.84	7.04	116.72
32	F	22	21	.	.	.	.	.	.	.	.

Key for tables AVI:1-5

N: Score on the EPQ-R Neuroticism Scale
HA: Score on the TPQ Harm Avoidance Scale
Free: plasma free tryptophan Units nMol/ml
Total: total plasma tryptophan Unit n/Mol/ml
am depletion day: baseline on the day they received the depleting drink
am placebo day: baseline on the day they received the placebo drink
pm depletion day: Scores or levels 4-6 hours after receiving the depleting drink
pm placebo day: Scores or levels 4-6 hours after receiving the placebo drink
BFS: Befindlichskeitskala
POMS: Profile of Mood States
% decrease depletion day = [(am level-pm level)/am level] x 100
% increase placebo day = [(pm level – am level)/am level] x 100
Change scores on mood scales = afternoon – morning score

Table AVI:2 Baseline and post drink scores on the BFS and the POMS in each individual subject

ID	Sex	N	HA	BFS am depletion day	BFS am placebo day	BFS pm depletion day	BFS pm placebo day	POMS am depletion day	POMS am placebo day	POMS pm depletion day	POMS pm placebo day
1	M	1	4	8.00	2.00	16.00	1.00	-14.00	-10.00	-17.00	-21.00
2	M	1	3	3.00	4.00	8.00	4.00	-3.00	-6.00	-11.00	-9.00
3	M	2	2	2.00	5.00	4.00	3.00	-17.00	-3.00	-20.00	-3.00
4	M	2	5	6.00	10.00	4.00	6.00	10.00	16.00	1.00	12.00
5	M	2	7	3.00	12.00	3.00	10.00	-21.00	-15.00	-18.00	-11.00
6	F	3	4	2.00	1.00	1.00	2.00	-28.00	-32.00	-30.00	-27.00
7	F	3	5	2.00	3.00	.00	.00	-22.00	-16.00	-17.00	-20.00
8	F	3	6	3.00	10.00	1.00	1.00	-18.00	-14.00	-7.00	-13.00
9	F	3	2	.00	4.00	2.00	2.00	-20.00	-15.00	-23.00	-21.00
10	F	4	10	1.00	1.00	10.00	3.00	-19.00	-9.00	-4.00	2.00
11	F	5	8	2.00	8.00	14.00	10.00	3.00	1.00	1.00	21.00
12	F	5	12	7.00	7.00	10.00	11.00	-9.00	-7.00	-16.00	-11.00
13	F	5	9	10.00	2.00	4.00	.00	1.00	-19.00	-10.00	-18.00
14	F	6	14	30.00	29.00	.00	4.00	10.00	36.00	-8.00	-2.00
15	F	7	18	20.00	15.00	3.00	34.00	10.00	13.00	3.00	43.00
16	M	18	19	2.00	16.00	15.00	8.00	-12.00	11.00	3.00	5.00
17	M	19	12	16.00	17.00	6.00	2.00	26.00	29.00	-7.00	-18.00
18	F	20	21	9.00	16.00	7.00	13.00	11.00	41.00	-5.00	8.00
19	F	21	23	27.00	12.00	16.00	22.00	20.00	-13.00	-7.00	-6.00
20	M	21	31	19.00	44.00	22.00	25.00	38.00	54.00	47.00	36.00
21	M	21	9	4.00	3.00	12.00	4.00	-10.00	-16.00	11.00	-12.00
22	M	21	25	2.00	3.00	1.00	3.00	-21.00	-7.00	-15.00	-13.00
23	M	21	10	10.00	19.00	9.00	5.00	11.00	15.00	11.00	11.00
24	M	21	11	7.00	3.00	5.00	7.00	-15.00	-5.00	-11.00	-19.00
25	F	22	21	26.00	39.00	21.00	47.00	55.00	85.00	15.00	87.00
26	F	22	21	10.00	4.00	16.00	8.00	7.00	1.00	21.00	15.00
27	F	22	28	2.00	4.00	25.00	3.00	-3.00	-5.00	28.00	9.00
28	F	22	12	6.00	2.00	10.00	2.00	-11.00	-14.00	-5.00	-17.00
29	F	22	27	19.00	19.00	31.00	20.00	18.00	39.00	22.00	29.00
30	F	22	29	.00	4.00	4.00	20.00	-7.00	-5.00	12.00	12.00
31	F	22	29	30.00	25.00	29.00	19.00	71.00	74.00	57.00	51.00
32	F	22	21	2.00	2.00	2.00	10.00	-15.00	-20.00	-7.00	-4.00

Table AVI:3 Baseline and post drink scores on the positive and negative affectivity scales in each individual subject

ID	Sex	N	HA	+ affectivity depletion day am	+ affectivity placebo day am	+ affectivity depletion day pm	+ affectivity placebo day pm	- affectivity depletion day am	- affectivity placebo day am	- affectivity depletion day pm	- affectivity placebo day pm
1	M	1	4	37.00	41.00	32.00	37.00	10.00	11.00	10.00	10.00
2	M	1	3	24.00	33.00	24.00	20.00	10.00	11.00	10.00	10.00
3	M	2	2	30.00	26.00	23.00	23.00	10.00	10.00	10.00	10.00
4	M	2	5	39.00	40.00	39.00	40.00	13.00	12.00	12.00	10.00
5	M	2	7	34.00	30.00	24.00	23.00	10.00	11.00	10.00	10.00
6	F	3	4	45.00	48.00	47.00	49.00	10.00	10.00	10.00	10.00
7	F	3	5	41.00	41.00	33.00	39.00	10.00	10.00	10.00	10.00
8	F	3	6	27.00	25.00	22.00	23.00	10.00	10.00	10.00	10.00
9	F	3	2	30.00	31.00	29.00	22.00	10.00	10.00	10.00	10.00
10	F	4	10	35.00	29.00	32.00	19.00	10.00	10.00	10.00	10.00
11	F	5	8	42.00	34.00	33.00	33.00	12.00	10.00	10.00	10.00
12	F	5	12	32.00	19.00	28.00	20.00	10.00	10.00	10.00	10.00
13	F	5	9	31.00	34.00	29.00	38.00	10.00	10.00	10.00	10.00
14	F	6	14	29.00	29.00	27.00	21.00	10.00	10.00	10.00	10.00
15	F	7	18	23.00	29.00	19.00	14.00	15.00	13.00	10.00	14.00
16	M	18	19	39.00	31.00	34.00	32.00	10.00	10.00	10.00	10.00
17	M	19	12	26.00	18.00	30.00	35.00	11.00	11.00	10.00	10.00
18	F	20	21	21.00	16.00	20.00	21.00	10.00	10.00	10.00	10.00
19	F	21	23	19.00	24.00	24.00	22.00	11.00	10.00	10.00	10.00
20	M	21	31	19.00	15.00	22.00	23.00	21.00	16.00	10.00	11.00
21	M	21	9	35.00	35.00	32.00	35.00	10.00	10.00	10.00	10.00
22	M	21	25	32.00	33.00	31.00	30.00	11.00	11.00	10.00	10.00
23	M	21	10	19.00	22.00	16.00	20.00	10.00	12.00	10.00	10.00
24	M	21	11	36.00	37.00	27.00	37.00	10.00	11.00	10.00	10.00
25	F	22	21	19.00	13.00	15.00	14.00	19.00	25.00	19.00	20.00
26	F	22	21	28.00	23.00	17.00	22.00	11.00	11.00	10.00	10.00
27	F	22	28	36.00	34.00	27.00	30.00	10.00	10.00	10.00	10.00
28	F	22	12	35.00	33.00	22.00	27.00	11.00	10.00	10.00	10.00
29	F	22	27	14.00	18.00	12.00	11.00	11.00	10.00	11.00	10.00
30	F	22	29	30.00	33.00	27.00	19.00	10.00	10.00	10.00	10.00
31	F	22	29	14.00	26.00	22.00	27.00	14.00	22.00	11.00	11.00
32	F	22	21	34.00	38.00	23.00	19.00	10.00	10.00	10.00	10.00

Table AVI:4 Percentage change in plasma free and total plasma tryptophan in each individual subject & change scores on the BFS

ID	Sex	N	HA	Free % decrease depletion day	Free % increase placebo day	Total % decrease depletion day	Total % increase placebo day	BFS change depletion day	BFS change placebo day
1	M	1	4	93.74	-18.23	92.75	12.78	8.00	-1.00
2	M	1	3	92.87	-9.03	91.01	2.24	5.00	.00
3	M	2	2	85.85	2.24	84.67	65.19	2.00	-2.00
4	M	2	5	90.06	-26.26	83.85	26.59	-2.00	-4.00
5	M	2	7	.	.	.	.	.00	-2.00
6	F	3	4	90.77	21.07	88.32	31.33	-1.00	1.00
7	F	3	5	90.34	96.82	88.58	67.35	-2.00	-3.00
8	F	3	6	88.12	145.29	89.01	99.49	-2.00	-9.00
9	F	3	2	63.72	28.65	89.81	44.36	2.00	-2.00
10	F	4	10	88.72	5.56	88.33	43.42	9.00	2.00
11	F	5	8	90.26	24.47	85.61	41.52	12.00	2.00
12	F	5	12	75.83	109.59	64.63	69.03	3.00	4.00
13	F	5	9	78.73	38.90	84.84	41.35	-6.00	-2.00
14	F	6	14	87.02	111.59	83.75	56.03	-30.00	-25.00
15	F	7	18	88.24	105.74	86.16	142.87	-17.00	19.00
16	M	18	19	77.75	8.56	88.34	14.33	13.00	-8.00
17	M	19	12	90.17	162.81	91.58	144.80	-10.00	-15.00
18	F	20	21	90.84	17.11	90.88	21.66	-2.00	-3.00
19	F	21	23	5.83	155.16	87.30	124.39	-11.00	10.00
20	M	21	31	89.25	23.93	87.01	37.34	3.00	-19.00
21	M	21	9	86.33	19.14	88.13	28.81	8.00	1.00
22	M	21	25	84.25	203.92	88.32	158.56	-1.00	.00
23	M	21	10	79.66	21.41	89.17	-10.70	-1.00	-14.00
24	M	21	11	78.14	77.56	91.94	65.27	-2.00	4.00
25	F	22	21	89.66	50.80	89.24	60.12	-5.00	8.00
26	F	22	21	66.05	48.08	87.93	25.46	6.00	4.00
27	F	22	28	.	.	.	.	23.00	-1.00
28	F	22	12	87.50	51.77	89.13	70.37	4.00	.00
29	F	22	27	88.35	55.26	91.62	51.89	12.00	1.00
30	F	22	29	94.15	20.26	92.40	69.12	4.00	16.00
31	F	22	29	90.81	73.58	87.97	192.97	-1.00	-6.00
32	F	22	21	.	.	.	.	.00	8.00

Table AVI:5 Baseline and post drink scores on the BFS and the POMS in each individual subject

ID	Sex	N	HA	POMS change depletion day	POMS change placebo day	+ affectivity change depletion day	+ affectivity change placebo day	- affectivity change depletion day	- affectivity change placebo day
1	M	1	4	-3.00	-11.00	-5.00	-4.00	.00	-1.00
2	M	1	3	-8.00	-3.00	.00	-13.00	.00	-1.00
3	M	2	2	-3.00	.00	-7.00	-3.00	.00	.00
4	M	2	5	-9.00	-4.00	.00	.00	-1.00	-2.00
5	M	2	7	3.00	4.00	-10.00	-7.00	.00	-1.00
6	F	3	4	-2.00	5.00	2.00	1.00	.00	.00
7	F	3	5	5.00	-4.00	-8.00	-2.00	.00	.00
8	F	3	6	11.00	1.00	-5.00	-2.00	.00	.00
9	F	3	2	-3.00	-6.00	-1.00	-9.00	.00	.00
10	F	4	10	15.00	11.00	-3.00	-10.00	.00	.00
11	F	5	8	-2.00	20.00	-9.00	-1.00	-2.00	.00
12	F	5	12	-7.00	-4.00	-4.00	1.00	.00	.00
13	F	5	9	-11.00	1.00	-2.00	4.00	.00	.00
14	F	6	14	-18.00	-38.00	-2.00	-8.00	.00	.00
15	F	7	18	-7.00	30.00	-4.00	-15.00	-5.00	1.00
16	M	18	19	15.00	-6.00	-5.00	1.00	.00	.00
17	M	19	12	-33.00	-47.00	4.00	17.00	-1.00	-1.00
18	F	20	21	-16.00	-33.00	-1.00	5.00	.00	.00
19	F	21	23	-27.00	7.00	5.00	-2.00	-1.00	.00
20	M	21	31	9.00	-18.00	3.00	8.00	-11.00	-5.00
21	M	21	9	21.00	4.00	-3.00	.00	.00	.00
22	M	21	25	6.00	-6.00	-1.00	-3.00	-1.00	-1.00
23	M	21	10	.00	-4.00	-3.00	-2.00	.00	-2.00
24	M	21	11	4.00	-14.00	-9.00	.00	.00	-1.00
25	F	22	21	-40.00	2.00	-4.00	1.00	.00	-5.00
26	F	22	21	14.00	14.00	-11.00	-1.00	-1.00	-1.00
27	F	22	28	31.00	14.00	-9.00	-4.00	.00	.00
28	F	22	12	6.00	-3.00	-13.00	-6.00	-1.00	.00
29	F	22	27	4.00	-10.00	-2.00	-7.00	.00	.00
30	F	22	29	19.00	17.00	-3.00	-14.00	.00	.00
31	F	22	29	-14.00	-23.00	8.00	1.00	-3.00	-11.00
32	F	22	21	8.00	16.00	-11.00	-19.00	.00	.00

References

Abas, M. A., Sahakian, B. J., & Levy, R. (1990). Neuropsychological deficits and CT scan changes in elderly depressives. *Psychological Medicine, 20*(3), 507-20.

Abbott, F. V., Etienne, P., Franklin, K. B., Morgan, M. J., Sewitch, M. J., & Young, S. N. (1992). Acute tryptophan depletion blocks morphine analgesia in the cold-pressor test in humans. *Psychopharmacology, 108*(1-2), 60-6.

Åberg-Wistedt, A., Hasselmark, L., Stain-Malmgren, R., Apéria, B., Kjellman, B. F., & Mathé, A. A. (1998). Serotonergic 'vulnerability' in affective disorder: a study of the tryptophan depletion test and relationships between peripheral and central serotonin indexes in citalopram-responders. *Acta Psychiatrica Scandinavica, 97*, 374-380.

Aderibigbe, Y. A., Riley, W., Lewin, T., & Gureje, O. (1996). Factor structure of the 28-item General Health Questionnaire in a sample of antenatal women. *International Journal of Psychiatry in Medicine, 26*(3), 263-269.

Agren, H. (1980). Symptom patterns in unipolar and bipolar depression correlating with monoamine metabolites in the cerebrospinal fluid: II. Suicide. *Psychiatry Research, 3*(2), 225-36.

Agren, H., & Reibring, L. (1994). PET studies of presynaptic monoamine metabolism in depressed patients and healthy volunteers. *Pharmacopsychiatry, 27*(1), 2-6.

Allport, G. W. (1961). *Pattern and growth in personality*. New York ; London: Holt, Rinehart and Winston.

American Psychiatric Association. (1994). *Diagnostic and Statisitical Manual of Mental Disorders* (4th edition ed.). Washington D.C.

Anastasi, A. (1988). *Psychological testing* (6th edition ed.): New York : Macmillan London : Collier Macmillan.

Ansseau, M., Troisfontaines, B., Papart, P., & von Frenckell, R. (1991). Compulsive personality as predictor of response to serotoninergic antidepressants. *British Medical Journal, 303*, 760-671.

Argyle, M., & Crossland, J. (1987). The dimensions of positive emotions. *British Journal of Social Psychology, 26*, 127-137.

Argyle, M., Martin, M., & Lu, L. (1995). Testing for stress and happiness: The role of social and cognitive factors. In C. D. Spielberger & I. G. Sarason (Eds.), *Stress and Emotion* . Washington: Taylor & Francis.

Aronson, S. C., Black, J. E., McDougle, C. J., Scanley, B. E., Jatlow, P., Kosten, T. R., Heninger, G. R., & Price, L. H. (1995). Serotonergic mechanisms of cocaine effects in humans. *Psychopharmacology, 119*(2), 179-85.

Arora, R. C., & Meltzer, H. Y. (1989). Increased serotonin2 (5-HT2) receptor binding as measured by 3H-lysergic acid diethylamide (3H-LSD) in the blood platelets of depressed patients. *Life Sciences, 44*(11), 725-34.

Asberg, M., Schalling, D., Traskman-Bendz, L., & Wagner, A. (1987). Psychobiology of suicide, impulsivity, and related phenomena. In H. Y. Meltzer (Ed.), *Psychopharmacology: the third generation of progress* (pp. 655-668). New York: Raven Press.

Asberg, M., Thoren, P., Traskman, L., Bertilsson, L., & Ringberger, V. (1976). "Serotonin depression"--a biochemical subgroup within the affective disorders? *Science, 191*(4226), 478-80.

Asberg, M., & Wagner, A. (1986). Biochemical effects of antidepressant treatment--studies of monoamine metabolites in cerebrospinal fluid and platelet [3H]imipramine binding. *Ciba Foundation Symposium, 123*, 57-83.

Aschauer, H. N., Meszaros, K., Willinger, U., Fischer, G., Berger, P., Reiter, E., Lenzinger, E., & Berger, K. (1994). Tridimensional Personality Questionnaire - Some Results On the Validity of a German Version of the Questionnaire. *Neuropsychiatrie, 8*(3), 177-181.

Austin, M. P., Mitchell, P., & Goodwin, G. M. (2001). Cognitive deficits in depression - Possible implications for functional neuropathology. *British Journal of Psychiatry, 178*, 200-206.

Austin, M.-P., Ross, M., Murray, C., O'Carroll, R. E., Ebmeier, K. P., & Goodwin, G. M. (1992). Cognitive function in major depression. *Journal of Affective Disorders, 25*, 21-30.

Avia, M. D., Sanz, J., Sanchezbernardos, M. L., Martinezarias, M. R., Silva, F., & Grana, J. L. (1995). The 5-Factor Model .2. Relations of the Neo-Pi With Other Personality-Variables. *Personality and Individual Differences, 19*(1), 81-97.

Bagby, R. M., Joffe, R. T., Parker, J. D. A., Kalemba, V., & Harkness, K. L. (1995). Major depression and the five-factor model of personality. *Journal of Personality Disorders, 9*, 224-234.

Bagby, R. M., Levitan, R. D., Kennedy, S. H., Levitt, A. J., & Joffe, R. T. (1999). Selective alteration of personality in response to noradrenergic and serotonergic antidepressant medication in depressed sample: evidence of non-specificity. *Psychiatry Research, 86*(3), 211-6.

Bagby, R. M., Parker, J. D. A., & Joffe, R. T. (1992). Confirmatory factor analysis of the Tridimensional Personality Questionnaire. *Personality and Individual Differences, 13*, 1245-1246.

Banks, M. H. (1983). Validation of the General Health Questionnaire in a young community sample. *Psychological Medicine, 13*(2), 349-53.

Barr, L. C., Goodman, W. K., McDougle, C. J., Delgado, P. L., Heninger, G. R., Charney, D. S., & Price, L. H. (1994). Tryptophan depletion in

patients with obsessive-compulsive disorder who respond to serotonin reuptake inhibitors. *Archives of General Psychiatry, 51*, 309-317.

Barr, L. C., Heninger, G. R., Goodman, W., Charney, D. S., & Price, L. H. (1997). Effects of fluoxetine administration on mood response to tryptophan depletion in healthy subjects. *Biological Psychiatry, 41*, 949-954.

Barr, M. L., & Kiernan, J. A. (1993). *The human nervous system : an anatomical viewpoint*. Philadelphia: J.B. Lippincott.

Barrett, P., & Eysenck, S. (1984). The assessment of personality factors across 25 countries. *Personality and Individual Differences, 5*, 615-632.

Barrett, P. T., Petrides, K. V., Eysenck, S. B. G., & Eysenck, H. J. (1998). The Eysenck Personality Questionnaire: an examination of the factorial similarity of P, E, N, and L across 34 countries. *Personality and Individual Differences, 25*(5), 805-819.

Bartolic, E. I., Basso, M. R., Schefft, B. K., Glauser, T., & Titanic-Schefft, M. (1999). Effects of experimentally-induced emotional states on frontal lobe cognitive task performance. *Neuropsychologia, 37*(6), 677-83.

Bech, P., Gram, L. F., E., D., Jacobsen, O., Vitger, J., & Bolwig, T. G. (1975). Quantitative rating of depressive states. *Acta Psychiatrica Scandinavica, 51*, 161-170.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561-571.

Beedie, C. J., Terry, P. C., & Lane, A. M. (2000). The profile of mood states and athletic performance: Two meta- analyses. *Journal of Applied Sport Psychology, 12*(1), 49-68.

Bel, N., & Artigas, F. (1996). Reduction of serotonergic function in rat brain by tryptophan depletion: effects in control and fluvoxamine-treated rats. *Journal of Neurochemistry, 67*, 669-676.

Benjamin, J., Li, L., Patterson, C., Greenberg, B. D., Murphy, D. L., & Hamer, D. H. (1996). Population and familial association between the D4 dopamine receptor gene and measures of novelty seeking. *Nature Genetics, 12*, 81-84.

Benkelfat, C., Ellenbogen, M. A., Dean, P., Palmour, R. M., & Young, S. N. (1994). Mood-lowering effect of tryptophan depletion. *Archives of General Psychiatry, 51*, 687-697.

Benton, A. L., & Hamsher, K. (1978). *Multilingual Aphasia Examination Manual - Revised.* Iowa City: University of Iowa.

Berman, R. M., Narasimhan, M., Miller, H. L., Anand, A., Cappiello, A., Oren, D. A., Heninger, G. R., & Charney, D. S. (1999). Transient depressive relapse induced by catecholamine depletion. *Archives of General Psychiatry, 56*, 395-403.

Bhatti, T., Gillin, J. C., Seifritz, E., Moore, P., Clark, C., Golshan, S., Stahl, S., Rapaport, M., & Kelsoe, J. (1998). Effects of a tryptophan-free amino acid drink challenge on normal human sleep electroencephalogram and mood. *Biological Psychiatry, 43*(1), 52-9.

Biegon, A., Weizman, A., Karp, L., Ram, A., Tiano, S., & Wolff, M. (1987). Serotonin 5-HT2 receptor binding on blood platelets--a peripheral marker for depression? *Life Sciences, 41*(22), 2485-92.

Bjork, J. M., Dougherty, D. M., Moeller, F. G., Cherek, D. R., & Swann, A. C. (1999). The effects of tryptophan depletion and loading on laboratory aggression in men: time course and a food-restricted control. *Psychopharmacology, 142*(1), 24-30.

Bjork, J. M., Dougherty, D. M., Moeller, F. G., & Swann, A. C. (2000). Differential behavioral effects of plasma tryptophan depletion and

loading in aggressive and nonaggressive men. *Neuropsychopharmacology, 22*(4), 357-69.

Blackburn, I. M., Cameron, C. M., & Deary, I. J. (1990). Individual differences and response to the Velton Mood Induction Procedure. *Personality and Individual Differences, 11*, 725-731.

Block, J. (1978). *The Q-sort method in personality assessment and psychiatric research*. Palo Alto, CA: Consulting Psychologists Press cited by Block et al (1991).

Block, J., & Block, J. H. (1980). *The California Child Q-Set*. Palo Alto, CA: Consulting Psychologists Press cited by Block et al (1991).

Block, J. H., Gjerde, P. F., & Block, J. H. (1991). Personality antecedents of depressive tendencies in 18-year-olds: A proxpective study. *Journal of Personality and Social Psychology, 60*, 726-738.

Bolmont, B., Thullier, F., & Abraini, J. H. (2000). Relationships between mood states and performances in reaction time, psychomotor ability, and mental efficiency during a 31- day gradual decompression in a hypobaric chamber from sea level to 8848 m equivalent altitude. *Physiology & Behavior, 71*(5), 469-476.

Bouchard, T. J., Jr., Lykken, D. T., McGue, M., Segal, N. L., & Tellegen, A. (1990). Sources of human psychological differences: the Minnesota Study of Twins Reared Apart. *Science, 250*(4978), 223-8.

Boyer, W. F., & Feighner, J. P. (Eds.). (1996). *Efficacy of selective serotonin re-uptake inhibitors in acute depression*: John Wiley & sons.

Boyle, G. J. (1987). A Cross-Validation of the Factor Structure of the Profile of Mood States - Were the Factors Correctly Identified in the 1st Instance. *Psychological Reports, 60*(2), 343-354.

Bradburn, N. M. (1969). *The structure of psychological well-being*. Chicago: Aldine.

Brand, C. R. (1994). How Many Dimensions of Personality - the Big-5, the Gigantic-3 or the Comprehensive-6. *Psychologica Belgica, 34*(4), 257-273.

Brandstrom, S., Schlette, P., Przybeck, T. R., Lundberg, M., Forsgren, T., Sigvardsson, S., Nylander, P. O., Nilsson, L. G., Cloninger, R. C., & Adolfsson, R. (1998). Swedish normative data on personality using the temperament and character inventory. *Comprehensive Psychiatry, 39*(3), 122-128.

Bremner, J. D., Innis, R. B., Salomon, R. M., Staib, L. H., Ng, C. K., Miller, H. L., Bronen, R. A., Krystal, J. H., Duncan, J., Rich, D., Price, L. H., Malison, R., Dey, H., Soufer, R., & Charney, D. S. (1997). Positron emission tomography measurement of cerebral metabolic correlates of tryptophan depletion - induced depressive relapse. *Archives of General Psychiatry, 54*, 364-374.

Brien, S., Martin, C., & Bonner, A. (1997). Tryptophan metabolism during the menstrual cycle. *Biological Rhythm Research, 28*, 391-403.

Bryan, J., & Luszcz, M. A. (1999). Speed of information processing and working memory as mediators of age differences in prose recall. *Australian Psychologist, 34*(2), 132-137.

Bryan, J., Luszcz, M. A., & Pointer, S. (1999). Executive function and processing resources as predictors of adult age differences in the implementation of encoding strategies. *Aging Neuropsychology and Cognition, 6*(4), 273-287.

Buss, A. H. (1989). Personality as traits. *American Psychologist, 44*, 1378-1388.

Caldwell, J. A., Caldwell, J. L., Smythe, N. K., & Hall, K. K. (2000). A double-blind, placebo-controlled investigation of the efficacy of modafinil for sustaining the alertness and performance of aviators: a helicopter simulator study. *Psychopharmacology, 150*(3), 272-282.

Cannon, D. S., Clark, L. A., Leeka, J. K., & Keefe, C. K. (1993). A reanalysis of the tridimensional personality questionnaire (TPQ) and its relation to Cloninger's Type 2 Alcoholism. *Psychological Assessment, 5*(1), 62-66.

Cappiello, A., Sernyak, M. J., Malison, R. T., McDougle, C. J., Heninger, G. R., & Price, L. H. (1997). Effects of acute tryptophan depletion in lithium-remitted manic patients: A pilot study. *Biological Psychiatry, 42*, 1076-1078.

Carpenter, L. L., Anderson, G. M., Pelton, G. H., Gudin, J. A., Kirwin, P. D., Price, L. H., Heninger, G. R., & McDougle, C. J. (1998). Tryptophan depletion during continuous CSF sampling in healthy human subjects. *Neuropsychopharmacology, 19*(1), 26-35.

Caruso, J. C., & Cliff, N. (1997). An examination of the five-factor model of normal personality variation with reliable component analysis. *Personality and Individual Differences, 23*(2), 317-325.

Casper, R. C., Tollefson, G. D., & Nilsson, M. E. (2001). No gender differences in placebo responses of patients with major depressive disorder. *Biological Psychiatry, 49*(2), 158-160.

Cassidy, F., Murry, E., & Carroll, B. J. (1998). Tryptophan depletion in recently manic patients treated with lithium. *Biological Psychiatry, 43*(3), 230-2.

Cassidy, F., Murry, E., Weiner, R. D., & Carroll, B. J. (1997). Lack of relapse with tryptophan depletion following successful treatment with ECT. *American Journal of Psychiatry, 154*(8), 1151-2.

Cattell, R. B. (1973). *Personality and Mood by Questionnaire*: San Francisco, Jossey-Bass.

Cattell, R. B. (1996). The meaning and strategic use of factor analysis, *Handbook of Multivariate Experimental Pyschology* . Chicago: Rand McNally.

Cattell, R. B., Eber, H. W., & Tatsuoka, M. M. (1970). *Handbook for the sixteen personality factor questionnaire*. Champaign, IL: Institute for Personality and Ability Testing.

Channon, S. (1996). Executive dysfunction in depression: The Wisconsin Card Sorting Test. *Journal of Affective Disorders, 39*(2), 107-14.

Checkley, S. A., & Crammer, J. L. (1977). Hormone responses to methylamphetamine in depression: a new approach to the noradrenaline depletion hypothesis. *British Journal of Psychiatry, 131*, 582-6.

Checkley, S. A., Slade, A. P., & Shur, E. (1981). Growth hormone and other responses to clonidine in patients with endogenous depression. *British Journal of Psychiatry, 138*, 51-5.

Chien, A. J., & Dunner, D. L. (1996). The tridimensional personality questionnaire in depression: State versus trait issues. *Journal of Psychiatric Research, 30*, 21-27.

Child, D. (1990). *The essentials of factor analysis* (2nd ed ed.). London: Cassell.

Clayton, P. J., Ernst, C., & Angst, J. (1994). Premorbid personality traits of men who develop unipolar or bipolar disorders. *European Archives of Psychiatry and Clinical Neuroscience, 243*(6), 340-6.

Cleare, A. J., & Bond, A. J. (1995). The effect of tryptophan depletion and enhancement on subjective and behavioural aggression in normal male subjects. *Psychopharmacology (Berl), 118*(1), 72-81.

Cleare, A. J., Murray, R. M., & O'Keane, V. (1996). Reduced prolactin and cortisol responses to d-fenfluramine in depressed compared to healthy matched control subjects. *Neuropsychopharmacology, 14*(5), 349-54.

Cloninger, C. R. (1986). A unified biosocial theory of personality and its role in the development of anxiety states. *Psychiatric Developments, 3*(3), 167-226.

Cloninger, C. R. (1987). A systematic method for clinical description and classification of personality variants. A proposal. *Archives of General Psychiatry, 44*(6), 573-88.

Cloninger, C. R., Przybeck, T. R., & Svrakic, D. M. (1991). The Tridimensional Personality Questionnaire: U.S. normative data. *Psychological Reports, 69*(3 Pt 1), 1047-57.

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*, 975-990.

Coccaro, E. F., Kavoussi, R. J., Cooper, T. B., & Hauger, R. (1998). Acute tryptophan depletion attenuates the prolactin response to d-fenfluramine challenge in healthy human subjects. *Psychopharmacology, 138*(1), 9-15.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (Second Edition ed.). Hillsdale, New Jersey: Lawrence Erblaum Associates.

Cohen, R. M., Weingartner, H., Smallberg, S. A., Pickar, D., & Murphy, D. L. (1982). Effort and cognition in depression. *Archives of General Psychiatry, 39*(5), 593-7.

Collier, D. A., Arranz, M. J., Sham, P., Battersby, S., Vallada, H., Gill, P., Aitchison, K. J., Sodhi, M., Li, T., Roberts, G. W., Smith, B., Morton, J., Murray, R. M., Smith, D., & Kirov, G. (1996). The serotonin transporter is a potential susceptibility factor for bipolar affective disorder. *Neuroreport, 7*(10), 1675-9.

Conley, J. J. (1984). Longitudinal consistency of adult personality: self-reported psychological characteristics across 45 years. *Journal of Personality & Social Psychology, 47*(6), 1325-33.

Coppen, A., Eccleston, E. G., & Peet, M. (1973). Total and free tryptophan concentration in the plasma of depressive patients. *Lancet, 2*(7820), 60-3.

Coppen, A., Swade, C., & Wood, K. (1978). Platelet 5-hydroxytryptamine accumulation in depressive illness. *Clinica Chimica Acta, 87*(1), 165-8.

Costa, P. T., Jr., & McCrae, R. R. (1980). Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology, 38*, 668-678.

Costa, P. T., & McCrae, R. R. (1992a). 4 Ways 5 Factors Are Basic. *Personality and Individual Differences, 13*(6), 653-665.

Costa, P. T., & McCrae, R. R. (1992b). *Revised NEO Personality Inventory (NEO PI-R™) and NEO Five-Factor Inventory (NEO-FFI)*. Odessa: Psychological Assessment Resources, Inc.

Coull, J. T., Sahakian, B. J., Middleton, H. C., Young, A. H., Park, S. B., McShane, R. H., Cowen, P. J., & Robbins, T. W. (1995). Differential effects of clonidine, haloperidol, diazepam and tryptophan depletion on focused attention and attentional search. *Psychopharmacology, 121*(2), 222-30.

Cowdry, R. W., & Gardner, D. L. (1988). Pharmacotherapy of borderline personality disorder. Alprazolam, carbamazepine, trifluoperazine, and tranylcypromine. *Archives of General Psychiatry, 45*(2), 111-9.

Crawford, J. R., Bryan, J., Luszcz, M. A., Obonsawin, M. C., & Stewart, L. (2000). The executive decline hypothesis of cognitive aging: Do executive deficits qualify as differential deficits and do they mediate age-related memory decline? *Aging Neuropsychology and Cognition, 7*(1), 9-31.

Cronbach, L. J. (1990). *Essentials of psychological testing* (5th edition ed.). New York: Harper and Row.

Cull, A., Fry, A., Rush, R., & Steel, C. M. (2001). Cancer risk perceptions and distress among women attending a familial ovarian cancer clinic. *British Journal of Cancer, 84*(5), 594-599.

Cummings, J. L. (1992). Depression and Parkinson's disease: A review. *American Journal of Psychiatry, 4*, 443-454.

Curzon, G. (1979). Relationships between plasma, CSF and brain tryptophan. *Journal of Neural Transmission Suppl, 15*, 81-92.

Dantchev, N., & Widlocher, D. J. (1998). The measurement of retardation in depression. *Journal of Clinical Psychiatry, 59*(Suppl 14), 19-25.

De Fruyt, F., Van de Wiele, L., & Van Heeringen, C. (2000). Cloninger's psychobiological model of temperament and character and the five-factor model of personality. *Personality and Individual Differences, 29*(3), 441-452.

Deary, I. J., McCrimmon, R. J., & Bradshaw, J. (1997). Visual information processing and intelligence. *Intelligence, 24*, 461-479.

Debener, S., Beauducel, A., Nessler, D., Brocke, B., Heilemann, H., & Kayser, J. (2000). Is resting anterior EEG alpha asymmetry a trait marker for depression? Findings for healthy adults and clinically depressed patients. *Neuropsychobiology, 41*(1), 31-7.

Degl'Innocenti, A., Ågren, H., & Bäckman, L. (1998). Executive deficits in major depression. *Acta Psychiatrica Scandinavica, 97*, 182-188.

Delgado, P. L., Charney, D. S., Price, L. H., Aghajanian, G. K., Landis, H., & Heninger, G. R. (1990). Serotonin function and the mechanism of antidepressant action. *Archives of General Psychiatry, 47*, 411-418.

Delgado, P. L., Miller, H. L., Salomon, R. M., Licinio, J., Heninger, G. R., Gelenberg, A. J., & Charney, D. S. (1993). Monoamines and the mechanism of antidepressant action: effects of catecholamine depletion on mood of patients treated with antidepressants. *Psychopharmacology Bulletin, 29*, 389-396.

Delgado, P. L., Miller, H. L., Salomon, R. M., Licinio, J., Krystal, J. H., Moreno, F. A., Heninger, G. R., & Charney, D. S. (1999). Tryptophan-depletion challenge in depressed patients treated with desipramine or fluoxetine: implications for the role of serotonin in the mechanism of antidepressant action. *Biological Psychiatry, 46*(2), 212-20.

Delgado, P. L., Price, L. H., Miller, H. L., Salomon, R. M., Aghajanian, G. K., Heninger, G. R., & Charney, D. S. (1994). Serotonin and the neurobiology of depression. *Archives of General Psychiatry, 51*, 865-874.

Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioural and Brain Sciences, 22*, 491-569.

Derakshan, N., & Eysenck, M. W. (1997). Interpretive biases for one's own behavior and physiology in high-trait-anxious individuals and repressors. *Journal of Personality and Social Psychology, 73*(4), 816-825.

D'Haenen, H., Bossuyt, A., Mertens, J., Bossuyt-Piron, C., Gijsemans, M., & Kaufman, L. (1992). SPECT imaging of serotonin$_2$ receptors in depression. *Psychiatry Research, 45*, 227-237.

D'Haenen, H. A., & Bossuyt, A. (1994). Dopamine D2 receptors in depression measured with single photon emission computed tomography. *Biological Psychiatry, 35*(2), 128-32.

Diehl, D. J., & Gershon, S. (1992). The role of dopamine in mood disorders. *Comprehensive Psychiatry, 33*, 115-120.

Diener, E. (1999). Introduction to the special section on the structure of emotion. *Journal of Personality and Social Psychology, 76*(5), 803-804.

Dierks, T., Barta, S., Demisch, L., Schmeck, K., Englert, E., Kewitz, A., Maurer, K., & Poustka, F. (1999). Intensity dependence of auditory

evoked potentials (AEPs) as biological marker for cerebral serotonin levels: effects of tryptophan depletion in healthy subjects. *Psychopharmacology, 146*(1), 101-7.

Digman, J. M. (1990). Personality Structure - Emergence of the 5-Factor Model. *Annual Review of Psychology, 41*, 417-440.

DiLalla, D. L., Gottesman, II, Carey, G., & Bouchard, T. J., Jr. (1999). Heritability of MMPI Harris-Lingoes and Subtle-Obvious subscales in twins reared apart. *Assessment, 6*(4), 353-66.

Dougherty, D. M., Bjork, J. M., Marsh, D. M., & Moeller, F. G. (1999). Influence of trait hostility on tryptophan depletion-induced laboratory aggression. *Psychiatry Research, 88*(3), 227-32.

Draycott, S. G., & Kline, P. (1995). The Big Three or the Big Five - the EPQ-R vs the NEO-PI: a research note, replication and elaboration. *Personality and Individual Differences, 18*, 801-804.

Drevets, W. C., Videen, T. O., Macleod, A. K., Haller, J. W., & Raichle, M. E. (1992). Pet Images of Blood-Flow Changes During Anxiety - Correction. *Science, 256*(5064), 1696-1696.

Duggan, C. F., Lee, A. S., & Murray, R. M. (1990). Does personality predict long-term outcome in depression? *British Journal of Psychiatry, 157*, 19-24.

Earleywine, M. (1993). The Examination of Alternative Models Enhances Confirmatory Factor-Analyses. *Personality and Individual Differences, 15*(5), 593-594.

Earleywine, M., Finn, P. R., Peterson, J. B., & Pihl, R. O. (1992). Factor Structure and Correlates of the Tridimensional Personality Questionnaire. *Journal of Studies On Alcohol, 53*(3), 233-238.

Eaves, L. J., Eysenck, H. J., & Martin, N. G. (1989). *Genes, culture and personality : an empirical approach*. London: Academic Press.

Ebmeier, K. P., Deary, I. J., O'Carroll, R. E., Prentice, N., Moffoot, A. P. R., & Goodwin, G. M. (1994). Personality associations with the uptake of the cerebral blood flow marker ^{99m}Tc-Exametazime estimated with single photon emission tomography. *Personality and Individual Differences, 5*, 587-595.

Ebstein, R. P., Lerer, B., Shapira, B., Shemesh, Z., Moscovich, D. G., & Kindler, S. (1988). Cyclic AMP second-messenger signal amplification in depression. *British Journal of Psychiatry, 152*, 665-9.

Ebstein, R. P., Novick, O., Umansky, R., Priel, B., Osher, Y., Blaine, D., Bennett, E. R., Nemanov, L., Katz, M., & Belmaker, R. H. (1996). Dopamine D4 receptor (*D4DR*) exon III polymorphism associated with the human personality trait of novelty seeking. *Nature Genetics, 12*, 78-80.

Egan, V., Deary, I., & Austin, E. (2000). The NEO-FFI: emerging British norms and an item-level analysis suggest N, A and C are norms reliable than O and E. *Personality and Individual Differences, 29*(5), 907-920.

Ekman, P., Friesen, W. V., & Davidson, R. J. (1990). The Duchenne Smile - Emotional Expression and Brain Physiology .2. *Journal of Personality and Social Psychology, 58*(2), 342-353.

Ekselius, L., & Von Knorring, L. (1999). Changes in personality traits during treatment with sertraline or citalopram. *British Journal of Psychiatry, 174*, 444-8.

Ellenbogen, M. A., Young, S. N., Dean, P., Palmour, R. M., & Benkelfat, C. (1996). Mood response to acute tryptophan depletion in healthy volunteers: Sex differences and temporal stability. *Neuropsychopharmacology, 15*, 465-474.

Ellenbogen, M. A., Young, S. N., Dean, P., Palmour, R. M., & Benkelfat, C. (1999). Acute tryptophan depletion in healthy young women with a

family history of major affective disorder. *Psychological Medicine, 29*(1), 35-46.

Elliott, R., Sahakian, B. J., McKay, A. P., Herrod, J. J., Robbins, T. W., & Paykel, E. S. (1996). Neuropsychological impairments in unipolar depression: the influence of perceived failure on subsequent performance. *Psychological Medicine, 26*(5), 975-89.

Ellis, P. M., & Salmond, C. (1994). Is platelet imipramine binding reduced in depression? A meta-analysis [see comments]. *Biological Psychiatry, 36*(5), 292-9.

Enns, M. W., & Cox, B. J. (1997). Personality dimensions and depression: Review and commentary. *Canadian Journal of Psychiatry, 42*, 274-284.

Epstein, S. (1979). The stability of behavior: 1. On predicting most of the people much of the time. *Journal of Personality and Social Psychology, 37*, 1097-1126.

Epstein, S. (1980). The stability of behavior: II. Implications for psychological research. *American Psychologist, 35*, 790-806.

Eysenck, H. J. (1967). *The biological basis of personality*: Springfield, IL: Thomas.

Eysenck, H. J. (1969). *Personality structure and measurement*. London: Routledge and Kegan Paul.

Eysenck, H. J. (1991). Dimensions of Personality - 16, 5 or 3 - Criteria For a Taxonomic Paradigm. *Personality and Individual Differences, 12*(8), 773-790.

Eysenck, H. J. (1992). 4 Ways 5 Factors Are Not Basic. *Personality and Individual Differences, 13*(6), 667-673.

Eysenck, H. J., & Eysenck, S. B. G. (1975). *Manual of the Eysenck Personality Questionnaire (junior and adult)*. London: Hodder & Stoughton.

Eysenck, M. W. (2000). A cognitive approach to trait anxiety. *European Journal of Personality, 14*(5), 463-476.

Eysenck, S. B. G., Eysenck, H. J., & Barrett, P. (1985). A revised version of the psychotocism scale. *Personality and Individual Differences, 6*, 21-29.

Fahrenberg, J., Foerster, F., Schneider, H. J., Muller, W., & Myrtek, M. (1986). Predictability of individual differences in activation processes in a field setting based on laboratory measures. *Psychophysiology, 23*(3), 323-33.

Fahrenberg, J., Walschburger, P., Foerster, F., Myrtek, M., & Muller, W. (1983). An evaluation of trait, state, and reaction aspects of activation processes. *Psychophysiology, 20*(2), 188-95.

Feinberg, M., Feinberg, M., Carroll, B. J., Smouse, P. E., & Rawson, S. G. (1981). The Carroll rating scale for depression 3: Comparison with other rating instruments. *British Journal of Psychiatry, 138*, 205-209.

Fernstrom, J. D. (1977). Effects of the diet on brain neurotransmitters. *Metabolism, 26*(2), 207-23.

Fernstrom, J. D., & Wurtman, R. J. (1971). Brain serotonin content: physiological dependence on plasma tryptophan levels. *Science, 173*(992), 149-52.

Ferreri, M., Lavergne, F., Berlin, I., Payan, C., & Puech, A. J. (2001). Benefits from mianserin augmentation of fluoxetine in patients with major depression non-responders to fluoxetine alone. *Acta Psychiatrica Scandinavica, 103*(1), 66-72.

Fiske, D. W. (1949). Consistency of the factorial structures of personality ratings from different sources. *Journal of Abnormal and Social Psychology, 44*, 329-44.

Fox, N. A., & Davidson, R. J. (1988). Patterns of Brain Electrical-Activity During Facial Signs of Emotion in 10-Month-Old Infants. *Developmental Psychology, 24*(2), 230-236.

Fox, N. A., Henderson, H. A., Rubin, K. H., Calkins, S. D., & Schmidt, L. A. (2001). Continuity and discontinuity ol behavioral inhibition and exuberance: Psychophysiological and behavioral influences across the first four years of life. *Child Development, 72*(1), 1-21.

Francis, L. J. (1993). The Dual Nature of the Eysenckian Neuroticism Scales - a Question of Sex-Differences. *Personality and Individual Differences, 15*(1), 43-59.

Francis, L. J., & Wilcox, C. (1998). The relationship between Eysenck's personality dimensions and Bem's masculinity and femininity scales revisited. *Personality and Individual Differences, 25*(4), 683-687.

Frasure-Smith, N., Lesperance, F., & Talajic, M. (1995). Depression and 18-month prognosis after myocardial infarction. *Circulation, 91*(4), 999-1005.

Frazer, A., Brown, R., Kocsis, J., Caroff, S., Amsterdam, J., Winokur, A., Sweeney, J., & Stokes, P. (1986). Patterns of melatonin rhythms in depression. *Journal of Neural Transmission. Supplementum, 21*, 269-90.

Furnham, A., & Brewin, C. R. (1990). Personality and Happiness. *Personality and Individual Differences, 11*(10), 1093-1096.

Furnham, A., & Cheng, H. (1999). Personality as predictor of mental health and happiness in the East and West. *Personality and Individual Differences, 27*(3), 395-403.

Gale, A. (1973). The psychophysiology of individual differences: Studies of extraversion and the EEG. In P. Kline (Ed.), *New approaches in psychological measurement* . New York: Wiley.

Gale, A., & Eysenck, M. W. (1992). *Handbook of Individual Differences: Biological Perspectives*. Chichester: John Wiley & Sons.

Garcia-Sevilla, J. A., Zis, A. P., Hollingsworth, P. J., Greden, J. F., & Smith, C. B. (1981). Platelet alpha 2-adrenergic receptors in major depressive disorder. Binding of tritiated clonidine before and after tricyclic antidepressant drug treatment. *Archives of General Psychiatry, 38*(12), 1327-33.

Garvey, M. J., Noyes, R., Jr., Woodman, C., & Laukes, C. (1995). Relationship of generalized anxiety symptoms to urinary 5-hydroxyindoleacetic acid and vanillylmandelic acid. *Psychiatry Research, 57*(1), 1-5.

Gelfin, Y., Gorfine, M., & Lerer, B. (1998). Effect of clinical doses of fluoxetine on psychological variables in healthy volunteers. *American Journal of Psychiatry, 155*, 290-292.

Gerra, G., Zaimovic, A., Timpano, M., Zambelli, U., Delsignore, R., & Brambilla, F. (2000). Neuroendocrine correlates of temperamental traits in humans. *Psychoneuroendocrinology, 25*(5), 479-496.

Gershon, S., & Shaw, F. H. (1961). Psychiatric sequelae of chronic organophosphorus insecticides. *Lancet, 1*, 1371-1374.

Giancola, P. R., Zeichner, A., Newbolt, W. H., & Stennett, R. B. (1994). Construct-Validity of the Dimensions of Cloninger Tridimensional Personality Questionnaire. *Personality and Individual Differences, 17*(5), 627-636.

Goddard, A. W., Charney, D. S., Germine, M., Woods, S. W., Heninger, G. R., Krystal, J. H., Goodman, W. K., & Price, L. H. (1995). Effects of tryptophan depletion on responses to yohimbine in healthy human subjects. *Biological Psychiatry, 38*(2), 74-85.

Goddard, A. W., Sholomskas, D. E., Walton, K. E., Augeri, F. M., Charney, D. S., Heninger, G. R., Goodman, W. K., & Price, L. H. (1994). Effects

of tryptophan depletion in panic disorder. *Biological Psychiatry, 36*(11), 775-7.

Gold, A. E., Macleod, K. M., Frier, B. M., & Deary, I. J. (1995). Changes in Mood During Acute Hypoglycemia in Healthy Participants. *Journal of Personality and Social Psychology, 68*(3), 498-504.

Goldberg, D. (1978). *General Health Questionnaire*. Windsor: NFER Publishing Company.

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment, 4*, 26-42.

Golightly, K. L., Lloyd, J. A., Hobson, J. E., Gallagher, P., Mercer, G., & Young, A. H. (2001). Acute tryptophan depletion in schizophrenia. *Psychological Medicine, 31*(1), 75-84.

Gorenstein, C., Gentil, V., Melo, M., Lotufo-Nego, F., & Lauriano, V. (1998). Mood improvement in 'normal' volunteers. *Journal of Psychopharmacology, 12*, 246-251.

Gottfries, C. G., von Knorring, L., & Oreland, L. (1980). Platelet monoamine oxidase activity in mental disorders: 2. Affective psychoses and suicidal behavior. *Progress in Neuro-Psychopharmacology, 4*(2), 185-92.

Gray, J. A. (1981). A critique of Eysenck's theory of personality. In H. J. Eysenck (Ed.), *A model for personality* (pp. 246-276). Berlin Heidleberg New York: Springer-Verlag.

Gray, J. A. (1987). Perspectives on anxiety and impulsivity: A commentary. *Journal of Research in Personality, 21*, 493-509.

Gray, J. A. (1991). Neural systems, emotion and personality. In J. Madden (Ed.), *Neurobiology of learning, emotion and affect* (pp. 273-306). New York: Raven Press.

Gronwall, D., & Wrightson, P. (1981). Memory and information processing capacity after closed head injury. *Journal of Neurology, Neurosurgery & Psychiatry, 44*(10), 889-95.

Gronwall, D. M. (1977). Paced auditory serial-addition task: a measure of recovery from concussion. *Perceptual & Motor Skills, 44*(2), 367-73.

Gutierrez, F., Torrens, M., Boget, T., Martin-Santos, R., Sangorrin, J., Perez, G., & Salamero, M. (2001). Psychometric properties of the Temperament and Character Inventory (TCI) questionnaire in a Spanish psychiatric population. *Acta Psychiatrica Scandinavica, 103*(2), 143-147.

Hamilton, M. (1960). A Rating Scale for Depression. *Journal of Neurology, Neurosugery and Psychiatry, 23*, 56-62.

Han, K. H., Weed, N. C., & McNeal, T. P. (1996). Searching for conscientiousness on the MMPI-2. *Journal of Personality Assessment, 67*(2), 354-363.

Hansenne, M., Pitchot, W., Moreno, A. G., Machurot, P. Y., & Ansseau, M. (1998). The tridimensional personality questionnaire (TPQ) and depression. *European Psychiatry, 13*(2), 101-103.

Hansenne, M., Pitchot, W., Moreno, A. G., Reggers, J., Machurot, P.-Y., & Ansseau, M. (1997). Harm avoidance dimension of the tridimensional personality questionnaire and serotonin-1A activity in depressed patients. *Biological Psychiatry, 42*, 959-961.

Hansenne, M., Reggers, J., Pinto, E., Kjiri, K., Ajamier, A., & Ansseau, M. (1999). Temperament and character inventory (TCI) and depression. *Journal of Psychiatric Research, 33*(1), 31-6.

Hardy, L. (1999). Stress, anxiety and performance. *Journal of Science & Medicine in Sport, 2*(3), 227-33.

Healy, D., & Leonard, B. E. (1987). Monoamine transport in depression: kinetics and dynamics. *Journal of Affective Disorders, 12*(2), 91-103.

Hecht, H., van Calker, D., Berger, M., & von Zerssen, D. (1998). Personality in patients with affective disorders and their relatives. *Journal of Affective Disorders, 51*(1), 33-43.

Hedlung, J. L., & Vieweg, B. W. (1979). The Hamilton Rating Scale for Depression: a comprehensive review. *J. Oper Psychiatry, 10*, 149-165 cited by Thompson C (1989) The instruments of psychiatric research. John Wiley, Chichester.

Heilman, K. M. (1997). The neurobiology of emotional experience. *Journal of Neuropsychiatry & Clinical Neurosciences, 9*(3), 439-48.

Heinze, G., Rossel, L., Gabelic, I., Galeano-Munoz, J., Stabl, M., & Allen, S. R. (1993). Double-blind comparison of moclobemide and tranylcypromine in depression. *Pharmacopsychiatry, 26*(6), 240-5.

Henriques, J. B., & Davidson, R. J. (1991). Left frontal hypoactivation in depression. *Journal of Abnormal Psychology, 100*, 535-545.

Hills, P., & Argyle, M. (2001). Happiness, introversion-extraversion and happy introverts. *Personality and Individual Differences, 30*(4), 595-608.

Hindberg, I., & Naesh, O. (1992). Serotonin concentrations in plasma and variations during the menstrual cycle. *Clinical Chemistry, 38*, 2087-2089.

Hirschfeld, R. M. A., Klerman, G. L., Clayton, P. J., & Keller, M. B. (1983a). Personality and depression. Empirical findings. *Archives of General Psychiatry, 40*(9), 993-8.

Hirschfeld, R. M. A., Klerman, G. L., Clayton, P. J., Keller, M. B., McDonald-Scott, P., & Larkin, B. H. (1983b). Assessing personality: effects of the depressive state on trait measurement. *American Journal of Psychiatry, 140*(6), 695-9.

Hirschfeld, R. M. A., Klerman, G. L., Lavori, P., Keller, M. B., Griffith, P., & Coryell, W. (1989). Premorbid personality assessments of first onset of major depression. *Archives of General Psychiatry, 46*, 345-350.

Hofstee, W. K. B., Kiers, H. A. L., DeRaad, B., Goldberg, L. R., & Ostendorf, F. (1997). A comparison of big-five structures of personality traits in Dutch, English, and German. *European Journal of Personality, 11*(1), 15-31.

Holdwick, D. J., & Wingenfeld, S. A. (1999). The subjective experience of PASAT testing: Does the PASAT induce negative mood? *Archives of Clinical Neuropsychology, 14*(3), 273-284.

Holsboer, F., Von Bardeleben, U., Gerken, A., Stalla, G. K., & Muller, O. A. (1984). Blunted corticotropin and normal cortisol response to human corticotropin-releasing factor in depression [letter]. *New England Journal of Medicine, 311*(17), 1127.

Hosaka, T., Sugiyama, Y., Tokuda, Y., & Okuyama, T. (2000). Persistent effects of a structured psychiatric intervention on breast cancer patients' emotions. *Psychiatry and Clinical Neurosciences, 54*(5), 559-563.

Hotard, S. R., McFatter, R. M., McWhirter, R. M., & Stegall, M. E. (1989). Interactive Effects of Extraversion, Neuroticism, and Social Relationships On Subjective Well-Being. *Journal of Personality and Social Psychology, 57*(2), 321-331.

House, A., Knapp, P., Bamford, J., & Vail, A. (2001). Mortality at 12 and 24 months after stroke may be associated with depressive symptoms at 1 month. *Stroke, 32*(3), 696-701.

Hughes, J. H., Ashton, C. H., Matthews, D., & Young, A. H. (2000a). Acute depletion of plasma tryptophan does not alter electrophysiological variables in healthy males. *Psychopharmacology, 152*(1), 119-121.

Hughes, J. H., Dunne, F., & Young, A. H. (2000b). Effects of acute tryptophan depletion on mood and suicidal ideation in bipolar patients symptomatically stable on lithium. *British Journal of Psychiatry, 177*, 447-451.

Hughes, J. H., Stewart, M. E., Matthews, D., Kelly, T., & Young, A. H. (2001). Acute tryptophan depletion selectively alters neuropsychological function. *submitted to ?*

Hurny, C., Bernhard, J., Gelber, R. D., Coates, A., Castiglione, M., Isley, M., Dreher, D., Peterson, H., Goldhirsch, A., & Senn, H. J. (1992). Quality of life measures for patients receiving adjuvant therapy for breast cancer: an international trial. The International Breast Cancer Study Group. *European Journal of Cancer, 28*(1), 118-24.

Huwig-Poppe, C., Voderholzer, U., Backhaus, J., Riemann, D., Konig, A., & Hohagen, F. (1999). The tryptophan depletion test. Impact on sleep in healthy subjects and patients with obsessive-compulsive disorder. *Advances in Experimental Medicine & Biology, 467*, 35-42.

Jackson, D. N. (1976). *Manual, Jackson Personality Inventory*. Goshen, NY: Research psychologists press.

Jacobs, K. W., & Boze, M. M. (1993). Correlations Among Scales of the Beck Depression Inventory and the Profile of Mood States. *Psychological Reports, 73*(2), 431-434.

Jang, K. L., McCrae, R. R., Angleitner, A., Riemann, R., & Livesley, W. J. (1998). Heritability of facet-level traits in a cross-cultural twin sample: support for a hierarchical model of personality. *Journal of Personality & Social Psychology, 74*(6), 1556-65.

Janke, W., Debus, G., Erdmann, G., & Huppe, M. (1995). *Befindlichkeitsskalierung anhand von Kategorien und Eigenschafen.* Wurzburg: Unpublished manual. Cited by Krebs et al (1998).

Janowski, D. S., & Risch, S. C. (1987). Role of acetylcholin mechanisms in the affective disorders. In H. Y. Meltzer (Ed.), *Psychopharmacology: the third generation of progress* (pp. 527-533). New York: Raven Press.

Jennrich, C., & Sampson, P. F. (1966). Rotation for simple loadings. *Psychometrika, 31*, 313-323 cited in [Kline, 1993 #800].

Johnson, D. L., Wiebe, J. S., Gold, S. M., Andreasen, N. C., Hichwa, R. D., Watkins, G. L., & Boles Ponto, L. L. (1999). Cerebral blood flow and personality: a positron emission tomography study. *American Journal of Psychiatry, 156*(2), 252-7.

Jorm, A. F. (1987). Sex differences in neuroticism: a quantitative synthesis of published research. *Australian & New Zealand Journal of Psychiatry, 21*(4), 501-6.

Joseph, M. H., Kadam, B. V., & Sanders, D. (1981). A simple device using disposable tubes for ultrafiltration of small samples for protein binding studies. *Laboratory Practice, 30*, 348-349.

Joyce, P. R. (1985). Mood response to methylphenidate and the Dexamethasone Suppression Test as predictors of treatment response to zimelidine and lithium in major depression. *Biological Psychiatry, 20*(6), 598-604.

Joyce, P. R., Mulder, R. T., & Cloninger, C. R. (1994). Temperament predicts clomipramine and desipramine response in major depression. *Journal of Affective Disorders, 30*, 35-46.

Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika, 23*, 187-200 cited by (Kline, 1994).

Kardum, I., & Hudek-Knezevic, J. (1996). The relationship between Eysenck's personality traits, coping styles and moods. *Personality and Individual Differences, 20*, 341-350.

Katigbak, M. S., Church, A. T., & Akamine, T. X. (1996). Cross-cultural generalizability of personality dimensions: relating indigenous and imported dimensions in two cultures. *Journal of Personality & Social Psychology, 70*(1), 99-114.

Kaye, W. H., Gendall, K. A., Fernstrom, M. H., Fernstrom, J. D., McConaha, C. W., & Weltzin, T. E. (2000). Effects of acute tryptophan depletion on mood in bulimia nervosa. *Biological Psychiatry, 47*(2), 151-7.

Kaye, W. H., Greeno, C. G., Moss, H., Fernstrom, J., Fernstrom, M., Lilenfeld, L. R., Weltzin, T. E., & Mann, J. J. (1998). Alterations in serotonin activity and psychiatric symptoms after recovery from bulimia nervosa. *Archives of General Psychiatry, 55*(10), 927-35.

Kendler, K. S., Neale, M. C., Kessler, R. C., Heath, A. C., & Eaves, L. J. (1993). A longitudinal twin study of personality and major depression in women. *Archives of General Psychiatry, 50*(11), 853-62.

Kennedymoore, E., Greenberg, M. A., Newman, M. G., & Stone, A. A. (1992). The Relationship Between Daily Events and Mood - the Mood Measure May Matter. *Motivation and Emotion, 16*(2), 143-155.

Kent, J. M., Coplan, J. D., Martinez, J., Karmally, W., Papp, L. A., & Gorman, J. M. (1996). Ventilatory effects of tryptophan depletion in panic disorder: a preliminary report. *Psychiatry Research, 64*(2), 83-90.

Kerr, T. A., Schapira, K., Roth, M., & Garside, R. F. (1970). The relationship between the Maudsley Personality Inventory and the course of affective disorders. *British Journal of Psychiatry, 116*, 11-19.

Killgore, W. D. S. (2000). Evidence for a third factor on the positive and negative affect schedule in a college student sample. *Perceptual and Motor Skills, 90*(1), 147-152.

Kimura, D. (1969). Spatial localization in left and right visual fields. *Canadian Journal of Psychology, 23*(6), 445-58.

Klaassen, T., Klumperbeek, J., Deutz, N. E., van Praag, H. M., & Griez, E. (1998). Effects of tryptophan depletion on anxiety and on panic provoked by carbon dioxide challenge. *Psychiatry Research, 77*(3), 167-74.

Klaassen, T., Riedel, W. J., Deutz, N. E., van Someren, A., & van Praag, H. M. (1999a). Specificity of the tryptophan depletion method. *Psychopharmacology, 141*(3), 279-86.

Klaassen, T., Riedel, W. J., van Someren, A., Deutz, N. E., Honig, A., & van Praag, H. M. (1999b). Mood effects of 24-hour tryptophan depletion in healthy first-degree relatives of patients with affective disorders. *Biological Psychiatry, 46*(4), 489-97.

Kleifield, E. I., Sunday, S., Hurt, S., & Halmi, K. A. (1994). The tridimensional personality questionnaire: An exploration of personality traits in eating disorders. *Journal of Psychiatric Research, f5*, 413-423.

Kline, P. (1993). *The Handbook of Psychological Testing*. London: Routledge.

Kline, P. (1994). *An easy guide to factor analysis*. London: Routledge.

Kline, P. (2000). *The Handbook of Psychological Testing* (2nd edition ed.). London: Routledge.

Kline, P., & Barrett, P. (1983). The factors in personality questionnaires among normal subjects. *Advances in Behavioural Research and Therapy, 5*, 141-202.

Knott, P. J., & Curzon, G. (1972). Free tryptophan in plasma and brain tryptophan metabolism. *Nature, 239*(5373), 452-3.

Knott, V. J., Howson, A. L., Perugini, M., Ravindran, A. V., & Young, S. N. (1999). The effect of acute tryptophan depletion and fenfluramine on quantitative EEG and mood in healthy male subjects. *Biological Psychiatry, 46*(2), 229-38.

Knutson, B., Wolkowitz, O. M., Cole, S. W., Chan, T., Moore, E. A., Johnson, R. C., Terpstra, J., Turner, R. A., & Reus, V. I. (1998). Selective alteration of personality and social behavior by serotonergic intervention. *American Journal of Psychiatry, 155*, 373-379.

Kocsis, J. H., Mason, B. J., Frances, A. J., Sweeney, J., Mann, J. J., & Marin, D. (1989). Prediction of response of chronic depression to imipramine. *Journal of Affective Disorders, 17*(3), 255-60.

Koszycki, D., Zacharko, R. M., Le Melledo, J. M., Young, S. N., & Bradwejn, J. (1996). Effect of acute tryptophan depletion on behavioral, cardiovascular, and hormonal sensitivity to cholecystokinin-tetrapeptide challenge in healthy volunteers. *Biological Psychiatry, 40*(7), 648-55.

Kozeny, J., & Hoschl, C. (1999). The temperament and character inventory: Psychometric integrity of the Czech version. *Studia Psychologica, 41*(2), 123-132.

Krahn, L. E., Lu, P. Y., Klee, G., Delgado, P. R., Lin, S.-C., & Zimmermann, R. C. (1996). Examining serotonin function: A modified technique for rapid tryptophan depletion. *Neuropsychopharmacology, 15*, 325-328.

Krebs, H., Weyers, P., & Janke, W. (1998). Validation of the German version of Cloninger's TPQ: Replication and correlations with stress coping, mood measures and drug use. *Personality and Individual Differences, 24*(6), 805-814.

Kuikka, J. T., Tiihonen, J., Bergström, K. A., Karhu, J., Hartikainen, P., Viinamäki, H., Länsimies, E., Lehtonen, J., & Hakola, P. (1995). Imaging of serotonin and dopamine transporters in the living human brain. *European Journal of Nuclear Medicine, 22*, 346-350.

Kvaal, S. A., & Patodia, S. (2000). Relations among Positive Affect, Negative Affect, and somatic symptoms in a medically ill patient sample. *Psychological Reports, 87*(1), 227-233.

Laakmann, G., Zygan, K., Schoen, H. W., Weiss, A., Wittmann, M., Meissner, R., & Blaschke, D. (1986). Effect of receptor blockers (methysergide, propranolol, phentolamine, yohimbine and prazosin) on desimipramine-induced pituitary hormone stimulation in humans--I. Growth hormone. *Psychoneuroendocrinology, 11*(4), 447-61.

Lam, R. W., Bowering, T. A., Tam, E. M., Grewal, A., Yatham, L. N., Shiah, I. S., & Zis, A. P. (2000). Effects of rapid tryptophan depletion in patients with seasonal affective disorder in natural summer remission. *Psychological Medicine, 30*(1), 79-87.

Lam, R. W., Zis, A. P., Grewal, A., Delgado, P. L., Charney, D. S., & Krystal, J. H. (1996). Effects of rapid tryptophan depletion in patients with seasonal affective disorder in remission after light therapy. *Archives of General Psychiatry, 53*(1), 41-4.

Langer, G., Heinze, G., Reim, B., & Matussek, N. (1976). Reduced growth hormone responses to amphetamine in "endogenous" depressive patients: studies in normal, "reactive" and "endogenous" depressive, schizophrenic, and chronic alcoholic subjects. *Archives of General Psychiatry, 33*(12), 1471-5.

Larsen, R. J., & Ketelaar, T. (1989). Extraversion, Neuroticism and Susceptibility to Positive and Negative Mood Induction Procedures. *Personality and Individual Differences, 10*(12), 1221-1228.

Le Bon, O., Staner, L., Tecco, J., Pull, C., & Pelc, I. (1998). Tridimensional personality questionnaire (TPQ): Validation of a French-speaking control population. *Encephale-Revue De Psychiatrie Clinique Biologique Et Therapeutique, 24*(1), 40-45.

Lechin, F., van der Dijs, B., Orozco, B., Lechin, A. E., Baez, S., Lechin, M. E., Rada, I., Acosta, E., Arocha, L., Jimenez, V., & et al. (1995). Plasma neurotransmitters, blood pressure, and heart rate during supine resting, orthostasis, and moderate exercise in dysthymic depressed patients. *Biological Psychiatry, 37*(12), 884-91.

Leibenluft, E., Noonan, B. M., & Wehr, T. A. (1992). Diurnal-Variation - Reliability of Measurement and Relationship to Typical and Atypical Symptoms of Depression. *Journal of Affective Disorders, 26*(3), 199-204.

LeMarquand, D. G., Benkelfat, C., Pihl, R. O., Palmour, R. M., & Young, S. N. (1999). Behavioral disinhibition induced by tryptophan depletion in nonalcoholic young men with multigenerational family histories of paternal alcoholism. *American Journal of Psychiatry, 156*(11), 1771-9.

LeMarquand, D. G., Pihl, R. O., Young, S. N., Tremblay, R. E., Seguin, J. R., Palmour, R. M., & Benkelfat, C. (1998). Tryptophan depletion, executive functions, and disinhibition in aggressive, adolescent males. *Neuropsychopharmacology, 19*(4), 333-41.

Lemke, M. R., Puhl, P., Koethe, N., & Winkler, T. (1999). Psychomotor retardation and anhedonia in depression. *Acta Psychiatrica Scandinavica, 99*(4), 252-6.

Leng, G. C. (1994). Depression following myocardial infarction. *Lancet, 343*, 2-3.

Lenzinger, E., Neumeister, A., Praschak-Rieder, N., Fuchs, K., Gerhard, E., Willeit, M., Sieghart, W., Kasper, S. F., Hornik, K., & Aschauer, H. N. (1999). Behavioral effects of tryptophan depletion in seasonal affective disorder associated with the serotonin transporter gene? *Psychiatry Research, 85*(3), 241-6.

Lepine, J. P., Pelissolo, A., Teodorescu, R., & Teherani, M. (1994). Psychometric Properties of the French Version of the Tridimensional Personality Questionnaire (Tpq). *Encephale-Revue De Psychiatrie Clinique Biologique Et Therapeutique, 20*(6), 747-753.

Lerer, B., Shapira, B., Calev, A., Tubi, N., Drexler, H., Kindler, S., Lidsky, D., & Schwartz, J. E. (1995). Antidepressant and Cognitive Effects of Twice-Weekly Versus 3- Times-Weekly Ect. *American Journal of Psychiatry, 152*(4), 564-570.

Lesch, K. P., Aulakh, C. S., & Murphy, D. L. (1992). 5-HT1A receptor sensitivity in depression and anxiety disorders: molecular mechanisms of neuroadaption. *Clinical Neuropharmacology, 15*(Suppl 1 Pt A), 208A-209A.

Lesch, K. P., Mayer, S., Disselkamp-Tietze, J., Hoh, A., Schoellnhammer, G., & Schulte, H. M. (1990). Subsensitivity of the 5-hydroxytryptamine1A (5-HT1A) receptor-mediated hypothermic response to ipsapirone in unipolar depression. *Life Sciences, 46*(18), 1271-7.

Lesch, K.-P., Bengel, D., Heils, A., Sabol, S. Z., Greenberg, B. D., Petri, S., Benjamin, J., Müller, C. R., Hamer, D. H., & Murphy, D. L. (1996). Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science, 274*, 1527-1531.

LeUnes, A., & Burger, J. (2000). Profile of mood states research in sport and exercise psychology: Past, present, and future. *Journal of Applied Sport Psychology, 12*(1), 5-15.

Leyton, M., Ghadirian, A. M., Young, S. N., Palmour, R. M., Blier, P., Helmers, K. F., & Benkelfat, C. (2000). Depressive relapse following acute tryptophan depletion in patients with major depressive disorder. *Journal of Psychopharmacology, 14*(3), 284-287.

Leyton, M., Young, S. N., Blier, P., Ellenbogen, M. A., Palmour, R. M., Ghadirian, A.-M., & Benkelfat, C. (1997). The effect of tryptophan depletion on mood in medication-free, former patients with major affective disorder. *Neuropsychopharmacology, 16*, 294-297.

Leyton, M., Young, S. N., Pihl, R. O., Etezadi, S., Lauze, C., Blier, P., Baker, G. B., & Benkelfat, C. (1999). A comparison of the effects of acute tryptophan depletion and acute phenylalanine/tyrosine depletion in healthy women. *Advances in Experimental Medicine & Biology, 467*, 67-71.

Lindgren, K. N., Masten, V. L., Tiburzi, M. J., Ford, D. P., & Bleecker, M. L. (1999). The factor structure of the profile of mood states (POMS) and its relationship to occupational lead exposure. *Journal of Occupational and Environmental Medicine, 41*(1), 3-10.

Loehlin, J. C. (1992). *Genes and environment in personality development.* Newbury Park, CA: Sage.

Lucas, R. E., Diener, E., Grob, A., Suh, E. M., & Shao, L. (2000). Cross-cultural evidence for the fundamental features of extraversion. *Journal of Personality and Social Psychology, 79*(3), 452-468.

Lucca, A., Lucini, V., Piatti, E., Ronchi, P., & Smeraldi, E. (1992). Plasma tryptophan levels and plasma tryptophan/neutral amino acids ratio in patients with mood disorder, patients with obsessive-compulsive disorder and normal subjects. *Psychiatry Research, 44*, 85-91.

Luu, P., Collins, P., & Tucker, D. M. (2000). Mood, personality, and self-monitoring: negative affect and emotionality in relation to frontal lobe mechanisms of error monitoring. *Journal of Experimental Psychology: General, 129*(1), 43-60.

Lydiard, R. B., Stahl, S. M., Hertzman, M., & Harrison, W. M. (1997). A double-blind, placebo-controlled study comparing the effects of sertraline versus amitriptyline in the treatment of major depression. *Journal of Clinical Psychiatry, 58*(11), 484-491.

Maayan, R., Yagorowski, Y., Grupper, D., Weiss, M., Shtaif, B., Abou Kaoud, M., & Weizman, A. (2000). Basal plasma dehydroepiandrosterone sulfate level: A possible predictor for response to electroconvulsive therapy in depressed psychotic inpatients. *Biological Psychiatry, 48*(7), 693-701.

Malison, R. T., Price, L. H., Berman, R., van Dyck, C. H., Pelton, G. H., Carpenter, L., Sanacora, G., Owens, M. J., Nemeroff, C. B., Rajeevan, N., Baldwin, R. M., Seibyl, J. P., Innis, R. B., & Charney, D. S. (1998). Reduced brain serotonin transporter availability in major depression

as measured by [123I]-2 beta-carbomethoxy-3 beta-(4-iodophenyl)tropane and single photon emission computed tomography [see comments]. *Biological Psychiatry, 44*(11), 1090-8.

Marshall, E. F., Kennedy, W. N., & Eccleston, D. (1987). Whole blood serotonin and plasma tryptophan using high-pressure liquid chromatography with electrochemical detection. *Biochemical Medicine and Metabolic Biology, 37*, 81-86.

Martin, D. T., Andersen, M. B., & Gates, W. (2000). Using Profile of Mood States (POMS) to monitor high-intensity training in cyclists: Group versus case studies. *Sport Psychologist, 14*(2), 138-156.

Massman, P. J., Delis, D. C., Butters, N., Dupont, R. M., & Gillin, J. C. (1992). The subcortical dysfunction hypothesis of memory deficits in depression: neuropsychological validation in a subgroup of patients. *Journal of Clinical and Experimental Neuropsychology, 14*(5), 687-706.

Mathew, R. J., Weinman, M. L., & Barr, D. L. (1984). Personality and regional cerebral blood flow. *British Journal of Psychiatry, 144*, 529-32.

Matthews, G., & Amelang, M. (1993). Extraversion, arousal theory and performance: A study of individual differences in the EEG. *Personality and Individual Differences, 14*, 347-363.

Matthews, G., & Deary, I. J. (1998). *Personality Traits*. Cambridge, U.K.: Cambridge University Press.

Matthews, G., & Gilliland, K. (1999). The personality theories of H.J. Eysenck and J.A. Gray: a comparative review. *Personality and Individual Differences, 26*, 583-626.

Matthews, G., Jones, D. M., & Chamberlain, A. G. (1990). Refining the measurement of mood: The UWIST Mood Adjective Checklist. *British Journal of Psychology, 81*, 17-42.

Mazzanti, C., Lappalainen, J., Long, J. C., Naukkarinen, H., Eggert, M., Virkkunen, M., Linnoila, M., & Goldman, D. (1998). Sib-pair linkage and association analysis of the serotonin transporter promoter polymorphism and TPQ personality traits. *American Journal of Medical Genetics, 81*(6), 487-488.

McCabe, S. B., Gotlib, I. H., & Martin, R. A. (2000). Cognitive vulnerability for depression: Deployment of attention as a function of history of depression and current mood state. *Cognitive Therapy and Research, 24*(4), 427-444.

McCrimmon, R. J., Deary, I. J., Huntly, B. J. P., MacLeod, K. J., & Frier, B. M. (1996). Visual information processing during controlled hypoglycaemia in humans. *Brain, 119*(Pt 4), 1277-87.

McDougle, C. J., Naylor, S. T., Cohen, D. J., Aghajanian, G. K., Heninger, G. R., & Price, L. H. (1996). Effects of tryptophan depletion in drug-free adults with autistic disorder. *Archives of General Psychiatry, 53*(11), 993-1000.

McDougle, C. J., Naylor, S. T., Goodman, W. K., Volkmar, F. R., Cohen, D. J., & Price, L. H. (1993). Acute tryptophan depletion in autistic disorder: a controlled case study. *Biological Psychiatry, 33*(7), 547-50.

McFatter, R. M. (1994). Interactions in Predicting Mood From Extroversion and Neuroticism. *Journal of Personality and Social Psychology, 66*(3), 570-578.

McIlroy, D., Bunting, B., & Adamson, G. (2000). An evaluation of the factor structure and predictive utility of a test anxiety scale with reference to students' past performance and personality indices. *British Journal of Educational Psychology, 70*(Pt 1), 17-32.

McKeith, I. G., Marshall, E. F., Ferrier, I. N., Armstrong, M. M., Kennedy, W. N., Perry, R. H., Perry, E. K., & Eccleston, D. (1987). 5-HT receptor binding in post-mortem brain from patients with affective disorder. *Journal of Affective Disorders, 13*(1), 67-74.

McMahon, F. J., Stine, O. C., Chase, G. A., Meyers, D. A., Simpson, S. G., & DePaulo, J. R., Jr. (1994). Influence of clinical subtype, sex, and lineality on age at onset of major affective disorder in a family sample [see comments]. *American Journal of Psychiatry, 151*(2), 210-5.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1992). *Profile of Mood States (Revised)*. San Diego: EdITS/Educational and Industrial Testing Service.

McTavish, S. F. B., Cowen, P. J., & Sharp, T. (1999). Effect of a tyrosine-free amino acid mixture on regional brain catecholamine synthesis and release. *Psychopharmacology, 141*(2), 182-8.

Meltzer, H. Y., Umberkoman-Wiita, B., Robertson, A., Tricou, B. J., Lowy, M., & Perline, R. (1984). Effect of 5-hydroxytryptophan on serum cortisol levels in major affective disorders. I. Enhanced response in depression and mania. *Archives of General Psychiatry, 41*(4), 366-74.

Menkes, D. B., Coates, D. C., & Fawcett, J. P. (1994). Acute tryptophan depletion aggravates premenstrual syndrome. *Journal of Affective Disorders, 32*(1), 37-44.

Miceli, G., Caltagirone, C., Gainotti, G., Masullo, C., & Silveri, M. C. (1981). Neuropsychological correlates of localized cerebral lesions in non-aphasic brain-damaged patients. *Journal of Clinical Neuropsychology, 3*(1), 53-63.

Mielke, J. B., & Hall, S. (1998). Anxiety level and performance on the paced auditory serial addition task, the aural sequential paced arithmetic test and the visual sequential paced arithmetic test. *Archives of Clinical Neuropsychology, 13*(1), 90-90.

Miller, E. N., Fujioka, T. A., Chapman, L. J., & Chapman, J. P. (1995). Hemispheric asymmetries of function in patients with major affective disorders. *Journal of Psychiatric Research, 29*(3), 173-83.

Miller, H. E., Deakin, J. F., & Anderson, I. M. (2000). Effect of acute tryptophan depletion on CO2-induced anxiety in patients with panic disorder and normal volunteers. *British Journal of Psychiatry, 176*, 182-8.

Miller, H. L., Delgado, P. L., Salomon, R. M., Berman, R., Krystal, J. H., Heninger, G. R., & Charney, D. S. (1996). Clinical and biochemical effects of catecholamine depletion on antidepressant-induced remission of depression. *Archives of General Psychiatry, 53*(2), 117-28.

Miller, H. L., Delgado, P. L., Salomon, R. M., Licinio, J., Barr, L. C., & Charney, D. S. (1992). Acute tryptophan depletion: a method of studying antidepressant action. *Journal of Clinical Psychiatry, 53 Suppl*, 28-35.

Mockel, M., Rocker, L., Stork, T., Vollert, J., Danne, O., Eichstadt, H., Muller, R., & Hochrein, H. (1994). Immediate physiological responses of healthy volunteers to different types of music: cardiovascular, hormonal and mental changes [published erratum appears in Eur J Appl Physiol 1994;69(3):274]. *European Journal of Applied Physiology & Occupational Physiology, 68*(6), 451-9.

Moeller, F. G., Dougherty, D. M., Swann, A. C., Collins, D., Davis, C. M., & Cherek, D. R. (1996). Tryptophan depletion and aggressive responding in healthy males. *Psychopharmacology, 126*, 97-103.

Moffoot, A. P., O'Carroll, R. E., Bennie, J., Carroll, S., Dick, H., Ebmeier, K. P., & Goodwin, G. M. (1994). Diurnal variation of mood and neuropsychological function in major depression with melancholia. *Journal of Affective Disorders, 32*(4), 257-69.

Moja, E. A., Cipolla, P., Castoldi, D., & Tofanetti, O. (1989). Dose-response decrease in plasma tryptophan and in brain tryptophan and serotonin after tryptophan-free amino acid mixtures in rats. *Life Sciences, 44*(14), 971-6.

Moja, E. A., Rocchi, E., Benedetti, F., Paolillo, F., Casalgrandi, G., & Ponz de Leon, M. (1991). Decrease in plasma tryptophan after a tryptophan-free amino acid solution. A comparison between cirrhotic and control subjects. *Life Sciences, 48*(5), 409-18.

Monteiro-dos-Santos, P. C., Graeff, F. G., dos-Santos, J. E., Ribeiro, R. P., Guimaraes, F. S., & Zuardi, A. W. (2000). Effects of tryptophan depletion on anxiety induced by simulated public speaking. *Brazilian Journal of Medical & Biological Research, 33*(5), 581-7.

Montgomery, S. A., & Asberg, M. (1979). A new depression scale designed to be sensitive to change. *British Journal of Psychiatry, 134*, 382-389.

Moore, P., Gillin, C., Bhatti, T., DeModena, A., Seifritz, E., Clark, C., Stahl, S., Rapaport, M., & Kelsoe, J. (1998). Rapid tryptophan depletion, sleep electroencephalogram, and mood in men with remitted depression on serotonin reuptake inhibitors. *Archives of General Psychiatry, 55*(6), 534-9.

Moore, P., Landolt, H. P., Seifritz, E., Clark, C., Bhatti, T., Kelsoe, J., Rapaport, M., & Gillin, J. C. (2000). Clinical and physiological consequences of rapid tryptophan depletion. *Neuropsychopharmacology, 23*(6), 601-622.

Moreno, F. A., Gelenberg, A. J., Heninger, G. R., Potter, R. L., McKnight, K. M., Allen, J., Phillips, A. P., & Delgado, P. L. (1999). Tryptophan depletion and depressive vulnerability. *Biological Psychiatry, 46*(4), 498-505.

Moreno, F. A., McGavin, C., Malan, T. P., Gelenberg, A. J., Heninger, G. R., Mathe, A. A., & Delgado, P. L. (2000). Tryptophan depletion selectively reduces CSF 5-HT metabolites in healthy young men: results from single lumbar puncture sampling technique. *International Journal of Neuropsychopharmacology, 3*(4), 277-283.

Murphy, F. C., Sahakian, B. J., & O'Carroll, R. E. (1998). Cognitive impairment in depression: Psychological models and clinical issues.

In D. Ebert & K. P. Ebmeier (Eds.), *New Models of Depression*. Basel: Karger.

Naito, M., Kijima, N., & Kitamura, T. (2000). Temperament and Character Inventory (TCI) as predictors of depression among Japanese college students. *Journal of Clinical Psychology, 56*(12), 1579-1585.

Naruse, K., & Hirai, T. (2000). Effects of slow tempo exercise on respiration, heart rate, and mood state. *Perceptual and Motor Skills, 91*(3), 729-740.

Nelson, E., & Cloninger, C. R. (1997). Exploring the TPQ as a possible predictor of antidepressant response to nefazodone in a large multi-site study. *Journal of Affective Disorders, 44*, 197-200.

Nemeroff, C. B., Widerlov, E., Bissette, G., Walleus, H., Karlsson, I., Eklund, K., Kilts, C. D., Loosen, P. T., & Vale, W. (1984). Elevated concentrations of CSF corticotropin-releasing factor-like immunoreactivity in depressed patients. *Science, 226*(4680), 1342-4.

Neumeister, A., Praschak-Rieder, N., Besselmann, B., Rao, M. L., Gluck, J., & Kasper, S. (1997a). Effects of tryptophan depletion on drug-free patients with seasonal affective disorder during a stable response to bright light therapy. *Archives of General Psychiatry, 54*(2), 133-8.

Neumeister, A., Praschak-Rieder, N., Hesselmann, B., Vitouch, O., Rauh, M., Barocka, A., & Kasper, S. (1997b). Rapid tryptophan depletion in drug-free depressed patients with seasonal affective disorder. *American Journal of Psychiatry, 154*(8), 1153-5.

Neumeister, A., Praschak-Rieder, N., Hesselmann, B., Vitouch, O., Rauh, M., Barocka, A., & Kasper, S. (1998a). Effects of tryptophan depletion in fully remitted patients with seasonal affective disorder during summer. *Psychological Medicine, 28*(2), 257-64.

Neumeister, A., Praschak-Rieder, N., Hesselmann, B., Vitouch, O., Rauh, M., Barocka, A., Tauscher, J., & Kasper, S. (1998b). Effects of tryptophan

depletion in drug-free depressed patients who responded to total sleep deprivation. *Archives of General Psychiatry, 55*(2), 167-72.

Neumeister, A., Turner, E. H., Matthews, J. R., Postolache, T. T., Barnett, R. L., Rauh, M., Vetticad, R. G., Kasper, S., & Rosenthal, N. E. (1998c). Effects of tryptophan depletion vs catecholamine depletion in patients with seasonal affective disorder in remission with light therapy. *Archives of General Psychiatry, 55*(6), 524-30.

Newman, J. R., Ewing, S. E., McColl, R. D., Borus, J. S., Nierenberg, A. A., Pava, J., & Fava, M. (2000). Tridimensional personality questionnaire and treatment response in major depressive disorder: a negative study. *Journal of Affective Disorders, 57*(1-3), 241-7.

Ng, H. S., Cooper, M., & Chandler, P. (1998). The Eysenckian personality structure: a 'Giant Three' or 'Big five' model in Hong Kong? *Personality and Individual Differences, 25*(6), 1111-1131.

Nishizawa, S., Benkelfat, C., Young, S. N., Leyton, M., Mzengeza, S., de Montigny, C., Blier, P., & Diksic, M. (1997). Differences between males and females in rates of serotonin synthesis in human brain. *Proceedings of the National Academy of Sciences, USA, 94*, 5308-5313.

Norcross, J. C., Guadagnoli, E., & Prochaska, J. O. (1984). Factor Structure of the Profile of Mood States (Poms) - 2 Partial Replications. *Journal of Clinical Psychology, 40*(5), 1270-1277.

O'Carroll, R. E., Conway, S., Ryman, A., & Prentice, N. (1997). Performance on the delayed word recall test (DWR) fails to differentiate clearly between depression and Alzheimer's disease in the elderly [see comments]. *Psychological Medicine, 27*(4), 967-71.

Ogilvie, A. D., Battersby, S., Bubb, V. J., Fink, G., Harmar, A. J., Goodwin, G. M., & Smith, C. A. D. (1996). Polymorphism in serotonin transporter gene associated with susceptibility to major depression. *Lancet, 347*(9003), 731-3.

Oldman, A., Walsh, A., Salkovskis, P., Fairburn, C. G., & Cowen, P. J. (1995). Biochemical and behavioural effects of acute tryptophan depletion in abstinent bulimic subjects: A pilot study. *Psychological Medicine, 25*, 995-1001.

Oldman, A. D., Walsh, A. E. S., Salkovskis, P., Laver, D. A., & Cowen, P. J. (1994). Effect of acute tryptophan depletion on mood and appetite in healthy female volunteers. *Journal of Psychopharmacology, 8*, 8-13.

Oreland, L., von Knorring, L., & Schalling, D. (1984). Connections between monoamine oxidase, temperament and disease. In W. Patton, J. Mitchell, & P. Turner (Eds.), *Proceedings of the IXth International Congress of Pharmacology* (Vol. 2, pp. 193-202). London: MacMillan Press.

Ortet, G., Ibanez, M. I., Moro, M., Silva, F., & Boyle, G. J. (1999). Psychometric appraisal of Eysenck's revised Psychoticism scale: a cross-cultural study. *Personality and Individual Differences, 27*(6), 1209-1219.

Ostendorf, F., & Angleitner, A. (1994). A Comparison of Different Instruments Proposed to Measure the Big-5. *European Review of Applied Psychology-Revue Europeenne De Psychologie Appliquee, 44*(1), 45-53.

Otter, C., Huber, J., & Bonner, A. (1995). Cloninger Tridimensional Personality Questionnaire - Reliability in an English Sample. *Personality and Individual Differences, 18*(4), 471-480.

Owen, F., Cross, A. J., Crow, T. J., Deakin, J. F., Ferrier, I. N., Lofthouse, R., & Poulter, M. (1983). Brain 5-HT-2 receptors and suicide [letter]. *Lancet, 2*(8361), 1256.

Pachana, N. A., Boone, K. B., Miller, B. L., Cummings, J. L., & Berman, N. (1996). Comparison of neuropsychological function in Alzheimer's disease and frontotemporal dementia. *Journal of the International Neuropsychological Society, 2*(6), 505-10.

Padberg, F., Zwanzger, P., Thoma, H., Kathmann, N., Haag, C., Greenberg, B. D., Hampel, H., & Moller, H. J. (1999). Repetitive transcranial magnetic stimulation (rTMS) in pharmacotherapy-refractory major depression: comparative study of fast, slow and sham rTMSI. *Psychiatry Research, 88*(3), 163-171.

Park, S. B., Coull, J. T., McShane, R. H., Young, A. H., Sahakian, B. J., Robbins, T. W., & Cowen, P. J. (1994). Tryptophan depletion in normal volunteers produces selective impairments in learning and memory. *Neuropharmacology, 33*, 575-588.

Parker, J. D. A., Bagby, R. M., & Joffe, R. T. (1996). Validation of the biosocial model of personality: Confirmatory factor analysis of the tridimensional personality questionnaire. *Psychological Assessment, 8*(2), 139-144.

Paunonen, S. V., & Jackson, D. N. (2000). What is beyond the Big Five? Plenty! *Journal of Personality, 68*(5), 821-835.

Peirson, A. R., & Heuchert, J. W. (2001). The relationship between personality and mood: comparison of the BDI and the TCI. *Personality and Individual Differences, 30*, 391-399.

Peirson, A. R., Heuchert, J. W., Thomala, L., Berk, M., Plein, H., & Cloninger, C. R. (1999). Relationship between serotonin and the Temperament and Character inventory. *Psychiatry Research, 89*(1), 29-37.

Pelissolo, A., & Lepine, J. P. (2000). Normative data and factor structure of the Temperament and Character Inventory (TCI) in the French version. *Psychiatry Research, 94*(1), 67-76.

Pérez, V., Bel, N., Celada, P., Ortiz, J., Alvarez, E., & Artigas, F. (1998). Relationship between blood serotonergic variables, melancholic traits, and response to antidepressant treatments. *Journal of Clinical Psychopharmacology, 18*, 222-230.

Pfohl, B., Black, D., Noyes, R., Jr., Kelley, M., & Blum, N. (1990). A test of the tridimensional personality theory: association with diagnosis and platelet imipramine binding in obsessive-compulsive disorder. *Biological Psychiatry, 28*(1), 41-6.

Phillips, M. A., Oxtoby, E. K., Langley, R. W., Bradshaw, C. M., & Szabadi, E. (2000). Effects of acute tryptophan depletion on prepulse inhibition of the acoustic startle (eyeblink) response and the N1/P2 auditory evoked response in man. *Journal of Psychopharmacology, 14*(3), 258-265.

Pihl, R. O., Young, S. N., Harden, P., Plotnick, S., Chamberlain, B., & Ervin, F. R. (1995). Acute effect of altered tryptophan levels and alcohol on aggression in normal human males. *Psychopharmacology, 119*, 353-360.

Pitchot, W., Ansseau, M., Gonzalez Moreno, A., Lembreghts, M., Hansenne, M., Wauthy, J., Reel, C., Jammaer, R., Papart, P., Sulon, J., & et al. (1995). The flesinoxan 5-HT1A receptor challenge in major depression and suicidal behavior. *Pharmacopsychiatry, 28*(Suppl 2), 91-2.

Poguegeile, M. F., & Rose, R. J. (1981). A Longitudinal Twin Study of the Mmpi - Genetic Analyses of Personality Stability and Change. *Behavior Genetics, 11*(6), 608-608.

Porter, R. J., Lunn, B. S., Walker, L. L. M., Gray, J. M., Ballard, C. G., & O'Brien, J. T. (2000). Cognitive deficit induced by acute tryptophan depletion in patients with Alzheimer's disease. *American Journal of Psychiatry, 157*(4), 638-640.

Porterfield, T., Cook, M., Deary, I. J., & Ebmeier, K. P. (1997). Neuropsychological function and diurnal variation in depression. *Journal of Clinical and Experimental Neuropsychology, 19*(6), 906-13.

Power, A. C., & Cowen, P. J. (1992). Neuroendocrine challenge tests: assessment of 5-HT function in anxiety and depression. *Molecular Aspects of Medicine, 13*(3), 205-20.

Price, L. H., Malison, R. T., McDougle, C. J., McCance-Katz, E. F., Owen, K. R., & Heninger, G. R. (1997). Neurobiology of tryptophan depletion in depression: Effects of *m*-chlorophenylpiperazine (mCPP). *Neuropsychopharmacology, 17*, 342-350.

Price, L. H., Malison, R. T., McDougle, C. J., Pelton, G. H., & Heninger, G. R. (1998). The neurobiology of tryptophan depletion in depression: Effects of intravenous tryptophan infusion. *Biological Psychiatry, 43*, 339-347.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 3*, 385-401 cited by Block (1991).

Rasmusson, A. M., Anderson, G. M., Lynch, K. A., McSwiggan-Hardin, M., Scahill, L. D., Mazure, C. M., Goodman, W. K., Price, L. H., Cohen, D. J., & Leckman, J. F. (1997). A preliminary study of tryptophan depletion on tics, obsessive-compulsive symptoms, and mood in Tourette's syndrome. *Biological Psychiatry, 41*(1), 117-21.

Ravindran, A. V., Griffiths, J., Merali, Z., Knott, V. J., & Anisman, H. (1999). Influence of acute tryptophan depletion on mood and immune measures in healthy males. *Psychoneuroendocrinology, 24*(1), 99-113.

Raykov, T. (1993). Confirmatory factor analysis of the Tridimensional Personality Questionnaire: comments on Bagby, Parker and Joffe. *Personality and Individual Differences, 15*, 729-731.

Reddon, J. R., Marceau, R., & Holden, R. R. (1985). A Confirmatory Evaluation of the Profile of Mood States - Convergent and Discriminant Item Validity. *Journal of Psychopathology and Behavioral Assessment, 7*(3), 243-259.

Reich, J., Noyes, R., Jr., Hirschfeld, R., Coryell, W., & O'Gorman, T. (1987). State and personality in depressed and panic patients. *American Journal of Psychiatry, 144*(2), 181-7.

Reilly, J. G., McTavish, S. F. B., & Young, A. H. (1997). Rapid depletion of plasma tryptophan: A review of studies and experimental methodology. *Journal of Psychopharmacology, 11*(4), 381-392.

Remington, N. A., Fabrigar, L. R., & Visser, P. S. (2000). Reexamining the circumplex model of affect. *Journal of Personality and Social Psychology, 79*(2), 286-300.

Richter, J., Brandstrom, S., & Przybeck, T. (1999). Assessing personality: the Temperament and Character Inventory in a cross-cultural comparison between Germany, Sweden, and the USA. *Psychological Reports, 84*(3), 1315-1330.

Richter, M. A., Summerfeldt, L. J., Joffe, R. T., & Swinson, R. P. (1996). The Tridimensional Personality Questionnaire in obsessive-compulsive disorder. *Psychiatry Research, 65*(3), 185-8.

Riedel, W. J., Klaassen, T., Deutz, N. E. P., van Someren, A., & van Praag, H. M. (1999). Tryptophan depletion in normal volunteers produces selective impairment in memory consolidation. *Psychopharmacology, 141*(4), 362-9.

Roberts, K. R., Dimsdale, J., East, P., & Friedman, L. (1998). Adolescent emotional response to music and its relationship to risk-taking behaviors. *Journal of Adolescent Health, 23*(1), 49-54.

Roger, D., & Morris, J. (1991). The Internal Structure of the EPQ Scales. *Personality and Individual Differences, 12*(7), 759-764.

Rogers, R. D., Blackshaw, A. J., Middleton, H. C., Matthews, K., Hawtin, K., Crowley, C., Hopwood, A., Wallace, C., Deakin, J. F. W., Sahakian, B. J., & Robbins, T. W. (1999a). Tryptophan depletion impairs stimulus-reward learning while methylphenidate disrupts attentional control in healthy young adults: implications for the monoaminergic basis of impulsive behaviour. *Psychopharmacology, 146*(4), 482-91.

Rogers, R. D., Everitt, B. J., Baldacchino, A., Blackshaw, A. J., Swainson, R., Wynne, K., Baker, N. B., Hunter, J., Carthy, T., Booker, E., London, M., Deakin, J. F. W., Sahakian, B. J., & Robbins, T. W. (1999b). Dissociable deficits in the decision-making cognition of chronic amphetamine abusers, opiate abusers, patients with focal damage to prefrontal cortex, and tryptophan-depleted normal volunteers: evidence for monoaminergic mechanisms. *Neuropsychopharmacology, 20*(4), 322-39.

Romans, S. E., Potter, K., Martin, J., & Herbison, P. (2001). The mental and physical health of female sex workers: a comparative study. *Australian and New Zealand Journal of Psychiatry, 35*(1), 75-80.

Roy, A. (1990). Personality variables in depressed patients and normal controls. *Neuropsychobiology, 23*, 119-123.

Roy, A. (1999). CSF 5-HIAA correlates with neuroticism in depressed patients. *Journal of Affective Disorders, 52*, 247-249.

Rubinow, D. R., Davis, C. L., & Post, R. M. (1988). Somatostatin in neuropsychiatric disorders. *Progress in Neuro-Psychopharmacology & Biological Psychiatry, 12*(Suppl), S137-55.

Rubinow, D. R., Gold, P. W., Post, R. M., Ballenger, J. C., Cowdry, R., Bollinger, J., & Reichlin, S. (1983). CSF somatostatin in affective illness. *Archives of General Psychiatry, 40*(4), 409-12.

Ruegg, R. G., Gilmore, J., Ekstrom, R. D., Corrigan, M., Knight, B., Tancer, M., Leatherman, M. E., Carson, S. W., & Golden, R. N. (1997). Clomipramine challenge responses covary with Tridimensional Personality Questionnaire scores in healthy subjects. *Biological Psychiatry, 42*(12), 1123-9.

Rushton, J. P., Brainerd, C. J., & Pressley, M. (1983). Behavioral development and construct validity: The principle of aggregation. *Psychological Bulletin, 94*, 18-38.

Russell, J. A., & Barrett, L. F. (1999). Core affect, prototypical emotional episodes, and other things called Emotion: Dissecting the elephant. *Journal of Personality and Social Psychology, 76*(5), 805-819.

Saggino, A. (2000). The Big Three or the Big Five? A replication study. *Personality and Individual Differences, 28*(5), 879-886.

Sahakian, B. J., & Owen, A. M. (1992). Computerized assessment in neuropsychiatry using CANTAB: discussion paper. *Journal of the Royal Society of Medicine, 85*(7), 399-402.

Saletu, M., Saletu, B., Grunberger, J., Mader, R., & Karobath, M. (1983). Clinical symptomatology and computer analyzed EEG before, during and after anxiolytic therapy of alcohol withdrawal patients. *Neuropsychobiology, 9*(2-3), 119-34.

Salomon, R. M., Mazure, C. M., Delgado, P. L., Mendia, P., & Charney, D. S. (1994). Serotonin function in aggression: the effect of acute plasma tryptophan depletion in aggressive patients. *Biological Psychiatry, 35*(8), 570-2.

Salomon, R. M., Miller, H. L., Delgado, P. L., & Charney, D. (1993). The use of tryptophan depletion to evaluate central serotonin function in depression and other neuropsychiatric disorders. *International Clinical Psychopharmacology, 8 Suppl 2*, 41-6.

SanMartini, P., Mazzotti, E., & Setaro, S. (1996). Factor structure and psychometric features of the Italian version for the EPQ-R. *Personality and Individual Differences, 21*(6), 877-882.

Satel, S. L., Krystal, J. H., Delgado, P. L., Kosten, T. R., & Charney, D. S. (1995). Tryptophan depletion and attenuation of cue-induced craving for cocaine. *American Journal of Psychiatry, 152*(5), 778-83.

Sato, T., Hirano, S., Narita, T., Kusunoki, K., Kato, J., Goto, M., Sakado, K., & Uehara, T. (1999). Temperament and character inventory

dimensions as a predictor of response to antidepressant treatment in major depression. *Journal of Affective Disorders, 56*(2-3), 153-61.

Saucier, G., & Ostendorf, F. (1999). Hierarchical subcomponents of the Big Five personality factors: A cross-language replication. *Journal of Personality and Social Psychology, 76*(4), 613-627.

Schalling, D. (1978). Psychopathy-related personality variables and the psychopthology of socialization. In R. D. Hare & D. Schalling (Eds.), *Psychopathic behaviour: approaches to research* (pp. 85-106). Chichester, England: Wiley.

Schalling, D., Asberg, M., Edman, G., & Oreland, L. (1987). Markers for vulnerability to psychopathology: temperament traits associated with platelet MAO activity. *Acta Psychiatrica Scandinavica, 76*(2), 172-82.

Schatzberg, A. F., Posener, J. A., DeBattista, C., Kalehzan, B. M., Rothschild, A. J., & Shear, P. K. (2000). Neuropsychological deficits in psychotic versus nonpsychotic major depression and no mental illness. *American Journal of Psychiatry, 157*(7), 1095-100.

Schmitt, J. A. J., Jorissen, B. L., Sobczak, S., Van Boxtel, M. P. J., Hogervorst, E., Deutz, N. E. P., & Riedel, W. J. (2000). Tryptophan depletion impairs memory consolidation but improves focussed attention in healthy young volunteers. *Journal of Psychopharmacology, 14*(1), 21-29.

Schneider, F., Gur, R. C., Gur, R. E., & Muenz, L. R. (1994). Standardized mood induction with happy and sad facial expressions. *Psychiatry Research, 51*, 19-31.

Schruers, K., Klaassen, T., Pols, H., Overbeek, T., Deutz, N. E. P., & Griez, E. (2000). Effects of tryptophan depletion on carbon dioxide provoked panic in panic disorder patients. *Psychiatry Research, 93*(3), 179-187.

Scott, J., Eccleston, D., & Boys, R. (1992). Can we predict the persistence of depression? *British Journal of Psychiatry, 161*, 633-7.

Shah, M., & O'Carroll, R. (1994). Depressed mood induction primarily impairs psychomotor functioning in healthy controls - implictions for psychobiological models of major depression. *University of Edinburgh, unpublished thesis.*

Shah, P. J., Ebmeier, K. P., Glabus, M. F., & Goodwin, G. M. (1998). Cortical grey matter reductions associated with treatment-resistant chronic unipolar depression. Controlled magnetic resonance imaging study. *British Journal of Psychiatry, 172*, 527-32.

Shansis, F. M., Busnello, J. V., Quevedo, J., Forster, L., Young, S., Izquierdo, I., & Kapczinski, F. (2000). Behavioural effects of acute tryptophan depletion in healthy male volunteers. *Journal of Psychopharmacology, 14*(2), 157-163.

Sharma, R. P., Shapiro, L. E., Kamath, S. K., Soll, E. A., Watanabe, M. D., & Davis, J. M. (1997). Acute dietary tryptophan depletion: effects on schizophrenic positive and negative symptoms. *Neuropsychobiology, 35*(1), 5-10.

Shaw, D. M., Tidmarsh, S. F., Johnson, A. L., Michalakeas, A. C., Riley, G. J., Blazek, R., & Francis, A. F. (1978). Multicompartmental analysis of amino acids: II. Tryptophan in affective disorder. *Psychological Medicine, 8*(3), 487-94.

Sher, K. J., Wood, M. D., Crews, T. M., & Vandiver, P. A. (1995). The Tridimensional Personality Questionnaire - Reliability and Validity Studies and Derivation of a Short-Form. *Psychological Assessment, 7*(2), 195-208.

Shopsin, B., Friedman, E., & Gershon, S. (1976). Parachlorophenylalanine reversal of tranylcypromine effects in depressed patients. *Archives of General Psychiatry, 33*(7), 811-9.

Shopsin, B., Gershon, S., Goldstein, M., Friedman, E., & Wilk, S. (1975). Use of synthesis inhibitors in defining a role for biogenic amines during

imipramine treatment in depressed patients. *Psychopharmacology Communications, 1*(2), 239-49.

Smeraldi, E., Diaferia, G., Erzegovesi, S., Lucca, A., Bellodi, L., & Moja, E. A. (1996). Tryptophan depletion in obsessive-compulsive patients. *Biological Psychiatry, 40*, 398-402.

Smith, K. A., Clifford, E. M., Hockney, R. A., Clark, D. M., & Cowen, P. J. (1997a). Effect of tryptophan depletion on mood in male and female volunteers: A pilot study. *Human Psychopharmacology, 12*, 111-117.

Smith, K. A., Fairburn, C. G., & Cowen, P. J. (1997b). Relapse of depression after rapid depletion of tryptophan. *Lancet, 349*, 915-919.

Smith, K. A., Fairburn, C. G., & Cowen, P. J. (1999a). Symptomatic relapse in bulimia nervosa following acute tryptophan depletion. *Archives of General Psychiatry, 56*(2), 171-6.

Smith, K. A., Morris, J. S., Friston, K. J., Cowen, P. J., & Dolan, R. J. (1999b). Brain mechanisms associated with depressive relapse and associated cognitive impairment following acute tryptophan depletion. *British Journal of Psychiatry, 174*, 525-529.

Smith, K. A., Williams, C., & Cowen, P. J. (2000). Impaired regulation of brain serotonin function during dieting in women recovered from depression [In Process Citation]. *British Journal of Psychiatry, 176*, 72-5.

Smith, S. E., Pihl, R. O., Young, S. N., & Ervin, F. R. (1987). A test of possible cognitive and environmental influences on the mood lowering effect of tryptophan depletion in normal males. *Psychopharmacology, 91*, 451-457.

Snaith, R. P. (1996). Present use of the Hamilton Depression Rating Scale: Observations on method of assessment in research of depressive disorders. *British Journal of Psychiatry, 168*, 594-597.

Soloff, P. H., George, A., Nathan, R. S., Schulz, P. M., Ulrich, R. F., & Perel, J. M. (1986). Progress in pharmacotherapy of borderline disorders. A

double-blind study of amitriptyline, haloperidol, and placebo. *Archives of General Psychiatry, 43*(7), 691-7.

Speca, M., Carlson, L. E., Goodey, E., & Angen, M. (2000). A randomized, wait-list controlled clinical trial: The effect of a mindfulness meditation-based stress reduction program on mood and symptoms of stress in cancer outpatients. *Psychosomatic Medicine, 62*(5), 613-622.

Spielberger, C. D., Gorsuch, R. L., Luschene, R., Vagg, P. R., & Jacobs, G. A. (1983). *State-trait anxiety inventory (form Y)*. Palo Alto California: Mind Garden.

Staley, J. K., Malison, R. T., & Innis, R. B. (1998). Imaging of the serotonergic system: interactions of neuroanatomical and functional abnormalities of depression. *Biological Psychiatry, 44*(7), 534-49.

Stancampiano, R., Melis, F., Sarais, L., Cocco, S., Cugusi, C., & Fadda, F. (1997). Acute administration of a tryptophan-free amino acid mixture decreases 5-HT release in rat hippocampus in vivo. *American Journal of Physiology, 272*, R991-994.

Stanley, M., & Mann, J. J. (1983). Increased serotonin-2 binding sites in frontal cortex of suicide victims. *Lancet, 1*(8318), 214-6.

Starcevic, V., Uhlenhuth, E. H., Fallon, S., & Pathak, D. (1996). Personality dimensions in panic disorder and generalized anxiety disorder. *Journal of Affective Disorders, 37*, 75-79.

Stelmack, R. M., & Houlihan, M. (1995). Event-related potentials, personality and intelligence: Concepts, issues and evidence. In D. H. Saklofske & M. Zeidner (Eds.), *International handbook of personality and intelligence* . New York: Plenum.

Stenberg, G., Risberg, J., Warkentin, S., & Rosen, I. (1990). Regional patterns of cortical blood flow distinguish extraverts from introverts. *Personality and Individual Differences, 11*, 663-673.

Stenberg, G., Wendt, P. E., & Risberg, J. (1993). Regional cerebral blood flow and extraversion. *Personality and Individual Differences, 15*, 547-554.

Strakowski, S. M., Faedda, G. L., Tohen, M., Goodwin, D. C., & Stoll, A. L. (1992). Possible Affective-State Dependence of the Tridimensional Personality Questionnaire in 1st-Episode Psychosis. *Psychiatry Research, 41*(3), 215-226.

Svrakic, D. M., Przybeck, T. R., & Cloninger, C. R. (1992). Mood states and personality traits. *Journal of Affective Disorders, 24*, 217-226.

Taylor, A. L., & Fishman, L. M. (1988). Corticotropin-releasing hormone. *New England Journal of Medicine, 319*(4), 213-22.

Tellegen, A. (1982). *Brief manual for the multidimensional personality questionnaire* (Unpublished manuscript): University of Minnesota.

Thurstone, L. L. (1931). Multiple factor analysis. *Psychological Review, 38*, 406-427.

Tome, M. B., Cloninger, C. R., Watson, J. P., & Isaac, M. T. (1997). Serotonergic autoreceptor blockade in the reduction of antidepressant latency: personality variables and response to paroxetine and pindolol. *Journal of Affective Disorders, 44*, 101-109.

Tomita, T., Aoyama, H., Kitamura, T., Sekiguchi, C., Murai, T., & Matsuda, T. (2000). Factor structure of psychobiological seven-factor model of personality: a model-revision. *Personality and Individual Differences, 29*(4), 709-727.

Totterdell, P. (1999). Mood scores: Mood and performance in professional cricketers. *British Journal of Psychology, 90*, 317-332.

Trichard, C., Martinot, J. L., Alagille, M., Masure, M. C., Hardy, P., Ginestet, D., & Féline, A. (1995). Time course of prefrontal lobe dysfunction in severely depressed in-patients: a longitudinal neuropsychological study. *Psychological Medicine, 25*, 79-85.

Tulen, J. H., Bruijn, J. A., de Man, K. J., Pepplinkhuizen, L., van den Meiracker, A. H., & Man in 't Veld, A. J. (1996). Cardiovascular variability in major depressive disorder and effects of imipramine or mirtazapine (Org 3770). *Journal of Clinical Psychopharmacology, 16*(2), 135-45.

Twenge, J. M. (2000). The age of anxiety? Birth cohort change in anxiety and neuroticism, 1952-1993. *Journal of Personality and Social Psychology, 79*(6), 1007-1021.

Twenge, J. M. (2001). Birth cohort changes in extraversion: a cross-temporal meta- analysis, 1966-1993. *Personality and Individual Differences, 30*(5), 735-748.

Ulrich, S., Northoff, G., Wurthmann, C., Partscht, G., Pester, U., Herscu, H., & Meyer, F. P. (2001). Serum levels of amitriptyline and therapeutic effect in non- delusional moderately to severely depressed in-patients: a therapeutic window relationship. *Pharmacopsychiatry, 34*(1), 33-40.

Underwood, M. D., Khaibulina, A. A., Ellis, S. P., Moran, A., Rice, P. M., Mann, J. J., & Arango, V. (1999). Morphometry of the dorsal raphe nucleus serotonergic neurons in suicide victims. *Biological Psychiatry, 46*(4), 473-83.

Van Goozen, S. H. M., Frijda, N. H., Wiegant, V. M., Endert, E., & Van de Poll, N. E. (1996). The premenstrual phase and reactions to aversive events: a study of hormonal influences on emotionality. *Psychoneuroendocrinology, 21*, 479-497.

van Hemert, A. M., den Heijer, M., Vorstenbosch, M., & Bolk, J. H. (1995). Detecting psychiatric disorders in medical practice using the General Health Questionnaire. Why do cut-off scores vary? *Psychological Medicine, 25*(1), 165-70.

van Pragg, H. M., & Korf, J. (1975). Central monamine deficiency in depressions: Causative or secondary phenomenon? *Pharmakopsychiatrie Neuro-Psychopharmakologie, 8*, 322-326.

Velten, E. J. (1968). A laboratory task for induction of mood states. *Behaviour Research and Therapy, 6*, 473-482.

Verkes, R. J., Hengeveld, M. W., van der Mast, R. C., Fekkes, D., & van Kempen, G. M. J. (1998). Mood correlates with blood serotonin, but not with glucose measures in patients with recurrent suicidal behavior. *Psychiatry Research, 80*(3), 239-48.

Voderholzer, U., Hornyak, M., Thiel, B., Huwig-Poppe, C., Kiemen, A., Konig, A., Backhaus, J., Riemann, D., Berger, M., & Hohagen, F. (1998). Impact of experimentally induced serotonin deficiency by tryptophan depletion on sleep EEG in healthy subjects. *Neuropsychopharmacology, 18*(2), 112-24.

von Zerssen, D., Strian, F., & Schwarz, D. (1974). Evaluation of depressive states especially in longitudinal studies. In P. Pichot (Ed.), *Psychological Measurements in Pharmacology* (pp. 189-202). Paris, France: Karger.

Walker, L. G. (1990). The Measurement of Anxiety. *Postgraduate Medical Journal, 66*, S11-S17.

Waller, D. A., Gullion, C. M., Petty, F., Hardy, B. W., Murdock, M. V., & Rush, A. J. (1993). Tridimensional Personality Questionnaire and serotonin in bulimia nervosa. *Psychiatry Research, 48*(1), 9-15.

Waller, N. G., Lilienfeld, S. O., Tellegen, A., & Lykken, D. T. (1991). The Tridimensional Personality Questionnaire - Structural Validity and Comparison With the Multidimensional Personality Questionnaire. *Multivariate Behavioral Research, 26*(1), 1-23.

Watson, D. (1999). Dimensions underlying the anxiety disorders: a hierarchical perspective. *Current Opinion in Psychiatry, 12*, 181-186.

Watson, D., & Clark, L. A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.

Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin, 98*, 219-235.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76*(5), 820-838.

Watson, J. M., Lunt, M. J., Morris, S., Weiss, M. J., Hussey, D., & Kerr, D. (2000). Reversal of caffeine withdrawal by ingestion of a soft beverage. *Pharmacology Biochemistry and Behavior, 66*(1), 15-18.

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale - Revised*. New York: The Psychological Corporation.

Weich, S., Lewis, G., & Jenkins, S. P. (2001). Income inequality and the prevalence of common mental disorders in Britain. *British Journal of Psychiatry, 178*, 222-227.

Weiss, F., Blum, G. S., & Gleberman, L. (1987). Anatomically Based Measurement of Facial Expressions in Simulated Versus Hypnotically Induced Affect. *Motivation and Emotion, 11*(1), 67-81.

Weissman, M. M., Prusoff, B. A., & Klerman, G. L. (1978). Personality and the prediction of long-term outcome of depression. *American Journal of Psychiatry, 135*(7), 797-801.

Welch, P. D. (1970). The use of the Fast Fourier Transform for the estimation of power spectra. *IEEE Transactions on Audio and Electroacoustics, 15*(June), 70-73 cited by [Oppenheim, 1975 #1366] pp 532-571.

Weltzin, T. E., Fernstrom, J. D., McConaha, C., & Kaye, W. H. (1994). Acute tryptophan depletion in bulimia: Effects on large neutral amino acids. *Biological Psychiatry, 35*, 388-397.

Weltzin, T. E., Fernstrom, M. H., Fernstrom, J. D., Neuberger, S. K., & Kaye, W. H. (1995). Acute tryptophan depletion and increased food intake

and irritability in bulimia nervosa. *American Journal of Psychiatry, 152*, 1668-1671.

Werneke, U., Goldberg, D. P., Yalcin, I., & Ustun, B. T. (2000). The stability of the factor structure of the General Health Questionnaire. *Psychological Medicine, 30*(4), 823-829.

Weyers, P., Krebs, H., & Janke, W. (1995). Reliability and Construct-Validity of the German Version of Cloningers Tridimensional Personality Questionnaire. *Personality and Individual Differences, 19*(6), 853-861.

Wheeler, R. E., Davidson, R. J., & Tomarken, A. J. (1993). Frontal brain asymmetry and emotional reactivity: A biological substrate of affective style. *Psychophysiology, 30*, 82-89.

Williams, D. G. (1990). Effects of psychotocism, extraversion, and neuroticism in current mood: A statistical review of six studies. *Personality and Individual Differences, 11*, 615-630.

Williams, W. A., Shoaf, S. E., Hommer, D., Rawlings, R., & Linnoila, M. (1999). Effects of acute tryptophan depletion on plasma and cerebrospinal fluid tryptophan and 5-hydroxyindoleacetic acid in normal volunteers. *Journal of Neurochemistry, 72*(4), 1641-7.

Wilson, K., & Gullone, E. (1999). The relationship between personality and affect over the lifespan. *Personality and Individual Differences, 27*(6), 1141-1156.

Wingrove, J., Bond, A. J., & Cleare, A. J. (1999a). Tryptophan enhancement/depletion and reactions to failure on a cooperative computer game. *Neuropsychopharmacology, 21*(6), 755-64.

Wingrove, J., Bond, A. J., Cleare, A. J., & Sherwood, R. (1999b). Trait hostility and prolactin response to tryptophan enhancement/depletion. *Neuropsychobiology, 40*(4), 202-6.

Wolfe, B. E., Metzger, E. D., & Jimerson, D. C. (1995). Comparison of the effects of amino acid mixture and placebo on plasma tryptophan to large neutral amino acid ratio. *Life Sciences, 56*(17), 1395-400.

World Health Organisation. (1992). *The ICD-10 Classification of Mental and Behavioural Disorders*. Geneva, Switzerland: World Health Organisation.

Wurtman, R. J., & Wurtman, J. J. (1988). Do carbohydrates affect food intake via neurotransmitter activity? *Appetite, 11*(Suppl 1), 42-7.

Yang, K. S., & Bond, M. H. (1990). Exploring implicit personality theories with indigenous or imported constructs: the Chinese case. *Journal of Personality & Social Psychology, 58*(6), 1087-95.

Young, A. H., Hughes, J. H., & Ashton, C. H. (2000). Brain 5-HT function in bipolar affective disorder. *Acta Neuropsychiatrica, 12*(3), 91-95.

Young, L. T., Bagby, R. M., Cooke, R. G., Parker, J. D. A., Levitt, A. J., & Joffe, R. T. (1995). A comparison of tridimensional personality questionnaire dimensions in bipolar disorder and unipolar depression. *Psychiatry Research, 58*, 139-143.

Young, S. N., Ervin, F. R., Pihl, R. O., & Finn, P. (1989). Biochemical aspects of tryptophan depletion in primates. *Psychopharmacology, 98*(4), 508-11.

Young, S. N., & Gauthier, S. (1981). Effect of tryptophan administration on tryptophan, 5-hydroxyindoleacetic acid and indoleacetic acid in human lumbar and cisternal cerebrospinal fluid. *Journal of Neurology, Neurosurgery & Psychiatry, 44*(4), 323-7.

Young, S. N., Smith, S. E., Pihl, R. O., & Ervin, F. R. (1985). Tryptophan depletion causes a rapid lowering of mood in normal males. *Psychopharmacology, 87*, 173-177.

Zimmermann, R. C., McDougle, C. J., Schumacher, M., Olcese, J., Heninger, G. R., & Price, L. H. (1993a). Urinary 6-hydroxymelatonin sulfate as a

measure of melatonin secretion during acute tryptophan depletion. *Psychoneuroendocrinology, 18*(8), 567-78.

Zimmermann, R. C., McDougle, C. J., Schumacher, M., Olcese, J., Mason, J. W., Heninger, G. R., & Price, L. H. (1993b). Effects of acute tryptophan depletion on nocturnal melatonin secretion in humans. *Journal of Clinical Endocrinology and Metabolism, 76*(5), 1160-4.

Zohar, A. H., Lev-Ari, L., Benjamin, J., Ebstein, R., Lichtenberg, P., & Osher, Y. (2001). The psychometric properties of the Hebrew version of Cloninger's Tridimensional Personality Questionnaire. *Personality and Individual Differences, 30*, 1297-1309.

Zuckerman, M. (1976). General and situation-specific traits and states: new approaches to assessment of anxiety and other constructs. In M. Zuckerman & C. D. Spielberger (Eds.), *Emotions and anxiety: new concepts, methods and applications* (pp. 133-74). Hiilsdale, NJ: Erblaum.

Zuckerman, M. (1979). *Sensation seeking: Beyond the optimal level of arousal.* Hillsdale, NJ: Erblaum.

Zuckerman, M. (1991). *Psychobiology of personality.* Cambridge, U.K.: Cambridge University Press.

Zuckerman, M. (1993). P-impulsive sensation seeking and its behavioral, psychophysiological and biochemical correlates. *Neuropsychobiology, 28*, 30-36.

Zuckerman, M., & Cloninger, C. R. (1996). Relationships between Cloninger's, Zuckerman's, and Eysenck's dimensions of personality. *Personality and Individual Differences, 21*, 283-285.

Zuckerman, M., Kuhlman, D. M., & Camac, C. (1988). What lies beyond E and N? Factor analyses of scales believed to measure basic dimensions of personality. *Journal of Personality and Social Psychology, 54*, 96-107.

Zuckerman, M., Kuhlman, D. M., Joireman, J., Teta, P., & Kraft, M. (1993). A comparison of three structural models for personality: The big three, the big five, and the alternative five. *Journal of Personality and Social Psychology, 65*, 757-768.

Zuckerman, M., Kuhlman, D. M., Thornquist, M., & Kiers, H. (1991). Five (or three) robust questionnaire scale factors of personality without culture. *Personality and Individual Differences, 12*, 929-941.

Zuckerman, M., & Lubin, B. (1965). *Manual for the multiple affect adjective checklist*. San Diego: Education and Industrial Testing Service.

Zung, W. W. K. (1965). A self-rating depression scale. *Archives of General Psychiatry, 12*, 63-70.