

## **Personality Correlates of Visual Stress**

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## **Abstract**

Personality dimensions of participants who suffer from visual stress were compared with normal participants using the Eysenck Personality Inventory. Extraversion-Introversion scores showed no significant differences between the participants who suffered visual stress and those who were classified as normal. In contrast, significant differences were found between the normal participants and those with visual stress in respect of Neuroticism-Stability. These differences accord with Eysenck's personality theory which state that those who score highly on the neuroticism scale do so because they have a neurological system with a low threshold with their neurological system being easily activated by external stimuli. The findings also relate directly to the theory of visual stress proposed by Wilkins which postulates that visual stress results from an excess of neural activity. The data may suggest that the location of the excess activity is likely to be localised at particular neurological regions or neural processes.

Keywords: visual stress, Meares-Irlen syndrome, coloured filters, Eysenck Personality Inventory

## **Introduction**

Visual stress has been defined as the inability to see comfortably without distortion or discomfort (Wilkins, 1995). Visual stress during reading was first characterised by Meares (1980) and Irlen (1983) and has also been termed Meares-Irlen syndrome. Evidence to support the existence of visual stress is centred on the reading advantage that people display when they use various therapeutic systems that are based on individually prescribed coloured tints and overlays. These changes in performance appear robust and are not considered to be a placebo (Wilkins *et al.*, 1994; Robinson and Foreman, 1999). For example, coloured overlays have been shown to both increase rate of reading and reduce symptoms (Evans *et al.*, 1995; Evans *et al.*, 1996; Wilkins and Lewis, 1999; Wilkins *et al.*, 2001; Bouldoukian *et al.*, 2002) as well as improving reading accuracy and comprehension (Robinson and Foreman, 1999). The preference of the coloured overlay has been shown to be unrelated to familiarity, memory (Wilkins *et al.*, 1995) or a reduction in contrast (Jeanes *et al.*, 1997).

The aetiology and characteristics of Meares-Irlen syndrome and visual stress have not been fully elucidated. The spatial and temporal characteristics of scenes that evoke visual stress have been described by Wilkins (1995). When aspects of the visual scene are of high contrast and in a striped configuration, with each stripe subtending 10 minutes of arc at the eye (spatial frequency of the pattern approximately 3 cycles/degree) and are of an even width and spacing (duty cycle of approximately 50%), cortical stimulation is maximal and visual stress is likely to be evoked in those who are susceptible. Wilkins and

Nimmo-Smith (1984) have suggested that the spatial properties of lines of print on a page form a striped pattern that may cause pattern glare and subsequently visual stress. Wilkins (2003) further argued that Meares-Irlen syndrome is related to pattern glare and is linked to the perceptual system. Striped patterns can cause strong physiological responses (hyperexcitability) in the visual system of the brain resulting in people experiencing discomfort and visual perceptual problems (Wilkins, 2003). Evidence from EEG and neuro-imaging supports these physiological claims (Wilkins, 1995; Wilkins *et al.*, 1999; Huang *et al.*, 2003; Huang *et al.*, 2004), whilst evidence from psychophysical investigations is more variable (Blaskey *et al.*, 1990; Solan, 1990; Menacker *et al.*, 1993; Simmers and Bex, 2001; Simmers *et al.*, 2001a,b). Visual stress is therefore just one example of how a person's physiology can have perceptual and behavioural consequences.

The mechanism by which coloured tints and lenses benefit those with visual stress and Meares-Irlen type symptoms is unclear. Representation of colour in the cortex has been shown to follow topographic maps where cells responding to a particular colour are located together and arranged with cells responding to other colours in a sequence not unlike the CIE colour diagram (Xiao *et al.*, 2003). Wilkins *et al.*, (2004) have hypothesised that coloured overlays or lenses will change the distribution of the firing pattern in the visual cortex, alleviating visual stress, with the colour needed being specific to each individual. An alternative is the magnocellular deficit theory (Livingstone *et al.*, 1991; Stein and Walsh, 1997; Stein, 2001) that suggests that contrast and motion sensitivity enhancement, achieved by the use of yellow filters, can

improve reading performance. Yellow filters reduce blue light entering the eye that may inhibit magnocellular function in individuals susceptible to visual stress. The latter theory is not supported by the individual and sometimes precise nature of the tints required to alleviate the symptoms of visual stress (Kriss and Evans, 2005). Furthermore, coloured overlays and precision tints have been shown to offer benefit to disorders including photosensitive epilepsy (Wilkins *et al.*, 1999), autism (Ludlow *et al.*, 2005) migraine (Wilkins *et al.*, 2002; Harle and Evans, 2004) all of which may be associated with cortical hypersensitivity.

Personality is a construct that is used to understand consistency in a person's behaviour across different situations. Personality theories from the nomothetic tradition are concerned with categorising people according to different personality factors. These nomothetic approaches to personality often attribute personality dimensions or factors to an underlying biological basis. Whilst personality research has generated many alternative labels for personality dimensions, two personality factors that appear in most theories are those of Extraversion and Neuroticism (Eysenck and Eysenck, 1964; Costa and McCrae, 1987; Myers, 1995).

The focus of this paper will be on established personality theory that has been theorised to have a basis in the neurological system, namely the personality factors of Extraversion and Neuroticism and their theoretical basis as described by Hans Eysenck (1967). Eysenck described personality in a hierarchy of levels and he argued that factor analysis could reduce all

personality traits or descriptors into what were essentially three personality dimensions; Extroversion-Introversion; Neuroticism-Stability, and Psychoticism-Ego control. These factors are often referred to as dimensions as they exist on a continuum. It is important to understand that these factors are just broad descriptors and people who score high on the neuroticism scale are not necessarily neurotics – just that they are more susceptible to neurotic problems. Note that descriptors such as neurotic and stable should not be confused or associated with mental health problems. Whilst the Extroversion-Introversion and Neuroticism-Stability dimensions are considered robust and appear in many different factor theories, the Psychoticism-Ego control dimension has been shown to be unreliable as a unitary factor comprising of a number of different combinations of other personality traits (Francis *et al.*, 2005; Pickering *et al.*, 2003; Costa and McCrae, 1987 ) The Psychoticism-Ego dimension is too heterogeneous to be taken as a single trait and will not be considered further in the current study.

In respect of the biological basis of personality, Eysenck argued that the Extroversion-Introversion dimension was based on cortical arousal, which occurs due to activity within the central nervous system; namely the reticular activating system (RAS) and the limbic system. The reticular formation is a poorly-differentiated area of the brain stem, situated at the core between the myelencephalon (medulla oblongata) and mesencephalon (midbrain). The ascending reticular activating system connects to areas in the thalamus, hypothalamus, and cortex, while the descending reticular activating system connects to the cerebellum (Jouvet, 1969). The limbic system includes many

different cortical and sub cortical brain areas including: the amygdala, the cingulate gyrus and the fornicate gyrus. Having associations with the hypothalamus, these areas are linked with the autonomic nervous system via endocrine system and control. The cingulate gyrus also aids autonomic functioning being involved in the regulation of heart rate and blood pressure as well as cognitive and attentional processing (Lautin, 2001).

According to the original Eysenckian theory, Extroversion is characterised as a behaviour that occurs when the RAS is not active enough in arousing the cortex. This leads the person to having a preference in finding additional external stimulation to raise cortical arousal closer to its optimum. In introverts, cortical arousal is already higher than optimal since the introvert RAS is more active than it should be in arousing the cortex. Thus, the introvert prefers situations which reduce the number of, or intensity of, external stimuli in the immediate environment. Neuroticism was the term that Eysenck gave to a dimension that ranged from normal, fairly calm and collected people to people that tend to be quite 'nervous'. The Neuroticism-Stability dimension is linked to the threshold of arousal within the autonomic nervous system (ANS). People high in neuroticism would have an ANS with a low threshold. Their ANS would be easily activated by external events and for this reason they experience emotions more strongly, and more often.

There is some disagreement in the literature as to whether Extraversion and Neuroticism is indeed related to neuro-anatomy as Eysenck originally claimed (Lester *et al.*, 1990) and alternative explanations and theories have appeared

since Eysenck's theory. Gray (1981) proposed the Behavioural Inhibition System mainly including limbic structures to explain behavioural tendencies closely related to neuroticism and Cloninger (1986) suggested that serotonergic neurons of the brain are responsible for anxious and fearful behaviour. Nevertheless, studies have concurred that those who score highly on the Neuroticism scale do so because they have a neurological system with a low threshold; their nervous system is easily activated by external stimuli and they have been described as experiencing emotions more strongly (Eysenck, 1967; Gray, 1981; Strelau and Zawadzki, 1997). Furthermore,, Eysencks (1967) theory of Introversion- Extraversion and its relation to cortical arousal system within reticulothalamic structures was recently investigated using functional magnetic resonance imaging (fMRI). Kumari *et al.* (2004) found that the higher the Extraversion score, the greater the change in fMRI signal from rest to the 3-back condition in an 'n-back' task involving four memory loads. In addition, Extraversion scores were negatively associated with resting fMRI signals in the thalamus and Broca's area extending to Wernicke's area, supporting the hypothesized (negative) relationship between Extraversion and resting arousal. These findings suggest that individual differences affect brain responses during cognitive activity and at rest and provide evidence for the hypothesized neurobiological basis of personality.

Clearly, the link between neurobiology and personality has implications for general health, well-being and behaviour. This can be seen in the extensive range of research that links personality with health, although it is

uncertain whether some of these associations occur due to a direct causal link or whether they are mediated via a health-related behaviour. For example, Spielberger and Jacobs (1982) have found that smokers have significantly higher scores than non-smokers on Eysenck's dimensions and Cramer (1991) has found significant associations between Type A behaviour pattern, extraversion, neuroticism and psychological distress. It is also well known that those with a Type A personality are more likely to suffer from chest pain and coronary heart disease (Costa and McCrae, 1987; Denollet, 1993; Cramer, 1991; see Sapolsky 1998 for a review of the area). There are also links between personality and health problems such as irritable bowel syndrome and other affective disorders such as depression and anxiety (Creed and Guthrie 1987; Rose *et al.*, 1986). Martin (1985) amongst others has noted a strong association between extraversion and affective disorders.

There are a number of different inventories for measuring Extraversion and Neuroticism and these psychometric instruments have been tested for their validity and reliability. Previously used measures include, the NEO Personality Inventory (NEO-PI; Costa & McCrae, 1992), the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway and McKinley, 1989), the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975), and the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1964). The personality scales of Extraversion and Neuroticism can also be found within many other personality theories and tests available, for example on the Myers Briggs Type Indicator (Myers, 1998).

Although there is physiological evidence for conditions such as visual stress (Wilkins, 1995; Wilkins *et al.*, 1999; Huang *et al.*, 2003; Huang *et al.*, 2004), some clinicians remain sceptical about their existence. Indeed, it has been suggested that children who prefer colour simply do so for attention, or have motivational or psychological reasons for claiming that they benefit from colour. Trevor-Roper and Curran (1984) have claimed that people who require tinted spectacles do so as they are under an illusion that their discomfort is relieved or that they do so because the tint draws attention to them. It has also been suggested that some medical practitioners may take tinted spectacles as a sign of attention seeking or neurosis (Brandon, 1985). Howard and Valori (1989) produced a small study on hospital patients who showed a preference for wearing tinted lenses to reduce symptoms. The authors profiled their patient group with an inventory known as the General Sensitivity Index, in which nine primary symptom dimensions are measured. Results suggested that these patients tended to suffer with ailments that were linked with a number of different behavioural traits of psychological distress.

Clearly these studies have a very negative perspective, and take no account of the people who show a measurable and objective change in performance to coloured tints and overlays (e.g. Evans *et al.*, 1996; Wilkins *et al.*, 2001; Wilkins & Lewis, 1999; Bouldoukian *et al.*, 2002; Hollis and Allen, 2006). Nevertheless, as personality dimensions are considered to have a defined, physiological basis there may exist a link between behavioural measures such as personality and conditions such as visual stress. Such an association

would provide another example of how physiological measures relate to and have both perceptual and cognitive-behavioural consequences.

The aim of this study was to investigate whether people with susceptibility to visual stress, who benefit from coloured overlays and lenses, also share similar scores on personality dimensions as measured on the Eysenck Personality Inventory. If people who are susceptible to visual stress do share similar personality characteristics that differ from a normal population this would provide an alternative source of evidence for the neurological basis of visual stress.

## **Methods**

### **Participants**

The participants were recruited from the Anglia Ruskin University student population. Twenty eight participants (12 Males, 16 Females), aged 18 to 30 years who met the inclusion criteria were enrolled into the study. Inclusion criteria are shown in Table 1. Other optometric data were not obtained as previous studies have suggested that subtle binocular and accommodative anomalies are not major aetiological factors in pattern stress (Evans *et al.*, 1996; Evans, 2001; Scott *et al.*, 2002). Informed consent was obtained from every subject after a verbal and a written explanation of the procedures was given. None of the participants had taken part in previous research involving

coloured overlays or tints. The tenets of the Declaration of Helsinki were followed.

### **Table 1**

Best corrected visual acuity of 6/5 and N5 in each eye

No history of migraine headaches

No previous use of coloured overlays or precision tinted spectacles

No previous classification of dyslexia, Meares-Irlen syndrome or any other reading disability

No treatment for any binocular vision anomalies

### **Evaluation of visual stress susceptibility**

A consecutive process was used to recruit a group of 14 Susceptible to visual stress participants and a group of 14 control participants. In total 66 people were screened until 14 Susceptible to visual stress participants were recruited with the first 14 'normals' taken as controls. All the Susceptible to visual stress participants were included in the study. Gender was similar between the groups (Susceptible to visual stress participants 9 males, 5 females; Controls 8 males, 6 females). Three selection criteria were used, in order to select people for the Susceptible to visual stress group. Participants were categorised on the basis of their initial screening scoring over 4 on a pattern

glare test (Wilkins, 1995, 2003). The participants were shown an interference grating, and then given a series of questions regarding the perceptual distortions that they experienced. (For example, 'Looking at the pattern do you see: blurring, bending of the lines, shadowy shapes amongst the lines, etc). For every 'yes' answer given one was added to the participant's score. The pattern was a grating with a square-wave luminance profile. It was circular in outline and when viewed at a distance of 0.4m the grating had the following spatial properties: a frequency of 3 cycles/degree, a radius of 14° and a Michelson contrast of 0.8. The grating is illustrated in Wilkins (2003). Individuals with scores of 4 or more indicated that a person may have a sensitivity to pattern glare and experience symptoms (Wilkins, 2003). This measure has been shown to be a reliable predictor of whether a person will benefit from colour overlays (Hollis and Allen, 2006). Secondly, the participants were required to show a preference for a particular coloured overlay. Assessment and testing was carried out using the Intuitive coloured overlays (I.O.O. Marketing Ltd.) as they sample colours systematically from the CIE 1976 UCS diagram (Wilkins *et al.*, 1994; Wilkins *et al.*, 1999; Bouldoukian *et al.*, 2002). All overlays were used singly. The overlays provided an average reflectance of approximately 47% and the matt coating has been reported to consistently reduce the contrast of the text beneath by less than 5% (Evans & Joseph, 2002). Lastly the participants were required to have a positive test on the Wilkins Rate of Reading test (Wilkins *et al.*, 1996), producing an improvement on rate of reading of more than 5% with the coloured overlay when compared with reading through a clear overlay (Wilkins *et al.*, 1996; Evans & Joseph, 2002).

The results of the Wilkins Rate of Reading Test confirmed that the participants who were susceptible to visual stress benefited from reading with the coloured overlay and that the normals did not as shown in Figure 1.

### **Insert Figure 1 about here**

For the group of 14 participants classed as Susceptible to visual stress, the score of the pattern glare evaluation ranged from 4 to 8. These ratings indicated that the group of participants were sensitive to pattern glare and may benefit from coloured overlays. This was verified using the Intuitive Overlays Test Pack (I.O.O. Marketing Ltd) and the Wilkins Rate of Reading Test. The group of participants were shown to significantly benefit from reading with a coloured overlay (Rate of Reading: mean with colour = 164 words/min; mean without colour = 157 words/min  $t_{(13)} = 2.77, p = 0.01$ ).

The group of 14 participants classified as normal showed scores for the pattern glare evaluation ranging from 0 to 2. For cases where no preference for a particular coloured overlay was found a random coloured overlay was selected for testing. This group of subjects did not benefit from coloured overlays (Rate of Reading: mean with colour = 164 words/min; mean without colour = 165 words/min  $t_{(13)} < 1, p = 0.41$ ).

### **Experiment design and procedure**

The personality inventory was given to all participants and the resulting scores were compared between those classified as having visual stress or as normal. The dependent variable was the Extraversion and Neuroticism scores from the Eysenck personality inventory. The change in reading speed in words per minute (taken from the WRRT obtained during the initial screening of participants whilst reading with and without an overlay) was used for additional analysis.

The original style Eysenck Personality Inventory (EPI) was used as a personality measure (Eysenck, 1967). The original version of the Eysenck Personality Inventory (EPI) was used in preference to the later version known as the Eysenck Personality Questionnaire (EPQ) which included a measure of Psychoticism. It was not considered appropriate to include a measure of Psychoticism as there is a disagreement as to what the P scale actually measures (Pickering *et al.*, 2003). Moreover, the Extraversion and Neuroticism scales were of relevance to this study as these were the personality dimensions that Eysenck made theoretical claims about regarding their relationship to the neurobiology. The extraversion and neuroticism that are used on this inventory have become the basis of other tests (Costa and McCrae, 1992, Hathaway and McKinley, 1989; Pettinger, 1993). The EPI and EPQ (Eysenck & Eysenck, 1964, 1975) have become the most commonly used measure for investigating the relationship between neuroticism and health. The EPI consists of a series of 57 questions that require a yes/no answer. The form consists of a number of test items, that are scored to produce measures of Extraversion, Neuroticism, and a small number of items

used to test the participants' response (termed a lie score). The EPI and the relationships between personality dimensions and neuro-anatomy are fully described in Eysenck (1990).

## **Results**

The EPI scores do not have a distinct cut off for different personality dimensions, rather they measure on a continuum ranging from a score of 0 with higher scores on the Extraversion-Introversion scale representing a more extravert behaviour and higher scores on the Neuroticism-Stability scale representing a more neurotic tendency.

In respect of the Extraversion-Introversion scores, the normal participants had a mean score of 16.4 (standard deviation = 3.3) and the visual stress participants had a mean score of 16.5 (standard deviation = 2.0) This difference was not significant ( $t_{(25)} = 0.11$ ,  $p = 0.94$ ) In respect of the Neuroticism-Stability scores, the normal participants had a mean score of 11.0 (standard deviation = 2.2) and the visual stress participants had a mean score of 13.1 (standard deviation = 2.6) This difference was statistically significant ( $t_{(25)} = 2.28$ ,  $p = 0.03$ ). Figure 2 illustrates that the visual stress group scored higher on the EPI Neuroticism scale than the normal group.

**Insert Figure 2 about here**

## **Discussion**

The results of the rate of reading test support previous studies and indicate that people who suffer from visual stress benefit from coloured overlays. The results illustrate that the participants who were classified as being susceptible to visual stress, did suffer with pattern glare. Furthermore, the change in reading speed found with the Wilkins Rate of Reading test also provides support for the mode of assessment and is in accordance with previous research which has shown that taking a rating of distortion and illusions immediately prior to the Wilkins rate of reading test, is a useful predictor of whether people will benefit from coloured overlays (Hollis and Allen 2006).

The results of the personality testing on the Eysenck personality inventory are interesting for a number of reasons. In respect of the Neuroticism-Stability scores, participants who suffered visual stress produced significantly higher ratings than those who were in the normal group. Theoretically this is important, as according to personality theories, those who score highly on the neuroticism scale do so because they have a neurological system with a low threshold; their nervous system is easily activated by external stimuli and they have been described as experiencing emotions more strongly (Eysenck, 1967; Gray, 1981; Strelau and Zawadzki, 1997). This concurs with the notion of visual stress resulting from an excess of neural activity. If colour reduces excitation in hyperexcitable areas of the brain this would explain the reduction in perceptual distortions with tints. It would also demonstrate why sensitive individuals would prefer a precision tinted lens. However, the effect of colour filters does not occur due to a simple change in contrast (Jeanes *et al.*, 1997).

All the coloured overlays used in this study have been reported to consistently reduce the contrast of the text beneath by less than 5% (Evans & Joseph, 2002). If the effects of colour were related simply to the opponent processing of colour that occurs due to the density or organisation of cones within the retina, one would predict that individuals who found blue tints to enhance performance would find yellow tints detrimental (MacLeod and Boynton, 1979). This has not been shown to be the case. It has been postulated that the hue, saturation and value are highly specific for each individual and related to the topographical representation of colour in the cortex, whose organisation does not follow an opponent manner (Xiao *et al.*, 2003).

The Extraversion-Introversion scores indicated that participants who suffered visual stress were no different to those who were in the normal group. In his original theory, Eysenck argued that the Extraversion-Introversion dimension was based on the reticular activating system; extroversion being the preferred behaviour that occurs when the reticular activating system is not active enough in arousing the cortex. Kumari *et al.*'s (2004) recent findings that the higher the Extroversion score, the greater the change in fMRI signal from rest to the 3-back condition in an 'n-back' task involving four memory loads and that Extroversion scores were negatively associated with resting fMRI support the hypothesized (negative) relationship between Extroversion and resting arousal.

Our data provide an alternative source of evidence that there is a relationship between neurological structures and conditions such as visual stress. The

significant relationship with Eysenck's measure of neuroticism may indicate that what is being identified is a relationship to an underlying neurological process, such as arousal. The specific nature of this relationship or whether indeed this is a co variation with other factors requires further investigation.

It is important to acknowledge the differences between our participants and the current measurements of personality with those in previous studies. Howard and Valori (1989) tested hospital patients and took their measure using a psychometric test. This did not measure personality but the experience of distressing symptoms and ailments. Although studies such as that of Trevor-Roper and Curran (1984) claim that patients may have an illusion of benefit from tinted lenses, no attempt was made to try and quantify this objectively and so it is difficult to make direct comparisons with their findings. Recently, Eperjesi (2007) investigated the relationship between tinted spectacle wearers and personality in a university based population and suggested that use of tinted lenses by physically healthy people is unlikely to be an indicator of personality type. However, all participants who wore tinted lenses for reading difficulties were excluded from the study.

It has been noted previously that those who score highly on neuroticism, also may show a positive bias for the self reporting of symptoms (Yousfi *et al.*, 2004); In particular subjects high in Neuroticism are said to be prone to complain about physical symptoms (Stone and Costa, 1990) This is of particular relevance, not only to this study, but also to any assessment where

the participant is asked to report both past experience and direct experience of illusions and distortions during tests such as the Pattern Glare test.

Potentially, it could be argued that previous findings of an association between personality and disease may be an artefact of response biases; participants with visual stress reporting (rather than actually experiencing) more symptoms due to their response bias. However, the dependent variable of interest in the current study was reading speed on the Wilkins rate of reading. Whilst rate of reading is not a truly objective measure, it cannot be considered a self-report. The experience of perceptual distortion was taken only as a screening assessment and not entered into the statistical analysis of differences between the groups when comparing Extraversion and Neuroticism scores. The findings demonstrate a relationship between personality and changes in performance using an alternative measure of change other than simply the self reporting of symptoms.

Our results indicate that the previous findings of hospital patients who wear tinted lenses are not necessarily unsubstantiated. It demonstrates that people who experience visual stress may be characterised with respect to particular personality 'dimensions'. Nevertheless, rather than assuming people who like tinted lenses are seeking attention, it indicates that there may be underlying reasons why certain individuals prefer tinted spectacle lenses. It suggests that these people are likely to show preferences for tints as these tints in some way help to attain balance within their neurological system. It should again be emphasised that people who score highly on the neuroticism-stability scale

have a lower threshold for external stimuli. Inventories such as the Eysenck EPI measure a continuum of personality, and not a 'neurosis' in terms of mental health. The previous research by Howard and Valori (1989) and Trevor-Roper and Curran (1984) clearly indicate the bias and prejudice that people face when they have impairments such as reading disability and feel that they require help with items such as special tints.

It is clear that colour has some quite specific role in the reduction of visual stress but the mechanism of how this colour specificity relates to theory is not yet fully detailed. The current study indicates that in accordance with personality theory, the location of 'hyperexcitable regions' which are considered to underlie visual stress may be within more specific areas of the nervous system. These specific areas are still to be detailed. It also demonstrates that people who experience visual stress may have particular personality characteristics. These people are likely to show preferences for tints as these tints in some way help to attain balance within their neurological system.

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Figure 1: Box-plots to show the change in reading speed (words per minute) for susceptible to visual stress and normal participants when reading with and without coloured overlays. The lines across the inside of each box represent the median values, the length of the box is the variable's inter-quartile range and the protruding lines (whiskers) go out to the variable's smallest and largest values.

Figure 2: Mean Extraversion and Neuroticism scores (EPI) for susceptible to visual stress and normal participants

Table 1: Inclusion Criteria for participants classed as susceptible to visual stress

Figure 1

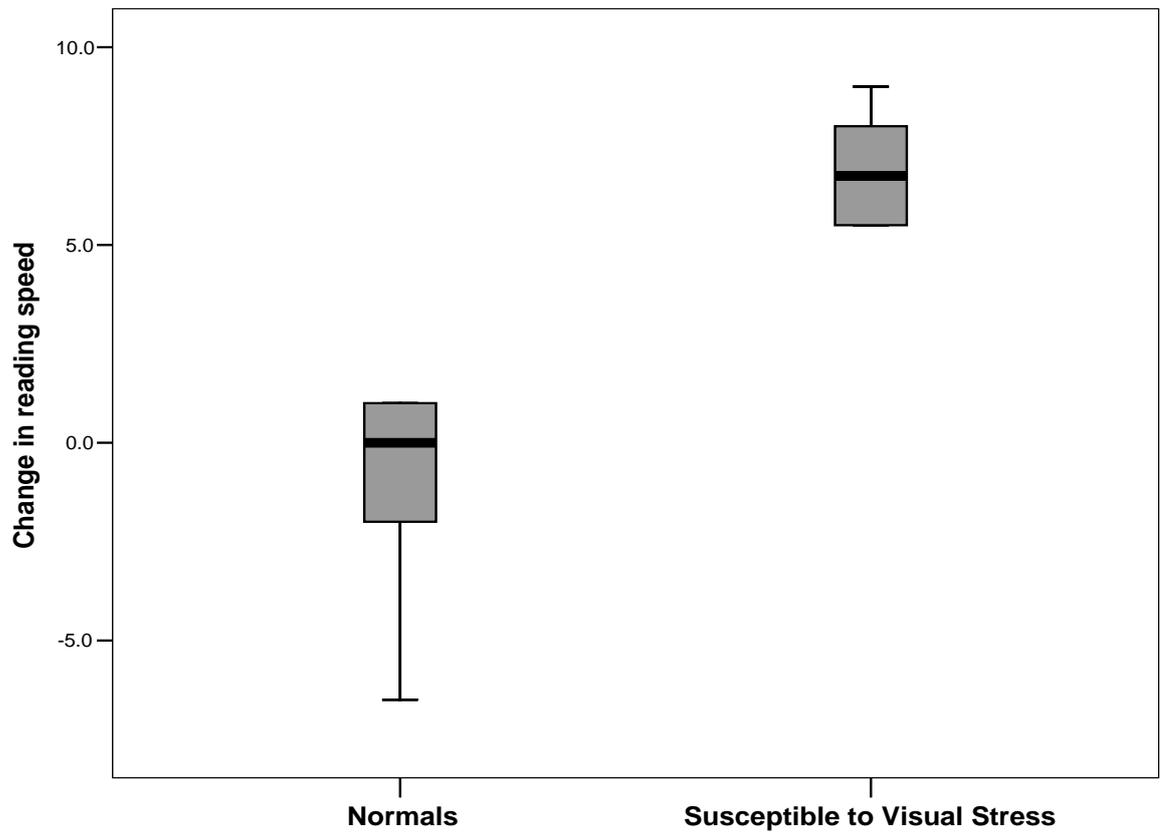


Figure 2

