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Who Are You to Judge? Investigating Narcissism through Pupil Dilation at Witness Testimonials

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Abstract

Various literature has explored narcissistic behaviour and its distinct emotional and aggressive nature. However, there is a significant gap in research when exploring the physiological differences of individual classified as having high narcissistic traits and tendencies. Pupillometry is a measure often utilised to measure distinct differences in emotional arousal. This measure allows for excellent insight into physiological responses to various stimuli presented. This exploratory study was set up to investigate pupillometry responses to auditory stimulation in narcissistic versus control participants. Findings were consistent with previous research; however, various limitations hindered significant findings. This pilot study is a guideline for future research as it is a first attempt at exploring a physiological relationship between emotionality and narcissism in the context of a criminal hearing.

Keywords

Pupillometry, Narcissism, Witness Testimonials, Physiology

1. Introduction

Pupil investigation is utilised to examine physiological reactions to certain stimuli within humans. This can be done through exposure to controlled external stimuli such as auditory, tactile, or olfactory variables. Furthermore, physiological responses have also been investigated through Galvanic Skin Response measurements. Additionally, specific research has found a correlation between pupillometry responses and emotional reactions as the pupil expands when emotional responses are elicited (per review, see van der Wel & van Steenbergen, 2018). A common challenge when investigating pupillometry is the individual differences

observed between persons, as some elicit stronger emotional reactions than others to the emotional stimuli presented. For instance, those high in narcissistic traits are associated with little emotional reactivity. Psychological research into the physiological features of narcissistic traits is limited due to a lack of empirical evidence. Furthermore, the narcissistic mind when judging others within a forensic setting such as court trials has yet to be investigated. Hence, this study examined the relationship between physical reactions to witness testimonials and narcissism levels by measuring pupil dilation.

2. Pupillometry Research

Pupillometry research uncovers why the pupil reduces and expands its size and which factors contribute to this phenomenon. Two main muscles control the expansion and contraction of the pupil (Janisse, 1977); The pupillary dilator opens the pupil and results in dilation. This muscle is tied directly to the sympathetic nervous system. In contrast, the pupillary sphincter regulates contraction and is connected to the parasympathetic nervous system. Furthermore, pupil size measurement is widely utilised in psychological research to investigate cognitive function. Hess and Polt (1960) first popularised the concept by stating, "the pupil of the eye has been found to accompany the viewing of emotionally toned or interesting visual stimuli". After gaining access to video oculography in the late 90s, a rise in pupillometry research publishing can be observed simply due to the high-resolution access gained. The pupillary light response (PLR) occurs when dilation and constriction occur due to changes in lighting (Campbell & Gregory, 1960). Interestingly, it was later found that the pupil does not exclusively respond to physical light entering the eye but also subjective perceptions of lightness (Fahle et al., 2011).

Furthermore, "under conditions of binocular rivalry, where visual consciousness alternates between different stimuli presented to each eye, changes in pupil size reflect the luminance of the stimulus that reaches conscious awareness" (Martin, 2019; Naber et al., 2011). Interestingly, Leknes et al. (2013) found that emotionality affects pupil size through oxytocin enhancement during a placebo-controlled crossover study. Furthermore, higher cognitive ability correlates to a larger pupil size (Tsukahara et al., 2016), explaining the importance of neural connections between the eye and the brain.

However, there are various difficulties when conducting pupillometry investigations. For instance, findings suggest that relationships impact pupil size (Prochazkova et al., 2018). This can be proven difficult as research on impressions, judgements and effects within relationships is extremely limited. Furthermore, hormonal changes could affect pupillary reactions and thereby limits research concerning children and adolescents (Laeng & Falkenberg, 2007). Additionally, as exposure to light and auditory stimuli affects pupil changes, it is essential to be extremely cautious and precise when conducting research (Brych et al., 2020).

3. Narcissism

Narcissism is often related to narcissistic personality disorder and is a term derived from Näcke (1899), who described the tendency as treating one's body objectively and not through emotional stimulation. Furthermore, the DSM-5 describes Narcissistic Personality Disorder to effectively reflect chronic expressions of excessive grandiosity alongside the constant need for admiration, a lack of empathy and 1) an inflated sense of self-worth; 2) preoccupation with fantasies of unlimited influence, achievement, intelligence, attractiveness, or romance; 3) belief that one is distinctive and elite and should only associate with others of similar stature; 4) excessive needs for respect, appreciation, and praise; 5) sense of privilege; 6) willingness to take advantage of others for personal gain; 7) lack of compassion; 8) the jealousy of others; and 9) exhibition of conceited behaviours and attitudes.

However, in this study, those identified with narcissistic traits and not those diagnosed with a personality disorder are being examined. As a means for effectiveness and under the complication of the undergraduate research project, the Narcissistic Personality Inventory (NPI) was utilised to measure narcissistic traits (see Measures, Narcissistic Traits). This is of interest due to the large gap in research investigating physiological differences in individuals high in narcissistic traits compared to those with low/normal expression.

4. Current Research

This study builds on pupillometry response research by investigating pupillometry in relation to auditory stimuli and narcissistic traits within a court setting. This was done by measuring narcissism levels utilising the Narcissistic Personality Inventory questionnaire and comparing pupil dilation in 2 auditory conditions: one high-intensity witness testimonial measure (describing items such as murder and kidnapping) and one control intensity witness testimonial measure (describing everyday phenomena). Further investigation is needed to assess this relationship accurately.

Previous literature has found auditory stimuli to cause pupil dilation. However, this has not been tested in a court setting nor with descriptions of criminal activity. Brych et al. (2020) investigated the effects of vocal demands on pupil dilation. This was proposed as a consequence of a reanalysis of a previous pre-existing data set which suggested vocalisation to have a more significant effect on pupil dilation in contrast to conditions without vocal demands. Participants were presented with auditory instruction words to systematically investigate which vocal demands most effectively affect pupil dilation. Furthermore, cognitive (explicit) working memory processes have been studied about speech understanding, where pupil dilation was measured as an understanding of task-induced mental effort (Zekveld et al., 2010). Results found listening effort (as seen by the pupil response) to increase with decreasing speech intelligibility.

Furthermore, this underlined the importance of pupillometry investigations as

listening skills and comprehension were explored and understanding how to reach a certain performance level as a listener. Research into juror attentiveness is highly relevant as listening skills are vital. However, cognitive attributions such as narcissistic traits have yet to be investigated.

4.1. Research Questions

Research questions were strategically drawn from the previous investigation on physical traits discovered in individuals with high narcissistic traits.

1) Can a relationship between narcissistic traits and pupil dilation be observed?

2) Is the dilation significantly decreased in the brutal witness testimonials category for those scoring high on the NPI questionnaire?

4.2. Experimental Hypotheses

Drawn from these previous investigations, alongside Leknes's (2020) findings on emotionality, are the following hypotheses for the current research:

1) Those scoring high on the narcissistic personality inventory have a less significant level of pupillometry changes to the brutal witness testimonials

2) Those scoring low on the narcissistic personality inventory have a significantly high level of pupillometry changes to the brutal witness testimonials.

5. Method

5.1. Participants

Participants were 19 psychology students (2 male, 18 females) from the University of Southampton. Seventeen were undergraduate, whilst 2 were postgraduate students. All undergraduate students received 12 research credits in exchange for their time. Demographic variables such as age and ethnicity were not collected.

5.2. Measures

Narcissistic traits. The 40-item Narcissistic Personality Inventory (Raskin & Hall, 1979) was utilised to measure levels of narcissistic traits. The Inventory is based on the definition of narcissistic personality disorder found in the DSM-3. However, this is not a diagnostic tool for the disorder but actively measures subclinical or regular expressions of narcissism (Raskin & Terry, 1988). The NPI is a self-report measure where 40 items are presented, and participants were instructed to circle either statement A or statement B per item. They were asked to choose the option they identified with the most. For instance, statement 36A reads, "I am a born leader", whilst statement 36B reads, "Leadership is a quality that takes a long time to develop" (please see appendix A for all questions given). Scores were then calculated according to the original instructions provided, and a summary of this can be seen in Appendix B. This measure of assessing narcissistic traits is classified as highly accurate as a high construct, and ecological validity (Campbell et al., 2011) has been found. However, criticisms of this test frequently question its accuracy as scores on the NPI are often positively corre-

lated with self-esteem. For this research, other tests, such as the Pathological Narcissism Inventory, the Narcissistic Grandiosity Scale and the Psychological Entitlement scale, were compared against the NPI. However, as these effectively measure sub-scales of narcissistic behaviour rather than directly narcissistic traits, it was found better to utilise the NPI. For future research, this can be looked into further, especially when evaluating subcategories of narcissism, such as entitlement.

Pupil dilation. In the current research, all eye-tracking data was acquired utilising the EyeLink1000 system (SR Research Ltd. Ontario, CA). This system is a stationary tower mount configuration which guarantees head stability by having a chin and forehead rest. This system tracker can determine gaze position with an accuracy of 0.25-degree visual angle alongside resolving pupil size to within 0.2% of the diameter and conducting 250, 5000 or 1000 Hz monocular video recording (SR Research Ltd., 2010). Furthermore, it utilises two pupil detection models: Centroid and Ellipse Fitting. The centroid fitting utilised an algorithm to effectively track and calculate the centre of the threshold pupil mass and is recommended when using a tower mount configuration system.

In contrast, the ellipse fitting fits an ellipse of the pupil and tracks its centre. This is exclusively utilised for remote configuration. Thereby, for this research, the centroid fitting model was used. Furthermore, the output given was in arbitrary pixel units, in this instance, diameter. As reflected in Figure 1, the EyeLink1000 requires a host computer for the eye tracker and eye tracking computations. A display computer runs the experimental application effectively, logs behavioural responses, and communicates with the eye tracker (see Figure 2) via an Ethernet Link.

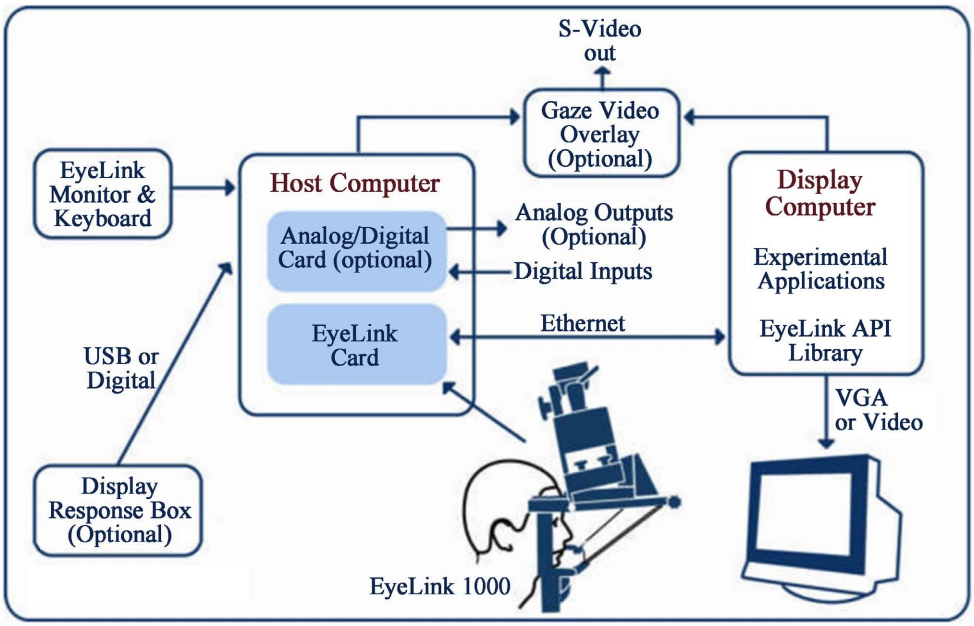

Figure 1. A schematic diagram illustrates the EyeLink system's typical configuration (Martin, 2019).

Figure 2. (Left) The general set-up of the eye-tracking software as utilised in this experiment. (Right) A more detailed overview of the sensors and speakers used throughout the study.

5.3. Design

The study took place in an eye-tracing lab equipped with the EyeLink1000 apparatus. To maintain similar conditions, all lights were switched out, and curtains were closed. This was also done to ensure accurate pupil readings. The room was also equipped with a speaker of the make "Trust", emitting the same volume for all participants. The experiment conducted was a repeated measure within the subject design. This was done to minimise differences between groups. Furthermore, a smaller sample size is needed when utilising this condition, which was beneficial as this was an undergraduate imperial project. The order effect was accounted for as the soundtracks were played in a random order for every participant.

5.4. Procedure

The University of Southampton ethics committee approved this experiment. All participants were provided with an information sheet and a mandatory health check form (to ensure safety for everyone due to the Covid-19 pandemic (SARS-CoV-2) 2 - 3 days before entering the laboratory. The health form was collected via email on the day of the procedure. If not read already, participants were given the information sheet containing an overview of the study and their right to withdraw participation at any time. A consent form was then given to them for signing, ensuring their voluntary involvement and consent for their data to be used. After this, participants were instructed to rest their heads on the chin rest and their forehead up against the bar supporting them. To ensure comfort, they were allowed to adjust their chairs either up or down. They were then instructed to look at the middle of the screen, where a white cross was present. Once comfortable, the focus of the eye tracker was adjusted to ensure clarity of measurement. After this, calibration and validation were conducted on a 9-point scale. Once acceptable measures were obtained (1 degree and a maximum of 0.5 average were categorised as acceptable), a practise test was run through with each participant. This consisted of staring at the middle of the screen, where a

fixed cross was present, whilst listening to audio played through the speaker in front of them. This consisted of 30 trials. Re-calibration and validation were conducted after the practice test before participants were presented with all X auditory stimuli in a randomly allocated order. After every four trials, participants were asked if they needed a break to rest their eyes. Thereby, the accuracy of pupillometry measures was ensured.

6. Results

The pupillometric measures obtained are expressed as a percentage in the present research. This is common in this area of research due to individuality, as each participant has a base pupil size. The ratio obtained is compared to a baseline, the period before the audio is played where the participants are silent. This baseline is 100. Consequentially, pupil expansion is detected when the percentage is more than 100, whilst constriction is seen if it is less than 100.

Descriptive Statistics/T-test/Regressions/Correlations

A paired samples t-test was used to analyse differences in the two conditions. No significant differences were found between the control condition (M = 107.072, SD = 14.544) and the high condition (M = 103.061, SD = 5.680). Therefore, no statistical significance was found (t (17) = 1.380, p < 0.185).

Furthermore, correlations were run to explore the relationship between narcissism levels and high conditions. It is important to empathise that the sample size did not represent an overall high level of narcissistic traits (M = 9.111). This relationship can further be seen in Figure 3, where the X axis illustrates the NPI scores calculated, and the Y axis represents pupil dilation observed in the high

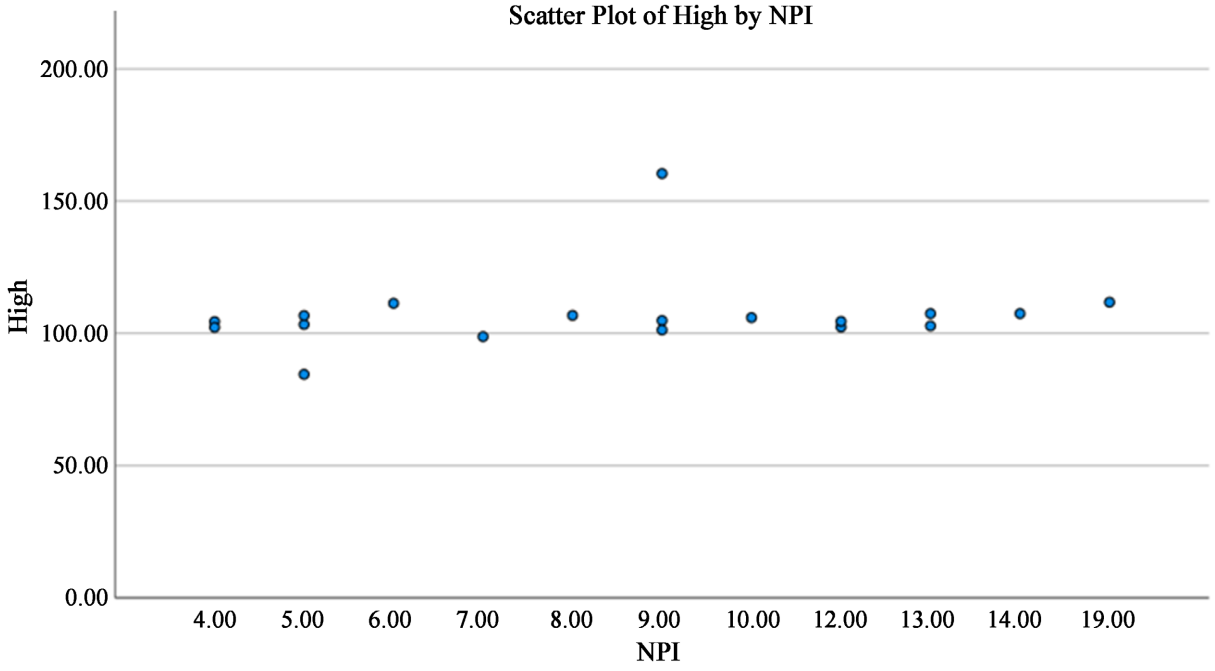

Figure 3. The relationship between NPI scores and High conditions is represented in a scatterplot graph.

condition.

Consequentially, Pearson's correlation tests showed that these were not significantly related (r (17) = 0.156, $p \leq 0.537$). This relationship was further explored by conducting a regression (r^2 = 0.024, F (0.398, 17) = p = 0.537) which underlined this statement.

7. Discussion

This study explored the proposed relationship between narcissism and pupillometry responses to auditory witness testimonials. This was achieved by measuring pupil dilation when presented with two witness testimonials: a control stimuli group and a high valence stimuli group. After this, the narcissism levels of the participants were measured. Finally, t-tests, regressions and correlations were calculated to analyse the data collected.

7.1. Research Question 1 and Experimental Hypothesis 1

Research question 1 asked whether a relationship between narcissistic traits and pupil dilation can be observed. However, such conclusions could not be drawn due to the limited sample size. Interestingly, one could observe a difference in the high and low conditions, as reflected in the descriptive statistics. This illustrates a lack of narcissistic tendencies present within the sample. Perhaps significance would arise if this study were conducted on individuals diagnosed with Narcissistic Personality Disorder. This would allow us to examine any physiological differences between narcissistic tendencies and non-narcissistic configurations.

Experimental Hypothesis 1 predicted that those scoring high on the narcissistic personality inventory would have less significant pupillometry changes to the brutal witness testimonials. According to the descriptive statistics obtained, this hypothesis was proven. In turn, non-significant results would have been effective if a population with higher narcissistic tendencies had been sampled. Furthermore, it is of interest that such a difference was found in the population tested as a lack of narcissistic traits was presented. Thereby conclusions about a general decrease in pupil size can be drawn when presented with emotionally brutal statements. This is further supported by research on pupillometry and emotionality ruling 'strong support for the hypothesis that the pupil's response during affective picture viewing reflects emotional arousal associated with increased sympathetic activity (Bradley et al., 2008; Steidtmann et al., 2010; Oliva & Anikin, 2018). In turn, this reveals a subconscious emotionality within humans which could be classified as non-emotional or non-sympathetic.

7.2. Research Question 2 and Experimental Hypothesis 2

Research question 2 asked whether the dilation significantly decreased in the brutal witness testimonials category for those scoring high on the NPI questionnaire. Interestingly, as reflected in the descriptive statistics, the control condition

had an overall higher score than the high condition, although insignificant. Thereby, this question can be concluded with a yes. However, due to the insufficient sample size, there is a lack of certainty concerning the empirical support of this conclusion. Furthermore, one particular outlier (seen in **Figure 3**) evidences the opposite argument. This participant had the highest score in the NPI category but still elicited more dilation in the high condition compared to the control condition. This reflects higher emotionality elicited and goes against this study's predictors.

Experimental Hypothesis 2 predicted those scoring low on the narcissistic personality inventory to have highly significant pupillometry changes to the brutal witness testimonials. Overall, this hypothesis was not proven, as underlined by the descriptive statistics, the Pearson correlation test and the regression performed.

7.3. Limitations and Future Research

The main limitation of this study was the lack of participants scoring highly on the NPI questionnaire. Previous literature utilising the NPI measure has had a relatively high average score (Luchner et al., 2011; Grijalva et al., 2015; Atlas & Them, 2008), often averaging a 19 compared to the 9.111 obtained in this study. One of the main goals of this study was to explore the difference between two groups: those scoring high and those scoring low on the NPI. Byrne and Worthy (2013) exemplify the methodology behind this by investigating the role of narcissistic tendencies on decision-making performance. Although not examined with the lens of physiology nor pupillometry specifically, the two groups consisted of 59 participants each, thereby allowing for internal validity.

Furthermore, it was underlined that "the normative mean narcissism score for non-clinical population samples is 15.55 (SD = 6.7)" and Byrne and Worthy's (2013) mean score was 16.45 (SD = 6.6) utilising the same recruitment methods as the present study. In contrast, the present study's mean was 9.11 (SD = 4.11), which underlines how underrepresented narcissism within the dataset is. However, as the data collection for the present study was completed during a global pandemic, limited participation was expected. In the future, a pre-screening method should be introduced to encourage a larger sample size of individuals with higher narcissism levels.

Thereby, replication of this study is encouraged with a larger pool of participants. It would also be interesting to explore age, religion, and sexuality further in relation to narcissism and pupil dilation, as these measures were not obtained. This is further encouraged by Laeng and Falkenberg's (2007) findings on pupil change being consistent with hormonal changes. As hormonal changes are expected in younger adults, it is, therefore, worthwhile expanding the age gap associated with this research as hormonal peak settles typically in the natural biological process of menopause (Santoro & Randolph, 2011). Furthermore, it would be interesting to investigate those going through sexual transitions, such as

hormone treatment and gender-affirming surgery, to prove this empirical finding further. Again, due to the lack of obtaining ethnicity information, the study lacks ethnic diversity and cannot be generalised across cultures. Again, this would be interesting to explore further.

Furthermore, this study expands on previous findings by replicating the Brych et al. (2020) investigation. Pupillometry responses to voice demands were investigated, which allowed for replication with the present auditory stimuli utilised. The new factor introduced was the NI questionnaire and its correlation with the pupillometry findings. Overall, this replication was successful, and the challenge of expanding on previous results was completed. In addition to utilising the NPI questionnaire, future research should integrate sub-sales of traits found, such as self-esteem and confidence.

Future research could also approach the witness testimonials stimuli with more realism. For instance, soundtracks from actual court cases could be utilised to guarantee authenticity. Even videos of courtroom procedures could be played. However, this study chose not to incorporate such measures as there is a higher risk of incorrect eye readings obtained due to causes such as movement and light alongside the bias stimuli being likely, as court cases are often replicated in famous movies. Furthermore, the artificial situation utilised within this study may create stress and anxiety, which could partially contribute to pupil response (Saleem et al., 2019). Therefore, using mobile pupillometry units on a jury during a live case would be optimal. However, due to sealed court cases and anonymity, this is not easy to arrange and execute within ethically approved standards. This study is a pilot for research into narcissism, court hearings and pupil dilation.

An interesting factor in investigating pupillometry and narcissism within a court setting was the jury system utilised within the commonwealth countries. The case of Andrew Adams (R v Adams, 2007) exemplifies the errors made by jurors to impact individuals' lives significantly. In short, Adams was convicted of murder and sentenced to life in prison. However, he was freed 14 years later due to findings by the Criminal Cases Review Commission, which concluded misconduct by jurors. This, in turn, describes the issue of fairness. If Adam's jurors had been different, would he still have been deprived of 14 years of his life in prison? In short, if the jurors had been pre-screened for emotionality and empathic concerns (for instance, through completing the NPI), would a fair distribution of individually different people significantly have changed Adam's sentence?

8. Conclusion

Overall, this study is consistent with previous research on pupillometry and emotionality. A general lack of a large dataset drastically hindered significant findings. However, this study could be utilised as a pilot study for future research. In addition, the association with narcissism being a factor for emotional

and physiological reactivity must be explored further to prove this theory empirically. The present study represents a first attempt to address questions regarding the physiological relationship between emotionality and narcissism in the context of a criminal hearing. Thereby, it contributes to an under researched area in both psychology and law. Furthermore, the author argues that additional research examining narcissism and pupil response may shed light on the distinct physiological uniqueness's of individuals.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix A

1.	A. I have a natural talent for influencing people.	B. I am not good at influencing people.
2.	A. Modesty doesn't become me.	B. I am essentially a modest person.
3.	A. I would do almost anything on a dare.	B. I tend to be a fairly cautious person.
4.	A. When people compliment me I sometimes get embarrassed.	B. I know that I am good because everybody keeps telling me so.
5.	A. The thought of ruling the world frightens the hell out of me.	B. If I ruled the world it would be a better place.
6.	A. I can usually talk my way out of anything.	B. I try to accept the consequences of my behavior.
7.	A. I prefer to blend in with the crowd.	B. I like to be the center of attention.
8.	A. I will be a success.	B. I am not too concerned about success.
9.	A. I am no better or worse than most people.	B. I think I am a special person.
10.	A. I am not sure if I would make a good leader.	B. I see myself as a good leader.
11.	A. I am assertive.	B. I wish I were more assertive.
12.	A. I like to have authority over other people.	B. I don't mind following orders.
13.	A. I find it easy to manipulate people.	B. I don't like it when I find myself manipulating people.
14.	A. I insist upon getting the respect that is due me.	B. I usually get the respect that I deserve.
15.	A. I don't particularly like to show off my body.	B. I like to show off my body.
16.	A. I can read people like a book.	B. People are sometimes hard to understand.
17.	A. If I feel competent I am willing to take responsibility for making decisions.	B. I like to take responsibility for making decisions.
18.	A. I just want to be reasonably happy.	B. I want to amount to something in the eyes of the world.
19.	A. My body is nothing special.	B. I like to look at my body.
20.	A. I try not to be a show off.	B. I will usually show off if I get the chance.
21.	A. I always know what I am doing.	B. Sometimes I am not sure of what I am doing.
22.	A. I sometimes depend on people to get things done.	B. I rarely depend on anyone else to get things done.
23.	A. Sometimes I tell good stories.	B. Everybody likes to hear my stories.
24.	A. I expect a great deal from other people.	B. I like to do things for other people.
25.	A. I will never be satisfied until I get all that I deserve.	B. I take my satisfactions as they come.
26.	A. Compliments embarrass me.	B. I like to be complimented.
27.	A. I have a strong will to power.	B. Power for its own sake doesn't interest me.
28.	A. I don't care about new fads and fashions.	B. I like to start new fads and fashions.
29.	A. I like to look at myself in the mirror.	B. I am not particularly interested in looking at myself in the mirror.
30.	A. I really like to be the center of attention.	B. It makes me uncomfortable to be the center of attention.
31.	A. I can live my life in any way I want to.	B. People can't always live their lives in terms of what they want.
32.	A. Being an authority doesn't mean that much to me.	B. People always seem to recognize my authority.
33.	A. I would prefer to be a leader.	B. It makes little difference to me whether I am a leader or not.
34.	A. I am going to be a great person.	B. I hope I am going to be successful.
35.	A. People sometimes believe what I tell them.	B. I can make anybody believe anything I want them to.
36.	A. I am a born leader.	B. Leadership is a quality that takes a long time to develop.
37.	A. I wish somebody would someday write my biography.	B. I don't like people to pry into my life for any reason.
38.	A. I get upset when people don't notice how I look when I go out in public.	B. I don't mind blending into the crowd when I go out in public.
39.	A. I am more capable than other people.	B. There is a lot that I can learn from other people.
40.	A. I am much like everybody else.	B. I am an extraordinary person.

Appendix B

To score:

For each of the following where you answered A give yourself one point:

1, 2, 3, 6, 8, 11, 12, 13, 14, 16, 21, 24, 25, 27, 29, 30, 31, 33, 34, 36, 37, 38, 39

For each of the following where you answered B give yourself one point:

4, 5, 7, 9, 10, 15, 17, 18, 19, 20, 22, 23, 26, 28, 32, 35, 40

Total Score: _____

The score you calculated should be between 0 and 40. Below is a graph of the distribution of how others score on test. Scores above 30 may be concerning.