EXAMINING THE NEUROLOGICAL MECHANISMS OF PATHOLOGICAL NARCISSISM THROUGH A REWARD PARADIGM

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Spring 2015

A thesis
submitted in partial fulfillment
of the requirements for a baccalaureate degree
in Psychology
with honors in Psychology

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ABSTRACT

The present study used functional Magnetic Resonance Imaging (fMRI) to investigate the neurological mechanisms of Pathological Narcissism, namely, Narcissistic Grandiosity and Narcissistic Vulnerability through a reward paradigm. I predicted that individuals with higher PNI Narcissistic Grandiosity scores would have increased activation in the medial prefrontal cortex and decreased activation in the orbitofrontal cortex (OFC), dorsal anterior cingulate cortex (ACC), and posteromedial cortex (PMC) during High Reward conditions, and that individuals with higher PNI Narcissistic Vulnerability scores would have increased activation in the OFC, dACC, PMC, temporal lobe, cingulate cortex, parahippocampal gyrus, right inferior and medial frontal gyrus, as well as, decreased activation in the mPFC during High Punishment conditions. Data was gathered from 36 participants, ranging in age from 19 to 48 years old. Subjects first completed the Pathological Narcissism Inventory (PNI) to measure levels of Narcissistic Grandiosity and Narcissistic Vulnerability, followed by an fMRI in which a Card Guessing Task was administered with three conditions: High Reward, High Punishment, and Control. Results revealed an association between Narcissistic Grandiosity and decreased activation in the postcentral gyrus, middle temporal gyrus, superior occipital gyrus, and superior temporal gyrus, as well as, increased activation in the precuneus during High Reward. An association between Narcissistic Vulnerability and increased activation in the superior frontal gyrus during High Punishment was also found. While the results do not confirm my hypotheses, they provide new insights into the processing of reward and punishment for individuals with higher levels of Pathological Narcissism.
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ACKNOWLEDGEMENTS

First and foremost, a huge thank you to Dr. Aaron Pincus and Dr. Stephen Wilson for all of the guidance you have provided me with throughout this process. Not only have you offered support with this project, but you have done everything in your power to provide me with the most academically enriching undergraduate experience I could have ever imagined. No number of “thank you’s” can truly express my gratitude for all that I have been afforded, but I will say it again, thank you so very much!

Thank you, Ross McLean for the opportunity to assist with your graduate dissertation and spending countless hours coaching me on various research protocols from the mBART to the fMRI eye-tracker. I also appreciate all of the invaluable advice and guidance you have shared along the way to help me achieve my aspirations of pursuing a PhD in Clinical Psychology. Your success is such an inspiration and thank you for all that you have done!

Finally, thank you to my parents, my brother, and my friends for sending me every article on narcissism you have come across, but more importantly, the unconditional support and endless pep-talks that have cheered me on until the very end. Your encouragement always motivates me to challenge myself and surpass my goals beyond what I thought was possible. Thank you!
Introduction

The construct of narcissism has increasingly gained the interest of media outlets and academic researchers alike in recent years. Unbeknownst to most, narcissism has an enduring history dating back to Roman and Greek mythology (Levy, Ellison, & Reynoso, 2011). Although significant advancements have been achieved in understanding narcissism within the fields of clinical psychology, psychiatry, social and personality psychology, there remains a gap in knowledge within neuroscience literature (Pincus, Roche, & Good, 2014). The present study seeks to reduce this gap by using a common neuroscience technique, called functional Magnetic Resonance Imaging (fMRI) coupled with a self-report measure known as the Pathological Narcissism Inventory (PNI; Pincus et al., 2009) to explore the neurological mechanisms of narcissism.

From Narcissus to Narcissism

Narcissism was first alluded to in the work, *Metamorphoses*, penned by Roman poet, Ovid. In the series of Roman and Greek myths, Ovid recites the story of Narcissus, a young man who rejects the love of all those around him despite being deeply admired for his beauty. As a consequence for his rebuff of others, Narcissus falls in love with his own reflection after glancing at a pool of water and becomes so captivated by his own image that he is unable to look away which ultimately leads to his demise (Levy et al., 2011). Despite the vast expansion of narcissism research over the past hundreds of years, Ovid’s recount of Narcissus resembles the present day misconception that the word “narcissism” is solely used to describe an individual whom expresses “arrogant, conceited, and domineering attitudes and behaviors” (Pincus, Cain, & Wright, 2014, p. 439). While this is partially true as these traits are inclusive of narcissistic
grandiosity, they only represent a mere half of the contemporary clinical model of pathological narcissism.

According to the contemporary clinical model of narcissism, an individual experiences both states of narcissistic grandiosity and narcissistic vulnerability under the umbrella of pathological narcissism (Pincus et al., 2014). Less infamous tales from Greek mythology written by Parthenius of Nicea and Conon more accurately foreshadow modern psychoanalytic theories about narcissism (Levy et al., 2011). Rather than emaciating from constantly staring at his own image, Narcissus commits suicide from either wallowing in the loneliness of his unrequited love or from feelings of remorse for rejecting those around him. These versions successfully capture the more commonly neglected, but equally critical domain known as narcissistic vulnerability, characterized by “depleted, enfeebled self-image; angry, shameful, and depressed affects; self-criticality and suicidality; interpersonal hypersensitivity and social withdrawal,” (Pincus & Lukowitsky, 2010, p. 427). A healthy personality can reflect feelings of narcissistic grandiosity and narcissistic vulnerability from time to time, but the frequency, pervasiveness, and severity to which these emotions and behaviors are expressed determines one’s level of pathology that can range anywhere from a natural defense mechanism to Narcissistic Personality Disorder (NPD).

Dimensions of Pathology

Heinz Kohut (1971, 1977) and Otto Kernberg (1967, 1970, 1975, 1992) were among the first pioneers to provide contemporary insights into narcissism that eventually led to the addition of NPD into the Diagnostic and Statistical Manual for Mental Disorders (DSM-III: American Psychiatric Association, 1980). Although the DSM is an important diagnostic reference within the field of mental health, it conceptualizes narcissism through a categorical model in which an
individual either meets a set of criteria for NPD or does not. An alternative approach to conceptualizing narcissism that is the primary focus of the present research involves a contemporary dimensional model that hierarchically organizes a set of personality traits to evaluate one’s degree of pathology. From this perspective, narcissism is not viewed as the undesirable trait it is often portrayed to be in the media and other outlets, rather an important set of psychological characteristics employed to obtain and maintain self-esteem that all humans possess to varying degrees, including adaptive and pathological forms of expression (Roche, Pincus, Lukowitsky, Ménard, & Conroy, 2013).

A modern definition of narcissism encompasses an individual’s ability to sustain a positive self-image through healthy regulatory processes that involve the self, affect, and interpersonal relationships whilst maintaining self-enhancement through seeking and obtaining recognition and admiration from others in socially acceptable ways (Pincus, 2013). Striving to see oneself in a positive way, seeking self-enhancement through successful accomplishments and competitive wins, and a desire for admiration are all normal personality functions. A majority of individuals effectively manage these needs and regulate their self-esteem, emotions, and interpersonal behaviors in socially and culturally appropriate ways, even when faced with disappointments. For some individuals, however, the ability to convert narcissistic needs and urges into mature and socially acceptable conduct is impaired and pathological narcissism results (Roche et al., 2013). As previously mentioned, a contemporary clinical model of pathological narcissism conceptualizes the construct as a set of pathological traits organized into two primary phenotypic themes known as narcissistic grandiosity and narcissistic vulnerability.
A contemporary clinical model of narcissism

A narcissistically grandiose self-state is characterized by “overvalued, entitled self-image; exploitative, exhibitionistic behaviors; absorption in idealized fantasies; and other maladaptive self-enhancement strategies” (Pincus & Lukowitsky, 2010, p. 426). Cognitive thought processing during grandiose states involves “repressing negative aspects of self- and other-representations and distorting disconfirming external information, leading to entitled attitudes and an inflated self-image without requisite accomplishments and skills, as well as engaging in regulatory fantasies of unlimited power, superiority, perfection and adulation” (Pincus & Lukowitsky, 2010, p. 426). Overt expressions of narcissistic grandiosity include “interpersonally exploitative acts, lack of empathy, aggression, and exhibitionism” while covert expressions involve “providing instrumental and emotional support to others but concurrently harboring contempt for the person being helped and secretly experiencing the situation as reflecting one’s own specialness, goodness, or superior capabilities” (Pincus & Lukowitsky, 2010, p. 427).

In the presence of high levels of grandiosity within one’s personality, an individual is inevitably susceptible to react more strongly to ego threats, leading to impaired regulation of self-esteem, emotions, and behaviors (i.e., narcissistic vulnerability) (Pincus et al., 2014). An individual may experience predominantly grandiose self-states, primarily vulnerable self-states or a relatively equal balance of grandiosity and vulnerability. The outward presentation of narcissism will vary depending on which self-state dominates and the ways in which one expresses dysregulation. Narcissistic vulnerability involves the “experiences of anger, envy, aggression, helplessness, emptiness, low self-esteem, shame, social avoidance, and even suicidality (Pincus et al., 2009). During a narcissistically vulnerable self-state, the individual’s
self-esteem is highly contingent on the reactions of others, and should they fail to receive needed recognition and admiration, they may channel their helplessness, enduring pain and suffering as a form of “special status” that becomes a mechanism to reinforce one’s unequivocal uniqueness. They may also resort to social avoidance and withdrawal to cope with ego threats when their ideal self-representation feels inadequate or requisite admiration is not achieved (Pincus et al., 2009).

It is important to note that narcissistic grandiosity and narcissistic vulnerability are not two separate subtypes of narcissism. Rather, individuals with narcissism vacillate between feelings of grandiosity and feelings of vulnerability that stem from their interpersonal interactions and everyday life experiences that can be expressed in either covert or overt ways (Pincus & Lukowitsky, 2010). Despite extensive support for the existence of narcissistic grandiosity and narcissistic vulnerability within the areas of clinical psychology, psychiatry, and social/personality psychology, there remains to be a lack of research exploring the biological mechanisms of these two phenotypic states (Pincus et al., 2014). The following will provide a brief overview of relevant neuroscience research to offer insights into possible brains areas related to narcissism and further expand upon the foundation of the present research study.

*The Neuroscience of Narcissism*

Transcranial Magnetic Stimulation (TMS) is a neuroscience imaging technique used to understand the functions of different brains regions by simulating a lesion in a designated area. Researchers delivered TMS to the medial prefrontal cortex (mPFC) in combination with a self-enhancement test. Differences between baseline and stimulated mPFC revealed that mPFC deactivation lead to a reduction in self-enhancement (Kwan, Barrios, Ganis, Gorman, Lange,
Another research study used TMS on the mPFC to determine if this brain region is involved with moralistic self-enhancement (i.e., how the individual rates their own abilities to meet positive social norms) or egoistic self-enhancement (i.e., how the individual rates their own abilities of intelligence and social status). The results of the study indicated that egotistic self-enhancement appears to primarily be mediated by the mPFC (Barrios Kwan, Ganis, Gorman, Romanowski, & Keenan, 2008). Both of these studies provide evidence that the mPFC may play a critical role in *narcissistic grandiosity*, specifically self-enhancement features.

A similar study on self-enhancement utilized functional Magnetic Resonance Imaging (fMRI) to evaluate regions of the brain associated with overconfidence in task performance. Participants were asked to answer questions regarding temperatures or poverty across various US states and rate their level of confidence in the accuracy of their response. The results of the study indicated that the mPFC showed significant deactivation compared to baseline measures in relation to overconfidence, but mPFC activation does not predict overconfidence. The researchers also discovered that a region of the brain known as the orbitofrontal cortex (OFC) showed significant activation during overconfidence in the temperature condition, but not the poverty condition. OFC activity was negatively associated with overconfidence (i.e., increased activity in the OFC decreased overconfidence ratings and decreased activity in the OFC increased overconfidence ratings) (Beer, Lombardo, & Bhanji, 2009).
In an alternative study, researchers coupled personality measures with fMRI data collection. The results uncovered a correlation between deactivation in the posteromedial cortex (PMC) and egocentricity, self-absorption and grandiosity while deactivation in the mPFC correlated with greater impulsive decision-making (Sheng, Gheytanchi, Aziz-Zadeh, 2010). Another group of researchers used fMRI techniques and administered the Rosenberg Self-Esteem Scale (RSE) to uncover brain regions associated with an individual’s level of self-esteem. The results of the study revealed that dorsal anterior cingulate cortex (dACC) activation negatively correlated with levels of self-esteem (Yang, Dedovic, Chen, & Zhang, 2012). This finding is applicable to both narcissistic grandiosity and narcissistic vulnerability. Individuals in a grandiose self-state may demonstrate less activation in the dACC when they are experiencing high levels of self-esteem while individuals in a vulnerable self-state may show greater activation in the dACC when their self-esteem is diminished.

In a final study, a team of researchers explored brain areas associated with shame, guilt, and neutral emotions through the use of fMRI. The results of the study revealed that shame and guilt are both correlated to increased activation within the temporal lobe compared to baseline ratings. Shame also elicited activation within the anterior cingulate cortex, parahippocampal gyrus, right inferior and medial frontal gyrus (Michl, Meindl, Meister, Born, Engel, Reiser, & Hennig-Fast, 2014). The findings of this study have important implications for possible brain regions associated with narcissistic vulnerability. Narcissistic individuals have increased proneness to shame, which can be related to deficits in their self-esteem (Ritter, Vater, Rüsch, Schröder-Abé, Schütz, Fydrich, Lammers, & Roepke, 2014). Individuals experiencing a
vulnerable self-state may show greater activation within the temporal lobe and other brain regions that demonstrate activation during shame eliciting tasks.

*The Current Study*

The aforementioned research findings provide a foundation for predicting possible outcomes for the current study. In the present study, *narcissistic grandiosity* and *narcissistic vulnerability* are explored through a reward paradigm using fMRI. It is predicted that individuals with higher levels of *narcissistic grandiosity* on the PNI will demonstrate similar patterns of activation in brain regions associated with self-enhancement (i.e. overconfidence, higher self-esteem) including increased activation in the mPFC and decreased activation in the OFC, dACC, and PMC during trials in which they win. It is also predicted that individuals with higher levels of *narcissistic vulnerability* on the PNI will show similar patterns of activation in regions of the brain associated with dysregulation (i.e., lower self-esteem, shame) including increased activation in the OFC, dACC, PMC, temporal lobe, cingulate cortex, parahippocampal gyrus, right inferior and medial frontal gyrus, as well as, decreased activation in the mPFC during trials in which they lose.

**Method**

**Participants**

Participants were recruited from the local State College, Pennsylvania area via internet listings and flyers posted around the community. Prior to participation, potential subjects completed a telephone screening to ensure that participants met the inclusion criteria: between the age of 18 and 65, does not smoke cigarettes, right-handed, native English speaker, successfully pass an MRI safety screening, and (females) report no chance of pregnancy.
Individuals who did not meet these criteria or reported actively taking prescribed medications that have been shown to impact neurological blood flow responses, a history of psychiatric illness or head trauma were excluded from the study. A total of 36 participants were included in the study. There were 22 women and 14 men ranging in age from 19 to 48 years old with a mean age of 23.

**Procedure**

Following the telephone screening, eligible participants attended an experimental session lasting up to 120 minutes. During the session, subjects first completed the informed consent process which outlined the associated risks and procedures for the study. After informed consent was obtained, participants completed a demographics form and questionnaire that measured levels of narcissistic grandiosity and narcissistic vulnerability (PNI), as well as a series of other assessments that were not used in the present investigation. After completing the questionnaires, participants were given instructions regarding the tasks performed during the fMRI and escorted to the Social, Life, and Engineering Sciences Imaging Center (SLEIC) where the scanner is located.

Upon arriving at SLEIC, subjects were instructed to complete an MRI safety screen to eliminate any potential risks associated with scanning. After the MRI technician reviewed the safety screen, participants were placed in the scanner (Siemens 3T Magnetom Trio whole body MRI scanner). While in the scanner, subjects completed a reward task (Card-Guessing Task) and a few other tasks that were not used in the present investigation. The duration of the fMRI lasted approximately 90 minutes. After completing all of the tasks, participants were removed from the
scanner and informed that it was the conclusion of the study. Subjects were compensated for their participation via a check mailed to their address.

Measures

*Pathological Narcissism Inventory*. The Pathological Narcissism Inventory (PNI) was developed from research within the fields of psychiatry, clinical and social/personality psychology to accurately assess Pathological Narcissism (Pincus, 2013; Pincus et al., 2009). The PNI consists of a 52-item self-report questionnaire and is divided into 7 subscales that measure: Contingent Self-Esteem (CSE), Exploitativeness (EXP), Self-Sacrificing Self-Enhancement (SSSE), Hiding the Self (HS), Grandiose Fantasy (GF), Devaluing (DEV), and Entitlement Rage (ER). Each item captures one of the aforementioned factors to comprise a total score for that subscale. An overall PNI total score is calculated by averaging the total for each subscale. Subjects are instructed to rate each item on a 6 point scale, ranging from 0 (not at all like me) to 5 (very much like me). Narcissistic Grandiosity is measured by averaging the scores for the subscales of EXP, GF, and SSSE while Narcissistic Vulnerability is measured by averaging the scores for the subscales of CSE, DEV, HS, and ER.

*Card-Guessing Task*. Reward processing was measured through a modified version of the Card Guessing Task which includes a High Reward (or win) condition, High Punishment (or loss) condition, and Control (button press) condition (the Card Guessing Task; Delgado, 2007). Participants are presented with a visual representation of a playing card and asked to guess if it’s value is higher or lower than 5. Subjects are told that the value of the card ranges from 1 through 9, but its value cannot be 5 to ensure there are definitive correct and incorrect responses. For each correct response, participants are told they will receive an additional $1.00 in compensation
and for each incorrect response, they are told they will lose $0.50 from the total compensation they will receive at the end of the study. Each trial begins with a 2 second period in which the subject presses a button with either their index finger, denoting a guess higher than 5 or their middle finger, signaling a guess lower than 5. After the choice period, a number from 1 through 9 (excluding 5) is presented for 500 ms and is followed by feedback which is also presented for 500 ms. Feedback for a correct response includes a green arrow pointing upwards, signaling an increase in compensation while an incorrect response shows a red arrow pointing downwards, denoting a decrease in compensation.

Although the participants believe they are guessing higher or lower for real money, the card values and feedback are selected following their guess to ensure a fixed response. The task is constructed in a block format with each block comprising five psuedo-randomly presented trials. Each trial within a block is separated by a fixation cross that appears for 2 seconds before the start of the next trial. Similarly, each block is separated by a 12 second rest period in which a fixation cross is presented. Participants perform three different types of blocks: High Reward in which 75% of their guesses are deemed correct, High Punishment in which 75% of their guesses are deemed incorrect, and Control in which they are asked to press one of the two buttons for a block. The specific outcome probabilities for each block are unbeknownst to subjects and a small number of incongruent trials are included in each block to maintain motivation and engagement in performance (Delgado, 2007).

Results

The BrainVoyager QX Cluster-Level Statistical Threshold Estimator plug-in (which implements a Monte-Carlo simulation approach to multiple comparisons correction) was used to
determine the appropriate threshold for group statistical maps (Goebel, Esposito, & Formisano, 2006). After 5000 iterations, it was determined that a corrected map-wise false positive rate of $p < .05$ would be obtained by combining a per-voxel threshold of $p < .005$ with cluster-extent thresholds of 12 contiguous voxels. Only clusters meeting these criteria were considered significant. The results of this analysis uncovered 6 regions of interest, 5 of which were significantly associated with Narcissistic Grandiosity scores on the PNI during High Reward while 1 area was significantly associated with Narcissistic Vulnerability scores on the PNI during High Punishment. Following this analysis, a standard linear regression analysis was conducted using IBM SPSS Statistics Version 22. PNI Narcissistic Grandiosity and Narcissistic Vulnerability scores were used to predict fMRI response (percent signal change) in the 6 regions of interest during High Reward (or win), High Punishment (or loss) and Control (button press) conditions. The prediction models for all 6 regions were statistically significant. Each prediction model includes both Narcissistic Grandiosity and Narcissistic Vulnerability as independent variables and the dependent variable is brain activity (increased or decreased) in each individual region of the brain during High Reward Trials or High Punishment Trials.

**Narcissistic Grandiosity**

Table 1 shows the results of the standard linear regression analysis for the 5 regions associated with Narcissistic Grandiosity during High Reward trials. The postcentral gyrus in the right hemisphere is the first statistically significant region and is illustrated in Figure 1. The prediction model was significant, $F(2, 33) = 12.230$, p-value = .002 and Narcissistic Grandiosity accounted for 40% of the variance in fMRI response ($R^2 = .426$, Adjusted $R^2 = .391$). The standardized coefficient Beta was -.511 (p-value = .008), demonstrating a significant decrease in
activation within the postcentral gyrus during the High Reward condition in association with Narcissistic Grandiosity scores on the PNI. The next region of interest is the middle temporal gyrus in the right hemisphere and is illustrated in Figure 2. The prediction model was significant, \( F(2, 33) = 8.569, \text{p}-value = .001 \) and Narcissistic Grandiosity accounted for 30% of the variance in fMRI response \( (R^2 = .342, \text{Adjusted } R^2 = .302) \). The standardized coefficient Beta was \( -.549 \) \( (\text{p}-value = .008) \), showing a significant decrease in activation within the middle temporal gyrus during the High Reward condition in association with Narcissistic Grandiosity scores on the PNI.

The superior occipital gyrus in the right hemisphere is the third statistically significant region and is referenced in Figure 3. The prediction model was significant, \( F(2, 33) = 7.778, \text{p}-value = .002 \) and Narcissistic Grandiosity accounted for approximately 30% of the variance in fMRI response \( (R^2 = .320, \text{Adjusted } R^2 = .279) \). The standardized coefficient Beta was \( -.590 \) \( (\text{p}-value = .005) \), demonstrating a significant decrease in activation within the superior occipital gyrus during the High Reward condition in association with Narcissistic Grandiosity scores on the PNI. The last region to show significantly decreased activation during High Reward trials in association with Narcissistic Grandiosity scores on the PNI is the superior temporal gyrus in the left hemisphere with a standardized coefficient Beta of \( -.568 \) \( (\text{p}-value = .008) \). The prediction model was significant, \( F(2, 33) = 6.849, \text{p}-value = .003 \) and Narcissistic Grandiosity accounted for 25% of the variance in fMRI response \( (R^2 = .293, \text{Adjusted } R^2 = .251) \). The superior temporal gyrus is illustrated in Figure 4.

The final area of the brain associated with Narcissistic Grandiosity scores on the PNI is the precuneus in the left hemisphere and was the only region to show significantly increased activation during High Reward. The prediction model was significant, \( F(2, 33) = 6.419, \text{p}-value = .008 \).
= .004 and Narcissistic Grandiosity accounted for 24% of the variance in fMRI response ($R^2 = .280$, Adjusted $R^2 = .236$). The standardized coefficient Beta was .526 (p-value = .014), showing a significant increase in activation within the precuneus in association with Narcissistic Grandiosity scores on the PNI during High Reward. An illustration of the precuneus can be found in Figure 5. As evident by the aforementioned findings, Narcissistic Grandiosity scores on the PNI are associated with a decrease in activation within the right postcentral gyrus, right middle temporal gyrus, right superior occipital gyrus, and the left superior temporal gyrus, as well as, an increase in activation in the left precuneus during High Reward trials.

**Narcissistic Vulnerability**

The region associated with Narcissistic Vulnerability scores on the PNI during High Punishment trials is the superior frontal gyrus in the left hemisphere. The prediction model for this region was significant, F(2, 33) = 6.762, p-value = .003 and Narcissistic Vulnerability accounted for 25% of the variance in fMRI response ($R^2 = .291$, Adjusted $R^2 = .248$). The standardized coefficient Beta was .609 (p-value = .005), demonstrating a significant increase in activation within the superior frontal gyrus during the High Punishment condition in association with Narcissistic Vulnerability scores on the PNI. Table 2 highlights the standard linear regression analysis for this finding and Figure 6 provides an illustration of the superior frontal gyrus.

**Discussion**

The present study investigated the brain regions associated with Pathological Narcissism, namely, Narcissistic Grandiosity and Narcissistic Vulnerability through a reward paradigm. I predicted that individuals with higher PNI Narcissistic Grandiosity scores would have increased
activation in the mPFC and decreased activation in the OFC, dACC, and PMC during High Reward trials and that individuals with higher PNI Narcissistic Vulnerability scores would have increased activation in the OFC, dACC, PMC, temporal lobe, cingulate cortex, parahippocampal gyrus, right inferior and medial frontal gyrus, as well as, decreased activation in the mPFC during High Punishment trials. Although the results of the study do not entirely support this hypothesis, they do provide evidence for differences in the processing of reward and punishment for individuals with higher levels of Narcissistic Grandiosity and Narcissistic Vulnerability.

Narcissistic Grandiosity

Narcissistic Grandiosity was significantly associated with decreased activation in the postcentral gyrus, middle temporal gyrus, superior occipital gyrus, and superior temporal gyrus during High Reward trials. Previous research has found that these areas of the brain are heavily responsible for controlling and processing motor and sensory functions. The postcentral gyrus controls the localization of touch, temperature, vibration, pain, as well as, finger proprioception, and hand movements. The middle temporal gyrus is responsible for processing visuospatial information, focusing attention, and reading, especially sight reading, such as music. Similar to the middle temporal gyrus, the superior occipital gyrus is also involved with visuospatial processing, as well as, detecting and maintaining working memory of visual stimuli, controlling finger and horizontal eye movements. The superior temporal gyrus is mainly responsible for auditory functions including detection of sound intensity, pitch sensitivity, and perception of visual speech (Trans Cranial Technologies, 2012). These brain regions appear to primarily be responsible for controlling functions related to performing the motor and cognitive requirements of the Card Guessing Task.
Narcissistic Grandiosity was also associated with increased activation in the precuneus during High Reward Trials. In recent years, the precuneus has gained the attention of researchers due to its diverse set of neurological functions that appear to span across various regions of the brain. The precuneus is also responsible for functions related to the task such as motor, memory, and attention (Trans Cranial Technologies, 2012). However, of particular interest to the present study, the precuneus is heavily involved in self-representation and emotional processing. A network of connections in which past experiences and self-identity are intertwined is located within this brain region. Studies using fMRI and TMS have found an associated between activation within the precuneus when processing empathy, considering one’s personality traits and physical appearance, as well as, adopting first-person perspective (viewing oneself) (Cavanna & Trimble, 2006).

Collectively, the results of the present study and previous research on the functions of the postcentral gyrus, middle temporal gyrus, superior occipital gyrus, superior temporal gyrus, and precuneus offer insights into the neurological mechanisms of Narcissistic Grandiosity. The results of the present study suggest that individuals with higher PNI Narcissistic Grandiosity scores focus more attention on the self (per increased activation in the Precuneus) rather than the task at hand (per deactivation in the postcentral gyrus, middle temporal gyrus, superior occipital Gyrus, and superior temporal gyrus) during trials in which they are winning. These individuals appear to be internalizing the wins on the Card Guessing Task as a mechanism of self-enhancement. This finding provides neurological support for the self-enhancement strategies involved with Narcissistic Grandiosity that are frequently cited in psychiatry, clinical, and social/personality psychology research (Pincus et al., 2014).
Narcissistic Vulnerability

Narcissistic Vulnerability was significantly associated with increased activation in the superior frontal gyrus during High Punishment trials. The superior frontal gyrus is responsible for controlling a range of functions within the brain related to motor, language, memory, and attention. This region of the brain processes movements (preparation, initiation, and coordination), speech (perception, lipreading, novel words), working and long-term memory, and vision (visuospatial/visuomotor attention, eye movements). Other functions that are particularly relevant to the present study include emotional processing and self-reflection during decision making (Trans Cranial Technologies, 2012). An fMRI research study on elite swimmers watching videos of their own personal failure, followed by cognitive therapy interventions revealed an association with increased activity in the superior frontal gyrus when monitoring the self and processing self-referential information, particularly very personal and emotionally-charged events (Davis et al., 2008). The results of the present study juxtaposed with current research on the superior frontal gyrus suggest that individuals with higher PNI Narcissistic Vulnerability scores are internalizing loss on the Card Guessing Task as a personal failure. An event that elicits the sensation of personal failure can prompt or feelings of shame, low self-esteem, and helplessness in individuals experiencing Narcissistic Vulnerability (Pincus et al., 2009). According to the findings, the superior frontal gyrus appears to play a role in modulating dysregulation for individuals with higher levels of Narcissistic Vulnerability.

Limitations

Although this is one of the first studies to examine the neurological mechanisms of Pathological Narcissism, there are a few limitations that should be noted. The major limitation in
the present study was the size and composition of the recruited sample. The sample size was relatively small with a total of 36 participants. Additionally, a majority of the participants were female (61%) and caucasian (83%). Although the age ranged from 19-48 years old, most of the participants were college-aged and in their early 20s. Ideally, future samples should include a larger and more diverse sample that is more proportionate across sex, race, and age. One of the exclusion criteria for participation in the study was a history of psychiatric illness which likely reduced the prevalence of pathology in the collected sample. Future studies should also include clinical samples for a more well-rounded approach to investigating pathological narcissism.

Conclusion

Investigating the neurological mechanisms of pathological narcissism promotes a better understanding of the disorder, leading to the development of improved treatment options and more successful outcomes for individuals living with the disorder. While extensive research on Narcissistic Grandiosity and Narcissistic Vulnerability exists within psychiatry, clinical, and social/personality psychology (Pincus et al., 2014), research on pathological narcissism within the field of neuroscience has been widely neglected. Examining the unique neurological mechanisms underlying Narcissistic Grandiosity and Narcissistic Vulnerability can help identify the distinct biological substrates of these self-states and contributes to more precise treatment interventions. Future research should investigate Narcissistic Grandiosity and Narcissistic Vulnerability through alternative paradigms using fMRI techniques to gain a better understanding of pathological narcissism.
References


**Appendix: Tables and Figures**

Table 1

*Multiple Linear Regression Analysis for High Reward Trials*

<table>
<thead>
<tr>
<th>Brain Region</th>
<th>Independent Variables</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
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<td>Right Postcentral Gyrus</td>
<td>(Constant)</td>
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<td>Left Precuneus</td>
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### Table 2

*Multiple Linear Regression Analysis for High Punishment Trials*

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<th>Brain Region</th>
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<th>Standardized Coefficients</th>
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<th>Sig.</th>
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Figure 1
Right Postcentral Gyrus with Decreased Activation
Figure 2
*Right Middle Temporal Gyrus with Decreased Activation*
Figure 3

Right Superior Occipital Gyrus with Decreased Activation
Figure 4
*Left Superior Temporal Gyrus with Decreased Activation*
Figure 5
Left Precuneus with Increased Activation
Figure 6
Left Superior Frontal Gyrus with Increased Activation
Aleece G. Churney  
The Pennsylvania State University  
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State College, PA  
Phone: (609) 864-0807  
Email: aleece93@gmail.com

Curriculum Vitae

Education

B.S. Psychology
Minor Rehabilitation and Human Services
The Pennsylvania State University, University Park, Pennsylvania, May 2015 (expected)

Honors Thesis: Examining the Neurological Mechanisms of Pathological Narcissism  
Through a Reward Paradigm, 2015

Honors, Grants, & Scholarships

Scottish Rite Scholarship Recipient, 2014  
Schreier Honors College Scholar, Penn State, University Park, PA, 2013  
Paterno Fellows Scholar, Penn State, University Park, PA, 2013  
Penn State Summer Enrichment Grant Recipient, 2013  
Superior Academic Excellence Award Recipient, 2012-Present  
Penn State Dean’s List, 2011-Present

Special Training & Skills

Functional MRI Visiting Fellowship, 2013  
Massachusetts General Hospital, Harvard Medical School & MIT, Boston, MA  
Attended a 5-day intensive course on conducting and analyzing fMRI research. The curriculum initially covered background information related to fMRI technology for optimal data collection, followed by tutorials on using a variety of software packages including BrainVoyager, FreeSurfer, FSL, and SPM. The program concluded with the application of these newly obtained skills by designing and implementing a novel research study.

Spanish and Russian Language Working Proficiency  
Penn State, University Park, PA  
Completed required coursework to achieve third level proficiency in the languages of Spanish and Russian.
Research Experience

**Research Assistant, 2013-present**
Smoking Research Lab, Advisor: Dr. Stephen Wilson  
Penn State, Department of Psychology, University Park, PA  
Assist with several studies and manage one study, recruit and screen potential subjects, post recruitment flyers around the community, complete and renew MRI safety training, instruct participants on tasks and MRI safety, conduct research using fMRI, mBART, eye tracking, and smartphone technology, analyze research with SPSS and BrainVoyager, collect and store biological samples, contact participants and send daily email reminders, data-entry, and train research assistants on study protocols. Dr. Wilson supervised my honors thesis.

**Research Assistant, 2011-present**
Personality Psychology Lab, Advisor: Dr. Aaron Pincus  
Penn State University, Department of Psychology, University Park, PA  
Assist with multiple studies, conduct literature searches, read required lab materials, attend weekly meetings, data-entry, contact participants, upload questionnaires to survey monkey, complete training on working with clinical samples, conduct clinical research interviews, instruct participants on the use of smartphone technology, send weekly reminders for longitudinal study and present honors thesis to lab members. Completed honors thesis under the guidance of Dr. Aaron Pincus.

Professional & Work Experience

**Student Mentor, 2014-present**
Schreyer Honors College, University Park, PA  
Offer students guidance with fulfilling the requirements of the Schreyer Honors College from personal experiences and through researching new information to help them best prepare and plan their future. Additionally, provide students with on-going support in anyway possible whether it is related to academics or life circumstances, in general.

**Psychology & English Tutor, 2014-present**
Penn State Student Support Services, University Park, PA  
Tutor students in Psychology and English courses for 1-2 hours each week. Assist with homework assignments, writing and editing papers, preparation for exams, and study tools. More generally, provide encouragement, support, and try to help students surpass their maximum potential in the course.

**Psychiatric Direct Support Specialist, 2013-present**
Strawberry Fields Incorporated, State College, PA  
Direct support specialist at a psychiatric facility that aims to help individuals living with severe mental illness to become more independent and capable of living on their own. Duties include
managing and administering medications, updating consumer/staff logs, attending staff meetings and mandatory trainings, handling crisis situations, transporting consumers to facility events or appointments, engaging consumers in activities that boost social interactions, and providing consumers with the necessary resources and guidance to help achieve their goals.

**Nursing Home Volunteer, 2005-present**  
Masonic Home of New Jersey, Burlington, NJ  
Volunteer at a nursing home with a range of duties including delivering items to resident’s rooms, assisting residents with transportation around the facility and on local trips within the community, providing lessons to residents interested in improving their computer skills, training new volunteers, leading tours for high school students and others individuals interested in the facility, helping out with special occasions such as holidays and events, as well as, offering general support to residents and staff whenever possible.

**ESL Tutor, 2014**  
Penn State, Department of English, University Park, PA  
Interned for the Penn State English Department as an ESL (English as a Second Language) tutor for international students. During the internship, I developed and implemented lesson plans on a variety of topics related to the United States including history, culture, traditions, education, healthcare, government polices, etc. I presented these lesson plans to students for 3 hours each week and also worked with students to improve their English writing and speaking skills.
References

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