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Personality disorder in social networks: Network position as a marker of interpersonal dysfunction

Allan Clifton [a,*], Eric Turkheimer [b], Thomas F. Oltmanns [c]

[a] Department of Psychology, Vassar College, Box 127, 124 Raymond Avenue, Poughkeepsie, NY 12604-0127, United States
[b] Department of Psychology, University of Virginia, United States
[c] Department of Psychology, Washington University in St. Louis, United States

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ABSTRACT

The present study investigated social network position as a marker of interpersonal functioning in personality disorders. Participants were groups of military recruits ($N = 809$) in 21 training groups. Participants completed self- and informant-versions of the Multisource Assessment of Personality Pathology, acting as both targets and judges in a round-robin design. Network characteristics were associated with both self- and peer-reported personality disorder traits. Consistent with DSM-IV descriptors, measures of centrality and degree connectivity were positively associated with Narcissistic and Histrionic PDs, and negatively associated with Avoidant, Schizoid, and Schizotypal PDs.

1. Introduction

Personality disorders (PDs) are patterns of personality which, rather than enhancing an individual's ability to function in the world, instead lead to significant impairment or distress (American Psychiatric Association, 2000). PDs are quite common, with an estimated 13% point prevalence of personality disorders in nonclinical populations (Torgersen et al., 2001), and considerably higher prevalence in clinical samples (APA, 2000). PDs are a growing area of focus in mental health treatment, as these individuals are at greater risk for developing major depression, anxiety, and other Axis I disorders, and have a poorer prognosis for treatment of these disorders (e.g., Bender et al., 2001).

The current version of the Diagnostic and Statistical Manual of Mental Disorders (APA, 2000) describes ten types of personality disorders, such as Borderline, Narcissistic, and Avoidant personality disorders. Each disorder is characterized by seven, eight, or nine criteria, of which a set minimum number (usually four or five) must be met to be diagnosed with the disorder. The ten personality disorders, which are briefly described in Table 1, are categorized into three clusters based on their similarities: Cluster A (Paranoid, Schizoid, and Schizotypal), consisting of odd, eccentric behaviors. Cluster B (Antisocial, Borderline, Histrionic, and Narcissistic), characterized by explosive, dramatic, or emotional behavior. Cluster C (Avoidant, Dependent, and Obsessive-Compulsive PD), marked by anxious or worried behavior.

The organizing principle in our view of personality disorders is the profoundly destructive effect they have on interpersonal relationships (Rutter, 1987; Pincus, 2005). PDs are associated with impaired functioning in a wide range of arenas, including maladaptive coping strategies, poor job performance, unstable romantic relationships, social isolation, interpersonal violence, and suicide (e.g., Skodol et al., 2002). However, relatively few studies have actually examined the interpersonal functioning of individuals with personality disorders (Leising et al., 2006). The majority of these have relied on global measures of interpersonal functioning, rather than assessing specific maladaptive relationship patterns (e.g., Daley et al., 2000; Labonte and Paris, 1993; Linehan et al., 1994). In addition, most measures of social functioning (e.g., the Social Adjustment Scale; Weissman and Bothwell, 1976) are based on self-report. Research that compares self-report of personality with self-report of social functioning may be capitalizing on method variance, making results difficult to interpret (Oltmanns et al., 2002).

Whereas traditional analyses operationalize interpersonal functioning as a trait of the individual, social network analysis instead treats interpersonal functioning as an emergent property of a complex pattern of relationships. Adopting a more nuanced approach to interpersonal dysfunction could provide an important alternative perspective on the assessment and treatment of personality disorders.

Social network correlates have been found for numerous normal personality traits. For example, less ego-network constraint (i.e.,

* Corresponding author.
E-mail address: alclifton@vassar.edu (A. Clifton).

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Table 1
Qualitative descriptions of DSM-IV-TR personality disorders (APA, 2000)

	Characteristic features
Cluster A	
Paranoid	Pervasive suspiciousness that others are trying to harm or exploit him or her
Schizotypal	Eccentric behavior, cognitive and perceptual abnormalities, social withdrawal
Schizoid	Emotional coldness and social isolation
Cluster B	
Antisocial	Violation of laws, morality, and the rights of others
Borderline	Emotional instability, tempestuous interpersonal relationships, impulsivity
Histrionic	Attention seeking, over-exaggerated expression of emotion
Narcissistic	Grandiosity, feelings of entitlement, lack of empathy for others
Cluster C	
Avoidant	Extreme shyness, social inhibition, fear of evaluation
Dependent	Need for reassurance and caretaking by others
OCPD	Perfectionism and need for control

more structural holes) was associated with greater independence, non-conformity, and need for change (Burt et al., 1998). Within bounded networks, greater centrality (betweenness) is associated with higher levels of self-monitoring (Mehra et al., 2001). Kanfer and Tanaka (1993) examined the network among 26 undergraduate students, and compared network position with brief Five Factor Model ratings made by other members of the network. They found that individuals with stronger connections to other members were viewed as more extraverted, agreeable, and emotionally stable. Taken as a whole, these findings suggest that an individual's network position may act as a reflection of personality characteristics.

To our knowledge, only two previous studies have specifically examined the relationship between social networks and personality disorder traits. Tyrer et al. (1994) examined the retrospective reports of social contact of individuals presenting for emergency psychiatric services, and found decreased social contact overall in patients with PDs than in those without. More recently, Clifton et al. (2007a) compared the ego-centered networks of psychiatric patients with Borderline personality disorder (BPD) to patients without personality disorders. They found that the BPD patients exhibited marked disturbances in their support-seeking, such that they sought closeness and support from inappropriate members of their social networks.

A better understanding of the relationship between personality disorders and social networks has the potential both to better describe the interpersonal functioning of these individuals, and to identify specific areas of dysfunction in order to implement more effective psychosocial intervention. The present study examined complete networks of 21 groups of military trainees, and compared individuals' network positions with personality disorder traits. PD traits were assessed by both self-report, and via nominations made by all other members of the training group.

Most research on PDs relies primarily on self-report for assessment of pathology, obtained through written inventories or clinical interview. However, the nature of PDs inherently involves the way in which one's personality affects others (Westen, 1997), which can be difficult to observe or report (John and Robins, 1994; Oltmanns and Turkheimer, 2006). Further, the criteria used to rate personality disorders tend to be highly evaluative, which may lead to defensiveness and cognitive distortions in self-report (Kenny and Kashy, 1994).

Obtaining information from peers provides an alternate view of the interpersonal aspects of personality (e.g., Kurtz and Sherker, 2003). Peer perceptions of pathological personality traits are usually obtained from a knowledgeable informant, who describes the personality of the participant via questionnaire or structured interview (Zimmerman et al., 1986). This methodology has two major limitations. First, it obtains information from only a single informant, which necessarily limits the reliability of the data. Second, informants selected by the participant may suffer from what has been described as the "letter of recommendation" problem (Klonsky et al., 2002). That is, the close friends, spouses, or relatives who are chosen as informants may tend to describe participants in a positive light. Unselected peers who interact with the individual on a regular basis, such as co-workers or classmates, are likely to be more representative of a diversity of judgments. Ours is the only project to date to gather information about maladaptive personality traits from a complete network of peers, presenting a more complete picture of pathological personality traits than a single self-selected informant.

In the present research, we investigated the relationship between network position and self- and peer-reported personality disorder traits. Personality disorders were assessed by a lay language translation of the DSM-IV personality disorder criteria, for both self- and peer-reported characteristics. Network position was operationalized using four standard social network measures: Centrality, Indegree, Outdegree, and a composite measure comparing the difference between Indegree and Outdegree.

Centrality refers to the intuitive notion that some members of a network are central to the structure, while others are more on the fringe of the network. The present work utilizes the "betweenness" model of centrality developed by Freeman (1977, 1979). In a social network, not all individuals are acquainted with one another. However, some may be connected indirectly, because both are connected via a mutual acquaintance. Freeman (1979) argued that if an individual connects many otherwise unconnected individuals, this greater "betweenness" makes the individual more central to the network. Individuals with high betweenness may act as "power brokers" or "gatekeepers," helping to mediate the relationships among other individuals in the network (Scott, 2000).

Indegree is a measure of number and strength of connections *to* an individual *from* others. That is, it is a measure of how well others report knowing the individual, and is therefore a peer-reported measure of acquaintance with the individual. Outdegree is the counterpart to Indegree, and quantifies the connections *from* an individual *to* others. It is essentially one's self-reported degree of acquaintance with others in the network. Finally, the difference between an individual's Indegree and Outdegree (Indegree–Outdegree) is the difference between self- and peer perception of acquaintance. It describes the disparity between one's own perceptions of associations, and the perceptions of others. A negative value indicates an over-estimation of social ties relative to others' perceptions.

Based on clinical experience and the behaviors associated with each personality disorder (e.g., APA, 2000), we hypothesized several associations between personality disorders and network position. First, we hypothesized that measures of acquaintance (Indegree and Outdegree) would be negatively associated with the Cluster A and Cluster C personality disorders. These disorders, particularly Schizotypal, Schizoid, and Avoidant PDs, are associated with aloofness, interpersonal anxiety, and social withdrawal, which we expected would be reflected by decreased Indegree and Outdegree values. Second, we expected that self-reported acquaintance (Outdegree) would be positively associated with the Cluster B personality disorders, such as Narcissistic, Histrionic,

and Antisocial PDs. Individuals with these personality disorders are often outgoing, dramatic and gregarious, and place a high priority on making an impression on others. However, their relationships are generally shallow and one-sided, suggesting that others may not reciprocate their impressions of connectedness. Therefore, our third hypothesis was that Histrionic and Narcissistic traits would be negatively associated with the Indegree–Outdegree measure, reflecting an overestimation of the closeness of their interpersonal relationships. Finally, we hypothesized that those with Cluster B traits would be located more centrally within the network (i.e., a positive association with Betweenness Centrality), reflecting a desire to use interpersonal connections to control others.

2. Methods

2.1. Participants

Participants ($N = 809$, 533 male, 276 female) were Air Force recruits who were assessed at the end of six weeks of basic training. The present sample is a subset of a larger sample, described more fully by Oltmanns and Turkheimer (2006). The participants in our sample were enlisted personnel, who would eventually receive assignments as military police, mechanics, computer technicians, or other supportive roles. Their mean age was 20 years (S.D. = 5), and 99% were high school graduates. 64% described themselves as white, 16% as black, 4% as Asian, 4% as biracial, 1% as Native American, and 12% as another racial group. Air Force recruits undergo mandatory psychological screenings before beginning basic training, in order to screen out those with Axis I (symptomatic) mental disorders. These screenings, however, were not designed to detect or screen out those with Axis II personality disorders. Selected semistructured interviews of the larger sample (of which the current study utilizes a subsample) indicate that approximately 9.4% of this population would meet DSM-IV criteria for at least one personality disorder (Oltmanns and Turkheimer, 2006), slightly less than the 13% prevalence in the general population (Torgersen et al., 2001).

The participants were members of 21 "flights," groups of 27–54 recruits who went through training together. Six of these flights were single-gender male flights, and 15 were mixed-gender flights (see Clifton et al., 2007b, for demographic details of each flight). Recruits in a given flight spend nearly 24 h a day together, including time training, eating, and sleeping. Recruits' names are written on their uniforms and are used frequently by their training instructors and in roll calls, such that members of even large flights become very familiar with one another by name. All flights were assessed at the same point in their training, after six weeks of training together. The study was a round robin design, in that each of the 809 participants acted as both a nominator and a potential nominee in the peer nomination process.

2.2. Procedure

Two or three flights at a time were brought to a central testing center at the Air Force base. Each participant was seated at a separate computer terminal, where he or she gave written informed consent to participate in the study. After giving consent, they first completed a computerized tutorial on how to select items by pointing and clicking using a mouse, before being administered the assessment measures. The battery took an average of two hours to complete. During this time, participants were instructed not to talk to one another and to raise their hands if they encountered a problem or question. Dividers between workstations prevented participants from seeing the computer screens of those around them.

2.3. Materials

Each participant was administered a computerized battery of measures. In order to generate the social network, participants were first presented with a list of all other members of the flight, and instructed "Please rate how well you know each person." Participants were required to rate each group member using a four-point rating scale ranging from 0 (not at all) to 3 (very well). Responses to the item were used to construct an affiliation matrix as described below.

Participants were then administered the peer-report version of the Multisource Assessment of Personality Pathology (MAPP). The MAPP consists of 103 items, 79 of which are lay language translations of the 10 DSM-IV personality disorder criteria. Each of these items directly corresponded to specific PD criteria in the DSM-IV, but was rewritten to remove technical jargon. 24 filler items are also included in these measures, based on additional, mostly positive, characteristics, such as "trustworthy and reliable" or "agreeable and cooperative." The self-report and peer-report versions of items are identical, with only the target of the questions differing. The MAPP has been utilized in large-scale studies of psychopathology in military and college populations, and has demonstrated good inter-rater reliability (Oltmanns and Turkheimer, 2006), concurrent validity (Oltmanns and Turkheimer, 2006), convergent validity (Clifton et al., 2005; Oltmanns et al., 2002) and long-term predictive validity (Fiedler et al., 2004).

The peer-nomination procedure was a round-robin design in which every individual in the group had the opportunity to report on all other members of the group using a hybrid nomination-rating procedure. Items were presented to participants in a quasi-random order. For each item, the participant was shown a list of all members of his or her group, and asked to nominate at least one member of the flight who exhibits the characteristic in question. For each nomination, the participant assigned the nominee a rating (1, 2, or 3), indicating that the nominee "sometimes," "often," or "always" displays the characteristic. Individuals who were not nominated for an item were tacitly given a score of 0. Participants were required to nominate at least one person for each trait, such that no items were left blank. Participants were instructed that if they had a particularly difficult time identifying someone who met that criterion, they should choose their best answer, and check a box stating "It was difficult to select anyone for this item." Analyses of the full data set have indicated that the "difficult" nominations are largely the same as those made by those who do not designate the choice as being difficult (Oltmanns and Turkheimer, 2006).

Peer-report scales, based on the DSM-IV criteria sets, were calculated by averaging the scores received for the items in each scale, resulting in a dimensional scale ranging from 0 to 3. The scores assigned by each judge on each scale were kept separate for each target, such that in a flight with N members, each person received $(N - 1)$ peer-report scores on each diagnostic scale.

Although scores by individual judges of targets were kept separate for some analyses, judges were fairly reliable (median ICC (2, k) = 0.88; Clifton et al., 2007b), so in most instances it was useful to combine reports of a target across all judges, in order to conduct target-level analyses. In these cases, aggregate peer scores were constructed for each target by taking the mean of all judges' reports for each of the diagnostic scales. Each target therefore had ten aggregate peer scales, ranging from 0 to 3, which corresponded to the ten peer diagnostic scales.

Following the peer-report section, all participants completed a self-report version of the same items. Participants were presented

with the items in the same order, and asked "What do you think you are really like on this characteristic?" Participants responded using a 4 point scale: 0 (never this way), 1 (sometimes this way), 2 (usually this way), and 3 (always this way). For each personality disorder, the scores for the relevant criteria were averaged to form a dimensional measure of personality disorder ranging from 0 to 3.

2.4. Data analysis

For each flight, an adjacency matrix was constructed based on each participant's Knowing score of each other individual. For a flight consisting of N participants, this consisted of an $N \times N$ matrix of how well (weighted using the 0–3 scale) each participant reported knowing each other individual. Ties were directed, such that Person i could report knowing Person j very well even if Person j reported knowing Person i not at all. This weighted, directed matrix was analyzed using UCINET 6 (Borgatti et al., 2002) to determine characteristics of the social network. The matrices were analyzed to calculate the overall density of each flight, as well as each individual's Indegree and Outdegree of relationship ties and betweenness centrality within the network. Correlation analyses were then performed to compare individuals' positions in the network with demographic information, self-reported personality traits, and aggregated peer-reported personality traits.

The betweenness measure can be used to calculate centrality in directed networks (Gould, 1987). Betweenness is based on finding the shortest possible path which connects two nodes, called the "geodesic." In concept, betweenness represents the probability that a given node lies on a geodesic connecting two other nodes (Wasserman and Faust, 1994). Formally, the number of shortest-path geodesics connecting j and k is represented by g_{jk}. The number of shortest-path geodesics connecting j and k, of which i is a part, is represented by $g_{jk}(n_i)$. The probability that i lies on any given geodesic between j and k is therefore estimated as: $g_{jk}(n_i)/g_{jk}$ (Freeman, 1979).

The betweenness (C_B) for individual i (n_i) is calculated as the sum of the probabilities that i lies on the geodesic between any pair of nodes (Wasserman and Faust, 1994):

$$C_B(n_i) = \sum_{j<k} g_{jk} \frac{(n_i)}{g_{jk}}$$

$C_B(n_i)$ is often standardized by dividing by the maximum possible number of pairs of actors, not including n_i. This value, $C'_B(n_i)$, ranges from 0 to 1, and allows comparisons across networks (Wasserman and Faust, 1994). $C'_B(n_i)$ is calculated (Wasserman and Faust, 1994, p. 201) as: $C'_B(n_i) = C_B(n_i)/(g-1)(g-2)/4$. Throughout this paper, Betweenness Centrality refers to this standardized value, $C'_B(n_i)$.

In directional relations, degree can be broken down based on whether the connections are those that individual reported to others, or whether they are connections that others have reported to the individual. The former is called Outdegree, referring to the number of connections originating from the node. The latter is called Indegree, and represents the number of connections directed toward the node. In a binary directed sociomatrix, the Indegree of a node is equal to its row sum, and the Outdegree is equal to its column sum. More formally, the formulae (Wasserman and Faust, 1994, p. 164) for the Indegree (d_I) and Outdegree (d_O) are:

$$\text{Indegree}: \; d_I(n_i) = \sum_{j=1}^{g} x_{ij}, \qquad \text{Outdegree}: \; d_O(n_i) = \sum_{j=1}^{g} x_{ji}$$

The difference between each individual's self- and peer-reported connections was taken by subtracting Outdegree from Indegree. This resulted in a composite value called Indegree–Outdegree.

3. Results

3.1.1. Personality disorder descriptive statistics

Each of the ten self-reported personality disorder scales ranged from a minimum possible value of 0 to a maximum possible value of 3. In practice, because scores consisted of the mean of several items, the range was slightly smaller, with scores ranging from 0 to 2.86. For each target, all of his or her peer ratings across the entire flight were also aggregated by taking the mean of all ratings assigned him or her on each scale. The means, standard deviations, and range of each of the self- and peer-reported scales are described in Table 2.

Reliabilities for each scale were moderate to high, with higher reliability for peer-reported than self-reported scales (Table 2). Cronbach's Alpha for self-reported scales ranged from 0.49 to 0.79, with an average reliability of 0.71. Alphas for peer-reported scales ranged from 0.74 to 0.97, with an average reliability of 0.87.

Correlations between self-report and aggregated peer-report were low, as is expected in comparisons of self- and peer-ratings of personality (Oltmanns and Turkheimer, 2006). Pearson's correlations (Table 2) for corresponding self- and peer scales ranged from 0.14 to 0.30, though all were significant at $p < 0.001$. Intercorrelations among PD scales within a modality were moderate to large, and generally larger within a cluster. For aggregated peer-report, correlations ranged from 0.12 (avoidant and narcissistic) to 0.88 (schizoid and schizotypal), with an overall mean value of 0.58 (S.D. = 0.21). For self-report, correlations ranged from 0.28 (schizoid and dependent) to 0.73 (schizotypal and borderline), with an overall mean value of 0.53 (S.D. = 0.11).

3.2. Network analysis

The density of the 21 flights, defined as the proportion of directed connections (weighted by rating score) to possible connections, varied from 0.881 to 1.28 ($M = 1.05$, S.D. = 0.11). Analysis of variance was used to compare network density in single-gender flights ($N = 6$) with that of two-gender flights ($N = 15$). Predicting density from same-gender/two-gender flight status found that two-gender flights were somewhat more dense than single-gender flights ($F(1,19) = 4.50$, $p < 0.05$). The mean density for two-gender flights was 1.08 (S.D. = 0.10, 95% CI: 1.02–1.13). The mean density for single-gender flights was 0.98 (S.D. = 0.09, 95% CI: 0.88–1.07).

In order to investigate how personality disorder characteristics are related to social network position, we correlated each individual's self- and peer-reported personality disorder scales with Centrality, Indegree, Outdegree, and Indegree–Outdegree scores. Effect sizes were all relatively small, with correlations ranging from 0.01 to 0.24. The results of these analyses are reported in Table 3.

As seen in Table 3, both self- and peer-reported personality disorder traits were significantly associated with network position. Individuals who were identified by peers as having Cluster B traits (especially Narcissistic, Histrionic, and Antisocial) and/or OCPD traits, had higher centrality and Outdegree scores. Conversely, Schizoid, Schizotypal, and Avoidant PD traits (both self- and peer-reported) were associated with decreased centrality, Indegree, and Outdegree.

4. Discussion

We examined the relationship between social networks and the pathological personality traits of group members in Air Force

Table 2
Descriptive statistics for self-reported and aggregated peer-reported personality disorder scaled scores

Variable	Mean	S.D.	Minimum	Maximum	Reliability α	Self-peer correlation
Aggregated peer-report (N = 809)						
Paranoid	0.10	0.10	0.00	0.71	0.89	0.15
Schizotypal	0.12	0.09	0.01	0.87	0.88	0.28
Schizoid	0.10	0.10	0.00	1.01	0.74	0.23
Antisocial	0.10	0.13	0.00	1.44	0.91	0.19
Borderline	0.09	0.10	0.00	0.94	0.87	0.22
Histrionic	0.12	0.13	0.00	1.18	0.87	0.17
Narcissistic	0.13	0.17	0.00	1.53	0.97	0.14
Avoidant	0.09	0.10	0.00	0.81	0.92	0.30
Dependent	0.09	0.11	0.00	1.04	0.90	0.18
OCPD	0.12	0.09	0.02	0.75	0.77	0.14
Self-report (N = 809)						
Paranoid	0.49	0.46	0.00	2.86	0.74	0.15
Schizotypal	0.37	0.39	0.00	2.20	0.77	0.28
Schizoid	0.62	0.41	0.00	2.71	0.49	0.23
Antisocial	0.24	0.32	0.00	2.43	0.73	0.19
Borderline	0.26	0.34	0.00	2.33	0.79	0.22
Histrionic	0.37	0.36	0.00	2.25	0.69	0.17
Narcissistic	0.29	0.33	0.00	2.20	0.77	0.14
Avoidant	0.39	0.41	0.00	2.86	0.76	0.30
Dependent	0.25	0.33	0.00	2.50	0.77	0.18
OCPD	0.71	0.40	0.00	2.50	0.55	0.14

training flights. We examined the association between self- and peer-reported personality disorder traits and individuals' Betweenness Centrality, Indegree, Outdegree, and the difference between Indegree and Outdegree. Although effect sizes were fairly small, the significant predictors were all in the hypothesized directions, and provide objective evidence of otherwise subjective personality traits. These results appear in Table 3, and are discussed below.

4.1. Indegree

Indegree is a measure of number and strength of connections *to* an individual *from* others (an other-reported form of acquaintance). Consistent with Hypothesis #1, Indegree was significantly and negatively associated with both peer- and self-reported Schizoid, Schizotypal, and Avoidant PD scales. That is, higher scores on these PD scales were associated with being less well known by others. The implications of these results are clear, as the DSM-IV definitions of these PDs all include an absence of close relationships. This finding corroborates the findings of Kanfer and Tanaka (1993), who also noted that targets with decreased Indegrees were described by peers as less outgoing and less secure, traits often associated with Avoidant PD. In addition, it is particularly interesting that the peer-reported PDs were predictors of decreased Indegree, as it suggests that, even though fewer raters reported knowing these individuals well, raters still singled out these individuals as targets for PD nominations.

Consistent with our hypotheses, there was no significant association between Indegree and any Cluster B personality disorder scales. That is, individuals who were described, either by themselves or by others, as being more Histrionic, Narcissistic, etc., were not identified by others as being either more or less well known.

Table 3
Pearson correlation between network position characteristics and aggregated peer-reported and self-reported personality disorder scales (N = 809)

	Centrality	Indegree	Outdegree	Indegree–Outdegree
Peer-report				
Paranoid	0.05	−0.03	0.10**	−0.09*
Schizoid	−0.09**	−0.19***	−0.19***	−0.09**
Schizotypal	−0.06	−0.14***	−0.16***	−0.05
Antisocial	0.09*	−0.01	0.11**	−0.07*
Borderline	0.03	−0.04	0.04	−0.06
Histrionic	0.14***	0.06	0.21***	−0.06
Narcissistic	0.10**	0.04	0.24***	−0.10**
Avoidant	−0.12**	−0.13***	−0.24***	0.01
Dependent	−0.03	−0.07	−0.12***	0.00
OCPD	0.06	−0.06	0.16***	−0.16***
Self-report				
Paranoid	0.04	−0.03	0.00	−0.04
Schizoid	−0.07	−0.17***	−0.09*	−0.12***
Schizotypal	−0.03	−0.13***	−0.11**	−0.08*
Antisocial	0.13	0.01	0.05	−0.02
Borderline	0.05	−0.03	−0.04	−0.01
Histrionic	0.08*	0.00	0.07*	−0.04
Narcissistic	0.11**	0.00	0.07*	−0.05
Avoidant	−0.13***	−0.14***	−0.14***	−0.07
Dependent	0.03	−0.01	−0.06	0.03
OCPD	−0.04	−0.09*	−0.06	−0.06

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

4.2. Outdegree

Outdegree is the counterpart to Indegree, and quantifies the connections *from* an individual *to* others. Outdegree is essentially one's self-reported degree of connection, compared with Indegree's peer-reported connection. As with Indegree, self- and peer-reported Schizoid, Schizotypal, and Avoidant PD scales were all negatively associated with Outdegree. As hypothesized, individuals described by themselves or others as having higher levels of these traits report fewer close acquaintanceships.

In addition, consistent with Hypothesis #2, both self- and peer-reported Histrionic and Narcissistic PD traits were positively associated with increased Outdegree (Table 3). These PDs are both associated, either primarily or peripherally, with being gregarious, glib, and superficially sociable (APA, 2000). It seems likely, therefore, that individuals seen by others as having these traits would have an increased self-perception of acquaintanceship with others. It is particularly notable that Outdegree, a self-reported measure, was most highly associated with peer-reported personality scores, providing evidence of the validity of peer-reported PD scales.

However, it was somewhat surprising that self-reported PD traits did not show the same association with Outdegree. Although nine out of the ten peer-reported PD scales correlated significantly,

only five self-reported PD scales were significantly associated with Outdegree (Table 3). For example, although we had hypothesized that Antisocial PD would correlate positively with Outdegree, this was true for peer-reported Antisocial traits, but not for self-reported. One explanation for this may be that individuals may have difficulty accurately self-reporting some negative traits, but demonstrate their tendencies in the ways they report their acquaintance with others. That is, Antisocial individuals may be unwilling to admit to antisocial behaviors, even though their peers reliably ascribe these traits to them. If these individuals subsequently report greater affiliation with others, Outdegree will be positively correlated with peer-reported, but not self-reported, Antisocial traits, as seen in Table 3. A second, equally possible explanation for the larger Outdegree correlations with peer-reported traits is the higher average reliability for peer-report information, as seen in Table 2. Because the peer-report data are aggregated across multiple raters, their increased reliability may serve to increase the observed correlation with network variables.

4.3. Indegree–Outdegree

In addition to examining Indegree and Outdegree separately, we examined each individual's discrepancy between the two values. Indegree–Outdegree can be thought of as a measure of an individual's expansiveness bias: the tendency to over-report or under-report one's interactions with others, compared to others' perceptions of those interactions (Feld and Carter, 2002). This is a difficult concept to measure using conventional reporting methods, making social network analysis especially useful. A negative correlation coefficient in Table 3 indicates that greater values of the personality trait scale were associated with over-reporting of one's social ties.

As predicted in Hypothesis #3, Narcissistic PD (peer-reported) was associated with an over-estimation of social connections. This may reflect the classic behavior of narcissism, in which the individual overestimates his or her own worth, while at the same time alienating others with his or her behavior. However, self-reported Narcissistic traits were not significantly associated with Indegree–Outdegree. One possible explanation for this finding comes from an earlier study of the MAPP (Clifton et al., 2004). This study found that individuals who were described by peers as Narcissistic did not describe themselves as Narcissistic, but rather endorsed overly positive items, describing themselves as extremely gregarious and likeable. In the present study, individuals seen by others as Narcissistic may again be reflecting this narcissism not through explicit agreement, but rather by over-estimating the amount of friends that they have.

Contrary to our third Hypothesis, there was no association between Histrionic PD and Indegree–Outdegree, suggesting that although Histrionic individuals do report greater acquaintance with others (as evidenced by the association with Outdegree), this is not a significant overestimation of their relationships. Other significant associations with Indegree–Outdegree included self-reported Schizoid and Schizotypal scales, and peer-reported Paranoid, Schizoid, Antisocial, and Obsessive-Compulsive PD scales. The factors discussed for both Indegree and Outdegree separately apply here as well. In addition, it may be that the traits measured by these scales are particularly distancing to peers, although the individual is unaware of the effect his or her behavior has on others.

4.4. Centrality

Betweenness centrality is a measure of an individual's importance in the network, and his or her "interpersonal influence" with others (Wasserman and Faust, 1994, p. 189). As predicted in Hypothesis #4, Centrality was significantly and positively associated with Cluster B traits, including peer-reported Histrionic, Narcissistic, and Antisocial, and self-reported Narcissistic and Antisocial PD scales. It is particularly telling that Histrionic PD is associated with centrality, as one of the essential features of Histrionic PD is feeling "uncomfortable in situations in which he or she is not the center of attention" (APA, 2000, p. 714). The positive association of Narcissistic and Antisocial PDs with Centrality is also notable, and consistent with prior research on normal personality. Highly central actors connect otherwise unconnected actors, moving between social groups and acting as "gatekeepers" for social exchange (Freeman, 1979). Burt et al. (1998) have found strong associations between high Betweenness (i.e., low structural constraint) and "entrepreneurial" personality traits such as independence, thriving on change, and using one's advantageous position to get ahead. Normal levels of these traits could be highly adaptive in a social network. However, maladaptive expressions of these traits could be manifested as Antisocial and Narcissistic personality disorders, as both are marked by manipulativeness and exploitation of others (APA, 2000).

In addition, Centrality was significantly and negatively associated with peer-reported Avoidant, and self-reported Avoidant and Schizoid PD scales. Low betweenness (i.e., high structural constraint) has been associated with conformity, obedience, and a need for security and stability (Burt et al., 1998). This description is consistent with these personality disorders, which are defined by fear of (Avoidant) or disinterest in (Schizoid) interpersonal relations. The analyses indicate a tendency for these individuals to remain on the periphery of networks, rather than being in the thick of things.

4.5. Conclusions and future directions

The findings of the present study suggest that social network analysis is a promising method of quantifying the interpersonal dysfunction associated with personality disorders. Numerous pathological personality traits were significant predictors of network position. In general these associations were consistent with the DSM-IV descriptions of the personality disorders, such that Cluster B scales (such as Narcissistic, Histrionic, and Antisocial PDs) were associated with increased social connections and a more central position in the network, whereas Cluster A and Cluster C scales (such as Schizoid, Schizotypal, and Avoidant PDs) were negatively associated with these characteristics. In general, peer-report was a better predictor of network position than self-report, which may reflect the higher reliability inherent to aggregated data.

Despite numerous highly significant associations, effect sizes were consistently small. However, as seen in Table 2, the effect sizes for the association between self-reported and peer-reported PDs are also quite small. For example, peer-reported Narcissism score is correlated 0.14 with self-reported Narcissism score. That is, knowing how Narcissistic an individual thinks he is doesn't tell us much about how Narcissistic his peers think he is. However, peer-reported Narcissism is correlated 0.24 with Outdegree (a self-reported measure), suggesting that how many connections the individual thinks he has in the network is a better predictor of how peers see him. The same holds true for other PDs, including Histrionic and Obsessive Compulsive. The fact that a self-reported measure of network connections would be a better predictor than a self-reported version of the same measure is fairly surprising, even with an admittedly small effect size.

As a measure of social functioning, we feel that social network holds great promise for personality research. However, the current research used a fairly crude measure of network connectivity, which also may have contributed to the small effect size. A primary area for improvement on the current study is an enhanced mea-

surement of the social networks themselves. Because the data for this study were collected primarily for an investigation of self- and peer-perceptions of personality pathology, a complete assessment of social relations was limited by time and feasibility. Acquaintance was assessed based on a single question about how well the rater knew each target. In future research, acquaintance might be assessed in alternate ways, including rank ordering, or questions regarding friendship, advice seeking, amount of time spent with, and other aspects of acquaintance. Longitudinal assessment, of both acquaintance and personality ratings, would be very helpful in understanding network associations with ratings. In addition, particularly given the focus of the present research, the network structure might be assessed in ways other than self-report. Asking participants to identify friendships between other dyads, or observations by an outside party might yield a different picture of the network than that derived from self-report data alone (e.g., Bernard et al., 1984).

In addition, a complete network analysis is time consuming and beyond the scope of most personality disorder research. However, recent research (Clifton et al., 2007a) has demonstrated the use of ego-centered networks as markers of interpersonal functioning in Borderline personality disorder. Extension of the present findings to ego-centered network assessment could provide a more feasible solution for mainstream researchers.

Based on the findings of the present study, we would encourage further research into social networks as an indicator of functioning in personality pathology. Incorporating social network techniques into personality research may be an important step toward quantifying and understanding the nature of interpersonal dysfunction in personality disorders.

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