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Personality Traits in Parkinson's Disease

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Introduction

Parkinson's Disease (PD) is one of the most common progressive neurodegenerative diseases. It affects 1% of the world's population over the age of 65, which is approximately six million people (Parkinson's Disease Overview, 2014). The prevalence of PD ranges from 31 to 201 per 100,000 individuals. The disease occurs in all ethnic groups, affects both genders, and becomes increasingly common with advancing age. The neuropathology of PD is complex and has been linked to a variety of motor and non-motor symptoms typically exhibited by PD patients.

Common motor symptoms of PD include a resting tremor, slowness of movement, motor rigidity, and postural instability. Some of the non-motor symptoms of PD include cognitive deficits, including problems with learning and memory, visualspatial processing, and executive function abilities (i.e., working memory, planning, inhibition, attention, and speed of processing [Uc et al., 2005]). Executive function deficits are primarily associated with frontal lobe pathology (specifically, a lack of dopamine) in PD (Lees & Smith, 1983; Taylor, Saint-Cry, & Lang, 1986). There is even evidence to support the theory that certain personality differences, also associated with frontal lobe functioning, are noted between PD patients and normal control participants. One question concerns whether these noted changes in personality directly relate to the observed cognitive changes noted in PD. Only two studies to date have examined this possibility (Koerts, Tucha, Leenders, & Tucha, 2013; McNamara, Durso & Harris, 2008). Another question concerns the link between noted personality changes and disease severity. The primary purpose of the following project, therefore, is to further investigate these questions by examining the relationship between personality traits, cognitive impairments, and disease severity in PD patients.
Frontal Dysfunction in PD

PD is associated with a wide variety of cognitive symptoms that significantly impair the quality of life of affected individuals. About 80% of patients develop cognitive changes detectable by clinical evaluation during the course of the disease. Executive dysfunction is the most frequently described cognitive change in patients with PD. Other frontal lobe changes include those noted in attention, and verbal and nonverbal fluency.

Brown and Marsden (1988) used the Stroop Test to measure executive functioning deficits in PD patients. Participants were shown the words "red" and "green" written in their complementary color (e.g., the word red was written in green ink). Participants were then required to say either the color of the printed words, or the actual word itself. However, they were not always told whether to specify either the color or the word before it was shown; in some conditions they had to recall previous instruction as to which attribute was relevant. Results showed that PD participants performed significantly worse than normal control participants only when they had to remember, from previous instruction, which attribute was relevant. This executive function impairment is thought to reflect a form of set-shifting that leads to difficulty in disengaging from one task and engaging in a new task, particularly while being distracted by a previously relevant dimension (Robbins, James, & Owen, 1994).

In addition to deficits in executive functioning, PD patients show impairments on simple tests of attention (i.e,.Trails A; Stravitsky, Neargarder, Bogdanova, McNamara, & Cronin-Golomb, 2012), as well as on tests of verbal fluency (i.e., FAS; Stravitsky et al., 2012; Miller, Neargarder, Risi, & Cronin-Golomb, 2013) and nonverbal fluency (i.e., Ruff Figural Fluency Task; Stravitsky et al., 2012; Miller et al., 2013). These tests measure one's ability to attend to simple stimuli, generate words within a specified period of time, and create unique designs using basic stimuli, respectively. All are consistent with frontal lobe pathology, and are independent of other deficits such as rule-learning, working memory, or a general slowing of cognitive function. Because frontal lobe pathology is evident in PD, one question concerns whether other frontal lobe functions, such as personality traits, might also be affected by this disorder.

Personality Traits in PD

The Temperament and Character Inventory (TCI), a self-administered questionnaire developed by Cloninger, Svrakic, & Przybeck (1993) has been frequently used to assess personality characteristics in PD. It assesses seven dimensions of personality that are associated with two major components: temperament and character traits. Character traits are aspects of personality that involve individual differences in self-concepts about goals and values. Temperament traits involve differences in automatic emotional reactions and habits. The three character traits are Self-Directedness (SD): where high SD individuals have personal integrity, honor, self-esteem, effectiveness, leadership, and hope; Cooperativeness (C): where high C individuals have concepts of community, compassion, conscience, and charity; and Self-Transcendence (ST): where high ST scores display feelings of mystical participation,

religious faith, and unconditional equanimity and patience. The four temperament traits are Harm Avoidance (HA): high HA individuals are cautious, careful, fearful, tense, apprehensive, nervous, timid, doubtful, discouraged, insecure, passive, negativistic, or pessimistic and worriers; Novelty Seeking (NS): high NS individuals are quick-tempered, excitable, exploratory, curious, enthusiastic, impulsive, and disorderly; Reward Dependence (RD): high RD individuals are tender-hearted, loving and warm, sensitive, dedicated, dependent and sociable; and Persistence (P): high P individuals are industrious, hard-working, persistent, and stable (Cloninger et al., 1993).

The TCI is the preferred choice of personality assessment in PD patients because it was created based on a model relating personality traits to underlying neurobiological processes (Cloninger et al., 1993). For example, the temperament traits of NS has been shown to be directly related to dopamine levels, suggesting that damage to the mesolimbic dopaminergic system may result in low NS traits. Further, research suggests that serotonin is related to HA traits and norepinephrine to RD traits. These neurotransmitters have also been implicated in the manifestation of some of the symptoms of PD (Cloninger et al., 1993). The TCI scales exhibit satisfactory psychometric properties, are widely used in studies of clinical populations, and have been used successfully with PD patients (Menza et al., 1990; Cloninger et al., 1993; Fujii et al., 2000).

The majority of research examining personality characteristics in PD patients has found that, in general, PD patients exhibit low NS traits, high HA traits, and show less consistency in RD type-tasks than individuals without PD (Menza et al., 1990; Menza, Golbe, Cody, & Forman, 1993; Fujii et al., 2000). Poletti and Bonuccelli (2011) suggest that these noted changes, specifically the low NS and high HA traits noted in PD, are not present prior to disease onset. They believe that these personality changes are a direct result of having PD.

A question to consider is whether these noted changes in personality in PD are related to other changes manifested by the disorder. McNamara, Durso, and Harris (2008) conducted a study to examine personality, autobiographical memory, and executive cognitive function in patients with PD. Assessments used included the TCI, Stroop color-word interference, verbal fluency (FAS), and category fluency (animals). In general, they found that PD patients exhibited high HA traits when compared to normal control participants. They also reported a significant inverse correlation in their PD sample between verbal fluency scores and HA traits; the higher the HA score, the poorer the performance on the verbal fluency test.

Koerts et al. (2013) conducted a study to further investigate the relationships between executive functioning and personality traits in PD. PD and normal control participants were administered the TCI, the Stroop Color Word Test, Digit Span Backward, Zoo-Map, Frontal Assessment Battery, Trail Making Test, semantic and phonemic verbal fluency tests equivalent to the FAS test, and the Odd Man Out. Results showed that PD patients exhibited significantly higher scores on HA traits than normal control participants. However, contrary to previous literature, no differences between PD and normal control participants were noted for personality traits of NS, RD, or P. PD participants did significantly worse than normal control participants on measures of executive functioning including the Frontal Assessment Battery, semantic fluency test, and the Odd Man Out. When comparing executive measures to personality measures, significant associations were found between some of the executive measures and P and RD, but not with HA and NS. Koerts et al. (2013) concluded that in general, cognition contributes to personality traits observed in patients with neurodegenerative disorders such as PD.

Present Project
The purpose of the present project is to evaluate personality traits in PD and normal control participants, and to relate those findings to degree of PD severity and performance on frontal lobe assessments. It is fairly well established in the literature that cognition and degree of PD severity are related to one another. Multiple studies have shown that PD patients with more severe motor symptoms have a higher risk of developing more severe cognitive symptoms (Owen et al., 1992; Lees & Smith, 1983; Taylor et al., 1986; Beatty & Monson, 1990; Fama & Sullivan, 2002). It is currently uncertain, however, whether these cognitive deficits and disease severity relate to changes in personality noted in PD. This is the purpose of the current project. This study will assess personality traits in PD and relate these findings to the degree of PD severity and cognition. We will administer a variety of cognitive assessments, a personality assessment, and a disease severity assessment to examine the hypotheses of this study, which include, 1) PD participants will perform more poorly than normal control participants on all five frontal lobe assessments administered; 2) PD participants, when compared to normal control participants, will exhibit lower Novelty Seeking traits and higher Harm Avoidance traits on a personality assessment; and 3) PD participants who show deficits in cognitive abilities will also show differences in personality traits compared to normal control participants. In addition, those with higher disease severity scores will exhibit more cognitive deficits and personality changes than normal control participants.

Method

Participants

The study consisted of 50 participants: 27 non-demented PD participants (12 males and 15 females) with an average age of 64.52 years (SD = 6.24) and an average education level of 17.74 years (SD = 1.81), and 23 normal control participants (NC; 10 males and 13 females) with average age 64.35 years (SD = 6.76) and education levels of 16.78 years (SD = 2.02). PD and NC participants did not significantly differ on age [t(48) = .09, p = .93] or education [t(48) = 1.77, p = .08]. All participants scored above 25 on the Modified Mini-Mental State Exam (mMMSE), indicating the absence of dementia. PD participants scored a 28.74 (SD = 0.75) and NC participants scored a 28.70 (SD = 1.00). The mean Hoehn & Yahr staging for PD participants was 2.15 (SD = .60). The Hoehn & Yahr assesses PD severity. The average duration of PD was 5.60 years (SD = 4.09). PD and NC participants were referred from the Parkinson's Disease Center of Boston University Medical Center and local support groups, and included individuals who met the clinical criteria for mild to moderate PD as diagnosed by the patients' neurologists. NC participants were recruited from the community.

Measures and Procedures

Participants were given a battery of assessments. The assessments measured degree of PD severity andcognitive abilities, specifically executive functioning, attention, verbal and nonverbal fluency, and different personality traits.

Degree of PD severity.

Movement Disorder Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS). PD participants were administered the Unified Parkinson's Disease Rating Scale (UPDRS; Fahn & Elton, 1987), a standard measure of symptom severity. The UPDRS has four scales. The scales are 1) non-motor experiences of daily living (13 items), 2) motor experiences of daily living (13 items), 3) motor examination (18 items) and 4) motor complications (6 items). Each subscale has 0-4 ratings, where 0 = normal, 1 = slight, 2 = mild, 3 = moderate, and 4 = severe. The total UPDRS score was used as the dependent measure. A score of zero indicates the absence of PD and a score of 400 indicates the greatest degree of PD disease severity.

Frontal dysfunction assessments.

Stroop Color-Word Task. The Stroop Color-Word Task (Stroop, 1935) is a test of executive functioning and measures selective attention, set-shifting, and processing speed. First, in the color naming condition, participants are presented with a series of "XXXXs" in five columns of 20 words. Each series is presented in one of three colors: green, blue, or red. Participants name the color of each series of "XXXXs" presented as quickly as possible. The total number correct after 45 seconds is used as the dependent measure. Next, the assessment is presented in columns with the words "green," "blue," and "red," that appear in black (the word portion of the assessment). Their task is to read the words as quickly as possible within a 45-second time frame. The total number correct is used as the dependent measure Finally, the assessment is presented in columns with the words "green," "blue," and "red," except now the words are colored such that the color of the word is incongruent with what the word says (e.g., the word "blue" appears in the color red; the color-word portion of the assessment). Participants are asked to name the color in which the words appear (the correct response to the above example would be "red"). Participants are timed and the resulting score is equal to the number correct within a 45-second time frame, which is used as the dependent measure. Lower scores indicate poorer performance.

The Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency Task. The D-KEFS Verbal Fluency task (Delis et al., 2001; Delis et al., 2004) measures verbal fluency, specifically, the ability to understand language rules and the ability to switch between rules. Participants were asked to generate as many words as possible that started with the letter F within a period of one minute. This procedure was repeated for the letters A and S. The results from each portion (F, A, and S) were summed to generate a total score, which was used as the dependent measure.

For the category switching portion of the D-KEFS, participants were asked to name as many pieces of fruit and furniture as possible while alternating between categories (e.g., banana, chair, peach, table, etc.) for a period of 60 seconds. The total number of words was used as the dependent measure. Lower numbers indicate poorer performance.

For the category that measures semantic fluency, the participant demonstrates verbal fluency within a given category. Participants name as many animals as possible in one minute. Individual words were counted resulting in a total score as the dependent measure, with lower scores indicating poorer performance.

The Ruff Figural Fluency Test. The Ruff Figural Fluency Test (RFFT) evaluates nonverbal fluency and mental flexibility in participants. The original assessment was a version with larger design patterns to minimize motor and visualspatial demands (Ruff et al., 1987). The test is made up of five pages, each consisting of 35 blocks of five-dot matrices, arranged in seven rows and five columns on an 8½ by 11 inch sheet of paper.

Each page consists of a different stimulus pattern of dots. The task on each page is to draw as many unique designs as possible in a one-minute interval, by connecting the dots in different patterns. The total number of unique designs, preservative errors, and an error ratio are recorded; all three scores were used as dependent measures. Lower scores indicate poorer performance.

The Trail Making Test. The Trail Making Test (Reitan, 1958) measures executive function, specifically attention and working memory (Trails A) and set-shifting or cognitive flexibility (Trails B). The Trail Making Test consists of two parts. Trails A has 25 circles with numbers (1-25) in them. Trails B has 25 circles with alternating letters and numbers (A-L, 1-13). The circles are scattered throughout the page in no discernible pattern. For Trails A, participants were asked to draw a line as quickly as they could, connecting all of the circles in numerical order without lifting the pen. The amount of time it took to connect all of the circles was recorded and used as the dependent measure. For Trails B, participants were asked to connect the circles in order, alternating between letters and numbers (1, A, 2, B, etc). The amount of time it took to connect all of the circles was recorded and used as the dependent measure. Lower time indicates better performance.

The Wisconsin Card Sorting Test (WCST) The Wisconsin Card Sorting Test was used to assess set-shifting and preservation (Kongs et al., 2000). The WCST version used for this study was the 64 Cards Computer Version. The purpose of the test is to assess the ability to form abstract concepts, to shift and maintain sets, and to utilize feedback. The tests consists of four stimulus cards, placed in front of the participant, the first with a red triangle, the second with two green stars, the third with three yellow crosses, and the fourth with four blue circles. The participant is then given two decks, each containing 64 response cards, which have designs similar to those on the stimulus cards, varying in color, geometric form, and number. The participant is told to match each of the cards in the decks to one of the four key cards and is given feedback after each trial. The computer assessment changes the sorting rules after a set number of trials and the participant needs to figure out that the rules have changed based upon the feedback he/she receives. For the purposes of this project, the number of categories completed was used as the dependent measure. Lower scores indicate poorer performance.

Personality assessment.
Temperament and Character Inventory (TCI). Participants were asked to complete the Temperament and Character Inventory (TCI), a self-report questionnaire consisting of 240 items. As described earlier, the TCI examines seven different dimensions of personality traits, including four so-called temperaments: Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (P), and three so-called characters: Self-Directedness (SD), Cooperativeness (CO), and Self-Transcendence (ST) (Cloninger et al., 1993). Each item is rated with a two-point scale: "True" (1) or "False" (0). Each subscale assesses opposing qualities. For example, one subscale of NS is "Exploratory Excitability vs. Stoic Rigidity." All seven TCI trait scores were included as dependent measures.

Results
Hypothesis 1
PD participants will perform more poorly than NC participants on all five frontal lobe assessments administered.

Stroop Color-Word Test. Independent samples t-tests were performed to examine group (PD, NC) differences on the three conditions of this assessment: color naming, word, and color-word. Results revealed a significant difference in the color naming condition, $t(48) = 2.09$, $p<.04$, and the word condition, $t(48) = 2.82$, $p< .007$, but not in the color-word condition, $t(47) = 1.87$, $p = .07$, although the result may be considered a trend. In each condition, the PD participants performed worse than the NC participants.

D-KEFS. Independent samples t-tests were performed to examine group (PD, NC) differences on the three conditions of this assessment: FAS total, switch fruit/furniture, and animals. Results revealed no significant group differences in the FAS total, $t(48) = .93$, $p = .36$, switch fruit/furniture, $t(48) = .74$, $p = .46$, or the animals condition, $t(48) = 1.22$, $p = .23$. PD participants did not exhibit any deficits on this assessment. RUFF. Independent samples t-tests were performed to examine group (PD, NC) differences on the three measures of this assessment: total number of unique designs, number of errors, and perseveration errors. Results revealed no significant difference in the total number of unique designs, $t(48) = .52$, $p = .61$, the number of errors, $t(48) = 1.25$, $p = .22$, or in perseveration errors, $t(48) = 1.24$, $p = .22$. PD participants exhibited no deficits on this assessment.

Trails A and B. Independent samples t-tests were performed to examine group (PD, NC) differences on the two conditions of this assessment: Trails A and Trails B. Results revealed no significant difference on Trails A, $t(48) = 1.50$, $p = .14$. There was a significant difference on the Trails B condition, $t(46) = 2.02$, $p<.05$. Here, PD participants performed worse than the NC participants.

WCST. Independent samples t-test were performed to examine group (PD, NC) differences on the number of categories

completed. Results revealed no significant difference in the number of categories completed, $t(48) = 1.25$, $p = .22$. PD participants exhibited no deficits on this assessment.

Hypothesis 2

PD participants, when compared to NC participants, will exhibit lower Novelty Seeking traits and higher Harm Avoidance traits on the TCI. Independent samples t-tests were performed to examine group (PD, NC) differences on the four temperament traits (NS, HA, RD, P) and the three character traits (SD, C, ST) of the TCI. There were no significant differences for any of the temperament traits (NS: $t[48] = .001$, $p = .99$; HA: $t[48] = .78$, $p = .44$; RA: $t[48] = .51$, $p = .62$; P: $t([48] = 1.04$, $p = .31$). For the character traits, there was a significant difference for Cooperativeness: $t(48) = 2.16$, $p<.04$, but not for SD: $t(48) = 1.09$, $p = .28$, or ST: $t(48) = .86$, $p = .40$. PD participants scored higher in cooperativeness than NC participants.

Hypothesis 3

PD participants who show deficits in cognitive abilities will also show differences in personality traits compared to normal control participants. In addition, those with higher disease severity scores will exhibit more cognitive deficits and personality changes. In regards to disease severity, PD participants exhibited a mean of 30.08 (SD = 9.67) on the UPDRS. This value is consistent with mild severity PD impairments

NC correlations. Pearson correlations were performed to examine the relation between disease severity, cognitive variables, and personality traits. Alpha was set to .01 to account for the large number of correlations performed. Correlations for the NC group revealed significant relations between RD and color naming measures: $r(23) = -.56$, $p<.006$ and between NS and the number of errors on the RUFF: $r(23) = .54$, $p<.007$. Specifically, individuals who exhibited higher RD traits performed better on the color naming measure and individuals who exhibited higher NS traits exhibited more errors on the RUFF.

PD correlations. Pearson correlations were performed to examine the relation between disease severity, cognitive variables, and personality traits. Alpha was set to .01 to account for the large number of correlations performed. Correlations for the PD group revealed no significant relations between any of the dependent measures.

Discussion

Overall, the results of the current project do not reflect general findings demonstrated by previous literature. Potential reasons for this discrepancy are discussed following a summary of the

results for each of the three stated hypotheses.

The first hypothesis predicted that PD participants would perform more poorly than NC participants on all five frontal lobe assessments. Results demonstrated that PD participants only exhibited deficits on the color naming and word conditions of the Stroop, and Trails B. No deficits were noted on the color-word condition of the Stroop, Trails A, the D-KEFS, the RUFF, or the WCST. Only some of these findings are consistent with previous literature. For example, Stravitsky et al. (2012) and Miller et al. (2013) found that PD participants performed poorly on Trails A and B, Verbal Fluency (FAS), and RUFF Figural Fluency when compared to normal control participants. Roca et al. (2012) and Liozidou, Potagas, Papageorgiou, & Zalonis (2012) also found that PD participants performed significantly poorer on the WCST. In sum, although PD participants in the current study did exhibit deficits consistent with previous literature (such as on the Stroop and Trails B), their impairments were not as extensive as those typically reported (i.e., showing deficits on most if not all of the frontal lobe type assessments).

The second hypothesis predicted that PD participants, when compared to normal control participants, would exhibit lower Novelty Seeking traits and higher Harm Avoidance traits on a personality assessment. Results demonstrated that PD participants did not exhibit lower Novelty Seeking traits nor higher Harm Avoidance traits, but they did exhibit higher scores in Cooperativeness traits. These findings are not consistent with previous literature. Specifically, Menza et al. (1990; 1993) and Fujii et al. (2000) found low Novelty Seeking and high Harm Avoidance traits in PD participants on the TCI. Koerts et al. (2013) found that their PD sample only showed significantly higher scores on Harm Avoidance traits but not Novelty Seeking traits. McNamara et al. (2008) looked at Cooperativeness traits in PD participants. However, unlike the current study, PD participants did not show any significant results on Cooperativeness traits. In sum, the results of the current study did not find the low Novelty Seeking and/or high Harm Avoidance trait pattern in PD patients noted in the literature.

According to the third hypothesis, it was predicted that PD participants who show frontal lobe dysfunction would also show differences in personality traits compared to normal control participants. In addition, PD participants with higher disease severity scores were expected to exhibit more cognitive deficits and personality changes. Correlations for the PD group revealed no significant relations between cognitive dysfunction, personality assessments, or degree of severity. This is inconsistent with the previous literature that has found

significant correlations between executive function measures and Persistence and Reward Dependence personality traits in PD participants (Koerts et al., 2013).

Sample Characteristics

As demonstrated by the findings, many of the published cognitive deficits and personality changes observed in PD patients were not observed in the current study. One possible explanation relates to the characteristics of the participant sample used. Specifically, the sample of PD participants used in the current study is higher functioning in regards to PD severity than samples published in the literature and higher than those that have participated in our previous research studies. Atypical participant recruitment procedures biased the sample by only including the highest functioning PD patients and those with the lowest disease severity scores in the research study. Once the bias was discovered, the method of recruitment was terminated. Had the normal routine recruitment strategies been implemented, PD patients with a range of abilities and disease severities would have been recruited, which is more representative of the population, and different findings may have resulted.

General Limitations

There are some limitations to the current study. First, a relatively small sample size was used, and as noted above, the sample was most likely biased. Second, it is unclear whether the assessments used in the current study, both cognitive and personality, are the most sensitive to detecting impairments in PD patients. Other assessments may prove to be more useful and should be explored. For example, the Big Five Personality Test could be used. The third limitation is that this PD sample was highly educated. PD participants reported 17.74 years (SD = 1.81) of education, which is equivalent to having a master's degree. Some of the participants even had doctoral degrees. This sample, therefore, may not be representative of the general PD population. An explanation as to why this pattern occurred is that highly educated PD participants may be more motivated to participate in research studies than those who are less educated. This observation may also relate to the current study's finding that PD participants reported more Cooperativeness traits. It would be interesting to see if Cooperativeness traits were evident in the general PD population and not just in those individuals motivated to participate in research. The fourth limitation relates to the examination of gender differences. A preliminary analysis of the current data suggests that there may be gender differences in personality traits in PD participants. Specifically, PD females reported higher levels of Reward Dependence than did PD males or normal control females. PD females also reported higher levels of Cooperativeness than did normal control

females. These findings extend the literature on personality in PD by documenting the relation of gender to temperament and character profiles. Future research should therefore include gender as a variable of interest.

Conclusion

The current study examined the relationship between personality traits, cognitive impairments, and disease severity in PD. Although some impairments in cognitive performance were noted, and PD patients exhibited higher degrees of Cooperativeness personality traits than normal control participants, the results were not generally consistent with previous literature, most likely due to a biased PD sample. By continuing to examine the range of non-motor deficits associated with PD, we hope to aid in developing interventions aimed at improving the quality of life of these individuals.

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