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“Accidental, really?” Attributional bias in patients with Parkinson’s disease

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Abstract

Introduction. Among the cognitive domains impaired in Parkinson's disease (PD), social cognition has received particular attention in recent years. Nevertheless, attributional bias, a social-cognitive subdomain, has not yet been studied in this population, despite its potential relationship with neuropsychiatric symptoms, and despite the possibility that deep-brain stimulation of the subthalamic nucleus, an effective treatment for disabling motor symptoms, worsens cognitive impairment. The present study therefore compared the attributional bias of patients with PD (stimulated and nonstimulated subgroups) with that of controls. It also explored the potential correlations between patients' attributional bias and their clinical scores.

Methods. Thirty-two patients with PD (12 stimulated and 20 nonstimulated) were recruited and matched with 32 healthy controls. Attributional bias was assessed using the Ambiguous Intentions Hostility Questionnaire, which yields three subscores: Hostility Bias, Aggression Bias, and Blame. Depressive symptoms (Hamilton Rating Scale for Depression), paranoid thoughts (Paranoia Scale), global cognition (Montreal Cognitive Assessment), and social functioning (Social Functioning Questionnaire) were also assessed.

Results. Patients exhibited more hostile and aggressive biases than controls, especially in ambiguous situations. Stimulated patients had greater hostility and aggression biases and a higher blame score than controls in accidental situations. No significant differences were observed between stimulated and nonstimulated patients.

Conclusion. To our knowledge, this is the first study to have assessed attributional bias in patients with PD and explored the impact of deep-brain stimulation on this particular

subdomain of social cognition. Results suggest that patients exhibit attributional bias, and this impairment may be exacerbated in stimulated patients.

Keywords: attributional style; social cognition; Parkinson disease; deep brain stimulation; subthalamic nucleus.

Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disorder, affecting 1-2% of the population over 65 years. Its estimated prevalence more than doubled between 1990 and 2016 [1]. It is characterized by motor impairments such as resting tremor, bradykinesia, rigidity, and postural instability, but patients also exhibit nonmotor symptoms such as dysautonomia syndrome and neuropsychiatric symptoms. These nonmotor symptoms can be disabling and have a negative impact on patients' quality of life. About 60% of patients report anxiety symptoms, and around 35% have experienced a major depressive episode [2]. Moreover, depression in patients with PD may be associated with a modulation of personality traits such as decreased levels of openness, agreeableness, extraversion, and conscientiousness [3]. Other psychiatric symptoms include sleep disturbance, apathy, anxiety, and psychotic symptoms such as hallucinations and paranoid delusions. The majority of patients with PD will develop cognitive deficits[4].

Several categories of social cognition have been studied in patients with PD. *Social cognition* is defined as the set of processes that regulate relations between persons and explain individual or group behaviors. Several dimensions are usually included in this construct: theory of mind, emotion processing, social perception, social knowledge, and attributional bias. Extensive research has shown that emotion processing and theory of mind are impaired in patients with PD [5-7], but other aspects of social cognition that seem relevant in this population have yet to be properly studied.

Attributional bias is a form of cognitive bias that defines how we explain the causes of positive and negative events. It may also be a precursor to persecutory delusions[8].

Different causes can be attributed to an event, and this attribution is shared between the self, others, and other factors related to the situation. People with attributional bias may

mistakenly attribute every situation to one particular cause. Several studies have used the Ambiguous Intentions Hostility Questionnaire (AIHQ) to explore attributional bias [9]. The AIHQ yields three scores: *aggression bias* (AB), *hostility bias* (HB), and *blame score* (BS; also referred to as *attribution of responsibility*) in situations that differ in terms of intentionality (ambiguous, accidental, and intentional). As patients with PD display judgment and appreciation difficulties in complex social situations, it seems relevant to study attributional bias in this population[10, 11].

PD treatments, especially deep-brain stimulation (DBS) of the subthalamic nucleus (STN), may well have an impact on social cognition. STN DBS is a safe and effective treatment in advanced PD and improves patients' quality of life [12]. Its effect on social cognition is also disputed, for while some studies have shown that this treatment has a negative effect on several aspects of social cognition, such as theory of mind and facial emotion processing [13], others have concluded that STN DBS is safe for social cognition [14]. The different aspects of the social-cognitive impact need to be explored further, and no study has yet assessed the impact of STN DBS on attributional bias in patients with PD.

The main goal of the present study was to assess attributional bias in patients with PD compared with healthy controls (HC) for the first time. We hypothesized that patients would be more impaired than controls, with a greater AB. Furthermore, we compared patients who were treated with STN DBS and those who were not on attributional bias, to explore the potential impact of brain stimulation on this social-cognitive subdomain. Finally, we conducted correlational analyses between AIHQ scores and clinical scores (paranoia, depression, global cognition, and social functioning) in patients with PD, to identify the clinical correlates of attributional bias.

Method

Participants

A total of 32 patients with PD, all native French speakers, were recruited in three French hospitals (Reims University Hospital, Troyes Hospital, and Amiens University Hospital) and compared with 32 HC matched for age, sex, and education level. HC were recruited from among hospital staff or via an advertisement. In the PD group, 12 patients were treated with STN DBS (Stimulated PD) and 20 were on medication only (Nonstimulated PD). Patients' diagnosis was confirmed by a neurologist and their score on Part III (motor assessment) of the Unified Parkinson Disease Rating Scale (UPDRS) [15]. Their antiparkinsonian treatment had not changed within the previous 15 days. All Stimulated PD were on stimulation during the testing. Patients were excluded from the study if they had a severe comorbid psychiatric disorder (bipolar affective disorder or schizophrenia according to DSM-5 criteria [16]) or ongoing addiction (except tobacco), disabling sensory disturbance, intellectual deficit, or dementia causing an inability to answer questions. HC had no history of psychiatric or neurological illness, no head trauma, and no alcohol or drug abuse.

Procedure

The selected patients underwent a single study session and were recruited during their hospitalization in the neurology or neurosurgery department, or immediately after a medical consultation at the hospital. All patients were interviewed face to face by the same trained psychiatrist (L.D.).

All participants gave their written informed consent before taking part. The study was approved by the regional ethics committee (CCP Sud-Est II, French National Regulatory

Authority) and carried out in accordance with the Declaration of Helsinki and its subsequent amendments.

Sociodemographic characteristics were collected, and five questionnaires were then administered to participants in the following order: Hamilton Rating Scale for Depression (HAM-D;[17]), Montreal Cognitive Assessment (MOCA;[18]), AIHQ[9], Paranoia Scale (PS;[19]), and French-language Social Functioning Questionnaire (QFS;[20]). The session lasted about 90 minutes.

Material

Ambiguous Intentions Hostility Questionnaire [9]

The AIHQ assesses hostile social-cognitive bias by measuring three main biases and scores: HB, BS, and AB. The task consists of 15 negative situations that differ in terms of intentionality: five intentional scenarios, five ambiguous scenarios, and five accidental scenarios. In the present study, the experimenter read out descriptions of the 15 situations to patients. For each of these vignettes, patients provided two open-ended responses: a brief explanation as to why the event occurred, and what they would do in that situation.

Furthermore, patients rated the following on Likert scales: intentionality of the other's action, ranging from 1 (*Definitely no*) to 6 (*Definitely yes*), how angry it would make them, ranging from 1 (*Not at all angry*) to 5 (*Very angry*), and how much they would blame the other person, ranging from 1 (*Not at all*) to 5 (*Very much*). We averaged ratings on these three Likert scales to obtain the BS.

Two independent raters coded participants' two open-ended responses to calculate HB and AB on a scale of 1-5. The higher the score, the more hostile or aggressive the attributional bias.

Clinical assessment

- Hamilton Rating Scale for Depression [17]

The HAMD is a 21-item measure of anxiety and depression. The higher the total score, the higher the levels of anxiety and depressive symptoms. This scale has good internal consistency (standardized coefficient alpha = 0.82) with an appropriate mean interitem correlation of 0.23.

- Paranoia Scale (PS) [19]

The PS is a 20-item scale that measures nonclinical paranoid ideation triggered by everyday experiences. Participants indicate what they think about themselves and others by rating statements on a 5-point Likert scale ranging from 1 (*Not at all*) to 5 (*Totally*). The higher the score, the higher the degree of paranoid thoughts (range = 20-100). This scale has good internal consistency (standardized coefficient alpha = 0.84), and good mean interitem correlation (0.42).

- Montreal Cognitive Assessment [18]

MOCA is a composite test that assesses global cognitive function, together with visuospatial function, executive functions, attention, language, orientation, and verbal memory (5-word recall task). The maximum score is 30, and a score below 26 indicates cognitive impairment. It has been validated in the setting of mild cognitive impairment and is also valid in the PD population.

- Social Functioning Questionnaire (*Questionnaire de Fonctionnement Social*)[20]

The QFS is a 16-item self-report instrument that assesses both the frequency of (8 items) and satisfaction with (8 items) various social behaviors adopted during the 2 weeks preceding the assessment. It yields two separate indices of social functioning, defined a priori and labeled *frequency* and *satisfaction*, as well as an overall score. The QFS has been validated in the French population and displays satisfactory psychometric properties, with Cronbach's α ranging from 0.65 to 0.83.

Statistical analysis

Categorical data were analyzed using the chi-square or Fisher's exact test when required. Quantitative data were summarized as mean scores \pm standard deviation (*SD*) and percentages. Parametric analyses were conducted when the necessary conditions were met. Student *t* tests were performed when comparing two groups (e.g. Stimulated PD vs. Nonstimulated PD for clinical data), and one-way analyses of variance when comparing all three groups. Mann-Whitney or Kruskal-Wallis tests were performed with Dunn's post hoc comparisons. For post hoc pairwise comparisons, significance levels were adjusted for multiple comparisons by applying the Bonferroni correction. Given that the two patient subgroups differed on disease duration, we also conducted analyses of covariance with group (Stimulated PD vs. Nonstimulated PD) as a between-participants factor, AIHQ scores as dependent variables, and disease duration as a covariate. Spearman correlation coefficients were used for the correlational analyses of AIHQ and clinical scores in the PD population. The threshold for statistical significance was set at $p < 0.05$. All analyses were performed using R Version 3.5.2 and the easieR metapackage [21].

Results

Participants' descriptive characteristics

Participants' demographic and clinical characteristics are summarized in Table 1. All groups were matched on age, $F(2, 61) = 1.93, p = .15$, sex ratio ($\chi^2 = 0.78, p = .67$), and education level ($H = 0.43, p = .81$). There were no significant differences between the two PD subgroups in terms of either prescribed medication (L-Dopa: Stimulated PD: 91.67%; Nonstimulated PD: 100%; $p = 0.37$; dopamine agonist: Stimulated PD: 58.33%; Nonstimulated PD: 75%; $p = 0.43$) or motor impairment, as assessed with the UPDRS III score, $t(24) = -0.28, p = .78$. The two subgroups did, however, differ significantly on disease duration, with a longer duration for Stimulated PD ($U = 7, p < .001$).

PS and MOCA scores differed significantly between patients with PD (Stimulated and Nonstimulated) and HC, with the former displaying more paranoid thoughts and greater cognitive impairment ($H = 6.07, p = .04$ and $H = 27.37, p < .001$). Stimulated PD and HC differed significantly on overall and frequency QFS scores, $F(2, 61) = 4.92, p = .01$, and $F(2, 61) = 3.16, p = .04$. The HAMD score did not differ significantly between groups ($H = 0.154, p = .92$).

Attributional style

All results are set out in Table 2. The Stimulated PD subgroup exhibited a greater HB than HC, especially in accidental situations. All patients exhibited a greater HB than HC in ambiguous situations. They also exhibited a greater AB than HC, specifically in ambiguous and accidental situations.

BS was higher for the Stimulated PD subgroup than for HC in accidental situations.

No significant differences were found between the Stimulated PD and Nonstimulated PD subgroups on AIHQ scores, even when disease duration was controlled.

Correlations between AIHQ and clinical scores in PD group

Correlational analyses were conducted between AIHQ scores that significantly differed between patients with PD and HC and psychiatric (i.e. HAMD, PS), cognitive (i.e. MOCA), and functional (i.e. QFS) scores. The PS score was positively correlated with BS for accidental situations ($p = 0.38$, $p = 0.04$), and there was a trend toward significance for HB in ambiguous situations ($p = 0.34$, $p = 0.056$). All the other correlations were nonsignificant (all $ps > 0.05$), and none of the described correlations survived false discovery rate correction.

Discussion

To our knowledge, this is the first study to have investigated attributional bias in patients with PD and the potential impact of STN DBS. Our multicenter cross-sectional study revealed that patients exhibited greater HB and greater AB than HC, notably in ambiguous situations. In accidental situations, the Stimulated PD subgroup exhibited greater HB, greater AB, and a higher BS than HC.

Higher perceived hostility has already been found in other clinical populations, such as psychosis, and correlated with psychopathological symptoms [22]. Regarding neurological disorders, a study exploring the social cognition of patients with Wilson's disease [23] found that this population tended to react more *aggressively* to ambiguous social situations than HC. The authors suggested that this reaction, related to impulsivity, could be an early marker

of neuropsychiatric symptoms. They also suggested that it could be secondary to the emotion processing impairment observed in this population [23]. Hostility and aggression are robustly linked in various populations [for a review, see [24]], and probably share some common features, such as poor emotion processing and regulation [25]. In the PD population, impaired emotion processing may also contribute to the misinterpretation of ambiguous situations[26].

More specifically, our results also revealed significant differences between Stimulated PD and HC on all AIHQ scores in accidental situations, which should more be clearly interpreted as nonintentional. Interestingly, these situations only gave rise to a difference in BS. This was the only self-rated score, with good psychometric properties [27]. It appears to be more characteristic of the paranoid thought process than the other biases [9], as persons with higher levels of paranoia tend to assign more blame to others for negative outcomes. In our study, we found a significant correlation between BS and paranoid thoughts, driven by the Stimulated PD subgroup, who had the highest mean PS score. The same correlation had already been found in studies of subclinical paranoia in students [28], youth at high risk of psychosis [29], and people with schizophrenia [9]. Accidental situations are therefore of particular interest, as their misinterpretation may-more specifically than ambiguous situations-reflect a pathological process related to the neuropsychiatric symptoms present in Stimulated PD.

A secondary objective was to study the impact of STN DBS on attributional bias. The two PD subgroups were matched, and no AIHQ differences were found between the two.

Nevertheless, the processing of accidental situations differed when compared with HC, and the absence of a significant difference between the two subgroups may partly have been due

to the small size of our sample. Interestingly, some authors have suggested that the STN serves as an integrative hub for affective information, and STN DBS impairs emotional conflict processing [30], owing to a modulation of the limbic system. Misattribution of situations with HB and AB could contribute to this model.

The present study had several limitations that need to be addressed. First, the sample size was relatively small, thus reducing statistical power and limiting the potential generalization of our results, especially when comparing the Stimulated and Nonstimulated PD subgroups. Future studies should aim to replicate our findings using larger samples and exploring relationships with other social-cognitive domains, notably emotion processing. Second, our analysis of AIHQ responses was quantitative and partly rater-scored. A qualitative analysis might be more appropriate and improve the overall comprehension of attributional bias in PD. Third, the duration of illness differed between our groups. As the cognitive impairment increases with disease progression, it could have contributed to the difference found between our groups so it was taken into account in our analyses.

Conclusion

Our results suggest that patients with PD display attributional bias, and even if there was no direct difference between the Stimulated and Nonstimulated PD subgroups, their bias may have differed in severity. Further research is needed to confirm these results and should aim to replicate our research using larger samples. At an individual level, an attributional bias can have an impact on patients' behavior and quality of life, and a better understanding of these challenges might allow new interventions to be designed to remediate bias in PD.

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Tables

Table 1. Participants' sociodemographic and clinical characteristics

| | Patients with PD (<i>n</i> = 32) | | HC (<i>n</i> = 32) |
|--------------------------|-----------------------------------|--------------------------------|---------------------|
| | Stimulated (<i>n</i> = 12) | Nonstimulated (<i>n</i> = 20) | |
| | Mean ± <i>SD</i> | Mean ± <i>SD</i> | Mean ± <i>SD</i> |
| Age (years) | 64.66 ± 9.10 | 69.95 ± 8.28 | 65.47 ± 9.25 |
| Sex (M/F) | 5/7 | 11/9 | 18/14 |
| Education (years) | 10.08 ± 2.71 | 10.35 ± 2.53 | 10.41 ± 2.54 |
| Disease duration (years) | 18.92 ± 6.96 | 6.55 ± 3.82 | - |
| UPDRS Part 3 [n] | 17.78 ± 6.78 [8] | 16.94 ± 7.37 [18] | - |
| HAMD | 3.25 ± 4.47 | 2.80 ± 3.20 | 2.56 ± 3.29 |
| PS | 45.33 ± 13.99 | 41.65 ± 14.58 | 35.66 ± 12.66 |
| MOCA | 25.00 ± 3.96 | 22.95 ± 4.74 | 28.59 ± 1.34 |
| QFS overall score | 60.92 ± 7.3 | 66.65 ± 6.18 | 67.72 ± 6.32 |
| Frequency score | 29.33 ± 3.36 | 31.75 ± 3.49 | 32.72 ± 4.43 |
| Satisfaction score | 31.67 ± 5.38 | 34.90 ± 4.49 | 35.19 ± 3.7 |

UPDRS: Unified Parkinson Disease Rating Scale; HAMD: Hamilton Rating Scale for Depression; PS: Paranoia Scale; MOCA: Montreal Cognitive

Assessment; QFS: *Questionnaire de Fonctionnement Social*.

Table 2. Participants' AIHQ scores

| | Patients with PD (<i>n</i> = 32) | | HC (<i>n</i> = 32) | Group comparison |
|------------------------|-----------------------------------|-----------------------------------|---------------------|--|
| | Stimulated (<i>n</i> = 12) | Nonstimulated (<i>n</i> = 20) | | |
| | Mean ± <i>SD</i> | Mean ± <i>SD</i> | Mean ± <i>SD</i> | |
| Hostility bias | | | | |
| Ambiguous items | 2.02 ± 0.57 | 1.97 ± 0.39 | 1.55 ± 0.56 | <i>H</i> = 12.58, <i>p</i> = .002 (Stim>HC; Nonstim>HC) |
| Intentional items | 2.1 ± 0.42 | 1.91 ± 0.63 | 1.98 ± 0.59 | <i>H</i> = 1.53, <i>p</i> = .46 |
| Accidental items | 1.27 ± 0.36 | 1.14 ± 0.22 | 1.04 ± 0.15 | <i>H</i> = 10.35, <i>p</i> = .006 (Stim>HC) |
| Total | 1.79 ± 0.29 | 1.67 ± 0.29 | 1.53 ± 0.38 | <i>H</i> = 7.67, <i>p</i> = .02 (Stim>HC) |
| Aggression bias | | | | |
| Ambiguous items | 1.66 ± 0.51 | 1.65 ± 0.48 | 1.35 ± 0.41 | <i>H</i> = 6.87, <i>p</i> = .03 |
| Intentional items | 2.30 ± 0.57 | 2.04 ± 0.6 | 2.18 ± 0.68 | <i>F</i> (2, 61) = 0.66, <i>p</i> = .52 |
| Accidental items | 1.78 ± 0.49 | 1.63 ± 0.58 | 1.22 ± 0.34 | <i>H</i> = 15.62, <i>p</i> < .001 (Stim>HC; Nonstim>HC) |
| Total | 1.87 ± 0.36 | 1.77 ± 0.46 | 1.58 ± 0.41 | <i>F</i> (2, 61) = 2.41, <i>p</i> = .09 |
| Blame score | | | | |
| Ambiguous items | 2.49 ± 0.94 | 2.21 ± 0.61 | 2.16 ± 0.82 | <i>H</i> = 0.97, <i>p</i> = .61 |
| Intentional items | 3.21 ± 0.69 | 3.28 ± 0.66 | 3.39 ± 0.82 | <i>F</i> (2, 61) = 0.31, <i>p</i> = .73 |
| Accidental items | 1.61 ± 0.30 | 1.58 ± 0.51 | 1.38 ± 0.42 | <i>H</i> = 6.55, <i>p</i> = .04 , (Stim>HC) |

Total

2.43 ± 0.46

2.36 ± 0.53

2.31 ± 0.57

$F(2, 61) = 0.26, p = .79$
