# Toys and Gadgets: Construct Validity of Apathy in Parkinson's Disease

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*Apathy is one of the primary neuropsychiatric signatures in Parkinson's disease, yet little research has addressed the construct validity of two commonly used apathy measures, the Apathy Scale and the Lille Apathy Rating Scale. The authors tested the hypothesis that apathy is associated with reduced initiative/engaged behaviors on a laboratory-based measure of apathy. Support was found for the hypothesis that apathy, as indexed by the Apathy Scale and the Lille Apathy Rating Scale, is associated with reduced initiative/engagement on an experimental measure of apathy in Parkinson's disease patients. These findings provide independent evidence for the construct validity of self-report apathy scales, beyond clinician judgment.*

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Apathy was first formally described by Marin in 1990[1] as a primary "lack of motivation," resulting in defects within cognitive, affective, and behavioral domains. It is characterized by decreased initiative, flattened affect, and reduced interest in new experiences, which cannot be attributed to "diminished level of consciousness, cognitive impairment, or emotional distress."[1] Since Marin's initial formulation a growing body of research has examined apathy across various neurological disorders, resulting in several major findings. Although associated with reduced cognitive status, apathy also occurs in cognitively intact individuals and is dissociable from depression. The underlying neural mechanisms appear to involve mesial-frontal motivational systems and alterations in dopamine.[2–6]

The main purpose of the present study was to examine apathy in Parkinson's disease (PD) and its relationship to experimental indices of behavioral initiation. As is well known, PD is a common neurodegenerative disorder, involving dopamine depletion, that affects 2% of adults over the age of 65. Primarily typified by motor symptoms (rigidity, tremor, akinesia, and postural instability), the disorder also includes neuropsychiatric

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symptoms, with apathy and depression being particularly prominent.[7] Apathy occurs in a large proportion of patients, ranging from 16.5% to 60% across studies.[3–5] Recent studies support the view that apathy is a unique syndrome in PD, rather than being a symptom of depression or secondary to physical disability per se.[6,8] Although concomitant dementia and depression can be present,[9] a recent publication supports the dissociation of apathy and depression in PD.[10] Longitudinal studies suggest that apathy symptoms in PD progressively worsen in parallel with nondopaminergic motor symptoms, whereas depression symptoms do not.[11,12] Further support for the distinction between apathy and depression in PD includes the differential effects on depression and apathy symptoms after deep brain stimulation (DBS)[11,13] and failure of antidepressant medications in treating apathy symptoms.[14] In fact, serotonergic reuptake inhibitors (SSRIs) are well known to increase symptoms of apathy in non-PD samples.[15–17]

Currently, the most widely used tool for assessing apathy in PD is the Apathy Scale (AS), a modification of Marin's original 18-item measure, the Apathy Evaluation Scale (AES).[18] A more recent measure is the Lille Apathy Rating Scale (LARS),[19] a semistructured interview providing an overall apathy score as well as four domain-specific scores, overlapping with Marin's original conceptualization of apathy. These four domains include intellectual curiosity (cognitive), action-initiation (behavioral), emotional response (affect), and concern.

Although the AS and LARS have reasonable psychometric properties and have been endorsed by a taskforce of the Movement Disorders Society, their criterion validity has been sparsely assessed.[20] This type of assessment is essential, as clinicians base their evaluations on current apathy measures. Marin initially examined the criterion validity of his scale (AES) in patients with unilateral stroke and dementia.[18] One way this was done was by examining scores on the AES in relation to an "incidental" laboratory-based measure that quantified the extent to which patients spontaneously spent time playing with toys and gadgets.[18] Unfortunately, a similar approach has not been taken with PD patients using the modified Apathy Scale. Because growing evidence suggests that apathy may be a key neuropsychiatric signature of PD, independent of depression, it becomes increasingly important to use indices of apathy that are meaningful in a real-world context. Thus, we aimed to examine the construct validity of two well-recognized measures, the AS and the LARS, by utilizing a measure of initiation modeled after that of Marin.[18] Our first hypothesis was that high levels of apathy, as defined by two frequently-used measures, the AS and the LARS, would be associated with reduced initiative and active engagement during a laboratory-based measure. Our second hypothesis was that reduced engagement during the laboratory-based measure would not be associated with depression symptom severity.

## METHODS

### Participants

The current convenience sample included 28 individuals with idiopathic PD and 19 healthy-control subjects. PD patients were recruited as part of a pre-DBS candidacy visit at the University of Florida's Center for Movement Disorders and Neurorestoration (N=15) and during a routine visit to the Center for Movement Disorders and Neurorestoration (N=17) during the period January to November 2009. Controls were recruited through the community or were spouses of the patients (N=19). All PD participants met stringent diagnostic criteria for idiopathic PD, according to the UKPDS Brain Bank Diagnostic criteria[21] and were free of other neurological or medical illnesses compromising participation. Exclusion criteria for all participants entailed current or past history of major psychiatric disturbance (e.g., bipolar disorder, psychosis, current major depression), severe chronic medical illness (e.g., HIV, metastatic cancer), and scores in the dementia range on the Mini-Mental State (MMSE) exam ($\leq$24); 4 were excluded from the PD sample based on the aforementioned exclusion criteria, giving us a final N of 28. Informed consent was obtained according to University of Florida Institutional Review Board guidelines and the Declaration of Helsinki.

Table 1 depicts descriptive characteristics of the PD and control groups. As shown, the two groups did not differ in terms of demographics, although there were proportionally more men in the PD group, and they tended to have lower MMSE scores. Overall, the participants were well-educated and ranged in age from 44 to 81 years. All patients were on dopaminergic medication and in the early to middle stage of their disease according to the Hoehn-Yahr classification;[22] on-medication mean: 2.16 (standard deviation [SD]: 0.4); off-medication mean: 2.43 (SD: 0.4). On the motor score

**TABLE 1. Parkinson's Disease (PD) and Control Groups: Descriptive Characteristics**

| | PD | Control | | |
|---|---|---|---|---|
| | N=28 | N=19 | Statistic | p |
| Age, years | 64.64 (10.2) | 67.26 (9.2) | | NS |
| Education, years | 15.54 (2.4) | 16.42 (2.9) | | NS |
| Mini-Mental State Exam | 28.75 (1.3) | 29.32 (0.8) | t = −1.758 | 0.087+ |
| Sex (M/F) | 21/7 | 8/11 | $\chi^2$=5.183 | 0.023* |
| Apathy Scale | | | | |
| 0–42 raw score | 13.21 (6.7) | 6.89 (4.5) | t=3.584 | 0.001** |
| ≥14 Apathy/Non-Apathy | 13/15 | 2/17 | $\chi^2$=6.74 | 0.010** |
| % Apathetic | 46% | 11% | | |
| Lille Apathy Rating Scale | | | | |
| −36 to +36 raw score | −21.79 (6.4) | −26.84 (3.5) | t=3.144 | 0.003** |
| −22 Apathy/Non-Apathy | 14/14 | 1/18 | $\chi^2$=10.42 | 0.010** |
| % Apathetic | 50% | 5% | | |
| Beck Depression Inventory–II | | | | |
| 0–63 raw score | 12.07 (10.1) | 2.63 (2.7) | *U*=70 | 0.010** |
| ≥14 Depression/No Depression | 7/21 | 0/19 | $\chi^2$=5.58 | 0.018** |
| % Depressed | 25% | 0% | | |

Data are mean (SD) unless otherwise specified.
+trend level.
*p ≤0.05.
**p ≤0.01.
NS: nonsignificant.

of the Unified Parkinson's Disease Rating Scale (UPDRS):[23] on-medication mean: 23.57 (SD: 8.2); off-medication mean: 34.9 (SD: 11.6). The Hoehn-Yahr and UPDRS staging took place within 6 months of participation in this study.

**Baseline and Self-Report Measures**

All participants completed the Beck Depression Inventory–II (BDI–II), a 21-item, self-report measure indexing depression symptom severity. The recommended cut-off ≥14 was used.[24]

Apathy was assessed with two scales that were positively correlated in the current sample (r=0.54; p <0.000). The Apathy Scale (AS) is a 14-item measure, initially created by Marin[18] and later abbreviated for PD patients by Starkstein.[25] Each item is rated on a 4-point Likert scale, with total score ranging from 0 to 42. Higher scores reflect more severe apathy symptoms. The AS has high internal consistency (Cronbach's α=0.76) as well as good test–retest reliability (r=0.90). We used the recommended cut-off of ≥14 for classifying participants as apathetic.[20,25] The Lille Apathy Rating Scale (LARS) is a 33-item, semistructured interview that covers everyday productivity, interests, initiative, novelty-seeking, motivation, emotional responses, concern, social life, and self-awareness.[19] Items are worded as positive questions, and yes-or-no answers are required, with the exception of three questions that require answers on a 5-point Likert scale. Scores are derived for total Apathy and four composite subscales: Intellectual Curiosity, Action-Initiation, Emotional Response, and Self-Awareness. The total Apathy score ranges from −36 (optimal score) to +36 (worst score), whereas subscales range from −4 to +4, with lower scores indicating higher impairment. We used the recommended cut-off of −22, to classify individuals as apathetic, based on a recent study in a U.S.-based Parkinson sample[26] as well as a recommendation by Sockeel and colleagues, with regards to its sensitivity (r=0.64) and specificity (r=0.92).[19] The latter classified apathy with four global cut-off values: −36 to −22, for non-apathetic; −21 to −17, for slightly; −16 to −10, for moderately; and −9 to +36, for severely apathetic, respectively, allowing for our cut-off of −22 to fall into the non-apathetic category.[19]

*The Novelty Toy Task (NTT)* All participants were given the NTT, adapted from Marin,[18] as an independent probe for gauging apathy. Testing took place in a quiet room in the Cognitive Neuroscience Laboratory at the McKnight Brain Institute. Participants sat alone for approximately 12 minutes with six toys/gadgets located on a table in front of them. The toys/gadgets included a slinky, kaleidoscope, IQ wooden puzzle, Etch-A-Sketch, Rubik's Cube, and a metal puzzle; these were randomly placed on the

table in a set location before the participant entered the room. After seating the participant, the examiner announced that she would be busy setting up the next task in an adjacent room and that participant should feel free to use the items on the table while waiting for the examiner. No other instructions were given. During the 12-minute interval, the participants were videotaped with a digital camera located across the room from the participants. Participants consented to being videotaped throughout the evaluation, although they were not told when the "critical" period of recording would occur.

For each participant, a 10-minute segment of video was extracted, beginning at the point when the examiner exited the room. Tapes were reviewed by two blinded raters (interrater reliability: 0.995), in terms of the amount of time (in seconds) spent on manipulating each of the six gadgets. From these time data, four dependent variables were calculated: 1) total percentage time spent playing with gadgets (NTT: % Time Engaged) derived from time spent handling gadgets/600 seconds; 2) percentage time spent on each gadget individually (NTT: % Time per Game) derived from time spent handling each individual gadget/600 seconds; 3) absolute number of gadgets used by the participant, irrespective of time (NTT: # of Unique Games), with scores ranging from 0 to 6; and 4) repeated use, defined by number of times participants returned to an item with a break in between (NTT: # Repeats) during a 10-minute time interval.

### Statistical Analysis

Demographic group differences were compared using univariate ANOVA and chi-square analysis. When data were not normally distributed according to Kolmogorov-Smirnov test, nonparametric analyses (Mann-Whitney *U*)[27] were performed. Three overall analyses were conducted to assess the construct validity of the AS and the LARS: 1) Mann-Whitney *U* with Group (PD × Control) on dependent variables of NTT (% Time Engaged, # Unique Games, # Repeats); 2) Mann-Whitney – with Group (Apathetic × Non-Apathetic PD) on dependent variables of NTT (% Time Engaged, # Unique Games, # Repeats, and % Time per Game); 3) Spearman rho (ρ) correlation analyses between LARS (Intellectual Curiosity, Emotional Responses, Action-Initiation, and Self-Awareness) × NTT (% Time Engaged, # Unique Games, # Repeats) and possible confounders (UPDRS–III, LED, BDI–II) were conducted.

## RESULTS

### General Mood Characteristics of PD and Control Groups

As shown in Table 1, the PD group endorsed significantly more symptoms of apathy (AS and LARS) and depression (BDI–II) than the control group. Even so, the scores of the PD patients as a group fell below the recommended cut-offs for clinically significant depression and apathy.[24–26] The frequency of apathy in our PD sample varied slightly, depending on which apathy scale was used, although they fell within the range of those previously reported in the literature.[3–6,26] The frequency of individuals exceeding the clinical cut-offs for depression was lower than that described in the older literature, but falls within the range reported by more recent studies.[24,28]

### Novelty Toy Task: Parkinson's Versus Control Groups

We first examined the performance of the PD and the control groups on the dependent variables of the NTT as a whole. Because these data were not normally distributed, nonparametric analyses (Mann-Whitney *U*) were performed. Results of these analyses indicated no significant difference between groups with respect to any of the three major dependent variables on the Novelty Toy Task; 1) % Time Engaged: PD: 58.44 (37.9); Control: 64.05 (41.7); $U$=235, NS; 2) # Unique Games: PD: 3.81 (2.2); Control: 3.84 (2.3); $U$=263, NS; 3) # Repeats: PD: 1.07 (1.1); Control: 1.26 (1.15); $U$=236, NS.

### Apathetic Versus Non-Apathetic PD Groups: Descriptive Characteristics

To test our hypothesis that apathetic PD patients would spend less time than non-apathetic PD patients using the games during the NTT, we divided the PD patients into apathetic versus non-apathetic groups based on the recommended AS cut-off of $\geq$14[25] and the LARS cut-off of −22, respectively.[26] Demographic and disease variables for these group divisions can be seen in Table 2. These groups did not differ in terms of demographic features and most disease characteristics. However, the apathetic group tended to have worse UPDRS–III motor scores when tested on medication and obtained significantly higher scores on the BDI–II than the non-apathetic group when the Apathy Scale was used for group classification.

Using the LARS, apathetic groups did not differ in terms of demographics and disease characteristics except for the UPDRS–III on motor scores. The BDI–II tended to

**TABLE 2. Apathetic Versus Non-Apathetic Parkinson's Disease (PD) Groups: Descriptive Characteristics**

| | PD Apathetic N=13 | PD Non-Apathetic N=15 | *U* Statistic | p |
|---|---|---|---|---|
| **Division by Apathy Scale** | | | | |
| AS (0–42) | 19.15 (4.4) | 8.07 (3.2) | 0 | 0.000** |
| BDI–II | 17.69 (12.4) | 7.02 (3.4) | 25 | 0.001** |
| Age, years | 64.77 (10.9) | 64.52 (9.8) | 41 | NS |
| Education, years | 15.38 (1.5) | 15.67 (2.5) | 88 | NS |
| Sex (M/F) | 11/2 | 10/5 | $\chi^2$ = 1.197 | NS |
| Disease duration, years | 7.46 (2.3) | 7.8 (2.8) | 86 | NS |
| UPDRS–III on[b] | 28.50 (6.6) | 21.53 (8.1) | 23 | 0.056+ |
| UPDRS–III off[b] | 35.14 (12.4) | 34.77 (12.1) | 47 | NS |
| Hoehn & Yahr stage on[b] | 2.21 (0.3) | 2.15 (0.3) | 43 | NS |
| Hoehn & Yahr stage off[b] | 2.50 (0.4) | 2.38 (0.4) | 55 | NS |
| LED[a] | 1,029.1 (776.2) | 707.4 (545.4) | 47 | NS |
| | **PD Apathetic N=14** | **PD Non-Apathetic N=14** | ***U* Statistic** | **p** |
| **Division by Lille Apathy Rating Scale (LARS)** | | | | |
| LARS (-36 to +36) | −17.21 (5.4) | −26.36 (3.3) | 0 | 0.000** |
| Intellectual Curiosity | −1.48 (1.3) | −2.86 (0.6) | 38 | 0.005** |
| Emotional Responses | −2.39 (1.0) | −2.57 (0.8) | 90 | NS |
| Action-Initiation | −2.93 (2.3) | −5.56 (1.8) | 30 | 0.001** |
| Self-Awareness | −3.07 (1.3) | −2.79 (1.4) | 87 | NS |
| BDI–II | 15.43 (12.7) | 8.71 (1.4) | 57 | 0.062+ |
| Age, years | 63.36 (10.7) | 65.93 (9.3) | 84 | NS |
| Education, years | 14.64 (1.6) | 16.43 (2.7) | 60 | 0.085+ |
| Sex (M/F) | 12/2 | 9/5 | $\chi^2$ =1.714 | NS |
| Disease duration, years | 7.64 (3.3) | 7.64 (2.6) | 92 | NS |
| UPDRS–III on[b] | 27.00 (7.0) | 20.45 (8.3) | 24.5 | 0.029* |
| UPDRS–III off[b] | 35.90 (10.2) | 34.00 (13.2) | 44 | NS |
| Hoehn & Yahr stage on[b] | 2.35 (0.4) | 2.00 (0.4) | 33 | NS |
| Hoehn & Yahr stage off[b] | 2.45 (0.4) | 2.40 (0.4) | 57 | NS |
| LED[a] | 905.5 (545.7) | 684.8 (770.1) | 48 | NS |

Data are expressed as mean (SD) unless otherwise specified and are not normally distributed per Kolmogorov-Smirnov test; thus, all comparisons used nonparametric statistics.

BDI–II: Beck Depression Inventory–II; UPDRS–III: Unified Parkinson's Disease Rating Scale (on/off medication); LED: levodopa-equivalent dosage.

+trend level.

*p ≤0.05.

**p ≤0.01.

[a]N=23 (5 missing values).

[b]N=21 (7 missing values).

be higher in the apathetic than the non-apathetic PD group. With regard to LARS subscales, the apathetic group attained significantly worse scores on two of the subscales: Intellectual Curiosity and Action-Initiation. They did not differ on Self-Awareness or Emotion.

### Apathetic Versus Non-Apathetic PD Groups: Novelty Toy Task Performance

*AS* Initial analyses using the Kolmogorov-Smirnov test indicate that none of the dependent variables were normally distributed for either group when apathy was defined by the AS (Apathetic: $d$[13] p <0.01); (Non-Apathetic: $d$[15] p <0.01). Thus, all subsequent analyses and effect size calculations were conducted using nonparametric statistics. Results of between-group comparisons for NTT variables are presented in Table 3. There was a tendency (p=0.056; effect size: 0.36) for the apathetic group to spend proportionately less time playing with toys/gadgets as compared with the non-apathetic group. Across the six specific toys, there were no significant group differences, though apathetic patients tended to spend less time playing with metal puzzles. Correlation analyses (Spearman ρ) among the AS, NTT variables, and disease characteristics demonstrated a significant positive correlation between the AS overall score and depression: r=0.63; p <0.000, explaining 41% of the variance.

*LARS* Because none of the dependent variables were normally distributed when apathy group assignment

**TABLE 3. Apathetic Versus Non-Apathetic Parkinson's Disease (PD) Groups: Novelty Toy Task (NTT) Performance**

| | PD Apathetic N=13 | PD Non-Apathetic N=15 | *U* Statistic | p |
|---|---|---|---|---|
| **Division by Apathy Scale** | | | | |
| NTT: % time engaged | 42.3 (36.4) | 72.4 (34.5) | 56 | 0.056+ |
| NTT: % time per game | | | | |
| Slinky | 9.7 (23.6) | 3.6 (2.2) | 95 | NS |
| Kaleidoscope | 1.9 (2.0) | 2.4 (1.3) | 98 | NS |
| IQ-Wood Puzzle | 10.0 (14.7) | 27.9 (33.6) | 70 | NS |
| Etch-A-Sketch | 7.1 (9.5) | 19.4 (27.6) | 73 | NS |
| Metal Puzzles | 1.3 (2.2) | 5.2 (9.8) | 64 | 0.094+ |
| Rubik's Cube | 12.4 (13.9) | 13.9 (26.7) | 76 | NS |
| NTT: # unique games | 3.6 (2.1) | 4.1 (2.1) | 84 | NS |
| NTT: # repeats | 0.9 (1.0) | 1.3 (1.7) | 89 | NS |
| | **PD Apathetic N=14** | **PD Non-Apathetic N=14** | ***U* Statistic** | **p** |
| **Division by Lille Apathy Rating Scale (LARS)** | | | | |
| NTT: % time engaged | 39.1 (37.2) | 77.8 (28.9) | 42 | 0.010** |
| NTT: % time per game | | | | |
| Slinky | 8.6 (22.8) | 4.2 (5.1) | 76 | NS |
| Kaleidoscope | 1.6 (1.9) | 2.8 (2.9) | 75 | NS |
| IQ-Wood Puzzle | 9.1 (21.1) | 30.1 (30.1) | 42 | 0.009** |
| Etch-A-Sketch | 4.6 (7.2) | 22.7 (27.4) | 51 | 0.026* |
| Metal Puzzles | 1.4 (3.2) | 5.4 (9.8) | 54 | 0.031* |
| Rubik's Cube | 13.8 (24.4) | 12.6 (18.7) | 96 | NS |
| NTT: # unique games | 3.1 (2.0) | 4.4 (2.1) | 60 | 0.074+ |
| NTT: # repeats | 1.1 (0.8) | 1.3 (1.3) | 80 | NS |

Data are mean (SD) and are not normally distributed per Kolmogorov-Smirnov test; thus, all comparisons used nonparametric statistics.
+trend level.
*$p \leq 0.05$.
**$p \leq 0.01$.

was based on the LARS (Apathetic: $d$[14] $p < 0.03$); (Non-Apathetic: $d$[14] $p < 0.00$), all subsequent analyses were based on nonparametric statistics. Results of between-group comparisons are presented in Table 3. The apathetic group spent significantly less time playing with toys than the non-apathetic group (effect size: 0.36). The apathetic group also tended to play with fewer unique toys than did the non-apathetic group. Across the six specific toys, the apathetic group spent significantly less time than the non-apathetic group on three of the toys, The IQ Wood Puzzle, the Etch-A-Sketch, and the metal puzzles.

Subsequent correlation analyses (Spearman ρ) between the four domains of the LARS (Intellectual Curiosity, Emotional Responses, Action-Initiation, and Self-Awareness), NTT variables, and disease characteristics showed a significant negative correlation between the LARS overall score and NTT %Time Engaged ($r = -0.63$; $p < 0.000$), explaining 40% of the variance. Thus, greater apathy was associated with less time engaged with toys and gadgets. This specific relationship appeared to be driven by the negative correlation between the NTT % Time Engaged and the domains Intellectual Curiosity, with $r = -0.57$; $p < 0.001$ explaining 32% and by trend of Action-Initiation $r = -0.28$; $p < 0.074$ explaining 8% of the variance.

### Possible Confounders

Additional analyses were conducted to examine the contribution of disease variables and mood to performance on the NTT. Results from Spearman ρ correlation analyses revealed no significant relationship with motor severity scores (UPDRS–III), LED, or depression (BDI–II).

## DISCUSSION

In this study, the hypothesis that high levels of apathy would be associated with reduced initiative and engaged behaviors during a laboratory-based task, was tested in PD patients. We used a convenience sample of PD patients who were well-educated, predominantly male, and in the middle stages of the disorder. Fifty percent were candidates for DBS, and none met criteria for clinical dementia. The prevalence of apathy (46%–50%)

and depression (25%) were in line with previous reports in the literature.[6,24] Our sample might not reflect the true prevalence of apathy in the population because of the large proportion of DBS candidates. Nonetheless, this study is the first to evaluate the construct validity of apathy by use of the AS and the LARS in a sample of PD patients.

The hypothesis—that higher levels of apathy would result in reduced initiative and engaged behaviors during the laboratory-based measure—was supported by our data. Using apathetic and non-apathetic grouping, we found that both the AS and the LARS demonstrated convergent validity with our laboratory-based measure of apathy, the NTT. These findings indicate that participants displaying higher levels of apathy spent less time examining gadgets/toys that were available during a relatively unstructured, laboratory-based task. Furthermore, the lack of discrepancy between PD and control groups on NTT variables signifies that reduced time on tasks was not related to having PD, per se, but, rather, to the presence of apathy in the context of PD. We demonstrated a marked difference between groups in overall time spent engaged in activity, with significantly less time spent on the IQ-Wood puzzle, Etch-A-Sketch, and Metal Puzzles. This broadly confirms the view that apathy involves decreased curiosity, interest, and motivation to engage in the environment.

Looking closer at the LARS and its composite subscales, we observed that, irrespective of apathy status, participants with lower time engaged during the task displayed reduced levels of initiative, interest, novelty-seeking, motivation, and everyday productivity. Indexed by the composite subscale Intellectual Curiosity and Action-Initiation of the LARS, this finding affirms the convergent validity of the cognitive and behavioral domains of the scale.[19] The reduced levels of LARS domains also coincide with the cognitive and behavioral domains of recent diagnostic criteria for apathy put forth by a worldwide task force.[29]

In the current study, the AS seemed slightly less sensitive than the LARS in detecting differences in the initiation and of use of novel gadgets and toys. AS Apathy classification yielded differences between apathetic/non-apathetic groups at a trend level ($p=0.056$; effect size: 0.37) on the NTT. In contrast, group differences were stronger using the LARS ($p=0.01$; effect size: 0.43). Future studies with larger sample sizes are important to determine whether true differences in sensitivity exist between these two measures. Although each measure has well-described psychometric properties,[20] there are a variety of differences in the structure of the two scales that could potentially contribute to these findings. The version of the AS used in our study was self-administered (paper-and-pencil version), whereas the LARS is a semistructured interview. It is unclear whether a clinician-administered version of the AS would be more sensitive. The two scales also differ in number of items and range of scores, which is well known to contribute to increased reliability of a measure. Also, the LARS includes more items that specifically query "activities." Despite differences between the AS and LARS, previous studies have found good reliability between the AS (self-administered) and the LARS in both U.S.[26] and European samples.[19]

Our second hypothesis regarding depression was supported. In contrast to apathy, we found no relationship between severity of depression symptoms as indexed by the BDI–II and any of the NTT variables, despite higher depression scores in the apathetic PD groups. Furthermore, this implies that time spent engaged during the NTT was primarily influenced by apathy scores and not depression per se. Although no psychiatric interviews were conducted, our findings add to the literature finding that apathy and depression symptoms are distinct constructs, at a symptomatic level of depression. Recent neuroimaging findings also support this view in older adults and patients with PD.[30–32]

One prevailing view regarding apathy is that it relates to dopaminergic depletion and the effects of this depletion on reward circuitry. The relationship between apathy and dopamine availability remains complex; however, we found no association between levodopa-equivalent dosage (LED)[33] and NTT variables. A key issue, of course, is that the amount of dopamine replacement is limited in PD because of its clinical side-effect profile (i.e., disabling dyskinesias, hallucinations). Thus, it is not possible to discount dopaminergic influences on apathy in general; these just were not apparent in our study with a measure of dopamine medication usage.

There are several confounding factors that might contribute to reduced engagement during the NTT by the "apathetic" PD groups. One relates to motor symptom severity. Indeed, motor symptoms, as indexed by the UPDRS total motor score (on medication) were greater in the apathetic than the non-apathetic

groups. This raises the possibility that poor motor skills may have reduced the propensity for PD patients to engage in the NTT task. However, we found no relationship between motor symptom severity and performance variables of the NTT task (i.e., nonsignificant correlations).

Another issue relates to the validity of the NTT task as a true index of behavioral initiation and engagement. Although directly modeled after the one originally used to validate Marin's initial apathy measure (i.e., the Apathy Evaluation Scale),[18] it is possible that the specific toys (Rubik's cube, Etch-A-Sketch, Slinky) did not engender sufficient interest and curiosity. However, this appears to be a moot argument, in that task differences were found when apathy was defined by the LARS and were at trend level when the AS was used. Future studies could extend this work by examining true "ecological validity" by evaluating home-base behaviors, using techniques such as experience-based sampling or actigraphy.[34] Moreover, future studies should consider utilizing factor scores of current apathy scales when evaluating their ecological validity.[35]

Our study has several limitations, including generalizability of our sample, as the majority of our Parkinson patients were men, and approximately half were candidates for DBS. Our sample size was relatively small, as well. A broader limitation is that there are no formal DSM-IV diagnostic clinical criteria for apathy. Although Marin[1] originally, and more recent workgroups[36,37] have attempted to develop and validate criteria, current decisions about "apathy" classification continue to be psychometrically-based. Furthermore, the exclusion of participants on the basis of MMSE (≤24) instead of current diagnostic criteria[38] may have led to the inclusion of individuals with dementia or exclusion of those without. Nevertheless, the high mean MMSE score of the PD sample speaks against this being a major limitation of the current study.

## CONCLUSION

This study is the first to report on the convergent validity of two of the most widely used apathy scales in the PD population. Although higher apathy scores on both measures were associated with reduced initiation and engagement on a laboratory measure (NTT), this relationship seemed slightly stronger for the LARS than the AS. Importantly, there was no relationship between severity of depression symptoms and task performance—findings in line with previous reporting on the dissociation of apathy and depression.[10,39,40] Apathy can have a devastating effect on PD patients' daily life and compliance with treatment plans,[41,42] making it imperative for clinicians to utilize scales such as the AS and LARS, that are meaningful in a real-world context and approximate the construct of apathy.

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