A qualitative examination of apathy and physical activity in Huntington's and Parkinson's disease

Kelly J Atkins[1] [iD], Ciarán P Friel[2] [iD], Sophie C Andrews[1,3,4] [iD], Trevor T-J Chong[1,5,6] [iD], Julie C Stout[1] [iD] & Lori Quinn*[,7,8] [iD]

[1]School of Psychological Sciences, Turner Institute for Brain & Mental Health, Monash University, Melbourne, VIC, 3800, Australia
[2]Center for Personalized Health, Feinstein Institutes for Medical Research, Northwell Health, New York, NY, 11030, USA
[3]Neuroscience Research Australia, Sydney, NSW, 2031, Australia
[4]School of Psychology, University of New South Wales, Sydney, NSW, 2033, Australia
[5]Department of Neurology, Alfred Health, Melbourne, VIC, 3004, Australia
[6]Department of Clinical Neurosciences, St Vincent's Hospital, Melbourne, VIC, 3065, Australia
[7]Department of Biobehavioral Sciences, Teacher's College, Columbia University, New York City, NY, 10027, USA
[8]Centre for Trials Research, Cardiff University, Cardiff, Wales, CF14 4YS, UK
*Author for correspondence: Tel.: +1 212 678 3424; lq2165@tc.columbia.edu

Aim: In Huntington's disease (HD) and Parkinson's disease (PD), apathy is a frequently cited barrier to participation in physical activity. Current diagnostic criteria emphasize dissociable variants of apathy that differentially affect goal-directed behavior. How these dimensions present and affect physical activity in HD and PD is unknown. **Methods:** Using a qualitative approach, we examined the experience of apathy and its impact on physical activity in 20 people with early-manifest HD or idiopathic PD. **Results:** Two major themes emerged: the multidimensionality of apathy, including initiation or goal-identification difficulties, and the interplay of apathy and fatigue; and facilitators of physical activity, including routines, safe environments and education. **Conclusion:** Physical activity interventions tailored to apathy phenotypes may maximize participant engagement.

Huntington's disease (HD) is a dominantly inherited neurodegenerative disorder that leads to motor dysfunction, cognitive impairment and neuropsychiatric changes. The disease is caused by the production of an abnormal protein that is especially toxic to the striatal cells of the basal ganglia [1]. In Western populations, HD is estimated to affect 10.6–13.7 people per 100,000. Similar to HD, Parkinson's disease (PD) is a neurodegenerative movement disorder caused by an unexplained degeneration of the nigrostriatal dopaminergic neurons of the basal ganglia [2]. PD is more common than HD, affecting an estimated 428 per 100,000 of 60–69 year olds, with prevalence increasing steadily with age [3].

HD and PD are diseases of the basal ganglia characterized by degeneration of the cortico-striatal-thalamic circuits. In healthy people, these circuits facilitate high level cognition and voluntary motor function [4,5]. In HD and PD the degeneration of the basal ganglia leads to physical changes that detrimentally affect daily functioning [6,7]. These include changes to balance, gait and postural stability. Physical activity programs are thus especially important in the management of neurodegenerative movement disorders to promote physical, social and emotional wellbeing.

Interventions that promote physical activity in HD and PD, alongside emotional and cognitive engagement, have been trialled across inpatient, outpatient and community settings [8–11]. Most research interventions focus on short-term gains, and do not prioritize the long-term maintenance of health behaviors. Similarly, limited resources mean that clinical interventions are often targeted and time limited [12]. The long-term efficacy of physical activity interventions thus depends on the compliance and engagement of the participant, who must independently adhere

to their program long-term to maximize the benefits. Long-term reliance on participant adherence, however, poses a challenge for people with neurological conditions in which apathy is a common symptom, such as HD and PD.

Alongside disturbances in motor function and cognition, people with HD and PD experience behavioral disturbances, of which apathy is one of the most common [13–15]. Apathy is defined as a reduction in goal directed behavior associated with reduced interest, motivation and emotional reactivity [16,17] that contributes to lower quality of life, less functional independence, cognitive decline and greater caregiver burden [18,19]. In early manifest HD, up to 63% of people report clinically relevant apathy [20], and in PD, clinically elevated apathy affects approximately 50% of people [15,21]. The high prevalence of apathy in HD and PD is attributable to altered cortico-striatal-thalamic circuits, as these pathways are important for initiating, maintaining and reinforcing motivated goal-directed behavior [22,23]. Current diagnostic criteria of apathy across psychiatric and neurological disease emphasize dissociable variants that differentially affect goal-directed behavior, including behavioral (difficulty initiating action), cognitive (difficulty identifying a goal and associated plan of action), emotional (blunted emotional responses) and social apathy (social withdrawal) [16,17,24]. How these apathy subtypes manifest and whether they relate differentially to physical activity in HD and PD is unknown.

Clinical assessment of apathy is typically based on self- or partner-rating scales, or clinician interview [25]. Self- and partner-report can enable tracking of apathy across time; however, this approach lacks information about the context in which apathy is experienced or observed and provides no account of apathy in a person's own words. Patient-centered accounts of apathy will facilitate more accurate measurement of apathy subtypes and inform physical activity interventions targeted to HD and PD populations; these accounts may be best achieved using qualitative methods but to date have been underutilized. Only two studies have employed a qualitative framework to examine apathy in PD [26,27], but the manifestation of apathy subtypes or their impact on physical activity was not explored. Likewise, qualitative studies of physical activity in HD and PD [28] focus on the general barriers and facilitators of physical activity, without consideration to non-motor symptoms, such as apathy, that may affect participation [29].

The aim of our exploratory study was to understand the subjective experience of apathy subtypes and how they influence engagement in physical activity. We included people with HD and PD because these neurodegenerative diseases share pathology of the basal ganglia and apathy is a commonly reported but poorly understood symptom in both diseases [17,30,31]. For the purpose of this study, we designed and implemented a semi-structured interview schedule and administered the Lille Apathy Rating Scale (LARS) [32], which is a clinician-administered structured interview of apathy. We then analyzed these interviews using qualitative methods, led by two overarching questions: how does the experience of apathy across its different dimensions affect engagement in physical activity behaviors? and which behavioral strategies compensate for apathy and enable physical activity?

Materials & methods

Design

We used a phenomenological qualitative research design to explore participant's lived experience of apathy and its subtypes and how these experiences effected their engagement in physical activity. To do so, we developed a semi-structured interview schedule, which we administered alongside the LARS.

Participants

Recruitment sources included a participant registry at Teachers College, Columbia University and word-of-mouth. Four participants with HD were approached in person at the time of their clinic appointment at the Huntington's Disease Society of America (HDSA) Center of Excellence at New York State Psychiatric Institute (NYSPI). We recruited 20 people diagnosed by a neurologist with manifest HD (n = 10) or idiopathic PD (n = 10). We included participants in the early to middle stages of disease (see Table 1 for demographic and clinical information) and excluded those with late or advanced stage disease. For HD participants, we determined disease stage using the Total Functional Capacity (TFC) score of the Unified Huntington's Disease Rating Scale (UHDRS) [33]. For PD participants, we determined disease stage using the Hoehn and Yahr Staging criteria [34]. Late and advanced disease for HD participants was defined as a (TFC) score of less than seven [33], and in the case of people with PD, a Hoehn and Yahr stage of greater than three [34]. We obtained medical information pertaining to disease stage from the clinical recruitment site or via our internal participant registry at Teachers College.

We used a purposive sampling approach to ensure equal representation of people with HD and PD. PD participants were on average of 12.9 years older than those with HD (p = 0.009) and had more years of education

Table 1. Summary of participant demographics and self-report measures (means [standard deviation]).

	Huntington's disease	Parkinson's disease
Gender (M:F)	7:3	6:4
Age** [range]	53 (10.56) [41–73]	65.9 (9.0) [55–79]
Education** [range]	15.6 (2.88) [12–21]	19.60 (1.90) [16–21]
LARS total [range]	-15.40 (7.96) [-27–1]	-15.70 (8.23) [-25–2]

Significant difference: *p < 0.05; **p < 0.001.
LARS: Lille Apathy Rating Scale.

Table 2. Overview of Huntington's disease participants' disease and functional information.

Participant	Age, gender and stage	Descriptive information
HD01	41-year-old male; 13 years of education; stage II	Single, living in rehabilitation facility; unemployed
HD02	59-year-old male; 14 years of education; stage I	Single; living independently; unemployed
HD03	46-year-old male; 16 years of education; stage I	Married; living at home with spouse; working full-time
HD04	43-year-old female; 14 years of education; stage I	Married; living at home with spouse and young child; working full-time
HD05	53-year-old male; 20 years of education; stage I	Single; living independently; working full-time
HD06	66-year-old male; 15 years of education; stage II	Single; living independently; retired
HD07	44-year-old female; 16 years of education; stage II	Married; living at home with spouse; retired
HD08	73-year-old male; 21 years of education; stage I	Married; living at home with spouse; volunteering part-time
HD09	49-year-old male; 12 years of education; stage I	Single; living independently; working full-time
HD10	46-year-old female; 12 years of education; stage I	Married; living independently with spouse; working full-time

Stage: Total Functional Capacity score.

Table 3. Overview of Parkinson's disease participants' disease and functional information.

Participant	Age, gender and stage	Descriptive information
PD11	66-year-old male; 21 years of education; stage II	Married; living at home with spouse; working part-time;
PD12	77-year-old female; 12 years education; stage II	Living with partner, retired
PD13	73-year-old male; 21 years of education; stage I	Married, living at home with spouse; working part time
PD14	57-year-old female; 21 years of education; stage I	Married, living at home with spouse and adult child; working full-time
PD15	59-year-old male; 18 years of education; stage II	Single, living independently, retired
PD16	79-year-old female; 16 years of age; stage I	Married, living at home with spouse, retired
PD17	55-year-old female; 18 years of education; stage I	Married, living at home with spouse; working part-time
PD18	57-year-old male; 21 years of education; stage II	Married; living at home with spouse and adult child; working-full time
PD19	63-year-old female; 21 years of education; stage I	Married; living at home with spouse; working full-time;
PD20	73-year-old male; 18 years of education; stage II	Living alone; retired

Stage: Hoehn & Yahr disease staging.

(p = 0.002; Table 1). All participants ambulated independently but reported some form of cognitive or physical impairment, or mood-related changes that interrupted their ability to perform certain activities (e.g., pain, slowness in movement, reduced dexterity, delayed reaction times, balance, anxiety, problem solving). Individual characteristics of participants with HD and PD are presented in Tables 2 and 3, respectively. Technical failure in the recording of two interviews resulted in missing transcripts from the qualitative analyses for two participants, both from the HD sample. This technical failure resulted in a final HD analytic sample of eight. All participants provided informed consent in accordance with the Declaration of Helsinki. Ethical approval was obtained from NYSPI and Teachers College, Columbia University Institutional Review Boards.

Procedure

We interviewed participants in person (n = 9) or remotely via audio/video conferencing (n = 11). In person interviews were conducted at the Neurorehabilitation Research Laboratory at Teachers College, or at the HDSA

Center of Excellence at NYSPI. All interviews were audio recorded. KJA conducted the interviews, which ranged from 60 to 90 min in duration and followed our pre-planned interview schedule, which served as a checklist and guide toward the topic area for discussion. To facilitate recall, the interview schedule was built around specific episodes of activity or sedentary behaviors. This minimized the executive load required of participants, thereby limiting the impact of possible cognitive impairment on interview responses. Broadly, the question schedule aimed to establish: the lived experience and motivation for physical activity; the lived experience of sedentary activity and the reason for sedentary behavior; and, the subjective impact of apathy on physical activity. At the completion of our interview schedule, we administered the LARS.

We then analyzed these interviews using qualitative methods, led by two overarching questions: How does apathy across its different dimensions affect engagement in physical activity behaviors; and which behavioral strategies compensate for apathy and enable physical activity?

Assessments
Lille apathy rating scale

The LARS [32] is a clinician-rated, semi-structured interview that assess four domains of apathy: intellectual curiosity, action initiation, emotion and self-awareness. Administration of the LARS includes 33 items read aloud to the respondent. The first three items are rated on a five-point Likert type scale, whereas the clinician evaluates the remaining 33 items on a binary yes/no scale with an not available (NA) rating option for responses that are non-classifiable. The LARS produces a total apathy score ranging from -36 to 36, with lower scores indicative of more apathy symptomatology. The developers suggest that a cutoff score of -16 or less is indicative of clinically relevant apathy [14,32].

Data analysis

We analyzed the verbatim responses of participants from both our interview schedule and the LARS, using the inductive thematic analysis approach described by Braun and Clarke [35]. Interviews were transcribed verbatim by KJA who subsequently re-reviewed them for accuracy. Analysis followed five stages. In the first stage, KJA carefully read all 18 transcripts to promote familiarization with the data. Throughout this stage, KJA used notes to record ideas for codes and themes, which informed the analyses. Second, transcripts were re-read in detail and coded, using an open-coding framework based on the principles of thematic analysis [35]. In the third stage, KJA and LQ sorted the generated codes into potential sub-themes. LQ is an experienced physical therapist with a research program specializing in physical therapy interventions. Charting and mind-maps were employed in the third stage to establish links between sub-themes and to visualize how each code fit within the broader theme. Fourth, KJA and LQ reviewed the codes to determine any overlap or repetition across codes, and whether any codes could be collapsed to more concisely describe the data. During this stage, we also considered whether we could improve the descriptors used to capture the content of each code or overarching sub-theme, and where relevant, we adjusted the descriptors accordingly. Finally, the sub-themes were collated into two major themes that encapsulated their overarching meaning and that related to the research questions of interest.

To ensure the accuracy of our interpretations, we employed analyst triangulation and peer debriefing. This included a sample of cross-coding, alongside multiple ongoing discussions between KJA and LQ about the generated codes and the identified themes. Through these discussions, we determined alternative interpretations and ensured data saturation was reached prior to the preparation of results. The interpretation of the major themes and the sub-themes within were discussed with all authors who together have extensive research and clinical experience in HD and PD. Discrepancies in interpretation were discussed as a group and resolved with the oversight of KJA and LQ. We used the qualitative data analysis package NVivo (QSR NVivo for Macintosh, version 2.0., QSR International Pty Ltd) to assist with summarizing and analyzing the data.

In addition to our qualitative analyses, we used the total apathy score derived from the LARS to characterize the severity of apathy in the sample.

Results
Qualitative results

Our qualitative analysis identified two major themes: the impact of multidimensional apathy on physical activity, and strategies to facilitate engagement in physical activity. To effectively convey their meaning, we deconstructed our major themes into six sub-themes (see Figure 1). Major theme one consisted of the following three sub-themes:
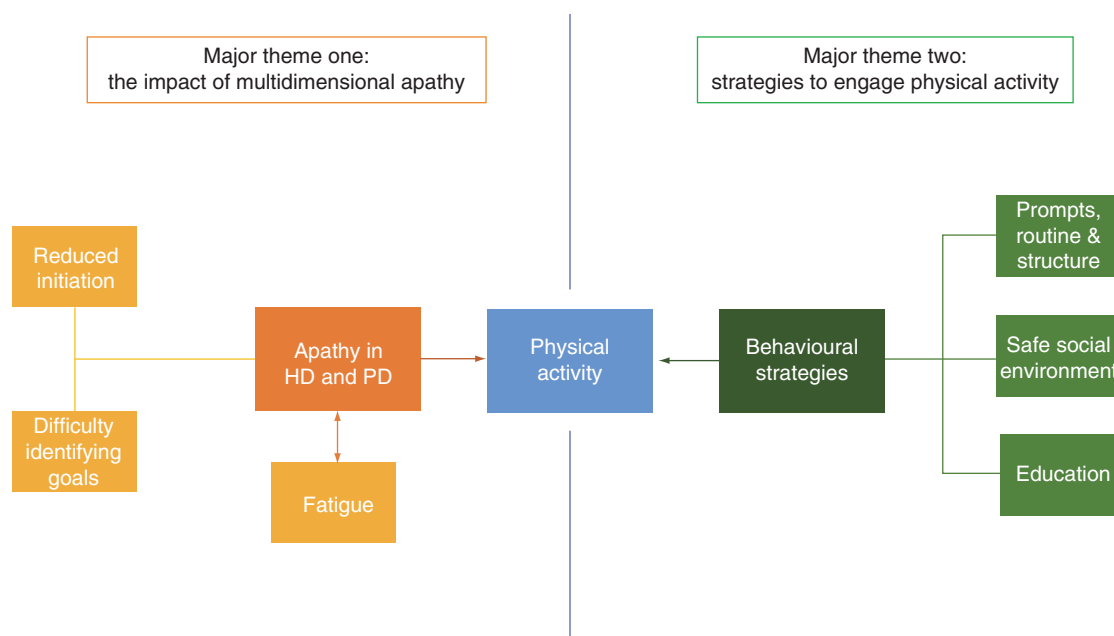
Figure 1. Visual schematic of the two major themes comprised of six subthemes. Orange shaded elements (left) refer to major theme one and subthemes within. Green shaded elements (right) refer to major theme two and subthemes within. The bidirectional arrow between apathy and fatigue indicates the overlap between these two distinct psychological constructs.
HD: Huntington's disease; PD: Parkinson's disease.

1a) apathy leads to difficulties in initiation in both PD and HD; 1b) people with HD have difficulties identifying goals for action; and 1c) fatigue influences physical activity and is not easily distinguished from apathy. Major theme two consisted of the following three subthemes: 2a) the use of prompts, routine and structure to promote physical activity; 2b) creating a safe social environment facilitates exercise engagement, however resources for people with HD appear to be lacking compared with PD; and 2c) The psychological response to a diagnosis affects engagement and psychoeducation after diagnosis may promote physical activity. We describe each sub-theme below, with examples of key quotes from participants.

Major theme one: the impact of multidimensional apathy on physical activity

Apathy leads to difficulties in the initiation of activity in both HD & PD

Both HD and PD participants described difficulty in initiating activities they believed would be positive for their physical and mental health. These descriptions were both overt, "*I don't know, if it's just me and I'm lazy or if it's just part of the disease, but I have difficulties sometimes getting myself off the ground and up off the couch and doing things*" (HD03), and indirect descriptions of wanting to "*get out*" and not doing so until prompted by a friend or spouse: "*I feel bad, I feel sad sometimes, because... I'll be home, I might put on the T.V ... then that's it... but as soon as she texted me, I thought 'ooh' this is a really good day to get out*" (HD04).

Many HD and PD participants identified activities or behaviors they wanted to engage in but described difficulty initiating the activity: "*we've always talked about* [walking] *and we definitely could go out and do it after work. But for some reason you just get home and you're just not particularly motivated*" (HD03). Difficulties in initiation were especially prominent after a disruption to established routines, which ranged from relatively minor changes, such as a holiday, to major events, such as moving to a new house or losing a job.

People with HD have difficulties identifying goals for action, which may reflect cognitive apathy

Particularly for people with HD, a reduced interest or curiosity was evident, which was often associated with a difficulty identifying goals or activities of interest. Although these participants did not directly indicate a lack of interests, they responded vaguely and were unable to draw on any recent examples of self-generated, spontaneous activity. For example, when asked what they typically did after work, one HD participant reflected: "*Go home... generally go home and ah...*" (HD05). Subsequent prompting of his hobbies provided little further information

and when asked whether he was interested in new things he replied: "*Hmmm. . . doesn't faze me. . . don't really care.*" Difficulties in goal identification were also exemplified by participants who described apathy as a sense of indecision, of being "*stuck and caught*" and not knowing how to proceed, possibly reflecting a difficulty in mentally elaborating on a plan of action [17,36].

Fatigue influences physical activity & is not easily distinguished from apathy

People with HD and PD tended to describe apathy in a way that was conceptually similar to fatigue. One participant with PD defined apathy as "*everyday activities* [become] *difficult, tiring, emotionally more difficult, and harder*", and a participant with HD described the experience of apathy as "*running out of steam*". Both peripheral (difficulty maintaining physical activity at desired level of intensity) and central fatigue (subjective experience of fatigue) were prominent symptoms reported by PD participants (see Chaudhuri and Behan [37] for a review of central and peripheral fatigue). In PD, reports of fatigue were typically discussed in the context of medication in which participants reported less energy on either side of their routine dosage. Peripheral fatigue described as muscle tiredness from physical exertion was reported (e.g., arms feeling tired) as was daytime sleepiness, which was attributed to sleep difficulties. Participants also made reference to central fatigue and how this often arose at the prospect of managing their symptoms, formulating plans, initiating activities or maintaining positivity. For example, when discussing the emotional experience of a single day, PD18 reflected: "*you may be feeling some fatigue because of . . . the effort needed to build up on motivation*". Several participants described feeling mentally fatigued in the morning, which dissipated once they had commenced their daily activities. The subjective experience of fatigue was also related to the perception of the activity whereby enjoyable activities were associated with more self-reported "*motivation*" and subsequently less fatigue, for example, "*It's funny, when I go to the gym I get bored very easily and I get tired much faster, when I go for dancing I can dance for three hours, and never get tired. It's amazing, depends on your attitude actually*" (PD15).

Major theme two: strategies to engage physical activity

The use of prompts, routine & structure to promote activity

By far the most common strategy to overcome symptoms of apathy was the use of external prompts, adopted by both people with HD and PD. Prompts included reminders from family or friends, as well as electronic reminders set with smartphones: "*I guess cues always help. . . so sometimes* [it helps]*, if somebody else has prompted me*"; (PD18). Participants also engaged cues from the environment, such as committing to an activity at a certain time of the day or agreeing to do the activity as part of a social outing. Participants who were the most physically and socially engaged described having schedules in place that provided structure to their lives and was especially prominent in PD participants. Schedules included weekly commitments to support groups, exercise classes, community groups and volunteer programs: "*During the day normally I can go for classes, all sorts of classes, I've got my dancing classes, and my underwater exercise classes, yoga . . .* " (PD15). These schedules appeared to provide the structure and routine needed to circumvent initiation deficits, whereby participants were not required to internally generate the activity. Importantly, the schedules of active participants tended to be long standing habits, adopted prior to the onset of their disease.

Creating a safe social environment facilitates exercise engagement, however resources for people with HD are lacking compared with PD

Participants with positive social supports tended to engage in more activity than those who were socially isolated or whose family members were also inactive, suggesting that community and environmental contexts may serve as a cue to overcome deficits in both initiation and goal generation. The significance of social supports was reiterated by participants who described the social setting of their activity as extremely important. For example, PD11 reflected: "*there is a social aspect, which can't be ignored because it's also a part of it. . . I could spend part of my day with other people or I could spend the entire day sitting alone in the apartment*", emphasizing community, inclusion and social acceptance as a vital component of initiating activity. This theme reflected that engagement in physical activity facilitated more than just physical health but also provided a sense of mental wellbeing: "*I had to find a way to get myself motivated and Dance for PD came along and the people who I dance with are really such a remarkable group of people, community, that organisation, the dancers, they're like family there*" (PD15). Whereas PD participants cited many community groups tailored to people with PD, only one HD participant discussed involvement in a HD
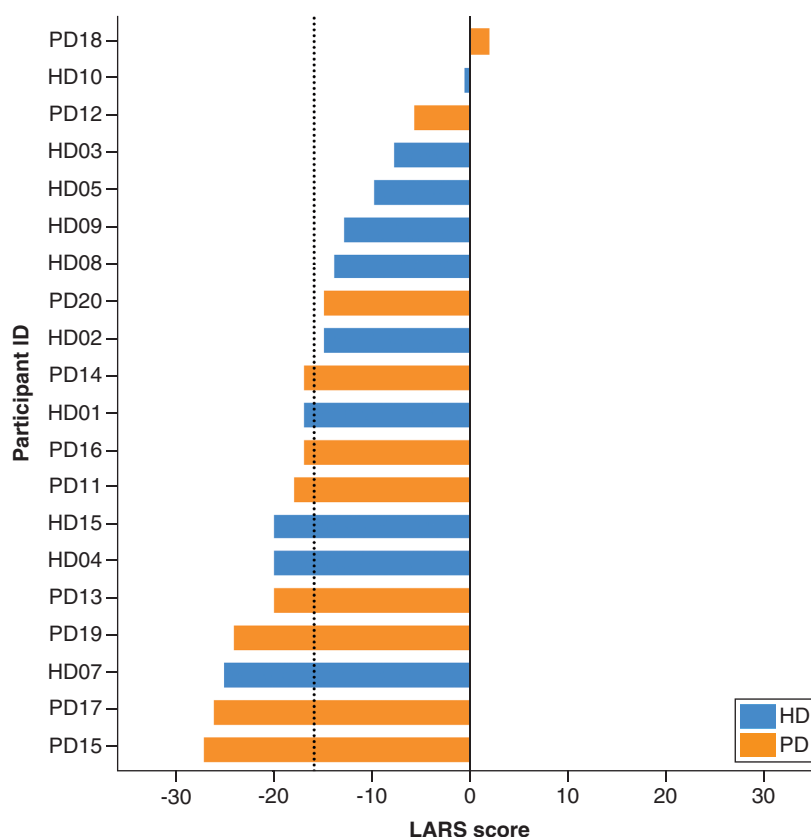
Figure 2.   Total Lille Apathy Rating Scale scores across Huntington's and Parkinson's disease participants. Vertical dashed line indicates LARS clinical cutoff score. Scores less than -16 are indicative of symptoms meeting clinical threshold.
HD: Huntington's disease; LARS: Lille Apathy Rating Scale; PD: Parkinson's disease.

support group. Most HD participants were not involved in community, support or social groups specific to people with HD.

The psychological response to a diagnosis affects engagement & psychoeducation after diagnosis may promote physical activity

This theme captured the variability in people's responses to the onset of symptoms and prognosis. Compared with the HD group, participants with PD often reflected that their diagnosis was a 'shock' and described a period of adjustment where they sought to regain normality: "*I want to do it [exercise] because it makes me feel more like a human being, you feel more normal... in spite of my limitations... it makes me feel like a real person and that is something I lost considerably*" (PD15). Despite certain symptoms threatening continued engagement in activity, for example "*there are certain things that are very frustrating, straining, using arms, things that reinforce the fact that you've got a disability, and things which are actively difficult to do but that in the past have been easy to do*" (PD15), most PD participants expressed the importance of regaining control through physical activity. For example, almost all PD participants indicated that their physical activity was partially motivated by the belief that exercise may slow the progression of their disease: "*the thing that motivates me... is I don't want to be sicker and I don't know whether there is any hope of that not happening, but I'm going to do everything possible to make it harder*" (PD16). In contrast, only four participants with HD cited the importance of physical activity in relation to their disease and few cited physical activity as disease modifying.

Summary of LARS data

Across both HD and PD participants, 13 people (65%) scored in the clinical range on the LARS. Of these 13, seven (70%) had PD and 5 (50%) had HD. Individual scores are presented in Figure 2.

Discussion

In this study, we explored the experience of multidimensional apathy in people with HD and PD and how these experiences affected engagement in physical activity. We found that people described apathy in distinct ways and utilized several strategies to overcome apathy to engage in physical activity. Positively, the qualitative descriptions of apathy that we report also emerged in our quantitative LARS data, with more than half of the sample scoring in the clinical apathy range.

Our study is the first to qualitatively examine how people with HD and PD conceptualize and experience symptoms of apathy in the context of physical activity. By investigating how people experience and describe their own symptoms we provide a valuable contribution to a growing body of literature attempting to refine definitional frameworks of apathy [16,24]. Such frameworks are essential because understanding the lived experience of apathy and the context in which the syndrome occurs is needed for accurate measurement and early identification in clinical settings. Participants described examples of behavioral and cognitive apathy that are consistent with current definitional frameworks [16,17]. In both PD and HD, apathy occurred commonly as a difficulty in initiating activities. HD participants also demonstrated the difficulties in goal identification that occur in cognitive presentations of apathy [17,38]. Although emotional apathy is included in theoretical frameworks of apathy, this element did not emerge strongly from our data. The absence of emotional or social apathy however warrants further investigation to understand how these aspects of apathy affect people with HD and PD. Rather than reflecting an absence of these apathy symptoms, people with HD or PD may lack awareness into their own emotional or social blunting attributable to social cognition deficits [39–42]. Of course, this interpretation is speculative and definitive conclusions are beyond our scope.

In our study, we also observed significant overlap in the subjective experience of mental fatigue and apathy, whereby the mental energy required to commence an activity was described as inherently fatiguing. As a result people with HD and PD tended to perceive fatigue and apathy as intertwined states, rather than distinct clinical symptoms or research constructs. This tendency has been reported elsewhere [19,43], but is not sufficiently considered in current apathy consensus criteria. There have been several attempts to characterize mental fatigue in PD [44], whereas little research has addressed how fatigue affects people with HD. A more nuanced understanding of how apathy and fatigue differentially relate to physical activity and how their current definitional constructs overlap and diverge will be essential for more refined diagnostic criteria, measurement tools and the subsequent monitoring of the two states in behavioral interventions.

As well as understanding the subjective experience of apathy, our study also highlighted several strategies that may promote engagement in physical activity. Participants who described being highly physically active tended to be those who had structured schedules that served as external prompts for activity. These prompts served to circumvent initiation deficits, as participants were not required to internally generate their activity. External prompts are likely to facilitate behavior in most people, independent of disease, however external prompts appear especially important for people with neurodegenerative diseases in which apathy is prominent [45,46]. Importantly, the schedules of active participants tended to be long standing habits, adopted prior to the onset of symptoms. These findings suggest that to reduce the impact of apathy, care providers may seek to engage participants early in the disease course, or in the case of HD, the pre-manifest period, before apathy becomes a prominent feature.

Implementing a structured routine early in the disease course may assist people in maintaining engagement later in the disease, when generating ideas or selecting goals becomes more difficult and the initiation of new behaviors becomes increasingly cognitively demanding [47–49]. Our study also suggested that educating people about the importance of physical activity is a critical first step of any community-based intervention to foster continued engagement and that this may be especially important for people with HD who, in our study, were not as engaged with services or as health literate, as people with PD [12,29]. Although it was not the focus of this study, improved service provision for people affected by HD may be necessary to help this community of people engage socially and physically.

The role of executive dysfunction in the manifestation of cognitive apathy must be acknowledged as a limitation of this study, given the evidence that cognitive apathy and cognition share aspects of their neuropathology [5,17]. Although a comparison of apathy and cognition is beyond the scope of the present study, there is likely to be a complex interplay between the cognitive aspects of apathy and the progressive cognitive impairment characteristic of neurodegenerative diseases, particularly in HD [45–47,49]. Our study sought to focus on the lived experience of apathy and as a result we did not include caregivers. We nonetheless acknowledge that some participants may not

have awareness of their neuropsychiatric symptoms [50] and that the inclusion of caregivers in future studies may provide a more nuanced understanding of apathy.

Conclusion

In this study, we have examined the subjective experience and context in which apathy, across its variable expressions, occurs in people with HD and PD, and how these expressions effect engagement with physical activity. These results provide qualitative support for recently published apathy diagnostic criteria, with the exception that emotional apathy did not strongly emerge from our data. The findings from this study are intended to assist clinicians and researchers in engaging HD and PD participants in physical activity interventions, acknowledging that an improved understanding of the subjective experience of apathy variants will lead to more targeted interventions with more meaningful participant engagement.

Summary points

- We examined the subjective experience of apathy in people with Huntington's disease (HD) and Parkinson's disease (PD), and how these expressions effect engagement with physical activity.
- Our results provide qualitative support for recently published apathy diagnostic criteria citing distinct subtypes of apathy.
- Participants with apathy tended to have difficulty initiating behavior or thinking of activities to engage in.
- The experience of fatigue was difficult to disentangle from the experience of apathy.
- Emotional subtypes of apathy did not strongly emerge from our qualitative data.
- The findings from this study are intended to assist clinicians and researchers in engaging HD and PD participants in physical activity interventions.
- An improved understanding of the subjective experience of apathy will lead to more targeted interventions with more meaningful participant engagement.

Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

References

Papers of special note have been highlighted as: ● of interest; ●● of considerable interest

1. Mccolgan P, Tabrizi SJ. Huntington's disease: a clinical review. *Eur. J. Neurol.* 25(1), 24–34 (2017).

2. Poewe W. The natural history of Parkinson's disease. *J. Neurol.* 253, 112–116 (2006).

3. Pringsheim T, Wiltshire K, Day L, Dykeman J, Steeves T, Jette N. The incidence and prevalence of Huntington's disease: a systematic review and meta-analysis. *Movement Disord.* 27(9), 1083–1091 (2012).

4.   Cepeda C, Wu N, Andre VM, Cummings DM, Levine MS. The corticostriatal pathway in Huntington's disease. *Prog. Neurobiol.* 81(5–6), 253–271 (2007).

5.   Tekin S, Cummings JL. Frontal-subcortical neuronal circuits and clinical neuropsychiatry: an update. *J. Psychosom. Res.* 53(2), 647–654 (2002).

6.   Quinn L, Kegelmeyer D, Kloos A, Rao AK, Busse M, Fritz NE. Clinical recommendations to guide physical therapy practice for Huntington disease. *J. Neurol.* 94, 1–12 (2020).

7.   Keus SHJ, Bloem BR, Hendriks EJM, Bredero-Cohen AB, Munneke M. Evidence-based analysis of physical therapy in Parkinson's disease with recommendations for practice and research. *Movement Disord.* 22(4), 451–460 (2007).

8.   Busse M, Quinn L, Debono K *et al.* A randomized feasability study of a 12-week community-based exercise program for people with Huntington's disease. *J. Neurol. Phys. Ther.* 37(4), 149–158 (2013).

•   **A manuscript that highlights the importance of community-based exercise programs for people with HD, alongside the difficulties in maintaining long-term engagement.**

9.   Fritz NE, Rao AK, Kegelmeyer D *et al.* Physical therapy and exercise interventions in Huntington's disease: a mixed methods systematic review. *J. Huntingtons' Dis.* 6(3), 217–235 (2017).

•   **A manuscript that highlights the importance of physical activity in HD.**

10. Goodwin VA, Richards SH, Taylor RS, Taylor AH, Campbell JL. The effectiveness of exercise interventions for people with Parkinson's disease: a systematic review and meta-analysis. *Movement Disord.* 23(5), 631–640 (2008).

11. Uhrbrand A, Stenager E, Pederson MS, Dalgas U. Parkinson's disease and intensive exercise therapy: a systematic review-and meta-analysis of randomized controlled trials. *J. Neurol. Sci.* 353(1–2), 9–19 (2015).

12. Ellis T, Boudreau JK, Deangelis TR *et al.* Barriers to exercise in people with Parkinson's disease. *Phys. Ther.* 93(5), 628–636 (2012).

13. Van Duijn E, Craufurd D, Hubers AA *et al.* Neuropsychiatric symptoms in a European Huntington's disease cohort (REGISTRY). *J. Neurol. Neurosur. Ps.* 85(12), 1411–1418 (2014).

14. Dujardin K, Sockeel P, Devos D *et al.* Characteristics of apathy in Parkinson's disease. *Movement Disord.* 22(6), 778–784 (2007).

15. Kulisevsky J, Pagonabarraga J, Pascual-Sedano B, Garcia-Sanchez C, Gironell A. Prevalence and correlates of neuropsychiatric symptoms in Parkinon's disease without dementia. *Movement Disord.* 23(13), 1889–1896 (2008).

16. Robert P, Lanctot KL, Aguera-Ortiz L *et al.* Is it time to revise the diagnostic criteria for apathy in brain disorders? The 2018 international consensus group. *Eur. Psychiat.* 54, 71–76 (2018).

17. Levy R, Dubois B. Apathy and the functional anatomy of the prefrontal cortex-basal ganglia circuits. *Cereb. Cortex* 16(7), 916–928 (2006).

•   **A seminal paper in advancing our understanding of the multidimensionality of apathy. A theoretical paper rather than a clinical applied paper.**

18. Fritz NE, Boileau NR, Stout JC *et al.* Relationships among apathy, health-related quality of life, and function in Huntington's disease. *J. Neuropsych. Clin. N.* 30(3), 194–201 (2018).

19. Pagonabarraga J, Kulisevsky J, Strafella AP, Krack P. Apathy in Parkinson's disease: clinical features, neural substrates, diagnosis, and treatment. *Lancet Neurol.* 14(5), 518–531 (2015).

••   **A thorough overview of apathy in Parkinson's disease highlighting the most important issues in our current conceptual understanding and how this dictates the quality of care/intervention.**

20. Martinez-Horta S, Perez-Perez J, Van Duijn E *et al.* Neuropsychiatric symptoms are very common in premanifest and early stage Huntington's disease. *Parkinsonism Relat. D* 25, 58–64 (2016).

21. Benito-Leon J, Cubo E, Coronell C. Impact of apathy on health-related quality of life in recently diagnosed Parkinson's disease: The ANIMO study. *Movement Disord.* 27(2), 211–218 (2012).

22. Le Heron C, Apps MaJ, Husain M. The anatomy of apathy: a neurocognitive framework for amotivated behavior. *Neuropsychologia* 118, 54–67 (2018).

23. Chong TTJ, Husain M. The role of dopamine in the pathophysiology and treatment of apathy. *Prog. Brain Res.* 229, 389–426 (2016).

24. Robert P, Onyike CU, Leentjens AF *et al.* Proposed diagnostic criteria for apathy in Alzheimer's disease and other neuropsychiatric disorders. *Eur. Psychiat.* 24(2), 98–104 (2009).

25. Chong TTJ, Bonnelle V, Husain M. Quantifying motivation with effort-based decision-making paradigms in health and disease. *Prog. Brain Res.* 229(229), 71–100 (2016).

26. Simpson J, Mcmillan H, Leroi I, Murray CD. Experiences of apathy in people with Parkinson's disease: a qualitative exploration. *Disabil. Rehabil.* 37(7), 611–619 (2015).

•   **One of the very few qualitative papers exploring apathy in neurodegenerative disease with a qualitative approach. The conceptualization of apathy in this manuscript differs from current neurobiological conceptualizations such as the one adopted in our paper.**

27. Mele B, Goodarzi Z, Hanson HM, Holroyd-Leduc J. Barriers and facilitators to diagnosing and managing apathy in Parkinson's disease: a qualitative study. *BMC Neurol.* 19(101), 1–11 (2019).

•• **A very relevant paper describing the importance of identifying and acknowledging apathy in PD and the utility of qualitative research to better understand the subjective experience of apathy.**

28. Hamana K, Quinn L, Gambling T, Busse M. An exploration of physical activity experiences throughout the Huntington's disease journey: supporting the development of theoretically underpinned complex interventions. *Disabil. Rehabil.* 1–11 (2019).

•• **An important paper documenting the experience of physical activity in HD and neurodegenerative disease more broadly.**

29. Quinn L, Busse M, Khalil H, Richardson S. Client and therapist views on exercise programmes for early-mid stage Parkinson's and Huntington's disease. *Disabil. Rehabil.* 32(11), 917–928 (2010).

30. Mackenzie IRA. The pathology of Parkinson's disease. *B. C. Med.* 43(3), 142–147 (2001).

31. Rub U, Vonsattel JPG, Heinsen H, Korf HW. The neuropathology of Huntington's disease: classical findings, recent developments and correlation to functional neuroanatomy. *Adv. Anat. Embryol. Cell Biol.* 217, 1–146 (2015).

32. Sockeel P, Dujardin K, Devos D, Deneve C, Destee A, Defebvre L. The Lille apathy rating scale (LARS), a new instrument for detecting and quantifying apathy: validation in Parkinson's disease. *J. Neurol. Neurosur. Ps.* 77(5), 579–584 (2006).

33. Shoulson I, Fahn S. Huntington disease: clinical care and evaluation. *Neurology* 29(1), 1–3 (1979).

34. Hoehn MM, Yahr MD. Parkinsonism: onset, progression, and mortality. *Neurology* 17(5), 427–442 (1967).

35. Braun V, Clarke V. Using thematic analysis in psychology. *Qual. Res. Psychol.* 3(2), 77–101 (2006).

36. Brown RG, Pluck G. Negative symptoms: the 'pathology' of motivation and goal-directed behavior. *Trends Neurosci.* 23(9), 412–417 (2000).

37. Chaudhuri A, Behan PO. Fatigue in neurological disorders. *Lancet* 368(9413), 978–988 (2004).

38. Radakovic R, Abrahams S. Developing a new apathy measurement scale: Dimensional Apathy Scale. *Psychiat Res.* 219(3), 658–663 (2014).

39. Bora E, Velakoulis D, Walterfang M. Social cognition in Huntington's disease: a meta-analysis. *Behav. Brain Res.* 297, 131–140 (2016).

40. Kempnich C, Andrews SC, Fisher F, Wong D, Georgiou-Karistianis N, Stout JC. Emotion recognition correlates with social-neuropsychiatric dysfunction in Huntington's disease. *J. Int. Neuropsych. Soc.* 24(5), 417–423 (2018).

41. Philpott AL, Andrews SC, Staios M, Churchyard A, Fisher F. Emotion evaluation and social inference impairments in Huntington's disease. *J. Huntington's Dis.* 5(2), 175–183 (2016).

42. Seubert-Ravelo AN, Yanez-Tellez MG, Lazo-Barriga ML, Vallejo AG, Martinez-Cortes CE, Hernandez-Galvan A. Social cognition in patients with early-onset Parkinson's disease. *Parkinsons Dis.* 2021, 1–13 (2021).

43. Salamone JD, Yohn S, Lopez-Cruz L, San Miguel N, Correa M. Activational and effort-related aspects of motivation: neural mechanisms and implications for psychopathology. *Brain* 139(Pt 5), 1325–1347 (2016).

44. Lou JS, Kearns G, Oken B, Sexton G, Nutt J. Exacerbated physical and mental fatigue in Parkinson's disease. *Movement Disord.* 16(2), 190–196 (2001).

45. Meyer A, Zimmermann R, Gschwandtner U *et al.* Apathy in Parkinson's disease is related to executive function, gender and age but not to depression. *Front. Aging Neurosci.* 6, 350 (2014).

46. Baudic S, Maison P, Dolbeau G *et al.* Cognitive impairment related to apathy in early Huntington's disease. *Dement. Geriatr. Cogn.* 21(5–6), 316–321 (2006).

47. Andrews SC, Langbehn DR, Craufurd D *et al.* Apathy predicts rate of cognitive decline over 24months in premanifest Huntington's disease. *Psychol. Med.* 51(8), 1–7 (2020).

48. Krishnamoorthy A, Craufurd D. Treatment of apathy in Huntington's disease and other movement disorders. *Curr. Treat Option N.* 13, 508–519 (2011).

49. Alzahrani H, Antonini A, Venneri A. Apathy in Mild Parkinson's disease: neuropsychological and neuroimaging evidence. *J. Parkinson Dis.* 6(4), 821–832 (2016).

50. Andrews SC, Craufurd D, Durr A *et al.* Executive impairment is associated with unawareness of neuropsychiatric symptoms in premanifest and early Huntington's disease. *Neuropsychology* 32(8), 958–965 (2018).