Supplementary Material 2

Search Strategy

PubMed

("Parkinson Disease"[mh] OR "Parkinsonian Disorders"[mh] OR Parkinson*[tiab]) AND ("Classification"[mh] OR "Cluster Analysis"[mh] OR "Algorithms*"[mh] OR "Factor Analysis, Statistical"[mh] OR "Population Characteristics"[mh] OR "Genetic Heterogeneity"[mh] OR "Phenotype"[mh] OR Subtyp* OR Cluster* OR Heterogen* OR Subgroup OR Classif* OR Typog* OR Type OR Phenotyp OR "Clinical feature" OR "Tremor-dominant" OR "Tremor dominant" OR "Akinetic-rigid" OR "Akinetic rigid" OR "PIGD" OR "Postural instability gait disorder" OR "Cluster analysis" OR "Factor analysis" OR "Data driven" OR "Data-driven") AND ("Psychomotor Performance"[mh] OR "Motor Disorders"[mh] OR "Motor Skills Disorders"[mh] OR "Tremor"[mh] OR "Hypokinesia"[mh] OR "Muscle Rigidity"[mh] OR "Gait"[mh] OR "Gait Disorders, Neurologic"[mh] OR "Postural Balance"[mh] OR "Dyskinesias"[mh] OR "Disease Progression"[mh] OR Motor OR UPDRS OR "Hoehn and Yahr" OR Tremor OR Bradykinesia OR Rigid* OR "Postural instability" OR Balance OR Gait OR Dyskinesia OR Akinesia OR "Disease duration" OR "Disease severity" OR "Disease progression") AND ("Cognition"[mh] OR "Cognition Disorders"[mh] OR "Cognitive Dysfunction"[mh] OR "Neuropsychology"[mh] OR "Neurologic Examination"[mh] OR "Neuropsychological Tests"[mh] OR "Intelligence"[mh] OR "Aptitude Tests"[mh] OR "Dementia"[mh] OR "Learning"[mh] OR "Attention"[mh] OR "Executive Function"[mh] OR "Inhibition, Psychological"[mh] OR "Visual Perception"[mh] OR "Decision Making"[mh] OR Cogniti* OR Neuropsych* OR Neurocog* OR Dementia OR "Mild cognitive impairment" OR MCI OR Intelligen* OR IQ OR Learn* OR Memory OR Attention OR "Task switching" OR "Executive Function" "Cognitive control" OR "Executive control" OR "Response inhibition" OR "Processing speed" OR "Visuospatial" OR "Reasoning" OR Verbal OR Vocabulary OR Language OR MoCA OR "Montreal Cognitive Assessment" OR MMSE OR "Mini Mental State Examination" OR CANTAB OR "Cambridge Neuropsychological Test Automated Battery" OR WCST OR "Wisconsin Card Sorting Task" OR "Wisconsin Card Sorting Test" OR IGT OR "Iowa Gambling Task" OR "Intra-Extra Dimensional Set Shift" OR "Stop signal" OR "Stop-signal" OR "Paired associates" OR "Digit span" OR N-back OR "N back" OR "Decision making" OR "Decision-making") NOT ("Animals"[mh] NOT "Humans"[mh])

Filters:

Language: English

PsycINFO

((exp Parkinsons Disease/ or Parkinson*.ti,ab.) and (exp Disorder Attributes/ or Taxonomies.sh. or "classification (cognitive process)".sh. or Phenotypes.sh. or Cluster Analysis.sh. or Factor Analysis.sh. or Machine Learning Algorithms.sh. or Subtyp*.tw. or Cluster*.tw. or Heterogen*.tw. or Subgroup.tw. or Classif*.tw. or Typo*.tw. or Type.tw. or Phenotyp*.tw. or "Clinical feature".tw. or Tremor-dominant.tw. or "Tremor dominant".tw. or Akinetic-rigid.tw. or "Akinetic rigid".tw. or PIGD.tw. or "Postural instability gait disorder".tw. or "Cluster analysis".tw. or "Factor analysis".tw. or "Data driven".tw. or "Data-driven".tw.) and (exp Motor Processes/ or Tremor.sh. or Bradykinesia.sh. or Equilibrium.sh. or Muscle Contractions.sh. or Motor.tw. or UPDRS.tw. or "Hoehn and Yahr".tw. or Tremor.tw. or Bradykinesia.tw. or Rigid*.tw. or "Postural instability".tw. or Balance.tw. or Gait.tw. or Dyskinesia.tw. or Akinesia.tw. or "Disease duration".tw. or "Disease severity".tw. or "Disease progression".tw.) and (exp Cognitive Processes/ or Cognitive Aging.sh. or exp Learning/ or exp Memory/ or exp Attention/ or Language.sh. or Neurocognition.sh. or exp Neurocognitive Disorders/ or exp Neuropsychological Assessment/ or exp Cognitive Assessment/ or response inhibition.sh. or visuospatial ability.sh. or reasoning.sh. or language.sh. or digit span testing.sh. or Cogniti*.tw. or Neuropsych*.tw. or Neurocog*.tw. or Dementia.tw. or Mild cognitive impairment.tw. or MCI.tw. or Intelligen*.tw. or IQ.tw. or Learn*.tw. or Memory.tw. or Attention.tw. or "Task switching".tw. or "Executive Function".tw. or "Cognitive control".tw. or "Executive control".tw. or "Response inhibition".tw. or "Processing speed".tw. or Visuospatial.tw. or Reasoning.tw. or Verbal.tw. or Vocabulary.tw. or Language.tw. or MoCA.tw. or "Montreal Cognitive Assessment".tw. or MMSE.tw. or "Mini Mental State Examination".tw. or CANTAB.tw. or "Cambridge Neuropsychological Test Automated Battery".tw. or WCST.tw. or "Wisconsin Card Sorting Task".tw. or "Wisconsin Card Sorting Test".tw. or IGT.tw. or "Iowa Gambling Task".tw. or "Intra-Extra Dimensional Set Shift".tw. or "Stop signal".tw. or "Stop-signal".tw. or "Paired associates".tw. or "Digit span".tw. or N-back.tw. or "N back".tw. or "Decision making".tw. or "Decision-making".tw.)) not (Animal not (animal and human)).po.

Filters:

Language: English

CINAHL

MH “Parkinson disease” OR TI Parkinson* OR AB Parkinson* AND MH “Cluster analysis+” OR MH “Factor analysis+” OR MH “Classification+” OR MH “Phenotype+” OR Subtyp* OR Cluster* OR Heterogen* OR Subgroup OR Classif* OR Typo* OR Type OR Phenotyp* OR “Clinical feature” OR “Tremor-dominant” OR “Tremor dominant” OR “Akinetic-rigid” OR “Akinetic rigid” OR “PIGD” OR “Postural instability gait disorder” OR "Cluster analysis" OR "Factor analysis" OR "Data driven" OR "Data-driven" AND MH “Psychomotor Performance+” OR MH “Gait+” OR MH “Gait Analysis” OR MH “Gait Disorders, Neurologic” OR MH “Balance, Postural” OR MH “Dyskinesias+” OR MH “Posture” OR MH “Motor Activity” OR MH “Psychomotor Disorders” OR MH “Disease Attributes+” OR MH “Severity of Illness Indices” OR Motor OR UPDRS OR “Hoehn and Yahr” OR Tremor OR Bradykinesia OR Rigid* OR “Postural instability” OR Balance OR Gait OR Dyskinesia OR Akinesia OR "Disease duration" OR "Disease severity" OR "Disease progression" AND MH “Cognition” OR MH “Intelligence” OR MH “Executive Function” OR MH “Learning+” OR MH “Attention+” OR MH “Perception+” OR MH “Language+” OR MH “Vocabulary” OR MH “Language Tests+” OR MH “Psychological Tests+” OR MH “Delirium, Dementia, Amnestic, Cognitive Disorders+” OR Cogniti* OR Neuropsych* OR Neurocog* OR Dementia OR “Mild cognitive impairment” OR MCI OR Intelligen* OR IQ OR Learn* OR Memory OR Attention OR “Task switching” OR “Executive Function” OR “Cognitive control” OR “Executive control” OR “Response inhibition” OR “Processing speed” OR Visuospatial OR Reasoning OR Verbal OR Vocabulary OR Language OR MoCA OR “Montreal Cognitive Assessment” OR MMSE OR “Mini Mental State Examination” OR CANTAB OR “Cambridge Neuropsychological Test Automated Battery” OR WCST OR “Wisconsin Card Sorting Task” OR "Wisconsin Card Sorting Test" OR IGT OR “Iowa Gambling Task” OR “Intra-Extra Dimensional Set Shift” OR “Stop signal” OR "Stop-signal" OR “Paired associates” OR “Digit span” OR N-back OR “N back” OR "Decision making" OR "Decision-making" NOT ((MH animals+ OR MH "animal studies" OR TI "animal model*") NOT (MH Human AND (MH animals+ OR MH "animal studies" OR TI "animal model*")))

Filters:

Language: English

Scopus

(TITLE (parkinson*) AND TITLE-ABS-KEY (subtyp* OR cluster* OR heterogen* OR subgroup OR classif* OR typo* OR type OR phenotyp* OR "Clinical feature" OR "Tremor-dominant" OR "Tremor dominant" OR "Akinetic-rigid" OR "Akinetic rigid" OR "PIGD" OR "Postural instability gait disorder" OR "Cluster analysis" OR "Factor analysis" OR "Data driven" OR "Data-driven") AND TITLE-ABS-KEY (motor OR updrs OR "Hoehn and Yahr" OR tremor OR bradykinesia OR rigid* OR "Postural instability" OR balance OR gait OR dyskinesia OR akinesia OR "Disease duration" OR "Disease severity" OR "Disease progression") AND TITLE-ABS-KEY (cogniti* OR neuropsych* OR neurocog* OR dementia OR "Mild cognitive impairment" OR mci OR intelligen* OR iq OR learn* OR memory OR attention OR "Task switching" OR "Executive Function" OR "Cognitive control" OR "Executive control" OR "Response inhibition" OR "Processing speed" OR visuospatial OR reasoning OR verbal OR vocabulary OR language OR moca OR "Montreal Cognitive Assessment" OR mmse OR "Mini Mental State Examination" OR cantab OR "Cambridge Neuropsychological Test Automated Battery" OR wcst OR "Wisconsin Card Sorting Task" OR "Wisconsin Card Sorting Test" OR igt OR "Iowa Gambling Task" OR "Intra-Extra Dimensional Set Shift" OR "Stop signal" OR "Stop-signal" OR "Paired associates" OR "Digit span" OR n-back OR "N back" OR "Decision making" OR "Decision-making"))

Filters:

Language: English

Document Type: Article

Web of Science

(((TS=("Parkinson* Disease")) AND ALL=(Subtyp* OR Cluster* OR Heterogen* OR Subgroup OR Classif* OR Typo* OR Type OR Phenotyp* OR "Clinical feature" OR "Tremor-dominant" OR "Tremor dominant" OR "Akinetic-rigid" OR "Akinetic rigid" OR "PIGD" OR "Postural instability gait disorder" OR "Cluster analysis" or "Factor analysis" OR "Data driven" OR "Data-driven")) AND ALL=(Motor OR UPDRS OR "Hoehn and Yahr" OR Tremor OR Bradykinesia OR Rigid* OR "Postural instability" OR Balance OR Gait OR Dyskinesia OR Akinesia OR "Disease duration" OR "Disease severity" OR "Disease progression")) AND ALL=(Cogniti* OR Neuropsych* OR Neurocog* OR Dementia OR "Mild cognitive impairment" OR MCI OR Intelligen* OR IQ OR Learn* OR Memory OR

Attention OR "Task switching" OR "Executive Function" OR "Cognitive control" OR "Executive control" OR "Response inhibition" OR "Processing speed" OR Visuospatial OR Reasoning OR Verbal OR Vocabulary OR Language OR MoCA OR "Montreal Cognitive Assessment" OR MMSE OR "Mini Mental State Examination" OR CANTAB OR "Cambridge Neuropsychological Test Automated Battery" OR WCST OR "Wisconsin Card Sorting Task" OR "Wisconsin Card Sorting Test" OR IGT OR "Iowa Gambling Task" OR "Intra-Extra Dimensional Set Shift" OR "Stop signal" OR Stop-signal OR "Paired associates" OR "Digit span" OR N-back OR "N back" OR "Decision making" OR Decision-making)

Filters:
Language: English
Document Type: Article

Note

All database searches were run on 20 July 2022 and then re-run (before the commencement of data synthesis) on 23 January 2024.

When the search was re-run:

- **PubMed**, **PsycINFO**, and **Scopus** did not allow the date range to be restricted to a specific date (i.e., 21 July 2022 – current), but only to a given year. Therefore, these searches were re-run with the added restriction of date 2022-2024/current.
- **CINAHL** did not allow the date range to be restricted to a specific date (i.e., 21 July 2022 – current), but only to a given month. Therefore, this search was re-run with the added restriction of date July 2022 – January 2024.
- **Web of Science** did allow an exact date range to be specified, so this search was re-run with the added timespan restriction of 2022-07-22 to 2024-01-23 (Publication Date).

Table S1

Title and Abstract and Full-Text Screening Interrater Agreement Statistics

	Title and Abstract Screening			Full-Text		
	Number of records screened	Proportionate Agreement	Kappa (κ)	Number of records screened	Proportionate Agreement	Kappa (κ)
Reviewer		BC			BC	
IS	7140	.95	.48	127	.88	.66
RDS	2295	.93	.53	197	.89	.79
BE	-	-	-	91	.86	.72
AM	-	-	-	61	.84	.58
IB	-	-	-	13	1	1

Note. AM = Angus McNamara; BC = Brittany Child; BE = Benjamin Ellul; IB = Irina Baetu; IS = Isaac Saywell; RDS = Robyn da Silva. AM, BE, and IB only served as reviewers at the full-text screening stage.

Data Extraction

A custom data extraction form comprising 127 items[1] (see Supplementary Material 3) was developed to extract study information pertaining to sample size and characteristics, subtyping methods, and cognitive outcome data. We extracted information on psychiatric comorbidities (anxiety, depression), *post hoc* motor data[2], and longitudinal cognitive data from all studies where these data were reported; however, we did not analyse these data for feasibility reasons. For information on which included studies reported *post hoc* motor data (n = 50) and longitudinal cognitive data (n = 16), see Supplementary Material 5.

When cognitive outcome data (means and standard deviations or frequencies/proportions, test statistics and p-values, or effect sizes) were not reported for motor subtype groups in either the main text or supplementary materials, data were requested from corresponding authors via email. If other desirable but non-essential data were missing (e.g., demographics or disease characteristics, such as disease duration), these were also requested[3]. If cognitive outcome data were reported in full, we did not contact authors to request any missing non-essential data. Up to two attempts at contact were made; if the author did not respond within a 1-week period from the date of the second email being sent[4], or if the requested data were unable to be provided, attempts were made to estimate the values needed to compute an effect size for at least one cognitive measure (see Section 2.7.2 'Effect Size Calculation'). If this was not possible, the study was excluded.

[1] An additional two items were added after the publication of our protocol, which included a 125-item data extraction template: one item to extract education (in years) from each motor subtype group separately; and one item to extract the levodopa equivalent daily dose (LEDD) for each motor subtype group separately.
[2] Here, we use '*post hoc*' to refer to any additional objective or clinician-rated motor assessment(s) on which motor subtype groups were compared which were *not* used to classify participants into motor subtype groups. For example, Ehm et al. (2019) classified participants into 'good tandem gait' and 'poor tandem gait' groups using a tandem gait test and then subsequently compared these groups on the freezing item and axial subscore of the Movement Disorder Society Unified Parkinson's Disease Rating Scale (MDS-UPDRS).
[3] Where mean age (at time of study participation) and mean age at disease onset were both reported but mean disease duration was not reported (and any data requests were unsuccessful), we calculated mean disease duration as mean age minus mean age at disease onset. Where mean disease duration and mean age (at time of study participation) were both reported but mean age at disease onset was not reported (and any data requests were unsuccessful), we calculated mean age at onset as mean age minus mean disease duration.
[4] Due to time constraints, we deviated from our protocol, where we reported that we would make up to three attempts at author contact, allowing up to 2 weeks for a response from the date of third email. Note that we accommodated all deadline extension requests. One author (without an extension) responded to our request after the deadline; we included these data in our meta-analysis.

Quality Assessment

We adapted from Hayden et al.'s (2013) Quality in Prognosis Studies (QUIPS) tool, which was designed to evaluate validity and bias in studies of prognostic factors. We customised this tool to better suit our review by modifying its 'prognostic factor' and 'outcome measurement' domains to appraise the quality of motor and cognitive measures in our included studies. In addition, we replaced the QUIPS' 'study confounding' domain with a single item and, as we did not analyse any longitudinal data, removed the 'attrition' domain[5]. Within each domain, we altered items to be specific to our review and incorporated several items adapted from Mestre and colleagues' (2021) methodological quality tool, which was specifically developed for appraising PD subtyping studies. We also adopted a numeric scoring approach to increase sensitivity and to allow for greater weight to be given to items considered to be of greater importance. After piloting this tool, we identified cut-off scores for classifying a study's risk of bias as low, moderate, or high for each domain and overall. Where two studies used the same (or overlapping) sample and were collapsed into a single study for the purposes of our review, the quality assessment tool was applied to both studies separately. An average quality assessment score was then calculated for each domain, and these were used to determine a risk of bias judgement (low/moderate/high) for each domain and overall. Similarly, where one study reported multiple subtyping methods eligible for inclusion in our review, the quality assessment tool was completed for each subtyping method separately and the above procedure was used to determine an average score for each domain, followed by a risk of bias judgement for each domain and overall. All quality assessment scores (including averages, where applicable) can be found on the Open Science Framework (OSF; https://osf.io/6ckwe/).

[5] In our published protocol (Child et al., 2024), we reported renaming the 'attrition' domain to 'use of follow-up data' and adapted its items to better suit our review. However, given that we subsequently chose not to analyse any longitudinal cognitive data, we removed this domain from our quality assessment tool altogether.

Table S2

Intraclass Correlations for Quality Assessment

Domain	Proportionate Agreement	ICC
1. Recruitment and Sample Characteristics	.89	.57
2. Motor Function Measurement	.91	.81
3. Cognitive Function Measurement	.93	.87
4. Statistical Analysis and Reporting	.69	.65
Overall	.83	.73

Note. ICC = intra-class correlation. Quality assessment was completed by two reviewers (BC and IS) on a minimum 20% of included studies, selected at random.

Analysis of Parkinson's Progression Marker Initiative (PPMI) Data

The open-access Parkinson's Progression Marker Initiative (PPMI) data repository comprises clinical, imaging, genetic, and biomarker data collected as part of a large longitudinal study investigating Parkinson's disease (PD; Marek et al., 2018). These data have been analysed in hundreds of publications, with research teams applying different participant inclusion criteria and varied analysis techniques to answer specific research questions of interest. Twelve studies analysing PPMI data were eligible for inclusion in our review; given the between-study heterogeneity in participant selection and analysed variables, and the open-access nature of the PPMI repository, we chose to exclude all published PPMI studies and instead analyse the PPMI dataset ourselves applying data filtering methods consistent with our review's inclusion criteria.

Data used in the preparation of this article were obtained on 25 June 2024 from the PPMI database (www.ppmi-info.org/access-data-specimens/download-data), RRID:SCR 006431.

We retained all participants who were *de novo* at baseline and for whom sufficient baseline Movement Disorder Society Unified Parkinson's Disease Rating Scale (MDS-UPDRS; Goetz et al., 2008) data were available to calculate tremor and PIGD scores according to Stebbin et al.'s (2013) subtyping method. We then applied Stebbins et al.'s (2013) subtyping method as per its traditional usage to allocate each participant to a tremor-dominant (TD), postural instability and gait disorder (PIGD), or indeterminate (ID) group. In addition, consistent with other researchers' variations on Stebbins et al.'s (2013) method (e.g., Pelicioni et al., 2021; Yu et al., 2022), we applied two further subtyping classifications: one where participants were classified as either TD or non-TD (NTD; in which the latter group is formed by collapsing the PIGD and ID groups); and one where participants were classified as either PIGD or non-PIGD (in which the latter group is formed by collapsing the TD and ID groups).

For each subtype group (across all three subtyping methods), we calculated means and SDs for all available cognitive tasks administered at baseline (or, for the Montreal Cognitive Assessment [MoCA], at screening or baseline). For cognitive status, the PPMI dataset provides a normal cognition (NC), mild cognitive impairment (PD-MCI), or PD dementia (PDD) classification based on clinical judgement; however, we instead classified participants as either NC or PD-MCI by applying the Movement Disorder Society Task Force's (Litvan et al., 2012) Level II diagnostic criteria for PD-MCI using the task cut-off

scores reported by PPMI (Coffey et al., 2020). Summary statistics (means and standard deviations) for each motor subtype group were also calculated for the following demographics and disease characteristics: age at baseline, proportion of men, disease duration (converted to years), age at disease onset, years of education, MDS-UPDRS-III score, MDS-UPDRS tremor subscore, MDS-UPDRS PIGD subscore. Effect size estimates were then computed using the methods described in the main text (Section 2.7.2).

PPMI – a public-private partnership – is funded by the Michael J. Fox Foundation for Parkinson's Research and funding partners, including 4D Pharma, Abbvie, AcureX, Allergan, Amathus Therapeutics, Aligning Science Across Parkinson's, AskBio, Avid Radiopharmaceuticals, BIAL, BioArctic, Biogen, Biohaven, BioLegend, BlueRock Therapeutics, Bristol-Myers Squibb, Calico Labs, Capsida Biotherapeutics, Celgene, Cerevel Therapeutics, Coave Therapeutics, DaCapo Brainscience, Denali, Edmond J. Safra Foundation, Eli Lilly, Gain Therapeutics, GE HealthCare, Genentech, GSK, Golub Capital, Handl Therapeutics, Insitro, Jazz Pharmaceuticals, Johnson & Johnson Innovative Medicine, Lundbeck, Merck, Meso Scale Discovery, Mission Therapeutics, Neurocrine Biosciences, Neuron23, Neuropore, Pfizer, Piramal, Prevail Therapeutics, Roche, Sanofi, Servier, Sun Pharma Advanced Research Company, Takeda, Teva, UCB, Vanqua Bio, Verily, Voyager Therapeutics, the Weston Family Foundation and Yumanity Therapeutics. For up-to-date information on the study, visit www.ppmi-info.org.

Results of Tremor-Dominant vs. Postural Instability Gait Disorder Analyses

Table S3

Meta-Analyses Comparing Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	***k* (*o*)**	**Pooled effect size (95% CI)**	***p***	**I^2 (%)**	***Q* (*p*)**	**Egger's test (*p*)**
Age						
All studies	47 (9232)	-0.20 (-0.29, -0.12)	**< .001**	56.0	104.58 (**< .001**)	.836
With outliers removed	43 (7935)	-0.18 (-0.24, -0.12)	**< .001**	20.0	52.53 (.128)	.202
Gender (proportion of men)*						
All studies	43 (8705)	1.05 (1.00, 1.10)	**.049**	25.7	56.55 (.066)	.791
Years of education*						
All studies	27 (4103)	0.10 (0.01, 0.20)	**.032**	26.0	35.12 (.109)	.321
Disease duration						
All studies	43 (8661)	-0.17 (-0.26, -0.08)	**< .001**	61.0	107.74 (**< .001**)	.222
With outliers removed	40 (8325)	-0.16 (-0.23, -0.09)	**< .001**	42.6	67.89 (**.003**)	.180
Age at onset						
All studies	20 (5925)	-0.17 (-0.34, -0.00)	**.049**	72.4	68.95 (**< .001**)	.650
With outliers removed	18 (5743)	-0.16 (-0.27, -0.06)	**.005**	48.6	33.09 (**.011**)	.549
LEDD						
All studies	30 (6517)	-0.41 (-0.49, -0.32)	**< .001**	48.9%	56.77 (**.002**)	.210

With outliers removed	29 (5997)	-0.45 (-0.53, -0.38)	**< .001**	21.4	35.63 (.152)	**.023**
UPDRS-III total score (original version)						
All studies	26 (4580)	-0.34 (-0.49, -0.19)	**< .001**	70.5	84.75 (**< .001**)	.849
With outliers removed	22 (4040)	-0.34 (-0.45, -0.24)	**< .001**	42.5	36.60 (**.019**)	.458
MDS-UPDRS-III total score						
All studies	20 (4575)	-0.11 (-0.25, 0.03)	.118	57.9	45.13 (**< .001**)	.257
With outliers removed	19 (3500)	-0.08 (-0.21, 0.05)	.203	42.0	31.01 (**.029**)	.576
UPDRS-III total score (any version)						
All studies	46 (9155)	-0.24 (-0.34, -0.13)	**< .001**	69.0	145.04 (**< .001**)	.955
With outliers removed	40 (8073)	-0.23 (-0.32, -0.15)	**< .001**	49.4	77.01 (**< .001**)	.798

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the postural instability gait disorder (PIGD) group relative to the tremor-dominant group; for risk ratio, values > 1 indicate that tremor-dominant patients have a greater risk of being men relative to postural instability gait disorder (PIGD) patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. *Results for model with outliers removed not reported as no outliers detected. Significant *p*-values (< .05) are highlighted in bold.

Table S4

Results of Continuous Moderator Analyses for Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	50	242	0.00 (-0.00, 0.00)	.928	-0.49
Publication year	50	242	0.01 (-0.01, 0.02)	.390	-0.57
Pooled mean age	47	218	0.03 (0.01, 0.04)	**.003**	10.58
Pooled proportion of men	44	189	-0.17 (-1.01, 0.67)	.693	-1.26
Pooled mean years of education	28	169	-0.02 (-0.05, 0.02)	.330	-1.33
Pooled mean disease duration	47	209	-0.00 (-0.03, 0.02)	.721	-1.24
Pooled mean age at onset	48	223	0.02 (0.00, 0.03)	**.013**	5.90
Pooled mean LEDD	30	152	-0.00 (-0.00, 0.00)	.584	-1.92
Pooled mean UPDRS-III (original)	26	126	0.01 (-0.00, 0.02)	.297	0.17
Pooled mean MDS-UPDRS-III	20	94	0.01 (-0.01, 0.03)	.521	-0.17

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; *β* = regression coefficient. For *β*, positive values reflect a positive association between the moderator and effect size (i.e., larger values of the moderator are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the postural instability gait disorder [PIGD] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). Significant *p*-values (< .05) are highlighted in bold.

Table S5

Results of Categorical Moderator Analyses for Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Moderator	***n***	***k***	**Pooled Hedges' *g* (95% CI)**	**β (95% CI)**	***p***	***Q* (*p*)**	**ToM (*p*)**
Subtype Method						407.69 (**< .001**)	2.03 (.133)
Jankovic[*]	26	110	0.18 (0.10, 0.26)		**< .001**		
Stebbins	21	106	0.29 (0.17, 0.41)	0.11 (-0.04, 0.26)	.149		
Other	3	26	0.35 (0.17, 0.54)	0.17 (-0.03, 0.38)	.094		
Cognitive Class						409.84 (**< .001**)	0.04 (.844)
Global[*]	47	67	0.24 (0.17, 0.31)		**< .001**		
Specific	24	175	0.23 (0.14, 0.32)	-0.01 (-0.09, 0.07)	.844		
Cognitive Domain						371.97 (**<.001**)	0.73 (.782)
Global Cognitive Function[*]	47	67	0.23 (0.17, 0.30)		**< .001**		
Executive Function - Attention	5	9	0.24 (0.03, 0.45)	0.01 (-0.19, 0.20)	.955		
Executive Function – Cognitive Flexibility	11	15	0.25 (0.10, 0.40)	0.02 (-0.12, 0.15)	.809		
Executive Function – Cognitive Inhibition	6	6	0.15 (-0.03, 0.33)	-0.08 (-0.26, 0.10)	.368		
Executive Function – Response Inhibition	3	3	0.41 (0.11, 0.72)	0.18 (-0.12, 0.48)	.230		

Executive Function – Working Memory	16	23	0.27 (0.11, 0.42)	0.03 (-0.11, 0.17)	.650
Higher-Order Fluid Abilities - Planning	5	5	0.28 (0.09, 0.47)	0.04 (-0.15, 0.24)	.645
Language	12	19	0.24 (0.11, 0.36)	0.00 (-0.11, 0.12)	.948
LTM/Learning – Lexical	8	8	0.10 (-0.03, 0.23)	-0.13 (-0.27, 0.01)	.062
LTM/Learning - Semantic	7	7	0.18 (0.03, 0.32)	-0.05 (-0.20, 0.09)	.457
LTM/Learning - Visuospatial	4	4	0.11 (-0.09, 0.31)	-0.13 (-0.33, 0.08)	.223
STM – Lexical	8	8	0.17 (0.02, 0.32)	-0.06 (-0.21, 0.08)	.384
STM – Numeric	5	5	0.22 (0.04, 0.41)	-0.01 (-0.20, 0.17)	.900
STM – Visuospatial	5	10	0.17 (0.02, 0.31)	-0.07 (-0.22, 0.08)	.384
STM – Other	3	4	0.29 (0.03, 0.54)	0.05 (-0.21, 0.31)	.683
Processing Speed	16	25	0.24 (0.08, 0.40)	0.00 (-0.14, 0.15)	.953
Visuospatial Abilities – Construction	3	4	0.12 (-0.08, 0.33)	-0.11 (-0.32, 0.10)	.292
Visuospatial Abilities – Perception	6	6	0.23 (0.02, 0.45)	-0.00 (-0.21, 0.21)	1.000
Visuospatial Abilities – Reasoning	3	4	0.34 (0.14, 0.54)	0.11 (-0.10, 0.32)	.307

Medication Status for Cognitive Assessment(s)						262.96 (**< .001**)	1.41 (.241)
De Novo[*]	8	53	0.23 (0.10, 0.35)		**< .001**		
ON	10	79	0.12 (-0.05, 0.28)	-0.11 (-0.31, 0.10)	.297		
OFF	5	34	0.37 (0.19, 0.54)	0.14 (-0.07, 0.35)	.198		
ON or OFF	1	2	0.19 (-0.14, 0.53)	-0.03 (-0.39, 0.33)	.857		
Medication Status for Motor Assessment(s)						312.10 (**< .001**)	0.625 (.600)
De Novo[*]	8	53	0.23 (0.10, 0.35)		**< .001**		
ON	13	66	0.33 (0.14, 0.52)	0.10 (-0.12, 0.33)	.371		
OFF	15	62	0.23 (0.10, 0.36)	0.00 (-0.17, 0.18)	.963		
ON or OFF	8	4	0.17 (0.05, 0.30)	-0.05 (-0.23, 0.13)	.561		
Cognitive Impairment/Dementia as Exclusion Criterion						411.36 (**< .001**)	0.11 (.744)
No[*]	27	115	0.24 (0.17, 0.32)		**< .001**		
Yes	23	127	0.22 (0.10, 0.34)	-0.02 (-0.17, 0.12)	.744		
Motor Subtypes Compared on Cognition in Paper						386.14 (**< .001**)	0.99 (.320)
No[*]	15	31	0.29 (0.14, 0.44)		**< .001**		
Yes	41	198	0.22 (0.15, 0.29)	-0.07 (-0.22, 0.07)	.320		

Overall Risk of Bias						408.98 (**< .001**)	0.19 (.829)
High[*]	20	72	0.26 (0.10, 0.42)		**.002**		
Moderate	19	98	0.21 (0.14, 0.29)	-0.05 (-0.22, 0.13)	.608		
Low	11	72	0.24 (0.12, 0.37)	-0.01 (-0.22, 0.19)	.897		

Note. CI = confidence interval; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values > 0 indicate poorer cognitive performance among postural instability gait disorder (PIGD) patients relative to tremor-dominant (TD) patients. Significant *p*-values (< .05) are highlighted in bold.

Table S6

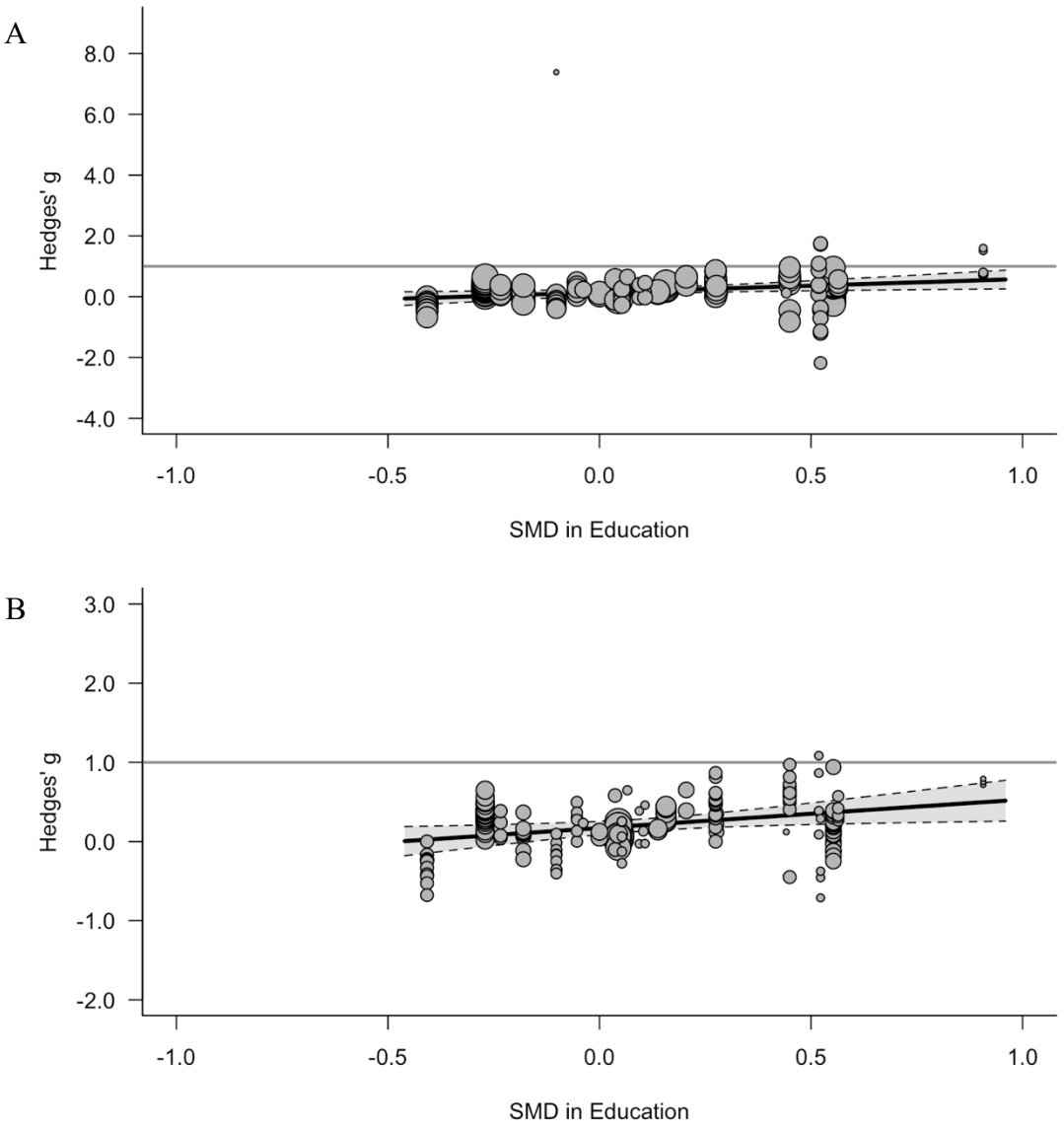
Results of Confound Analyses for Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	47	218	-0.48 (-0.67, -0.29)	**< .001**	23.75
Difference in proportion of men	44	189	0.03 (-0.56, 0.62)	.929	-1.32
SMD years of education	28	169	0.36 (0.07, 0.65)	**.016**	7.44
SMD disease duration	44	199	-0.13 (-0.35, 0.10)	.257	1.23
SMD age at onset	20	86	-0.55 (-0.80, -0.29)	**< .001**	26.73
SMD LEDD	30	152	-0.22 (-0.53, 0.09)	.161	3.64
SMD UPDRS-III (original)	26	126	-0.37 (-0.54, -0.19)	**< .001**	30.40
SMD MDS-UPDRS-III	20	94	-0.20 (-0.60, 0.21)	.333	26.52
SMD UPDRS-III (any version)	46	220	-0.19 (-0.39, 0.00)	.051	4.44

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, positive values reflect a positive association between the confound (moderator) and effect size (i.e., larger values of the confound [moderator] are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the postural instability gait disorder [PIGD] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). Significant *p*-values (< .05) are highlighted in bold.

Figure S1

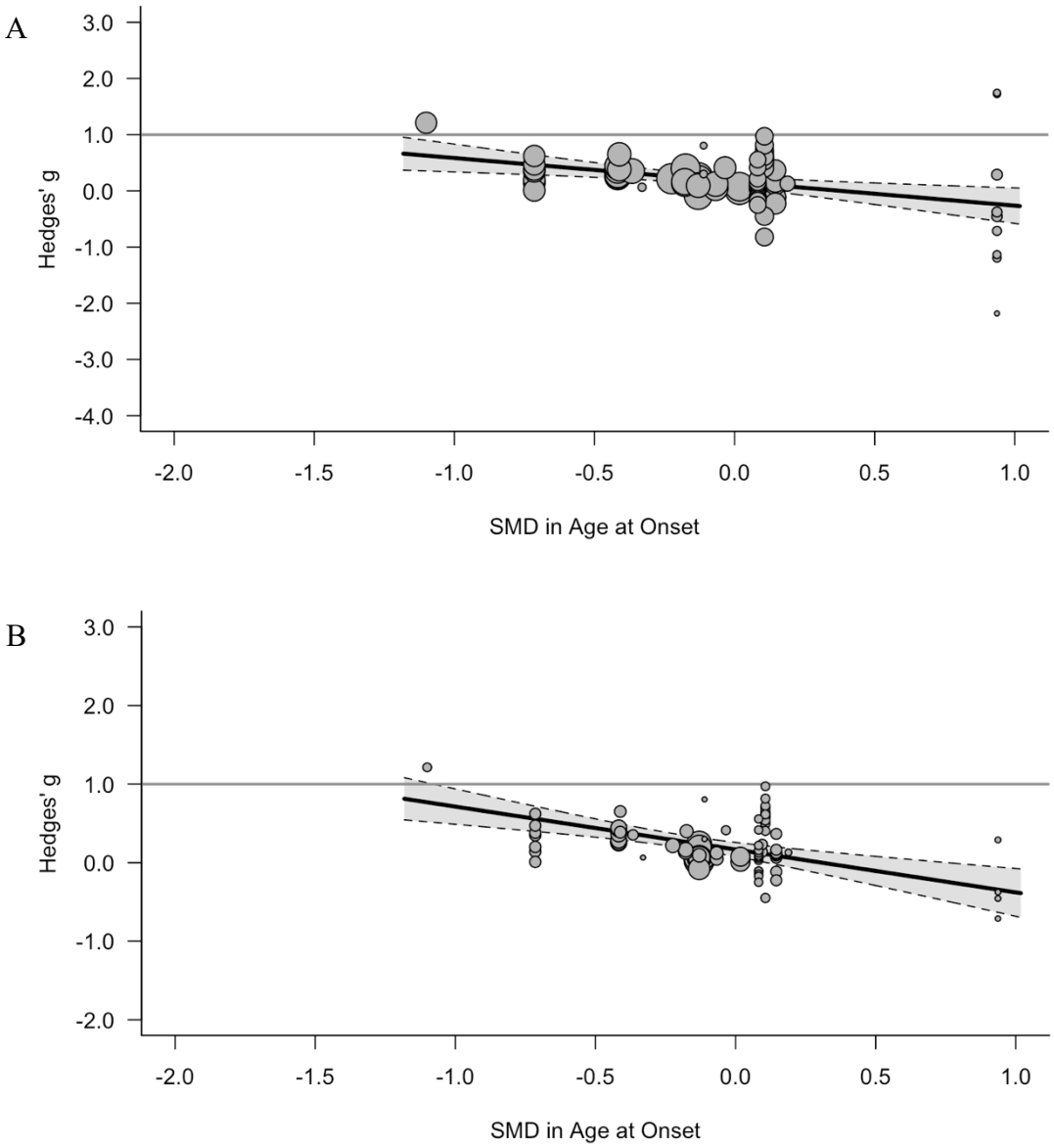
Relationships Between Standardised Mean Difference (SMD) in Years of Education and Effect Size for Cognitive Difference Between Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups



Note. A. No outliers removed. B. Outliers removed using residuals approach. For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to postural instability gait disorder (PIGD) patients.

Figure S2

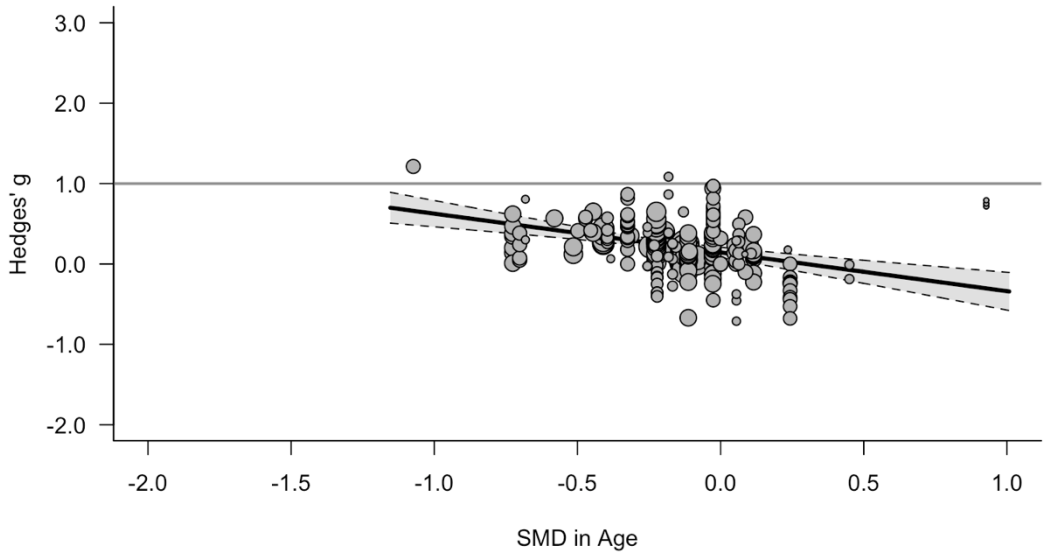
Relationship Between Standardised Mean Difference (SMD) in Age at Disease Onset and Effect Size for Cognitive Difference Between Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups



Note. A. No outliers removed. B. Outliers removed using residuals approach. For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to postural instability gait disorder (PIGD) patients.

Figure S3

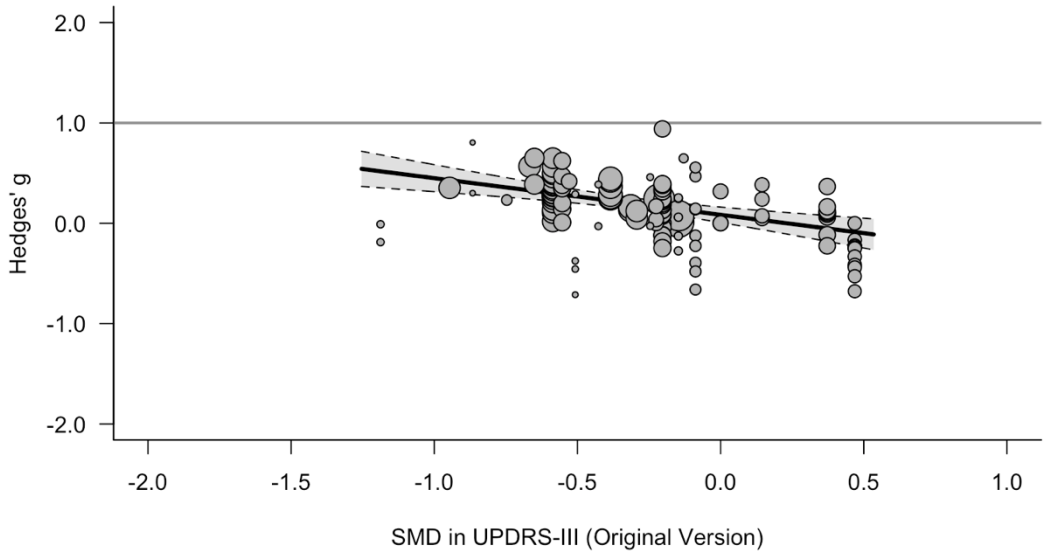
Relationship Between Standardised Mean Difference (SMD) in Age and Effect Size for Cognitive Difference Between Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups (Outliers Removed – Residuals Approach)



Note. SMD = standardised mean difference. For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to postural instability gait disorder (PIGD) patients.

Figure S4

Relationship Between Standardised Mean Difference (SMD) in Unified Parkinson's Disease Rating Scale (UPDRS) Part III Scores (Original Version) and Effect Size for Cognitive Difference Between Tremor-Dominant (TD) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups (Outliers Removed – Residuals Approach)



Note. SMD = standardised mean difference; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III (original version). For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to postural instability gait disorder (PIGD) patients.

Results of Tremor-Dominant vs. Indeterminate Analyses

Demographics and Disease Characteristics

The results of traditional meta-analyses comparing TD and ID motor subtype groups on demographics and disease characteristics are reported in Table S7. No significant group differences emerged for gender, years of education, or age at disease onset. All remaining pooled effect sizes indicated negligible-to-small differences between groups; ID patients were marginally older in age (k (o) = 19 (3642), g = 0.12 [0.03-0.21], p = .016), had slightly longer disease duration (k (o) = 17 (3306), g = 0.14 [0.03-0.25], p = .014), and had a higher LEDD (k (o) = 13 (2627), g = 0.29 [0.22-0.37], p < .001). When motor symptom severity was assessed using the original version of the UPDRS-III (Fahn et al., 1987), a small-to-moderate difference was found (k (o) = 10 (1368), g = 0.41 [0.17-0.66], p = .004), suggesting greater motor impairment in ID patients relative to TD patients. However, when the MDS-UPDRS-III (Goetz et al., 2008) was used to assess motor symptom severity, this group difference was weaker in magnitude and failed to reach statistical significance (k (o) = 9 (2274), g = 0.21 [0.01-0.42], p = .055). This is consistent with our TD vs. PIGD comparison, where a significant pooled effect size for the group difference in motor symptom severity was found for the original UPDRS-III but not the MDS-UPDRS-III.

Table S7

Meta-Analyses Comparing Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)	Egger's test (*p*)
Age[*]						
All studies	19 (3642)	-0.12 (-0.21, -0.03)	**.016**	11.4	20.31 (.315)	**.006**
Gender (proportion of men)[*]						
All studies	18 (3532)	1.03 (0.97, 1.09)	.364	0.0	13.28 (.717)	.765
Years of education[*]						
All studies	9 (1212)	0.02 (-0.14, 0.19)	.762	13.2	9.22 (.324)	-
Disease duration[*]						
All studies	17 (3306)	-0.14 (-0.25, -0.03)	**.014**	25.1	21.35 (.166)	.081
Age at onset[*]						
All studies	13 (2836)	-0.10 (-0.20, 0.00)	.057	3.2	12.40 (.414)	.193
LEDD[*]						
All studies	13 (2627)	-0.29 (-0.37, -0.22)	**< .001**	0.0	6.53 (.887)	.535
UPDRS-III total score (original version)						
All studies	10 (1368)	-0.41 (-0.66, -0.17)	**.004**	61.9	23.64 (**.005**)	.402
With outliers removed	9 (1258)	-0.31 (-0.46, -0.15)	**.002**	9.8	8.87 (.353)	-
MDS-UPDRS-III total score[*]						
All studies	9 (2274)	-0.21 (-0.42, 0.01)	.055	65.1	22.90 (**.004**)	-

UPDRS-III total score (any version)						
All studies	19	-0.32	**< .001**	66.8	54.18	.118
	(3642)	(-0.48, -0.17)			(**< .001**)	
With outliers removed	18	-0.26	**< .001**	51.7	35.22	.118
	(3532)	(-0.39, -0.14)			(**.006**)	

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the indeterminate group relative to the tremor-dominant group; for risk ratio, values > 1 indicate that tremor-dominant patients have a greater risk of being men relative to indeterminate patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. *Results for model with outliers removed not reported as no outliers detected. Significant *p*-values (< .05) reported in bold.

Cognition

Main Analyses. Compared to our analysis of TD and PIGD motor subtypes, less than half the number of studies (*n* = 19) and effect sizes (*k* = 72) were available for our multi-level meta-analysis comparing cognitive performance in TD and ID patients. A negligible-to-small difference in cognitive performance was observed between TD and ID patients, favouring TD patients (Table S8). Multi-level Egger's tests did not indicate evidence of publication bias; however, removal of outliers did reduce the magnitude of the pooled effect. Of note, sampling error variance was especially high for all three models (range = 88.93-100.00%).

Table S8

Results of Multi-Level Meta-Analyses of Cognitive Performance in Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtype Groups

Subtype Pair	Model	*n* (*k*)	Pooled Hedges' *g* (95% CI)	*p*	Within-Study I^2 (%) (*p*)	Between-Study I^2 (%) (*p*)	*Q* (*p*)	Multi-level Egger's test (*p*)
TD vs. ID	All studies	19 (72)	0.15 (0.08, 0.23)	**< .001**	11.07 (.162)	0.00 (.500)	81.57 (.184)	0.19 (.665)
	With outliers removed – residuals approach	19 (62)	0.15 (0.08, 0.22)	**< .001**	0.00 (.500)	0.00 (.500)	43.64 (.955)	0.00 (.971)
	With outliers removed – Cook's distance approach	13 (60)	0.13 (0.05, 0.21)	**.003**	0.00 (.500)	0.00 (.500)	49.51 (.806)	0.40 (.528)

Note. CI = confidence interval; ID = indeterminate; *k* = number of effect sizes; *n* = number of unique studies; TD = tremor-dominant. For Hedges' *g*, values > 0 indicate poorer cognitive performance among indeterminate (ID) patients relative to tremor-dominant (TD) patients. Significant *p*-values (< .05) are highlighted in bold.

The results of our traditional meta-analyses evaluating the prevalence of MCI and dementia in TD and ID patients are presented in Table S9. Compared to TD patients, ID patients had an 18% greater relative risk of MCI and a 41% greater relative risk of dementia. Relative to our multi-level meta-analysis of continuous cognitive data, the number of included studies for these analyses was small (n = 9 and n = 7, respectively), but between-study heterogeneity was low (p > .05 for both Qs).

Table S9

Results of Meta-Analyses Comparing Cognitive Status in Tremor-Dominant and Indeterminate (ID) Motor Subtype Groups

Outcome	***k* (*o*)**	**Pooled risk ratio (95% CI)**	***p***	***I*² (%)**	***Q* (*p*)**
Mild cognitive impairment*	9 (2301)	1.18 (0.97, 1.44)	.082	0.00	7.44 (.490)
Dementia*	6 (1383)	1.41 (0.84, 2.39)	.149	12.6	5.72 (.334)

Note. CI = confidence interval; k = number of studies/effect sizes; o = pooled sample size (both groups). For risk ratio, values > 1 indicate that indeterminate patients have a greater risk of mild cognitive impairment/dementia relative to tremor-dominant patients. I^2 is for between-study variance. *Results for model with outliers removed not reported as no outliers detected. Egger's test (using Pustejovsky and Rodgers' (2019) revised method) not performed as $k < 10$. Significant p-values (< .05) are highlighted in bold.

Dose-Effect Analyses. Neither the SMD in UPDRS tremor subscore nor the SMD in UPDRS PIGD subscore were significant moderators of differences in cognition between TD and ID motor subtypes (Table S10).

Table S10

Results of Dose-Effect Analyses for Pairwise Comparisons Between Tremor-Dominant (TD), Postural Instability Gait Disorder (PIGD), and Indeterminate (ID) Motor Subtype Groups

Subtype Pair	Moderator	*k*	*n*	*β* (95% CI)	*p*	Change in Between-Study I^2
TD vs. PIGD (full model)	SMD in UPDRS tremor subscore	23	80	-0.04 (-0.35, 0.27)	.817	-2.44
	SMD in UPDRS PIGD subscore	23	80	0.28 (-0.13, 0.68)	.178	2.75
TD vs. PIGD (outliers removed – residuals approach)	SMD in UPDRS tremor subscore	23	79	-0.05 (-0.16, 0.07)	.429	-4.41
	SMD in UPDRS PIGD subscore	23	79	0.05 (-0.10, 0.20)	.521	-0.48
TD vs. ID	SMD in UPDRS tremor subscore	12	42	0.03 (-0.09, 0.15)	.630	0.00
	SMD in UPDRS PIGD subscore	12	42	0.02 (-0.08, 0.12)	.665	0.00
PIGD vs. ID	SMD in UPDRS tremor subscore	12	42	-0.05 (-0.23, 0.13)	.544	0.00
	SMD in UPDRS PIGD subscore	12	42	-0.06 (-0.42, 0.29)	.712	0.00

Note. CI = confidence interval; ID = indeterminate; *k* = number of unique studies; *n* = number of effect sizes; PIGD = postural instability gait disorder; SMD = standardised mean difference (Hedges' *g*); TD = tremor-dominant; UPDRS = Unified Parkinson's Disease Rating Scale (any version); *β* = regression coefficient. For *β*, positive values reflect a positive association between the moderator and effect size (i.e., larger values of the moderator are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the postural instability gait disorder [PIGD] or indeterminate [ID] group, or better cognitive performance in the PIGD group relative to the ID group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). Significant *p*-values (< .05) are highlighted in bold.

Moderator Analyses. None of our moderators were statistically significant (Tables S11-S12). Among our continuous moderators, publication year did approach significance (p = .059; Table S11). As shown in Figure S5, the two studies published prior to 2010 (Alves et al., 2006; Williams-Gray et al., 2007) reported larger pooled effect sizes that favoured the TD group, consistent with our overall multi-level model (Table S8). In comparison, there was much greater variability in the effect sizes of studies published more recently. These studies tended to report a smaller cognitive advantage for TD patients or report the opposite effect of superior cognitive performance among ID patients relative to TD patients.

Of note, while cognitive domain was not a significant moderator of effect size, the pooled effect size reported for measures of cognitive flexibility (g = 0.38) did differ significantly from the effect size estimate reported for measures of global cognitive function (g = 0.13; Table S12, Figure S6). While this suggests that TD patients have a marked advantage over ID patients on measures of cognitive flexibility, this finding should be interpreted cautiously given that the mean effect size for cognitive flexibility was taken from a limited sample of only three data points (n = 2 unique studies).

Table S11

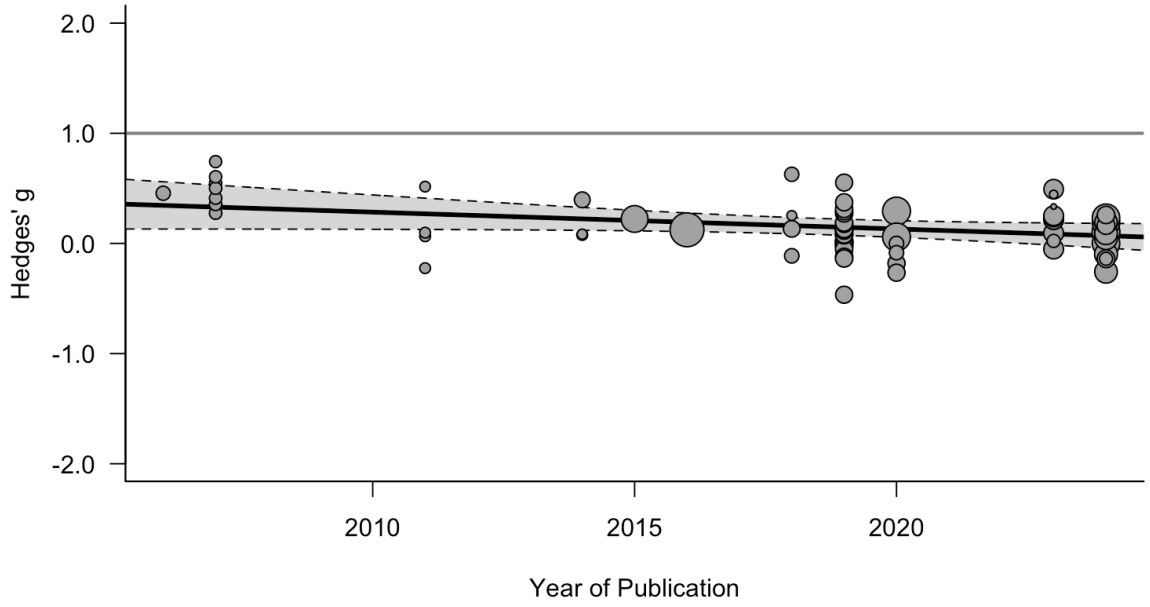
Results of Continuous Moderator Analyses for Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtype Groups

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	19	72	0.00 (-0.00, 0.00)	.904	0.00
Publication year	19	72	-0.02 (-0.03, 0.00)	.059	0.00
Pooled mean age	19	72	0.02 (-0.01, 0.05)	.129	0.00
Pooled proportion of men	18	71	-0.15 (-1.07, 0.76)	.738	0.00
Pooled mean disease duration	19	72	0.01 (-0.02, 0.05)	.465	0.00
Pooled mean age at onset	19	72	0.01 (-0.01, 0.04)	.368	0.00
Pooled mean LEDD	13	43	0.00 (-0.00, 0.00)	.867	0.00
Pooled mean UPDRS-III (original)	10	49	0.02 (-0.01, 0.04)	.169	2.49

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; *β* = regression coefficient (larger positive values reflect better cognitive performance in the tremor-dominant (TD) group relative to the indeterminate (ID) group). Change in I^2 is the difference between between-study I^2 for the model with and without the moderator; larger positive values correspond to greater between-study variance being accounted for by the moderator. No moderator analyses performed for pooled mean years of education or pooled mean MDS-UPDRS-III score as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Figure S5

Relationship Between Publication Year and Effect Size for Cognitive Difference Between Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtype Groups



Note. For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to indeterminate (ID) patients.

Table S12

Results of Categorical Moderator Analyses for Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtype Groups

Moderator	*n*	*k*	Pooled Hedges' *g* (95% CI)	*β* (95% CI)	*p*	*Q* (*p*)	ToM (*p*)
Subtype Method						54.08 (.254)	0.77 (.383)
Jankovic[*]	9	27	0.20 (0.07, 0.33)		**.004**		
Stebbins	9	23	0.12 (0.02, 0.23)	-0.07 (-0.24, 0.10)	.383		
Cognitive Class						79.77 (.199)	0.94 (.335)
Global[*]	17	23	0.12 (0.03, 0.22)		**.011**		
Specific	5	49	0.19 (0.07, 0.31)	0.07 (-0.07, 0.22)	.335		
Cognitive Domain[†]						59.23 (.128)	1.37 (.228)
Global Cognitive Function[*]	17	23	0.13		**.008**		
Executive Function – Cognitive Flexibility	2	3	0.38	0.25 (0.02, 0.48)	**.035**		
Executive Function – Working Memory	3	6	0.22	0.09 (-0.11, 0.28)	.361		
Higher-Order Fluid Abilities – Planning	2	2	0.16	0.03 (-0.36, 0.41)	.884		
Language	4	8	0.16	0.03 (-0.14, 0.20)	.745		
LTM/Learning – Lexical	2	2	0.26	0.13 (-0.09, 0.34)	.245		
LTM/Learning – Semantic	3	3	0.19	0.06 (-0.18, 0.35)	.526		

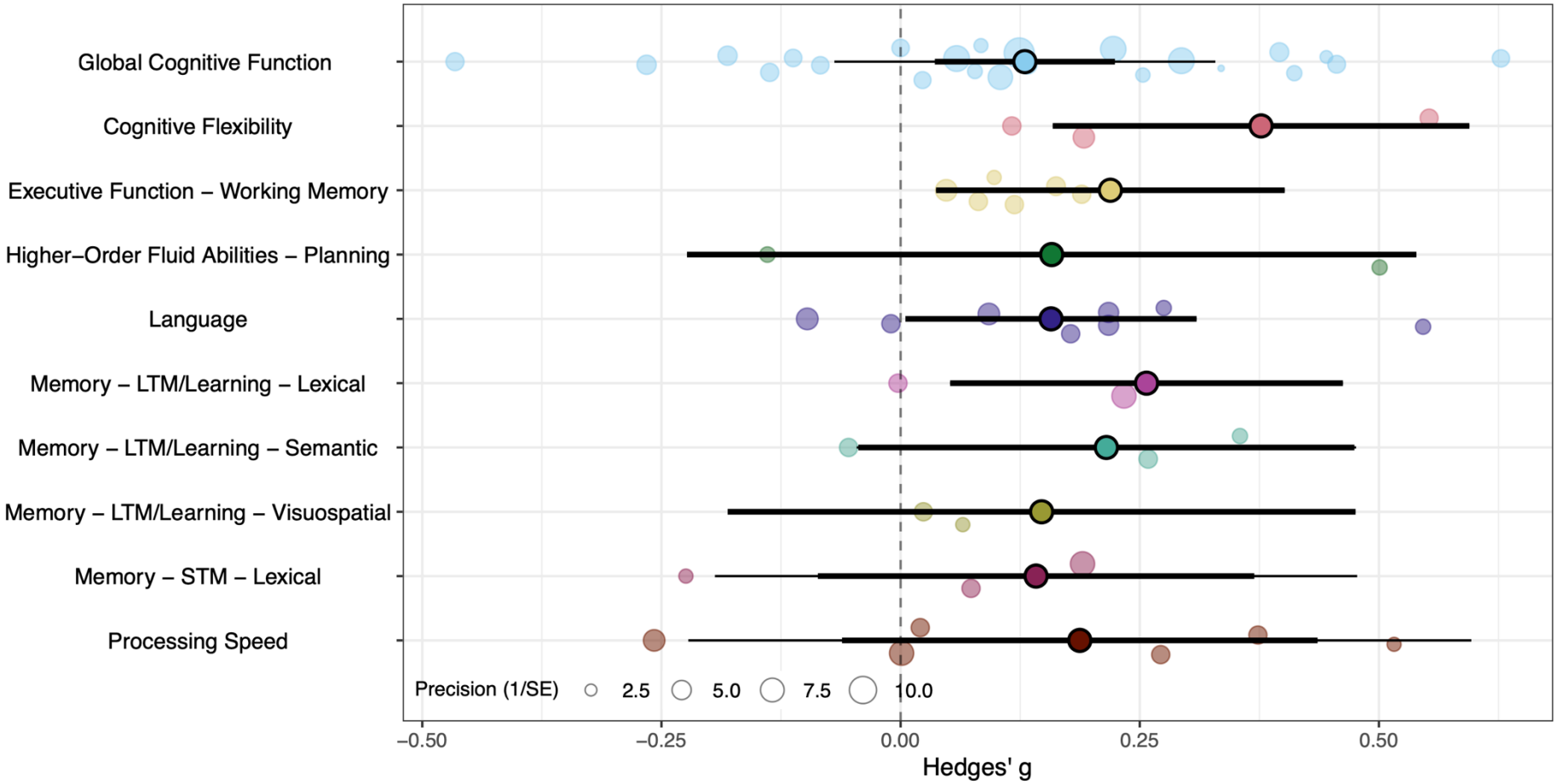
LTM/Learning – Visuospatial	2	2	0.15	0.02 (-0.32, 0.36)	.918		
STM – Lexical	3	3	0.14	0.01 (-0.25, 0.27)	.928		
Processing Speed	3	6	0.19	0.06 (-0.22, 0.34)	.679		
Medication Status for Motor Assessment(s)						51.36 (.239)	0.86 (.469)
De novo[*]	5	28	0.10 (-0.03, 0.23)		.134		
ON	7	14	0.28 (0.08, 0.48)	0.18 (-0.05, 0.42)	.127		
OFF	3	4	0.17 (-0.01, 0.36)	0.08 (-0.15, 0.30)	.505		
ON or OFF	2	3	0.12 (-0.09, 0.32)	0.02 (-0.22, 0.26)	.870		
Cognitive Impairment/Dementia as Exclusion Criterion						80.15 (.191)	1.45 (.232)
No[*]	11	53	0.12 (0.04, 0.21)		.005		
Yes	8	19	0.22 (0.08, 0.36)	0.10 (-0.06, 0.26)	.232		
Motor Subtypes Compared on Cognition in Paper						63.78 (.250)	1.49 (.228)
No[*]	8	22	0.22 (0.10, 0.34)		**< .001**		
Yes	10	37	0.12 (0.01, 0.23)	-0.10 (-0.26, 0.06)	.228		

Overall Risk of Bias						80.31 (.166)	0.74 (.482)
High[*]	7	20	0.21 (0.09, 0.32)		**< .001**		
Moderate	8	31	0.11 (-0.05, 0.26)	-0.10 (-0.29, 0.09)	.305		
Low	4	21	0.12 (-0.03, 0.26)	-0.09 (-0.27, 0.09)	.337		

Note. CI = confidence interval; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values > 0 indicate poorer cognitive performance among indeterminate (ID) patients relative to tremor-dominant (TD) patients. [†] 95% confidence intervals not reported as model without intercept failed to reach convergence. No moderator analyses performed for medication status for cognitive assessment(s) as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Figure S6

Orchard Plot of Effect Sizes for Difference in Cognitive Performance Between Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtype Groups According to Cognitive Domain



Note. For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to indeterminate (ID) patients.

Confound Analyses. None of the variables we investigated as possible confounds significantly moderated effect size magnitude for the difference in cognitive performance between TD and ID motor subtype groups (Table S13).

Table S13

Results of Confound Analyses for Tremor-Dominant (TD) and Indeterminate (ID) Motor Subtype Groups

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	19	72	-0.10 (-0.48, 0.29)	.618	0.00
Difference in proportion of men	18	71	0.78 (-0.31, 1.87)	.158	0.00
SMD disease duration	17	64	-0.04 (-0.49, 0.40)	.842	0.00
SMD age at onset	13	40	-0.11 (-0.63, 0.41)	.673	0.00
SMD LEDD	13	43	-0.40 (-1.08, 0.28)	.246	0.00
SMD UPDRS-III (original)	10	49	-0.19 (-0.59, 0.21)	.349	-1.30
SMD UPDRS-III (any version)	19	72	-0.09 (-0.34, 0.17)	.498	0.00

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, positive values reflect a positive association between the confound (moderator) and effect size (i.e., larger values of the confound [moderator] are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the indeterminate [ID] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). No confound (moderator) analyses performed for SMD in years of education or SMD in Movement Disorder Society (MDS)-UPDRS-III score as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Results of Postural Instability Gait Disorder vs. Indeterminate Analyses

Demographics and Disease Characteristics

The results of traditional meta-analyses comparing PIGD and ID motor subtype groups on demographics and disease characteristics are reported in Table S14. No significant differences were found between subtype groups for gender, years of education, disease duration, or UPDRS-III scores (original or MDS version). All remaining pooled effect sizes indicated negligible-to-small differences between groups. Relative to ID participants, PIGD participants were older at time of disease onset (k (o) = 13 (3284), g = 0.14 [0.02-0.26], p = .028) and at time of study participation (k (o) = 19 (4885), g = 0.14 [0.03-0.25], p = .012), and reported a higher LEDD (k (o) = 13 (3388), g = 0.18 [0.06-0.31], p = .007).

Table S14

Meta-Analyses Comparing Postural Instability and Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)	Egger's test (*p*)
Age						
All studies	19 (4885)	0.14 (0.03, 0.25)	**.012**	32.8	26.79 (.083)	.848
With outliers removed	18 (4804)	0.12 (0.04, 0.21)	**.006**	0.0	16.90 (.461)	.347
Gender (proportion of men)*						
All studies	18 (4592)	0.97 (0.91, 1.04)	.406	0.0	17.00 (.454)	.641
Years of education*						
All studies	9 (2346)	-0.06 (-0.19, 0.08)	.348	0.0	7.25 (.510)	-
Disease duration*						
All studies	17 (4571)	0.07 (-0.01, 0.15)	.071	0.0	14.35 (.573)	.819
Age at onset*						
All studies	13 (3284)	0.14 (0.02, 0.26)	**.028**	32.5	17.79 (.122)	.590
LEDD						
All studies	13 (3388)	0.18 (0.06, 0.31)	**.007**	23.3	15.65 (.208)	.301
With outliers removed	12 (3095)	0.23 (0.16, 0.31)	**< .001**	0.0	6.48 (.840)	.220
UPDRS-III total score (original version)*						
All studies	10 (2387)	0.08 (-0.04, 0.19)	.171	0.0	8.07 (.527)	.719

MDS-UPDRS-III total score*						
All studies	9 (2498)	-0.01 (-0.17, 0.15)	.892	27.5	11.03 (.200)	-
UPDRS-III total score (any version)*						
All studies	19 (4885)	0.04 (-0.04, 0.13)	.318	9.2	19.83 (.343)	.392

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the indeterminate group relative to the postural instability and gait disorder (PIGD) group; for risk ratio, values > 1 indicate that postural instability and gait disorder (PIGD) patients have a greater risk of being men relative to indeterminate patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. *Results for model with outliers removed not reported as no outliers detected. Significant *p*-values (< .05) are highlighted in bold.

Cognition

Main Analyses. Our multi-level meta-analysis of 72 effect sizes from 19 studies revealed a negligible-to-small difference in cognitive performance between PIGD and ID participants, favouring the ID group (Table S15). Removal of outliers resulted in a slight reduction in the pooled effect size estimate, but multi-level Egger's tests did not indicate evidence of publication bias. As with our TD vs. ID comparison, sampling error variance was high across all models (range = 69.85-82.09%).

Table S15

Results of Multi-Level Meta-Analyses of Cognitive Performance in Indeterminate (ID) and Postural Instability Gait Disorder (PIGD) Motor Subtype Groups

Subtype Pair	Model	*n* (*k*)	Pooled Hedges' *g* (95% CI)	*p*	Within-Study I^2 (%) (*p*)	Between-Study I^2 (%) (*p*)	*Q* (*p*)	Multi-level Egger's test (*p*)
PIGD vs. ID	All studies	19 (72)	-0.14 (-0.21, -0.06)	**.005**	24.18 (**.007**)	5.97 (.358)	105.44 (**.005**)	0.08 (.777)
	With outliers removed – residuals approach	16 (65)	-0.12 (-0.19, -0.05)	**.001**	17.91 (**.046**)	2.92 (.500)	72.19 (.226)	1.27 (.265)
	With outliers removed – Cook's distance approach	14 (63)	-0.13 (-0.21, -0.04)	**.004**	21.02 (**.021**)	7.24 (.500)	78.91 (.073)	0.49 (.488)

Note. CI = confidence interval; ID = indeterminate; *k* = number of effect sizes; *n* = number of unique studies; PIGD = postural instability gait disorder. For Hedges' *g*, values < 0 indicate poorer cognitive performance among postural instability gait disorder (PIGD) patients relative to indeterminate (ID) patients. Significant *p*-values (< .05) are highlighted in bold.

Our traditional meta-analysis found no statistically significant difference in MCI prevalence between PIGD and ID subtypes (Table S16). While dementia rates did differ considerably between subtypes (RR = 1.53), indicating a higher rate of dementia among PIGD patients, this effect did not reach significance (p = .073). Between-study heterogeneity was low (I^2 = 23.6%; Q = 6.54, p = .257).

Table S16

Results of Meta-Analyses Comparing Cognitive Status in Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups

Outcome	*k* (*o*)	Pooled risk ratio (95% CI)	*p*	I^2 (%)	*Q* (*p*)
Mild cognitive impairment*	9 (2642)	1.15 (0.92, 1.43)	.195	37.0	12.69 (.123)
Dementia*	6 (1403)	1.53 (0.94, 2.48)	.073	23.6	6.54 (.257)

Note. CI = confidence interval; *k* = number of studies/effect sizes; *o* = pooled sample size (both groups). For risk ratio, values > 1 indicate that postural instability and gait disorder patients have a greater risk of mild cognitive impairment/dementia relative to indeterminate patients. I^2 is for between-study variance. *Results for model with outliers removed not reported as no outliers detected. Egger's test (using Pustejovsky and Rodgers' (2019) revised method) not performed as $k < 10$. Significant *p*-values (< .05) are highlighted in bold.

Dose-Effect Analyses. Neither the SMD in UPDRS tremor subscore nor the SMD in UPDRS PIGD subscore were significant moderators of differences in cognition between PIGD and ID motor subtypes (Table S10).

Moderator Analyses. The results of our analyses investigating potential moderators of the difference in cognitive performance between PIGD and ID motor subtype groups are reported in Tables S17 and S18. None of our moderators were statistically significant. Interestingly, although cognitive domain was not a significant moderator of effect size, as per our comparison of TD and ID motor subtypes, we found that the pooled effect size estimate for cognitive flexibility (g = 0.03 [95% CI = -0.16-0.22]) differed significantly from the mean effect size estimate for global cognitive function (Figure S7). Whereas TD patients, relative to ID patients, were found to have a *greater* advantage on measures of cognitive flexibility compared to measures of global cognition, the opposite effect was found for our PIGD vs. ID

comparison; namely, ID patients' cognitive advantage relative to PIGD patients was negligible on measures of cognitive flexibility compared to measures of global cognition. Although this estimate lacked precision (and did not differ significantly from global cognitive function), we also found the difference in performance on measures of cognitive flexibility between TD and PIGD patients to be of moderate magnitude (g = 0.24 [95% CI = -0.03-0.51], Table 8 in Main Text). Taken together, these results indicate that preserved (or enhanced) cognitive flexibility may be a distinct feature of TD patients' cognitive profile.

Table S17

Results of Continuous Moderator Analyses for Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	19	72	0.00 (-0.00, 0.00)	.208	0.72
Publication year	19	72	-0.01 (-0.03, 0.01)	.413	-7.15
Pooled mean age	19	72	-0.02 (-0.04, 0.00)	.127	5.85
Pooled proportion of men	18	71	0.06 (-1.23, 1.34)	.932	-4.22
Pooled mean disease duration	19	72	-0.01 (-0.04, 0.01)	.311	5.33
Pooled mean age at onset	19	72	-0.01 (-0.02, 0.01)	.578	-4.20
Pooled mean LEDD	13	43	-0.00 (-0.00, 0.00)	.369	1.49
Pooled mean UPDRS-III (original)	10	49	0.01 (-0.01, 0.03)	.280	1.24

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; *β* = regression coefficient. For *β*, positive values reflect a positive association between the moderator and effect size (i.e., larger values of the moderator are associated with larger effect sizes, reflecting better cognitive performance in the postural instability gait disorder [PIGD] group relative to the indeterminate [ID] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). No moderator analyses performed for pooled mean years of education or pooled mean Movement Disorder Society (MDS)-UPDRS Part III score as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Table S18

Results of Categorical Moderator Analyses for Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups

Moderator	***n***	***k***	**Pooled Hedges' *g* (95% CI)**	**β (95% CI)**	***p***	***Q* (*p*)**	**ToM (*p*)**
Subtype Method						68.59 (**.027**)	0.11 (.740)
Jankovic[*]	9	27	-0.11 (-0.22, -0.00)		**.041**		
Stebbins	9	23	-0.15 (-0.33, 0.03)	-0.04 (-0.25, 0.18)	.740		
Cognitive Class						102.75 (**.007**)	1.89 (.173)
Global[*]	17	23	-0.18 (-0.29, -0.07)		**.002**		
Specific	5	49	-0.09 (-0.19, 0.01)	0.09 (-0.04, 0.21)	.173		
Cognitive Domain						73.47 (**.010**)	1.30 (.263)
Global Cognitive Function[*]	17	23	-0.18 (-0.29, -0.07)		**.002**		
Executive Function – Cognitive Flexibility	2	3	0.03 (-0.16, 0.22)	0.21 (0.00, 0.41)	**.048**		
Executive Function – Working Memory	3	6	-0.12 (-0.28, 0.04)	0.06 (-0.11, 0.22)	.504		
Higher-Order Fluid Abilities – Planning	2	2	-0.09 (-0.46, 0.28)	0.09 (-0.29, 0.47)	.635		
Language	4	8	-0.13 (-0.27, 0.01)	0.05 (-0.11, 0.21)	.571		
LTM/Learning – Lexical	2	2	0.07 (-0.12, 0.26)	0.25 (0.05, 0.44)	**.015**		
LTM/Learning – Semantic	3	3	-0.06 (-0.36, 0.24)	0.12 (-0.16, 0.39)	.394		

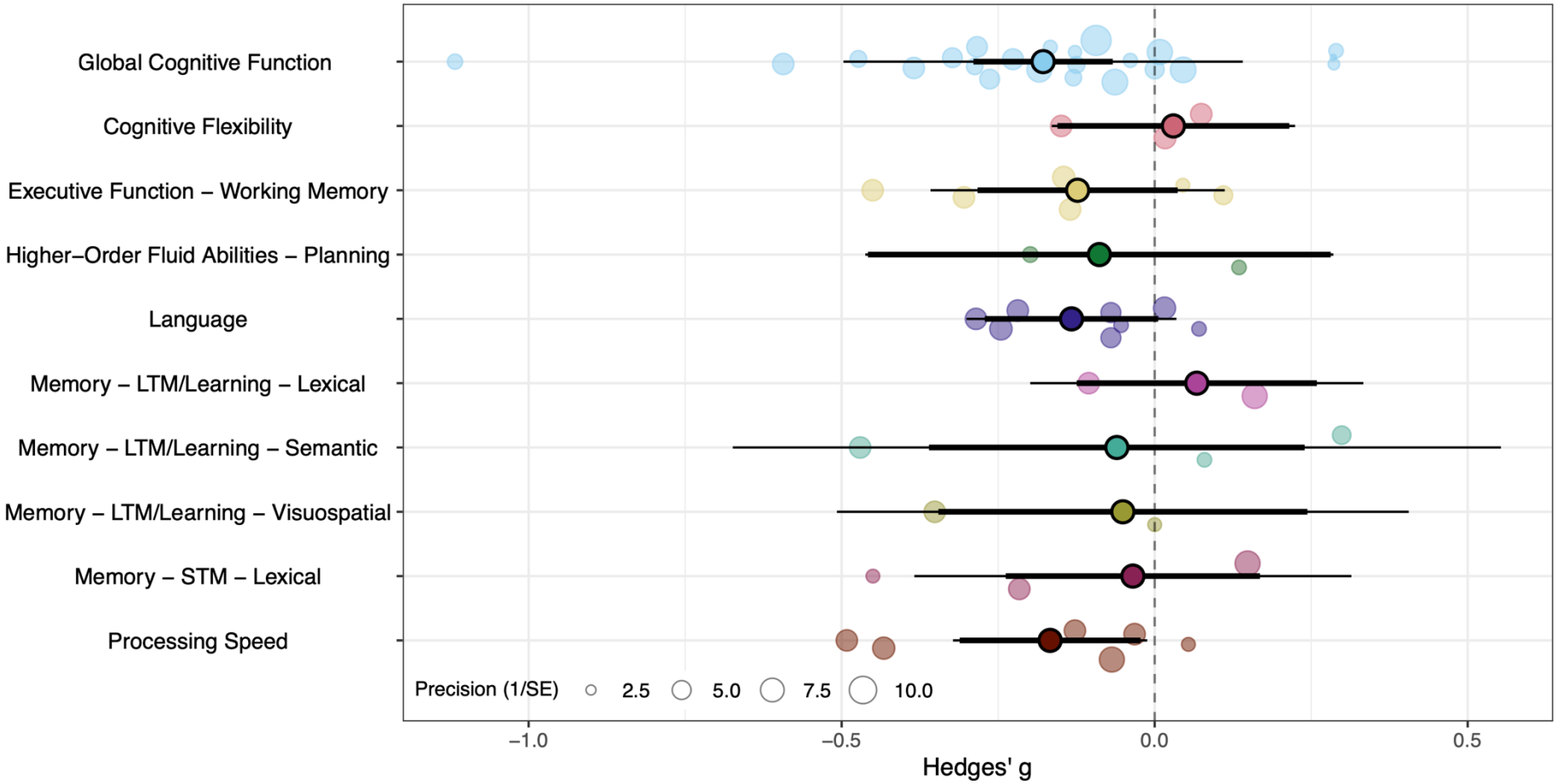
LTM/Learning – Visuospatial	2	2	-0.05 (-0.35, 0.24)	0.13 (-0.16, 0.41)	.376		
STM – Lexical	3	3	-0.03 (-0.24, 0.17)	0.14 (-0.05, 0.34)	.149		
Processing Speed	3	6	-0.17 (-0.31, -0.02)	0.01 (-0.16, 0.18)	.897		
Medication Status for Motor Assessment(s)						67.07 (**.018**)	0.21 (.892)
De novo[*]	5	28	-0.11 (-0.24, 0.01)		.074		
ON	7	14	-0.19 (-0.51, 0.14)	-0.07 (-0.41, 0.27)	.680		
OFF	3	4	-0.05 (-0.24, 0.14)	0.06 (-0.17, 0.29)	.578		
ON or OFF	2	3	-0.09 (-0.32, 0.14)	0.02 (-0.24, 0.28)	.857		
Cognitive Impairment/Dementia as Exclusion Criterion						105.20 (**.004**)	0.01 (.935)
No[*]	11	53	-0.14 (-0.23, -0.06)		**.001**		
Yes	8	19	-0.15 (-0.42, 0.11)	-0.01 (-0.29, 0.26)	.935		
Motor Subtypes Compared on Cognition in Paper						74.83 (.057)	0.01 (.910)
No[*]	8	22	-0.19 (-0.40, 0.03)		.094		
Yes	10	37	-0.17 (-0.27, -0.07)	0.01 (-0.23, 0.25)	.910		

Overall Risk of Bias						102.22 (**.006**)	1.03 (.362)
High[*]	7	20	-0.18 (-0.42, 0.06)		.146		
Moderate	8	31	-0.20 (-0.32, -0.08)	-0.02 (-0.29, 0.25)	.883		
Low	4	21	-0.06 (-0.21, 0.08)	0.11 (-0.17, 0.39)	.424		

Note. CI = confidence interval; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values < 0 indicate poorer cognitive performance among postural instability gait disorder (PIGD) patients relative to indeterminate (ID) patients. No moderator analysis performed for medication status at time of cognitive assessment(s) as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Figure S7

Orchard Plot of Effect Sizes for Difference in Cognitive Performance Between Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups According to Cognitive Domain



Note. For Hedges' *g*, values < 0 indicate better cognitive performance among indeterminate (ID) patients relative to postural instability gait disorder (PIGD) patients.

Confound Analyses. The results of our confound analyses are presented in Table S19. The standardised mean difference (SMD) in age, age at disease onset, and UPDRS-III score (any version) between PIGD and ID motor subtype groups were all significant moderators of the difference in cognitive performance between subtypes.

As shown in Figures S8 and S9, the SMD in age and age at time of disease onset had a similar influence on the difference in cognitive performance between PIGD and ID groups. As the magnitude of the SMD in mean age (or mean age at onset) increased above zero, reflecting older age (or older age at onset) in the PIGD group relative to the ID group, the (absolute) magnitude of the difference in cognitive performance also increased, favouring better cognition in the ID group. In contrast, as the magnitude of the SMD in mean age (or mean at age onset) increased below zero, reflecting older age (or older age at onset) in the ID group relative to the PIGD group, the magnitude of the difference in cognitive performance also increased, favouring better cognition in the PIGD group. Stated more simply, relatively older age and older age at onset are associated with worse cognitive performance in both motor subtype groups. Inspection of Figures S8 and S9 does, however, indicate that these trends are predominantly driven by a small handful of extreme values for the SMD in age and age at onset, respectively; thus, these results should be interpreted with caution[6].

We found evidence of a similar deleterious effect of motor symptom severity on the cognitive performance of both PIGD and ID motor subtype groups. As shown in Figure S10, as the SMD in UPDRS-III scores (any version) increased above zero, reflecting worse motor function in the PIGD group relative to the ID group, the (absolute) magnitude of the difference in cognitive performance also increased, reflecting poorer cognition among PIGD patients relative to ID patients. Similarly, as the SMD in UPDRS-III scores (any version) increased below zero, reflecting worse motor function in the ID group relative to the PIGD group, the magnitude of the difference in cognitive performance increased in favour of the PIGD group. These results provide evidence for an association between motor symptom severity and cognitive impairment in PD; however, it should be acknowledged that this pattern seems to be predominantly driven by a small handful of extreme values for the SMD in UPDRS-III scores (Figure S10), and so results should be interpreted cautiously. For all three significant confounds, between-study I^2 neared zero (between-study $I^2 < 0.00\%$).

[6] It is also pertinent to note that these extreme values for the SMD in age and the SMD in age at onset have been reported by the *same* studies (Petrijan et al., 2023; Shen et al., 2023), indicating that the moderating effects of both characteristics may in fact be confounded with each other.

Table S19

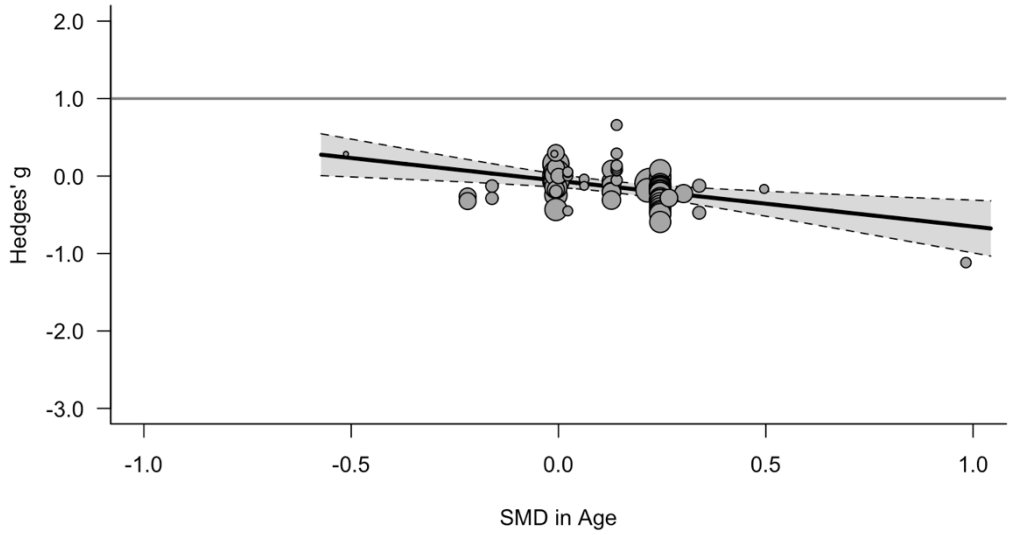
Results of Confound Analyses for Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	19	72	-0.59 (-0.97, -0.21)	**.003**	5.97
Difference in proportion of men	18	71	0.30 (-0.76, 1.36)	.570	-7.96
SMD disease duration	17	64	-0.12 (-0.59, 0.34)	.603	1.51
SMD age at onset	13	40	-0.58 (-1.06, -0.10)	**.019**	12.54
SMD LEDD	13	43	-0.22 (-0.73, 0.30)	.398	-0.50
SMD UPDRS-III (original)	10	49	-0.50 (-1.05, 0.04)	.069	3.84
SMD UPDRS-III (any version)	19	72	-0.38 (-0.76, -0.00)	**.048**	5.97

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, negative values reflect a positive association between the confound (moderator) and effect size (i.e., larger negative values of the confound [moderator] are associated with larger negative effect sizes, reflecting better cognitive performance in the indeterminate [ID] group relative to the postural instability gait disorder [PIGD] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). No confound (moderator) analyses performed for SMD in years of education or SMD in Movement Disorder Society (MDS)-UPDRS-III score as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Figure S8

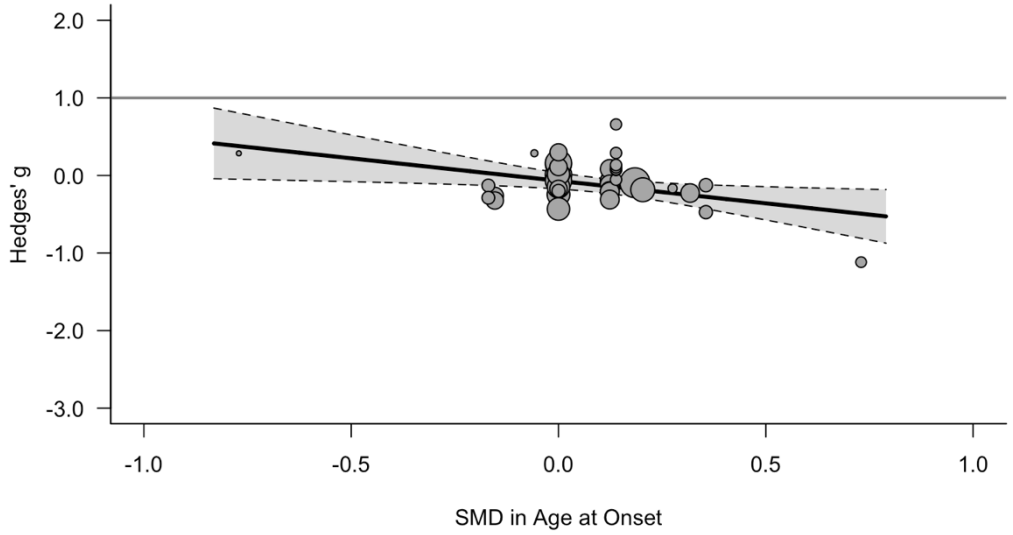
Relationship Between Standardised Mean Difference (SMD) in Age and Effect Size for Cognitive Difference Between Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups



Note. SMD = standardised mean difference. For Hedges' *g*, values < 0 indicate better cognitive performance among indeterminate (ID) patients relative to postural instability gait disorder (PIGD) patients.

Figure S9

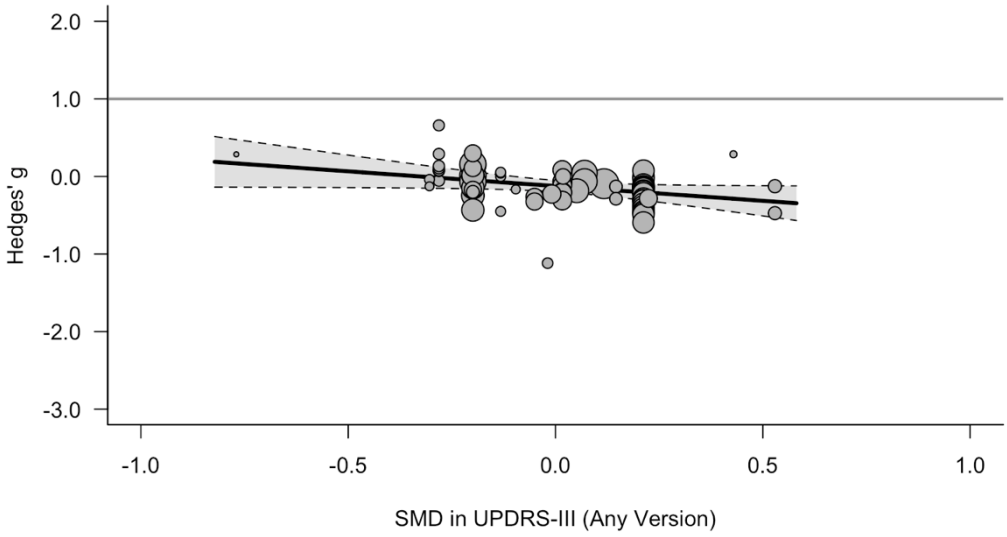
Relationship Between Standardised Mean Difference (SMD) in Age at Disease Onset and Effect Size for Cognitive Difference Between Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups



Note. SMD = standardised mean difference. For Hedges' *g*, values < 0 indicate better cognitive performance among indeterminate (ID) patients relative to postural instability gait disorder (PIGD) patients.

Figure S10

Relationship Between Standardised Mean Difference (SMD) in Unified Parkinson's Disease Rating Scale (UPDRS) Part III Score (Any Version) and Effect Size for Cognitive Difference Between Postural Instability Gait Disorder (PIGD) and Indeterminate (ID) Motor Subtype Groups



Note. SMD = standardised mean difference. For Hedges' *g*, values < 0 indicate better cognitive performance among indeterminate (ID) patients relative to postural instability gait disorder (PIGD) patients.

Results of Predominantly Tremor-Dominant vs. Predominantly Postural Instability Gait Disorder Analyses

Two studies (Herman et al., 2015; Ren et al., 2020) compared predominantly tremor-dominant (p-TD) and predominantly postural instability gait disorder (p-PIGD) motor subtype groups on continuous measures of cognition. No cognitive status (rates of MCI and/or dementia) data were reported for this motor subtype pair. Of note, Ren and colleagues (2020) compared p-TD and p-PIGD subtypes among a sample of *de novo* patients with a mean disease duration of 2.3 years whilst Herman and colleagues (2015) compared these subtypes among medicated patients with a mean disease duration of 5.5 years.

Both studies used a similar subtyping method (first reported in Herman et al., 2014), where either Jankovic et al. (1990) or Stebbins et al.'s (2013) subtyping method is first used to classify patients into TD, PIGD, and ID groups. Following this, more stringent criteria are then applied to exclude (1) ID patients; (2) TD patients with especially high PIGD subscores or low tremor subscores; and (3) PIGD patients with especially low PIGD subscores or high tremor subscores, irrespective of tremor to PIGD subscore ratio. This produces constrained TD and PIGD groups that only include patients with either severe tremor symptoms (p-TD) or severe PIGD symptoms (p-PIGD).

Given that the p-TD and p-PIGD subtype groups are intended to capture the most extreme cases of TD and PIGD, it is unsurprising that group differences were qualitatively similar to those observed for TD and PIGD groups (see Section 3.3 of main text). Group differences in age, gender, years of education, and age at disease onset were all negligible-to-small, and Herman et al. (2015) reported greater LEDD among p-PIGD patients relative to p-TD patients (g = 0.33). While Ren and colleagues (2020) reported much greater overall motor impairment among their *de novo* p-PIGD patients relative to their *de novo* p-TD patients (g = 0.55), Herman et al. (2015) reported a negligible effect among their medicated sample (g = 0.06). Interestingly, Herman and colleagues (2015) also reported longer disease duration among p-TD patients relative to p-PIGD patients (g = 0.32), contrary to the general observation that the PIGD subtype is associated with later disease stages (Fereshtehnejad & Postuma, 2017; Nutt, 2016).

Both Herman et al. (2015) and Ren et al. (2020) administered the MMSE and MoCA; Herman et al. (2015) also administered a series of domain-specific tasks, including the Trail Making Test (Parts A [TMT-A] and B [TMT-B]) and NeuroTrax Mindstreams computerised

cognitive battery. Group differences on the MMSE and MoCA differed markedly between studies; whilst Herman and colleagues (2015) reported moderate effect sizes (MMSE g = 0.49; MoCA g = 0.30) indicating better cognition among p-TD patients, Ren and colleagues (2020) reported negligible group differences on both screening measures (MMSE g = 0.03; MoCA g = 0.01). Among the domain-specific tasks administered by Herman et al. (2015), similar small-to-moderate effect sizes favouring p-TD patients were observed for all domains except for cognitive flexibility (g = 0.14), where p-PIGD patients demonstrated marginally superior performance, and working memory (g = 0.02), where no significance group difference was found.

Results of Tremor-Dominant vs. Non-Tremor-Dominant Analyses

Table S20

Meta-Analyses Comparing Tremor-Dominant (TD) and Non-Tremor-Dominant (NTD) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)	Egger's test (*p*)
Age*						
All studies	10 (2655)	-0.12 (-0.22, -0.01)	**.034**	0.0	8.81 (.455)	.909
Gender (proportion of men)*						
All studies	9 (2578)	1.05 (0.98, 1.13)	.171	0.0	6.83 (.555)	-
Years of education*						
All studies	3 (1369)	0.04 (-0.55, 0.63)	.794	51.4	4.11 (.128)	-
Disease duration						
All studies	8 (2515)	-0.02 (-0.15, 0.11)	.700	32.8	10.41 (.167)	-
With outliers removed	7 (2498)	-0.03 (-0.13, 0.07)	.464	0.0	4.62 (.594)	-
Age at onset*						
All studies	5 (2269)	-0.10 (-0.24, 0.05)	.131	8.3	4.36 (.359)	-
LEDD*						
All studies	5 (1132)	-0.31 (-0.50, -0.13)	**.009**	0.0	3.59 (.465)	-
UPDRS-III total score (original version)						
All studies	7 (1342)	-0.11 (-0.62, 0.40)	.622	72.7	21.97 (**.001**)	-
With outliers removed	6 (1325)	-0.20 (-0.50, 0.10)	.153	57.6	11.80 (**.038**)	-

UPDRS-III total score (any version)						
All studies	9 (2592)	-0.17 (-0.49, 0.15)	.246	73.8	30.53 (**< .001**)	-
With outliers removed	8 (2575)	-0.23 (-0.44, -0.01)	**.041**	63.5	19.19 (**.008**)	-

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the non-tremor-dominant (NTD) group relative to the tremor-dominant (TD) group; for risk ratio, values > 1 indicate that tremor-dominant (TD) patients have a greater risk of being men relative to non-tremor-dominant (NTD) patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. *Results for model with outliers removed not reported as no outliers detected. No meta-analyses performed for Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III as $k < 3$ studies. Significant *p*-values (< .05) are highlighted in bold.

Table S21

Results of Continuous Moderator Analyses for Tremor-Dominant (TD) and Non-Tremor-Dominant (NTD) Motor Subtype Groups

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	10	25	0.00 (-0.00, 0.00)	.800	0.00
Publication year	10	25	0.01 (-0.02, 0.03)	.520	-3.69
Pooled mean age	10	25	-0.00 (-0.04, 0.04)	.920	0.00

Note. CI = confidence interval; *k* = number of effect sizes; *n* = number of unique studies; *β* = regression coefficient. For *β*, positive values reflect a positive association between the moderator and effect size (i.e., larger values of the moderator are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the non-tremor-dominant [NTD] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). No moderator analyses performed for pooled proportion of men, pooled mean years of education, pooled mean disease duration, pooled mean age at onset, pooled mean levodopa equivalent daily dose (LEDD), pooled mean Unified Parkinson's Disease Rating Scale (UPDRS) Part III score, or pooled mean Movement Disorder Society (MDS)-UPDRS Part III score as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Table S22

Results of Categorical Moderator Analyses for Tremor-Dominant (TD) and Non-Tremor-Dominant (NTD) Motor Subtype Groups

Moderator	***n***	***k***	**Pooled Hedges' *g* (95% CI)**	**β (95% CI)**	***p***	***Q* (*p*)**	**ToM (*p*)**
Subtype Method						30.99 (.096)	0.48 (.623)
Jankovic[*]	4	4	0.09 (-0.05, 0.23)				
Stebbins	2	14	0.09 (-0.00, 0.18)	0.00 (-0.17, 0.17)	1.000		
Other	4	7	-0.22 (-0.87, 0.43)	-0.31 (-0.97, 0.35)	.344		
Cognitive Class						32.31 (.094)	1.70 (.205)
Global[*]	9	10	0.08 (-0.01, 0.17)		.076		
Specific	3	15	-0.42 (-1.23, 0.38)	-0.50 (-1.30, 0.29)	.205		
Cognitive Domain						21.59 (**.042**)	1.73 (.219)
Global Cognitive Function[*]	9	10	0.08 (-0.01, 0.18)		.792		
Language	2	3	-0.91 (-3.23, 1.42)	-0.99 (-3.31, 1.33)	.370		
LTM/Learning – Semantic	2	2	-0.42 (-1.29, 0.44)	-0.51 (-1.37, 0.35)	.224		
Cognitive Impairment/ Dementia as Exclusion Criterion						32.42 (.092)	0.05 (.816)
No[*]	5	17	0.08 (-0.00, 0.15)		.054		
Yes	5	8	0.04 (-0.22, 0.31)	-0.03 (-0.31, 0.25)	.816		

Note. CI = confidence interval; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the

moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values > 0 indicate poorer cognitive performance among non-tremor-dominant (NTD) patients relative to tremor-dominant (TD) patients. No moderator analyses performed for medication status at time of cognitive assessment(s), for medication status at time of motor assessment(s), for motor subtypes compared on cognition in paper, or for overall risk of bias as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Table S23

Results of Confound Analyses for Tremor-Dominant (TD) and Non-Tremor-Dominant (NTD) Motor Subtype Groups

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	10	25	0.07 (-0.61, 0.76)	.828	0.00

Note. CI = confidence interval; *k* = number of effect sizes; *n* = number of unique studies; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, positive values reflect a positive association between the confound (moderator) and effect size (i.e., larger values of the confound [moderator] are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the non-tremor-dominant [NTD] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). No confound (moderator) analyses performed for raw difference in proportion of men, SMD in years of education, SMD in disease duration, SMD in age at disease onset, SMD in levodopa equivalent daily dose (LEDD), SMD in Unified Parkinson's Disease Rating Scale (UPDRS) Part III scores, or SMD in Movement Disorder Society (MDS)-UPDRS Part III scores, or SMD in UPDRS Part III scores (any version) as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Results of Postural Instability Gait Disorder vs. Non-Postural Instability Gait Disorder Analyses

Table S24

Meta-Analyses Comparing Postural Instability Gait Disorder (PIGD) and Non-Postural Instability Gait Disorder (non-PIGD) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)
Age					
All studies	7 (1750)	-0.01 (-0.22, 0.03)	.100	0.2	6.01 (.422)
Gender (proportion of men)					
All studies	7 (1750)	1.09 (1.03, 1.15)	**.009**	0.0	2.17 (.903)
Disease duration*					
All studies	7 (1750)	-0.29 (-0.51, -0.06)	**.021**	71.8	21.25 (**.002**)
Age at onset*					
All studies	4 (1377)	-0.10 (-0.32, 0.12)	.245	34.9	4.61 (.203)
LEDD*					
All studies	4 (451)	-0.35 (-1.06, 0.37)	.223	81.9	16.61 (**<.001**)
UPDRS-III total score (original version)*					
All studies	4 (307)	-0.21 (-0.75, 0.32)	.295	40.6	5.05 (.168)
UPDRS-III total score (any version)*					
All studies	6 (1686)	-0.22 (-0.40, -0.04)	**.027**	30.1	7.15 (.210)

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the postural instability gait disorder (PIGD)

group relative to the non-PIGD group; for risk ratio, values > 1 indicate that non-PIGD patients have a greater risk of men relative to PIGD patients. I^2 is for between-study variance. Egger's test not conducted as $k < 10$ for all analyses. *Results for model with outliers removed not reported as no outliers detected. No meta-analyses performed for years of education or Movement Disorder Society (MDS)-UPDRS-III as $k < 3$ studies. Significant *p*-values (< .05) are highlighted in bold.

Results of Tremor-Dominant vs. Akinetic-Rigid Analyses

Table S25

Meta-Analyses Comparing Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)	Egger's test (*p*)
Age						
All studies	19 (2944)	-0.12 (-0.38, 0.15)	.362	87.8	147.52 (**< .001**)	.053
With outliers removed	17 (2409)	-0.05 (-0.16, 0.06)	.375	0.0	15.46 (.491)	.337
Gender (proportion of men)						
All studies	16 (2824)	1.06 (0.91, 1.23)	.461	45.0	27.29 (**.027**)	.953
With outliers removed	15 (2734)	1.08 (0.95, 1.24)	.222	33.9	21.19 (.097)	.857
Years of education						
All studies	15 (2039)	-0.05 (-0.21, 0.10)	.487	63.0	37.80 (**< .001**)	.759
With outliers removed	14 (1546)	0.01 (-0.14, 0.15)	.913	32.8	19.34 (.113)	.170
Disease duration						
All studies	18 (2441)	-0.11 (-0.28, 0.05)	.169	53.2	36.35 (**.004**)	.533
With outliers removed	17 (2388)	-0.06 (-0.12, 0.07)	.343	37.7	25.69 (.059)	.734
Age at onset						
All studies	9 (1934)	-0.18 (-0.67, 0.31)	.422	86.8	60.62 (**< .001**)	-
With outliers removed	8 (1831)	0.03 (-0.10, 0.15)	.615	0.0	4.28 (.747)	-

LEDD						
All studies	12	-0.38	.058	83.4	66.22	.367
	(1147)	(-0.77, 0.02)			(**< .001**)	
With outliers removed	11	-0.24	**.042**	59.1	24.43	.096
	(1044)	(-0.47, -0.01)			(**.007**)	
UPDRS-III total score (original version)*						
All studies	17	-0.29	**< .001**	0.0	8.59	.446
	(2396)	(-0.37, -0.20)			(.929)	
UPDRS-III total score (any version)†						
All studies	19	-0.89	.078	98.4	1128.08	.085
	(3321)	(-1.90, 0.11)			(**< .001**)	

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the akinetic-rigid group relative to the tremor-dominant group; for risk ratio, values > 1 indicate that tremor-dominant patients have a greater risk of being men relative to akinetic-rigid patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. *Results for model with outliers removed not reported as no outliers detected. †Results for model with outliers removed not reported as outliers were both studies reporting MDS-UPDRS-III and no other studies reported MDS-UPDRS-III, so model with outliers removed was identical to model for UPDRS-III (original version). No meta-analyses were performed for Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III as $k < 3$ studies. Significant *p*-values (< .05) are highlighted in bold.

Table S26

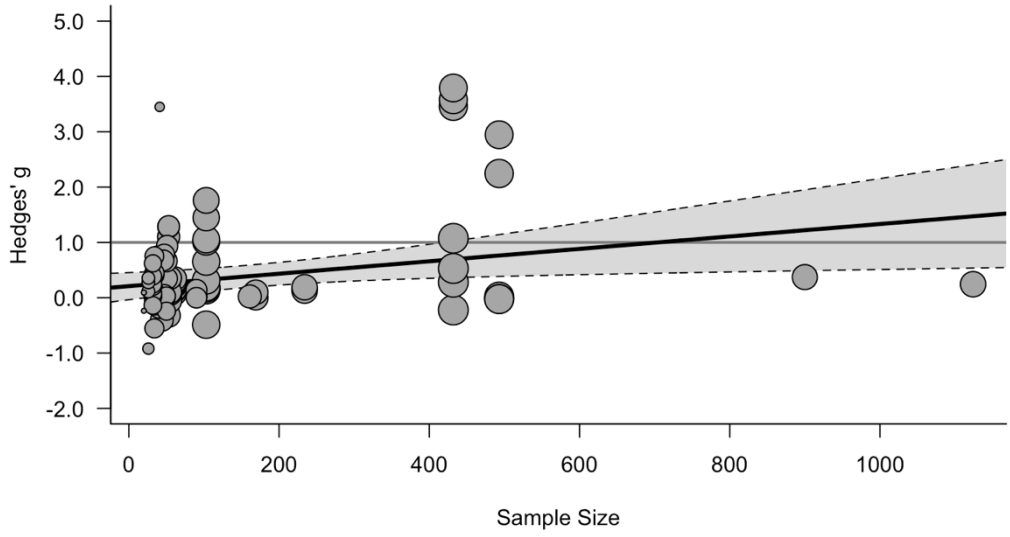
Results of Dose-Effect Analysis for Pairwise Comparison Between Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtype Groups

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD in UPDRS tremor subscore	6	35	-0.06 (-0.51, 0.39)	.782	0.00

Note. CI = confidence interval; *k* = number of effect sizes; *n* = number of unique studies; SMD = standardised mean difference (Hedges' *g*); UPDRS = Unified Parkinson's Disease Rating Scale (any version); *β* = regression coefficient. For *β*, positive values reflect a positive association between the moderator and effect size (i.e., larger values of the moderator are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the akinetic-rigid [AR] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). No results reported for SMD in UPDRS AR subscore as $n < 10$ studies. No results are reported for SMD in UPDRS tremor subscore when outliers removed (identified from the full model, using a residuals approach) as none of the studies with outliers reported UPDRS tremor subscore data; consequently, the results of our dose-effect analysis were the same regardless of whether these outliers were retained or removed from the data set. Significant *p*-values (< .05) are highlighted in bold.

Figure S11

Relationship Between Sample Size and Effect Size for Cognitive Difference Between Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtype Groups



Note. For Hedges' *g*, values > 0 indicate better cognitive performance among tremor-dominant (TD) patients relative to akinetic-rigid (AR) patients.

Table S27

Results of Continuous Moderator Analyses for Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	20	108	0.00 (-0.00, 0.00)	.798	0.00
Publication year	20	108	-0.01 (-0.03, 0.02)	.624	0.00
Pooled mean age	18	98	0.01 (-0.02, 0.04)	.419	0.00
Pooled proportion of men	15	73	0.59 (-0.63, 1.81)	.340	0.00
Pooled mean years of education	15	85	-0.00 (-0.05, 0.04)	.899	0.00
Pooled mean disease duration	18	101	0.02 (-0.01, 0.05)	.200	0.00
Pooled mean age at onset	18	101	0.00 (-0.02, 0.02)	.845	0.00
Pooled mean LEDD	12	74	0.00 (-0.00, 0.00)	.186	0.00
Pooled mean UPDRS-III (original)	17	92	-0.00 (-0.01, 0.01)	.931	0.00

Note. CI = confidence interval; *k* = number of effect sizes; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; β = regression coefficient. For β, positive values reflect a positive association between the moderator and effect size (i.e., larger values of the moderator are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the akinetic-rigid [AR] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). No moderator analyses performed for pooled mean Movement Disorder Society (MDS)-UPDRS Part III score as *n* < 10 studies. Significant *p*-values (< .05) are highlighted in bold.

Table S28

Results of Categorical Moderator Analyses for Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Moderator	***n***	***k***	**Pooled Hedges' *g* (95% CI)**	***β* (95% CI)**	***p***	***Q* (*p*)**	**ToM (*p*)**
Subtype Method						361.46 (**< .001**)	0.482 (.489)
Kang[*]	11	64	0.17 (0.03, 0.31)		**.014**		
Other	9	44	0.25 (0.08, 0.41)	0.07 (-0.14, 0.29)	.489		
Cognitive Class						339.19 (**< .001**)	0.783 (.378)
Global[*]	20	30	0.16 (0.03, 0.29)		**.019**		
Specific	12	78	0.25 (0.10, 0.39)	0.08 (-0.11, 0.28)	.378		
Cognitive Domain						256.59 (**< .001**)	1.53 (.120)
Global Cognitive Function[*]	20	30	0.16 (0.04, 0.28)		**.009**		
Executive Function – Cognitive Flexibility	4	4	0.29 (-0.07, 0.65)	0.13 (-0.24, 0.51)	.489		
Executive Function – Cognitive Inhibition	4	4	0.40 (0.06, 0.73)	0.24 (-0.10, 0.58)	.170		
Executive Function – Working Memory	5	8	0.36 (0.08, 0.64)	0.20 (-0.10, 0.50)	.181		
Composite IQ	2	2	0.36 (-0.16, 0.88)	0.21 (-0.32, 0.73)	.439		
Language	3	3	0.58 (-0.14, 1.30)	0.42 (-0.31, 1.15)	.252		
LTM – Lexical	2	2	0.09 (-0.44, 0.62)	-0.07 (-0.61, 0.47)	.791		

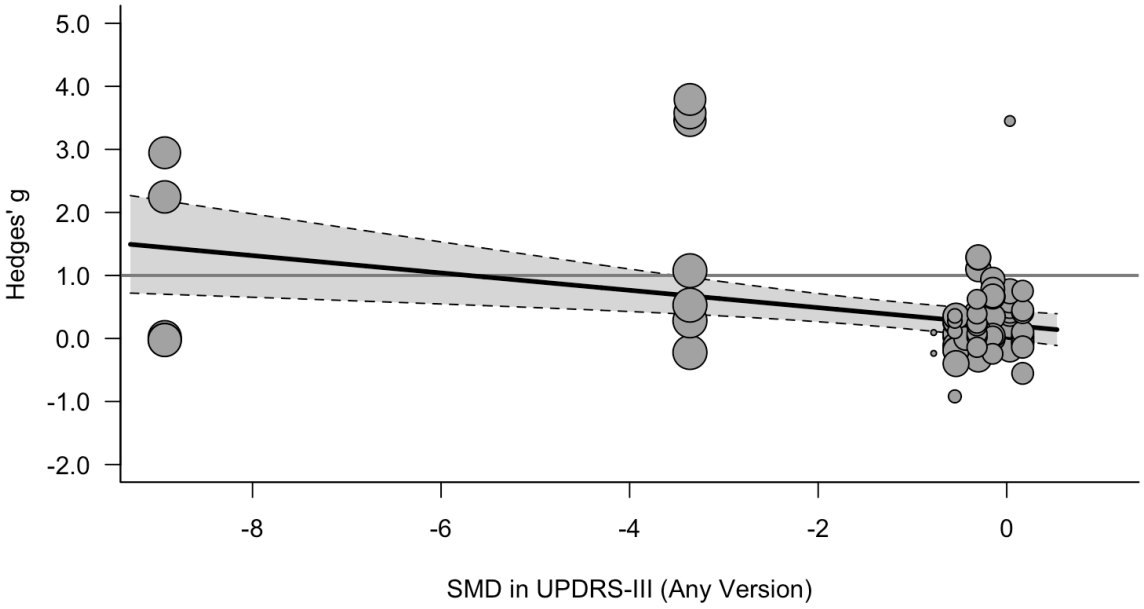
LTM – Semantic	2	2	0.86 (0.38, 1.33)	0.70 (0.21, 1.18)	**.005**		
LTM – Visuospatial	4	5	0.30 (-0.05, 0.65)	0.14 (-0.22, 0.50)	.441		
STM – Lexical	3	3	0.05 (-0.36, 0.47)	-0.11 (-0.53, 0.32)	.621		
STM – Numerical	2	2	-0.38 (-0.80, 0.05)	-0.53 (-0.97, -0.10)	**.018**		
STM – Visuospatial	4	7	0.04 (-0.26, 0.33)	-0.12 (-0.43, 0.19)	.434		
Processing Speed	7	14	0.25 (-0.02, 0.51)	0.09 (-0.20, 0.38)	.548		
Visuospatial Abilities – Construction	2	2	0.23 (-0.26, 0.72)	0.08 (-0.42, 0.57)	.764		
Visuospatial Abilities – Perception	2	2	0.48 (-0.05, 1.02)	0.32 (-0.22, 0.86)	.236		
Medication Status for Cognitive Assessment(s)						328.76 (**< .001**)	0.54 (.656)
De Novo[*]	4	17	0.25 (0.05, 0.46)		**.016**		
ON	5	37	0.26 (0.04, 0.47)	0.01 (-0.29, 0.30)	.965		
OFF	4	18	0.05 (-0.23, 0.34)	-0.20 (-0.55, 0.15)	.263		
ON or OFF	3	17	0.25 (-0.04, 0.53)	-0.00 (-0.36, 0.35)	.978		
Medication Status for Motor Assessment(s)						330.86 (**< .001**)	1.29 (.283)
De Novo[*]	4	17	0.25 (0.06, 0.45)		**.011**		
ON	4	27	0.30 (0.06, 0.53)	0.04 (-0.26, 0.35)	.789		
OFF	7	38	0.05 (-0.13, 0.23)	-0.20 (-0.47, 0.06)	.125		
ON or OFF	3	17	0.24 (-0.04, 0.52)	-0.01 (-0.35, 0.33)	.945		

Cognitive Impairment/Dementia as Exclusion Criterion						360.99 (**< .001**)	1.13 (.290)
No[*]	10	35	0.26 (0.12, 0.41)		**.001**		
Yes	10	73	0.15 (0.01, 0.29)	-0.11 (-0.31, 0.09)	.290		
Motor Subtypes Compared on Cognition in Paper						348.23 (**< .001**)	2.75 (.100)
No[*]	3	13	0.49 (0.13, 0.85)		**.009**		
Yes	19	95	0.17 (0.06, 0.28)	-0.312 (-0.69, 0.06)	.100		
Overall Risk of Bias						356.59 (**< .001**)	0.26 (.769)
High[*]	9	41	0.20 (0.02, 0.37)		**.026**		
Moderate	6	26	0.26 (0.08, 0.44)	0.06 (-0.18, 0.31)	.604		
Low	5	41	0.17 (-0.02, 0.36)	-0.03 (-0.29, 0.23)	.837		

Note. CI = confidence interval; IQ = intelligence quotient; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values > 0 indicate poorer cognitive performance among akinetic-rigid (AR) patients relative to tremor-dominant (TD) patients. Significant *p*-values (< .05) are highlighted in bold.

Figure S12

Relationship Between Standardised Mean Difference (SMD) in Unified Parkinson's Disease Rating Scale Part III (Any Version) and Effect Size for Cognitive Difference Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtype



Note. SMD = standardised mean difference (Hedges' *g*). UPDRS-III = Unified Parkinson's Disease Rating Scale. For Hedges' *g*, values > 0 indicate poorer cognitive performance among akinetic-rigid (AR) patients relative to tremor-dominant (TD) patients.

Table S29

Results of Confound Analyses for Tremor-Dominant (TD) and Akinetic-Rigid (AR) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	18	98	-0.04 (-0.19, 0.12)	.620	0.00
Difference in proportion of men	15	73	-0.35 (-1.09, 0.39)	.349	0.00
SMD years of education	15	85	0.32 (-0.02, 0.66)	.069	0.00
SMD disease duration	17	92	-0.19 (-0.46, 0.08)	.170	0.00
SMD LEDD	12	74	-0.12 (-0.30, 0.07)	.214	0.00
SMD UPDRS-III (original)	17	92	0.12 (-0.36, 0.60)	.621	0.00
SMD UPDRS-III (any version)	19	99	0.01 (-0.02, 0.05)	.518	0.00

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, positive values reflect a positive association between the confound (moderator) and effect size (i.e., larger values of the confound [moderator] are associated with larger effect sizes, reflecting better cognitive performance in the tremor-dominant [TD] group relative to the akinetic-rigid [AR] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). No confound (moderator) analyses performed for SMD in age at disease onset or SMD in Movement Disorder Society (MDS)-UPDRS Part III scores as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Results of Tremor-Dominant vs. Mixed Analyses

Demographics and Disease Characteristics

Our traditional meta-analyses comparing tremor-dominant (TD) and mixed (MX) motor subtype groups on demographics and disease characteristics revealed no significant differences (Table S30).

Table S30

Meta-Analyses Comparing Tremor-Dominant (TD) and Mixed (MX) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)
Age[*]					
All studies	5 (984)	-0.07 (-0.32, 0.19)	.512	0.0	3.52 (.476)
Gender (proportion of men)[*]					
All studies	5 (984)	0.95 (0.83, 1.08)	.299	0.0	1.34 (.854)
Years of education[*]					
All studies	3 (261)	-0.18 (-1.03, 0.68)	.469	33.4	3.00 (.223)
Disease duration[*]					
All studies	5 (984)	-0.19 (-0.62, 0.24)	.282	57.1	9.33 (.053)
Age at onset[*]					
All studies	4 (949)	0.12 (-0.06, 0.30)	.119	0.0	0.90 (.824)
UPDRS-III total score (original version)[*]					
All studies	5 (984)	-0.46 (-1.25, 0.33)	.183	73.0	14.82 (**.005**)

Note. CI = confidence interval; *k* = number of studies/effect sizes; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the mixed group relative to tremor-dominant group; for risk ratio, values > 1 indicate that

tremor-dominant patients have a greater risk of being men relative to mixed patients. I^2 is for between-study variance. Egger's test not conducted as $k < 10$ for all analyses. *Results for model with outliers removed not reported as no outliers detected. No meta-analyses performed for LEDD as $k < 3$ studies. No meta-analyses performed for MDS-UPDRS-III total score or UPDRS-III total score (any version) as no studies reported MDS-UPDRS-III data. Significant *p*-values (< .05) are highlighted in bold.

Cognition

Main Analyses. Our multi-level meta-analysis of 17 effect sizes from 5 studies produced a non-significant, negligible pooled effect size estimate, indicating no difference in cognitive performance between TD and MX motor subtype groups (Table S31). Removal of outliers (using both methods) resulted in a slight increase in the pooled effect size estimate, but it remained non-significant and of negligible magnitude. Inspection of sunset (power-enhanced) funnel plots (Figure S13) indicated that all included studies were highly underpowered (median power = 5.5% for full model) to detect an effect. No dose-effect, moderator, or confound analyses were performed due to an insufficient number of studies ($n < 10$). With respect to cognitive status, one study (Zhang et al., 2016) compared rates of MCI among TD and MX patients; this study found comparable rates of MCI among both subtype groups, with a slightly higher rate observed in the MX group (60.00%) relative to the TD group (50.00%).

Table S31

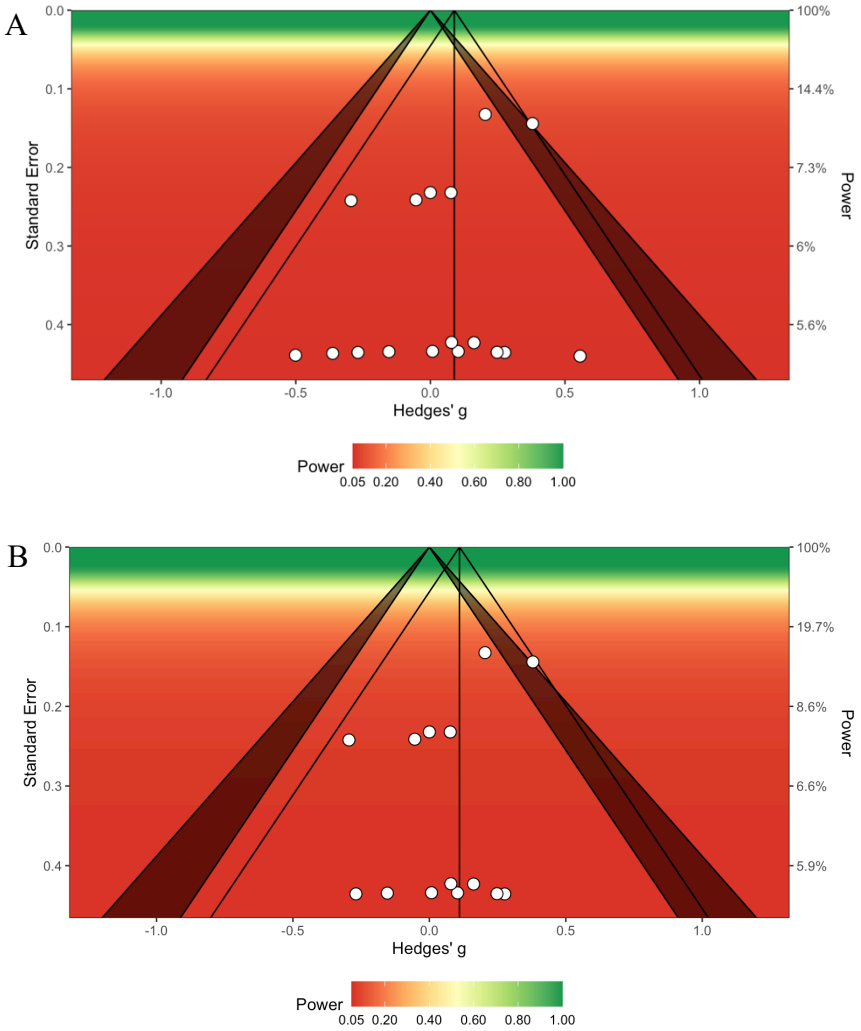
Results of Multi-Level Meta-Analyses of Cognitive Performance in Tremor-Dominant (TD) and Mixed (MX) Motor Subtype Groups

Subtype Pair	Model	*n* (*k*)	Pooled Hedges' *g* (95% CI)	*p*	Within-Study I^2 (%) (*p*)	Between-Study I^2 (%) (*p*)	*Q* (*p*)	Multi-level Egger's test (*p*)
TD vs. MX	All studies	5 (17)	0.09 (-0.14, 0.31)	.419	1.29 (.500)	18.05 (.204)	13.71 (.620)	.366
	With outliers removed – residuals approach	5 (14)	0.11 (-0.09, 0.31)	.267	4.64 (.500)	10.13 (.329)	8.37 (.819)	.451
	With outliers removed – Cook's distance approach†	5 (15)	0.10 (-0.09, 0.29)	.277	3.59 (.500)	6.24 (.500)	8.37 (.869)	-

Note. CI = confidence interval; *k* = number of effect sizes; MX = mixed; *n* = number of unique studies; TD = tremor-dominant. For Hedges' *g*, values > 0 indicate poorer cognitive performance among mixed (MX) patients relative to tremor-dominant (TD) patients. † Multi-level Egger's test not reported as model failed to reach convergence. Significant *p*-values (< .05) are highlighted in bold.

Figure S13

Sunset (Power-Enhanced) Funnel Plots for Difference in Cognitive Performance Between Tremor-Dominant (TD) and Mixed (MX) Motor Subtype Groups



Note. A: Full model (no outliers removed). B. Model with outliers removed (residuals approach). For Hedges' *g*, values > 0 indicate poorer cognitive performance among mixed (MX) patients relative to tremor-dominant (TD) patients.

Results of Akinetic-Rigid vs. Mixed Analyses

Demographics and Disease Characteristics

Results of our traditional meta-analyses comparing akinetic-rigid (AR) and mixed (MX) motor subtype groups on demographics and disease characteristics are reported in Table S32. With the exception of age and age at time of disease onset, all meta-analyses were non-significant. The pooled effect sizes for both age and age at time of disease onset were of negligible magnitude but reflected older age (at time of disease onset and at time of study participation) among AR patients relative to MX patients.

Table S32

Meta-Analyses Comparing Akinetic-Rigid (AR) and Mixed (MX) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)
Age*					
All studies	5 (2093)	0.13 (0.06, 0.21)	**.009**	0.0	1.33 (.856)
Gender (proportion of men)*					
All studies	5 (2093)	0.87 (0.57, 1.30)	.381	54.6	8.81 (.066)
Years of education*					
All studies	3 (307)	-0.18 (-1.19, 0.83)	.524	46.9	3.77 (.152)
Disease duration*					
All studies	5 (2093)	0.02 (-0.07, 0.12)	.542	0.0	2.18 (.702)
Age at onset*					
All studies	4 (2052)	0.10 (0.05, 0.15)	**.009**	0.0	0.33 (.954)
UPDRS-III total score (original version)*					
All studies	5 (2093)	-0.07 (-0.60, 0.46)	.734	67.0	12.12 (**.017**)

Note. CI = confidence interval; *k* = number of studies/effect sizes; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the mixed group relative to the akinetic-rigid group; for risk ratio, values > 1 indicate that akinetic-rigid patients have a greater risk of being men relative to mixed patients. I^2 is for between-study variance. Egger's test not conducted as $k < 10$ for all analyses. *Results for model with outliers removed not reported as no outliers detected. No meta-analyses performed for LEDD as $k < 3$ studies. No meta-analyses performed for MDS-UPDRS-III total score or UPDRS-III total score (any version) as no studies reported MDS-UPDRS-III data. Significant *p*-values (< .05) are highlighted in bold.

Cognition

Main Analyses. Our multi-level meta-analysis of 17 effect sizes from 5 studies produced a non-significant, negligible pooled effect size estimate, suggesting no difference in cognitive performance between AR and MX motor subtype groups (Table S33). Removal of outliers identified using residuals resulted in a slight decrease in the (absolute) magnitude of the pooled effect. Of note, whilst the pooled effect size estimate remained of negligible magnitude following removal of outliers identified using Cook's distance, the estimate for this model was in the opposite direction to our other models. Inspection of sunset (power-enhanced) funnel plots (Figure S14) indicated that all included studies were highly underpowered (median power = 5.1% for full model) to detect an effect. No dose-effect, moderator, or confound analyses were performed due to an insufficient number of studies ($n < 10$). With regards to cognitive status, only one study (Zhang et al., 2016) examined rates of MCI between AR and MX subtype groups and reported a negligible difference in MCI prevalence between AR (57.44%) and MX (60.00%) patients.

Table S33

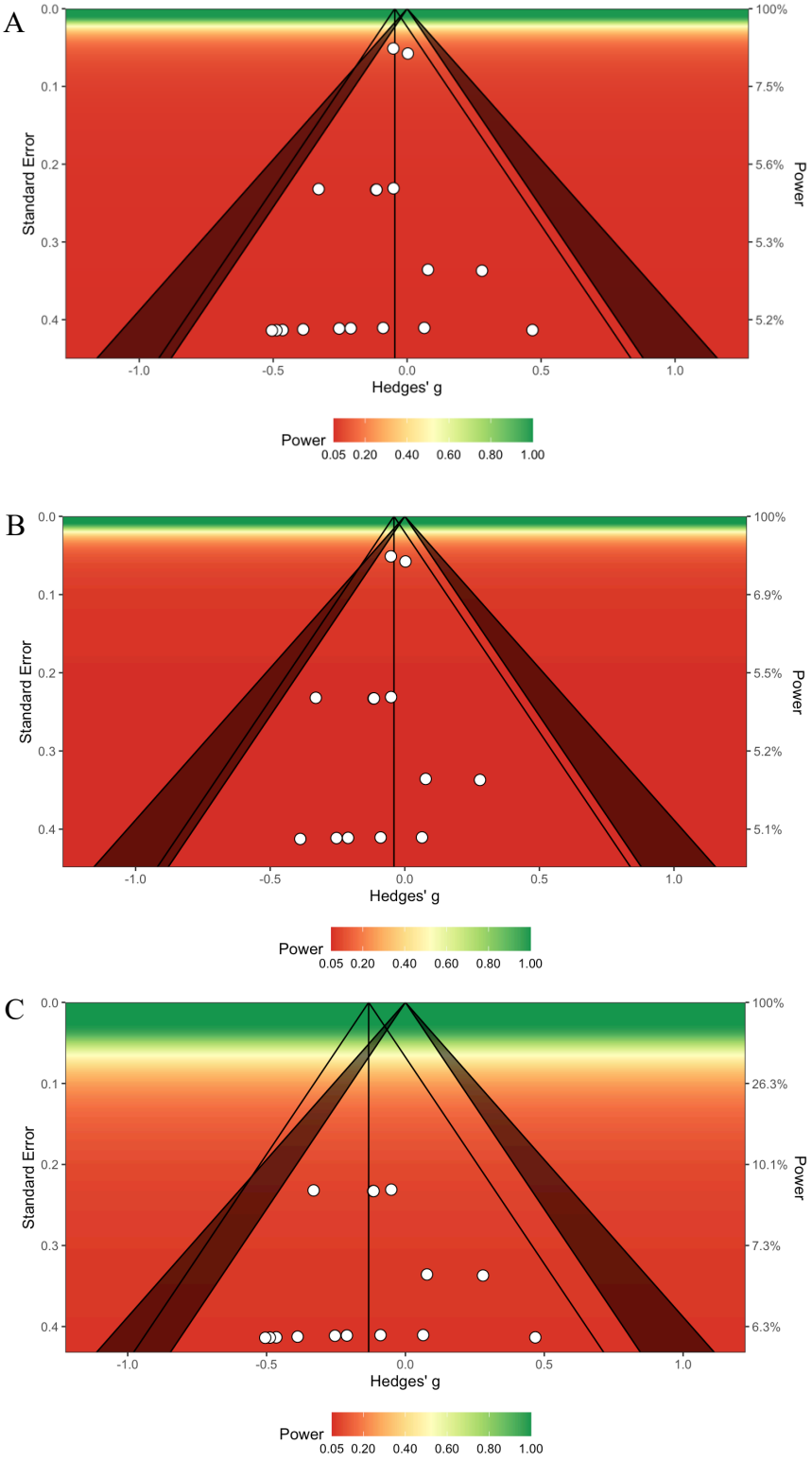
Results of Multi-Level Meta-Analyses of Cognitive Performance in Akinetic-Rigid (AR) and Mixed (MX) Motor Subtype Groups

Subtype Pair	Model	*n* (*k*)	Pooled Hedges' *g* (95% CI)	*p*	Within-Study I^2 (%) (*p*)	Between-Study I^2 (%) (*p*)	*Q* (*p*)	Multi-level Egger's test (*p*)
AR vs. MX	All studies	5 (17)	-0.04 (-0.13, 0.05)	.330	5.09 (.500)	4.63 (.500)	10.74 (.825)	.582
	With outliers removed – residuals approach	5 (13)	-0.04 (-0.13, 0.05)	.351	1.11 (.500)	6.49 (.500)	4.75 (.966)	.662
	With outliers removed – Cook's distance approach	4 (15)	0.11 (-0.34, 0.12)	.323	4.11 (.500)	5.55 (.500)	9.55 (.794)	.856

Note. AR = akinetic-rigid; CI = confidence interval; *k* = number of effect sizes; MX = mixed; *n* = number of unique studies. For Hedges' *g*, values < 0 indicate poorer cognitive performance among akinetic-rigid (AR) patients relative to mixed (MX) patients. Significant *p*-values (< .05) are highlighted in bold.

Figure S14

Sunset (Power-Enhanced) Funnel Plots for Difference in Cognitive Performance Between Akinetic-Rigid (AR) and Mixed (MX) Motor Subtype Groups



Note. A: Full model (no outliers removed). B. Model with outliers removed (residuals approach). C. Model with outliers removed (Cook's distance approach). For Hedges' *g*, values < 0 indicate poorer cognitive performance among akinetic-rigid (AR) patients relative to mixed (MX) patients.

Results of Tremor vs. Bradykinesia Analyses

Five studies compared the cognitive performance of a tremor (TR) motor subtype to that of a bradykinesia (BR) motor subtype. In three studies (Dewey et al., 2012; Erro et al., 2013; Katzen et al., 2006), patients were subtyped according to whether their *initial* motor symptom was tremor or bradykinesia, as determined via medical records alone or patient-report verified by chart review. In another study (Vakil & Herishanu-Naaman, 1998), patients were classified by a senior neurologist according to whether tremor or bradykinesia was their most predominant motor symptom at the time of study participation. Only one study (Huber et al., 1991) used a more rigorous approach, wherein UPDRS scores (original version; Fahn et al., 1987) were used to classify patients as either tremor-predominant (≥2 on rest tremor and ≤1 on rigidity and bradykinesia items) or rigid/bradykinetic (≥2 on rigidity and bradykinesia items and ≤1 on rest tremor).

None of our traditional meta-analyses comparing TR and BR subtypes on demographics and disease characteristics reached statistical significance (Table S34). Wide 95% confidence intervals were observed around all pooled effect sizes, indicating a high level of imprecision in these estimates, likely due to the low number of included studies ($k = 4$) and small pooled sample size ($o = 260$). With respect to cognitive function, all five studies reported data from continuous cognitive measures; none reported cognitive status data. All of our multi-level meta-analyses (both with and without outliers removed) comparing cognitive function between the TR and BR subtypes produced negligible, non-significant pooled effect size estimates with wide confidence intervals (Table S35). Multi-level Egger's tests indicated presence of publication bias in all three models. Inspection of sunset (power-enhanced) funnel plots (Supplementary Material 2, Figure S15) revealed that all included studies were highly underpowered (median power = 9.6% for full model) to detect an effect. No dose-effect, moderator, or confound analyses were performed due to an insufficient number of studies ($n < 10$).

Table S34

Meta-Analyses Comparing Tremor (TR) and Bradykinesia (BR) Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)
Age[*]					
All studies	4 (260)	0.24 (-0.41, 0.89)	.320	49.9	5.99 (.112)
Gender (proportion of men)[*]					
All studies	4 (260)	1.00 (0.82, 1.21)	.956	0.0	1.02 (.798)
Years of education[*]					
All studies	4 (260)	0.07 (-0.31, 0.45)	.611	0.0	2.39 (.495)
Disease duration[*]					
All studies	4 (260)	-0.01 (-0.59, 0.56)	.952	41.0	5.08 (.166)

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, negative pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the bradykinesia (BR) group relative to the tremor (TR) group; for risk ratio, values > 1 indicate that tremor (TR) patients have a greater risk of being men relative to bradykinesia (BR) patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. [*] Results for model with outliers removed are not reported as no outliers were detected. Significant *p*-values (< .05) are highlighted in bold.

Table S35

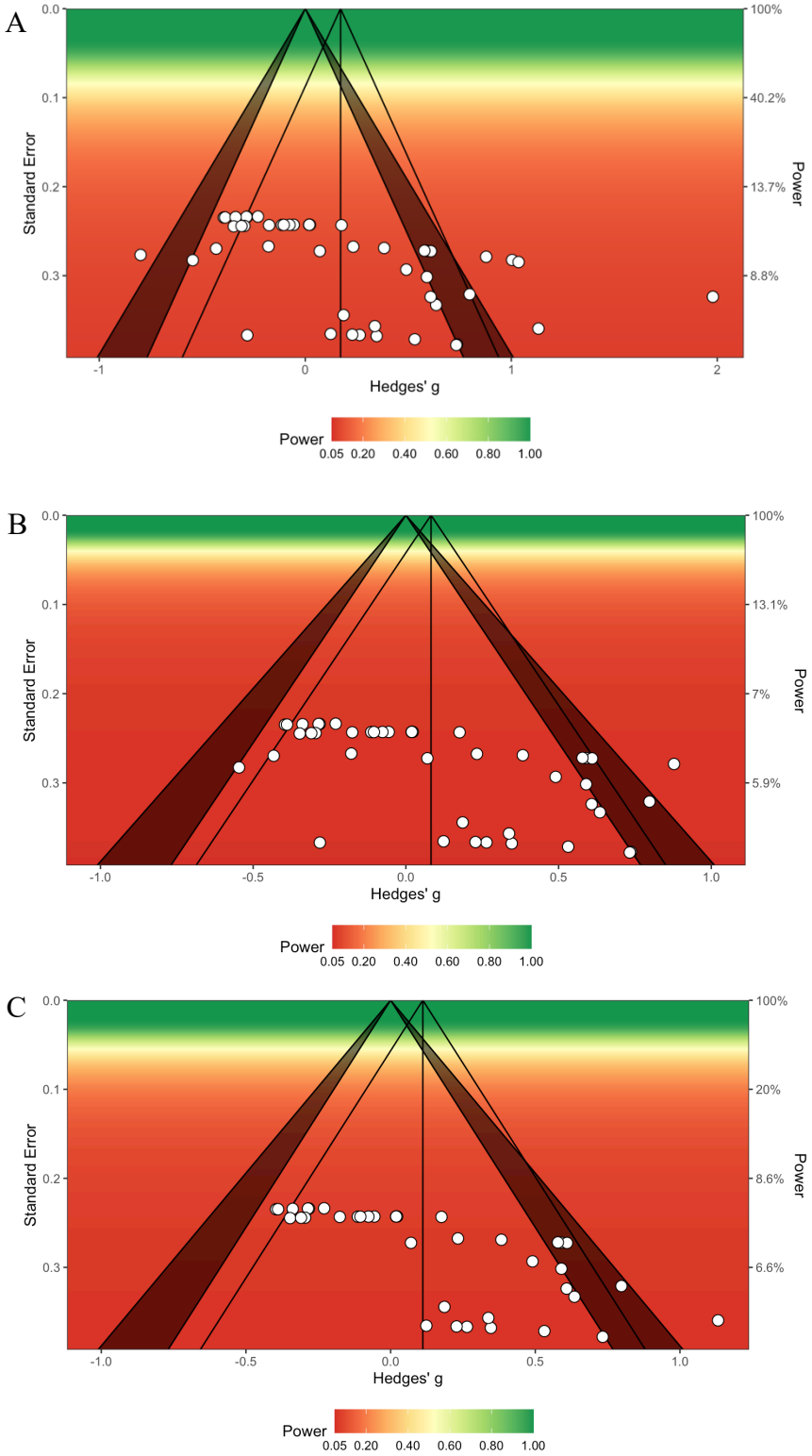
Results of Multi-Level Meta-Analyses of Cognitive Performance in Tremor (TR) and Bradykinesia (BR) Motor Subtype Groups

Subtype Pair	Model	*n* (*k*)	Pooled Hedges' *g* (95% CI)	*p*	Within-Study I^2 (%) (*p*)	Between-Study I^2 (%) (*p*)	*Q* (*p*)	Multi-level Egger's test (*p*)
TR vs. BR	All studies	5 (49)	0.13 (-0.18, 0.44)	.395	47.02 (**< .001**)	25.60 (.052)	156.86 (**< .001**)	**.001**
	With outliers removed – residuals approach	5 (44)	0.08 (-0.19, 0.34)	.575	19.41 (**.019**)	33.80 (**.048**)	74.97 (**.002**)	**.003**
	With outliers removed – Cook's distance approach	5 (39)	0.15 (-0.19, 0.48)	.380	5.65 (.500)	58.41 (**.002**)	40.12 (.377)	**.018**

Note. BR = bradykinesia; CI = confidence interval; *k* = number of effect sizes; *n* = number of unique studies; TR = tremor. For Hedges' *g*, values > 0 indicate poorer cognitive performance among bradykinesia (BR) patients relative to tremor (TR) patients. Significant *p*-values (< .05) are highlighted in bold.

Figure S15

Sunset (Power-Enhanced) Funnel Plots for Difference in Cognitive Performance Between Tremor (TR) and Bradykinesia (BR) Motor Subtype Groups



Note. A: Full model (no outliers removed). B. Model with outliers removed (residuals approach). C. Model with outliers removed (Cook's distance approach). For Hedges' *g*, values > 0 indicate better cognitive performance among tremor (TR) patients relative to bradykinesia (BR) patients.

Results of Bradykinesia vs. No-Bradykinesia Synthesis

One study (Tomer et al., 2002) compared the cognitive performance of PD patients with and without bradykinesia on a single task, the Wisconsin Card Sorting Test (WCST). The authors reported that patients were classified into bradykinesia and no-bradykinesia motor subtype groups according to UPDRS scores (original version; Fahn et al., 1987), but they did not specify the specific item(s) used. In general, no-bradykinesia patients performed better than bradykinesia patients on the WCST. Compared to patients with bradykinesia, patients without bradykinesia achieved more categories (g = 0.53) and made fewer total errors on the task (g = 0.44), but no difference was observed on set loss (g = 0.05). Of note, a large effect size was reported for number of perseverative errors (g = 0.82), indicating that bradykinetic patients may experience particularly marked problems with cognitive perseveration.

Results of Tremor vs. No-Tremor Synthesis

Two studies (Poletti et al., 2012; Rana et al., 2012) formed motor subtype groups based on the presence (TR-Y) or absence (TR-N) of tremor. In Poletti et al. (2012), the presence of tremor was determined using items 20 and 21 of the UPDRS-III, administered at the time of study participation, while Rana et al. (2012) based their subtype classification on retrospective chart analysis of each patient's medical records. Demographics and disease characteristics were only available for one study (Poletti et al., 2012); these data indicated negligible-to-small subtype differences between TR-Y and TR-N groups. Of note, consistent with our analyses of other subtype pairs including a tremor-based subtype group, a small effect size was found, indicating greater overall motor impairment (as assessed by UPDRS-III total score) in the TR-N group relative to the TR-Y group ($g = 0.261$).

With respect to cognitive function, Poletti et al. (2012) administered a comprehensive cognitive assessment battery comprising 15 tasks, reporting the results from these individual tasks as well as MCI rates based on task performance (defined as scores on at least two tasks falling below 1.5 standard deviations of the mean). Rana et al. (2012) reported dementia rates in both subtype groups, as diagnosed by a neurologist according to Diagnostic and Statistical Manual of Mental Disorders criteria (DSM-IV; American Psychiatric Association, 1994). Among Poletti and colleagues' (2012) tasks, two global (Mini-Mental State Examination [MMSE], Frontal Assessment Battery [FAB]) and 13 domain-specific (e.g., digit span, phonemic fluency) tasks were administered. Effect sizes for the global measures ranged from $g = 0.14$ (MMSE) to $g = 0.22$ (FAB), with TR-Y patients outperforming TR-N patients on both tasks. Consistent with this, both studies' cognitive status data indicated greater cognitive impairment among TR-N patients relative to TR-Y patients; compared to TR-N patients, TR-Y patients had 70.0% relative reduced risk of MCI (Poletti et al., 2012) and 57.2% relative reduced risk of dementia (Rana et al., 2012).

Notably, effect sizes for the domain-specific tasks indicated that whilst TR-Y patients outperformed TR-N patients on most measures (largest $g = 0.58$, digit span), this advantage did not extend to all domains. Relative to TR-Y patients, TR-N patients demonstrated superior semantic long-term memory/learning ($g = -0.28$), and no significant subtype differences were observed for executive function measures of cognitive inhibition and working memory (all absolute $g < 0.10$). Moreover, no consistent advantage emerged across measures of language; although TR-Y patients performed better on the Boston Naming Test – Short Form ($g = 0.31$), no difference between subtypes was found on a task of phonemic

fluency (g = 0.06). Across all other cognitive domains assessed, however, the TR-Y subtype did outperform the TR-N subtype, showing superior performance on measures of cognitive flexibility (g range = 0.20 – 0.27), processing speed (g = 0.38), and both short- and long-term memory (g range = 0.40 – 0.58). Of note, there was consistent evidence for TR-Y patients having superior visuospatial abilities (reasoning, construction, and perception; g range = 0.20 – 0.30) relative to TR-N patients, which extended to measures of short- and long-term memory in the visuospatial modality (g range = 0.42 – 0.45).

Results of With Facial Tremor vs. Without Facial Tremor Synthesis

One study (Ou et al., 2021) subtyped participants according to the presence (n = 403) or absence (n = 1821) of facial tremor, as determined by clinical judgement using UPDRS-III item 20A (tremor at rest: face, lips, and chin). In this study, participants with facial tremor were significantly older at time of study participation (g = 0.39) and at time of disease onset (g = 0.23); had a longer disease duration (g = 0.42); were less educated (g = 0.15); and were less likely to be men (RR = 0.77) than participants without facial tremor. Participants with facial tremor also had greater overall motor symptom severity (g = 0.29), as indicated by significantly higher UPDRS-III total scores (excluding item 20A). Both of the global cognitive measures administered to participants (MoCA, FAB) indicated a small effect size (g = 0.23 and g = 0.18, respectively) favouring better cognition among patients without facial tremor relative to those with facial tremor.

Results of Freezing of Gait vs. Non-Freezing of Gait Analyses

Table S36

Meta-Analyses Comparing Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtypes on Demographics and Disease Characteristics

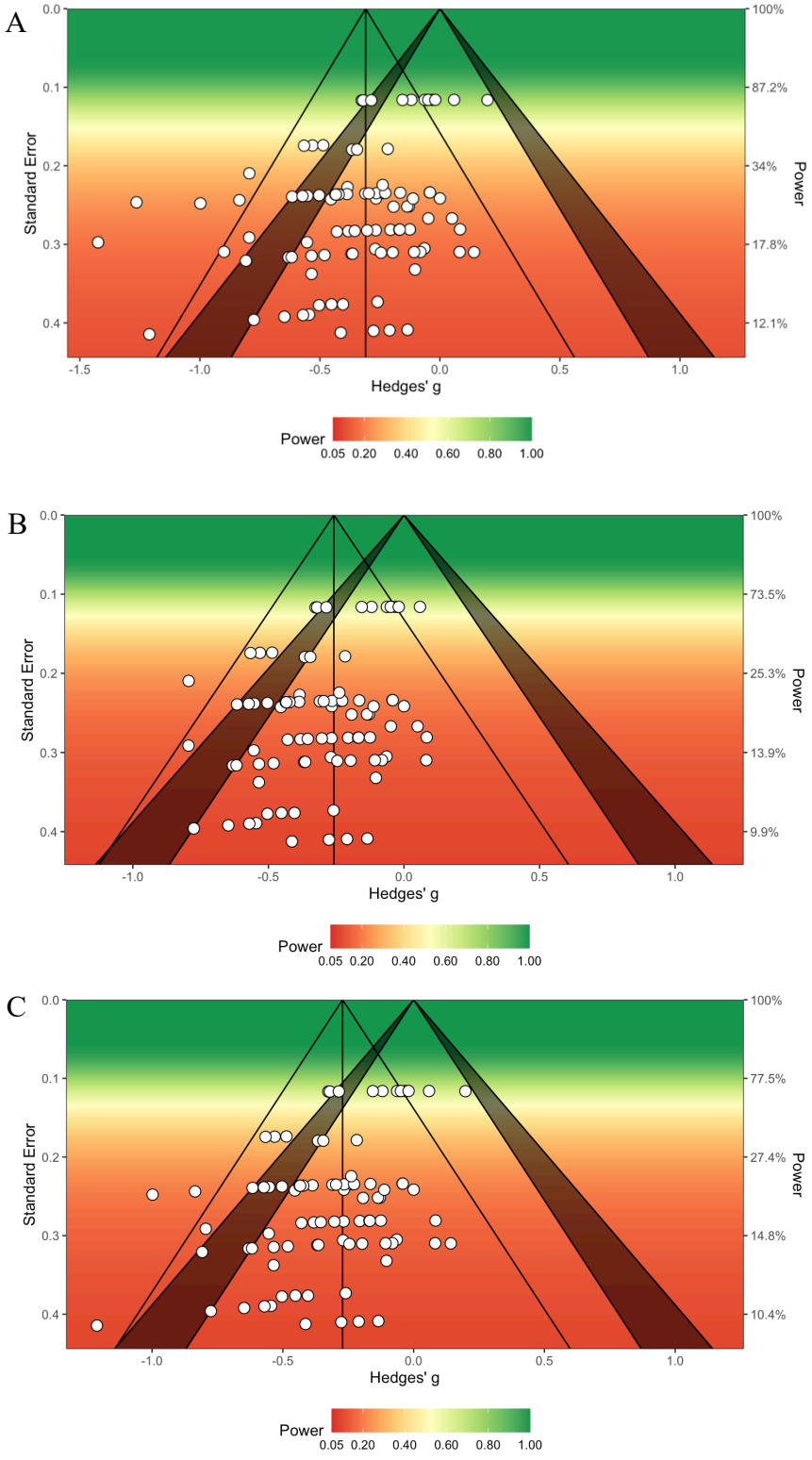
Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)	Egger's test (*p*)
Age[*]						
All studies	19 (1632)	0.14 (0.03, 0.25)	**.015**	0.0	17.54 (.486)	.633
Gender (proportion of men)[*]						
All studies	17 (1574)	1.12 (1.07, 1.19)	**< .001**	0.0	6.51 (.982)	.103
Years of education[*]						
All studies	9 (837)	-0.14 (-0.31, 0.03)	.087	0.0	7.83 (.451)	-
Disease duration						
All studies	20 (1706)	0.52 (0.37, 0.68)	**< .001**	38.8	31.06 (**.040**)	.295
With outliers removed	19 (1631)	0.50 (0.36, 0.64)	**< .001**	28.0	24.99 (.125)	.116
Age at onset[*]						
All studies	3 (456)	-0.18 (-0.50, 0.13)	.129	0.0	1.19 (.553)	-
LEDD						
All studies	15 (1442)	0.46 (0.24, 0.68)	**< .001**	57.8	33.18 (**.003**)	.603
With outliers removed	14 (1367)	0.41 (0.23, 0.58)	**< .001**	41.0	22.03 (.055)	.177
UPDRS-III total score (original version)[*]						
All studies	10 (979)	0.59 (0.36, 0.83)	**< .001**	50.8	18.28 (**.032**)	.481
MDS-UPDRS-III total score[*]						
All studies	10	0.73	**< .001**	46.8	16.91	.285

	(727)	(0.46, 1.00)			(.050)	
UPDRS-III total score (any version)*						
All studies	20	0.66	**< .001**	50.4	38.27	.499
	(1706)	(0.49, 0.82)			(**.006**)	

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, positive pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the freezing of gait (FOG) group relative to the non-freezing of gait (nFOG) group; for risk ratio, values > 1 indicate that freezing of gait (FOG) patients have a greater risk of being men relative to non-freezing of gait (nFOG) patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. *Results for model with outliers removed not reported as no outliers detected. Significant *p*-values (< .05) are highlighted in bold.

Figure S16

Sunset (Power-Enhanced) Funnel Plots for Difference in Cognitive Performance Between Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups



Note. A: Full model (no outliers removed). B. Model with outliers removed (residuals approach). C. Model with outliers removed (Cook's distance approach). For Hedges' *g*, values < 0 indicate poorer cognitive performance among freezing of gait (FOG) patients relative to non-freezing of gait (nFOG) patients.

Table S37

Results of Continuous Moderator Analyses for Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups (No Outliers Removed)

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	20	93	0.00 (-0.00, 0.00)	.131	8.10
Publication year	20	93	0.01 (-0.02, 0.04)	.404	-1.34
Pooled mean age	19	75	0.01 (-0.03, 0.05)	.628	-1.94
Pooled proportion of men	17	67	0.06 (-1.04, 1.16)	.908	-2.01
Pooled mean years of education	10	51	0.08 (-0.04, 0.20)	.175	4.89
Pooled mean disease duration	20	93	0.01 (-0.04, 0.06)	.669	0.08
Pooled mean age at onset	20	93	0.00 (-0.03, 0.03)	.806	-2.58
Pooled mean LEDD	15	79	0.00 (-0.00, 0.00)	.470	-0.47
Pooled mean UPDRS-III (original)	10	48	-0.01 (-0.03, 0.00)	.827	8.87
Pooled mean MDS-UPDRS-III	10	45	-0.01 (-0.03, 0.01)	.330	0.00

Note. CI = confidence interval; *k* = number of effect sizes; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; *β* = regression coefficient. For *β*, positive values reflect a negative association between the moderator and effect size (i.e., larger values of the moderator are associated with effect sizes approaching zero, reflecting a smaller difference in cognitive performance between the freezing of gait [FOG] group and the non-freezing of gait [nFOG] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). Significant *p*-values (< .05) are highlighted in bold.

Table S38

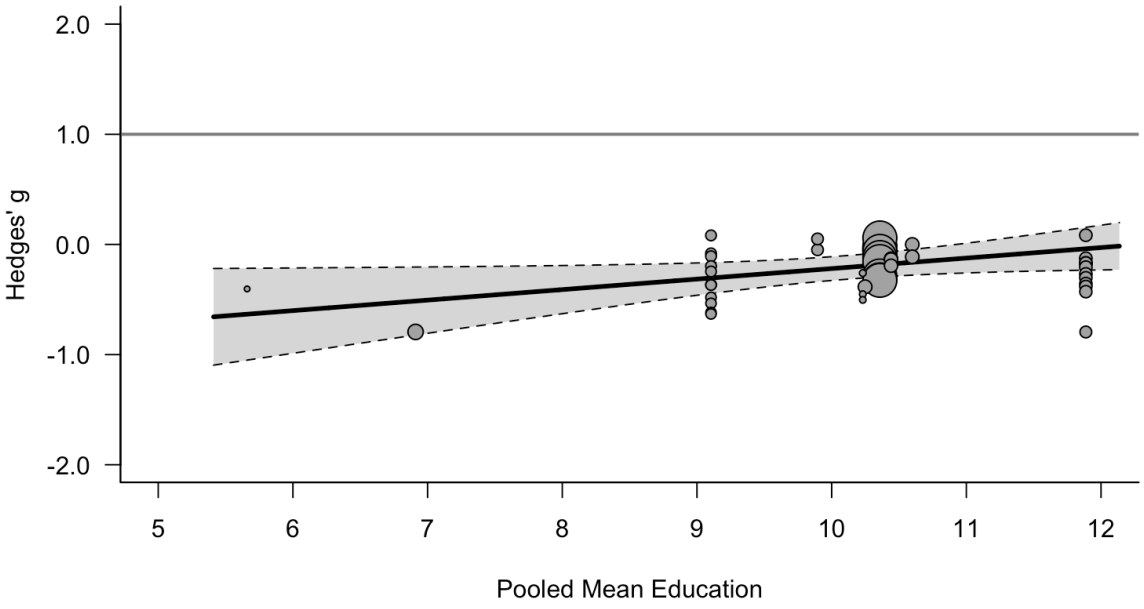
Results of Continuous Moderator Analyses for Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Moderator	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
Sample size	20	84	0.00 (-0.00, 0.00)	.474	0.85
Publication year	20	84	0.01 (-0.01, 0.04)	.335	-1.37
Pooled mean age	19	68	-0.01 (-0.05, 0.03)	.627	-1.00
Pooled proportion of men	17	61	0.45 (-0.50, 1.40)	.351	3.35
Pooled mean years of education	10	46	0.10 (0.00, 0.19)	**.040**	17.52
Pooled mean disease duration	20	84	0.01 (-0.03, 0.05)	.637	0.69
Pooled mean age at onset	20	84	-0.01 (-0.03, 0.02)	.594	0.37
Pooled mean LEDD	15	71	0.00 (-0.00, 0.00)	.608	-0.88
Pooled mean UPDRS-III (original)	10	41	-0.01 (-0.02, 0.01)	.415	-0.64
Pooled mean MDS-UPDRS-III*	10	43	-0.01 (-0.03, 0.01)	.404	0.00

Note. CI = confidence interval; *k* = number of effect sizes; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; *β* = regression coefficient. For *β*, positive values reflect a negative association between the moderator and effect size (i.e., larger values of the moderator are associated with effect sizes approaching zero, reflecting a smaller difference in cognitive performance between the freezing of gait [FOG] group and the non-freezing of gait [nFOG] group). Change in I^2 is the difference in between-study I^2 for the model with and without the moderator (larger positive values correspond to greater between-study variance being accounted for by the moderator; negative values suggest that model fit worsened as a consequence of including the moderator). Significant *p*-values (< .05) are highlighted in bold.

Figure S17

Relationship Between Pooled Mean Years of Education and Effect Size for Cognitive Difference Between Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups



Note. For Hedges' *g*, values < 0 indicate better cognitive performance among non-freezing of gait (nFOG) patients relative to freezing of gait (FOG) patients.

Table S39

Results of Categorical Moderator Analyses for Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups (No Outliers Removed)

Moderator	***n***	***k***	**Pooled Hedges' *g* (95% CI)**	**β (95% CI)**	***p***	***Q* (*p*)**	**ToM (*p*)**
Cognitive Class						138.37 (**.001**)	7.56 (**.007**)
Global[*]	19	34	-0.42 (-0.54, -0.30)		**< .001**		
Specific	9	59	-0.24 (-0.35, -0.12)	0.18 (0.05, 0.31)	**.007**		
Cognitive Domain						113.42 (**.001**)	1.16 (.325)
Global Cognitive Function[*]	19	34	-0.43 (-0.55, -0.30)		**< .001**		
Executive Function – Cognitive Flexibility	4	6	-0.28 (-0.46, -0.10)	0.14 (-0.05, 0.34)	.144		
Executive Function – Cognitive Inhibition	3	3	-0.46 (-0.73, -0.19)	-0.03 (-0.29, 0.23)	.802		
Executive Function – Working Memory	5	8	-0.26 (-0.45, -0.06)	0.17 (-0.03, 0.37)	.087		
Higher-Order Fluid Abilities – Planning	2	2	-0.37 (-0.77, 0.03)	0.06 (-0.35, 0.46)	.784		
Language	3	4	-0.31 (-0.57, -0.05)	0.12 (-0.13, 0.37)	.346		
LTM/Learning – Lexical	3	3	-0.12 (-0.43, 0.20)	0.31 (-0.02, 0.63)	.061		
LTM/Learning – Semantic	3	3	-0.26 (-0.51, -0.00)	0.17 (-0.08, 0.42)	.177		

LTM/Learning – Visuospatial	3	3	-0.14 (-0.45, 0.16)	0.28 (-0.01, 0.58)	.058		
STM – Lexical	3	3	-0.01 (-0.32, 0.30)	0.41 (0.10, 0.74)	**.013**		
STM – Numerical	2	2	-0.27 (-0.64, 0.11)	0.16 (-0.22, 0.54)	.402		
STM – Visuospatial	3	4	-0.19 (-0.50, 0.13)	0.24 (-0.09, 0.56)	.149		
Processing Speed	4	7	-0.34 (-0.52, -0.16)	0.09 (-0.11, 0.28)	.384		
Visuospatial Abilities – Perception	2	2	-0.12 (-0.49, 0.25)	0.30 (-0.07, 0.68)	.111		
Visuospatial Abilities – Reasoning	2	3	-0.17 (-1.08, 0.74)	0.26 (-0.64, 1.16)	.566		
Medication Status for Cognitive Assessment(s)						105.96 (**.002**)	0.43 (.515)
*ON or OFF**	2	5	-0.47 (-0.71, -0.24)		**< .001**		
ON	13	65	-0.38 (-0.54, -0.23)	0.09 (-0.19, 0.38)	.515		
Medication Status for Motor Assessment(s)						106.76 (**.008**)	0.61 (.546)
ON or OFF [*]	2	5	-0.48 (-0.71, -0.24)				
ON	10	42	-0.32 (-0.48, -0.16)	0.16 (-0.13, 0.44)	**< .001**		
OFF	6	30	-0.40 (-0.62, -0.17)	0.08 (-0.25, 0.41)	.626		

Cognitive Impairment/Dementia as Exclusion Criterion						149.48 (**< .001**)	0.12 (.731)
No[*]	7	24	-0.39 (-0.61, -0.17)		**.001**		
Yes	13	69	-0.35 (-0.46, -0.23)	0.04 (-0.20, 0.29)	.731		
Overall Risk of Bias						140.93 (**< .001**)	1.54 (.220)
High[*]	11	27	-0.45 (-0.61, -0.30)		**< .001**		
Moderate	6	33	-0.35 (-0.53, -0.16)	0.10 (-0.14, 0.34)	.394		
Low	3	33	-0.23 (-0.43, -0.04)	0.22 (0.03, 0.47)	.084		

Note. CI = confidence interval; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. For Hedges' *g*, values < 0 reflect indicate poorer cognitive performance among freezing of gait (FOG) patients relative to non-freezing of gait (FOG) patients. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values < 0 indicate poorer cognitive performance among freezing of gait (FOG) patients relative to non-freezing of gait (FOG) patients. No moderator analyses performed for subtyping method as all effect sizes belonged to the same moderator level ('Other'). No moderator analyses performed for motor subtypes compared on cognition in paper as only *k* = 1 for 'No' level of moderator. Significant *p*-values (< .05) are highlighted in bold.

Table S40

Results of Categorical Moderator Analyses for Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Moderator	***n***	***k***	**Pooled Hedges' *g* (95% CI)**	**β (95% CI)**	***p***	***Q* (*p*)**	**ToM (*p*)**
Cognitive Class						68.73 (.852)	3.46 (.066)
Global[*]	19	30	-0.34 (-0.44, -0.23)		**< .001**		
Specific	9	54	-0.24 (-0.34, -0.13)	0.10 (-0.01, 0.21)	.066		
Cognitive Domain						53.96 (.784)	1.01 (.453)
Global Cognitive Function[*]	19	30	-0.34 (-0.45, -0.24)		**< .001**		
Executive Function – Cognitive Flexibility	4	6	-0.29 (-0.44, -0.14)	0.05 (-0.10, 0.20)	.494		
Executive Function – Cognitive Inhibition	3	3	-0.47 (-0.77, -0.17)	-0.13 (-0.40, 0.15)	.358		
Executive Function – Working Memory	5	8	-0.27 (-0.47, -0.08)	0.07 (-0.11, 0.25)	.437		
Higher-Order Fluid Abilities – Planning	2	2	-0.39 (-0.76, -0.03)	-0.05 (-0.42, 0.32)	.794		
Language	3	3	-0.28 (-0.52, -0.03)	0.07 (-0.16, 0.29)	.548		
LTM/Learning – Lexical	2	2	-0.06 (-0.49, 0.37)	0.29 (-0.13, 0.70)	.170		
LTM/Learning – Semantic	3	3	-0.26 (-0.47, -0.04)	0.08 (-0.12, 0.29)	.410		

LTM/Learning – Visuospatial	2	2	-0.23 (-0.68, 0.22)	0.11 (-0.34, 0.57)	.621		
STM – Lexical	3	3	0.06 (-0.28, 0.40)	0.40 (0.07, 0.73)	**.018**		
STM – Numerical	2	2	-0.19 (-0.65, 0.26)	0.15 (-0.29, 0.59)	.497		
STM – Visuospatial	3	4	-0.17 (-0.48, 0.15)	0.18 (-0.13, 0.48)	.250		
Processing Speed	4	6	-0.28 (-0.43, -0.12)	0.07 (-0.10, 0.24)	.431		
Visuospatial Abilities – Perception	2	2	-0.15 (-0.49, 0.20)	0.20 (-0.15, 0.54)	.254		
Visuospatial Abilities – Reasoning	2	2	-0.18 (-0.61, 0.25)	0.17 (-0.27, 0.60)	.448		
Medication Status for Cognitive Assessment(s)						56.06 (.688)	1.78 (.187)
ON or OFF[*]	2	5	-0.48 (-0.70, -0.26)		**< .001**		
ON	13	59	-0.31 (-0.44, -0.18)	0.17 (-0.08, 0.42)	.187		
Medication Status for Motor Assessment(s)						56.77 (.832)	2.41 (.097)
ON or OFF[*]	2	5	-0.48 (-0.69, -0.26)		**< .001**		
ON	10	39	-0.23 (-0.34, -0.12)	0.25 (0.01, 0.49)	**.043**		
OFF	6	27	-0.37 (-0.60, -0.15)	0.11 (-0.21, 0.42)	.502		
Cognitive Impairment/Dementia as Exclusion Criterion						72.93 (.753)	0.84 (.363)
No[*]	7	22	-0.38 (-0.58, -0.18)		**< .001**		
Yes	13	62	-0.27 (-0.38, -0.16)	-0.11 (-0.12, 0.34)	.363		

Overall Risk of Bias						68.73 (.833)	0.68 (.508)
High[*]	11	23	-0.31 (-0.47, -0.16)		**< .001**		
Moderate	6	31	-0.35 (-0.55, -0.15)	-0.04 (-0.29, 0.21)	.753		
Low	3	30	-0.22 (-0.37, -0.06)	0.10 (-0.12, 0.31)	.379		

Note. CI = confidence interval; *k* = number of effect sizes; LTM = long-term memory; *n* = number of unique studies; STM = short-term memory; ToM = Test of Moderators; β = regression coefficient. [*] denotes reference category for model. For Hedges' *g*, values < 0 reflect indicate poorer cognitive performance among freezing of gait (FOG) patients relative to non-freezing of gait (FOG) patients. The β coefficients and corresponding *p*-values indicate whether the pooled effect size for that level of the moderator differs significantly from the pooled effect size of the reference category; for the reference category, these values indicate whether the pooled effect size differs significantly from zero. For Hedges' *g*, values < 0 indicate poorer cognitive performance among freezing of gait (FOG) patients relative to non-freezing of gait (FOG) patients. No moderator analyses performed for subtyping method as all effect sizes belonged to the same moderator level ('Other'). No moderator analyses performed for motor subtypes compared on cognition in paper as only *k* = 1 for 'No' level of moderator. Significant *p*-values (< .05) are highlighted in bold.

Table S41

Results of Confound Analyses for Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups (No Outliers Removed)

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	19	75	-0.02 (-0.48, 0.44)	.945	-2.01
Difference in proportion of men	17	67	0.58 (-1.13, 2.28)	.503	1.90
SMD years of education	10	51	0.31 (-0.48, 1.11)	.433	-0.21
SMD disease duration	20	93	-0.03 (-0.38, 0.32)	.851	-1.96
SMD LEDD	15	79	-0.01 (-0.36, 0.33)	.945	-2.12
SMD UPDRS-III (original)	10	48	-0.09 (-0.64, 0.46)	.734	-2.12
SMD MDS-UPDRS-III	10	45	-0.15 (-0.54, 0.23)	.431	0.00
SMD UPDRS-III (any version)	20	93	-0.13 (-0.43, 0.17)	.400	3.08

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, positive values reflect a negative association between the confound (moderator) and effect size (i.e., larger values of the confound [moderator] are associated with effect sizes approaching zero, reflecting a smaller difference in cognitive performance between the freezing of gait [FOG] group and the non-freezing of gait [nFOG] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). No confound (moderator) analyses performed for SMD in age at disease onset as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Table S42

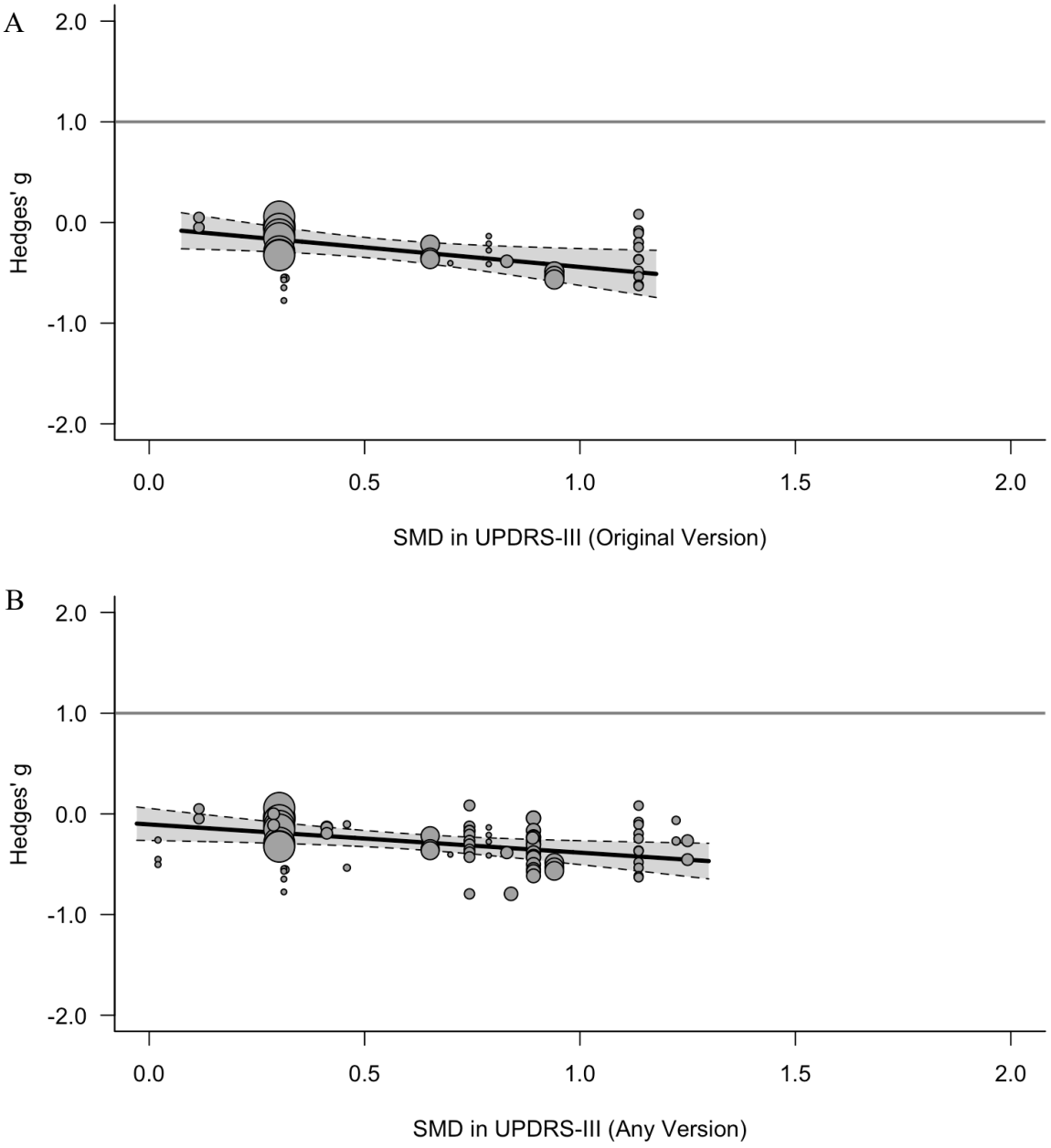
Results of Confound Analyses for Freezing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups (Outliers Removed – Residuals Approach)

Confound	*n*	*k*	*β* (95% CI)	*p*	Change in Between-Study I^2
SMD age	19	68	0.00 (-0.42, 0.42)	.995	-2.03
Difference in proportion of men	17	61	0.09 (-1.49, 1.67)	.912	-2.46
SMD years of education	10	46	0.37 (-0.23, 0.97)	.220	8.67
SMD disease duration	20	84	-0.10 (-0.42, 0.22)	.539	-2.27
SMD LEDD	15	71	-0.07 (-0.39, 0.25)	.676	-2.58
SMD UPDRS-III (original)	10	41	-0.39 (-0.72, -0.06)	**.021**	29.44
SMD MDS-UPDRS-III	10	43	-0.15 (-0.52, 0.23)	.437	0.00
SMD UPDRS-III (any version)	20	84	-0.28 (-0.51, -0.05)	**.018**	16.65

Note. CI = confidence interval; *k* = number of effect sizes; LEDD = levodopa equivalent daily dose; MDS-UPDRS-III = Movement Disorder Society Unified Parkinson's Disease Rating Scale Part III; *n* = number of unique studies; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III; SMD = standardised mean difference (Hedges' *g*); *β* = regression coefficient. For *β*, positive values reflect a negative association between the confound (moderator) and effect size (i.e., larger values of the confound [moderator] are associated with effect sizes approaching zero, reflecting a smaller difference in cognitive performance between the freezing of gait [FOG] group and the non-freezing of gait [nFOG] group). Change in I^2 is the difference in between-study I^2 for the model with and without the confound (moderator; larger positive values correspond to greater between-study variance being accounted for by the confound [moderator]; negative values suggest that model fit worsened as a consequence of including the confound [moderator]). No confound (moderator) analyses performed for SMD in age at disease onset as $n < 10$ studies. Significant *p*-values (< .05) are highlighted in bold.

Figure S18

Relationship Between Standardised Mean Difference (SMD) in Unified Parkinson's Disease Rating Scale Part III and Effect Size for Cognitive Difference Between Freeing of Gait (FOG) and Non-Freezing of Gait (nFOG) Motor Subtype Groups



Note. A. Unified Parkinson's Disease Rating Scale Part III – original version. B. Unified Parkinson's Disease Rating Scale Part III – any version. SMD = standardised mean difference; UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. For Hedges' *g*, values < 0 indicate better cognitive performance among non-freezing of gait (nFOG) patients relative to freezing of gait (FOG) patients.

Results of Poor Gait vs. Good Gait Analyses

Table S43

Meta-Analyses Comparing Poor Gait and Good Gait Motor Subtypes on Demographics and Disease Characteristics

Characteristic	*k* (*o*)	Pooled effect size (95% CI)	*p*	I^2 (%)	*Q* (*p*)
Age[*]					
All studies	4 (263)	0.14 (-1.20, 1.48)	.759	89.4	28.33 (**< .001**)
Gender (proportion of men)[*]					
All studies	4 (263)	0.95 (0.87, 1.04)	.165	0.00	0.23 (.972)
Disease duration[*]					
All studies	4 (263)	0.58 (0.26, 0.91)	**.011**	0.00	1.79 (.618)
LEDD[*]					
All studies	4 (263)	0.12 (-1.39, 1.63)	.814	90.0	30.03 (**< .001**)

Note. CI = confidence interval; *k* = number of studies/effect sizes; LEDD = levodopa equivalent daily dose; *o* = pooled sample size (both groups); UPDRS-III = Unified Parkinson's Disease Rating Scale Part III. Pooled effect size is Hedges' *g* for all variables except gender, which is risk ratio. For Hedges' *g*, positive pooled effect sizes reflect higher values (i.e., older age, longer disease duration) in the poor gait group relative to the good gait group; for risk ratio, values > 1 indicate that poor gait patients have a greater risk of being men relative to good gait patients. I^2 is for between-study variance. Egger's test was conducted only when $k \geq 10$ and using Pustejovsky and Rodgers' (2019) revised method. [*] Results for model with outliers removed are not reported as no outliers were detected. Significant *p*-values (< .05) are highlighted in bold.

Results of Fallers vs. Non-Fallers Synthesis

One study (Altmann et al., 2023) subtyped patients (o = 1810) according to whether they had at least one fall during a two-week inpatient stay at a PD clinic. A fall event or its outcome had to be observed and recorded by a clinician. Consistent with our previously reported subtype comparisons that included a gait-related subtype, fallers had a longer disease duration than non-fallers (g = 0.36) and greater overall motor impairment (g = 0.60). Altmann and colleagues (2023) compared fallers and non-fallers on two global measures of cognition and found non-fallers to have significantly better cognitive function relative to fallers (g = 0.74 and g = 0.69 for MoCA and FAB, respectively).

Risk of Bias

Figure S19

Risk of Bias Summary Plots for Jankovic et al. (1990) and Stebbins et al. (2013) Motor Subtyping Methods

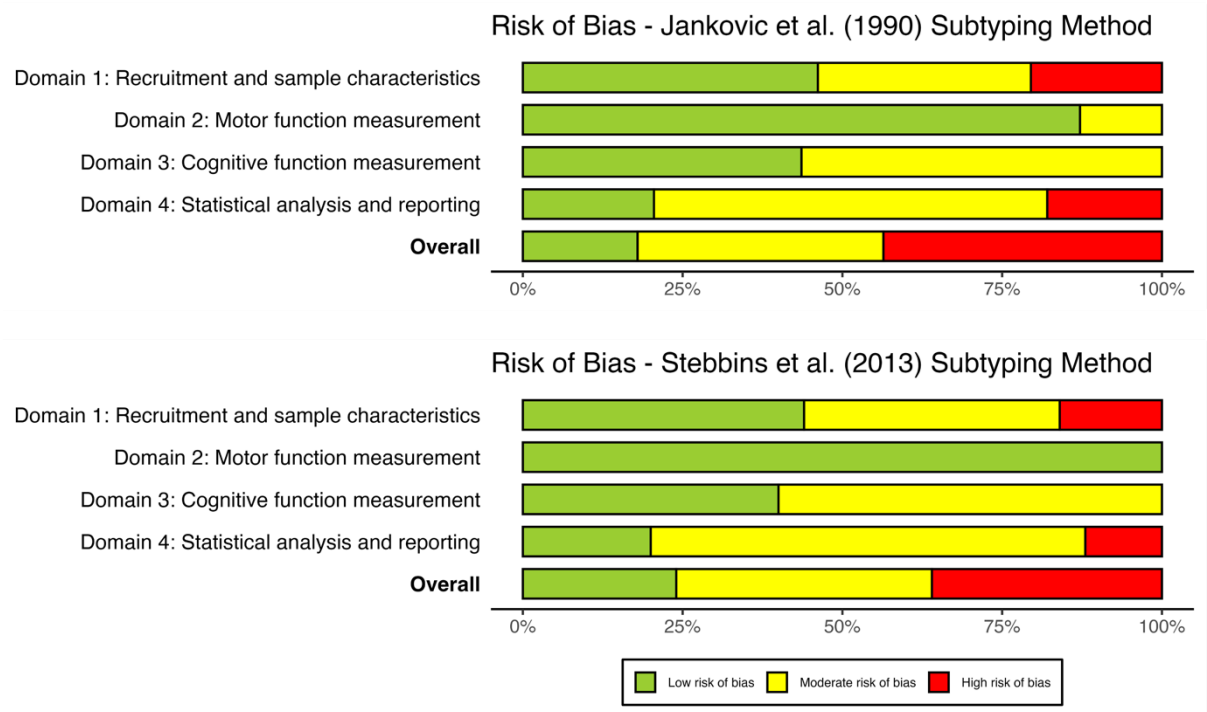
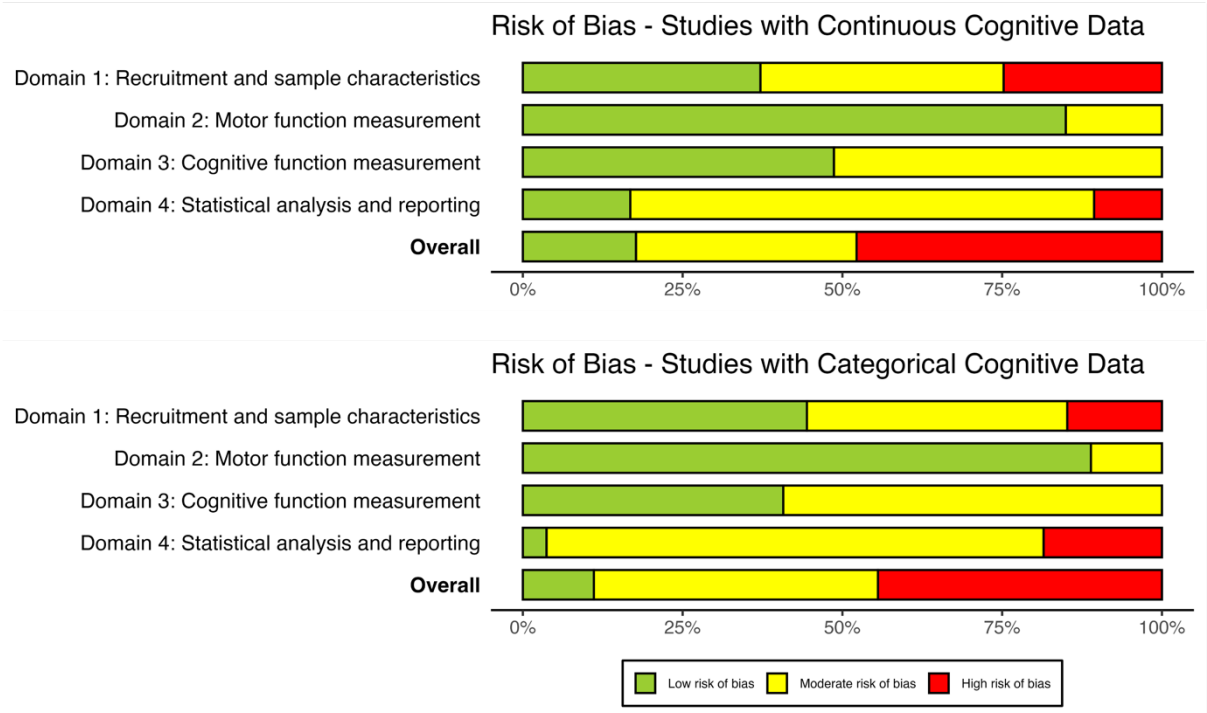


Figure S20

Risk of Bias Summary Plots for Studies Reporting Continuous and Categorical Cognitive Outcome Data



Grading of Recommendations, Assessment, Development, and Evaluations (GRADE)

Table S44 provides a summary of the GRADE framework used to evaluate pooled effects for motor subtype pairs with continuous cognitive outcome data available for at least 10 studies. Quality of evidence for all motor subtype pairs was deemed low or very low. All motor subtype pairs were downgraded due to study limitations, which resulted from most included studies being assessed as having a moderate or high risk of bias. TD/PIGD and all motor subtype pairs (TD/AR, TD/NTD, FOG/nFOG) not belonging to the TD/PIGD/ID framework were also downgraded for evidence of publication bias. Quality of evidence was strongest for the subtype pairs produced from the TD/PIGD/ID subtyping framework. This is likely, at least in part, due to the large number of available studies and consistency in subtyping procedures used to classify patients into these groups, which contributed to more precise estimates and allowed for a more comprehensive coverage of cognitive domains (directness).

Table S44

Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) Summary of Findings

	GRADE Factor							
Subtype Pair	Study limitations	Inconsistency	Indirectness	Imprecision	Publication bias	Moderate/ large effect size	Dose-effect	Overall certainty of evidence
TD / PIGD	×	×	✓	✓	×	×	×	+
TD / ID	×	✓	✓	✓	✓	×	×	++
PIGD / ID	×	✓	✓	✓	✓	×	×	++
TD / AR	×	×	✓	✓	×	×	×	+
TD / NTD	×	✓	×	✓	✓	×	unclear	+
FOG / nFOG	×	✓	✓	✓	×	×	unclear	+

Note. Dose-effect = exposure-gradient response. For GRADE factors: ✓ = no serious limitations; × = serious limitations (or not present for moderate/large effect sizes, dose-effect); unclear = unable to rate item based on available information. For overall quality of evidence: + = very low; ++ = low; +++ = moderate; ++++ = high.

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