Supplementary Materials

Supplementary Table S1

Study characteristics, phenotypic outcomes, and tests performed in genetic PD models used in 3 studies or greater.

Ref No.	Author, year	Animal model	Rodent	Background strain	Promoter	Sex	Age (months)	Outcome	Test Performed	Motor or Cell Count tested?
[1]	Griffioen et al, 2013	**A53T**	Mouse	B6;C3H	Thy1	M	2, 5, 7-11	↓ Cardio	ECG telemetry	NA
[2]	Kuo et al, 2010	**A53T** PAC crossed with SNCA KO	Mouse	FVB/N 129S6/SvEvTac	Endogenous gene regulatory elements	MF	3-18	Olfaction, — 12mo GI function, ↓ 3-18mo Cardio, — 12mo	Non-Social Novel Odour Test, Buried Food Test Faecal and water content, Bead expulsion test, Whole gut transit time ECG telemetry	Motor, ↓ 6-18mo
[3]	Carboni et al, 2017	**A53T**	Mouse	B6;C3H	PrnP	NS	7	↓ Cognition	Novel Object Recognition	↓ Motor — Cell Count
[4]	Valek et al, 2021	**A53T** (Study tested A53T*PINK1 KO but not A53T for olfaction)	Mouse	FVB/N	PrnP	NS	9	NA	NA	— Motor
[5]	Kuo et al, 2019	**A53T** PAC crossed with SNCA KO	Mouse	129S6/SvEvTac	Endogenous gene regulatory elements	M	4, 7, 9	↓ GI function	Bead Expulsion Test, Whole Gut Transit Time	Motor, —7mo
[6]	Seo et al, 2020	**A53T**	Mouse	C57BL/6J	PrnP	NS	8, 10	↓ Olfaction	Buried Pellet Test	— Motor
[7]	Farrell et al, 2014	**A53T**	Mouse	C57BL/6J	PrnP	NS	12-14	↓ Anxiety ↓ Olfaction	Centre of Open Field, Hyponeophagia Test Buried Pellet Test	NA
[8]	Wi et al, 2018	**A53T**	Mouse	C57BL/6J	PrnP	NS	8, 10	↓ Olfaction	Buried Pellet Test	NA

[9]	Zhang et al, 2015	**A53T**	Mouse	B6/C3H	PrnP	M	3, 6, 10	Olfaction, — 3mo ↓ 6, 10mo	Block Test (social discrimination), Habituation Dishabituation, Buried Food Test	Motor, — 10mo Cell Count, — 10mo
[10]	Gerson et al, 2018	**A53T**	Mouse	B6/C3H	PrnP	MF	7	↓ Cognition	Novel Object Recognition	— Motor
[11]	Diwakarla et al, 2021	**A53T**	Mouse	B6/C3H	PrnP	MF	15-19	GI function, ↓ 16-19mo	Bead Expulsion Test, Whole Gut Transit Time	Motor, ↓ 19mo
[12]	Diwakarla et al, 2020	**A53T**	Mouse	B6/C3H	PrnP	MF	5-15	GI function, — 5-14mo ↓ 15mo	Bead Expulsion Test, Whole Gut Transit Time, Faecal and Water Content	Motor, ↓ 8-15mo
[13]	Taguchi et al, 2020	**A53T** BAC	Mouse	C57Bl/6	Endogenous gene regulatory elements	MF	3-18	Circadian ↓ 11, 18mo Olfaction, ↓ 9mo Anxiety, — 9mo Cognition, — 9mo	Sleep Recordings Urine Odour Test, Olfactory Avoidance Test Light Dark Box Spatial Recognition Barnes Maze	Motor, — 9mo Cell Count, — 3mo ↓ 9, 18mo
[14]	Li et al, 2021	**A53T**	Mouse	C57Bl/6	NS	MF	20	↓ Cognition ↓ Olfaction	Fear Conditioning Olfactory Bedding Test	↓ Motor ↓ Cell Count
[15]	Do et al, 2021	**A53T**	Mouse	C57BL/6	PrnP	MF	8, 10, 12, 14, 16 monthly to 23	Cognition, — 8-23mo Olfaction, — 8-23mo	Novel Object Recognition Buried Pellet Test	Motor, ↓ 8-23mo
[16]	Stanojlovic et al, 2019	**A53T**	Mouse	C57BL/6	NS	M	3, 5, 7	↓ Cognition	Barnes Maze, Contextual Object Recognition	NA
[17]	Graham et al, 2010	**A53T**	Mouse	B6/C3H	PrnP	NS	2, 8, 12	Anxiety, ↓ 2mo — 8mo ↑ 12mo	Elevated Plus Maze	Motor, ↓ 2mo — 8mo ↑ 12mo
[18]	Costa et al, 2020	**A53T**	Mouse	B6/C3H	PrnP	MF	12	↓ Olfaction ↓ GI function	Buried Pellet Test Faecal Pellet Output	—Motor ↓ Cell Count

								↓ Cognition	Novel Object Recognition, Spontaneous Alternation	
[19]	Peters et al, 2020	**A53T**	Mouse	C57Bl/6	PrnP	MF	3-4, 6-7, 9-10	Circadian, ↓ 3-10mo	EMG/EEG Recordings	NA
[20]	Paumier et al, 2013	**A53T**	Mouse	C57BL/6	PrnP	M	2, 6, 12	Cognition, — 2mo ↓ 6, 12mo Anxiety, — 2mo ↑ 6, 12mo	Spatial Recognition Centre of Open Field	Motor, ↑ 2, 6, 12mo
[21]	Thom et al, 2022	**A53T** crossed with cellular Prp KO	Mouse	C57Bl/6	PrnP	M	9, 18	Anxiety, ↓ 9, 18mo	Elevated Plus Maze	Motor, — 18mo
[22]	Singh et al, 2019	**A53T**	Mouse	C57Bl/6	PrnP	M	6, 12	↓ Cognition	Barnes Maze, Spatial Recognition Fear Conditioning	↑ Motor
[23]	Pfeffer et al, 2018	**A53T**	Mouse	FVB/N	PrnP	M	4-6	↓ Circadian	Re-entrainment test	— Motor
[24]	Zhang et al, 2018	**A53T**	Mouse	NS	PrnP	M	12	↓ Cognition	Novel Object Recognition, Spatial Recognition	↓ Motor
[25]	Rockenstein et al, 2016	**A53T**	Mouse	C57Bl/6	PrnP	NS	2	↓ Cognition — Anxiety	Fear Conditioning Centre of Open Field	↑ Motor
[26]	West et al, 2020	**A53T**	Mouse	C57BL/6	PrnP	M	7	↓ GI Function	In vitro colonic monitoring, Faecal Pellet Output	NA
[27]	Noorian et al, 2012	**A53T**	Mouse	FVB/N	PrnP	MF	2-3, 8-10, 14-16, 18-20	GI Function, — 2, 9mo ↓ 15-20mo	Faecal Pellet Output, Gastric Emptying	NA
[28]	Tikhonova et al, 2020	**A53T**	Mouse	C57Bl/6	PrnP	M	6-8	↓ Cognition	Passive Avoidance Test, Spontaneous Alternation, Barnes Maze	↑ Motor
[29]	Wang et al, 2018	**A53T**	Mouse	B6/C3H	PrnP	M	3, 6, 9, 12	GI Function, ↓ 3, 6, 9mo ↑12mo Depression, — 3mo ↓ 6mo ↓ Anxiety, 3, 6mo	Faecal Pellet Output Tail Suspension Test Centre of Open Field	Motor, ↑ 3, 6 mo — 9, 12 mo

[30]	Li et al, 2020	**A53T**	Mouse	B6/C3H	PrnP	M	3, 6, 9, 12	Anxiety, — 3mo ↓ 6, 9, 12mo Depression, — 3mo ↓ 6, 9, 12mo	Elevated Plus Maze Tail Suspension Test, Forced Swim Test	Motor, — 3, 6, 9mo ↓ 12mo
[31]	Rota et al, 2019	**A53T**	Mouse	C57Bl/6	PrnP	MF	3, 6, 9, 12, 14	GI function, ↓ 3-12mo	Whole Gut Transit Time, Faecal Pellet Output	Motor, — 3, 6mo
[32]	Kim et al, 2014	**A53T**	Mouse	NS	PrnP	NS	14-15	↓ Anxiety	Light Dark Box, Elevated Plus Maze	— Motor
[33]	Vidal-Martinez et al, 2016	**A53T**	Mouse	B6/C3H	PrnP	NS	1-15	GI function, — 1-5mo ↓ 6-15mo	Faecal Pellet Output, Whole Gut Transit Time	NA
[34]	Huang et al, 2019	**A53T**	Mouse	NS	PrnP	NS	12	↓ Cognition	Spatial Recognition	↓ Motor
[35]	Finkelstein et al, 2016	**A53T**	Mouse	C57BL/6	PrnP	NS	8	↓ Cognition	Morris Water Maze, Spatial Recognition Novel Object Recognition	↓ Motor ↓ Cell Count
[36]	Oaks et al, 2013	**A53T**	Mouse	B6/C3H	PrnP	NS	2, 4, 8, 12	Depression, — 2, 12mo ↑ 4-8mo Anxiety, — 2, 4, 8mo ↑ 12mo	Forced Swim Test Elevated Plus Maze	Motor, ↓ 2-12mo
[37]	Sardi et al, 2017	**A53T**	Mouse	B6/C3H	PrnP	NS	4, 8	↓ Cognition, 4, 8mo	Novel Object Recognition, Fear Conditioning	NA
[38]	Wu et al, 2016	**A53T**	Mouse	B6/C3H	PrnP	MF	7	— Depression — Olfaction	Sucrose Preference Test Buried Pellet Test	↓ Motor
[39]	Rothman et al, 2013	**A53T**	Mouse	C57Bl/6	Thy1	M	3-7	Circadian, ↓ 3mo Anxiety, ↑ 3-6mo	Circadian Monitoring System Elevated Plus Maze	Motor, ↓ 3-7mo
[40]	Tatenhorst et al, 2016	**A53T**	Mouse	B6	PrnP	NS	6, motor impairment onset	Cognition, — 6mo ↓ ~16mo	Novel Object Recognition	Motor, — 1-6mo ↓ ~16mo
[25]	Rockenstein et al, 2016	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6-DBA/2	Thy1	F	6, 9	Anxiety, ↑ 6, 9mo	Centre of Open Field	Motor, ↑ 6, 9mo

								Olfaction, ↓9mo	Buried Pellet Test	
[41]	Hallett et al, 2012	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	2-4, 12-15	GI Function, — 2-4mo ↓ 9-12	Faecal Pellet Output, Whole Gut Transit Time	Motor, ↓ 12-15mo
[42]	Yamakado et al, 2012	**Ha-syn OE** a-syn BAC	Mouse	NS	Endogenous gene regulatory elements	NS	12-13, 24	Cognition, — 12, 24mo Anxiety, ↑13mo, — 24mo	Radial Maze Test, Barnes Maze Test, Fear Conditioning Elevated Plus Maze, Centre of Open Field	Motor, ↑ 13mo Cell Count, — 24mo
[43]	Mandler et al, 2014	**Ha-syn OE** 1) Thy1-asyn 2) PDGF-asyn	Mouse	NS	Thy1, PDGF- β	NS	9-10 (Thy-1 asyn), 12 (PDGF-asyn)	Cognition, ↓ 12 mo (PDGF-asyn)	Morris Water Maze	Motor, ↓ 9-12 (Thy1-asyn)
[44]	Wassouf et al, 2018	**Ha-syn OE** Asyn BAC	Mouse	C57BL/6	Endogenous gene regulatory elements	MF	6	Anxiety, ↓ 6mo	Light Dark Box, Elevated Plus Maze	Motor, — 6mo ↓ 13, 20mo
[45]	Subramaniam et al, 2018	**Ha-syn OE** Thy1-asyn	Mouse	C57BL6/DBA/2	Thy1	M	2, 4, 8	Cognition, — 5mo ↓ 6-7mo	Spontaneous Alternation Novel Object Recognition	Motor, ↓ 2, 4, 6, 8mo
[46]	Brown et al, 2021	**Ha-syn OE** Thy1-asyn	Mouse	BDF-1	Thy1	M	1, 3	Olfaction, ↓ 1mo — 3mo	Buried Pellet Test	Motor, ↓ 1, 3mo Cell Count, — 3mo
[47]	Games et al, 2014	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6-DBA/2	Thy1	F	12	↓ Cognition	Morris Water Maze	↓ Motor — Cell Count
[48]	Schwab et al, 2017	**Ha-syn OE** H-asynL62	Mouse	C57Bl/6	Thy1	MF	5.5	↓ Anxiety	Light Dark Box	NA
[49]	Wang et al, 2012	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	2-5, 7-10, 12-14, 18	GI Function, ↓ 2-3, 7-8 mo — 4-5, 9-10, 12-14, 18mo	Faecal Pellet Output, Gastric Emptying	Motor, ↑ 4-5mo

								Anxiety, ↑ 4-5mo	Centre of Open Field	
[50]	McDowell et al, 2014	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	9.5-10.5	↓ Circadian	EEG/EMG Recordings	NA
[51]	Bermudez et al, 2019	**Ha-syn OE** Thy1-asyn	Mouse	BDF1	Thy1	M	2, 4	Olfaction, ↓ 2mo — 4mo	Buried Pellet Test	Motor, ↓ 2, 4mo
[52]	Biju et al, 2020	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6	Thy1	M	18	↓ Olfaction	Buried Pellet Test	↓ Motor
[53]	Fleming et al, 2008	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	3-4, 5-6, 9, 11	↓ Olfaction	Buried Pellet Test, Block Test, Habituation/Dishabituation	NA
[54]	Fleming et al, 2011	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	3-4	↓ Olfaction	Buried Pellet Test	↓ Motor
[55]	Fleming et al, 2013	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	3-5, 9-12	↓ Cardio	Telemetry	NA
[56]	Magen et al, 2012	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	3-9, 11-13	Cognition, — 3, 11-13mo ↓ 5-9mo	Spontaneous Alternation, One-trial Object-Place Recognition, Novel Object Recognition, Operant Learning Task	NA
[57]	Torres et al, 2021	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6-DBA/2	Thy1	M	3-4	↑ Cognition — Anxiety	Fear Conditioning Centre of Open Field	— Motor
[21]	Thom et al, 2022	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6	Thy1	M	9	↓ Cognition ↑ Anxiety	Novel Object Recognition, Fear conditioning Elevated Plus Maze	— Motor
[58]	Wang et al, 2008	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6-DBA/2	Thy1	M	11-12	↓ GI Function	Bead Expulsion Test, Faecal Pellet Output	NA
[59]	Li et al, 2022	**Ha-syn OE** Thy1-asyn	Mouse	C57Bl/6	Thy1	M	6, 7, 9, 12	Olfaction, ↓ 6, 7, 9, 12mo Depression, — 7mo	Buried Pellet Test, Block Test Sucrose Preference Test	Motor, — 6, 9mo ↓ 12mo Cell Count ↓ 12mo
[60]	Grant et al, 2014	**Ha-syn OE** Thy1-asyn	Mouse	C57BL/6-DBA/2	Thy1	M	2-3, 6-7, 9	↓ Cognition	USV Recordings	NA
[61]	Keane et al, 2019	**A30P**	Mouse	C57Bl/6	NS	MF	3, 13	Cognition, — 13mo	Barnes Maze	Motor, — 3-12mo

										Cell Count, ↓ 13mo
[2]	Kuo et al, 2010	**A30P** PAC crossed with SNCA KO	Mouse	NS	Endogenous gene regulatory elements	MF	6-12	GI function, ↓ 3-18mo	Faecal Pellet Output, Bead Expulsion Test, Whole Gut Transit Time	Motor, — 6, 12mo
[62]	Gureviciene et al, 2009	**A30P**	Mouse	C57BL/6	PrnP	M	7-9, 22-25	Cognition, — 7-9, 22-24mo	Morris Water Maze	Motor, — 7-9mo, ↓ 22-24mo
[5]	Kuo et al, 2019	**A30P** PAC crossed with SNCA KO	Mouse	29S6/SvEvTac_FVB/N_C57/BL6	Endogenous gene regulatory elements	M	4, 7, 9	↓ GI Function	Bead Expulsion	— Motor
[22]	Singh et al, 2019	**A30P**	Mouse	C57Bl/6	PrnP	M	12	— Cognition	Spatial Recognition	NA
[63]	Marxreiter et al, 2013	**A30P** Tet regulated	Mouse	NS	CaMK	M	2	↓ Anxiety	TMT-induced Fear, Elevated Plus Test	— Motor
[64]	Schell et al, 2012	**A30P**	Mouse	NS	Thy1	M	6-18	Cognition, ↓ 6, 16mo	Fear Conditioning	NA
[65]	Neuner et al, 2014	**A30P**	Mouse	C57Bl/6	Thy1	NS	6-8	Olfaction, ↓ 6mo Cognition, — 8mo	Olfactory Discrimination Test (with cognitive component)	NA
[66]	Freichel et al, 2007	**A30P**	Mouse	C57Bl/6	Thy1	NS	4, 9-15, 16-18	Cognition, — 4mo ↓ 12mo	Morris Water Maze, Fear Conditioning, Active Avoidance Test	Motor, — 4, 9-15mo ↑12mo ↓ 16-18mo
[67]	Stylianou et al, 2020	**A30P**	Mouse	C57Bl/6	Thy1	M	2.5-4	↓ Circadian	In vivo recordings in PFC, CA1 hip	NA
[68]	Gries et al, 2021	**A30P**	Mouse	C57Bl/6	Thy1	MF	2, 12-13	GI Function, ↓ 2mo	GI motility recording in organ bath	Motor, —2mo ↓ 12-13mo
[69]	Langley et al, 2021	**Mitopark**	Mouse	NS	Dopamine Transporter (DAT)	MF	1-5	Olfaction, — 1-2mo ↓ 3-5mo Cognition, — 1-2mo ↓ 3-5mo	Social and Novel Scent Test Morris Water Maze	Motor, — 1-2mo ↓ 3-5mo

								Depression, — 1-2mo ↓ 3-5mo Anxiety, — 1-2mo ↓ 3-5mo Circadian, — 1-5mo	Force Swim Test, Tail Suspension Test Elevated Plus Maze Sleep Latency Test	
[70]	Li et al, 2013	**Mitopark**	Mouse	C57Bl/6	DAT	MF	1-5	Cognition, ↓ 1mo	Barnes Maze, Novel Object Recognition	Motor, — 1-2mo ↓ 3-5mo
[71]	Cong et al, 2016	**Mitopark**	Mouse	C57Bl/6	DAT	MF	5-7	Cognition, ↓ 5-6mo Depression ↓ 5-6mo	Novel Object Recognition Tail Suspension Test	Motor, ↓ 7mo
[72]	Ghaisas et al, 2019	**Mitopark**	Mouse	C57BL/6	DAT	MF	2-5	GI Function, ↓ 3-5mo	Gastric Emptying, Whole Gut Transit Time, Bead Expulsion Test	NA
[73]	Fifel et al, 2014	**Mitopark**	Mouse	NS	DAT	NS	2-6	Circadian, — 2mo ↓ 6mo	Re-entrainment Test	NA
[74]	Paβ et al, 2020	**Mitopark**	Mouse	C57Bl/6	DAT	MF	1-4, 6	Olfaction, —1-3, ↓ 4, 6mo	Buried Pellet Test, Odour Discrimination	Cell Count, ↓ 4-6mo
[75]	Langley et al, 2018	**Mitopark**	Mouse	C57Bl/6	DAT	MF	2	— Olfaction	Social Odour Discrimination	↓ Motor
[76]	Baumann et al, 2016	**VMAT2 KO**	Mouse	C47Bl/6	NS	M	12	↓ Depression	Saccharin Preference Test, Forced Swim Test	NA
[77]	Cui et al, 2021	**VMAT2 KO**	Mouse	NS	Dual promoters (*Phox2a*, *Phox2b*, *Hand 2* or *Gata3* from mice)	MF	12, 18	↓ Cognition	Morris Water Maze	↓ Motor
[78]	Taylor et al, 2009	**VMAT2 KO**	Mouse	C57Bl/6	NS	MF	2, 4, 5, 6, 12, 18	Olfaction, — 2-4mo ↓ 5-12mo	Social and Non-Social Olfactory Discrimination Test	Motor, — 2, 18mo

								Anxiety, ↓ 2mo — 18mo Depression, — 2, 18mo Circadian, ↑ 2mo — 18mo GI function, ↓ 2, 18mo	Elevated Plus Maze Forced Swim Test, Tail Suspension Test Sleep Latency Test Gastric Emptying	
[79]	Rabl et al, 2017	**Ha-syn OE (Thy1-asyn) hemi**	Mouse	NA	C57Bl/6xDBA		1-8	Cognition, — 2-3, 6mo ↓ 8mo	Fear Conditioning	Motor, — 1mo ↑ 2-3, 6mo
[80]	Gabreilyan et al, 2021	**Ha-syn OE (Thy1-asyn) hemi**	Mouse	NA	C57Bl/6xDBA2	MF	5-6	Anxiety, ↓ 6mo Olfaction, ↓ 6mo	Marble Burying Test Buried Pellet Test	Motor, ↓ 5mo
[81]	Goldberg et al, 2015	**Ha-syn OE (Thy1-asyn) hemi**	Mouse	NA	C57Bl/6	NS	13	↓ Cognition	Novel Object Recognition, Object Place Recognition	↓ Motor
[82]	Lim et al, 2018	**LRRK2 G2019S** Human gene	Mouse	B6;C3H	PDGFB	MF	2-4, 9-11, 14-19	Anxiety, — 2-4mo, ↓ 9-11, 14-19mo ↓ Depression	Light Dark Box, Elevated Plus Maze Sucrose Preference Test, Forced Swim Test, Tail Suspension Test	Motor, — 2-4, 9-11mo ↓ 14-19mo
[83]	Matikainen-Ankney et al, 2018	**LRRK2 G2019S** Mouse gene	Mouse	C57BL/6NTac	Endogenous gene regulatory elements	M	2	— Anxiety — Depression	Elevated Plus Maze Sucrose Preference Test	— Motor
[84]	Volta et al, 2015	**LRRK2 G2019S** BAC human gene	Mouse	C57Bl/6	Human regulator	M	3, 6, 12	Cognition, — 3mo, ↓ 12mo	Novel Object Location, Novel Object Recognition	Motor, — 6, 12mo
[85]	Crown et al,	**LRRK2**	Mouse	C57BL/6NTa	Endogenou	M	8-10	↓ Circadian	Sleep Recording	— Motor

	2020	**G2019S** Mouse gene		c	s gene regulatory elements					
[86]	Adeosun et al, 2017	**LRRK2 G2019S**	Mouse	C57Bl/6	NS	M	8-9	↓ Cognition	Radial Arm Water Maze, Spatial Recognition, Spontaneous Alternation	— Motor
[4]	Valek et al, 2021	**PINK1 KO** (Study tested A53T*PINK1 KO but not PINK1 KO for olfaction)	Mouse	129/SvEv; FVB/N	NA	NS	9	NA	NA	— Motor
[87]	Glasl et al, 2012	**PINK1 KO**	Mouse	C57Bl/6	NA	MF	3-9, 24-27	Cognition, — 4mo Olfaction, ↓ 27mo	Novel Object Recognition Olfactory Discrimination Test with Reward Associations	Motor, — 3-4, 24-26mo Cell Count, — 6, 19mo
[88]	Maynard et al, 2020	**PINK1 KO**	Mouse	C57Bl/6	NA	M	9-11	↓ Cognition — Anxiety	Spontaneous Alternation, Fear conditioning Marble Burying	— Motor
[89]	Agnihotri et al, 2019	**PINK1 KO**	Mouse	C57Bl/6	NA	MF	3	— Depression — Anxiety	Tail Suspension Test, Forced Swim Test, Sucrose Preference Test Novelty Suppressed Feeding Test, Elevated Plus Maze	— Motor
[90]	Ferris et al, 2018	**PINK1 KO**	Rat	Long Evans	NA	M	2	— Cognition	Novel Object Recognition, Barnes Maze	↓ Motor
[91]	Hoffmeister et al, 2021	**PINK1 KO**	Rat	Long Evans	NA	M	4, 8, 12	↓ Anxiety	Elevated Plus Maze	NA
[92]	Marquis et al, 2020	**PINK1 KO**	Rat	Long Evans	NA	F	2, 4, 6, 8	↓ Depression ↓ Anxiety	Sucrose Preference Test Elevated Plus Maze, Light/Dark Box	↓ Motor
[93]	Billia et al, 2011	**PINK1 KO**	Mice	NA	NA	M	2, 6	↓ Cardio	ECG Recordings	NA
[19]	Peters et al, 2020	**Tau KO**	Mouse	C57Bl/6	NA	MF	3-4, 6-7, 9-10	— Circadian	EMG/EEG recordings	NA

[94]	Beauchamp et al, 2018	**Tau KO**	Mouse	Sv129B/6	NA	MF	7, 12, 15	Olfaction, ↓ 7, 12mo —15mo	Non-Social Olfactory Discrimination Test	Motor, — 7, 12mo ↓ 15mo
[95]	Li et al, 2014	**Tau KO**	Mouse	C57Bl/6	NA	MF	22-24	— Cognition	Spontaneous Alternation, Fear Conditioning	— Motor
[96]	Lei et al, 2012	**Tau KO**	Mouse	NS	NA	NS	6, 12, 24	Cognition, — 6,12mo	Spontaneous Alternation	Motor, — 6mo, ↓ 12-24mo Cell Count, — 6mo ↓ 12mo
[97]	Lei et al, 2014	**Tau KO**	Mouse	Compared two background strains: Bl6/129sv and C57Bl/6	NA	MF	12	Cognition, ↓ for Bl6/129sv, — for C57Bl/6	Spatial Recognition	↓ Motor Both models ↓ Cell Count Both models
[98]	Morris et al, 2013	**Tau KO**	Mouse	C57Bl/6	NA	MF	12-15, 21-22	— Cognition	Novel Object Recognition, Morris Water Maze	Motor, ↓ 12-15mo — 21-22mo
[22]	Singh et al, 2019	**Tau KO**	Mouse	C57Bl/6	NA	M	6, 12	— Cognition	Fear Conditioning, Barnes Maze	— Motor
[99]	Dongworth et al, 2014	**DJ-1 KO**	Mouse	C57Bl/6	NA	NS	NS	— Cardio	ECG Recordings	NA
[100]	Pham et al, 2010	**DJ-1 KO**	Mouse	C57Bl/6	NA	MF	6-7, 13-14	Cognition, — 6-7mo ↓ 13-14mo	Novel Object Recognition	NA
[101]	Li et al, 2019	**DJ-1 KO**	Mouse	B6;129	NA	M	3-5	↓ Anxiety	Elevated Plus Maze, Light Dark Box	↓ Motor
[102]	Billia et al, 2013	**DJ-1 KO**	Mouse	NA	NA	MF	2	— Cardio	ECG Recordings	NA
[103]	Kyser et al, 2019	**DJ-1 KO**	Rat	Long Evans	NA	M	2, 4, 7, 12, 16	Cognition, — 4mo Anxiety, — 4mo Depression, ↓ 6mo — 15mo	Novel Object Recognition Elevated Plus Maze Forced Swim Test, Sucrose Preference Test	Motor, — 2mo ↓ 4, 7mo

								Olfaction, — 16mo	Buried Pellet Test	
[104]	Liu et al, 2018	**A53T Hemi**	Mouse	B6/C3H	PrnP	NS	3, 6, 9, 12	Cognition, ↑ 3, 9mo	Morris Water Maze	Motor, — 3, 6, 9mo ↑12mo
[105]	Uemura et al, 2021	**A53T Het** BAC	Mouse	C57Bl/6	Endogenous gene regulatory elements	M	4, 9-12	Olfaction, — 4mo Anxiety, — 9mo Depression, — 9, 11mo Cognition, — 9, 10 Circadian, — 12mo	Social and Novel Odour Discrimination Light Dark Box Forced Swim Test, Tail Suspension Test Spontaneous Alternation, Barnes Maze, Fear Conditioning Home Cage Activity	Motor, — 9mo
[106]	Hamill et al, 2012	**A53T Hemi**	Mouse	B6/C3H	PrnP	MF	1-16	Urinary, ↓ 4-16mo	Cystometric Recordings	Motor, ↓ 11-16mo
[107]	La Vitola et al, 2021	**A53T Hemi**	Mouse	C57Bl/6	PrnP	NS	8	— Cognition	Novel Object Recognition, Spontaneous Alternation, Morris Water Maze	↑ Motor ↓ Cell Count
[108]	Tikhonova et al, 2020	**A53T Hemi**	Mouse	C57Bl/6	PrnP	M	6	↓ Cognition	Passive Avoidance Test	↑ Motor
[109]	Giesert et al, 2017	**LRRK2 R1441C**	Mouse	C57BL/6	NS	NS	2, 3, 5, 24-26	Olfaction, ↓ 24-26mo Cognition, — 3mo Depression, ↓ 7-8mo	Olfactory Discrimination Test with Reward Association Novel Object Recognition Forced Swim Test, Tail Suspension Test	Motor, — 3mo ↓ 24-26mo Cell Count, — 5, 28 mo
[110]	Bichler et al, 2013	**LRRK2 R1441G** BAC	Mouse	FVB/N	human LRRK2 promoter/enhancer regions on the BAC	NS	4, 6, 9, 12, 14, 16, 18-21	Anxiety, — 6, 14, 19mo Depression,	Elevated Plus Maze Tail Suspension Test,	Motor, — 2-12mo ↓16-21mo

					transgene			— 6-19mo Cognition, — 21mo GI function, ↓ 6, 9, 21mo Olfaction, — 6, 14mo	Forced Swim Test Passive Avoidance Test Faecal Pellet Output Block Test, Buried Pellet Test	
[111]	Mikhail et al 2015	**LRRK2 R1441G** BAC	Mouse	FVB	NS	NS	6-9	— Cognition	Fear Conditioning	— Motor
[112]	Dranka et al, 2014	**LRRK2 R1441G** BAC	Mouse	FVB/N	human LRRK2 promoter/enhancer regions on the BAC transgene	M	15	↓ Olfaction	Buried Pellet Test	↓ Motor
[113]	Lopatina et al, 2014	**CD157 KO**	Mouse	C57Bl/6	NA	M	2	↓Anxiety ↓Depression ↑ Cognition — Circadian	Centre of Open Field, Light Dark Box, Elevated Plus Maze Tail Suspension Test Forced swim Test Fear Conditioning Home Cage Activity	— Motor
[114]	Mizuno et al, 2015	**CD157 KO**	Mouse	C57Bl/6	NA	M	NS	↓ Anxiety	Anxiety and Social Preference Test with Social Target	NA
[115]	Kasai et al, 2017	**CD157 KO**	Mouse	C57Bl/6	NA	M	2	↓ Anxiety ↓ Depression	Centre of Open Field Forced Swim Test	↓ Motor
[116]	Higashida et al, 2017	**CD157 KO**	Mouse	C57Bl/6	NA	MF	1	↓ Anxiety	Light Dark Box	NA
[117]	Maekawa et al, 2019	**LRRK2 KO**	Mouse	C57Bl/6	NA	M	1-3	— GI Function	Bead Expulsion Test, Intestinal Transit Assay	NA
[118]	Beccano-Kelly et al, 2015	**LRRK2 KO**	Mouse	NSA	NA	M	3-6	— Cognition	Novel Object Recognition	— Motor

[119]	Maset et al, 2021	**LRRK2 KO**	Mouse	C57Bl/6	NA	MF	1	↓ Olfaction	Habituation/Dishabituation Test	NA
[84]	Volta et al, 2015	**LRRK2 KO**	Mouse	C57Bl/6	NA	M	12	— Cognition	Novel Object Location, Novel Object Recognition	— Motor
[109]	Giesert et al, 2017	**LRRK2 KO**	Mouse	NS	Human U6	NS	3-4, 11-13, 24	Olfaction, — 24mo Cognition, — 4mo Depression, ↓ 11-13mo	Olfactory Discrimination Test with Reward Association Novel Object Recognition Forced Swim Test, Tail Suspension Test	Motor, — 3, 24mo
[120]	Navarro et al, 2008	**Parkin KO** Exon 2 deletion	Mouse	C57BL/6	NA	M	6-8, 15-17	↓ Cognition	Novel Object Recognition	NA
[121]	Zhu et al, 2007	**Parkin KO** Exon 3 deletion	Mouse	C57Bl/6	NA	NS	6, 12, 15, 18, 21	Cognition, ↓ No age Anxiety, ↓ 6-15, 21mo	Morris Water Maze Light Dark Box	— Motor
[122]	Rial et al, 2014	**Parkin KO** Exon 3 deletion	Mouse	C57Bl/6	NA	M	5-6	— Olfaction — Depression — Anxiety ↓ Cognition	Olfactory Bedding Discrimination Test Forced Swim Test, Tail Suspension Test Elevated Plus Maze Novel Object Recognition, Spatial Recognition	↑ Motor
[123]	Itier et al, 2003	**Parkin KO** Exon 3 deletion	Mouse	129SV/C57BL6	NA	MF	2-24	Cognition, ↓ 4mo	Spontaneous Alternation	Motor, ↓ 5-6, 12mo Cell Count, — 15mo
[124]	Perez et al, 2005	**Parkin KO** Exon 2 deletion	Mouse	B6;129S4	NA	M	3, 6, 12, 18-22	Depression, — 12 ↓ 20mo Anxiety, —12, 20m	Forced Swim Test, Tail Suspension Test Light Dark Box, Elevated Plus Maze	↓ Motor

								Cognition, ↑ 12mo —21mo	Novel Object Recognition, Spontaneous Alternation, Straight-alley-swim escape, Black-White-Discrimination Swim task, Lashley III Swim Maze, Morris Water Maze, Passive Avoidance Test	
[125]	Kubli, et al 2013	**Parkin KO**	Mouse	129S4/SvJae	NA	M	3	—Cardio	ECG Recordings	NA
[126]	Hollville et al, 2020	**Parkin KO** Exon 3 deletion	Mouse	C57Bl/6	NA	MF	3-7, 17-19mo	Olfaction, — 6-7mo Cognition, — 5-7mo	Buried Pellet Test Morris Water Maze	Motor, — 3-5mo Cell Count, — 17-19mo

Table 1. Summary of all animal model characteristics, phenotypic tests performed and the outcomes. ↓ represents a significant impairment, ↑ represents an improvement and — represents no change between wildtype and transgenic animals. M – male, F – female, MF – male and female, NS – not specified. BAC – Bacterial Artificial Chromosomes, PAC – P1 derived artificial chromosome.

Supplementary Table S2

Study characteristics, phenotypic outcomes, and tests performed in genetic PD models used in 2 studies or fewer.

Ref no.	Author, Year	Model	Rodent	Target	Background Strain	Sex and Age (mo)	Outcome	Test Performed	Motor or Cell Count?
[127]	Pavia-Collado et al, 2021	A30P/A53T	Mouse	Double transgenic model of alpha-synuclein mutations under TH promotor	C57BL/6J	M, 5	↓ Anxiety — Depression ↓ Cognition	Light Dark Box Tail Suspension Test Novel Object Recognition	↓ Motor — Cell Count
[128]	Lelan et al, 2011	A30P/A53T	Rat	Double transgenic model of A30P and A53T under TH promotor	Sprague Dawley	F, 6, 9, 14, 18	Olfaction, ↓ 6, 9, 14mo	Olfactory Discrimination Test	Motor, — 14, 18mo
[4]	Valek et al, 2021	PINK KO/A53T	Mouse	Double transgenic model containing PINK KO and A53T	129/SvEv; FVB/N	NS, 13-16	Olfaction, — 16mo	NOR using odours	Motor, — 13-16mo

				mutation					
[15]	Do et al, 2021	GBA+/-/A53T and GBA+/-	Mouse	Double transgenic of GBA+/- and A53T, and model of single GBA+/- mutation	C57BL/6	MF, 8, 10, 12, 14, then monthly to 23mo	— Cognition Both models Olfaction, ↓ 20mo Both models	NOR Buried Pellet Test	— Motor Both models
[22]	Singh et al, 2019	Tau KO/A53T	Mouse	Double transgenic with mutant A53T and lacking endogenous Tau	C57BL/6	M, 3, 6, 12	— Cognition	Fear Conditioning, Y Maze	Motor, ↑ 6, 12mo
[19]	Peters et al, 2020	Tau KO/A53T	Mouse	Double transgenic with mutant A53T and lacking endogenous Tau	C57BL/6	MF, 3-4, 6-7, 9-10	↓ Circadian	EMG/EEG recordings	NA
[129]	Ikuno et al, 2019	a-syn/GBA+/-	Mouse	Double transgenic with BAC a-syn OE and heterozygous GBA mutation	B6/J	M, 15-18	Anxiety, ↑15mo Cognition, — 15mo	Centre of Open Field Barnes Maze	Motor, ↑ 15mo Cell count, ↓ 16-18mo
[130]	Hosford et al, 2020	αβγ-syn triple KO	Mouse	Triple transgenic model of alpha, beta, and gamma synuclein knock out	C57Bl/6	M, 3-4, 18-20	Cardio, 3-4mo ↓ 18-20mo	Non-invasive tail cuff plethysmography	NA
[131]	Tian et al, 2021	a-syn N103	Mouse	New transgenic model of PD overexpressing a-syn 1-103 fragments with Thy-1 promotor	C57BL/6	MF, 3, 9, 16	Anxiety, — 3mo ↓ 9-16mo ↓ GI Function	Centre of Open Field Faecal Pellet Output	Motor, — 3mo ↓ 9, 16mo Cell Count, — 3mo ↓9,16mo
[132]	Martinez ernandez et al, 2021	Ha-syn^{119} and ha-syn^{TP}	Mouse	C-terminal truncations of haSyn (ha-syn^{119}), and a-syn gene variant with three alanine to proline substitutions at residues 30, 56 and 76 (ha-syn^{TP})	C57BL/6	M, 12, 18	Olfaction, ↓ 18mo Both models	Buried Pellet Test	Motor, ↓ 12mo Ha-syn^{119} — 12mo Ha-syn^{TP} ↓18mo Both Models — Cell Count Both models
[133]	Escobar et	*SNCA*^{S129A}PAC	Mouse	2 models of S129	FVB/N x	MF,	↓ GI Function	Bead Expulsion Test	NA

	al, 2014	and *SNCA*^{S129D}PAC		phosphorylation mutation in alpha-synuclein	129S6	6	Both models		
[120]	Navarro et al, 2008	Park-/Tau^{VLW} and Tau^{VLW}	Mouse	Double transgenic model of Parkin deficient and a Tau^{VLW} model and a single model of Tau^{VLW} mutation	C57Bl/6	M, 6-8, 15-17	Cognition, ↓ 6-8mo Both models ↓15-17mo Tau^{VLW} only	Novel Object Recognition	NA
[111]	Mikhail et al, 2015	LRRK2 R1441G/Tau P301S and TauP301S	Mouse	Double transgenic model of LRRK2 R1441G and TauP301S mutation and a single model of TauP301S mutation	Unspecified	NS, 6-9	— Cognition Both models	Fear Conditioning	— Motor Both models
[134]	Craven et al, 2018	TauP301L	Mouse	Tau mutation model	C57Bl/6	MF, 5.5-7	↓ Cognition ↓ Circadian Rhythm	Morris Water Maze, Fear Conditioning and Extinction Activity Onset Running Wheel Activity	↑ Motor
[98]	Morris et al, 2013	Tau+/-	Mouse	Heterozygous Tau KO model	C57Bl/6	MF, 12-15, 21-22	Cognition, —21-22mo	Novel Object Recognition, Morris Water Maze	↓ Motor
[135]	Lambourne et al, 2007	TauV337M hemi	Mouse	Hemizygous mutation model of TauV337M under Thy1 promotor	C57BL/6J x CBA/Ca	M, 6, 10, 24-26	Cognition, — 10mo ↓ 24mo	5 Choice Serial Reaction Time Test	Motor, — 6, 24mo
[136]	Lambourne et al, 2005	TauV337M hemi	Mouse	Hemizygous mutation model of TauV337M under Thy1 promotor	C57Bl/6 x CBA/Ca	NS, 6, 12	Olfaction, — 6mo — 12mo Cognition, — 6mo ↓ 12mo	Food Preference Test STFP Olfactory Memory Paradigm	Motor, —12mo
[137]	Anvret et al, 2012	Adh1-/- and Adh1/4-/-	Mouse	Double KO of the ADH gene, relevant to the DA system	C57Bl/6	MF, 7, 15	— Olfaction Both models	Olfactory Hole Poke Test	Motor, ↑ 7mo Adh1 KO and Adh1/4 KO ↑ 15mo Adh1 KO

									— 15mo Adh1/4 KO
[138]	Belin et al, 2011	Adh4-/-	Mouse	KO of the Class IV ADH gene, relevant to the DA system	C57Bl/6	M, 12-17	↓ Olfaction	Olfactory Hole Poke Test	— Motor
[118]	Beccano-Kelly et al, 2015	LRRK2 OE	Mouse	Overexpression of LRRK2	Unspecified	M, 3-6	— Cognition	Novel Object Recognition	↓ Motor
[84]	Volta et al, 2015	LRRK2 OE	Mouse	Overexpression of LRRK2	C57Bl/6	M, 12	↓ Cognition	Novel Object Recognition	↓ Motor
[139]	Veenit et al, 2021	GPR37 KO	Mouse	KO of the G-protein-coupled receptor, implicated in DA system	C7Bl/6	MF, 3-4	↓ Anxiety ↓ Depression ↑ Cognition	Elevated Plus Maze, Light Dark Box Forced Swim Test Passive Avoidance Test	NA
[140]	Mandillo et al, 2013	GPR37 KO	Mouse	KO of the G-protein-coupled receptor, implicated in DA system		MF, 4-6, 16-18	Olfaction, — 4-6mo ↓ 16-18mo GI function, ↓ 4-6mo — 16-18mo — Cognition Anxiety, — 4-6mo ↓ 16-18mo Depression, — 4-6mo ↓ 16-18mo	Buried Pellet Test, Block Test, Odour habituation Test Faecal Output Test Fear conditioning Elevated Plus Maze, Centre of Open Field, Light Dark Box Forced Swim Test	NA
[141]	Morgan et al, 2015	DAT:TH KO and DAT-DTR	Mouse	Inactivation of Th gene in DAT neurons (DAT:TH KO), and targeted expression of human DT-receptor (DAT-DTR)	C57Bl/6	MF, 3-5	↓ Cognition Both models	Turn and Cued Discrimination Learning, Morris Water Maze, Novel Object Recognition	↓ Motor Both models

[142]	Buhusi et al, 2016	GDNF deficient	Mouse	Heterozygous model of GDNF deficiency; involved in DA regulation	C57Bl/6	M, 6-8	— Cognition	Temporal Discounting Paradigm	NA
[143]	Prediger et al, 2011	Mdk-/-	Mouse	Deletion of heparin-binding growth factor midkine, implicated in nigrostriatal development	C57Bl/6	M, 3-4	↓ Olfaction ↓ Cognition	Olfactory Discrimination Task Short Term Recognition Memory Task	— Motor ↓ Cell Count
[144]	Jiang et al, 2020	VMAT2 Het	Mouse	Mice from crossing CreERT2 and floxed Vmat2 gene. Selective inactivation of one allele of VMAT2 in DA neurons.	C57Bl/6	M, 18	↓ Olfaction — Circadian — Anxiety — Cognition — Depression	Social and Non-Social Olfactory Discrimination Test E-motion Test Elevated Plus Maze Novel Object Recognition Sucrose Preference Test, Tail Suspension Test	↓ Motor
[145]	Sonnier et al, 2007	En1+/-	Mouse	Heterozygous model lacking one En1 (engrailed1) allele, involved in DA neuron survival	Swiss	M, 1-11	Depression, ↓ 6, 8mo	Forced Swim Test, Saccharin Preference Test	Motor, ↓ 5mo — 6mo Cell Count, — 1mo ↓ 2, 3, 5, 11mo
[146]	Wu et al, 2020	B4galnt1 KO	Mouse	Disruption of *B4galnt1* gene leading to partial deficiency of GM1 family of gangliosides	C57Bl/6	MF, 8-9	↓ Cognition ↓ GI Function	Alternation Task (T maze) Faecal Pellet Output	↓ Motor ↓ Cell Count
[147]	Gil-Tommee et al, 2019	B4galnt1 KO	Mouse	Disruption of *B4galnt1* gene leading to partial deficiency of GM1 family of	NA	MF, 9, 12, 16, 19-20	Urinary, —9mo ↓ 12-20mo	Urination Patterns, Bladder Volumes	— Motor

				gangliosides					
[148]	Parrella et al, 2019	c-rel-/-	Mouse	Model deficient for the NF-κB/c-Rel protein, a transcription factor for mitochondrial antioxidant factors	C57Bl/6	M, 2, 5, 9, 15, 20	↓ GI Function — Anxiety ↓ Olfaction — Cognition	Faecal Pellet Output Centre of Open Field Test Odour Detection Test, Odour and item discrimination test, Odour preference Test Novel Object Recognition	NA
[126]	Hollville et al, 2020	Cul9/parkin KO and Cul9 KO	Mouse	Double knockout model of Cul9 and Parkin, both E3 ligases involved in mitochondrial function, and single Cul9 KO model	C57Bl/6	MF, 3-7	— Olfaction Both models — Cognition Both models	Buried Pellet Test Morris Water Maze	— Motor Both models — Cell Count Both models
[149]	Ageta-Ishihara et al, 2013	SEPT4+/-	Mouse	Parkin substrate that is a component of Lewy bodies	C57Bl/6	M, 5-9	↑ Anxiety — Depression — Cognition — Circadian	Elevated Plus Maze, Light Dark Box Forced Swim Test, Tail Suspension Test Fear Conditioning Home Cage Monitoring of Locomotion 24hrs	— Motor
[150]	Havrda et al, 2013	Id2 KO	Mouse	Transcription factor expressed in developing central nervous system	C57Bl/6	MF, 1, 3, 6	Anxiety, ↑ 1, 3mo — 6mo	Centre of Open Field, Elevated Plus Maze	Motor, ↑ 1, 3mo — 6mo Cell Count, — 1 mo ↓ 6mo

Table 2. Summary of all animal model characteristics, behavioural tests performed and the outcomes. ↓ represents a significant impairment, ↑ represents an improvement and – represents no change between wildtype and transgenic animals. M – male, F – female, MF – male and female, NS – not specified. PAC – P1 derived artificial chromosome.

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