

Supplementary Data - Statistical significance levels for phase analysis in main figure 5

Loc1	Loc2	k	p	H	n
M1	M1	-0,296009944	0,472362281		119
M1	OC	0,017697359	0,902313544		87
M1	OFC	-0,088160636	0,138640711		132
M1	S1	-0,787170559	2,76585E-05	***	79
M1	amyg	0,411805223	6,3127E-08	***	84
M1	dHipp	-0,149657134	0,017899518	*	77
M1	dStr	-0,565135231	4,23441E-17	***	173
M1	mPFC	-0,121892147	0,024508851	*	82
M1	thal	0,224019418	0,05913208		177
M1	vHipp	-0,661111981	1,1057E-05	***	53
M1	vStr	0,341119208	5,82084E-06	***	55
OC	OC	-0,162244841	0,506267371		71
OC	amyg	0,152515963	5,45548E-06	***	38
OC	dHipp	-0,235814125	3,10187E-07	***	104
OC	vHipp	-0,061147295	0,139078913		39
OFC	OC	-0,17709091	0,078979473		47
OFC	OFC	-0,257800189	0,447623636		37
OFC	amyg	-0,105091901	0,004245441	**	36
OFC	dHipp	-0,224848034	0,002562049	**	48
OFC	vHipp	-0,197019597	0,001425648	**	33
OFC	vStr	0,077386045	0,819868406		28
S1	OC	-0,072585771	0,004137208	**	21
S1	OFC	-0,194239056	0,612050976		49
S1	S1	-0,703886763	0,002624512	**	16
S1	amyg	0,192554094	0,002767775	**	58
S1	dHipp	-0,530810768	0,001731827	**	25
S1	dStr	-0,440812325	2,64299E-07	***	100
S1	mPFC	-0,243653778	0,016812693	*	35
S1	thal	-0,423289407	7,16408E-06	***	77
S1	vHipp	-1,292324093	3,16517E-06	***	29
S1	vStr	0,160082169	0,018066406	*	15
amyg	amyg	1,722205702	1,47113E-10	***	93
amyg	dHipp	0,155579356	0,097989303		16
amyg	vHipp	0,488921747	0,0078125	**	8
dHipp	dHipp	-0,166329584	0,829013032		30
dHipp	vHipp	-0,409618928	0,125705641		37
dStr	OC	-0,360428782	9,86526E-06	***	86
dStr	OFC	-0,253173334	3,65645E-06	***	97
dStr	amyg	0,387727444	1,82628E-11	***	151
dStr	dHipp	-0,412967775	1,17164E-09	***	85
dStr	dStr	-0,48972046	0,025667496	*	133
dStr	mPFC	-0,275230372	9,94711E-05	***	77
dStr	thal	-0,488929208	5,54793E-18	***	188
dStr	vHipp	-0,755914647	2,23384E-12	***	71
dStr	vStr	0,186377731	0,377742804		48
mPFC	OC	-0,063273137	0,587890625		13
mPFC	OFC	-0,02488694	0,345773558		54
mPFC	amyg	0,150217887	6,68817E-07	***	42
mPFC	dHipp	-0,171687783	0,073450861		21

mPFC	mPFC	0,012532734	0,807739258		14
mPFC	vHipp	-0,721135988	0,00193099	**	17
mPFC	vStr	0,462281491	0,009765625	**	11
thal	OC	-0,318706525	2,64859E-05	***	146
thal	OFC	-0,25129593	1,61379E-10	***	102
thal	amyg	0,333741808	2,9085E-07	***	109
thal	dHipp	-0,336472878	7,00612E-07	***	105
thal	mPFC	-0,436951524	0,009369031	**	54
thal	thal	-0,383913364	0,018883523	*	95
thal	vHipp	-0,728835633	2,24106E-06	***	68
thal	vStr	-0,024525559	0,487704864		82
vHipp	vHipp	-1,11097305	0,052246094		12
vStr	OC	-0,069905834	0,363352799		79
vStr	amyg	0,436209225	1,15759E-08	***	45
vStr	dHipp	-0,0939984	0,036147227	*	47
vStr	vHipp	0,07327887	0,234320972		16
vStr	vStr	0,173380399	0,876721743		16

Loc1	Loc2	k	p	H	n
M1	M1	-0,476776513	0,962401931		120
M1	OC	-0,026160288	0,365078057		87
M1	OFC	-0,170261736	0,059338925		130
M1	S1	-0,939005592	1,87022E-05	***	73
M1	amyg	0,760863578	3,73102E-13	***	84
M1	dHipp	-0,461648735	0,003061985	**	76
M1	dStr	-0,688446269	1,2152E-20	***	173
M1	mPFC	-0,279405219	0,027067848	*	81
M1	thal	0,085142915	0,7370521		175
M1	vHipp	-0,703420903	2,03912E-06	***	53
M1	vStr	0,234396154	0,00643503	**	63
OC	OC	-0,278186025	0,197324025		71
OC	amyg	0,149813469	9,15325E-07	***	38
OC	dHipp	-0,259106137	3,31636E-06	***	104
OC	vHipp	-0,008363825	0,459533704		39
OFC	OC	-0,267224456	0,02626619	*	47
OFC	OFC	-0,562686426	0,019713757	*	33
OFC	amyg	-0,056091762	0,031369896	*	36
OFC	dHipp	-0,235258985	6,20641E-07	***	48
OFC	vHipp	-0,255571969	3,01755E-05	***	33
OFC	vStr	-0,256680062	0,020674093	*	33
S1	OC	-0,182032511	0,000418868	***	21
S1	OFC	-0,204379806	6,18179E-06	***	42
S1	S1	-1,222378967	0,006713867	**	15
S1	amyg	-0,016772302	0,256688027		58
S1	dHipp	-0,516415292	2,3518E-05	***	24
S1	dStr	-0,775086955	1,47621E-11	***	99
S1	mPFC	-0,56267844	1,62342E-05	***	31
S1	thal	-0,730389985	1,46826E-08	***	75
S1	vHipp	-1,370032359	2,8489E-06	***	29
S1	vStr	0,069113504	0,325870024		16
amyg	amyg	1,046502686	5,81106E-09	***	93
amyg	dHipp	0,140952608	0,133729893		16
amyg	vHipp	0,296818247	0,078125		8
dHipp	dHipp	-0,312246978	0,011748106	*	30
dHipp	vHipp	-0,513882397	0,078823718		37
dStr	OC	-0,53161327	7,89154E-13	***	86
dStr	OFC	-0,318461562	3,52973E-10	***	97
dStr	amyg	0,17951389	4,39346E-07	***	151
dStr	dHipp	-0,502791811	1,01104E-10	***	85
dStr	dStr	-0,82808276	3,57434E-05	***	133
dStr	mPFC	-0,400249574	5,57055E-10	***	77
dStr	thal	-0,725269594	4,15996E-22	***	188
dStr	vHipp	-0,839984842	1,80361E-11	***	71
dStr	vStr	-0,003563562	0,807455321		51
mPFC	OC	-0,110748516	0,146484375		13
mPFC	OFC	-0,126064722	0,023809944	*	54
mPFC	amyg	-0,04818705	0,935224198		42
mPFC	dHipp	-0,474755076	0,001865752	**	21

mPFC	mPFC	-0,033104125	0,583007813		14
mPFC	vHipp	-0,797321765	0,000420791	***	17
mPFC	vStr	0,115964223	0,846923828		15
thal	OC	-0,331143854	4,14525E-09	***	146
thal	OFC	-0,165968859	3,27156E-09	***	102
thal	amyg	0,217651998	2,87655E-05	***	109
thal	dHipp	-0,477691865	5,15842E-09	***	105
thal	mPFC	-0,483408662	0,001648659	**	54
thal	thal	-0,473350746	0,00786884	**	95
thal	vHipp	-0,876828748	5,40215E-07	***	68
thal	vStr	-0,043429979	0,04304771	*	82
vHipp	vHipp	-1,065722932	0,042480469	*	12
vStr	OC	-0,177388069	0,002651029	**	79
vStr	amyg	0,248795363	2,54145E-08	***	45
vStr	dHipp	-0,115342486	0,006568092	**	48
vStr	vHipp	0,210866545	0,000531243	***	16
vStr	vStr	0,259055173	0,836138662		16

Loc1	Loc2	k	p	H	n
M1	M1		-0,052358681	0,945713516	120
M1	OC		-0,301180006	3,66373E-08 ***	87
M1	OFC		-0,042739583	0,190210339	141
M1	S1		-0,676511577	4,54185E-09 ***	73
M1	amyg		-0,372092426	1,1694E-07 ***	84
M1	dHipp		-0,253172325	0,009829859 **	87
M1	dStr		-0,536435338	8,49797E-19 ***	168
M1	mPFC		0,010013097	0,422113526	92
M1	thal		-0,434659055	8,46733E-18 ***	170
M1	vHipp		-0,612489471	7,90859E-08 ***	53
M1	vStr		-0,146161767	0,000277677 ***	63
OC	OC		-0,13841045	0,040239567 *	71
OC	amyg		-0,278598277	2,52639E-06 ***	38
OC	dHipp		-0,10418814	5,11957E-06 ***	103
OC	vHipp		0,131724907	0,012361866 *	38
OFC	OC		-0,189407068	0,189456818	47
OFC	OFC		0,12642852	0,386923609	39
OFC	amyg		0,040087154	0,441407759	36
OFC	dHipp		-0,167159027	0,000205258 ***	58
OFC	vHipp		-0,058804355	0,140455771	33
OFC	vStr		-0,008181389	0,743227084	35
S1	OC		-0,123309848	0,00061791 ***	21
S1	OFC		-0,140179447	0,047263339 *	44
S1	S1		-0,399838637	0,063720703	15
S1	amyg		0,456047876	0,010502025 *	58
S1	dHipp		-0,440105762	0,000526647 ***	26
S1	dStr		-0,256260168	0,215325919	99
S1	mPFC		-0,0711275	0,190559491	33
S1	thal		-0,473423195	2,40498E-07 ***	75
S1	vHipp		-0,881418707	6,04355E-05 ***	29
S1	vStr		-0,064218477	0,876721743	16
amyg	amyg		1,58418246	7,61768E-05 ***	93
amyg	dHipp		-0,114782822	0,605094946	16
amyg	vHipp		-0,493114302	0,25	8
dHipp	dHipp		0,075215952	0,935914967	33
dHipp	vHipp		-0,217337409	0,9939815	37
dStr	OC		-0,228148246	4,03503E-06 ***	86
dStr	OFC		-0,176614342	0,001737711 **	96
dStr	amyg		0,453487022	1,00757E-16 ***	151
dStr	dHipp		-0,249862478	2,34877E-07 ***	89
dStr	dStr		0,351882771	0,000304632 ***	132
dStr	mPFC		-0,032958154	0,787692371	78
dStr	thal		-0,453147922	1,04165E-17 ***	186
dStr	vHipp		-0,403753226	7,84863E-06 ***	71
dStr	vStr		-0,02771497	0,822007899	51
mPFC	OC		-0,19112779	0,032714844 *	13
mPFC	OFC		0,014278789	0,250799319	67
mPFC	amyg		0,70418368	6,8218E-05 ***	42
mPFC	dHipp		-0,265628239	0,047578509 *	31
mPFC	mPFC		0,005167682	0,846923828	20
mPFC	vHipp		-0,560176378	0,000293053 ***	17
mPFC	vStr		-0,021362834	0,917631593	17
thal	OC		-0,120510063	2,82429E-05 ***	146
thal	OFC		-0,188689793	6,4611E-05 ***	96
thal	amyg		0,110382078	0,019865635 *	109
thal	dHipp		-0,380589514	1,60249E-10 ***	104

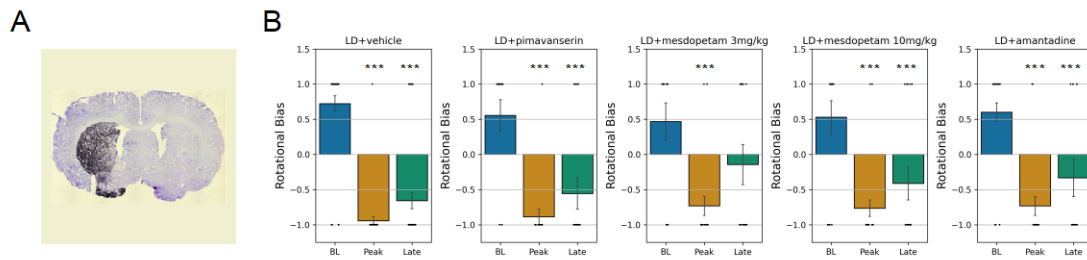
thal	mPFC	-0,513219526	0,005773518 **	50
thal	thal	-0,215837863	0,685932774	95
thal	vHipp	-0,596243758	0,00065431 ***	68
thal	vStr	0,009720342	0,304757452	82
vHipp	vHipp	-0,698109514	0,063964844	12
vStr	OC	-0,135405059	0,127317548	79
vStr	amyg	0,316032455	0,002727894 **	45
vStr	dHipp	-0,067825397	0,002993709 **	50
vStr	vHipp	0,175155647	0,034001025 *	16
vStr	vStr	0,15234022	0,147660256	16

Loc1	Loc2	k	p	H	n
M1	M1	-0,305226619	0,944348234		99
M1	OC	-0,06963571	0,034309447	*	45
M1	OFC	-0,179009055	0,000386521	***	127
M1	S1	-0,602795085	3,45044E-06	***	59
M1	amyg	-0,419819484	5,382E-10	***	56
M1	dHipp	-0,22402055	0,074859809		59
M1	dStr	-0,168188006	9,91423E-05	***	147
M1	mPFC	-0,422759121	2,40245E-13	***	77
M1	thal	-0,269342066	7,10098E-11	***	128
M1	vHipp	-0,314059119	0,005254554	**	39
M1	vStr	-0,15136658	0,006788542	**	42
OC	OC	0,306465182	0,001347184	**	56
OC	amyg	0,237278123	0,153076172		14
OC	dHipp	0,183275303	3,94939E-06	***	80
OC	vHipp	0,11132895	0,142777753		27
OFC	OC	-0,143098509	0,053268374		35
OFC	OFC	-0,329080825	0,658258089		38
OFC	amyg	-0,002634804	0,7326735		28
OFC	dHipp	-0,140578825	0,004215403	**	48
OFC	vHipp	0,187582969	0,00316166	**	29
OFC	vStr	-0,087533747	0,198240555		29
S1	OC	0,157644184	0,8203125		9
S1	OFC	0,172784795	0,039732566	*	40
S1	S1	-0,029966101	0,241210938		14
S1	amyg	0,255560633	0,005680697	**	50
S1	dHipp	-0,189733654	0,327143875		18
S1	dStr	0,22882389	4,20095E-07	***	93
S1	mPFC	-0,002507085	0,585711569		30
S1	thal	-0,012508369	0,98907554		63
S1	vHipp	0,174063515	0,798247624		25
S1	vStr	0,077575522	0,6953125		10
amyg	amyg	2,126479292	1,77431E-12	***	87
dHipp	dHipp	0,066170274	0,548089799		27
dHipp	vHipp	-0,194959044	0,837243675		29
dStr	OC	0,412872367	2,46404E-06	***	68
dStr	OFC	-0,021997384	0,157266028		90
dStr	amyg	0,073473455	7,98186E-06	***	139
dStr	dHipp	-0,040319791	0,053362445		77
dStr	dStr	0,351240513	6,30119E-08	***	129
dStr	mPFC	-0,001197654	0,928456403		72
dStr	thal	0,134407746	4,82285E-06	***	168
dStr	vHipp	0,081520427	0,934895857		65
dStr	vStr	0,70731962	0,00139983	**	42
mPFC	OC	-0,044571363	0,8125		7
mPFC	OFC	-0,008094645	0,243928587		58
mPFC	amyg	0,163072552	0,00031358	***	38
mPFC	dHipp	-0,095308885	0,002030638	**	24
mPFC	mPFC	-0,011168073	0,977966309		15
mPFC	vHipp	0,091865924	0,890380859		15

mPFC	vStr	-0,00987862	0,587890625		13
thal	OC	0,261150853	4,58111E-09 ***		110
thal	OFC	0,083183118	0,017663311 *		84
thal	amyg	0,010098881	0,119300415		85
thal	dHipp	0,101777746	0,091354981		80
thal	mPFC	-0,358502047	0,00509688 **		44
thal	thal	-0,107572794	0,874238155		80
thal	vHipp	-0,273695958	0,020973849 *		56
thal	vStr	0,255098784	0,000185258 ***		64
vHipp	vHipp	0,394137121	0,764648438		11
vStr	OC	0,290097083	0,000142793 ***		61
vStr	amyg	0,173652621	3,26327E-05 ***		33
vStr	dHipp	0,470120997	0,000637151 ***		38
vStr	vHipp	-0,004665717	0,845703125		10
vStr	vStr	0,418377994	0,057373047		13

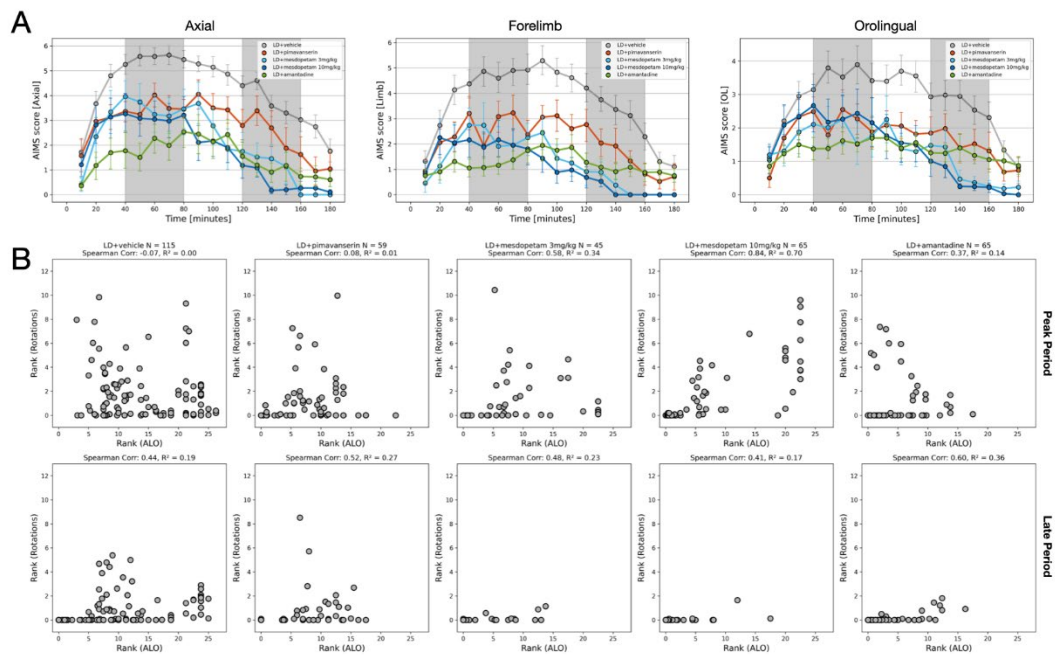
Wires were located in 95 anatomical structures (Paxinos & Watson). Locations were grouped into 27 broader functional groups.

anatomical system	AI	AO	AI	AV	SL2	SL3	ST1	ST3
accusatorial system	3	0	0	0	0	0	0	0
angular insular cortex	0	0	0	0	3	0	0	2
amygdala	0	0	0	12	0	0	7	4
auditory	0	0	0	0	1	0	0	0
dorsal hippocampus	0	0	0	0	7	0	0	0
dorsal striatum	4	4	4	11	11	5	1	1
globus pallidus	0	0	0	0	0	0	0	0
globus pallidus	0	0	0	0	0	1	0	0
hippocampus	0	0	0	0	0	0	0	0
medial geniculate nucleus	0	0	0	0	0	0	0	0
olfactory cortex	0	0	0	1	11	2	6	4
orbitofrontal cortex	7	0	0	0	5	0	0	0
parietal association cortex	0	0	0	0	4	0	0	0
prefrontal cortex	8	0	0	2	3	0	2	1
prelunate	0	0	0	0	0	0	0	0
primary motor cortex	8	7	7	0	2	8	7	7
primary somatosensory cortex	0	0	0	0	0	0	0	0
primary visual cortex	0	0	0	0	0	0	0	0
secondary motor cortex	4	0	0	0	1	0	0	0
secondary somatosensory cortex	0	0	0	0	0	0	0	0
septum	0	0	0	1	0	0	0	0
substantia nigra, reticular part	0	0	0	0	0	0	0	0
subthalamic nucleus	0	0	0	0	0	0	0	1
thalamus	0	0	0	0	0	0	0	0
ventral hippocampus	0	0	0	0	5	2	0	2
ventral pallidum	1	0	0	1	0	5	0	0
ventral striatum	1	0	0	1	0	5	0	3



Supplementary Figure 2 – Assessment of 6-OHDA lesion severity.

A) Example brain section stained for tyrosine hydroxylase (TH) from a rat lesioned with 6-OHDA in the MFB of the right hemisphere, illustrating the extent of dopaminergic neuron loss. **B)** Rotational bias quantified as the net change in the cumulative angle shift over time, calculated by subtracting the initial value from the final value during each experimental period: Baseline (< -20 minutes), Peak (40–80 minutes), and Late (120–160 minutes). Positive and negative values of the net change indicate ipsilateral and contralateral rotational bias, respectively. Data are presented as Mean $\pm$ SEM, with individual data points representing recording sessions. Statistical significance was assessed using a GLME and Tukey-HSD post test. *** $p < 0.0001$.



Supplementary Figure 3 - Quantification of abnormal involuntary movements involving different muscle groups.

A) Time course of Axial, Forelimb and Orolingual AIMs for each drug treatment after L-DOPA administration. Values represent AIMs scored during 1-min periods sampled every 10 min. For details on scoring procedures see Methods. **B)** Relationship between Rotational events and Global AIMs scores (ALO) for each treatment either during Peak (top row) or Late period (bottom row). Spearman correlation coefficients were calculated for the rank-transformed data to account for potential non-linear relationships between variables. Spearman correlation scores and R² are shown over each graph. Circles represent datapoints in each time bin within the indicated period.