

## **Supplementary Methods**

**Analysis of stimulus rate:** Participants did not indicate during scanning what beat rate they perceived in the different conditions, as this could have contaminated beat perception activation with response-preparation or -execution activation. This meant it was possible that more ‘beats’ could be perceived in the unaccented beat condition, as no external accents were present to influence the perceived beat rate. However, within each condition the rate varied from trial to trial, allowing an analysis of neural response to rate to be conducted. If the activity in beat-responsive areas does not correlate with rate, then any differences in activity between beat conditions are unlikely to be due to simple rate effects.

For this analysis, the subject-specific first level models were as before, but with the different rates in each condition modeled separately. A correlation analysis (examining signal for a linear correlation with stimulus rate) and an ANOVA (using tempo as a factor) were conducted to examine each region of interest’s signal for an effect of rate.

## **Supplementary Results**

### **Behavioral results.**

During scanning in experiment one, the mean proportion of deviants in each condition correctly detected for the musicians was: DB = .98 (SE = .01), DN = .82 (SE = .04), VB = .92 (SE = .05), VN = .86 (SE = .06). For the non-musicians: DB = .79 (SE = .05), DN = .80 (SE = .06), VB = .77 (SE = .04), VN = .61 (SE = .07). A mixed ANOVA including Beat, Accent type, and Musical training showed significant effects of Beat ( $F(1,34) = 7.35$ ,  $p = .01$ ) and Musical training ( $F(1,34) = 11.59$ ,  $p < .001$ ). There was a marginal effect of Accent type ( $F(1,34) = 3.18$ ,  $p = .08$ ). These main effects, however, are qualified by a significant 3-way interaction between Beat,

Accent type, and Musical training ( $F(1,34) = 6.38, p = .016$ ). This reflects the fact that musicians perform more accurately than non-musicians in all conditions apart from the DN condition, where there is no significant difference between the groups.

### **Beat rate results**

Analyses of the effects of stimulus rate were conducted for the caudate, putamen, and pallidum, as these areas were active in the Beat – Nonbeat contrasts. First, an analysis of correlation with rate was conducted, examining each region's activity for a correlation with rate, in each condition separately. No significant correlation with rate was found within any of the regions for any of the conditions. In addition, one-way ANOVAs were conducted on each region's activity in each condition, with rate as the factor. No significant effects of rate were found in this analysis, within any of the basal ganglia regions.

**Supplementary Table 1. Rhythmic sequences for beat-based duration (DB) condition**

Rhythms
22413
31422
43122
221422
211224
221331
222114
311322
422112
1111431
1122114
1123113
1123122
2112231
2113113
2211114
3122112
3141111
4111131
4221111

1 = 180 - 220 ms (in steps of 8 ms). All other intervals in that sequence are multiplied by length chosen for the 1 interval.

**Supplementary Table 2. Stereotaxic locations of peak voxels in all rhythms – rest SPM contrast for experiment 1.**

Brain Region	t score	x	y	z
R middle frontal gyrus	3.72	42	38	28
R inferior frontal gyrus p. triangularis	6.79	44	22	8
R insula	6.51	34	28	2
L insula	4.67	-34	20	2
R SMA	5.39	6	0	66
L SMA	3.77	-6	-4	66
R precentral gyrus	7.39	54	0	48
L postcentral gyrus	5.98	-52	-10	50
L precentral gyrus	4.07	-48	-8	54
L superior temporal gyrus	22.82	-50	-20	4
L superior temporal gyrus	20.72	-42	-34	10
R superior temporal gyrus	21.14	56	-14	4
R superior temporal gyrus	19.94	56	-24	6
R supramarginal gyrus	4.18	62	-42	32
R inferior parietal Lobule	2.8	46	-50	46
L cerebellum crus 1	4.04	-30	-64	-28
L cerebellum VIII lobule	4.04	-28	-62	-50
R cerebellum VI lobule	3.24	28	-60	-28
R putamen	3.13	24	2	8

This table shows the brain region, t values, and stereotaxic coordinates (in mm) of peak voxels ( $p < .05$  whole-brain FDR corrected) in MNI space.

**Supplementary Table 3. Stereotaxic locations of peak voxels in Volume conditions – Duration conditions for experiment 1.**

<b>Brain Region</b>	<b>t score</b>	<b>x</b>	<b>y</b>	<b>z</b>
R superior frontal gyrus	3	20	8	68
L superior medial gyrus	3.57	-2	24	54
L superior medial gyrus	3.43	-6	32	46
R middle frontal gyrus	4.55	46	16	42
R middle frontal gyrus	4.39	36	4	62
R middle frontal gyrus	3.73	44	44	18
R middle frontal gyrus	3.61	40	26	26
R middle frontal gyrus	3.34	48	38	28
R middle frontal gyrus	3.51	42	34	40
R middle frontal gyrus	3.4	30	56	30
R middle orbital gyrus	3.04	42	46	-6
L middle frontal gyrus	3.79	-42	22	42
L middle frontal gyrus	3.64	-44	18	44
L middle frontal gyrus	3.43	-50	12	42
L middle orbital gyrus	3	-40	46	-2
R middle cingulate cortex	2.9	10	34	36
R pre-supplementary motor area	3.09	8	20	66
L precentral gyrus	3.4	-44	-6	36
R inferior frontal gyrus p. triangularis	3.84	50	28	32
R inferior frontal gyrus p. triangularis	3.79	42	22	36
R inferior frontal gyrus p. triangularis	3.14	32	14	34
R inferior frontal gyrus p. opercularis	3.47	34	8	38
R inferior frontal gyrus p. opercularis	3.15	28	12	32
R inferior frontal gyrus p. opercularis	3.81	38	6	40
R inferior frontal gyrus p. orbitalis	3.35	48	46	2
L inferior frontal gyrus p. opercularis	2.97	-50	8	32

L inferior frontal gyrus p. triangularis	2.8	-38	6	32
L inferior frontal gyrus p. triangularis	3.38	-48	38	16
L inferior frontal gyrus p. triangularis	3.19	-54	30	16
L inferior frontal gyrus p. triangularis	3.12	-48	36	20
R superior temporal gyrus	11.52	64	-14	4
L superior temporal gyrus	9.71	-40	-34	14
L middle temporal gyrus	12.56	-56	-22	6
L middle temporal gyrus	4.12	-66	-36	-4
L middle temporal gyrus	3.33	-52	-60	4
L inferior temporal gyrus	3.73	-56	-50	-10
R middle temporal gyrus	4.98	70	-32	2
R middle temporal gyrus	3.25	64	-50	-2
R middle temporal gyrus	3.74	68	-40	-6
R inferior temporal gyrus	2.95	62	-34	-16
R inferior temporal gyrus	3.47	56	-50	-16
R inferior parietal lobule	3.79	42	-50	46
R inferior parietal lobule	2.92	52	-42	54
R inferior parietal lobule	3.7	42	-56	50
R inferior parietal lobe	3.6	34	-62	48
L inferior parietal lobule	4.41	-48	-48	42
L inferior parietal lobule	4.18	-50	-54	50
L inferior parietal lobule	3.08	-42	-62	54
R supramarginal gyrus	3.76	62	-38	42
R supramarginal gyrus	3.57	60	-40	44
R supramarginal gyrus	3.43	56	-44	42
L supramarginal gyrus	4.92	-64	-42	36
L cerebellum viii	3.51	-32	-70	-48
L cerebellum crus 2	3.29	-12	-78	-32
L cerebellum vii	2.81	-38	-64	-40

R cerebellum crus 2	3.47	10	-78	-32
R thalamus	3.11	18	-26	22
R thalamus	3.06	22	-32	16
L thalamus	3.03	-12	-22	22
L thalamus	3.16	-18	-24	-2

**Supplementary Table 4. Stereotaxic locations of peak voxels in Volume Nonbeat – Volume Beat contrast for experiment 1.**

<b>Brain Region</b>	<b>t score</b>	<b>x</b>	<b>y</b>	<b>z</b>
L superior medial gyrus	3.72	-8	24	44
R middle frontal gyrus	3.08	48	44	14
L inferior frontal gyrus p. triangularis	4.69	-46	12	26
L inferior frontal gyrus p. triangularis	4.4	-46	16	2
L inferior frontal gyrus p. triangularis	2.79	-40	26	22
R inferior frontal gyrus p. opercularis	5.34	52	10	20
R inferior frontal gyrus p. opercularis	4.84	40	12	26
R inferior frontal gyrus p. opercularis	4.66	60	18	28
R inferior frontal gyrus p. orbitalis	4.6	32	26	-6
R inferior frontal gyrus p. triangularis	5.69	44	22	12
R inferior frontal gyrus p. triangularis	5.02	46	24	24
R inferior frontal gyrus p. triangularis	4.72	56	26	26
R inferior frontal gyrus p. triangularis	4.7	54	28	24
R inferior frontal gyrus p. triangularis	2.89	50	40	14
L insula	5.03	-34	24	4
R insula	4.68	34	24	-4
L premotor cortex	4.48	-52	-6	48
R premotor cortex	4.99	54	2	44
R ventral premotor cortex	4.87	40	2	38
R premotor cortex	4.69	56	8	40
L SMA	4	-6	14	54
L SMA	2.8	-2	0	66
R SMA	3.42	6	18	48
R SMA	3.42	8	12	60
R SMA	2.95	10	4	70
L superior temporal gyrus	7.49	-54	-40	12



L superior temporal gyrus	7.31	-66	-36	10
L superior temporal gyrus	4.91	-54	-2	-8
L superior temporal gyrus	4.07	-48	-16	-6
R superior temporal gyrus	8.23	56	-24	0
R superior temporal gyrus	5.54	56	-6	-4
L middle temporal gyrus	7.7	-58	-38	10
L middle temporal gyrus	7.51	-66	-26	4
L middle temporal gyrus	5.69	-52	-22	0
L middle temporal gyrus	3.09	-44	-2	-16
R middle temporal gyrus	6.79	70	-36	6
R inferior parietal lobule	3.2	40	-52	44
R thalamus	3.58	12	-12	4
L thalamus	3.03	-14	-10	0
R midbrain	3.13	12	-18	-8
L midbrain	2.83	-8	-10	-6
Cerebellar vermis 6	2.72	0	-58	-20
L cerebellum crus 1	3.48	-12	-74	-28
L cerebellum crus 1	3.15	-20	-70	-36
L cerebellum IV-V	2.78	-8	-36	-12
L cerebellum VI	4.44	-24	-64	-28
L cerebellum VI	4.01	-12	-76	-20
L cerebellum VI	2.75	-38	-68	-22
R cerebellum VI	3.08	20	-70	-26
R cerebellum VI	3.07	28	-64	-28
R cerebellum VI	2.75	36	-68	-24
R cerebellum VI	2.78	16	-58	-28
L cerebellum VII	3.14	-16	-74	-40
L cerebellum VIII	3.24	-28	-62	-50
R cerebellum crus 2	2.92	14	-76	-34

**Supplementary Table 5. Stereotaxic locations of peak voxels in Beat x Accent interaction SPM contrast for experiment 1.**

<b>Brain Region</b>	<b>t score</b>	<b>x</b>	<b>y</b>	<b>z</b>
L inferior frontal gyrus p. triangularis	3.28	-50	38	6
L inferior frontal gyrus p. opercularis	3.89	-46	14	2
L inferior frontal gyrus p. opercularis	4.59	-44	14	22
L inferior frontal operculum	4.38	-32	24	4
R inferior frontal gyrus p. opercularis	4.78	54	20	28
R inferior frontal gyrus p. triangularis	4.16	44	22	12
R inferior frontal gyrus p. opercularis	4.61	50	12	16
R inferior frontal gyrus p. opercularis	4.23	44	14	26
R inferior frontal gyrus p. opercularis	3.57	50	16	2
R inferior frontal gyrus p. orbitalis	3.89	30	26	-8
R inferior frontal gyrus p. triangularis	4	42	20	22
L premotor cortex	4.91	-52	-8	48
L ventral premotor cortex	2.9	-46	2	36
R premotor cortex	4.66	54	0	46
R ventral premotor cortex	4.11	40	0	38
R ventral premotor cortex	4.1	38	2	36
L SMA	3.97	-2	0	66
L SMA	3.96	-8	16	52
R SMA	3.79	8	2	66
L superior temporal gyrus	4.43	-54	-2	-8
L superior temporal gyrus	4.19	-54	-6	-6
L superior temporal gyrus	3.73	-44	-10	-10
L superior temporal gyrus	2.85	-36	-34	10
L superior temporal gyrus	6.84	-50	-44	18
L superior temporal gyrus	6.88	-56	-38	12
L superior temporal gyrus	2.94	-42	0	-16

R superior temporal gyrus	4.03	58	-4	-2
R superior temporal gyrus	6.71	56	-34	4
R superior temporal gyrus	5.44	70	-34	4
R superior temporal gyrus	6.07	52	-40	12
R middle temporal gyrus	7.16	56	-26	0
R middle temporal gyrus	5.82	70	-24	0
L middle temporal gyrus	5.88	-66	-26	4
R temporal pole	4.53	56	4	-6
R inferior Parietal Lobule	2.91	42	-50	46
L cerebellum VI lobule	4	-26	-62	-26
L cerebellum VI lobule	3.61	-14	-74	-16
R cerebellum VI lobule	3.67	30	-62	-26
R cerebellum VI lobule	3.28	26	-74	-24
R putamen	3.12	24	4	4
R putamen	2.98	24	2	8
L putamen <sup>†</sup>	2.57	-22	2	4
R thalamus	3.07	12	-12	2

This table shows the brain region, t values, and stereotaxic coordinates (in mm) of peak voxels ( $p < .05$  whole-brain FDR corrected) in MNI space. <sup>†</sup>  $p = .07$ .

**Supplementary Table 6. Stereotaxic locations of peak voxels in Beat – No beat PPI with anterior putamen.**

Brain Region	t score	x	y	z
L SMA	2.83	-6	-4	70
R SMA	2.47	6	2	68
L Premotor cortex	3.19	-52	-10	50
R Premotor cortex	2.49	54	-2	46
R STG	2.57	56	-18	4

This table shows the brain region, t values, and stereotaxic coordinates (in mm) of peak voxels in MNI space ( $p < .05$  SVC corrected).

**Supplementary Table 7. Stereotaxic locations of peak voxels for DB – VB in cortical PPI analyses.**

Source Region	Target Region	t score	x	y	z	Mus > non t-score
L PMC	L STG	3.18	-52	-22	6	1.86
	R STG	4.59	56	-14	2	1.43
	R PMC	2.08	54	2	48	0.43
L SMA	L STG	4.79	-54	-20	4	*2.84
	R STG	4.4	58	-12	4	*2.26
	R PMC	3.29	54	0	44	0.21
R SMA	L STG	3.69	-54	-20	4	*2.58
	R STG	3.32	58	-12	2	*2.26
	R PMC <sup>†</sup>	2.1	54	-2	46	0.27

This table shows the source and target brain regions for the reported PPI analyses, t values, and stereotaxic coordinates (in mm) of peak voxels ( $p < .05$  SVC corrected) in MNI space.

<sup>†</sup>RSMA to RPMC significance is marginal ( $p = .067$ ). The mus > non t-score indicates the correlation difference between musicians and nonmusicians (\* =  $p < .05$ , independent samples t-test on mean correlation parameter estimates drawn from each region).

Supplementary Figure 1. Mean activity levels (arbitrary units) for peak voxels showing significant interaction between beat and accent type in whole-brain contrast of (DB-DN) – (VB-VN). \* = interaction is significant at  $p < .05$  FDR corrected.

