Brain Correlates of Motor Complexity during Observed and Executed Actions

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Supplementary materials

Table S1. Mean and standard deviation of the 3D position of optodes (short-distance detectors not included) across subjects (n=18).

| Optodes | X     | Y     | Z     | Standard Deviation (mm) |
|---------|-------|-------|-------|-------------------------|
| 1       | 62.64 | 125.33| 63.03 | 13.70                   |
| 2       | 48.45 | 122.39| 93.21 | 10.95                   |
| 3       | 45.61 | 121.56| 124.34| 9.03                    |
| 4       | 47.25 | 123.55| 151.90| 9.48                    |
| 5       | 55.27 | 129.72| 180.03| 10.33                   |
| 6       | 59.81 | 90.96 | 93.29 | 11.86                   |
| 7       | 57.78 | 86.61 | 125.45| 11.04                   |
| 8       | 60.47 | 92.55 | 156.01| 11.27                   |
| 9       | 207.32| 133.97| 178.53| 8.38                    |
| 10      | 212.09| 130.5 | 153.07| 8.43                    |
| 11      | 214.49| 126.04| 121.70| 10.88                   |
| 12      | 208.87| 126.27| 87.83 | 13.87                   |
| 13      | 191.21| 125.57| 59.01 | 18.03                   |
| 14      | 202.27| 99.56 | 158.75| 9.88                    |
| 15      | 207.91| 97.05 | 125.61| 10.38                   |
| 16      | 201.19| 94.55 | 90.57 | 13.62                   |
| 17      | 68.13 | 144.41| 52.01 | 15.02                   |
| 18      | 52.14 | 139.44| 80.15 | 11.32                   |
| 19      | 42.55 | 139.41| 107.41| 9.91                    |
| 20      | 44.96 | 141.15| 138.20| 9.57                    |
| 21      | 47.64 | 146.69| 163.16| 9.00                    |
| 22      | 58.83 | 148.30| 191.03| 9.87                    |
| 23      | 82.29 | 111.39| 49.16 | 15.69                   |
| 24      | 59.31 | 108.33| 76.31 | 12.11                   |
| Index | Column 1 | Column 2 | Column 3 | Column 4 |
|-------|----------|----------|----------|----------|
| 25    | 49.23    | 104.20   | 110.35   | 10.22    |
| 26    | 50.98    | 103.77   | 140.28   | 9.77     |
| 27    | 54.61    | 111.34   | 168.23   | 10.29    |
| 28    | 68.10    | 117.61   | 194.67   | 10.92    |
| 29    | 201.94   | 150.24   | 191.32   | 8.63     |
| 30    | 212.35   | 147.25   | 159.98   | 8.60     |
| 31    | 214.44   | 141.61   | 134.07   | 9.57     |
| 32    | 214.77   | 139.62   | 102.02   | 11.92    |
| 33    | 203.40   | 143.67   | 78.05    | 26.41    |
| 34    | 185.71   | 146.67   | 53.34    | 34.10    |
| 35    | 195.52   | 121.27   | 191.65   | 8.94     |
| 36    | 205.26   | 114.32   | 169.69   | 9.04     |
| 37    | 211.37   | 114.57   | 139.17   | 9.81     |
| 38    | 211.89   | 110.25   | 105.20   | 12.19    |
| 39    | 196.70   | 108.01   | 72.67    | 15.68    |
| 40    | 173.28   | 109.89   | 49.28    | 19.78    |
Table S2. MNI coordinates and brain regions of channels.

| Channels | MNI        | Label name            | Brodmann area | ROIs                        |
|----------|------------|-----------------------|---------------|-----------------------------|
| 1        | 44 -67 13  | Temporal_Mid_R        | Right BA 19   |                             |
| 2        | 63 -64 18  | Temporal_Mid_R        | Right BA 39   | Right TPJ                   |
| 3        | 44 -62 21  | Temporal_Mid_R        | Right BA 39   |                             |
| 4        | 51 -76 28  | Occipital_Mid_R       | Right BA 39   | Right MOG                   |
| 5        | 39 -50 26  | Angular_R             | Right BA 39   | Right TPJ                   |
| 6        | 68 -51 19  | Temporal_Mid_R        | Right BA 39   |                             |
| 7        | 56 -41 17  | Temporal_Sup_R        | Right BA 22   | Right STS                   |
| 8        | 60 -50 29  | SupraMarginal_R       | Right BA 39   | Right TPJ                   |
| 9        | 48 -42 26  | SupraMarginal_R       | Right BA 40   | Right IPL and supramarginal gyrus |
| 10       | 64 -23 18  | SupraMarginal_R       | Right BA 40   | Right STS                   |
| 11       | 73 -12 16  | Postcentral_R         | Right PrimSensory (1) |                             |
| 12       | 62 -15 24  | SupraMarginal_R       | Right BA 40   |                             |
| 13       | 52 -21 30  | SupraMarginal_R       | Right PrimSensory (1) | Right IPL and supramarginal gyrus |
| 14       | 56 -11 30  | SupraMarginal_R       | Right PrimMotor (4) |                             |
| 15       | 70 2 15    | Postcentral_R         | Right PrimMotor (4) |                             |
| 16       | 57 10 13   | Frontal_Inf_Oper_R    | Right BA 44   |                             |
| 17       | 60 1 30    | Postcentral_R         | Right BA 6    | Right pars opercularis IFG and PMv |
| 18       | 64 13 28   | Precentral_R          | Right BA 6    |                             |
| 19       | 63 21 12   | Frontal_Inf_Oper_R    | Right BA 44   |                             |
| 20       | 63 40 12   | Frontal_Inf_Tri_R     | Right BA 44   |                             |
| 21       | 48 22 17   | Frontal_Inf_Oper_R    | Right BA 44   |                             |
| 22       | 58 22 26   | Frontal_Inf_Tri_R     | Right BA 44   |                             |
| 23       | 62 39 24   | Frontal_Inf_Tri_R     | Right BA 9    |                             |
|   |   |   |   |   |
|---|---|---|---|---|
| 24 | 58 -50 43 | Angular R | Right BA 39 | Right IPL and supramarginal gyrus |
| 25 | 45 -35 41 | SupraMarginal R | Right BA 40 | Right IPL and supramarginal gyrus |
| 26 | 61 -24 47 | SupraMarginal R | Right BA 40 | Right IPL and supramarginal gyrus |
| 27 | 59 -12 45 | Postcentral R | Right PrimMotor (4) | Right M1 |
| 28 | 45 -17 44 | Postcentral R | Right PrimMotor (4) | Right M1 |
| 29 | 53 0 40 | Precentral R | Right BA 6 | Right pars opercularis IFG and PMv |
| 30 | 55 13 36 | Precentral R | Right BA 6 | Left pars opercularis IFG and PMv |
| 31 | -30 30 13 | Frontal Inf Tri L | Left BA 45 | Left pars opercularis IFG and PMv |
| 32 | -56 19 12 | Frontal Inf Oper L | Left BA 45 | Left pars opercularis IFG and PMv |
| 33 | -35 16 22 | Frontal Inf Oper L | Left BA 44 | Left pars opercularis IFG and PMv |
| 34 | -53 36 20 | Frontal Inf Tri L | Left BA 46 | Left pars opercularis IFG and PMv |
| 35 | -47 21 24 | Frontal Inf Tri L | Left BA 44 | Left pars opercularis IFG and PMv |
| 36 | -41 6 13 | Rolandic Oper L | Left BA 44 | Left pars opercularis IFG and PMv |
| 37 | -56 -1 10 | Rolandic Oper L | Left BA 6 | Left pars opercularis IFG and PMv |
| 38 | -52 10 24 | Frontal Inf Oper L | Left BA 44 | Left pars opercularis IFG and PMv |
| 39 | -61 4 25 | Precentral L | Left BA 6 | Left pars opercularis IFG and PMv |
| 40 | -63 -16 14 | Temporal Sup L | Left PrimSensory (1) | Left PrimSensory (1) |
| 41 | -41 -24 12 | Temporal Sup L | Left PrimAuditory (41) | Left STS |
| 42 | -49 -20 18 | Rolandic Oper L | Left PrimSensory (1) | Left PrimSensory (1) |
| MNI Coordinate (mm) | Structure              | Hemisphere | Brodmann Area (BA) | Comments                                      |
|---------------------|------------------------|------------|---------------------|-----------------------------------------------|
| -46 -17 24          | Postcentral_L          | Left       | BA 1                | Left IPL and supramarginal gyrus              |
| -51 -25 27          | SupraMarginal_L        | Left       | BA 40               | Left BA 40                                    |
| -47 -43 14          | Temporal_Mid_L         | Left       | BA 39               | Left STS                                       |
| -40 -45 14          | Temporal_Mid_L         | Left       | BA 39               | Left BA 39                                    |
| -43 -44 25          | SupraMarginal_L        | Left       | BA 39               | Left IPL and supramarginal gyrus              |
| -56 -55 29          | SupraMarginal_L        | Left       | BA 39               | Left TPJ                                       |
| -37 -58 14          | Temporal_Mid_L         | Left       | BA 39               | Left TPJ                                       |
| -37 -66 11          | Occipital_Mid_L        | Left       | BA 19               | Left TPJ                                       |
| -42 -71 23          | Occipital_Mid_L        | Left       | BA 19               | Left TPJ                                       |
| -40 -61 25          | Angular_L              | Left       | BA 39               | Left TPJ                                       |
| -31 -66 28          | Occipital_Mid_L        | Left       | BA 39               | Left MOG Left pars opercularis IFG and PMv     |
| -40 11 28           | Frontal_Inf_Oper_L     | Left       | BA 8                | Left BA 8                                      |
| -38 3 28            | Precentral_L           | Left       | BA 6                | Left M1 Left PrimMotor (4)                    |
| -38 -16 36          | Postcentral_L          | Left       | BA 6                | Left M1 Left PrimMotor (4)                    |
| -44 -23 37          | SupraMarginal_L        | Left       | BA 1                | Left IPL and supramarginal gyrus              |
| -47 -23 42          | Parietal_Inf_L         | Left       | BA 1                | Left IPL and supramarginal gyrus              |
| -41 -40 36          | SupraMarginal_L        | Left       | BA 40               | Left BA 40                                    |
| -51 -54 39          | Parietal_Inf_L         | Left       | BA 39               | Left BA 39                                    |

Note: Brodmann area for each MNI coordinate were acquired from [http://sprout022.sprout.yale.edu/mni2tal/mni2tal.html](http://sprout022.sprout.yale.edu/mni2tal/mni2tal.html).
Table S3. Paired t-test on the averaged peak activation of HbO changes between conditions (p-values after FDR correction).

| ROIs                        | Observation simple VS Observation complex | Observation complex VS Visual control | Execution simple VS Execution complex |
|-----------------------------|-------------------------------------------|---------------------------------------|---------------------------------------|
| Left IFG and PMv            | Averaged from 6-12 sec 0.40               | 0.61                                  | 0.08                                  |
| Right IFG and PMv           | 0.01                                      | <.01                                  | <.01                                  |
| Left M1                     | 0.01                                      | 0.20                                  | 0.04                                  |
| Right M1                    | 0.01                                      | 0.05                                  | <.01                                  |
| Left IPL and supramarginal gyrus | 0.40                                      | 0.20                                  | 0.08                                  |
| Right IPL and supramarginal gyrus | ≈0.05                                    | 0.05                                  | 0.01                                  |
| Left MOG                    | 0.54                                      | 0.20                                  | 0.12                                  |
| Right MOG                   | 0.42                                      | 0.20                                  | 0.04                                  |
| Left TPJ                    | 0.82                                      | 0.09                                  | 0.08                                  |
| Right TPJ                   | 0.31                                      | 0.18                                  | 0.15                                  |
| Left STS                    | 0.66                                      | 0.75                                  | 0.20                                  |
| Right STS | 0.66 | 0.18 | 0.07 |
Fig S1. Inter-subject variability of the 3D position of all the optodes (short-distance detectors not included). Each dot represents an optode. The standard deviation of the 3D location of optodes across subjects is indicated by the color of the dot (in mm).
Fig S1. *Paired-t* test between observation simple condition and baseline (FDR corrected). The time range for averaging peak activation of observation simple condition is from 7s to 11s, while the time range of baseline is from -2s to 0s. Channel 53 in the ROI of left MOG and Channel 50 had significant activation. Channel 4 in right MOG and channel 52 in left TPJ had significant activation before FDR correction.
Fig S2. Paired-t test between observation complex condition and baseline (FDR corrected). The time range for averaging peak activation of observation complex condition is from 7s to 11s, while the time range of baseline is from -2s to 0s. Some significant channels were located in the ROIs of bilateral MOG and TPI and right STG. Channel 18 in right IFG and PMv and channel 48 and 52 in left TPJ had significant activation before FDR correction.
Fig S3. *Paired-t* test between execution simple condition and baseline (FDR corrected). The time range for averaging peak activation of execution simple condition is from 2s to 6s, while the time range of baseline is from -2s to 0s. No significant channel was found.
Fig S4. Paired-t test between execution complex condition and baseline (FDR corrected). The time range for averaging peak activation of execution complex condition is from 2s to 6s, while the time range of baseline is from -2s to 0s. Some significant channels were located in the ROIs of right pars opercularis IFG and PMv along with right IPL and supramarginal gyrus. Channel 35 in left pars opercularis IFG and PMv, channel 27 and 55 at bilateral M1s, channel 13, 25 and 26 in right IPL and supramarginal gyrus, channel 10 in right STS had significant activation before FDR correction.
Fig S5. Paired-t test between control condition and baseline (FDR corrected). The time range for averaging peak activation of observation simple condition is from 7s to 11s, while the time range of baseline is from -2s to 0s. No significant channel was found.