frontiers

*Supplementary Materials*

# Assessing Functional Impulsivity Using Functional Near-Infrared Spectroscopy

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## 1 Supplementary Tables

Supplementary Table 1 Estimated most likely locations of all channels using the probabilistic registration method.

| CH | MNI-coordinates | | | SD | Anatomy | Prob. |
|---|---|---|---|---|---|---|
| | x | y | z | | | % |
| 1 | 65.0 | -36.3 | 48.3 | 11.5 | R-Wernicke's area (BA40) | 82% |
| 2 | 60.7 | -10.3 | 48.3 | 11.5 | R-M1 (BA4) | 32% |
| 3 | 50.0 | 15.7 | 49.7 | 11.3 | R-DLPFC (BA9) | 60% |
| 4 | 33.7 | 34.7 | 50.7 | 11.6 | R-DLPFC (BA9) | 75% |
| 5 | 13.7 | 45.7 | 53.0 | 11.4 | R-DLPFC (BA9) | 69% |
| 6 | -9.7 | 45.7 | 52.7 | 11.5 | L-DLPFC (BA9) | 65% |
| 7 | -30.3 | 33.3 | 51.3 | 11.7 | L-DLPFC (BA9) | 67% |
| 8 | -47.0 | 15.3 | 51.3 | 10.9 | L-DLPFC (BA9) | 62% |
| 9 | -58.3 | -10.7 | 48.7 | 10.8 | L-M1 (BA4) | 34% |
| 10 | -62.3 | -36.7 | 48.7 | 11.3 | L-Wernicke's area (BA40) | 81% |
| 11 | 66.0 | -46.7 | 35.7 | 12.3 | R-Wernicke's area (BA40) | 69% |
| 12 | 69.0 | -18.7 | 35.7 | 10.5 | R-S1 (BA2) | 49% |
| 13 | 61.0 | 9.3 | 36.3 | 10.8 | R-Pre-SMA (BA6) | 63% |
| 14 | 47.7 | 34.7 | 38.3 | 10.6 | R-Broca's area (BA45) | 42% |
| 15 | 26.3 | 52.3 | 40.3 | 11.1 | R-DLPFC (BA9) | 79% |
| 16 | 3.3 | 56.7 | 40.3 | 11.1 | R-DLPFC (BA9) | 85% |
| 17 | -22.0 | 52.3 | 41.0 | 11.0 | L-DLPFC (BA9) | 84% |
| 18 | -43.7 | 34.7 | 38.7 | 10.3 | L-Broca's area (BA45) | 37% |
| 19 | -57.7 | 9.7 | 36.7 | 10.6 | L-Pre-SMA (BA6) | 59% |
| 20 | -66.7 | -19.3 | 35.7 | 10.4 | L-S1 (BA2) | 52% |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | -65.0 | -46.7 | 36.7 | 11.6 | L-Wernicke's area (BA40) | 75% |
| 22 | 71.0 | -30.7 | 21.3 | 11.1 | R-STG (BA22) | 51% |
| 23 | 68.0 | 0.3 | 23.3 | 9.1 | R-Subcentral area (BA43) | 71% |
| 24 | 57.7 | 29.7 | 24.3 | 9.5 | R-Broca's area (BA45) | 92% |
| 25 | 41.3 | 52.3 | 27.3 | 10.0 | R-DLPFC (BA46) | 80% |
| 26 | 16.7 | 65.7 | 29.3 | 10.1 | PFC (BA10) | 83% |
| 27 | -11.7 | 65.0 | 29.7 | 10.0 | PFC (BA10) | 80% |
| 28 | -36.7 | 53.7 | 27.7 | 9.7 | L-DLPFC (BA46) | 97% |
| 29 | -54.3 | 29.7 | 24.3 | 9.4 | L-Broca's area (BA45) | 93% |
| 30 | -65.3 | -0.3 | 23.3 | 9.4 | L-Subcentral area (BA43) | 73% |
| 31 | -69.0 | -30.7 | 23.3 | 11.1 | L-STG (BA22) | 37% |
| 32 | 72.0 | -41.7 | 4.7 | 10.8 | R-STG (BA22) | 58% |
| 33 | 71.0 | -11.7 | 5.3 | 9.1 | R-STG (BA22) | 86% |
| 34 | 62.0 | 21.3 | 10.3 | 8.9 | R-Broca's area (BA45) | 43% |
| 35 | 51.0 | 48.3 | 11.3 | 8.9 | R-DLPFC (BA46) | 64% |
| 36 | 30.3 | 67.3 | 13.7 | 9.2 | PFC (BA10) | 98% |
| 37 | 4.0 | 70.0 | 15.0 | 10.0 | PFC (BA10) | 100% |
| 38 | -25.7 | 67.7 | 14.7 | 8.8 | PFC (BA10) | 99% |
| 39 | -48.0 | 48.7 | 11.3 | 8.6 | L-DLPFC (BA46) | 64% |
| 40 | -59.0 | 21.3 | 9.7 | 8.9 | L-Broca's area (BA45) | 42% |
| 41 | -67.3 | -12.3 | 6.7 | 9.9 | L-STG (BA22) | 80% |
| 42 | -70.0 | -41.7 | 6.3 | 10.8 | L-STG (BA22) | 63% |
| 43 | 73.0 | -22.7 | -10.3 | 9.1 | R-MTG (BA21) | 99% |
| 44 | 64.3 | 5.7 | -8.7 | 9.1 | R-MTG (BA21) | 54% |
| 45 | 56.0 | 40.3 | -3.7 | 7.2 | R-Broca's area (BA45) | 56% |
| 46 | 41.3 | 62.7 | -1.7 | 7.9 | FPC (BA10) | 76% |
| 47 | 16.7 | 73.0 | 0.3 | 8.2 | FPC (BA10) | 68% |
| 48 | -12.3 | 74.0 | 0.7 | 7.7 | FPC (BA10) | 74% |
| 49 | -37.3 | 63.7 | -1.3 | 7.2 | FPC (BA10) | 91% |
| 50 | -54.0 | 40.7 | -3.7 | 6.7 | L-Broca's area (BA45) | 59% |
| 51 | -62.0 | 5.7 | -8.3 | 9.4 | L-MTG (BA21) | 48% |
| 52 | -71.0 | -22.3 | -10.3 | 9.2 | L-MTG (BA21) | 96% |

Supplementary Table 2 Oxy-Hb hemodynamic responses assessed using one-sample t-tests on the PRTLT task for all channels.

| CH | mean | *SD* | *t* | *P* | *d* |
|---|---|---|---|---|---|
| 1 | 0.014 | 0.027 | 2.80 | 0.009 | 0.529 |
| 2 | 0.019 | 0.045 | 2.26 | 0.032 | 0.427 |
| 3 | 0.008 | 0.032 | 1.42 | 0.168 | 0.268 |
| 4 | 0.016 | 0.037 | 2.34 | 0.027 | 0.442 |
| 5 | 0.009 | 0.031 | 1.65 | 0.110 | 0.312 |
| 6 | 0.009 | 0.020 | 2.47 | 0.020 | 0.467 |
| 7 | 0.008 | 0.027 | 1.68 | 0.104 | 0.318 |
| 8 | 0.012 | 0.030 | 2.16 | 0.040 | 0.408 |
| 9 | 0.012 | 0.037 | 1.72 | 0.097 | 0.325 |
| 10 | 0.011 | 0.029 | 2.09 | 0.046 | 0.394 |
| 11 | 0.020 | 0.034 | 3.17 | 0.004 | 0.598 |
| 12 | 0.009 | 0.063 | 0.81 | 0.428 | 0.152 |
| 13 | 0.017 | 0.040 | 2.30 | 0.029 | 0.434 |
| 14 | 0.029 | 0.028 | 5.65 | **<.001** | 1.068 |
| 15 | 0.025 | 0.039 | 3.47 | 0.002 | 0.655 |
| 16 | 0.019 | 0.034 | 2.93 | 0.007 | 0.553 |
| 17 | 0.014 | 0.022 | 3.40 | 0.002 | 0.642 |
| 18 | 0.025 | 0.033 | 4.06 | **<.001** | 0.768 |
| 19 | 0.004 | 0.032 | 0.76 | 0.453 | 0.144 |
| 20 | -0.005 | 0.047 | -0.61 | 0.549 | -0.115 |
| 21 | 0.015 | 0.033 | 2.55 | 0.017 | 0.481 |
| 22 | 0.012 | 0.051 | 1.26 | 0.217 | 0.239 |
| 23 | 0.012 | 0.058 | 1.16 | 0.258 | 0.218 |
| 24 | 0.027 | 0.045 | 3.20 | 0.003 | 0.604 |
| 25 | 0.041 | 0.034 | 6.57 | **<.001** | 1.241 |
| 26 | 0.031 | 0.031 | 5.50 | **<.001** | 1.040 |
| 27 | 0.030 | 0.040 | 3.97 | **<.001** | 0.750 |
| 28 | 0.031 | 0.039 | 4.24 | **<.001** | 0.801 |
| 29 | 0.019 | 0.033 | 3.03 | .005 | 0.572 |
| 30 | -0.007 | 0.064 | -0.57 | .572 | -0.108 |
| 31 | 0.004 | 0.044 | 0.45 | .659 | 0.084 |
| 32 | 0.016 | 0.048 | 1.78 | .085 | 0.337 |
| 33 | 0.012 | 0.062 | 1.02 | .315 | 0.193 |

| | | | | | |
|---|---|---|---|---|---|
| 34 | 0.023 | 0.057 | 2.18 | .038 | 0.413 |
| 35 | 0.033 | 0.033 | 5.40 | **<.001** | 1.020 |
| 36 | 0.039 | 0.038 | 5.51 | **<.001** | 1.042 |
| 37 | 0.032 | 0.049 | 3.47 | .002 | 0.657 |
| 38 | 0.032 | 0.056 | 3.07 | .005 | 0.580 |
| 39 | 0.031 | 0.039 | 4.28 | **<.001** | 0.809 |
| 40 | 0.001 | 0.055 | 0.08 | .936 | 0.015 |
| 41 | 0.004 | 0.066 | 0.30 | .766 | 0.057 |
| 42 | -0.005 | 0.049 | -0.56 | .583 | -0.105 |
| 43 | 0.010 | 0.059 | 0.87 | .393 | 0.164 |
| 44 | 0.016 | 0.069 | 1.28 | .210 | 0.242 |
| 45 | 0.027 | 0.049 | 3.02 | .005 | 0.570 |
| 46 | 0.040 | 0.035 | 6.14 | **<.001** | 1.161 |
| 47 | 0.037 | 0.047 | 4.24 | **<.001** | 0.801 |
| 48 | 0.039 | 0.053 | 3.98 | **<.001** | 0.751 |
| 49 | 0.037 | 0.048 | 4.19 | **<.001** | 0.792 |
| 50 | 0.027 | 0.048 | 2.97 | .006 | 0.561 |
| 51 | 0.014 | 0.081 | 0.90 | .377 | 0.170 |
| 52 | 0.006 | 0.078 | 0.40 | .692 | 0.076 |

Notes. p values of significant channels ($p < \alpha (= .05) / 52$) are in boldface. *SD* = standard deviation of spatial estimates; *t* = *t*-values; *p* = *p*-values; *d* = Cohen's *d*.

Supplementary Table 3 Deoxy-Hb hemodynamic responses assessed using one-sample t-tests on the PRTLT task.

| CH | mean | *SD* | *t* | *P* | *d* |
|---|---|---|---|---|---|
| 1 | -0.001 | 0.011 | -0.49 | .631 | -0.09 |
| 2 | 0.000 | 0.027 | -0.10 | .922 | -0.02 |
| 3 | -0.010 | 0.021 | -2.51 | .018 | -0.47 |
| 4 | -0.001 | 0.010 | -0.80 | .432 | -0.15 |
| 5 | 0.000 | 0.009 | -0.10 | .918 | -0.02 |
| 6 | -0.003 | 0.011 | -1.26 | .219 | -0.24 |
| 7 | 0.000 | 0.010 | 0.10 | .922 | 0.02 |
| 8 | 0.003 | 0.010 | 1.69 | .103 | 0.32 |
| 9 | 0.001 | 0.013 | 0.38 | .709 | 0.07 |
| 10 | -0.006 | 0.010 | -3.03 | .005 | -0.57 |
| 11 | -0.004 | 0.013 | -1.75 | .091 | -0.33 |
| 12 | 0.000 | 0.018 | -0.03 | .976 | -0.01 |
| 13 | -0.008 | 0.021 | -1.99 | .057 | -0.38 |
| 14 | 0.002 | 0.011 | 1.14 | .265 | 0.21 |
| 15 | 0.000 | 0.009 | -0.06 | .955 | -0.01 |
| 16 | 0.003 | 0.018 | 0.83 | .416 | 0.16 |
| 17 | 0.004 | 0.015 | 1.57 | .128 | 0.30 |
| 18 | 0.000 | 0.009 | -0.25 | .802 | -0.05 |
| 19 | 0.003 | 0.012 | 1.47 | .153 | 0.28 |
| 20 | 0.004 | 0.022 | 0.98 | .336 | 0.19 |
| 21 | -0.003 | 0.013 | -1.28 | .212 | -0.24 |
| 22 | 0.001 | 0.023 | 0.14 | .892 | 0.03 |
| 23 | 0.002 | 0.025 | 0.37 | .712 | 0.07 |
| 24 | -0.001 | 0.012 | -0.24 | .813 | -0.05 |
| 25 | 0.000 | 0.010 | -0.15 | .885 | -0.03 |
| 26 | 0.003 | 0.011 | 1.45 | .159 | 0.27 |
| 27 | 0.007 | 0.010 | 3.76 | **.001** | 0.71 |
| 28 | 0.001 | 0.013 | 0.49 | .631 | 0.09 |
| 29 | 0.003 | 0.008 | 1.90 | .068 | 0.36 |
| 30 | 0.002 | 0.033 | 0.31 | .756 | 0.06 |
| 31 | -0.001 | 0.028 | -0.11 | .917 | -0.02 |
| 32 | -0.013 | 0.027 | -2.55 | .017 | -0.48 |
| 33 | -0.003 | 0.026 | -0.66 | .518 | -0.12 |

| | | | | | |
|---|---|---|---|---|---|
| 34 | -0.005 | 0.021 | -1.15 | .258 | -0.22 |
| 35 | 0.003 | 0.011 | 1.35 | .187 | 0.26 |
| 36 | 0.006 | 0.013 | 2.58 | .015 | 0.49 |
| 37 | 0.011 | 0.020 | 2.96 | .006 | 0.56 |
| 38 | 0.010 | 0.016 | 3.34 | .002 | 0.63 |
| 39 | 0.005 | 0.008 | 3.09 | .004 | 0.58 |
| 40 | 0.004 | 0.028 | 0.84 | .408 | 0.16 |
| 41 | 0.000 | 0.046 | 0.05 | .961 | 0.01 |
| 42 | -0.001 | 0.028 | -0.21 | .837 | -0.04 |
| 43 | -0.003 | 0.033 | -0.41 | .683 | -0.08 |
| 44 | -0.003 | 0.030 | -0.57 | .574 | -0.11 |
| 45 | 0.001 | 0.021 | 0.35 | .726 | 0.07 |
| 46 | 0.005 | 0.012 | 2.52 | .018 | 0.48 |
| 47 | 0.010 | 0.013 | 4.42 | **<.001** | 0.84 |
| 48 | 0.013 | 0.014 | 4.72 | **<.001** | 0.89 |
| 49 | 0.008 | 0.016 | 2.68 | .012 | 0.51 |
| 50 | 0.009 | 0.018 | 2.54 | .017 | 0.48 |
| 51 | 0.001 | 0.038 | 0.13 | .897 | 0.02 |
| 52 | 0.003 | 0.033 | 0.48 | .634 | 0.09 |

Notes. p values of significant channels ($p < \alpha (= .05) / 52$) are in boldface. *SD* = standard deviation of spatial estimates; *t* = *t*-values; *p* = *p*-values; *d* = Cohen's *d*.

Supplementary Table 4 Oxy-Hb hemodynamic response contrast between expensive and inexpensive conditions assessed using paired t-tests for channels activated by PRTLT.

| CH | mean diff. | SD | t | p | d |
|---|---|---|---|---|---|
| 14 | 0.007 | 0.045 | 0.84 | .408 | 0.16 |
| 18 | 0.014 | 0.037 | 1.95 | .062 | 0.37 |
| 25 | 0.018 | 0.045 | 2.16 | .040 | 0.41 |
| 26 | 0.017 | 0.041 | 2.18 | .038 | 0.41 |
| 27 | 0.022 | 0.046 | 2.63 | .014 | 0.50 |
| 28 | 0.020 | 0.038 | 2.87 | **.008** | 0.54 |
| 35 | 0.006 | 0.045 | 0.70 | .489 | 0.13 |
| 36 | 0.014 | 0.038 | 1.96 | .060 | 0.37 |
| 39 | 0.013 | 0.040 | 1.71 | .098 | 0.32 |
| 46 | 0.011 | 0.036 | 1.64 | .112 | 0.31 |
| 47 | 0.019 | 0.035 | 2.96 | **.006** | 0.56 |
| 48 | 0.028 | 0.048 | 3.12 | **.004** | 0.59 |
| 49 | 0.019 | 0.047 | 2.16 | .040 | 0.41 |

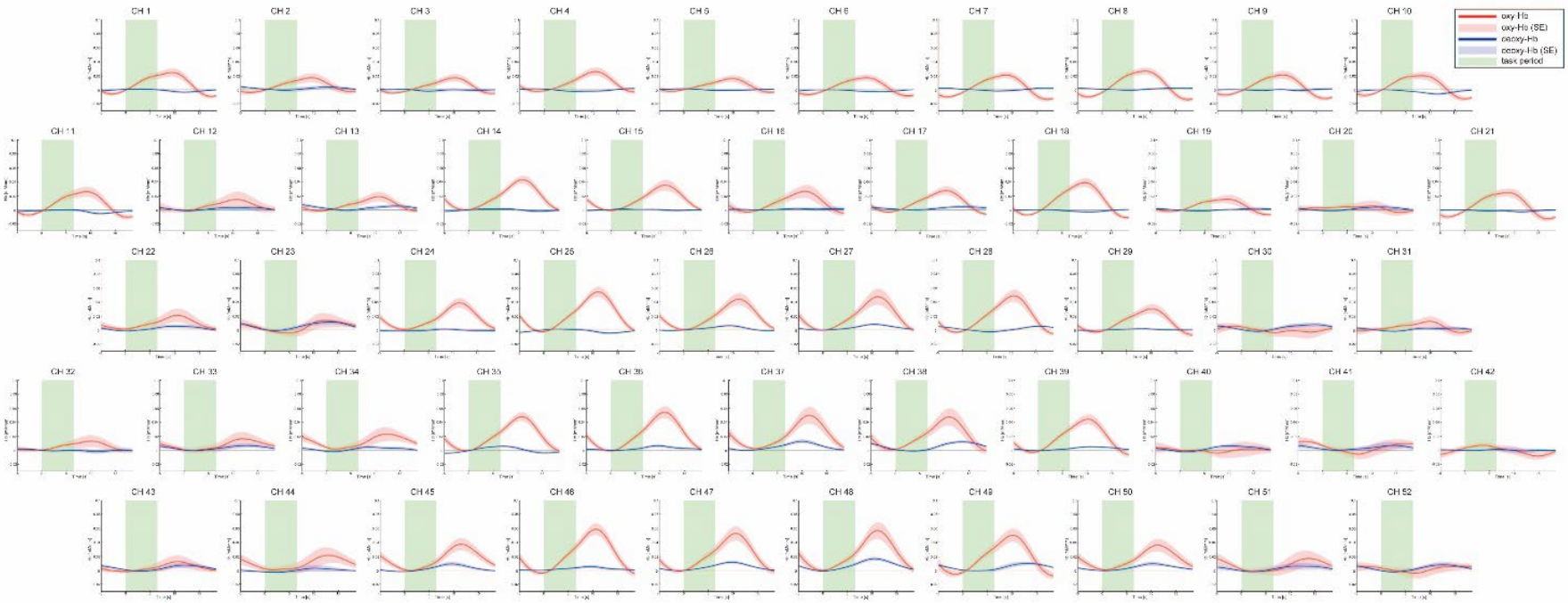
Notes. p values of significant channels ($p < \alpha$ (= .05) / Meff value) are in boldface. Meff value = 5.23. *SD* = standard deviation of spatial estimates; *t* = *t*-values; *p* = *p*-values; *d* = Cohen's *d*.

Supplementary Table 5 Deoxy-Hb hemodynamic response contrast between expensive and inexpensive conditions assessed using paired t-tests for channels presented in Supplementary Table 4.

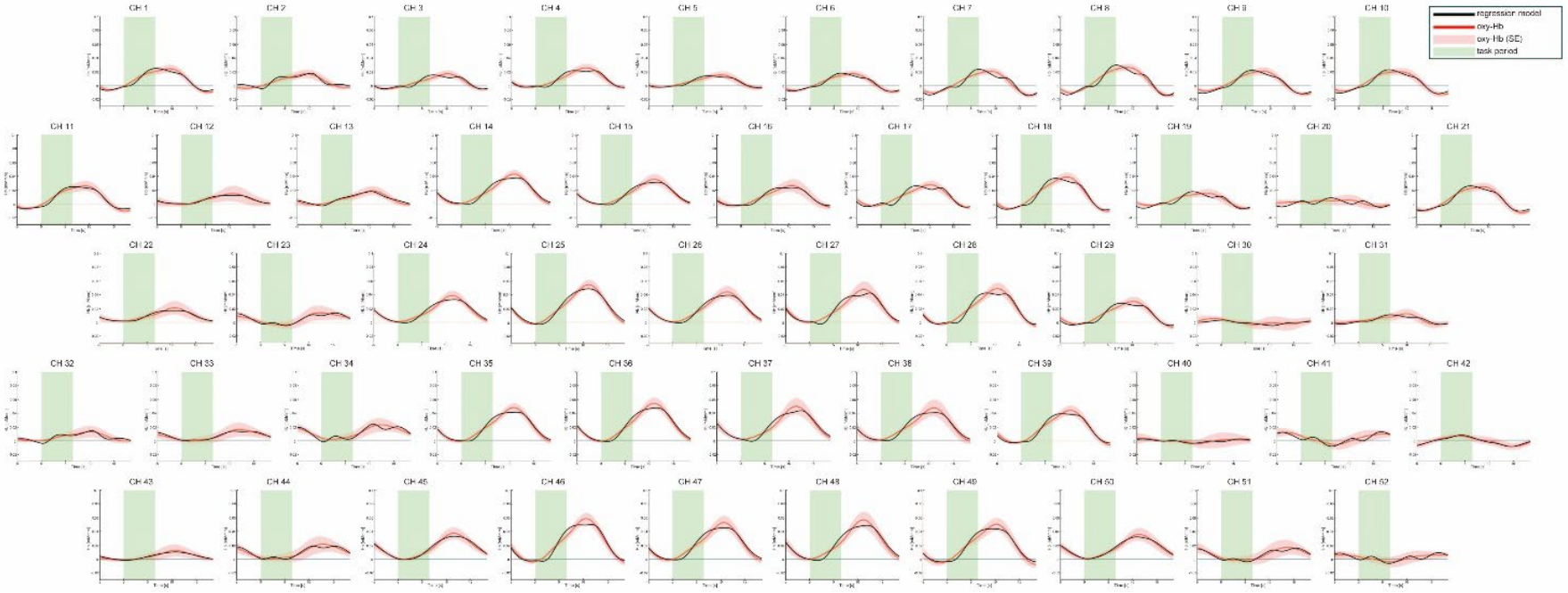
| CH | mean diff. | SD | t | p | d |
|---|---|---|---|---|---|
| 14 | -0.005 | 0.013 | -1.99 | .056 | -0.38 |
| 18 | -0.004 | 0.010 | -2.20 | .036 | -0.42 |
| 25 | -0.004 | 0.013 | -1.76 | .090 | -0.33 |
| 26 | -0.003 | 0.009 | -1.66 | .107 | -0.31 |
| 27 | -0.001 | 0.010 | -0.44 | .660 | -0.08 |
| 28 | -0.003 | 0.012 | -1.22 | .233 | -0.23 |
| 35 | 0.000 | 0.020 | -0.07 | .947 | -0.01 |
| 36 | -0.003 | 0.016 | -1.02 | .315 | -0.19 |
| 39 | -0.002 | 0.010 | -1.21 | .237 | -0.23 |
| 46 | 0.004 | 0.018 | 1.09 | .285 | 0.21 |
| 47 | 0.003 | 0.010 | 1.63 | .115 | 0.31 |
| 48 | 0.004 | 0.012 | 1.81 | .080 | 0.34 |
| 49 | 0.001 | 0.014 | 0.29 | .773 | 0.06 |

Notes. p values of significant channels ($p < \alpha$ (= .05) / Meff value) are in boldface. Meff value = 8.23. *SD* = standard deviation of spatial estimates; *t* = *t*-values; *p* = *p*-values; *d* = Cohen's *d*.

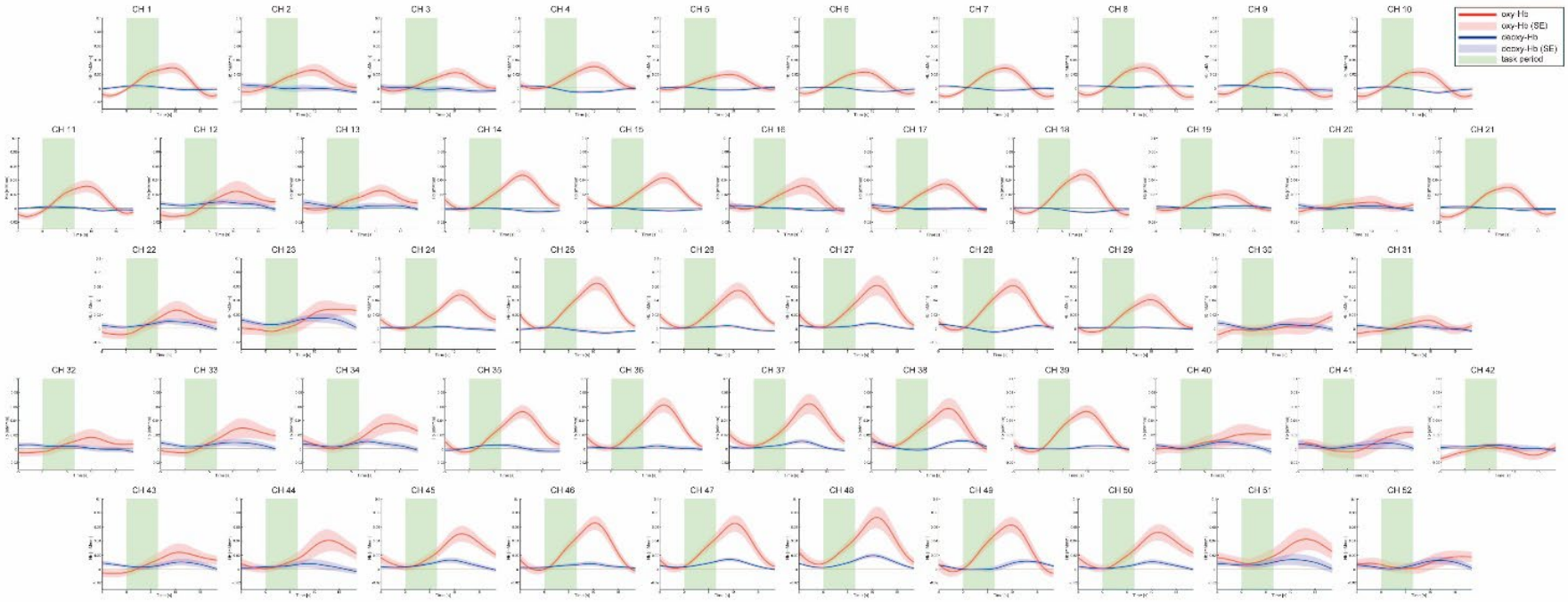
## 2 Supplementary Figures



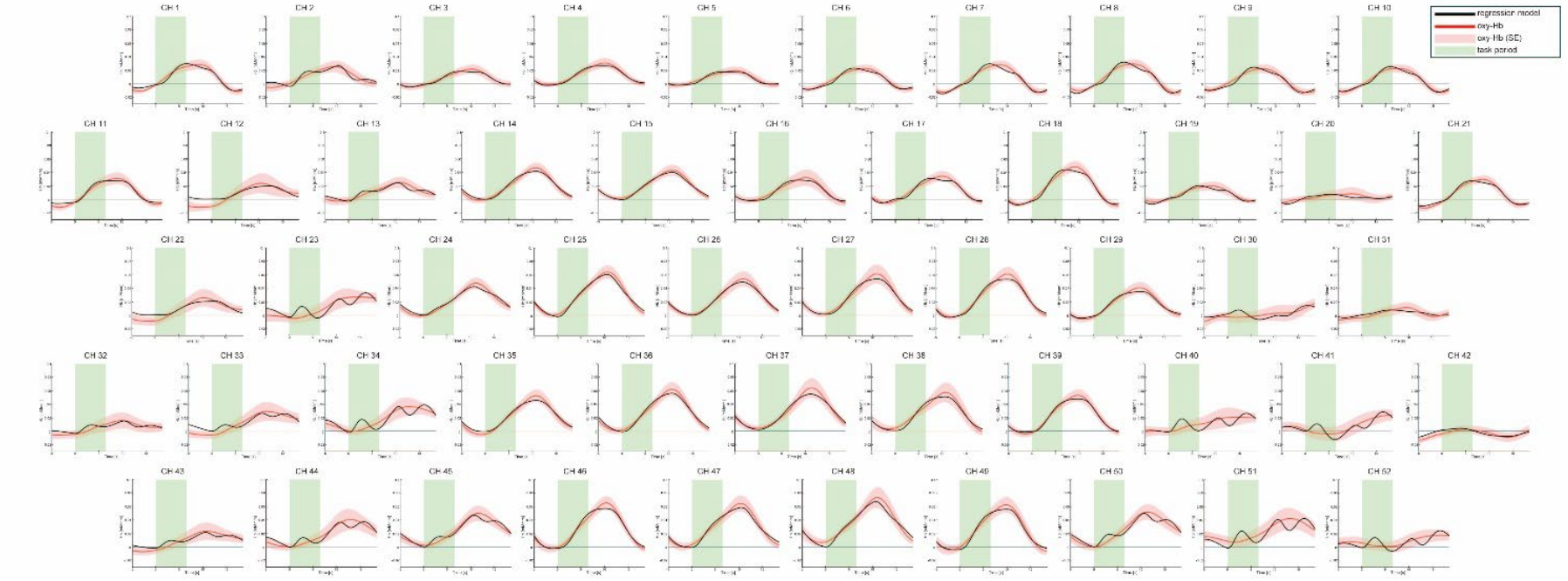

Supplementary Figure 1 Observed oxy-Hb and deoxy-Hb time-series data for all fNIRS channels during the PRTLT.



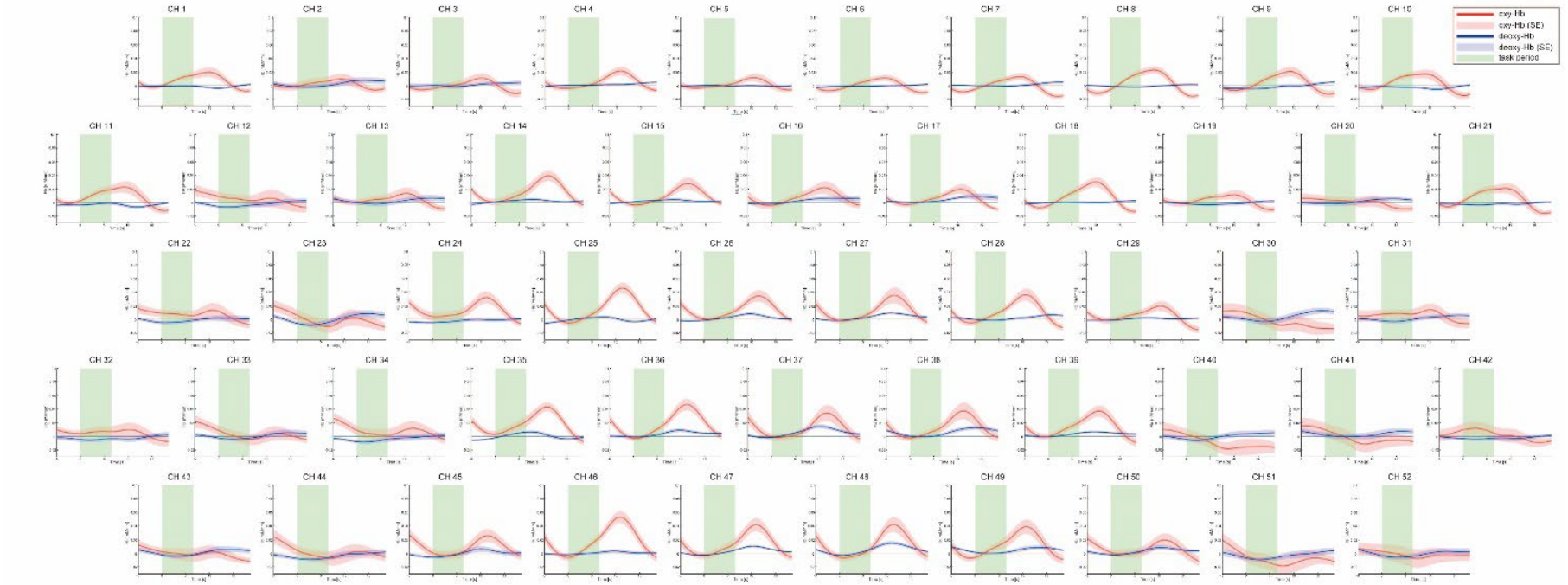

Supplementary Figure 2 Comparison between observed and predicted oxy-Hb hemodynamic time-series data for the PRTLT.



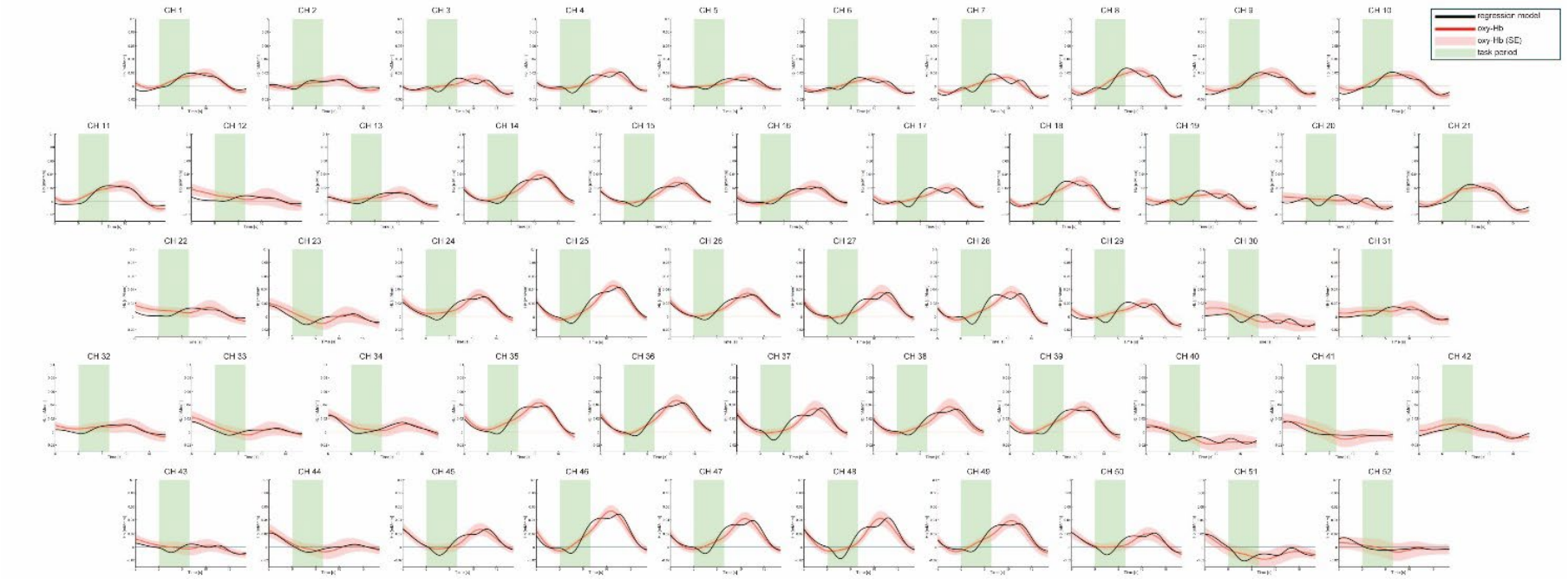

Supplementary Figure 3 Observed oxy-Hb and deoxy-Hb time-series data for all fNIRS channels in the expensive condition.




Supplementary Figure 4 Comparison between observed and predicted oxy-Hb hemodynamic time-series data in the expensive condition.




Supplementary Figure 5 Observed oxy-Hb and deoxy-Hb time-series data for all fNIRS channels in the inexpensive condition.




Supplementary Figure 6 Comparison between observed and predicted oxy-Hb hemodynamic time-series data in the inexpensive condition.