Supplemental Table 1: Associations between ICOH during neonatal REM sleep, indeterminate sleep, and wakefulness and 18-month language outcomes (Central electrodes)

| EEG Frequency | Maternal Voice Playback | C3-Cz ICOH all subjects | EEG Frequency | Maternal Voice Playback | C4-Cz ICOH all subjects |
|---------------|------------------------|-------------------------|---------------|------------------------|-------------------------|
|               |                        | rho                     |               |                        | rho                     |
| 0.33-2 Hz     | off                    | -0.136                  | 0.33-2 Hz     | off                    | 0.032                   |
| 2-4 Hz        | off                    | -0.157                  | 2-4 Hz        | off                    | 0.216                   |
| 4-8 Hz        | off                    | -0.182                  | 4-8 Hz        | off                    | -0.284                  |
| 8-12 Hz       | off                    | -0.371 (0.028*)         | 8-12 Hz       | off                    | -0.285                  |
| 12-16 Hz      | off                    | -0.233                  | 12-16 Hz      | off                    | 0.368 (0.029*)          |
| 16-30 Hz      | off                    | -0.141                  | 16-30 Hz      | off                    | 0.318                   |
| 0.33-2 Hz     | on                     | -0.042                  | 0.33-2 Hz     | on                     | 0.075                   |
| 2-4 Hz        | on                     | -0.130                  | 2-4 Hz        | on                     | 0.245                   |
| 4-8 Hz        | on                     | -0.177                  | 4-8 Hz        | on                     | 0.274                   |
| 8-12 Hz       | on                     | -0.348                  | 8-12 Hz       | on                     | 0.254                   |
| 12-16 Hz      | on                     | -0.503 (0.003*)         | 12-16 Hz      | on                     | 0.238                   |
| 16-30 Hz      | on                     | -0.377 (0.033*)         | 16-30 Hz      | on                     | 0.195                   |
| 0.33-2 Hz     | on                     | -0.477 (0.006*)         | 0.33-2 Hz     | on                     | 0.244                   |
| 2-4 Hz        | on                     | -0.501 (0.003*)         | 2-4 Hz        | on                     | 0.268                   |
| 4-8 Hz        | on                     | -0.339                  | 4-8 Hz        | on                     | 0.303                   |
| 8-12 Hz       | on                     | -0.475 (0.006*)         | 8-12 Hz       | on                     | 0.302                   |
| 12-16 Hz      | on                     | -0.299                  | 12-16 Hz      | on                     | 0.313                   |
| 16-30 Hz      | on                     | -0.312                  | 16-30 Hz      | on                     | 0.181                   |
| 0.33-2 Hz     | on                     | -0.349 (0.050*)         | 0.33-2 Hz     | on                     | 0.192                   |
| 2-4 Hz        | on                     | -0.137                  | 2-4 Hz        | on                     | 0.172                   |
| 4-8 Hz        | on                     | -0.068                  | 4-8 Hz        | on                     | 0.114                   |
| 8-12 Hz       | on                     | -0.246                  | 8-12 Hz       | on                     | 0.125                   |
| 12-16 Hz      | on                     | -0.362 (0.033*)         | 12-16 Hz      | on                     | 0.257                   |
| 16-30 Hz      | on                     | -0.095                  | 16-30 Hz      | on                     | 0.016                   |
| 0.33-2 Hz     | on                     | -0.193                  | 0.33-2 Hz     | on                     | 0.019                   |
| 2-4 Hz        | on                     | -0.254                  | 2-4 Hz        | on                     | 0.027                   |
| 4-8 Hz        | on                     | -0.214                  | 4-8 Hz        | on                     | 0.294                   |
| 8-12 Hz       | on                     | -0.349 (0.050*)         | 8-12 Hz       | on                     | 0.168                   |
| Frequency Range | Condition | ICOH | Frequency Range | Condition | ICOH |
|-----------------|-----------|------|-----------------|-----------|------|
| 12-16 Hz        | on        | -0.321 | 12-16 Hz        | on        | -0.244 |
| 16-30 Hz        | on        | -0.167 | 16-30 Hz        | on        | -0.049 |

*aREM = rapid eye movement
bICOH = imaginary part of the coherence ([presented as average ICOH across each frequency range](#))
*denotes p<0.05
**Supplemental Table: Associations between ICOH during neonatal REM sleep, indeterminate sleep, and wakefulness and 18-month language outcomes (temporal electrodes)**

| EEG Frequency | Maternal Voice Playback | T3-Cz ICOH all subjects | EEG Frequency | Maternal Voice Playback | T4-Cz ICOH all subjects |
|---------------|-------------------------|-------------------------|---------------|-------------------------|-------------------------|
|               |                         | rho | p-value |               |                         | rho | p-value |
| 0.33-2 Hz     | off                     | 0.093 | 0.594 | 0.33-2 Hz     | off                     | 0.042 | 0.810 |
| 2-4 Hz        | off                     | -0.114 | 0.515 | 2-4 Hz        | off                     | -0.091 | 0.603 |
| 4-8 Hz        | off                     | -0.23 | 0.184 | 4-8 Hz        | off                     | -0.188 | 0.279 |
| 8-12 Hz       | off                     | -0.241 | 0.163 | 8-12 Hz       | off                     | -0.120 | 0.493 |
| 12-16 Hz      | off                     | -0.148 | 0.395 | 12-16 Hz      | off                     | -0.267 | 0.121 |
| 16-30 Hz      | off                     | -0.380 | **0.024*** | 16-30 Hz      | off                     | -0.261 | 0.130 |
| 0.33-2 Hz     | on                      | 0.124 | 0.498 | 0.33-2 Hz     | on                      | 0.057 | 0.755 |
| 2-4 Hz        | on                      | -0.207 | 0.255 | 2-4 Hz        | on                      | -0.240 | 0.186 |
| 4-8 Hz        | on                      | -0.265 | 0.143 | 4-8 Hz        | on                      | -0.231 | 0.204 |
| 8-12 Hz       | on                      | -0.355 | **0.046*** | 8-12 Hz       | on                      | -0.173 | 0.344 |
| 12-16 Hz      | on                      | -0.495 | **0.004*** | 12-16 Hz      | on                      | -0.093 | 0.611 |
| 16-30 Hz      | on                      | -0.565 | **0.001*** | 16-30 Hz      | on                      | -0.098 | 0.593 |

**Association between LEFT hemisphere ICOH^a (T3-Cz EEG electrodes) during neonatal indeterminate sleep and 18-month language outcomes**

| EEG Frequency | Maternal Voice Playback | T3-Cz ICOH all subjects | EEG Frequency | Maternal Voice Playback | T4-Cz ICOH all subjects |
|---------------|-------------------------|-------------------------|---------------|-------------------------|-------------------------|
|               |                         | rho | p-value |               |                         | rho | p-value |
| 0.33-2 Hz     | off                     | 0.100 | 0.57 | 0.33-2 Hz     | off                     | -0.089 | 0.611 |
| 2-4 Hz        | off                     | -0.078 | 0.658 | 2-4 Hz        | off                     | -0.134 | 0.443 |
| 4-8 Hz        | off                     | -0.259 | 0.133 | 4-8 Hz        | off                     | -0.217 | 0.211 |
| 8-12 Hz       | off                     | -0.337 | **0.048*** | 8-12 Hz       | off                     | -0.288 | 0.094 |
| 12-16 Hz      | off                     | -0.404 | **0.016*** | 12-16 Hz      | off                     | -0.353 | **0.037*** |
| 16-30 Hz      | off                     | -0.504 | **0.002*** | 16-30 Hz      | off                     | -0.309 | 0.071 |
| 0.33-2 Hz     | on                      | -0.133 | 0.468 | 0.33-2 Hz     | on                      | -0.109 | 0.551 |
| 2-4 Hz        | on                      | -0.44 | **0.012*** | 2-4 Hz        | on                      | -0.367 | **0.039*** |
| 4-8 Hz        | on                      | -0.379 | **0.033*** | 4-8 Hz        | on                      | -0.213 | 0.242 |
| 8-12 Hz       | on                      | -0.381 | **0.031*** | 8-12 Hz       | on                      | -0.210 | 0.248 |
| 12-16 Hz      | on                      | -0.570 | **0.001*** | 12-16 Hz      | on                      | -0.498 | **0.004*** |
| 16-30 Hz      | on                      | -0.637 | **0.0001*** | 16-30 Hz      | on                      | -0.164 | 0.368 |

**Association between LEFT hemisphere ICOH (T3-Cz EEG electrodes) during neonatal wakefulness and 18-month language outcomes**

| EEG Frequency | Maternal Voice Playback | T3-Cz ICOH all subjects | EEG Frequency | Maternal Voice Playback | T4-Cz ICOH all subjects |
|---------------|-------------------------|-------------------------|---------------|-------------------------|-------------------------|
|               |                         | rho | p-value |               |                         | rho | p-value |
| 0.33-2 Hz     | off                     | -0.074 | 0.675 | 0.33-2 Hz     | off                     | 0.206 | 0.235 |
| 2-4 Hz        | off                     | -0.063 | 0.720 | 2-4 Hz        | off                     | 0.198 | 0.254 |
| 4-8 Hz        | off                     | -0.142 | 0.415 | 4-8 Hz        | off                     | -0.209 | 0.227 |
| 8-12 Hz       | off                     | -0.080 | 0.649 | 8-12 Hz       | off                     | -0.129 | 0.459 |
| 12-16 Hz      | off                     | -0.339 | **0.046*** | 12-16 Hz      | off                     | -0.444 | **0.008*** |
| 16-30 Hz      | off                     | -0.484 | **0.003*** | 16-30 Hz      | off                     | -0.188 | 0.279 |
| 0.33-2 Hz     | on                      | -0.008 | 0.967 | 0.33-2 Hz     | on                      | 0.159 | 0.386 |
| 2-4 Hz        | on                      | -0.123 | 0.501 | 2-4 Hz        | on                      | 0.020 | 0.914 |
| 4-8 Hz        | on                      | -0.312 | 0.083 | 4-8 Hz        | on                      | -0.099 | 0.589 |
| 8-12 Hz       | on                      | -0.178 | 0.330 | 8-12 Hz       | on                      | -0.165 | 0.366 |
| 12-16 Hz      | on                      | -0.464 | **0.007*** | 12-16 Hz      | on                      | -0.356 | **0.046*** |
| Frequency Range | Amount  | Value  |
|-----------------|---------|--------|
| 16-30 Hz on     | -0.439  | 0.012* |
| 16-30 Hz on     | -0.304  | 0.091  |

*REM = rapid eye movement

ICOH = imaginary part of the coherence (presented as average ICOH across each frequency range)

*denotes p<0.05