Using intracranial EEG and direct stimulation for neural cartography

Response to Shafi

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In 2001, Francesco Varela suggested that *"the emergence of a unified cognitive moment relies on the coordination of scattered mosaics of functionally specialized brain regions"* (Varela et al., 2001). In our recent work (Shine et al., 2017), we attempted to provide additional scaffolding for this exhilarating vision of the human brain. From our vantage point, the combination of targeted electrical potentials with direct recordings of the evoked electrophysiological signal offered the most sensitive means for elucidating the latent rules that govern the effective functioning of the system. We thank Reema Shafi for acknowledging the importance of our findings and framing them in the context of the large-scale brain networks that, through their continual and varied interaction, subserve a wide variety of cognitive functions.

Here, we would like to comment on the fact that participants in our study required neurosurgical implantation of depth electrodes for the identification of potential seizure foci. That is, the cohort in which the data were collected were not healthy individuals, but rather from a population of people with epilepsy. This fact naturally raises some questions regarding the generalizability of any results identified using our methodology. However, as we have described in detail in our recent manuscript (Parvizi and Kastner 2018), individuals recruited to intracranial research studies suffer from focal seizures – i.e., they do not have a diffuse, brain-wide disease. Indeed, with the application of appropriate preprocessing strategies, data from these subjects' brains can be considered as representative of those from healthy individuals (Parvizi and Kastner 2018). Furthermore, in our current study, the location of the seizure focus differed across our cohort, and as such, did not represent only subjects with the same epilepsies. Together, these facts suggest that the conclusions from our study could generalize well to the healthy, human brain, although we would like to emphasize that our findings require replication in a larger cohort.

From our vantage point, the combination of targeted electrical potentials with direct recordings of the electrophysiological signal during invasive neurosurgery offers a sensitive means for elucidating the latent rules that govern effective communication pathways in the human brain, catalyzing our understanding of how our brains' make us who we are.

References

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