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Spotlight

Birds of a Feather Synchronize Together

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The multitudinous thoughts, feelings, and perceptions that constitute each person's phenomenological awareness, their subjective experience, might be seen as that which most deeply distinguishes us from one another. We can never fully know one another's experiences and words fail all but the greatest wordsmiths in communicating this experience adequately. Yet new data suggests that the ineffable might be effable after all. And rather than being what separates us from others, our way of seeing the world is a remarkable predictor of who we will connect with.

Over the last decade, the study of neural synchrony, or intersubject correlations, has provided an exciting new way to use neuroimaging to examine the human mind [1]. Rather than focusing on whether activity levels in particular brain regions are responsive to different tasks, neural synchrony examines the conditions under which fluctuations in brains regions correlate from one person to the next. If two people have a conversation, will their brains synchronize? Yes, but one must consider the temporal lag between one person producing speech and the other understanding it [2]. If two people watch the same video, will their brains synchronize? Yes, but how much depends on the quality of video [3]. Effective messages produce more synchrony than less effective messages because effective messaging induces people to see something in the particular way that the messenger wants. In addition, those who are presented with ambiguous information will show greater synchrony with others who see it the same way they do [4,5].

Parkinson, Kleinbaum, and Wheatley's new study [6] is one of only a handful of neural synchrony studies to use machine learning algorithms, such that neural synchrony is actually being used to predict something about the people whose brains are synchronized. But rather than predicting one's experiences and memories [7,8], Parkinson *et al*. predicted the social structure of a large novel group from the similarity of their neural responses.

Parkinson *et al*. obtained social network data from all first year students in an MBA program ($n = 279$). The network was characterized based on mutual nominations in response to a question about 'the people with whom you like to spend your free time.' If two people each checked the other from the list of all students, then this dyad was denoted as 'friends' with an 'edge' directly connecting them in the network and assigned a social distance of 1. If two people were not directly connected, but shared a mutual friend, then they were considered 'friends of friends' and were assigned a social distance of 2. Friends of friends of friends were assigned a 3 and beyond this was coded as a 4.

A subset of this social network ($n = 42$) participated in a second study that involved watching videos ranging from 1.5 to 5 minutes each on a variety of topics (sports, comedy, politics, science), while lying in an MRI scanner. Parkinson *et al*. parcellated the brains of each participant into 80 distinct regions. The time course of activity in response to the video clips in each of these 80 regions was correlated across each of the 861 possible dyadic pairings, with each pair receiving an overall neural similarity score.

The results revealed strong links between neural similarity and social distance within the MBA social network. As neural similarity increased by one standard deviation, a pair was 47% more likely to be friends in real life. Strikingly, this 47% was observed after controlling for gender, ethnicity, nationality, and age – other factors likely to be drivers of social connection. Although this analysis was done by aggregating across all regions of the brain, subsequent analyses indicated that these effects were driven primarily by regions associated with shared perspective taking, attention, and affective processing.

Finally, using machine learning, Parkinson *et al*. trained a classifier on part of the data to try to predict which of the four levels of social distance characterized new dyads within the study. The classifier succeeded at significantly better than chance levels (41%; chance = 25%) and classified close to 50% of friends as friends, rather than as one of the other three levels of social distance.

This study elegantly demonstrates that our private experiences of ordinary everyday events, like YouTube videos, are powerful predictors of who we will spend our time with and come to care about. This study did not attempt to assess the direction of causality, but its findings are consistent with the idea that our unique personal way of seeing the world is so central to who we are, that those who show signs of being our phenomenological comrades would be highly valued by us.

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Ultimately, this study raises more questions than it answers, in that it opens up many new avenues of inquiry going forward. Does the neural similarity one shows with other members of a cause, when viewing materials related to the cause's sacred values, predict the lengths one will go to in supporting the cause, even in some cases giving one's life? Can neural similarity predict not just who we will like, but who we will love? Among those we might swipe right for, wouldn't we be very motivated to know in advance which subset of people experience the world in a way similar to our own? Perhaps companies will one day put together teams for projects based on getting the right balance of neural similarity and dissimilarity to optimize team performance and satisfaction [9]. One could even imagine a day when neural similarity assessments might inform teenagers of future careers that are a good match for their own neural proclivities [10].

~A world in which such things are predicted is in the far-off realm of science fiction, but for how long? Combining the approach of Parkinson *et al*. with more portable affordable neuroimaging modalities, such as near infrared spectroscopy, might allow these hypotheticals to be tested and taken out into the world. This study and others like it portend an exciting future for neuroscience, making direct contributions to how we work, how we love, and how we live.

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Spotlight

Cross-Species Neuromodulation from High-Intensity Transcranial Electrical Stimulation

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Transcranial electrical stimulation (TES) is a proposed tool for noninvasively modulating human brain circuits, but its ability to affect cortical physiology remains unclear. A recent study merged TES with live animal and human cadaveric recordings to verify intracranial electrical effects, then used these findings to develop a novel neuromodulation protocol.

Modern neuroscience increasingly focuses on circuits, with increasingly rapid progress in dissecting brain networks. It has been challenging to translate that progress into new therapies for brain disorders because human circuit manipulation tools are limited. Deep brain stimulation has shown some success [1], but this type of invasive therapy cannot address the vast clinical need. Brain disorders, particularly mental illnesses, strike millions of people per year. A better clinical circuit intervention would be noninvasive and could be self-administered by patients at home. Similarly, human neuroscience might be greatly advanced by a tool that could manipulate brain states without the seizure risk and expensive equipment associated with transcranial magnetic stimulation. Transcranial electrical stimulation (TES) might meet these needs. TES delivers electrical current through two or more scalp electrodes and is believed to alter cortical excitability in the regions directly beneath those electrodes. The relative safety and ease of use of TES have spurred great interest, with many small clinical trials in a variety of brain illnesses [2] and rapidly growing use in cognitive neuroscience experiments [3].

Those studies have equivocal and contradictory results [4,5]. This is in part because we do not know how TES actually affects the brain, or even whether TES current reaches its presumed target [2,6,7]. Subcranial cerebrospinal fluid (CSF) could shunt current back to the return electrode before it reaches the cortex. Recently, an international collaboration sought to measure both the electrical reach of TES and its effects on neurophysiology in both laboratory animals and humans. Vöröslakos *et al.* [8] applied TES to anesthetized rats and, recently, to postmortem (unfixed) human cadavers. In both preparations, they recorded intracranially at multiple locations to map the voltage gradient. They further compared stimulation at the skull surface (a common animal preparation) with true TES through the scalp (the standard human preparation). Their results confirm the cautions previously raised by modeling studies: much of the current applied through a scalp electrode never reached the target cortex. More than 80% of the applied current was lost in the rat. In human cadavers, the loss was closer to 60%,