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The Body of "the Body of Christ": An Introduction to Hyperscanning Research and a Discussion of Its Possible Implications for Understanding Social Experiences During Religious Gatherings

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Abstract
Neuroscience has become a well-accepted methodological modality in the study of religion, especially of religious behavior, personal prayer, meditation, mysticism, spiritual experience, and personal religious experiences. However, such studies have been performed on individuals only; none have helped scholars understand the neuro-physiological correlates of religious communities, religious interactions, collective liturgical action, or the like. This article introduces the new field of social neuroscience, showing how its primary tool, hyperscanning, is revealing surprising levels of "brain-to-brain synchrony." Though there are no hyperscanning studies of religious communities yet, the authors suggest that findings about shared attention, interpersonal coordination, and feelings of closeness all have clear parallels in and implications for religious communities. The authors then suggest both directions and cautions for future research.

Keywords Hyperscanning · Religious communities · Hyperbrain · Social neuroscience

Neuroscience has become a well-accepted methodological modality in the study of religion. It has been used to identify the neurological foundations of religious belief (Kapogiannis et al., 2009) religious behavior (Hayward et al., 2011) and personal prayer. (Schjoedt et al., 2009) Neuroscience has been especially helpful in the study of meditation (Fox et al., 2016), mysticism (Newberg & Waldman, 2017), spiritual experience (Beauregard & Paquette, 2006),and personal religious experiences (Azari et al., 2001). Recently, there has been a spate of studies of the psychedelic state (Carhart-Harris et al., 2012) and ayahuasca (Palhano-Fontes et al., 2015). These valuable and important studies have helped scholars understand the physiological correlates of religion, religious experience, and meditation as they are found in individual practitioners and contribute to developing models for categorizing the wide range of religious, spiritual, and meditative experiences based on their distinct brain activation patterns (Matko & Sedlmeier, 2019; Walter & Koenig, 2023).

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However valuable they may be, these studies have an enormous lacuna. They have never studied more than the neurophysiology of one person's religious experience. Although Travis and Orme-Johnson (1989) recorded simultaneous EEG activity of meditators and nearby subjects engaged in cognitive tasks, studies have never addressed the physiological correlates of religious communities, religious interactions, liturgical action, or the like. They cannot tell us what happens neuro-physiologically in religious congregations. They do not tell us why community gatherings are so important to so many religions. They do not help us understand why church, synagogue, or mosque communities often feel so close-knit and supportive. Nor do they explain, neuro-physiologically, what Christians are pointing to when they say that their parish feels like a family, as did the middle-aged man who said, "My church is just like family to me. I feel closer to the people in our church than I do to my own brothers and sisters. I just don't know what I'd do without them" (Sayles, 2013). They do not help us understand what Lee Pomrenke (2021) meant when she said, "The church is like a family, [with its] warm feelings, a sense of belonging... and a community that knows and cares for its members." Nor what Janet Zimmerman, an Episcopalian priest in Great Barrington, Massachusetts, meant when she described "the body of Christ"[1] as follows:

In Church you're joining with other people. It's like, "welcome to the family."... Having a sense that I'm part of something larger than myself is important. Feeling part of this Body of Christ means someone will walk with me and also hold me accountable. It opens us up to the idea that we're not all there is.... It gives us a sense that they care for me, they want the best for me, they're there for me. They are people who will show up in good and bad times (Forman, 2024).

From its very beginning, Christianity has fostered what we might call the "social aspect of religion." In the first century, Christians met in homes, in something like a family. They ate together, prayed together, got to know each other, and hopefully built deep relationships. Christians of the past, the present, and the future form the church and have been described as "the body of Christ." This term points to the church community as a social organization, a coalition of like-minded persons who are united in a voluntary association and who share a common fealty to Christ as the divine. It points to the sense of commonality, comradery, and closeness that is found in many churches. A particularly strong expression of this idea is found in the common description of the Eucharist as a "communion," in which everyone becomes part of Christ by receiving his body. Accordingly, formal church services are designed not only to worship God and to remind the faithful of the basic contents of their belief but also to strengthen their feelings of being part of the church community. The Catholic *General Instruction of the Roman Missal*, for example, says the purpose of the opening rites is "to ensure that the faithful who come together as one establish communion" and of the entrance song to "foster the unity of those who have been gathered" (Vatican, 2003).

In this paper, we introduce recent neuroscientific research on social experiences that uses a new method called hyperscanning and suggest how it might apply to specifically religious communities.

[1] The notion of Christians forming the body of Christ goes back to Paul. In his discussion of the variety of spiritual gifts in 1 Corinthians 12, he reminds the reader that a body is comprised of many parts, each of which is important. Then he writes, "Now you are the body of Christ, and each one of you is a part of it" (1 Corinthians 12:27 NIV). But this phrase has also come to point to the feeling of closeness that many feel to their church community.

Fig. 1 Physiology (heart rate and breathing), motion capture, and EEG signals being recorded from eight singers simultaneously. © Max Planck Institute for Empirical Aesthetics (permission granted)

Hyperscanning: A new way to study social experiences

Whereas the social and cultural sciences have a long history of studying group behaviors and experiences with qualitative and observational methods, neuroscientists have recently become interested in the physiological correlates and underpinnings of social interactions. This new field of social neuroscience employs the hyperscanning technique. In it, physiological responses and brain activities are recorded from not only one but from two, three, four, or even dozens of people simultaneously. Some recording techniques even collect data outside the laboratory in a real-world context where people actually gather and interact (Funane et al., 2011; Montague et al., 2002).

For an easy introduction to hyperscanning, see a short video introduction to the field by Jason Silva, the host of National Geographic's Brain Games (https://vimeo.com/177197586) or a talk by Susan Dikker (https://www.youtube.com/watch?v=ZrjIjqE9HJo). To give you a sense of this unusual technique, in Fig. 1 you can see a music ensemble of six people singing Renaissance polyphony while wearing gear that records each singer's heart, respiration, movement patterns, and EEG signals. The signals from the relevant sensors are preprocessed and analyzed in a powerful computer.

With such processes, neuroscientists can measure subjects' responses to external "events" or long-term patterns. Brain states and activities, as well as heartbeats and breaths, typically show repeated rhythms or cycles, which neuroscientists call oscillations (Buzsáki, 2006). These oscillations respond to external events, changing with body movements and emotions. Social neuroscientists expand the use of EEGs by examining if, when, and to what degree these bodily processes synchronize among people who are in the same situation or are interacting with each other.

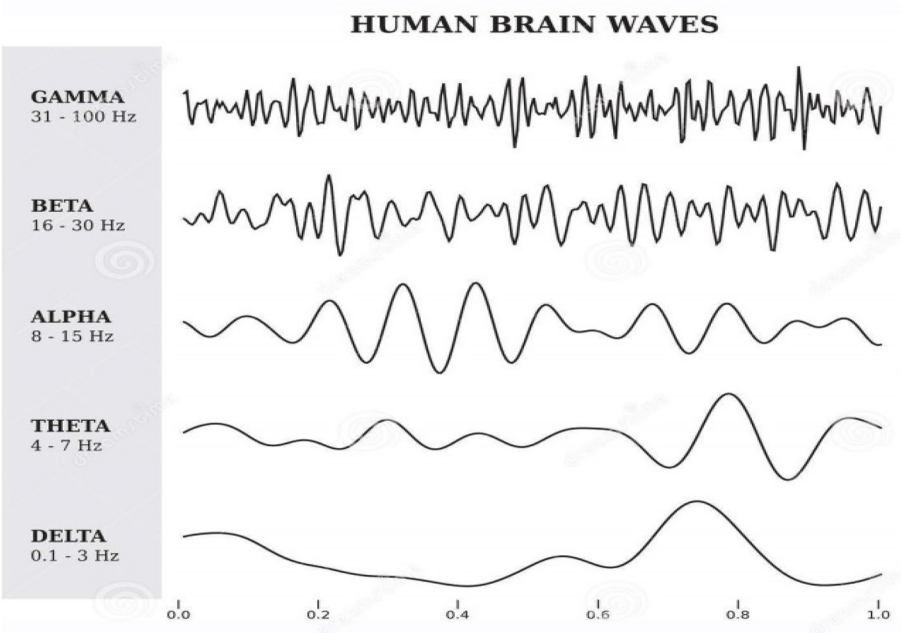

Fig. 2 The five frequency spectra of brain wave patterns

The following sections define several terms and some basic theories to help in understanding the studies that we discuss (Buzsáki, 2006).

Brain waves

Our brain consists of brain cells, neurons, and their connections with each other and synapses. Communication across the synapses happens in the form of rhythmic strings of tiny electromagnetic bursts. In this sense, the entire brain is a continually pulsating organ. Neuroscientists have identified several main patterns of different speeds, which are the frequency bands or spectra (Fig. 2). In the middle of the brain, rhythm generators produce relatively slow rhythmic patterns (alpha and lower). When there is mental or motor activity or sensory input, the outer and most recent part of the brain tends to desynchronize from the internal pacemakers and show faster, localized activity patterns (beta and gamma).

Those electric signals that originate from brain activity not too far away from the skull's surface can be measured with an electroencephalogram (EEG), functional near-infrared spectroscopy (fNIRS), and other tools. Scientists analyze frequency, amplitude, and phase of brain waves (see Fig. 3).

When brain cells work together on the same task or when they lock into the rhythm of an external signal such as speech or music, they tend to synchronize with each other.

Heartbeats and breathing activity can also be understood as oscillatory body signals or waves. They too have a default rate at rest (e.g., around 60 heart beats and 10 to 15 respiration cycles per minute) but change in response to physical or emotional changes.

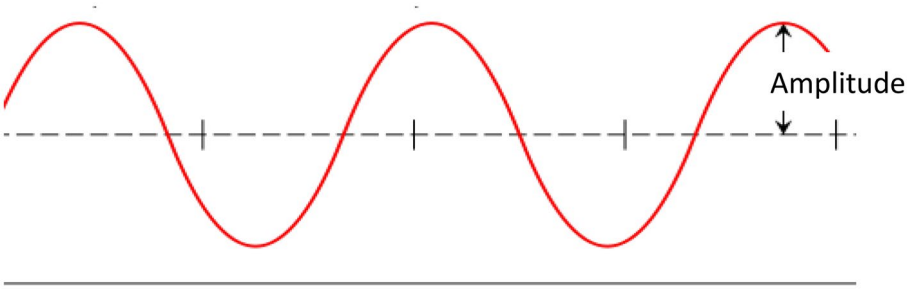

Fig. 3 Schematic depiction of an oscillation wave. Amplitude is "height" and frequency is number of waves per second of the wave

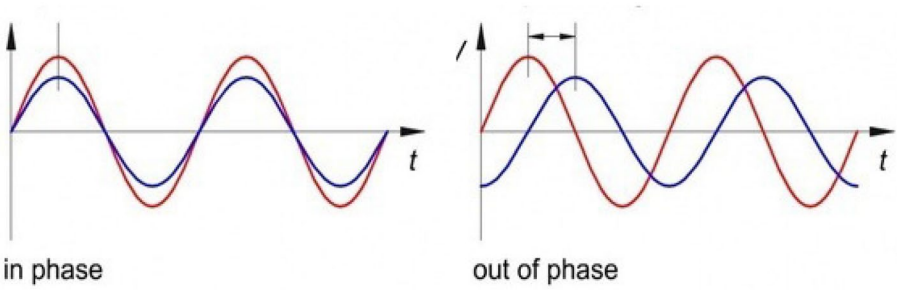

Fig. 4 In phase (phase-locked) and out of phase waves

Forms of synchrony across waves

To arrive at a measure of synchronization within or across brains or bodies, one needs to compare individual signals with each other. While there are also short-term event-related, synchronized frequency, and amplitude or phase responses, we focus mainly on longer-term synchronizations. Here, two main forms exist: (1) "phase coherence," in which waves oscillate in the same frequency, i.e., their phases have the same length, and (2) "phase locked," in which the phases have not only the same length but also start and end at the same time (Fig. 4).

When neuroscientists describe intra- and interbrain coupling, they typically look at the frequency spectra that get synchronized and at the parts of the skull where the synchrony is most clearly found. They can also use more sophisticated analysis methods to trace the temporal dynamics of the synchronization processes, how they ebb and flow, or to depict the networks that emerge across brains and bodies that may show, for example, if one of the oscillating systems plays a more active role in setting the pace while other ones instead follow or "entrain" to it.

Interbrain synchrony as an index of shared attention, interpersonal coordination and feeling close

Only recently have researchers from cognitive neuroscience started to record brain data and other physiological responses simultaneously from people who are interacting with each other in various social situations (Pfeiffer et al., 2013). Studies of three types of groups of people are especially relevant for our topic: (1) shared attention—groups who are paying attention to the same thing (e.g., a movie, a music performance, a lecture), (2) social interaction—groups who are coordinating their actions with each other (tapping simultaneously to a beat, playing a duet), (3) synchrony and feeling close—groups whose inter-body synchrony is compared to how group members feel towards one another. In the following, we briefly introduce groups of studies from each field together with their main methods and results that we think are relevant to our topic.

Synchronization during shared attention

A number of studies have demonstrated that people who listen to music (Tschacher et al., 2021)or stories (Pérez et al., 2017), watch a movie (Schmälzle & Grall, 2020), or attend class (Dikker et al., 2017) together show synchronized brain rhythms as well as coupled heart and respiration rhythms. Pérez et al. (2017), for example, analyzed the brains of pairs of speakers and listeners. He found enhanced synchronization in the delta, theta, alpha, and beta bands. This is in part a consequence of the fact that they all have to process the same sensory input. In Pérez's study, the delta and theta coherence was in part mediated by the speech signal. Here, the sensory input acts as an external synchronizer. However, since couplings have a temporal dynamic, i.e., they get stronger and weaker along the way, this cannot be the only explanation. Some researchers have therefore argued that brain-to-brain synchronization in these situations is also related to some other interpersonal or interbrain processes. Pérez et al. (2017) found that the alpha and beta bands "seem to emerge directly from the mutual interaction of the dyad, without being mediated by the physical properties of speech (i.e., a 'pure' instance of brain-to-brain entrainment)" (p. 6). This coherence, whose synchronization pattern cannot be explained by the mediating role of speech (marked in green), is represented in Fig. 5.

Synchronization during social interaction

In another area of research, scientists have studied the emergence and role of neural, physiological, and behavioral synchrony in situations when people interact with each other and have to coordinate their actions (Müller et al., 2022). These interactions range from very simple (such as two people tapping to the same beat) to very complex (such as a two-voice guitar improvisation, performing four-part polyphony, or building a Jenga tower together) (Liu et al., 2016). In this modality, subjects are not listening to music, for example, but rather are playing or singing together (Lindenberger et al., 2009; Müller et al., 2022; Müller & Lindenberger, 2019; Sänger et al., 2012). Ulman Lindenberger and Viktor Müller's team from the Max Planck Institute for Human Development in Berlin conducted a number of studies with pairs of guitarists who either played a tune in unison, played a piece with two voices, or improvised together. Their EEG data revealed both phase-coherent and phase-locked synchrony in the theta and delta frequencies, particularly immediately before and at the beginning of their duet, as well as when the

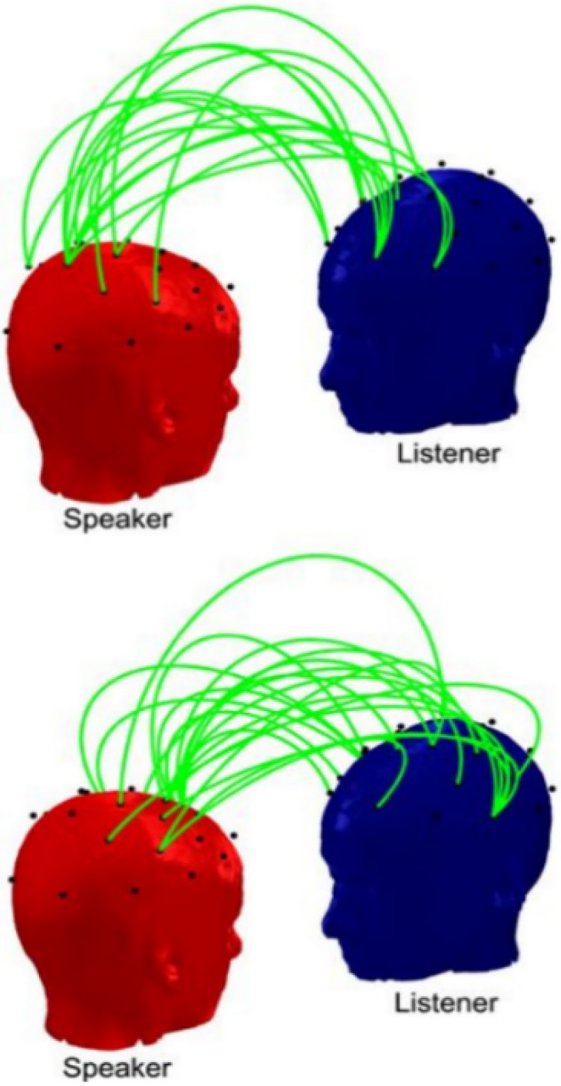

Fig. 5 Interbrain coupling of speakers and listeners. The red head represents the speaker and the blue head represents the listener. The green lines show the electrode pairs whose interbrain coherence is not mediated by speech. The coupling in the alpha band (upper panel) is mainly frontal for the listener and central for the speaker. In the beta band (lower panel), the coupling is mainly frontal for the speaker and temporal for the Listener.

players were playing asynchronously (Lindenberger et al., 2009). Figure 6 shows the synchronicities between two guitarists while they were playing a duet.

In studies of singing ensembles, conducted by the same group and by the Max Planck Institute for Empirical Aesthetics in Frankfurt am Main, dense interpersonal networks were identified, as were various forms of temporally dynamic cardiac, respiratory, and behavioral synchronization. These studies identified somewhat different characteristics among people who sang in unison, sang canons, or sang complex polyphonic pieces (Lange et al., 2022; Müller et al., 2018). The researchers looked into the degree of interpersonal synchronization and also the emerging networks and their dynamics. Figure 8 diagrams the richly layered connections among the voices, breathing, and heart rates of a choral group of 11 singers plus their conductor (Fig. 7).

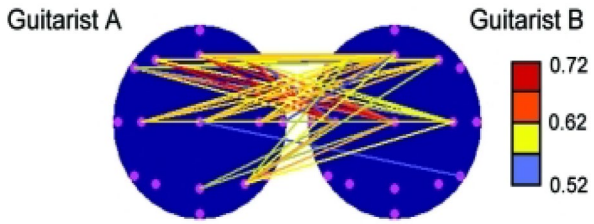

Fig. 6 Interbrain synchronicities between guitarists. Colored lines indicate synchrony between the electrode pairs of the two guitarists, corresponding to significant interbrain synchronization. The colors correspond to strength of the synchronization, ranging from 0.0 to 1.0. © Lindenberger et al. (2009), figure 1, Creative Commons license, http://creativecommons.org/licenses/by/2.0

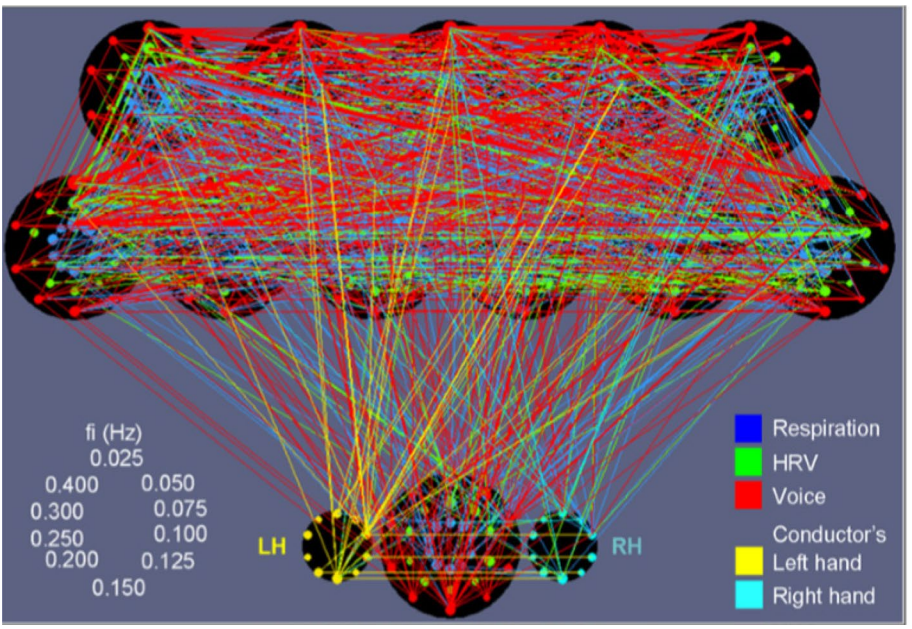

Fig. 7 The connections between several systems of 11 singers and their conductor's left hand (LH) and right hand (RH). The strength of the connections between the nodes is shown with wider lines; colors represent the systems. © Müller et al. (2018), figure 2, permission granted by Wiley, New York Academy of Science, License 5540260779232

> Because their breathing, heart rates, voices, and sound become as if part of a single network, a single organism, a highly integrated group like this can be called a *superorganism* or a *hyperbrain*.

Another domain is verbal communication. Here, social neuroscientists have examined forms such as knowledge sharing, turn-taking, cooperation, creative thinking, and naturalistic discussion (Kelsen et al., 2022). The forms of interbrain synchronization are similar to those in the music studies. In a recent experiment, scientists from the team of psychologist Ning Hao in Shanghai also demonstrated a relationship between the strength of interbrain synchronization and the performance quality of the

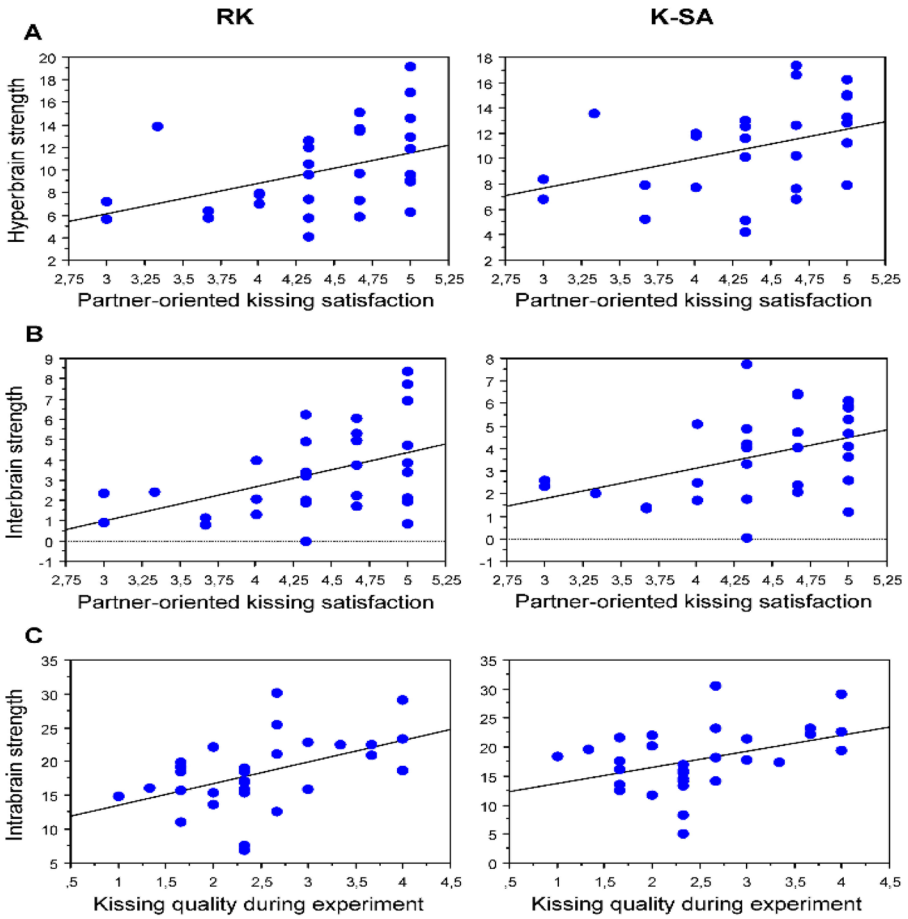

Fig. 8 Interbrain coherence increases when kissing satisfaction increases. K-SA is kissing while doing arithmetic; RK is romantic kissing. This suggests that feelings are positively correlated with interbrain coherence. © Müller and Lindenberger (2014), figure 5, Creative Commons license (CC BY)

communicating pairs (Wang et al., 2022). When we're being more cooperative, when we're engaging one another with greater depth or creativity, the researchers wrote, "Our brains are more aligned, more intertwined, and form a more efficient inter-brain network" (Wang et al., 2022).

Again, the current state of research suggests that physiological synchronization among individuals in the context of coordinating joint actions is mostly a result of perceiving and doing the same or related things in the same course of time, while parts of brain synchronization can be understood as the underlying neural mechanisms that make high-interaction precision possible in the first place. In a recent piece, Viktor Müller et al. (2022) proposed a theory for this by saying we may think of interacting brains as hyperbrains where certain groups of cells form an interbrain community through synchronized oscillations.

Synchrony as an index of feeling close

When people experience the same things or do something meaningful together, this may create or foster social bonds between them. Several studies have suggested that feeling close to others seems to be associated with brain and other forms of interpersonal synchronization. In the aforementioned study by Suzanne Dikker and others from New York University, the Max Planck Institute for Empirical Aesthetics, and two Dutch universities on synchronization among students in a classroom, the coherence of EEG measures was even stronger for those students who reported that they enjoyed the classwork and that they liked the other students (Dikker et al., 2017, 2021). This correlation has been amplified in studies that explicitly connect increased interbrain coherence with feelings of personal connection or involvement with others. For example, one study showed that the brain of a person who empathizes with another becomes more coherent with that person's brain than does the brain of someone who merely recognizes that another feels something (Anders et al., 2020).

The study that is most telling on this point is Müller and Lindenberger's (2014) hyperscanning study of the brains of people who are kissing. The researchers measured the EEG of couples in three settings: (a) kissing their own hand, (b) kissing each other while doing arithmetic in their heads, and (c) kissing romantically. When they computed cross-frequency coupling, they found that, as we might expect, levels of interbrain coherence increased with every step. This study becomes revelatory, however, when the authors asked their participants to subjectively *rank* their kisses. Figure 8 plots three measures of brain synchronicity against kissing satisfaction while kissing romantically (RK) and while people did arithmetic while they kissed (K-SA). In all cases, the relationship is positive; the more satisfying the kiss, the stronger the couple's interbrain synchronicities.

This link between feelings and interbrain coherence is reinforced by a Singapore study of mothers and their babies by Atiqah Azhari et al. (Azhari et al., 2019). When the mothers played with and felt subjectively connected with their children, their brain waves were, as we might expect, more highly synchronized. Where it gets more telling was when Azhari showed the mothers a scary TV scene and asked them to rank their resulting stress levels. The more the mothers subjectively felt stress, the more the mother–child interbrain coherence plummeted. Again, people's feelings are mirrored by their brain-to-brain synchronicities. Both Müller and Lindenberger's (2014) and Azhari et al.'s (2019) subjects' subjective feelings were *accurate* indicators of brain-to-brain synchronicities. Our interbrain connections rise and fall with our feelings of connection.

Similar observations have been made in the context of eye contact (Hirsch et al., 2017) and of involvement in and enjoyment of conversations (Jiang et al., 2012; Pérez et al., 2017) Also, studies in the field of psychotherapy research have shown that the coupling of gestures, body movements, or physiological measures is a marker of subjectively felt patient-therapist connections (Tschacher & Meier, 2020; Wiltshire et al., 2020).

Possible implications for religious gatherings: Some hypotheses

Ever since Descartes, philosophers have assumed that our mental processes take place only within our own minds and brains. Guided by this assumption, neurophysiologists have focused on the brain processes of single individuals. After all, a person's thoughts,

feelings, and even EEG signals all seem to be theirs alone! But, according to the findings of neuroscientists and psychologists such as those whose studies we have cited, important and measurable processes are happening both within *and* between us. The brains of people playing music together, making eye contact, making love, playing a game, doing something creative together, or engaged in other cooperative tasks consistently show greater interbrain synchrony. These findings can also be related to the so-called 4E theory of cognition that has been proposed in the interdisciplinary field of cognitive studies (De Bruin & Gallagher, 2018). The four Es are used to characterize cognition as something that extends beyond the individual brain, namely, as embodied (it's not just the brain that thinks, but the rest of our body as well), embedded (into an environment), enactive (in the form of interactions with our environment), and extended (to others). For our context, the aspects of embodied and extended cognition seem to be particularly relevant.

Now, most of the studies we've seen were conducted in lab-like settings. To the best of our knowledge, there are no hyperscanning studies of church or other religious gatherings. But, we are convinced that the studies we have summarized can partly explain the social aspect of religious settings because many of the social situations and aspects that hyperscanning studies have shown to result in physiological and/or brain synchronization are present in essence in religious gatherings as well. We exemplify this with Christian services:

1. As noted, people who watch and listen to the same thing such as a story, a movie, or music, as well as people who perform similar body movements, show strong levels of physiological and brain synchronization. In Christian services, people are behaving as an audience, watching and listening together, to what is essentially a mix of performances; people are listening together to prayers, stories, and readings, watching rites performed, etc. They also perform similar body movements such as walking, standing, or kneeling at the same time.
2. As also noted, when people act cooperatively, especially in musical settings, they demonstrate greater physiological and interbrain synchrony. In virtually every church, people recite, chant, or sing together. As the choir sings a tune and the congregation chimes in, their minds, hearts, lips, voices, and breathing patterns will likely align with the choir director, the choir, and everyone else in the church. Hence it is possible, even likely, that simultaneous singing or recitations of religious phrases typical of church activities will generate not only physiological but also greater brain-to-brain synchrony. As neuroscientist Johanna Sänger put it, "When people coordinate actions with one another, small networks... between their brains are being formed," and this should be measurable in a church as well (Sänger et al., 2012).
3. But there are also other forms of cooperative interactions that are associated with many church services, such as setting the altar table, arranging flowers, passing out bulletins, preparing food in a soup kitchen. Liturgical personnel often enter two by two in processions, with deacons bringing in candles, thurifers swinging incense burners, and the like. Acolytes also help the priest lay out the religious implements and offer the Eucharist meal, all of which sometimes seems like a highly aligned ballet *pas de deux*.
4. We also noted that when someone empathizes with another, as compared to merely understanding what they feel, both participants enjoy greater brain-to-brain synchrony. That is, when someone feels sad or happy *with* another, as opposed to merely noticing that another feels such, their two brains become more coherent. We can also find such empathy in many Christian services. When someone offers a powerful emotional tale

as they ask for prayers, for example, many congregation members will likely empathize with them, often to tears. When a preacher speaks of feelings of victory, tragedy, or grief and the congregation celebrates or mourns with them, they're all probably sharing more than they realize, i.e., brain wave rhythms. When a minister raises the emotional temperature of the parish and evokes tears or laughter, they're probably affecting their congregants far more than the minister who gives an intellectual, unemotional sermon or who simply names a feeling.

5. We noted that even eye-to-eye contact produces interbrain synchronicities. This suggests that when congregants make eye contact, hug, or shake hands in the Christian "kiss of peace," it is possible, even likely, that they are further fostering interbrain synchrony.
6. The findings on interbrain synchrony in the context of intimate contact, e.g., kissing or creative cooperation, may have their complement in religious gatherings that involve more intimate interactions such as small Bible study groups, intimate one-on-one conversations about religious experiences, and other times of personal cooperating or connecting.
7. Religious gatherings also have characteristics that have not yet been examined by hyperscanning studies but may serve as additional drivers of interpersonal synchronization processes. The studies we've seen all focus on a single sense, such as *looking at* someone's eyes, *hearing* a speaker, *listening* to music. But religious services are essentially multi-sensory. People *listen* to words and sounds, they *see* the interior walls and decorations and *watch* the rites, they *smell* the frankincense, *taste* the bread and wine, and *feel* each other when they shake hands or exchange the kiss of peace. We may therefore expect greater degrees of interpersonal synchronization to arise from such multi-sensory stimulation.
8. Also, existing studies look at either shared perceptions or joint actions. In a religious service, *both* are present. This too may multiply synchronization levels.
9. Finally, religious gatherings are communities that share a worldview, a framework, beliefs, and a sense of the infinite or divine. We hypothesize that having such a common vision is likely to foster greater coherence within the community than, say, a competitive archery club or a gang of hikers. But just how a common sense or a common experience of the transcendent manifests and effects interbrain synchrony is not clear. This, too, is something that only further study can establish.

We think that with this mix of characteristics—i.e., the multi-sensory stimulation, the interaction of shared perceptions and actions, and the emotional qualities, as well as the sphere of deep meaning and spiritual belief—we can expect to see a wide breadth of coherences between participants' bodies and brains: i.e., physiological and brain-to-brain synchrony between heart beats, respiration cycles, visual cortices, auditory cortices, cerebellums, and other regions. This is likely to lend religious services an exceptional richness of interpersonal physiological and neural synchronization that may not be found in other forms of social interaction. This may even result in a complex interpersonal network that weaves adherents into a single superorganism, the brains and hearts of the members serving as the warp and woof of an individual-transcending fabric of connections. Such directing and aligning of participants' perceptions and actions in these rituals suggests that the generations that designed the rituals were, even without any modern psychological and neuroscientific knowledge, intuitively alert to of the power of such synchronized behaviors (Dunbar, 2013; Kaiser, 2017; Klingbeil, 2007; Mellor, 2007; Sosis & Ruffle, 2003).

Given this, our broad hypothesis may be stated as follows: In general, compared to nonreligious gatherings, religious assemblages will demonstrate higher levels of physiological and interbrain synchrony, and higher levels of subjectively evaluated group coherence within them. As members perform more and less cohering actions such as singing, kneeling, eating, drinking, and listening to sacred stories or sermons together, different levels of interpersonal synchrony will rise and fall correlatively.

However, if one were to embark on hyperscanning studies of Christian communities, the following cautions need to be kept in mind:

1. Christian churches and denominations around the world vary enormously in liturgical forms and styles. There are, to just name a few, Pentecostal services in which people speak in tongues, quiet Episcopalian services in which people receive communion, silent Quaker meetings, Mennonite gatherings in which members sing four-part harmony a capella (with no organ or piano), Roman Catholic masses with fixed choreography and lavish multi-sensory displays, and hours-long mystery-filled Orthodox rites in ancient languages. Any study will have to clarify the kind of religious gathering and types of interpersonal interactions being examined. Researchers would also need to be cautious in assuming that results from one context would be automatically relevant to another. To see if the different liturgical styles of the Christian denominations lead to different degrees and types of interpersonal synchronization, comparisons across denominations would be a promising approach.
2. Furthermore, services differ even within the same denomination, often depending on the weekday, type of holiday or period within the church year, and pastor. Simpler and quieter weekday or Lent services are probably experienced differently from the solemn celebrations of the more important holidays. Cultures, countries, and even single parishes may differ in styles and connections. So, again, it will be important to be transparent about the character of the studied service and to think about a comparative approach.
3. Finally, within any one parish, members will probably demonstrate more or less focus, more or less interpersonal connectedness, more or less emotional involvement, etc. We cannot assume interpersonal or emotional homogeneity. It will be important to note which times and intensity of religious action are associated with specific types and levels of interpersonal synchrony. Any study will have to clarify such matters.
4. Any future hyperscanning study of a religious gathering that uses EEGs will have to design the procedures to minimize the artifacts that come from eye movements, talking, and singing, as well as from head and other physical movements. One possibility to ensure that the recording is as 'artifact-free' as possible is to minimize physical movements during the group activity. Even with such a restriction, one should be able to glean valuable EEG data on the neurophysiological underpinnings of such a gathering.
5. This study has focused on Christian rituals and activities. Hyperscanning studies of Judaism, Hinduism, Islam, and other religious sects and pathways would likely have both similar and different levels and qualities of interbrain synchrony. Again, further studies of these religions will have to clarify the similarities and differences and account for both.
6. If future hyperscanning study data on religious gatherings identifies "pure" instances of brain-to-brain entrainment similar to what Pérez et al. (2017) found that cannot be explained solely by external synchronizers, it would add enormously to our understanding of the possible underlying mechanisms of such religious experiences in terms of the mind–body problem.

Conclusions

Hyperscanning studies are still in their infancy, and it's hard to draw conclusions about their implications. But they do suggest that the idea of the church as "the body of Christ" and the related phenomenon of feeling part of a bigger whole have not only a spiritual and metaphorical meaning but a physiological meaning as well. Our bodies, hearts, and brains connect when we share meaningful experiences and join in personally relevant communal activities. In this way, they suggest that one of the gifts we can give each other, and give to a church community, is *us*. We can give our presence. We can offer the energy that courses through our bones and skulls. We can share love. Even at this early point in these studies, hyperscanning has established that the links that we feel with a dear friend and in a living church community are not merely subjective feelings. If I experience myself joining into a flow with you, if you sense yourself connecting with me lovingly, and if we're both acting out of a more or less common set of beliefs and commitments, as people theoretically do in a church, we are simultaneously generating subjectively felt as well as objectively measurable connections between us. The notion of the body of Christ is not a theological nicety. If our hypothesis is correct, it is a measurable objective phenomenon. When we give the gift of ourselves and of that which is beyond ourselves, we seem to be doing so in ways of which we are and are not aware.

Declarations

Conflict of interest No conflicts of Interest.

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