

# Cyclical Time and Rhythmic Rituals: Entrainment, Neural Synchrony, and Social Bonding

## Research Summary

### Cyclic Conceptions of Time and Ritual Across Cultures

Time is not universally viewed as a linear arrow; many cultures conceive of time as **cyclical**, tied to natural rhythms and recurring events <sup>1</sup> <sup>2</sup>. Indigenous worldviews, for example, emphasize seasonal cycles, lunar phases, and agricultural rhythms as repeating patterns that connect communities with nature <sup>1</sup>. Ritual calendars in such cultures mark **recurring ceremonies** (harvests, solstices, etc.), reinforcing communal bonds through shared observances <sup>3</sup>. Classic anthropological theory holds that our very divisions of time (days, weeks, years) emerged from the regular recurrence of **social rituals and ceremonies** <sup>4</sup>. Émile Durkheim noted over a century ago that the common calendar is rooted in collective rhythmic activities – “it is not my time... it is time conceived objectively by all [members] of the same civilization” <sup>4</sup>. In other words, communal cycles and rituals have historically structured time and social life.

This cyclical temporality often carries spiritual significance. Many religious traditions treat ritual time as *sacred time* that loops back or reconnects to origins (e.g. annual festivals re-enacting mythic events). By repeatedly “resetting” the clock through ritual, communities renew social ties and cultural continuity. Anthropologists describe how **repeating rituals aligned with natural cycles foster social cohesion and intergenerational continuity** <sup>3</sup>. In Native American and First Nations contexts, time is sometimes described as a “**spiral**” or **circle**, where past and future are interconnected through recurring ceremonies on the land <sup>2</sup>. Such cyclic frameworks encourage a mindset of harmony, seeing life as a web of recurring patterns rather than isolated moments <sup>1</sup>.

Historical examples underscore the social function of cyclical rituals. The French sociologist Durkheim observed that during collective ceremonies, participants experience what he called *collective effervescence* – a state of unified emotional excitation that makes individuals feel part of a larger whole <sup>5</sup>. This effect diminishes individuality and synchronizes the group’s mindset, reinforcing solidarity. Early anthropologists also noted that rituals often intensify in times of uncertainty or stress. **Bronislaw Malinowski’s** fieldwork in the Pacific (1910s) famously showed that Trobriand Islanders performed elaborate rituals before dangerous open-sea fishing expeditions but few rituals before safe lagoon fishing <sup>6</sup>. He concluded that rituals serve to reduce anxiety and instill confidence when outcomes are unpredictable. Repetitive ritual actions can thus provide a **psychological rhythm of reassurance** – a predictable cycle of behaviors that soothes fear of the unknown. This insight foreshadows modern findings that rhythmic practices (prayer, chanting, breathing exercises) help regulate stress physiology. In short, the anthropological record highlights that humans everywhere have used **temporal rhythms and ritual repetition as tools for social unity and emotional management**.

## Rhythmic Communal Rituals and Attentional Entrainment

Communal rituals commonly feature rhythmic elements – **drumming, chanting, singing, clapping, or dancing in unison** – that capture attention and draw participants into sync. Psychologically, rhythmic **repetition focuses attention** by providing an expected temporal structure. According to dynamic attending theory, a regular beat can literally *entrain attention*, causing people to anticipate and attend to each beat or action in time <sup>7</sup>. When a crowd drums or chants together, individual attentional streams lock onto the shared rhythm, aligning everyone's focus to the same pulses and pauses. **Neuroscientific studies confirm that regular auditory rhythms can entrain brain oscillations**, timing neural excitability to peak at each beat and thus “optimize the perceptual processing of forthcoming events” <sup>8</sup>. In essence, a steady beat gets everyone's brains ticking to the same clock, which **sharpens collective attention** to the ritual moment.

Beyond structured attention, rhythmic rituals often induce a trancelike or flow state. Repeated chanting or drumbeats over extended periods can lead to **deep absorption**, narrowing one's awareness to the here-and-now of the ritual. Ethnographic accounts of Sufi zikr ceremonies, Afro-Brazilian Candomblé drumming, or Indigenous powwow dances, for example, describe participants entering altered states of consciousness through rhythmic repetition. From a cognitive perspective, the **predictable cycles free the mind from distraction**, as attention continually resets on the next beat or chant. This can create a powerful sense of *joint presence* – everyone's minds collectively “in the same place” temporally. Indeed, laboratory research shows that when people listen to or move with the same beat, their neural activity can oscillate in unison, effectively **aligning their internal timing** <sup>9</sup> <sup>7</sup>. One study notes that observing rhythmic actions can elicit *time-locked resonance* in the observer's motor cortex, essentially mirroring the timing in the brain of the actor <sup>10</sup>. Such brain-to-brain entrainment underlies the feeling of being “on the same wavelength” during group activities.

Importantly, these effects are not limited to active performers. Even *spectators* of rhythmic rituals may become entrained. In a striking field study, researchers measured heart rates during a fire-walking ceremony and found that **spectators' arousal patterns synchronized with those of the performers** <sup>11</sup>. As the fire-walkers experienced surges of excitement, the heart rates of emotionally invested observers spiked in near-unison <sup>11</sup>. This physiologic entrainment was strongest among community members closely related to or familiar with the performers, indicating that social closeness modulated the effect <sup>12</sup>. Outsiders watching did **not** exhibit the same sync <sup>12</sup> – an important point that attentional and emotional entrainment in ritual is bolstered by a sense of belonging or identification with the group. In sum, communal rhythmic engagement funnels everyone's attention along the same temporal groove, uniting not only outward movements but **internal cognitive-emotional states into a synchronized collective experience**.

## Neural Synchrony and “Group Mind” in Rhythmic Practices

Modern cognitive neuroscience has begun to illuminate how group rituals literally get people's brains “in sync.” Using hyperscanning techniques (simultaneous brain recordings from multiple people), scientists can observe **interbrain synchrony** – the alignment of neural activity across individuals – during social interactions. Findings from the last decade show that when people engage in **cooperative or synchronous tasks, their brainwaves often exhibit measurable synchronization**. A 2022 meta-analysis of 13 studies using fNIRS (functional near-infrared spectroscopy) hyperscanning found significant interbrain synchrony in frontal brain regions when people simply cooperate on a task <sup>13</sup>. All thirteen studies observed robust brain

synchronization in the prefrontal cortex during cooperation, suggesting that **aligning goals and actions literally aligns neural firing patterns** in that region <sup>13</sup> . Notably, this held true across diverse tasks, implying a general phenomenon: *working together gets brains coupled together*. Such neural coupling has earned the moniker “**social glue**” in the literature, as it correlates with feeling connected and working smoothly as a unit <sup>14</sup> .

Rhythmic coordination is a particularly potent trigger of neural synchrony. Because music and movement rhythms create strong external timing cues, they can drive brains into lockstep. For instance, **drummers playing in unison or dancers moving together often show synchronized brain activity patterns** related to timing and motor control. One pioneering neuroimaging study demonstrated that when two people drum in sync, their brains’ reward centers activate and a subsequent increase in altruistic behavior toward each other is observed <sup>15</sup> . In this experiment, participants drummed alongside an experimenter either in synchrony or out-of-sync; those who drummed in perfect time not only showed heightened caudate activity (a region associated with reward processing) during the task, but later were far more likely to help the experimenter with a spontaneous dropped-pencils task <sup>16</sup> <sup>17</sup> . The authors concluded that **interpersonal synchrony engages the brain’s reward system, essentially giving participants a “bonding boost” that translated into prosocial commitment** <sup>15</sup> . Other neurostudies similarly suggest that *synchrony feels good*: one review notes that **moving in sync is experienced as rewarding**, which makes evolutionary sense because group cohesion has survival advantages <sup>18</sup> . In fact, theorists propose that our species’ rare ability to flexibly entrain to a beat (uncommon in the animal kingdom) may have evolved to strengthen social groups – through the pleasure and signal value of grooving together <sup>19</sup> .

Beyond two-person interactions, group-scale neural synchrony has been observed in real-world rhythmic contexts. A recent study (2025) outfitted an **audience of 23 people with EEG headsets during a live contemporary dance performance** to measure collective brain dynamics <sup>20</sup> . Remarkably, the spectators’ slow-wave (delta band) brain activity became highly synchronized, especially during moments when the dancers directly engaged the audience and when the audience members watched the show **together** in the same venue <sup>20</sup> <sup>21</sup> . The degree of interbrain synchrony tracked with self-reported engagement: the more engrossing the performance, the more the audience’s brains oscillated in unison <sup>20</sup> . When people later watched a video of the dance alone, the effect was weaker – indicating it was **the shared live experience that amplified the neural coupling and collective absorption** <sup>22</sup> . This finding echoes the ancient intuition that performing arts (dance, music, theater) serve a social bonding function: by synchronizing spectators’ brains and emotions, **a group literally “tunes in” together to a common experience**. Neuroscientists Nummenmaa and colleagues have argued that being in sync aligns participants’ mental representations and streamlines communication, effectively putting everyone on the same page while *reducing cognitive load* for each individual <sup>7</sup> . When a group falls into a shared rhythm, your brain doesn’t have to work as hard to predict others’ actions or intentions – you are *in harmony* with them. Thus, rhythmic rituals achieve a kind of **cognitive unison**, where attention, emotion, and even physiology reverberate collectively.

## Social and Prosocial Effects of Synchronized Ritual

Converging evidence from psychology, anthropology, and neuroscience all supports the idea that **“those who sync together, link together.”** Performing rituals in synchrony tends to increase social cohesion, trust, and cooperative behavior among participants. A comprehensive meta-analysis in 2016 examined 60 experiments and found a **medium overall effect size for interpersonal synchrony enhancing prosocial attitudes and behaviors** <sup>23</sup> . Crucially, these experiments established *causality*: when people were made to

move, sing, or even just tap fingers in unison, they subsequently showed greater liking for each other, more willingness to help, and better team cooperation compared to non-synchronous control groups <sup>24</sup> <sup>25</sup> . The social bonding hypothesis of synchrony, first suggested by Durkheim in 1912, thus now has solid empirical backing <sup>26</sup> . Synchronous marching, clapping, music-making – ubiquitous in military drills, sports chants, and religious choirs – indeed generates a **feeling of unity** and increases group cooperation in controlled studies <sup>26</sup> <sup>5</sup> .

Anthropologists have documented similar outcomes in natural settings. In **high-intensity rituals**, the fusion of rhythmic synchrony and strong emotions can yield especially powerful prosocial effects. Cognitive anthropologist Dimitris Xygalatas conducted field experiments during a **Hindu Thaipusam festival in Mauritius**, where some devotees participate in an extreme kavadi ritual (carrying heavy decorated shrines with **spear piercings** through their skin, all while walking and dancing in procession). Before and after the ritual, participants and their accompanying family members were anonymously tested for generosity via a charity donation task. The results were striking: **after going through the painful, rhythmically coordinated procession, participants were about three times more likely to donate money to charity than they were before** <sup>27</sup> . Even their **non-pierced family members who simply walked alongside in support showed the same elevated generosity** – in fact, their donation levels matched those of the actual ritual performers <sup>12</sup> . This implies that the *vicarious* involvement and emotional synchronization of supporting a loved one in the ritual still produced a prosocial rush. Outsiders and tourists observing did not experience this boost, highlighting that it's the **combination of shared ordeal + synchronized group activity + social identity that drives an altruistic “high.”** Notably, Xygalatas also found a linear relationship between **the amount of pain endured and the amount of money donated** <sup>27</sup> , suggesting endorphin release and group euphoria (a possible biochemical basis of Durkheim's effervescence) translate into communal goodwill.

Laboratory studies on more gentle rhythmic activities show consistent, if less dramatic, prosocial outcomes. **Singing together**, for example, has been shown to increase trust and cooperative decision-making. In one classic study, adults who sang a song in unison subsequently cooperated better in a prisoner's dilemma game and reported higher trust in their group than those who performed a task without synchrony <sup>28</sup> . With children, researchers have found that even **toddling infants who were bounced in sync to music with an adult later demonstrated more helping behavior** toward that adult than infants bounced out-of-sync <sup>29</sup> . Such findings suggest humans are inherently inclined to bond through rhythm from an early age. A 2015 study also highlighted the role of **endorphins in musical synchrony**: when people danced together in sync (versus out of sync, and with varying intensities), both synchronization *and* physical exertion independently raised participants' pain thresholds (an index of endorphin release) and self-reported bonding <sup>30</sup> <sup>31</sup> . In other words, moving energetically is bonding (think of the camaraderie after a hard group workout), moving in unison is bonding, and doing both is especially effective. The authors conclude that **dance involving both vigorous movement and synchronized timing is “an effective group bonding activity”** that likely taps our endorphin system to forge social ties <sup>31</sup> . This aligns with neuroscientific evidence that **synchrony activates reward circuits** <sup>18</sup> and with evolutionary theories that group music and dance served to signal coalition strength and promote in-group solidarity <sup>19</sup> .

Taken together, contemporary research across disciplines paints a clear picture: **communal rhythmic rituals entrain not just bodies but minds, creating measurable neural and physiological alignment that underpins a heightened sense of togetherness.** This synchronized state tends to foster empathy, trust, and altruism – *prosocial qualities essential to collective life*. Temporal rhythm and ritual thus link directly to cognitive entrainment mechanisms: by aligning attention and brain states, rituals can induce a *collective*

*mindset* in a group. These findings not only deepen our understanding of age-old practices (from Indigenous ceremonies to modern concerts), but also suggest practical ways to design experiences that harness gentle synchrony for positive social outcomes.

## Design Recommendations for Rhythmic Entrainment in Interfaces

Interface designers can apply insights from ritual studies and cognitive entrainment to **create shared rhythmic experiences that enhance group focus and cohesion**. Below are actionable design recommendations, grounded in the research above, for integrating gentle cyclic cues into collaborative or multi-user technologies:

- **Embed Gentle Visual Rhythms for Shared Focus:** Introduce subtle cyclic visual cues in the UI that all users perceive simultaneously. For example, a **softly pulsing element** (like a circle that expands and contracts or a background hue that slowly oscillates) can serve as a shared metronome. If a team in a video meeting or virtual workspace sees the same calm pulsation, it may **entrain their internal rhythms (attention, even breathing) to a common tempo**, fostering a sense of unity. Research on sensorimotor entrainment shows that even without conscious effort, people's physiology can sync to rhythmic stimuli <sup>32</sup> <sup>33</sup>. A gentle 6-second cycle animation, for instance, could encourage a slow collective breathing rate, helping **synchronize arousal levels and focus** across participants. The key is to keep the visual rhythm **non-intrusive and soothing** – it should be an ambient presence that subtly aligns timing, not a distraction. By creating a shared “heartbeat” in the interface, designers invoke the same principles as communal drumming or chanting in a modern, light-touch form.
- **Use Ambient Audio Beats to Entrench a Collective Tempo:** Leverage the power of sound by integrating quiet, **steady auditory cues** that provide a joint sense of cadence. This might be a soft drum beat, a bell that rings at a regular interval, or a gentle musical loop with a consistent tempo in the background of a shared virtual environment. **Auditory rhythms are especially effective at entraining attention and neural activity** <sup>7</sup> – people naturally synchronize to a beat. In a co-working or study app used by distributed groups, an option to play a faint ticking or pulsing tone could help everyone **settle into the same pace of work**. For example, an online brainstorming platform might have an optional “focus soundtrack” with 60 BPM (beats per minute) tones that all collaborators hear, subtly encouraging them to type and think in a coordinated rhythm. Such cues tap into our instinct to align with auditory patterns. It's important to keep the volume and timbre gentle (e.g. a low drum or pleasant hum) so that it **guides without overriding** the main content. The goal is a **temporal scaffold** that **keeps the group in sync cognitively**, much like a choir staying on beat, resulting in smoother coordination.
- **Facilitate Synchronized User Actions as Modern Rituals:** Design interface moments where users deliberately do something in unison, creating a mini-ritual that aligns their mindset. For instance, a collaborative app could include a **“start-of-meeting ritual”** where all participants press a button or perform a gesture at the same time (perhaps prompted by a 1-2-3-count or a brief rhythmic countdown). This mirrors how real-world meetings might start with everyone clapping once together or taking a collective deep breath. **Initiating tasks with a synchronized action can rapidly build group cohesion**, as experiments on synchronous movement have shown increases in trust and cooperation from even very simple simultaneous acts <sup>26</sup> <sup>5</sup>. Another idea is a shared **countdown timer** that pulses or ticks, which teams use to begin a Pomodoro work session together or to

simultaneously send in their inputs during a voting exercise. The anticipation of a unison start and the act of doing it together give a small dose of *collective effervescence* in an otherwise digital interaction. Designers should make these rituals **optional and respectful** (not everyone may want to participate), but by embedding the affordance, they provide groups an easy way to harness synchrony's bonding effects.

- **Integrate Cyclic Reminders to Pause and Regroup:** In longer group interactions, introduce **regular rhythmic breaks or prompts** that everyone experiences together. For example, a virtual classroom platform might gently chime every 20 minutes indicating a moment for teacher and students to **stretch or breathe in sync**. This creates a repeating cycle (akin to a class bell or a meditation gong) that **punctuates time collectively**, helping to re-synchronize attention if it has drifted. By following a common cycle (say, a short pause every hour on the hour), participants develop a **shared temporal rhythm** in their workflow. Research on cyclical time in communities shows that **recurring rituals (even small ones) strengthen social bonds by virtue of their predictability and shared meaning** <sup>3</sup>. Designers can implement features like group “check-in” notifications at set intervals, perhaps with a calming animation or sound, to serve as a **collective reset button**. When everyone pauses together, even briefly, it reinforces the sense of “we’re all in this together” and can mitigate cognitive fatigue by aligning rest-activity cycles across the team.
- **Leverage Biofeedback and Synchrony Indicators:** Where possible, provide feedback on group synchronization to make the *invisible connections visible*. For instance, if an app can access sensors (wearables, cameras, microphones), it could detect when users’ **heart rates, typing rhythms, or speaking cadences start to align**, and then reflect that back in the interface in an abstract way. One could imagine a video conference tool that shows a subtle visualization when the group’s average heart rate variability indicates collective calm, or when everyone’s voice has fallen into a similar tempo. Even without high-tech sensing, simple indicators like “All participants have completed Task A – you’re in sync!” can reinforce synchrony. Studies have noted that people often **aren’t aware** of the degree to which they have synchronized with others, yet this synchrony correlates with positive outcomes <sup>14</sup>. By **acknowledging and rewarding moments of synchrony** (e.g. a little glow or sound when a team achieves something simultaneously), interfaces might encourage that “social glue” to thicken. Designers should be careful that such indicators remain **encouraging rather than competitive** – the aim is to foster a collective mindset, not to single out those “out of sync.” Done right, showing that “*your minds are in tune*” can boost group confidence and empathy.
- **Cultivate Shared Ritual Experiences in Digital Spaces:** More broadly, approach the design of collaborative software features as opportunities to create **meaningful rituals online**. This can be as simple as a consistent opening activity (like a short communal music clip that plays at the start of a session) or as elaborate as virtual environments that simulate gathering around a “campfire” with rhythmic ambient effects. The key components are **rhythm, repetition, and shared attention**. For example, a team productivity app might have an optional “*morning sync*” mode where at a set time each day, team members online are guided through a 2-minute synchronized routine (e.g. everyone watches a live updating quote of the day fade in, takes a breath, and then types one goal in unison). By **ritualizing certain interactions through gentle time-based structures**, designers give remote groups the kind of bonding moments that co-located teams might get from, say, a daily stand-up meeting where everyone claps or chants a slogan. These digital rituals, grounded in cyclic cues and rhythmic coordination, can help induce a **desired collective mindset – whether it’s calm focus,**

**energization, or solidarity** – at key moments. They echo age-old practices (like monks chanting at regular hours or soldiers marching in step) but in a form tailored to modern interfaces.

In implementing these recommendations, designers should remain **inclusive and flexible**. Not every user will respond to rhythmic cues in the same way, and some may find any imposed pattern off-putting. Thus, gentle cues should be **opt-in or adjustable**, allowing groups to calibrate the intensity (e.g. volume of a beat, brightness of a pulse) or turn them off as needed. The goal is to **enhance the group experience unobtrusively**, aligning with our neurological and cultural predispositions for rhythm without forcing anything overtly “ritualistic” on those uncomfortable with it. When thoughtfully applied, however, **temporal design elements inspired by communal rituals – cyclical visuals, synchronized audio, and orchestrated moments of unity – can act as digital facilitators of entrainment and empathy**. By getting users’ attention, brains, and behaviors **in sync**, such interfaces may unlock higher collective focus and a stronger sense of “team” or “community” among people, even if they are physically apart. The research is clear that humans have long tapped into the power of rhythmic togetherness to bond and cooperate; **interface designers can now do the same, weaving gentle rhythms into technology to nurture a shared mind and shared heart in the digital age**.

**Sources:** Durkheim (1912); Malinowski (1920s); Xygalatas (2013, 2023); Rennung & Göritz (2016); Kokal et al. (2011); Tarr et al. (2015); Gordon (2025); Rai et al. (2025); and others <sup>4</sup> <sup>5</sup> <sup>34</sup> <sup>12</sup> <sup>23</sup> <sup>31</sup> <sup>14</sup> <sup>20</sup> .

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<sup>1</sup> <sup>2</sup> <sup>3</sup> Cyclical Time Definition - Intro to Native American Studies Key Term | Fiveable

<https://fiveable.me/key-terms/introduction-to-native-american-studies/cyclical-time>

<sup>4</sup> Time | Open Encyclopedia of Anthropology

<https://www.anthroencyclopedia.com/entry/time>

<sup>5</sup> <sup>7</sup> <sup>9</sup> <sup>10</sup> <sup>11</sup> <sup>18</sup> <sup>19</sup> <sup>23</sup> <sup>24</sup> <sup>25</sup> <sup>26</sup> Prosocial Consequences of Interpersonal Synchrony: A Meta-Analysis - PMC

<https://pmc.ncbi.nlm.nih.gov/articles/PMC5137339/>

<sup>6</sup> <sup>12</sup> <sup>27</sup> <sup>34</sup> Dimitris Xygalatas on Ritual - Social Science Space

<https://www.socialsciencespace.com/2023/12/dimitris-xygalatas-on-ritual/>

<sup>8</sup> Alpha Oscillations Related to Anticipatory Attention Follow Temporal ...

<https://www.jneurosci.org/content/31/40/14076>

<sup>13</sup> Cooperative Behavior Evokes Interbrain Synchrony in the Prefrontal and Temporoparietal Cortex: A Systematic Review and Meta-Analysis of fNIRS Hyperscanning Studies - PubMed

<https://pubmed.ncbi.nlm.nih.gov/35365502/>

<sup>14</sup> Interpersonal Synchrony Research in Human Groups - Bar-Ilan University

<https://cris.biu.ac.il/en/publications/interpersonal-synchrony-research-in-human-groups/>

<sup>15</sup> <sup>16</sup> <sup>17</sup> <sup>28</sup> Synchronized Drumming Enhances Activity in the Caudate and Facilitates Prosocial Commitment - If the Rhythm Comes Easily | PLOS One

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0027272>

<sup>20</sup> <sup>21</sup> <sup>22</sup> Delta-band audience brain synchrony tracks engagement with live and recorded dance - ScienceDirect

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