

Breath of Light

Reclaiming Shared Breathing Through a Meditative Installation

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ABSTRACT

Breath of Light is an immersive breath-responsive installation aiming to reclaim the connective act of sharing breath in public spaces. During the exhibition at the 13th Shanghai Biennale in March 2021, the lead author interviewed and observed participants to better understand their experience. A follow-up interview conducted in January 2023 illustrated the work's long-term effect on participants. This technological mediation of breathing explores its transformative potential to revive connective connotations of shared breathing and cultivate interoceptive awareness, reflection, and interhuman connection during the pandemic and beyond with the use of breathing interaction, metaphors, symbols, and ambiguous instructions.

Pushing a curtain aside, you enter a dim room, isolated from the bright exhibition hall. You see two microphones delicately suspended from the ceiling and a large projection screen showing two small glowing orbs that subtly shimmer and fluctuate. You step up to one of the microphones and blow into it. One of the orbs responds, emitting a burst of bright particles that float toward the sky on the screen in front of you. Experimenting with the system, you discover that the orb grows and becomes excited with your exhale before shrinking again. Another person enters the space with you. As they breathe into the second microphone, the other orb of light expands on the screen and comes to life. You start to playfully breathe together, watching the orbs merge and grow in response. As the rhythms of your breathing coincide, you see a ripple of light that grows and expands, filling

the entire screen with wisps of light (Color Plate A). As you breathe together, you hear a Tibetan singing bowl resonating through the air around you. Its sound is calming yet seems to encourage you to explore further, to breathe together with this stranger for a while longer.

Breath of Light is an interactive installation that invites visitors to breathe together to create a beautiful and ethereal audiovisual experience. The dark exhibition space is activated by visitors' breathing, transforming the gallery into a meditative communal space. In creating *Breath of Light*, we were motivated by increased social isolation further exacerbated by the COVID-19 pandemic [1]. While masks and social distancing measures exist to protect us from the spread of coronavirus, they also conceal significant social cues and separate us from one another. Cultural spaces are valuable for stimulating new connections and building community crucial for our mental health, yet during COVID, art galleries were among the first venues that had to close. In response, we created *Breath of Light* to reconnect people in public spaces once opportunities became possible again.

Interpretive anthropologist Clifford Geertz describes culture as "an ensemble of texts" [2]. These "texts" include objects, actions, and behaviors that carry the systems of cultural meanings. Breathing in a public context is one such cultural text whose connotations have transformed drastically over recent years and will continue to evolve in the future.

Breathing has long implied life, spirit, and connection. In Chinese philosophy, breath is described as *qi* [3], which can bear many senses—breath; vital force; the substance of the body; the physical basis of one's energy, demeanor, or temper. Ancient Chinese beliefs advocated seeking the mental state of "equilibrium and harmony" [4] by learning how to control *qi*. Likewise, Aristotle, in his treatise "On Respiration" [5], speaks of *pneuma* as an extended soul that is part of the surrounding air and enters the body as we breathe in. With this shared breath, our interhuman connection is both physical—as the shared air incorporated into our bodies—and spiritual, relating us to others and our surrounding

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social context. At the same time, breath is typically invisible, making its connotations implicit and its ever-present connective power imperceptible.

However, the connective potential of shared breathing is undergoing a transformation of its connotations. Along with the ongoing pandemic comes an increased awareness of potential exposure to the invisible virus in the air. The cultural text of shared breath has become associated with danger, fear, and even death. These negative connotations often overwhelm longstanding positive associations of breath as essential to life and conducive to human connection. *Breath of Light* was on view from 5 through 21 March 2021 to counter these negative connotations of breath that have been continually reinforced during the COVID pandemic.

DESIGN AND ARTISTIC INSPIRATION

We created *Breath of Light* to explore the connective power of shared breathing and synchronization in an immersive meditative installation. Simply focusing on the breath has been a technique in various branches of traditional meditation, including more modern mindfulness meditation [6]. Our meditative environment is intended to help participants reconnect with their often-unnoticed breathing and then allow them to extend this connection to their partner through breathing synchronization.

Immersive Technology for Mindful Meditation

In *The Meditation Chamber* [7], A. Fleming Seay and colleagues help participants achieve the benefits of meditation practice, such as cultivating introspective awareness, through a bioresponsive animation, guided muscle relaxation, and breathing meditation in an immersive virtual environment. In *Sonic Cradle* [8], Jay Vidyarthi and colleagues designed a dark chamber where users shape a peaceful soundscape with only their breathing. It was designed to foster a meditative experience by facilitating users' sense of immersion while following a specific attentional pattern easing novices into the mindfulness practice. Inspired by these works, we designed a dark space to help participants pay attention to their breathing. We incorporated meditative elements such as ocean waves and singing bowl sounds into the audiovisual feedback responsive to participants' breathing, encouraging them to slow down and direct their attention inward.

Breathing Interaction in Immersive Environments

In *Osmose*, Char Davies [9] utilizes breath as an interaction design method for navigating a virtual space, inspired by the artist's own practice of scuba diving. By navigating a magical nature-themed environment using balance and breath, the audience is encouraged to consider the relation between their breath and bodily movement, reconnecting with their bodies as the site of their experiences and an intermingled constituent of nature. In *We Live in an Ocean of Air* [10], Marshmallow Laser Feast visualizes breath as a blue stream of dots floating from the audience's mouth in a virtual reality experience. The trees and leaves in the virtual environment are also composed of dots, which invites a sense of

connection to nature through breathing. In this experience, one's breath can be seen by other participants but cannot be directly interacted with.

Biosignal Sharing and Synchronization for Social Connection

Sharing physiological data with others allows us to expose ordinarily hidden intimate internal states, which can remind us of our unity as a human species [11]. For instance, in *exhale* [12], Thecla Schiphorst explored wearable public art with skirts that could share networked breath data through vibration motors, light arrays, small fans, and speakers sewn in the linings. Another installation called *Breath of Light* by glass manufacturer PRECIOSA [13] uses participants' breath to light up a chain of handcrafted light bulbs to connect visitors. Moreover, becoming aware of the physiological rhythms of other people can foster interpersonal synchronization associated with social connection [14]. In coauthor Stepanova et al.'s *JeL* [15], the breathing of two participants is represented as a movement of jellyfish in an underwater world they see in a virtual reality headset or projection. When immersants synchronize their breathing, a coral-like structure emerges, representing and rewarding their connection.

Our work is singularly situated in the context of an isolating pandemic with continuously transforming connotations of shared breathing. Prior work explored guiding attention to breathing to foster mindfulness and stimulate connection, while our contribution is rooted in our goal of reclaiming breathing as a nurturing act and revitalizing the positive connotation of shared breath through a public exhibition during the pandemic. In creating *Breath of Light* we sought to embed the cultural texts of life, spirit, and connection as metaphors and symbols within the aesthetic experience.

THE INSTALLATION SETUP AND COVID RESTRICTIONS

Setting up an installation during a lull in the pandemic, we were aware that some visitors would not be comfortable with touching physical interfaces used by many people even if regularly sanitized. This was a design constraint requiring a solution that would minimize health risks and support inclusivity of participants with diverse comfort levels and expectations. Accordingly, while belts are often used to sense breathing, we instead used sound-based sensors (i.e. microphones) to provide a contactless interface.

A dark and quiet room created an immersive environment (Fig. 1). The system was composed of two microphones, a hidden 2020 iMac computer, and a projector with built-in speakers. The microphones were hung from the ceiling at eye level as a physical affordance to guide attention and spark curiosity.

Although all kinds of breathing could be used in the installation, pilot testing showed that pursed-lip breathing worked best in terms of responsiveness. With this technique the exhalation could also be detected by microphones through masks, though distorted and weaker compared with unmasked breathing. Participants had the option to take their masks off while interacting at a safe distance [16].

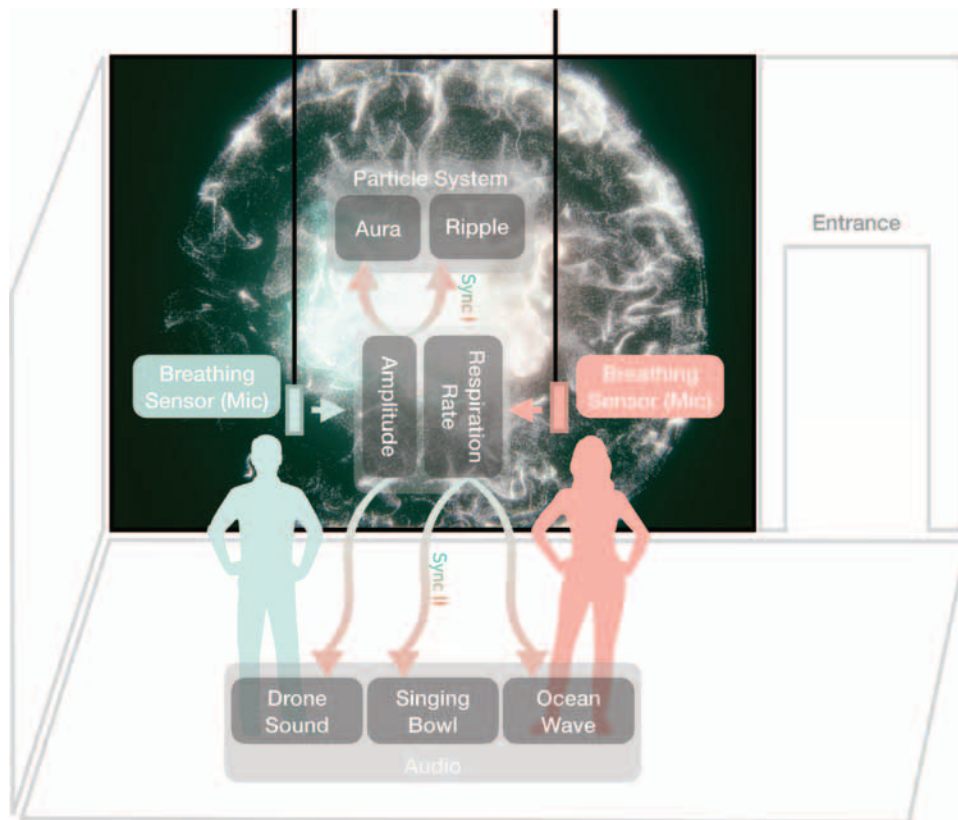


Fig. 1. Schematic diagram of the installation. Microphones hang from the ceiling with a projection shown on the wall. The breathing data from the microphones drive the audio and visuals. (© Pinyao Liu)

AESTHETIC SYMBOLISM AND BUILDING TOWARD SYNCHRONIZATION

Procedural Ocean Wave—Indirect Mapping of Breathing

When the user starts to breathe into the mic, the system senses the breathing cycle by detecting if the amplitude has exceeded a predefined threshold. The system counts another breath each time this threshold is exceeded. Based on this, the user's respiration rate is calculated and an ocean wave sound matching this rate is played. When only one user is interacting with the system, the rhythm of the ocean wave moves corresponding to their breathing. When another user joins in, the frequency of the ocean wave takes the average value between two respiration rates, guiding the users to breathe along with the wave rhythm to converge at an average rate between them, thus encouraging synchronization at a rate suitable to each pair.

The Aura—Direct Mapping of Breathing

By nature, our breathing is expansive but usually invisible and imperceptible to us. When participants exhale in the installation, they see the expansiveness of their breath in an aura of glowing particles on a large immersive projection, generated along with a changing airy drone sound (see Fig. 1 and supplemental video). We chose the luminous aesthetic of the aura to symbolize a spiritual quality of expanding breath leaving our body. The spawn rate and particles' speed, the aura's size, and the drone's sound volume change along with the amplitude of the breathing sound to reflect participants' breathing.

Participants can associate their breathing with the expanding and contracting auras, thus subtly guiding attention back to their bodies and helping them reconnect with their breathing.

The Ripple—First Stage of Synchronization

When both users breathe into the microphones simultaneously, a ripple of light grows and expands as a shared creation (Fig. 2). Inspired by water, the fluid aesthetic of both aura and cocreation was chosen because of its associations with life and nature. Participants witness the auras along with the ripple expanding and overlapping, making visible how breathing and air are ordinarily shared with others, expanding throughout the room. Following this metaphor, the expansion animation symbolizes the expansion and dissolution of our bodily boundaries and connections emerging from it. The ripple extends outward, shifting participants' perception of unity and connectedness through a mediated experience visually representing our ever-present entanglement of our bodily selves and space. The combined symbolism of water, luminosity, and expansion are meant to compose cultural texts where life, spirit, and connection converge. Through these symbols we can still experience the exchange of breath metaphorically while being restricted from the material connection through breath by masks.

Encouraging continuous breathing synchronization is challenging because the lag in calculating synchronization can take as long as 30 seconds between sensing the breathing rate and identifying persistent synchrony. By using the

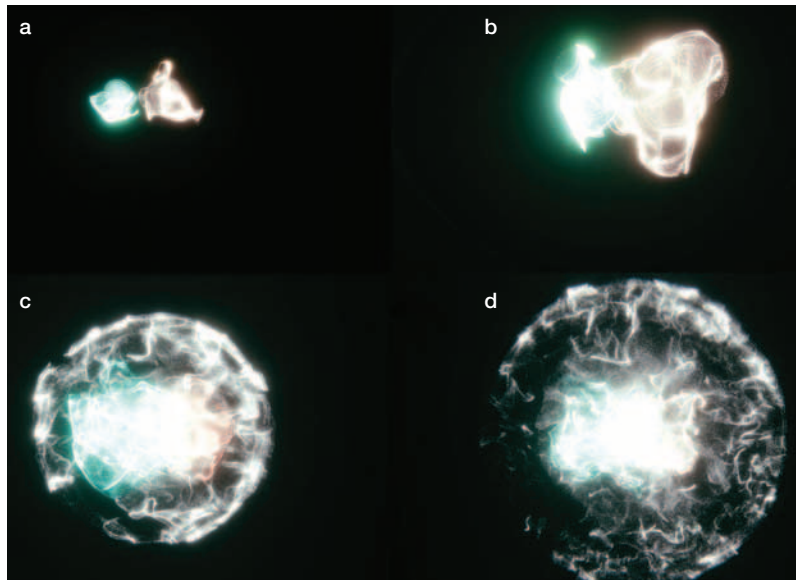


Fig. 2. Progression of synchronization: (a, b) At first, when a breath is detected, two small orbs glow and expand with an airy drone sound. (c, d) As the two users synchronize their exhalation, a ripple is generated and moves outward. Finally, when the two users' breathing rates synchronize, a singing bowl sound emerges. (© Pinyao Liu)

ripple, we capture the subtleties of synchronization to give the user timely feedback, nudging them toward deeper synchronization.

Singing Bowl Sound—Second Stage of Synchronization

There is a long tradition of using singing bowls for communal meditation in Buddhism. When user respiration rates are synchronized in *Breath of Light*, a sound of a singing bowl is played, representing their meditative connection. By using an ambient sound as an indicator of synchrony, we avoid participants focusing on the goal of synchronization, which could lead to an undesirable “chasing behavior” as observed in *JeL* [17]. Instead, users are encouraged to maintain focus on their own breathing with ambient feedback. Chiming and lingering, the singing bowl sound is woven into the soundscape of the ocean wave and the airy drone in the periphery of users' attention.

INSIGHTS FROM CONVERSATIONS WITH VIEWERS: CONNECTION THROUGH BREATHING

Breath of Light was exhibited at the 13th Shanghai Biennale 5 through 21 March 2021. For three days during the exhibition, we observed audiences' interaction and conducted semistructured five-minute interviews in Mandarin with 12 visitors (P1–P12) to better understand their experience of the installation. The lead author translated their quotes presented below. The lead author approached visitors at the entrance to the installation and asked for their permission to be interviewed. Participants were invited to freely explore the installation for two minutes. Afterward, the lead author told the participants to interact through pursed-lip breathing and that the ripple appeared when they both breathed into the sensor. The participants were then encouraged to explore the installation freely for another three minutes. After the interaction, participants were asked the following questions:

- What three adjectives would you use to describe the experience?
- What was your emotion during the experience?
- What was your emotion towards your partner during the experience?

From the responses of this small group and observation of other visitors for three days, we identified themes and experiential qualities that were elicited through the interaction (Fig. 3). In the following discussion, specific quotes in response to the above questions are “*italicized with quotes*” while themes and subthemes are in **bold**.

Participants described their **interactive breathing** experiences as **peaceful**. “*Quiet*” and “*relaxing*” were two of the most frequent descriptors during the interviews and were shared by 9 participants out of 12. Peacefulness is a foundational emotional layer of the experience. Indeed, we observed that most participants appeared to be calm and quiet when interacting through their breath. This peaceful quality is aligned with our design goal of encouraging mindful meditation. The breathing interface also sensitized participants to their breath by **amplifying** it. The interaction was “*sensitive*” (P4) and “*subtle*” (P3, P5, and P9). Participants were observed consciously slowing or accelerating their breathing to explore the interaction with their expansive aura. These observed behaviors aligned with our design's aim of enhancing awareness of breathing.

Participants' responses suggest that the installation evokes some level of **interoceptive** awareness. Participants reported qualities relating to **mindfulness**: They experienced “*inward*” focus (P5 and P6), being more “*conscious*” of one's breathing (P12) or “*letting-go*” (P11), akin to a “*pre-meditative*” state (P5). In addition, some participants reported qualities relating to **spiritual** experiences: They found the visualizations “*entrancing*” (P1), “*ethereal*” (P1), or “*dreamy*” (P7).

Despite the responses that suggested an inward focus, many participants reported three different levels of **inter-**

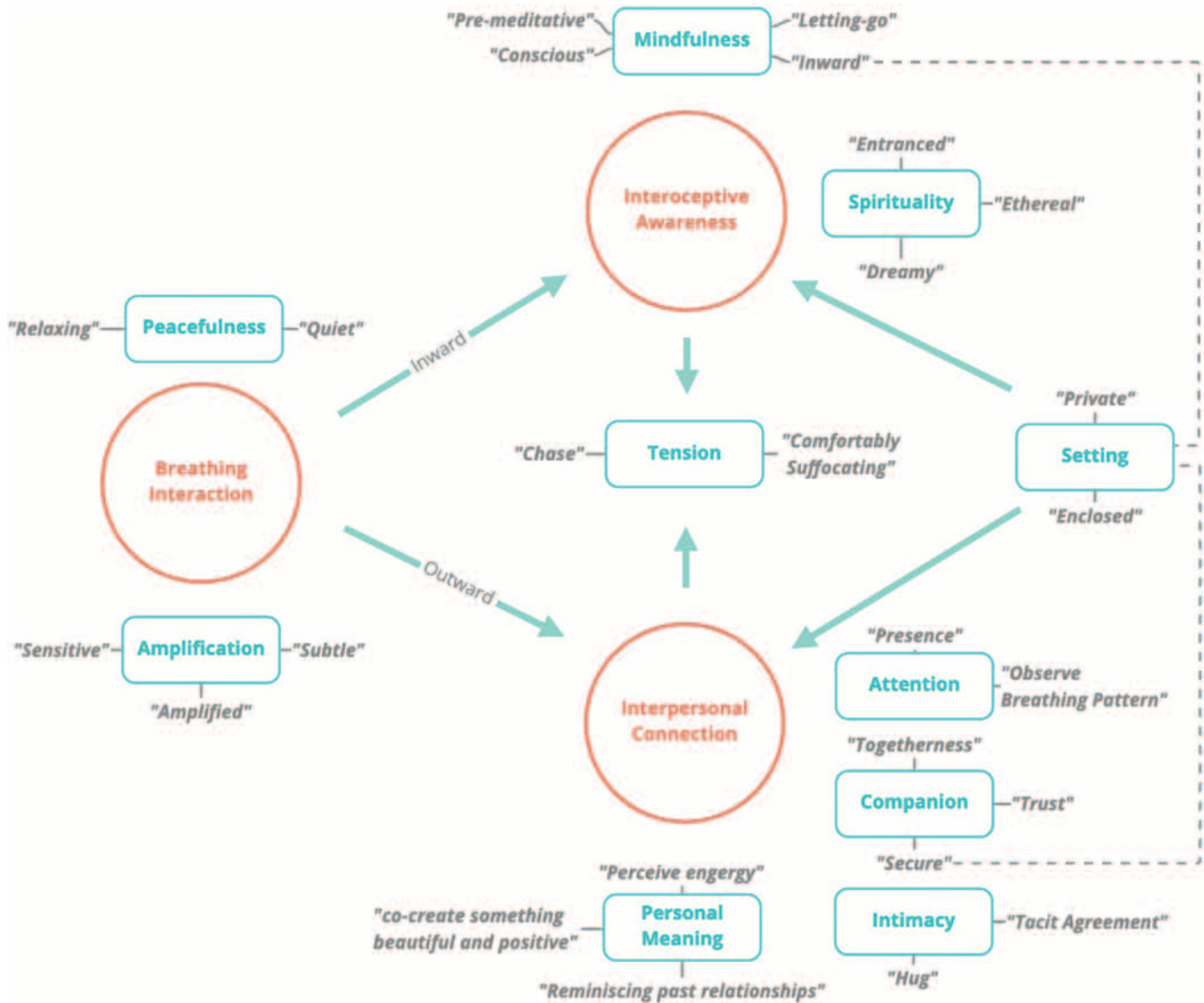


Fig. 3. Mind map of themes identified in participants' descriptions of their experience with *Breath of Light*. The three main themes are presented in red, with subthemes in blue and quotes in black. The arrows indicate contribution and dotted lines indicate potential connection. (© Pinyao Liu, John Desnoyers-Stewart, Ekaterina R. Stepanova, and Bernhard E. Riecke)

personal connection interwoven with **personal meaning** through the installation. Participants reported shifting **attention** outward to the partner's "*presence*" (P2) while "*observing [the partner's] breathing pattern*" (P2) and starting to "*perceive [the partner's] energy*" (P5). In addition, participants further described the interpersonal connection afforded by the installation as a **companionship**. Through interaction they reported building "*trust*" (P7), feeling "*secure*" (P11) and a sense of "*togetherness*" (P4, P6, and P7) with the presence of the partner. Finally, a few participants even perceived distinct qualities of **intimacy**. P6 reported she wanted to "*hug*" her partner, also a friend of hers, to deepen their relationship. P4 reported that he felt a sense of "*tacit agreement*" when matching the pace of respiration together with his partner. These levels of connection are accompanied by **personal meaning** and interpretation as afforded by the installation. For example, P7 described the experience as "*co-exploring*" and "*co-creating*" and noted the enjoyable quality of their

experience because they were cocreating something beautiful and positive together.

The inward and outward directions of attention reported above created a **tension** between letting go and control. P11 felt the need to "*hold [their] breath*," and P4 tried to "*chase*" the partner's breathing. Also reflected in our observations: Some participants seemed short of breath when trying to match a quite different breathing rate normal for their partner. Interestingly, P4 and P5 from separate pairs both mentioned they felt out of breath but relaxed at the same time. P5 described this feeling as "*comfortably suffocating*." In addition, all four participants who reported tension also reported experiencing peace and mindfulness, which indicates that a breathless feeling and positive emotions are not mutually exclusive.

Finally, participants found that the supportive **setting** allowed for an intimate connection to emerge. They described the experience to be "*private*" (P11) and "*enclosed*" (P5), while

the setting helped them direct attention “inward” (P5 and P6) and feel “secure” when establishing an outward connection (P11).

INSIGHTS FROM OBSERVATION: CONNECTION BEYOND BREATHING

While some visitors intuitively engaged with microphones as intended by exhaling into them, other participants initially tended to explore physical ways to interact with the system instead. Without explicit instructions, many people began by physically touching and playing with the microphones despite the central role of “breath” in the artwork’s description. Some visitors would whistle, clap, chant, sing, grip, or even scratch the mic. This behavior either encouraged other visitors to follow the pattern or inspired them to create their own ways of interacting.

These creative forms of engagement could come not only from ambiguous instructions, but also from diverse attitudes toward open breathing in public and perceived social pressure. One participant swung the hanging microphone like a pendulum while wearing her mask throughout. In effect, she was replacing her own breath with the air flowing across the microphone. The variability of individual comfort levels presents a particular design challenge, where the interactive art during the pandemic and beyond should become more dynamic and inclusive. The physical affordances of a microphone suggest a potential path in response to the challenge for a more inclusive experience.

Accordingly, we observed two overarching paradigms of interaction: one relatively quiet and still and the other vibrant and chaotic. The **vibrant** paradigm involves more bodily movements and is represented by discrete input such as tapping. The sporadic response of auras and ripples likely evoked interpretations that are far different than breathing. The **still** paradigm is represented by sound-based interactions, such as whistling and chanting. One participant whistled like a bird’s chirping, changing pitch and rhythm. The cloud of light grew and dissolved along with the delicate chirping, with the ambient sound mystically echoing the whistle. As a result, distinct experiences and interpretations emerged from the spectrum between these two paradigms.

INSIGHTS FROM FOLLOW-UP INTERVIEW

In January 2023, we conducted follow-up interviews with 9 out of 12 participants (P1–P9) to better understand what impact the experience might have had on them. We asked open-ended questions such as:

- Did you think back to your experience with *Breath of Light* at any time?
- Is there a life experience that shares a quality with *Breath of Light*?
- Did your experience with the installation have a noticeable impact on you afterwards?

Some participants reported reflection on the installation over the past 20 months, triggered by life events that involved a **dark setting** (P6 and P8), **togetherness** (P1, P4, and P9), or

breathing awareness (P1, P6, P8, and P9). P1 and P4 each paired up with their own longtime friend in the experience, and both reflected on how their interaction in this installation resembled the dynamics of their relationship. For P4, his installation partner would always “*withdraw before synchronization*,” which aligned with their larger experience in the relationship beyond the installation. For P1, even though they are particularly good friends, he and his installation partner “*are often not able to match each other’s rhythm*” nor “*perceive subtle responses*” in their relationship, which was reflected in P1’s experience of the installation. For others, the impact of this installation was more subtle. P7 described it as “*an invisible seed*,” while P8 described it as “*subconscious and silent change*.” When asked to clarify the “*invisible seed*” and similar feelings in life, P7 said “*the experience felt ensouled. . . . [I]t may awaken a state in yourself to ponder, to recall, or to quest*.” Interestingly, P8 also used the word “*ensouled*” to describe his breathing experience that resembles the installation experience. P9 and P7 further described the impact simply as leaving them with a “*positive*” experience, and P9 reflected that “*having such an experience [was] definitely better than doing anything else that day*.” While the specifics of such ineffable impacts could not be pinned down, participants’ responses indicated that they felt impacted more than they could describe.

At the same time, COVID still contributed to ongoing fear surrounding shared breathing. Given the new COVID wave in China and drastic changes in health policy at the time of the interview, many still voiced fears toward others’ breath (P1, P4, P6, and P8). Conversely, P4 said there wasn’t fear at the time of visiting the installation, because “*there [were] no epidemic [cases] at all*,” and P7 referred to the installation period as “*pre-epidemic*” compared to the ongoing wave of infection. This could explain why few participants mentioned COVID concerns in the first interview, while the pandemic was at its height in many countries in Europe and the United States. This again reflected the “ebb-and-flow” nature of pandemics and the corresponding attitude toward shared breathing. As much of the world is experiencing another “ebb” of the pandemic, more artworks like *Breath of Light* are needed to help cope with the ongoing uncertainty and lingering negative social effects [18].

CONCLUSIONS

Cultural spaces are critical social venues that have historically offered opportunities to build interhuman connections openly and freely. Cultural spaces’ capacity to facilitate connection has been transformed due to evolving restrictions and emerging social norms during the COVID-19 pandemic. The *Breath of Light* installation created a social space for discovery and connection through a collaborative exploration of mediated breathing. It invited participants to reflect on the role of shared breathing in our interactions and how this role and connotation of shared breathing have transformed in recent years.

Hundreds of years ago, breath was celebrated as a means of communication between all beings and elements of the ani-

mate world across diverse ancient cultures, including Greece, China, and Indigenous tribes [19–21]. Today, we leverage the same connotation of shared breathing that connected us before to transform how it is being experienced now, mediated through our installation.

With radically reshaped social norms inhibiting open breathing in public spaces, *Breath of Light* proposes a possible

future for interhuman connection. By focusing participants on their shared act of breathing as metaphorically visualized by the installation, we hope to help them overcome social boundaries through the very thing that we are protecting each other from, revitalizing breath as a symbol of life and connection, nudging the world toward a more connective and introspective future.

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COLOR PLATE A: **BREATH OF LIGHT: RECLAIMING SHARED BREATHING
THROUGH A MEDITATIVE INSTALLATION**



Two users synchronizing their breath in *Breath of Light*, 2022. (© Pinyao Liu) (See the article in this issue by Pinyao Liu, John Desnoyers-Stewart, Ekaterina R. Stepanova, and Bernhard E. Riecke.)