

Synchronous Yoga and Meditation Over Distance using Video Chat

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ABSTRACT

Community and social relationships are an important part of yoga and meditation despite the fact that they are commonly perceived as solitary activities. Family members and loved ones often share activities and experiences over video chat technology to sustain their relationships across distance, and we wondered if similar technology could allow for yoga and meditation partners to share their practice remotely. In our study, sixteen participants completed yoga and meditation sessions over distance and participated in semi-structured interviews about their experience. Our results show that video chat can support synchronous yoga and meditation over distance through seeing and hearing one's remote partner. Both video and audio play an important role in creating a sense of remote presence. Yet there are space issues, camera challenges, and issues with a lack of touch for instructional purposes. Future video chat systems for synchronous yoga should consider ways to improve these issues while balancing the need to keep technology in the background.

Index Terms: H5.3. Information interfaces and presentation: Group and Organization Interfaces – Synchronous interaction

1 INTRODUCTION

Yoga is the Sanskrit word meaning “to add,” “to join,” or “to unite.” Yoga instructors and practitioners in the West today often use this meaning to discuss the connection between the mind and body, body and breath, and even our connection to the people and world around us. The sense of community in yoga is important. Lewis [16] found that interpersonal relationships and social interactions were the most important factors in motivating and continuing a yoga practice. For such a spiritual and physical practice, one might assume that these communities would be composed of people living in close proximity who join together in the same space, but there also exists a desire to form online communities, without a physical location [4]. These may form entirely online, or community members may have formed their relationships in day-to-day life before extending those connections to a virtual space [4]. As such, we are now seeing a host of ways in which technology is being infused into yoga practices [22][31][32]. For example, a large number of yoga and meditation classes are available online via video streaming, and many studios and instructors offer yoga podcasts for download.

While valuable, such services do not support synchronous activities where an instructor can interact with students in real time. Instead, information is presented to others using a ‘broadcast’ mode of communication over a video link. This likely limits the ability of the technology to present feelings of connectedness, social presence, and community that one may get from practicing yoga with others in person. As technology advances, we anticipate that synchronous video communication technologies will begin to fill this gap where pairs or groups of users will be able to talk and interact with one another in real time while practicing yoga. This could alleviate the need to travel to

meet one another, allow people to practice yoga in a more private location like one's home, and, perhaps, practice yoga with family or friends who may live far away yet be one's ideal yoga partner.

For these reasons, our interest was in exploring what the experience of practicing yoga over distance might be like for family or friends. We focused on exploring off-the-shelf video chat technologies (e.g., Skype) given their widespread availability. We wanted to understand how people would setup and use video chat for synchronous yoga and meditation over distance, what challenges they might face in doing so, if and how they would maintain a sense of presence of the remote partner, and how people would react to the use of video chat in an often ‘technology free’ activity like yoga. Our goal in exploring these topics was to understand how synchronous video communication technologies could be better designed in the future to support activities like yoga over distance, or if such technologies were undesirable because of a potential intrusion of technology. Our work contrasts other studies of synchronous video for domestic activities (e.g., [1][7][13]), which often focus on conversation, home tours, showing children's development, or the sharing of everyday mundane activities. In contrast, yoga presents a very different scenario where specific body movements might be important to see over the video link, talking may be minimal, and one may not even have her eyes open (e.g., while meditating).

We conducted an interview-based study with 16 people who completed yoga sessions as pairs. Our results show that video chat supports yoga over distance at a basic level. Participants were able to practice yoga ‘together’ during a video call, take on student/teacher roles, and feel present with one another despite physical separation. A sense of presence was created by the video link even in cases where participants were meditating and not looking at the video feed. Subtle audio cues such as the sound of breathing or body movements were also highly valued as a means to feel present with the remote person. We also saw several issues emerge as a result of present-day video chat hardware and software: narrow camera fields of view, a lack of touch for instructional purposes, and challenging camera angles. We discuss how these challenges suggest alternative video chat designs, while balancing the need to keep yoga as technology-free as possible.

We first describe yoga as it is practiced in North America today. We then describe research on video chat, yoga-specific technology, and studies of exercise over distance. We continue on to describe our study, interview methods, and results. Finally, we offer a discussion of our findings and design implications.

2 THE PRACTICE OF YOGA

Yoga originated in ancient India with teachings passed down orally from teacher to student and has been practiced in different ways over the centuries and around the world [2]. Looking collectively across readings on yoga (e.g., [2][15][16][19][29]) as well as reflecting on our own practice of it, we see that in the West there are several main attributes that form the core of yoga:

1. **The Physical Practice:** Many people in North America today are familiar with yoga as a series of postures that help increase flexibility and strength [29]. Some of the poses are relatively simple, or at least similar to popular stretches. Other postures are more advanced and nearly acrobatic, requiring regular practice to prepare the body and careful attention to prevent injury.

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2. The Teacher: Teachers remain an important part of yoga practice. Instructors lead students through a series of yoga poses, in many cases offering corrections to students with verbal cues or hands-on adjustments and offering demonstrations for students to see what the postures should look like. Once yoga practitioners know the poses well, they may choose to practice alone, in their own space, without an instructor taking them through a sequence. A home practice offers practitioners the ability to tailor their yoga around their own schedule and needs.

3. The Meditation: Yoga is meditative and introspective [8]. When learning the physical yoga postures, students are taught to pay attention to and control their breathing, which can also serve as an entry point into meditation. Focusing the attention onto one point is a kind of concentrative meditation. Watching the breath, staring at a candle flame, and reciting a mantra are all methods of focusing the mind and increasing concentration. The benefits of meditation include a sense of calm, reduction of stress, and increased self-awareness [8].

4. The Space and Environment: The environment in which people do yoga is important. Yoga studios offer a space where students are free from the distractions of their everyday lives. Phones and devices are put away, and practitioners can focus on their practice without being reminded of the responsibilities of daily life. Yoga studios carefully consider their design and décor, with some keeping things simple and free of distraction while others opt for bright colors or intricate murals. With the increasing availability of downloadable yoga podcasts and online video streams [22][31][32], we are also now seeing people increasingly practice yoga in their own homes.

5. The Community: While yoga and meditation might be thought of as solitary practice, the community and presence of others is actually quite important. Lewis [16] found that yoga practitioners are often introduced to yoga by family members or friends, and often make social plans together around a yoga class or travel plans around a retreat. New relationships also form from continued yoga practice, as practitioners become familiar with teachers, studio staff, and fellow students. Even the presence of other students in class is important to practitioners, as the energy of other students can be motivating and the collective intention of practicing yoga can help focus and attention.

Together, we feel these attributes of yoga are important for defining when, where, how, and why people participate in yoga as part of Western culture. As such, our research uses them as lenses to explore yoga over distance in the remainder of the paper.

3 RELATED WORK

3.1 Domestic Video Communications over Distance

The use of video chat to share experiences and activities as a part of domestic life has been a topic of heavy focus over the last few years. This research explores how family members make use of video communication systems to stay connected, feel present, and maintain an awareness of their loved one's lives [1][5][11][13]. Activities that commonly occur over video chat include shared conversations [1][5][11][13], tours of a new home, area, or the showing of objects (e.g., toys) [1][6][13], shared television watching [5][7][17], play [10][30], and reading [27]. People also sometimes leave video links open for longer periods of time to share everyday activities with one another [7][12][24] such as cooking, cleaning, or getting 'ready' for one's day.

Together, the above sharing activities all tend to be about showing family and friends fairly general things where it is less about the specifics of the acts occurring and more about simply being a part of the activity by seeing it [11]. For example, if a video chat session is connecting long distance partners and the

video link shows a person cleaning dishes, the important aspect is not *how* specifically the person is cleaning the dishes [7]. Instead, it is about knowing that the activity is indeed happening right now (to gather availability information) or simply that a person is around and present [7][12]. Similarly, if a parent is showing a remote grandparent how a new child walks over video chat, the act of sharing is less about the specific movements taken to walk, and more about the fact that the child is walking (showing a developmental milestone) and the grandparent saw it occur [6]. In contrast, our study of yoga explores an activity where very specific body movements are important to see over video, there is an almost spiritual element that comprises the activity, and audio may be used as an indicator of presence rather than video (e.g., if one's eyes are closed during meditation). There are reported cases of very specific activities occurring over video chat, such as teaching others mechanical repairs [5], yet these do not contain the introspective and meditative aspects that we investigate.

Research has also shown that video chat within the domestic realm is not without its complications. Kirk et al. [13] addressed what they describe as "moral issues" in video chat. Even for close family members, there might be limits to how much a person wants to share over video. Connecting with someone over video chat can be rather intimate, as it is akin to inviting someone into a private, domestic space [13]. This reflects our study of yoga over video chat. Ames et al. [1] noted that video chat requires a certain amount of effort and thought to occur successfully. There is "social" work that contributes to a video chat, such as coordinating a time and scheduling and preparing the presentation of the space and the view. Furthermore, while video chat and its related technologies are becoming more prevalent, there is still "technical" work involved. Problems with the technology may arise that could prevent or end the video chat if people are not familiar with how to resolve complications [1]. Our study explores how such social and technical challenges manifest themselves for yoga over distance. We also extend the literature by exploring how technology is used for an often technology-free activity. This raises and explores the question: can video chat support meditative acts like yoga?

3.2 Learning Yoga

The Internet offers many opportunities to practice yoga and meditation, with subscription websites streaming classes on-demand and private yoga instructors creating audio recordings of their classes and making them available as podcasts [22][31][32]. However, these are one-way interactions where a person watches a yoga instructor and tries to recreate poses on her own. Thus, such services do not offer direct feedback from an instructor. Wii Fit and Xbox 360 Kinect offer exercise-training programs like yoga and give feedback based on balance and stability, yet this is automated and not from an actual instructor. Hsieh et al. [9] examined the possibility of using computer vision to give corrections based on the posture and shape of the body. Silhouettes of yoga practitioners were used to determine the yoga pose in real time. Rector et al. [28] also explored the use of the Kinect Skeletal Tracking in a yoga exergame, but the focus was on giving verbal feedback to blind and low vision participants.

3.3 Physical Exercise Across Distance

There is also research that explores physical exercise over distance by pairs of people. Overall this works shows that video and audio connections can play an important role in making people feel close to one another while sharing physical activities over distance. Mueller et al. [20] explored how physical activities

could be mediated by technology using exertion interfaces for fun and bonding. Remote partners played a game that combined soccer, tennis, and the computer game, "Breakout," where they saw the remote partner over a video link. Participants did not know their partner before the start of the game, but those who were actually kicking the ball perceived stronger bonding and friendship with their partner and reported having more fun overall [20]. O'Brien and Mueller [25] found that runners often jog with others for socializing, motivation, encouragement, and fun. Based on this knowledge, they designed a shared jogging system that used an audio connection and heart rate monitors to create an intimate shared jogging experience between partners [21][25]. Procyk et al. [26] explored shared geocaching where pairs of people geocached together over distance using wearable video cameras. They found that the audio and video connection created a 'micro' shared experience where partners felt especially close to one another as they hiked between geocaches.

Maybach et al. [18] created the Social Yoga Mats system to encourage exercise and address issues of loneliness faced by older adults. The system comprised a networked yoga mat augmented with sensors. In early work with the system, participants could use the tablet to see when others were exercising in real time. Avatars showed if they were keeping up with the exercises, encouraged others to complete their exercises, and, in some cases, led to socializing when participants had finished their yoga practice [18]. Changes were later made to the system so users could receive video demonstrations and instructions for their own workout [23]. Interactions with both versions of the system were largely asynchronous. Our research extends this work to explore synchronous yoga over distance.

4 STUDY METHOD

The goal of our study was to understand how pairs of participants would setup and use video chat when participating in synchronous yoga over distance, what challenges they might face, if and how they would maintain a sense of presence, and how people would react to the use of video chat in an often 'technology free' activity like yoga. As a result of participants' location selections, we also specifically study in-home yoga.

We chose to study pairs as opposed to groups of participants as pairs represent the simplest case of practicing yoga over video chat. It also represents a common practice of wanting to practice yoga with a close friend or yoga partner. Studying pairs also allowed us to explore a base case to understand the strengths and weaknesses of the technology without additional factors brought on by large groups.

4.1 Participants

Sixteen participants were recruited in pairs using snowball sampling and word-of-mouth. As this research relates to maintaining and strengthening of relationships through the shared activities of yoga and meditation, participants were invited to join the study as a couple with someone they would feel comfortable practicing yoga or meditation with, such as a family member or close friend. All participants had an existing social or familial relationship with their partner, and in some cases they practiced yoga and meditated together. Participants ranged in age from 23 to 66 years old, and all but two were female. Attempts were made to recruit more male participants, but it should be noted that yoga participants do tend to be women (in their 2012 "Yoga in America" Market Study, Yoga Journal reported that 82.2% of yoga practitioners were female) [33]. Participants varied in experience level and frequency of yoga and meditation practice.

Some were yoga instructors who practiced regularly, while others practiced yoga sporadically. Only one participant was new to yoga, having taken a class for the first time within the previous six months and having not yet developed a regular practice, while another participant had been practicing over twenty years.

4.2 Yoga/Meditation Session and Interviews

Our study involved three stages, including approximately sixty minutes of individual interviews with each participant along with their participation in a shared yoga activity over video chat.

1. **Initial Interviews:** We conducted semi-structured interviews with each participant individually to gain an understanding of how they typically used video chat and what their previous yoga and meditation experience was like. These interviews lasted about 30 minutes and took place using video chat (two occurred over the phone). We asked open-ended questions such as "Tell me about the last time you used video chat," and "Describe your most memorable yoga experience," to gain insight into how they incorporated video chat and yoga into their lives.

2. **Yoga Session:** Partners then shared a yoga session together over video chat that lasted up to 30 minutes in length (though two pairs reported extending their session time). Some partners were in different areas of the same city, while others were using video chat from across the globe. Each pair decided whether they wanted to practice yoga or meditation based on their level of comfort and experience with each, resulting in six pairs practicing yoga and two pairs choosing to meditate. Participants were instructed to use the video chat tool of their choosing, place it the area that they wanted to practice yoga in, and then conduct the yoga session with their partner as they saw fit. Ten participants chose to use Skype, four used Apple's FaceTime, and two used Google+ Hangouts. All chose their own home to conduct the yoga session; we explore this aspect as part of our results.

The yoga and meditation sessions were one-on-one between partners; they were not recorded or observed by the researchers. Because we were exploring nuanced aspects of yoga such as meditation and the sense of connection and community between two people, we felt that having an unfamiliar outside observer to the session could have influenced the participants' experiences. Alternatively, we could have recorded video chat sessions for follow-on analysis; however, again, we felt this might impede on people's focus on the act of yoga where they might instead be more concerned about how they would look in a video recording.

3. **Activity-Focused Interview:** We conducted an additional interview with each participant focusing on his or her experience during the yoga session. This lasted around 30 minutes. Thirteen took place using video chat and three were done on the phone. Questions focused on the experience of using video chat for yoga and meditation to understand the challenges and successes. Example questions included, "Tell me what worked well/not well about using video chat for yoga," and "Were you able to follow your normal yoga practice? If not, why?"

4.3 Data Collection and Analysis

Interviews were audio-recorded and handwritten notes were taken. Interviews were later analyzed using open coding, and key points were transcribed. We further examined our results using the lenses of the physical practice of yoga, the role of the teacher, the meditation, the impact of the environment and space, and the sense of community and presence. We wanted to understand how the technology might be impacting each of these aspects of yoga, if at all. This results in several main themes that we report in our results. Quotes from participants are listed with a P# and A or B,

depending on which participant in the pair gave the quote (e.g., P1A indicates Pair #1, Participant A).

5 GENERAL REACTIONS AND PRACTICES

Overall, we found that our participants were relatively successful in using video chat technology to support their yoga and meditation sessions. They reported having an enjoyable experience practicing yoga with their partner. They were able to engage in yoga poses and meditation, and also see or hear the remote person while doing so. Five pairs (ten participants) practiced yoga using a form of teacher or instruction. Three pairs (six participants) opted to practice without one of the partners taking on the role of the instructor and without the aid of a video or audio class. Two of these pairs chose to meditate, while one pair practiced yoga. One pair, who often attended yoga classes and meditation sessions together, completed a Loving Kindness Meditation in which practitioners concentrate on wishes such as happiness, health, and freedom for themselves and others. The other two meditators were a mother and son who practiced a kriyā (a technique meant to fulfill a specific outcome) that involved the visualization of breathing in and out of various points in the body. Lastly, one pair decided to practice yoga with each leading the movement for half of the session. Neither were teachers, but both had years of experience with yoga.

Next we walk through several main themes that emerged during the above activities and in our interviews. We describe participants' existing experiences with yoga along with their experiences in doing yoga over video chat.

6 PRESENCE

Our initial interviews revealed that the majority of participants enjoyed the presence of others and sense of community they felt when taking a class at a yoga studio or gym. They talked about how being with others motivated them to practice yoga.

"The collective energy helps settle you. I think there's a strong collective intention, and I think that affects the energy of the room. So I think that helps settle in." – P7B

Participants also told us that practicing yoga while watching yoga videos did not create the same sense of presence and were much less motivating than practicing yoga with others.

"[With yoga videos] I get bored and I get annoyed and I get lazy... You don't really have to be there... I can do whatever I want if it's online. I have no connection to the teacher. I have no connection to the class. I just don't feel connected to it." – P1A

In contrast to this experience, participants found that video chat affording them feelings of presence with their remote partner in two ways: via the video stream, and via the audio connection. We elaborate on each next.

6.1 Presence from the Video Stream

First, participants told us that the video stream allowed them to feel like they were part of their partner's environment. This was because they could see their remote partner and the room where they were practicing yoga along with specific details of the space. Sometimes this even added to a participant's own knowledge and memory of the location to further enhance the experience (if they had been there in person).

"Before we set up I could see the position that she was in and the room that she was in and she could see where I was. I could see she had a blanket under her head and a blanket on top of her, which she never would probably have mentioned on the phone."

But I could see a more full picture of what was happening." – P7A

"I could see her really well... And I know that house, so I could picture where she was in the house. It was fun when she was doing Warrior II (pose), because she could see the ocean. I know what that view is like so I that was nice to be able to picture what she was seeing... There are icebergs there right now." – P8A

This sense of presence extended throughout the yoga session as participants periodically glanced at their video chat display in-between or during poses to see their partner. Partners need not see one's entire body; sometimes only a partial view was necessary. For example, a pair who completed an unguided yoga practice together still felt connected and present with one another, even when it was difficult to see the other person.

Curiously, the video stream also played an important role simply because it existed. Not all participants looked at the video window regularly, and some not at all. Because they were 'doing yoga,' they felt less need to look at the screen than they might have during a conversation over video chat. In these cases, participants remembered that the system was streaming video to the remote location and they knew they could look up to see their partner's video stream, if they wanted to (whether or not they actually did). This made them feel like the remote person was present with them.

The most prominent example comes from a participant who was skeptical of the experience before the session, admitting that she thought it would be like meditating alone. Yet after she participated in the activity, she felt that the video chat system helped create a strong feeling of presence with her remote partner.

"It did sort of transcend internet-ness... I thought it was going to feel like I was meditating, and she was meditating, and we just had this silly computer thing in between us. But actually there was an element of being next to someone." – P1A

The other meditation partners, too, reported feeling a connection, even though they completed their meditation with eyes closed and did not look at the video chat window.

"It's just like if someone is in the room with you. Even though you're both meditating, you're not looking at each other, you can feel each other. And the visual does that." – P7B

6.2 Presence from Audio

Second, we found that the audio link played a critical role in supporting feelings of presence. As mentioned, this was particularly evident for those practicing in teacher/student roles where the teacher would instruct the student to perform certain poses. Audio was also extremely valuable for some partners when they were unable to see each other. In these situations, presence came from shared conversation, where conversation was often only comprised of short comments rather than long exchanges.

"When you're in certain poses you can't actually see what she was doing. But we could talk and I could hear, and we could hear our cues. You would turn your head and... "Oh yeah, there's mom doing the same thing" or you'd meet together in standing pose and then go through your flow on your own without actually looking at the camera... there did feel like a connection. It felt like we were doing yoga together even though we weren't physically right next to each other. There was a familiarity to it (because) I have done yoga so many times with her." – P8B

Audio was also important to hear sounds beyond conversation. This included subtle and very quiet sounds such as one's breathing and sounds of body movement. For example, one pair

selected a yoga video to watch that was too difficult for them. They could hear each other's sighs and heavy breathing. Knowing they were together made them finish the video, even though they both said they would have stopped the video if they had been by themselves. After the video was over, they commiserated about how difficult it had been.

"The most present I felt with her was when we both laughed and kind of exhaled out of exasperation... so I felt connected with her at that moment because I was feeling unhappy with what was going on."—P2B

The challenge with hearing the important yet faint sounds of breathing and body movements was that participants' microphones sometimes had a difficult time picking it up. This was worse if background noise was present in the environment, such as from other people in the home.

7 CONCERNS ABOUT THE CAMERA

Interestingly, while it seemed to provide a sense of presence of the remote partner, a small number of participants expressed concerns about the video connection. One participant who meditated with the iPad in front of her reported that the face-to-face video setup was unsettling, as it was not what she was used to in meditation halls where people are normally seated side by side. She and her partner situated their iPads in front of them as they would in an ordinary video chat conversation, yet this created the effect of feeling like she was being watched even though their eyes were closed during the meditation. While certainly a negative attribute, this setup also had the positive effect of creating a stronger sense of awareness of her partner.

"It was a weird feeling. I felt calm. I didn't open my eyes because I was scared that if I opened my eyes it would be the one moment she also opened her eyes. We were facing one another, which I don't ever do in a meditation hall... so that was bizarre... But it made me aware of her presence."—PIA

Her partner felt awkward just before closing her eyes, the sense that they had to negotiate the start of their meditation. Once her eyes were closed, though, she found the audio to be particularly pleasing, hearing small indications that her partner was there.

"We saw each other set up, and we were looking at each other. And she said go, and I said 'Okay I'm closing my eyes now.' I could hear background noise and I could hear if she was shifting a bit but I didn't open my eyes..."—PIB

On the other hand, none of the other participants expressed concerns or social inhibitions about performing yoga in front of a webcam (e.g., doing potentially awkward or challenging body movements while on camera). This was likely because they had an existing social relationship with their partner and most pairs comprised people of the same gender.

8 TEACHING INTERACTIONS

In our initial interviews, we found that teachers had a significant impact on participants' day-to-day yoga practice. Participants mentioned instructors in their stories of both their best yoga memories, as well as their worst.

"There are moments when a teacher says something in just the right way or just give you the proper adjustment and then your whole mind is blown. And you're like, wow, I just figured it out! [Some teachers], everything they say is gold. It's just good."—PIA

Given these stories, it is not too surprising that many of our participants structured their sessions with varying levels of guidance based on their needs: taking on teacher/student roles as they would in a class setting, following a yoga video online, or doing a self-guided practice without an instructor. This occurred without any direction from us as the researchers and despite the fact that the pairs were friends/peers. We describe the two most prominent situations next.

8.1 Watching Yoga Videos

Two of the pairs (four participants) decided to watch a yoga video while they participated in their yoga session. These pairs were less experienced and normally practiced with an instructor or the aid of a video. In both cases, technical issues arose from audio feedback or issues with playing the video while the video chat link was open. Similar issues have been reported for those watching television together during video chat calls [7][17][24].

8.2 Teacher/Student

Three of the pairs (six participants) structured their yoga session as a private class, taking on the roles of teacher and student. This arrangement occurred when one of the partners had at least some experience teaching yoga. For two of these pairs, one partner was an experienced instructor; for the third, one partner was enrolled in a yoga teacher-training program.

Participants who acted as teachers told us that their normal teaching process involved *not* actually practicing yoga with the students. That is, they would not perform the yoga poses themselves while teaching. Instead, they focused on instructing, adjusting, and demonstrating when necessary. After a few minutes into the session, participants described how they followed this practice even when using video chat. Teachers described using verbal instructions and visual aids to explain the poses and offering guidance when the student needed help.

"I found that I taught the same way as when I teach a live class. I talk through it, demo, and then, when if I were in a live class I would walk around and adjust, that's when I would watch [my partner] and give her verbal cues."—P3A

Teachers found that it was relatively easy to see their partner and give verbal adjustments, though sometimes their partner would have to move the angle of the camera slightly and parts of the body might not always be visible. In some cases, this was awkward and inhibited the act of teaching. In other cases, certain body parts did not need to be seen and so the act of teaching could easily carry on as needed.

"The lighting was good, and it was pretty clear... In some standing postures there were points where if she came too close to the screen I couldn't really see her head, but it didn't really matter."—P3A

When cameras did need to be moved to better allow the teacher to see the student's pose, the 'rhythm' of the practice was easily lost. Students would need to come out of their current pose, adjust the camera, and then move back in to their pose so the teacher could view it.

Those acting as teachers did miss having the ability to touch their partner, as hands-on adjustments are a large part of teaching yoga. That is, video chat lacked the physical presence of others—afforded by direct touch—that was normally present in yoga. Participants also wanted the ability to move around their partner and see the remote person from multiple angles. Walking around their students normally offered them greater understanding of their students' body position. Yet in the video chat setup, this was

not possible since the camera was in a fixed location in front of the remote participant.

“The most difficult thing was not being able to touch her and give her adjustments. Also I couldn’t see things like if her hips were level in certain poses... I would want to be able to see her from the front or back.”—P4B

“I wasn’t always able to see what was going on...and it limits the kind of feedback that you that can give if you’re not sure what the person is doing.”—P4B

The participants who took on the role of the student for their yoga session enjoyed receiving personal feedback from their teacher, and they could make any necessary adjustments by listening to their partner.

“(My partner) was responding to me, so it definitely felt personal. Whereas if I am doing a yoga video, it has more of an exercise feel to it no matter the instructor, just because it’s for everyone. This was one-on-one. It felt specialized.”—P6A

This illustrates the benefit of using video chat for yoga over distance, as compared to following online yoga instruction that is one way and offers no interactive feedback.

9 SPACE AND ENVIRONMENT

When participants described their most memorable yoga experience in our initial interviews, many included details on the space and setting. This was because of a range of things, including the serenity of the space, freedom from ‘life’, and a lack of technology.

“(My studio) I love because it has a beautiful view of the mountains. I always like to be in the front where I can see the mountains and the trees” — P8A

In contrast, when choosing a location to practice yoga in for our study, all participants chose their own home because it was convenient and comfortable for them, relatively private, and afforded easy access to an Internet connection. Within their home, participants explained that they were simply looking for a space that was calm, quiet, and clean; this reflects the somewhat serene setting of a yoga studio. Participants also often chose a more private room of the home, such as a bedroom. This allowed greater privacy and less distraction from family members, roommates, and significant others, which again, reflects more of what participants might get at a yoga studio. A more private area also meant that the yoga session would also not disturb others in the home.

Within each space, laptops or tablets running the video chat software were placed either on the floor, a table (e.g., coffee table), or desk within several feet of the local person. This placement often reflected how much ‘empty’ space there was in the room along with the placement of furniture or space to situate the video chat device. A small number of people used stationary computers with a webcam embedded or plugged in. In comparison to the technology-free environments that comprise most yoga studios, participants did not report any issues with using a technology (video chat) as a part of their yoga session. Instead, it was seen more of as a replacement for a face-to-face partner, thus it was ‘okay’ to be a part of the environments. Participants also did not talk about trying to purposely remove other technologies that might be around. We did, however, find two main challenges that participants experienced in terms of their environment and space. We describe each next.

9.1 Lack of Space

The most salient issue regarding space was not having enough of it. Participants reported issues with not being able to properly do some poses because of objects around them or a lack of space in the room that they chose. In this way, their desire for a private room to use video chat in conflicted with the space that the room might afford them and their yoga practice.

“I thought my bedroom had enough space but as we were doing (the yoga session), I realized there was a lot of stuff in here.” — P3B

Other participants taking on teacher-student roles encountered difficulties with the small space hindering the view they had of one another, as noted in Section 8.2.

“We were both in really small spaces... and I realized ‘Oh, she couldn’t really see me, so I’m just going to focus on using my words.’” —P6B

9.2 Perceptions of Solitude

We also learned that perceived notions of solitude and privacy in the home can easily be wrong. Homes are locations that are often shared by multiple people where each person is often doing his or her own activities. In contrast, when practicing yoga at a yoga studio, everyone is ‘doing yoga’ with the expectation that people will not interrupt or disturb one another. Thus, there is a common sense of social norms specific to yoga. Privacy issues arose for some of our participants when others in the home became distracting, even if the yoga activity was done in a private bedroom. In these cases, family members or housemates were found to periodically make noises or come into the room where the yoga session was occurring.

“My boyfriend poked his head in at some point, but when you’re doing yoga you don’t really want to be interrupted. I just told him to go away.”—P3B

10 DISCUSSION

Overall, we found that participants were able to engage in yoga practice and meditation with a remote partner when using video chat. A sense of connection occurred during remote yoga sessions even when the visual and auditory presence of their partner was minimal. Thus, it is *both* the video and audio within the video chat connection that allows yoga partners to feel connected and present with one another despite distance separation. The importance of both shifts throughout the activity and will depend on the specific style of yoga or meditation being practiced as well as the needs of the people practicing yoga. This contrasts work on shared jogging, which emphasizes the role of audio for feeling present with a remote person [21]. It also contrasts domestic video chat more generally where studies have shown that seeing another person and their environment—and not necessarily hearing them—leads to strong feelings of connection and presence [7][12][13]. Instead, feelings of presence in yoga over distance are more similar to studies of shared geocaching, which emphasizes the importance of both audio and video [26].

We now reflect on our results to explore propose areas of future work and suggest design opportunities within the realm of yoga over distance.

10.1 Spirituality in HCI

Over the course of planning, conducting, interviewing, and writing about this study on meditation and yoga, we have barely mentioned spirituality. By limiting ourselves to terms common in

HCI literature such as ‘connection’ and ‘presence,’ we can only hint at the extensions of these words that characterize spiritual experiences (‘connection to the universe’ or ‘presence of something greater than oneself’).

While we do not want to speculate on the depth or profundity of connection our participants felt, our findings do suggest that further research should explore the extent to which technology can mediate a spiritual experience or connection.

Laarni et al. [14] began to touch on this in their research of transcendent experiences with computer-based media, but the media was limited to hypertext and film. When Buie and Blythe [3] wrote a brief overview of spirituality research in HCI, they noted that Laarni et al. wrote the *one* paper they found that examined transcendent experiences in different technologies.

10.2 Field of View and Multiple Cameras

Our study revealed there are challenges around cameras and capturing a person’s entire body, or at least the relevant portions during a yoga session when it occurs in the small confines of a room in someone’s home. Many devices now have built-in cameras (e.g., tablets, laptops), but the cameras on these devices are still limited in terms of their field of view. Obvious solutions to this include lens add-ons that offer a wider field of view or camera devices that provide depth information about a person (e.g., Kinect cameras) for cases of teaching and evaluating postures. Overall, such design solutions are not typically needed for more general domestic video chat activities (e.g., sharing child moments, home tours, etc.) [1][11] [13].

For yoga, it could be advantageous to also support the use of multiple ceiling or wall mounted cameras as a part of a video chat yoga sessions focused on teaching in order to see a person from different angles. Yet this would seem to turn a simple act of practicing yoga into more of a complex task of managing and administering a technical setup more akin to a professional motion capture studio. Such systems could easily mean that technology is now ‘too much’ a part of the activity. Our participants did not feel that technology intruded on the act of yoga because their setup was simple: one device. More devices may easily compromise this position. Instead, design solutions might utilize simple setups that are technology-free such as mirrors placed in strategic locations.

There are also issues with coordinating simultaneous video playback alongside a yoga session over distance. A simple option allowing remote yoga partners to watch a video together (similar to [17]) would eliminate nearly all of the technical issues faced by participants in our study.

10.3 Decoupling Displays, Cameras, and Microphones

We see opportunities for considering the decoupling of video chat hardware, namely the display, camera, and microphone. Devices that embed both cameras and microphones together are somewhat problematic. On one hand, cameras may need to be placed far away from a person to capture a broader field of view. On the other hand, a microphone embedded in the same device as the camera may then not be able to pick up faint audio sounds that are far away yet important during yoga sessions, e.g., breathing, body movements. There are also questions around the decoupling of the video display of the remote person from the device with the camera and/or microphone. The desirable location for this display may easily not be the same location as the camera or microphone. The camera may best be placed far away from the user while it may be more desirable to situate the display next to the user, more akin to how a person would situate herself in a yoga class. In video chat systems, cameras are often located right next to the

display to help support eye contact [24]; yet, in yoga, this may not be necessary since people are focusing on their postures, rather than conversing with the remote person. Overall, designers need to be careful about how many devices are needed if the hardware components are decoupled. One would not want the setup of multiple devices to interfere with the activity.

10.4 Simple Solutions for Meditation

In cases of meditation where one’s eyes may not even be open, we see design opportunities for simplifying video chat even more. In these situations, using devices (e.g., tablets, iPads) that support many activities beyond just video chat somewhat take away from the simplicity of yoga, especially when people may not even look at the display. However, the fact that a camera is streaming content and that a person could see her partner if she wanted to is important, for it creates the sense of presence that is desired. People *feel* like they are on camera and remember their partner is ‘there’ because of it. One might imagine then small devices that provide a very simple camera and small display just to provide the sense of connection rather than making it purposeful for viewing. This type of technology might even be embedded inside of objects that are typically calming or soothing (e.g., candles, picture frames) or meditative focal points. It may also focus more on supporting low-level audio detection (e.g., breathing), rather than high fidelity video.

10.5 Physical Presence through Touch

Perhaps the largest limitation for yoga over distance is touch, which teachers often use to correct or improve student postures. This is much more difficult to address with simple design changes to video chat and presents a large design space that needs tackling. One way to be support physical touch might be with wearable tactile feedback suits with vibrating sections controlled by a remote instructor or small garments with tactile feedback (e.g., vibrating or warming items placed on certain parts of the body).

10.6 Where Does Video Chat Fit Within Yoga Practice?

Lastly, our research surfaces the broader cultural question of where does video chat fit within yoga practice, if at all? As described, yoga is traditionally an act that is technology-free, but the reality is that technology is already permeating yoga practices through instructional videos, audio podcasts, and online classrooms. Yet in these cases, we would argue that some properties of yoga, such as the role of teacher feedback and the sense of community, are being poorly represented, as noted by our participants. Video chat appears to side step some of the issues with other interventions, supporting actual teacher/student interaction and feedback at some level. It also allows people to feel a sense of presence, at least in the case of one-on-one sessions. When designing technologies for this space, it is still critical that designers consider how to reduce the impact of technology in order to make the act of yoga still feel as ‘technology-free’ as possible. Nobody in our study talked about being distracted or disturbed by the video chat technology; the presence of the remote person was valued beyond such potential feelings of technology intrusion. Of course, there is the chance that other yoga practitioners may disagree.

It is plausible that the use of video chat for yoga could extend to include more remote participants, akin to a more typical yoga class. However, given our study results, we anticipate that the challenges that we saw in our study of pairs would easily be exacerbated. For example, with pairs, it was already challenging to see all of a person’s body in the video window. With a larger

class, multiple video views may be needed and most likely ‘tiled’ within a video chat client. This would make each person’s view even smaller and harder to see. Views could resize as needed to focus on particular individuals, yet this would involve additional interactions that may be less desirable. There would also likely be issues in hearing the very subtle yet important sounds of breathing that were found with the pairs we studied. Louder sounds like talking by an instructor might obscure breathing sounds. It could also be difficult to attribute breathing sounds to particular individuals given a lack of spatial audio in video chat systems. Of course, these discussion points are speculative and should be explored in future studies.

11 CONCLUSION AND LIMITATIONS

Our research has examined how existing video chat might be used for sharing yoga practice with a remote partner. We found that people successfully teach and learn yoga postures, watch yoga videos for instruction, and practice silently and simultaneously to connect with their partners through video chat. The video and audio links provide a sense of presence, even if people do not look at the video feed. Technical problems associated with video chat still occur, along with further issues related to the space needed for activities such as yoga.

Our work is not without limitations. Our sample represents mostly young females from North America. While this may statistically represent the majority of yoga practitioners in the region, our study would benefit from greater diversity in gender, age, and background. Furthermore, our participants had access to the required Internet connection and technology for the study. While again this might be a statistically accurate representation of the population of yoga practitioners, our study is still lacking a broader range of socioeconomic backgrounds. We also recognize that our participants were not adverse to using video chat technologies and that there may exist yoga practitioners who would reject the idea of using technology during yoga practice. Our study also focused on single yoga and meditation sessions with remote pairs. We recognize that challenges and experiences of yoga over video chat may evolve over repeated sessions or with additional participants practicing together, and we suggest that future studies explore these scenarios.

REFERENCES

- [1] Ames, M., Go, J., Kaye, J., and Spasojevic, M. Making Love in the Network Closet: The Benefits and Work of Family Videochat, *Proc. CSCW*, ACM Press (201).
- [2] Bryant, E. *The Yoga Sutras of Patañjali: A New Edition, Translation, and Commentary*. North Point Press, 2009.
- [3] Buie, E., and Blythe, M. Spirituality: There’s an App for That! (But Not a Lot of Research), *Proc. CHI EA*, ACM Press (2013).
- [4] Busch, L. To come to a correct understanding of Buddhism: A case study on spiritualizing technology, religious authority, and the boundaries of orthodoxy and identity in a Buddhist Web forum, *New Media & Society*, 13(1), (2010), 58-74.
- [5] Brubaker, J., Venolia, G., and Tang, J. Focusing on Shared Experiences: Moving beyond the camera in video communication, *Proc. DIS*, ACM Press (2012).
- [6] Forghani, A. and Neustaedter, C. The Routines and Needs of Grandparents and Parents for Grandparent-Grandchild Conversations Over Distance, *Proc. CHI*, ACM Press (2014).
- [7] Greenberg, S., and Neustaedter, C. *Shared Living, Experiences, and Intimacy over Video Chat*, Springer-Verlag (2013).
- [8] Grossman, P., Niemann, L., Schmidt, S., and Walach, H. Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research* 57, 1 (2004), 35–43.

- [9] Hsieh, C.C., Wu, B.S., and Lee, C.C. A Distance Computer Vision Assisted Yoga Learning System, *Journal of Computers*, 6(11), (2011), 2382-2388.
- [10] Inkpen, K.M. *Kids & Video: Playing with Friends at a Distance, Connecting Families: The Impact of New Communication Technologies on Domestic Life*, Springer-Verlag (2013).
- [11] Judge, T.K., and Neustaedter, C. *Sharing Conversation and Life: Video Conferencing in the Home*, *Proc. CHI*, ACM Press (2010).
- [12] Judge, T.K., Neustaedter, C., and Kurtz, A.F. The Family Window: The Design and Evaluation of a Domestic Media Space, *Proc. CHI*, ACM Press (2010).
- [13] Kirk, D., Sellen, A., and Cao, X., *Home Video Communication*, *Proc. CSCW*, ACM Press (2010).
- [14] Laarni, J., Ravaja, N., and Kallinen, K. Transcendent experience in the use of computer-based media, *Proc. NordiCHI*, ACM Press (2004).
- [15] Lalonde, A. *Embodying asana in All New Places: Transformational Ethics, Yoga Tourism and Sensual Awakenings*. PhD dissertation, University of Victoria. 2012.
- [16] Lewis, C.S. Life chances and wellness: meaning and motivation in the ‘yoga market,’ *Sport in Society: Cultures, Commerce, Media, Politics*, 11(5), (2008), 535-545.
- [17] Macaranas, A., Venolia, G., Inkpen, K., Tang, J.C., *Sharing Experiences over Video: Watching Video Programs together at a Distance*. *Interact* (2013), 73-90.
- [18] Maybach, K. et al. *Social Yoga Mats: Reinforcing Synergy between Physical and Social Activity*, *Ext. Abs. CHI*, ACM Press (2011).
- [19] *Meditation: A simple, fast way to reduce stress*. Retrieved May 22, 2014, from Mayo Clinic: <http://www.mayoclinic.org/healthy-living/stress-management/in-depth/meditation/art-20045858>.
- [20] Mueller, F., Agamanolis, S., and Picard, R. *Exertion Interfaces: Sports over a Distance*, *Proc. CHI*, ACM Press (2003).
- [21] Mueller, F. et al. *Jogging over a Distance between Europe and Australia*, *Proc. UIST*, ACM Press (2010).
- [22] *My Yoga Online*. 2014. Retrieved May 26, 2014, from: <http://www.myyogaonline.com/>.
- [23] Nagargoje, A., Maybach, K., and Sokoler, T. *Social Yoga Mats: Designing for Exercising/Socializing*, *Proc. TEI*, ACM Press (2012).
- [24] Neustaedter, C., and Greenberg, S., *Intimacy in Long-Distance Relationships over Video Chat*, *Proc. CHI*, ACM Press (2012).
- [25] O’Brien, S., and Mueller, F. *Jogging the Distance*, *Proc. CHI*, ACM Press (2007).
- [26] Procyk, J., Neustaedter, C., Pang, C., Tang, A., and Judge, T.K. *Exploring Video Streaming in Public Settings: Shared Geocaching Over Distance*, *Proc. CHI*, ACM Press (2014).
- [27] Raffle, H., Ballagas, R., Revelle, G., Horii, H., Follmer, S., Go, J., Reardon, E., Mori, K., Kaye, J., and Spasojevic, M. (2010) *Family story play: reading with children*, *Proc. CHI*, ACM Press (2010).
- [28] Rector, K., Bennett, C. L., and Kientz, J. A. *Eyes-Free Yoga: An Exergame using Depth Cameras for Blind & Low Vision Exercise*, *Proc. ASSETS*, ACM Press (2013).
- [29] White, D.G. *Yoga, Brief History of an Idea*, *Yoga in Practice*, Princeton University Press (2011).
- [30] Yarosh, S., and Abowd, G.D. *Enriching Virtual Visitation in Divorced Families, Connecting Families: The Impact of New Communication Technologies*, Springer-Verlag (2013).
- [31] *Yoga.com*. 2014. Retrieved May 26, 2014, from <https://yoga.com/>.
- [32] *Yogaglo*. 2014. Retrieved May 26, 2014, from: www.yogaglo.com/.
- [33] *Yoga in America*, 2012. Retrieved May 6, 2014, from *Yoga Journal*: www.yogajournal.com/press/yoga_in_america.