



Workout connections: Investigating social interactions in online group exercise classes

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ABSTRACT

Exercising in a group context effectively motivates physical activity participation. However, gyms and health clubs closed in-person services due to the COVID-19 global pandemic. Online group exercise classes became an emerging service that attracted many participants. Exercisers are predicted to continue participation even after the restriction is lifted. However, it is unclear how such transition influenced exercisers' and fitness instructors' experiences. In this study, we conducted interviews with 13 exercisers and 11 fitness instructors who participated in synchronous online group exercise classes. We identified the opportunities and challenges that the participants faced in different types of social interactions, as well as how technology limited or facilitated participants' experiences. We reported an increase in responsibilities that the instructors need to take on. The online context also expanded the stakeholders in the social interactions by including other household members. We contributed to the HCI and CSCW community by presenting how social interactions occur in the online group exercise context, reporting the challenges and opportunities in transitioning social interactions from in-person to the online context, as well as proposing design implications to alleviate these challenges and realize the opportunities of the online context.

1. Introduction

Engaging in physical activity is beneficial for physical and mental health. Physical activity can reduce the risk of cardiovascular disease, diabetes, obesity, and lower the risk of depression and anxiety (Centers for Disease Control and Prevention, 2021b). In the U.S., 80 percent of the population failed to follow the physical activity guidelines published by the U.S. Department of Health and Human Services (U.S. Department of Health and Human Services, 2018).

Previous studies used different strategies to encourage and sustain physical activity. One main approach is transforming exercising alone into exercising in group contexts. Exercisers are more likely to sustain physical activity and improve life quality in a group context compared to exercising alone (Burke et al., 2006). Having connections with peers is a factor that influences the retention issue (Zheng et al., 2015). Studies used strategies such as sharing physical activity data (Epstein et al., 2015; Munson et al., 2015), adding cooperation and competition (Chen et al., 2017; Choi et al., 2016; Park et al., 2012), and leveraging social support (Adams et al., 2014; Poole et al., 2013).

In-person group exercise classes are popular among gym attendees

before the Covid-19 pandemic. In those classes, exercisers follow the guidance of instructors and exercise in a synchronized manner. Fitness franchises such as CrossFit, Orange Theory Fitness, Barr, and yoga, offer group fitness classes as main services. Due to the Covid-19 global pandemic, people become more sedentary at home, and engage in less physical activity worldwide (Tison, 2020). The effects of a lack of physical activity, such as obesity and cardiovascular disease, are associated with a higher risk of experiencing severe symptoms and a higher death rate from Covid-19 (Centers for Disease Control and Prevention, 2019). Engaging in physical exercise become more urgent during this unique time.

To continue providing services while following the social distancing guidelines, many gyms and health centers explored innovative ways to sustain previous members and recruit new members to participate in physical activity. For instance, group classes are moved to online platforms. Instructors and exercisers stopped meeting in-person, instead, they used video conferencing software to exercise synchronously online. Exercisers responded positively to such a transition. The use of live-streamed services increased by over 70 percent compared to prior to the Covid-19 pandemic (Mindbody, 2021). This transition is predicted to

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last even after the pandemic. Almost half of the exercisers intend to continue the participation in online classes even after the pandemic (Davalos, 2021).

Many technology designs created social interactions to motivate physical activity participation, such as competition, coordination, and message exchanges, to encourage physical activity (Chen et al., 2017; Choi et al., 2016; Park et al., 2013; 2012). Social interactions are different for online exercise classes compared to in-person context. For instance, in online classes, exercisers are not in the same space with other participants and instructors. Social interactions in this context would be different from what they used to have in-person. We would like to explore how the participants used the technology to maintain the social interaction and the challenges that they faced during the transition to online classes due to the pandemic.

To answer this question, we conducted 24 interviews with 11 instructors who have taught online group exercise classes and 13 exercisers who have participated in online exercise classes. Specifically, we investigated synchronous exercise classes hosted on Zoom, a video conferencing platform. These classes used to be hosted in-person but were transformed to the online setting due to the Covid-19 pandemic. We identified the opportunities and challenges that the participants faced in different types of social interactions: indirect, among exercisers, between instructors and exercisers, as well as with other household members. Within each type of interaction, we presented how technology limited or facilitated participants' experiences. We found that there is a need to balance the different needs of the participants, as the same technology features may support some exercisers' needs while limiting others'. We also identified an increase of responsibilities that the instructors need to take on. The online context also expanded the stakeholders in the social interactions by including other household members.

This study contributed to the HCI community in several aspects. Firstly, we used empirical data to present how social interactions occur in the online group exercise context. For instance, we pointed out that additional facilitation is needed for initiating social interactions in the online context. Some instructors were not aware of such constraints and were not able to provide sufficient social interactions. Secondly, we reported the challenges and opportunities in transitioning social interactions from in-person to the online context. For instance, there is a lack of feedback exchange between the instructors and the exercisers, and there is a need to help instructors to understand exercisers' experiences. Thirdly, we proposed design implications to alleviate these challenges and realize the opportunities of the online context.

2. Related work

2.1. Social interactions in online learning contexts

Previous studies have explored how social interactions happen and their effects in the online formal learning context during the pandemic. Instructors and students made the transition from in-person classes to online classes during this time. Recent studies explored how social interactions changed for students during the pandemic. (Chen et al., 2021) investigated the learning experiences of Chinese college students in live-streaming classes. The formats of interactions included audio, video, text box, and quizzes among others, and some formats were more effective than others. For instance, the audio quality and other technical instability made the experiences less pleasant compared with the in-person context. Text box was a more useful communication for students. Students can send messages and ask questions during the classes using the text box. It was considered an effective tool to connect with other students. Another recent study explored how learning from home has impacted the experiences of young children, teachers, and parents (Cumbo et al., 2021). They found that the social interactions changed from mainly being between the instructors and the students to heavily relying on the parents. Parents took on different roles such as helping

with technology set up, providing school supplies, and motivating learning among others. They became more essential stakeholders after the schools were urgently moved to online (Cumbo et al., 2021).

Moreover, prior studies explored the social interaction in the online learning context prior to the pandemic as well. Online learning has been popular even before the global pandemic started. Many studies focused on asynchronous learning contexts such as Massive Open Online Courses (MOOCs). In those contexts, studies explored students' motivation to enroll and stay in classes (Zheng et al., 2015). Researchers found that a lack of social interactions contributed to higher dropout rates even in the in-person formal learning context (Tinto, 1975). Being online brings more unique challenges for students to interact. Students faced the challenges of not being able to have a sense of others' presence and inefficient social interactions (Zheng et al., 2015). For instance, students may browse others' profiles to get to know them, but the profiles were often not completed (Zheng et al., 2015). Also, students may not have time to engage in casual interactions (Rabourn et al., 2015). Some studies explored how to support social interactions. Designs have investigated how students build connections with others (Sun and Rossion, 2017; Sun et al., 2019b). The connections among students were created through social media (Brzozowski et al., 2015), chat rooms (Kulkarni et al., 2015), and feedback exchange (Krishna Kumaran et al., 2017). For instance, a chat room can encourage previous students to support others who are new to the courses (Nelimarkka and Vihavainen, 2015).

Previous studies presented the possible challenges that students and teachers faced in the online learning environment. These challenges were explored in the formal learning context, which may differ from the exercise context. For instance, exercisers learn mainly through looking at movement demonstrations from the instructors, while students learn through listening to the instructors, reading files, and completing quizzes among others in the formal learning context. The feedback that exercisers and students need may also be different. The scale of an exercise class is much smaller than online learning classes such as MOOCs. Previous studies have investigated some exercise contexts such as video-based exercise programs as options to engage in physical activity in a distributed context. Studies mainly focused on the effects on performance or behavioral changes (Abed et al., 2014; Haines et al., 2009), especially working with participants with illness (van den Berg et al., 2016). The social interactions were limited in this context. For example, one study used YouTube exercise videos as interventions to encourage physical activity and asked the participants to use the comment features to interact with one another, but the comments were used to track participation adherence (McDonough et al., 2022). There was no analysis conducted to understand how exercisers interacted in the comment section. One study mentioned that the asynchronous nature of the workout classes made it challenging to carry over the social interactions (Sui et al., 2022). These class formats are essentially broadcasts and do not have any interactive or collaborative components to them. Studies have identified the beneficial effects of exercising within a group context compared with exercising alone. Researchers have also put effort into finding ways to connect exercisers to motivate physical activity. Different from the previous work, the study presented in this paper aims to explore the experiences of exercisers and instructors in online group exercise classes on Zoom, which is a collaborative and interactive setting that potentially allows two-way communication between instructors and exercisers.

2.2. Technology designs to encourage physical activity

Compared to exercising alone, group exercise is especially beneficial for exercisers. The benefits include a higher level of motivation (Centers for Disease Control and Prevention, 2021a; Feltz et al., 2011) and adherence (Burke et al., 2006; Estabrooks et al., 2012). Researchers in the field of HCI have a great interest in physical activity engagement. Many designs encouraged exercisers' interactions in group contexts to

improve engagement and adherence to physical activity (Chen et al., 2017; Epstein et al., 2015; Esakia et al., 2018; Park et al., 2012).

Many systems utilized auditory cues to encourage interactions among exercisers. Researchers argued that designing exergame for multiplayer, as opposed to for private individual players, should be its default starting point (Marshall et al., 2016). The social component is an essential component of exergame (Marshall et al., 2016). For instance, *Jogging the Distance* used auditory systems to allow conversations between two joggers in different locations (O'Brien and Mueller, 2007). *Swan boat* was a social exergame that designed for two co-located joggers to run together (Park et al., 2012). The players were encouraged to discuss running strategies to reach better coordination (Park et al., 2012). Data from biometric sensors were also used to facilitate interactions among exercisers. Many fitness trackers have the ability to track fitness progress such as steps, distance, and heart rates among others. Studies used these fitness tracking devices to curate competition and cooperation among exercisers (Ren et al., 2018). For instance, *HealthyTogether* allows two users to share daily step and floor counts and achieve physical activity goals to win badges (Chen and Pu, 2014). The study also compared three different modes to achieve goals: competition, cooperation, and a hybrid mode which was a combination of competition and cooperation. The design evaluation revealed that competition was the least effective mode to motivate physical activity compared to the other ones. Similarly, *SwimTrain* used competition and cooperation to raise awareness of the performance of other group members in different locations (Choi et al., 2016). Users can get to know others' performance through auditory and vibro-tactile feedback. Moreover, commercial products such as Peloton (Peloton, 2021) also use competition to connect exercisers participating in the same live classes. Peloton users have access to live synchronous classes guided by instructors. During the live classes, the exercisers have access to a leader board to see other users' progress. There is also an option to invite friends to on-demand classes and exercise at the same time, and a leader board is also available for friends to engage in competition. However, as previously mentioned, competition might not be the best option to motivate exercise engagement. Other studies also investigated message exchange and public fitness data sharing as forms of social support. For instance, (Munson et al., 2015) explored the relationship between accountability and posting exercise plans on Facebook where friends can see and leave comments. They found that data sharing on social media elicited supportive comments, but did not help participants to commit to improving physical activity level. Similarly, sharing fitness performance data on Twitter can evoke positive reactions such as likes and comments (Epstein et al., 2015). Besides social media, other commercial products such as Fitbit (Fitbit, 2021), Apple Watch (Apple, 2021), and Nike Run Club (Nike, 2021) allow users to share physical activity data with other users and on social media. For instance,

The benefit of social interactions in physical exercise can be explained by self-determination theory (SDT) (Teixeira et al., 2012). SDT presented three basic psychological needs, which are autonomy, competence, and relatedness. The needs for relatedness is the needs for personal connection with others. Fulfillment of these needs can help increase exercisers' physical activity satisfaction and their well-being (Teixeira et al., 2012). Exercisers are more likely to feel motivated to participate in physical activity. According to a systematic review, SDT is a valuable lens to understand people's motivation in physical activity engagement (Teixeira et al., 2012). Several studies in the field of HCI also used SDT to guide interventions to encourage physical activity (Mascarenhas et al., 2018; Saksono et al., 2020). For instance, *Storywell* used family members' desire for relatedness as a reward to motivate parents and children to take more daily steps (Saksono et al., 2020).

Moreover, studies revealed that interactions with exercisers in a group context are more effective in groups with pre-existing relationships such as family and friends. Exercisers do not prefer sharing fitness data with strangers (Puusaaar et al., 2017). Sharing exercise data with strangers may even demotivate physical activity for people with chronic

illness (Chen et al., 2016). Strategies such as cooperation and competition do not yield as much physical activity improvement in groups of strangers (Chen et al., 2017). One helpful approach is using pre-existing relationships such as friends, family, and co-workers to motivate physical activities (Gui et al., 2017; Munson et al., 2015; Ren et al., 2018; Saksono et al., 2020; Simoski et al., 2019). However, exercisers might not always have access to family or friends to form exercise groups, due to challenges in time coordination (Simoski et al., 2019; Wu et al., 2009). This is a challenge that may hinder exerciser to experience the fullest extent of the benefit from group context. In the emergence of synchronous online group exercise classes, exercisers may not have existing connections with all other exercisers. However, many exercisers are still motivated to engage and sustain their participation even after the pandemic ends (Davalos, 2021). This presents us an opportunity to investigate if there were any interactions among the exercisers and instructors, as well as how they social interactions may influence their experiences.

2.3. Instruction-based group exercise

A unique exercise format that is popular among commercial gym services is instruction-based exercise. Group fitness classes provide people who are novice or amateur to fitness training an opportunity to enjoy guided exercise (Ntoumanis et al., 2017). They are also attractive to those who lack interest in solitary exercise (Ntoumanis et al., 2017). These group classes provide benefits from the group contexts (Burke et al., 2006), and more affordable programs as a substitute for one-on-one personal trainers. Popular gyms and health clubs, such as CrossFit (CrossFit, 2018), Orangetheory Fitness (Orangetheory Fitness, 2021), Equinox (Equinox, 2021), and YMCA (YMCA, 2021), provide instruction-based group exercise classes as an option or even as their primary services. These classes are traditionally set up in a classroom that multiple exercisers can attend classes at the same time. Exercisers can attend various types of exercise classes, including high-intensity interval training, yoga, weight lifting, cycling, and kickboxing among others. In these classes, experienced instructors have pre-designed class programs for exercisers to work through different movements and paces. During the classes, instructors demonstrate the movements, sometimes provide modification if needed, and inform exercisers about the time or repetition of each movement. After the pandemic, many services moved to an online format. These different formats of online exercise have various levels of social interaction features. For instance, Orangetheory Fitness (Orangetheory Fitness, 2021) provided live classes via Zoom that have potentials for participants to interact via visual view, audio, and text. Pure Barre created live and on-demand classes on their Xponential+ (Pure Barre, 2022) platform. Different from Zoom, camera views or audio connections are not available for exercisers, but a list of participants' names and locations are presented on the screen. Similarly, commercial products such as Peloton (Peloton, 2021) and Apple Fitness plus (Apple, 2021) became popular as well. They present performance information of the participants to motivate engagement. Fitbit Premium (Fitbit, 2022) and other services also provide on-demand exercise videos, but no social interaction features are available.

In the field of HCI, designs were evaluated to substitute for or support instructors to better provide feedback in instruction-based exercise contexts. Designs used devices such as body sensors (Bial et al., 2012; Velloso et al., 2013; Zhou et al., 2016) and motivational agents (Kanaoka and Mutlu, 2015; Luo et al., 2020) to substitute for the function of experts as fitness instructors. Body sensors and motivational agents have been used to regulate exercise participation and augment movements. Others investigated and evaluated designs in co-located contexts that support instructors to give performance corrections (Turmo Vidal et al., 2019; 2018; 2020). These designs focus on supporting exercisers to gain feedback more efficiently. These studies provide great insights to inform how to better support critics and feedback from instructors in co-located exercise classes.

However, the factors that motivate exercisers to engage in physical activity are more than achieving desired performance. Exercisers are also motivated by social factors such as having personal connections (Standage et al., 2003). Specifically, a study that evaluated coaching styles revealed that when instructors made themselves more available before and after classes, exercisers were more likely to provide feedback and ask questions (Hancox et al., 2018). Exercisers also defined coaches' quality based on, not only fitness expertise and technical knowledge, but also on interpersonal quality such as the ability to motivate and show sympathy (Campos et al., 2017; 2015). As the group classes move online, exercisers may face unique challenges to build these personal connections and gain a sense of relatedness with fitness instructors and other exercisers. It may be more difficult due to a lack of contextual cues and an obstacle to perceive the presence of oneself in a group context (Walther, 1992). It is unclear if and how connections can be built in exercise groups in the online environment. This study aims to fill this gap by investigating the interactions between instructors and exercisers in online group exercise classes.

3. Method

To explore social interactions in online group exercise classes, we conducted semi-structured interviews with 11 instructors and 13 exercisers from June 2020 to February 2021. The instructors and exercisers all have participated in online exercise classes hosted on Zoom, a video conferencing platform. The classes were synchronous, meaning that the classes were streamed live while all exercisers and instructors are participating at the same time. These classes used to be hosted in an in-person setting but were moved to Zoom due to the Covid-19 pandemic. We recruited participants through personal connections, internet search, and snowball sampling. We only included participants who attended or led classes on Zoom. We limited the platform to Zoom to specify the scope and context of the study. Firstly, we recruited the instructors through personal connections, in which we reached out to gym instructors that were in one researcher's social network. We recruited two instructors using this approach. Secondly, we used online searches to identify gyms and health clubs that offered online group exercise classes. We, then, emailed dozens of gyms and health clubs through the public accessible contact information and obtained permission to interview nine instructors who were interested in participating. We recruited the exercisers through researchers' personal networks and through a snowball sampling approach. Firstly, researchers reached out to people who attended online group exercise classes in the researchers' social network. We recruited three participants using this method. Secondly, we asked the recruited instructors to reach out to exercisers in their classes who may be interested in sharing their experiences. We recruited ten participants through the snowball sampling approach. All the participants were new to the online class format. They did not attend similar format classes before the Covid-19 Pandemic. Among 13 exercisers, five exercisers attended classes that required monthly membership, but attendance was not required. Eight exercisers were in classes that allowed one-time participation or one-time payment. Both types of classes had at least a portion of the group who were regular attendees, and other new members would join sometimes.

We included exercise classes that covered a variety of exercise types including yoga, pilates, high-intensity interval training (HIIT), cycling, Barre, and aerobic dance. Our participants also had a diverse background. We had two male and ten female who were exercisers in the participants. Although we had fewer male than female participants, the gender demographic aligned with the population of group exercise participants. Female composed the majority of the group exercise class attendees and fitness instructors (Human Kinetics, 2019; Statista, 2018; Zipa, 2021). The exercisers' age ranged from 22 to 61 years old (median age = 46 years old) and lived in three states in the United States. Their occupations included business manager, registered nurse, college student, software engineer, post-doctoral scholar, administrative

assistant, and campus ministry staff. The time length of online group exercise class participation ranged from two months to a year by the time of the interview. We had two male and nine female who were fitness instructors in the participants. The instructors' age ranged from 20 to 58 years old (median age = 32 years old) and lived in four states in the United States.

During the interviews with the exercisers, we asked questions regarding what motivated them to sustain continued participation, how they interacted with other exercisers and instructors, as well as any challenges that they experienced. During the interviews with the instructors, we asked questions related to how instructors structured the classes, how they interacted with exercisers, what strategies they used to efficiently interact with the exercisers, and the challenges that they faced. All interviews were conducted through phone calls or Zoom calls. These interviews lasted for 30 minutes to an hour. All interviews were audio-recorded and transcribed.

Due to the exploratory nature of this study, two researchers analyzed the data using inductive coding guided by the six phases of thematic analysis (Braun and Clarke, 2006). Firstly, two researchers read the interview transcripts to gain a general understanding of the exercisers' and instructors' experiences. Secondly, we identified and coded any quotes that were related to 1) how the exercisers felt about their experiences, 2) how the exercisers interacted with other exercisers and instructors, 3) strategies that the instructors used to provide a satisfying experience. We organized data into several groups (e.g. three phases of classes, interactions among exercisers, and interactions between exercisers and instructors) in this phase. We coded all interview transcripts in this phase. Thirdly, we organized the codes generated in the previous phase, and group them into potential overarching themes. Initial themes emerged in this phase (e.g. highly valued pre-class and post-class interaction and crucial engagement from instructors). In the fourth phase, we further refined the theme, including regrouping and breaking down themes. For instance, we broke down the interaction between exercisers into more nuanced factors that exercisers enjoyed. We reviewed the codes and re-coded any quotes that were left for future refinement. In the next phase, we reviewed the refined themes in the previous phase, analyzed, and extracted the meaning of each theme and sub-themes. In the final phase, we selected representative quotes from each theme and presented them in the finding section. We removed all identifying information to protect participants' privacy. All the names mentioned in the quotes were replaced with pseudonyms. We refer to the exercisers as EXX and instructors as IXX in the quotes in the finding section. This study was reviewed and approved by the Institutional Review Board.

4. Results

In this section, we discuss different levels of social interactions that occurred in online exercise classes. These online interactions were different from the in-person ones. The technology features can both facilitate and limit these interactions. Both the instructors and exercisers were making trade-offs when utilizing those features. We report the findings from low-level social interactions (i.e. visual cues), to peer interactions (i.e. interactions among exercisers), to interactions with the instructors, and the interactions with other household members.

4.1. Indirect interaction via visual cues

Visual cues are important in exercise classes. Visual cues help exercisers to follow instructions from the instructors, feel the presence of others in classes, and self-correct based on the mirror view.

In the online classes, the attendees needed to decide what camera view that they preferred and manually changed the setting to a desirable view. In Zoom, there are two options for users to choose from: *speaker view* and *gallery view*. *Speaker view* would relocate the speaker to the spotlight which takes a large portion of the screen. *Gallery view* displays

the participants' thumbnail in a grid pattern. For the instructors, they needed to think about the trade-off between having a bigger view of themselves (i.e. speaker view) and having a view of participants (i.e. gallery view) to ensure they were following the instructions. For the exercisers, they needed to decide whether they would like to prioritize seeing the instructors (e.g. speaker view), themselves (e.g. gallery view), or other exercisers (e.g. gallery view). Some exercisers chose to use *speaker view*, because they believed that the visual interaction with the instructors was more important. They would like to see the instructors more clearly. Other exercisers chose to use *gallery view* to prioritize a sense of being in a group.

The exercisers enjoyed having the visual representation of themselves being among others, and they were all moving along the instructions. The online context took some visual cues away that helped exercisers to feel a sense of being in a group. Thus, some exercisers prioritized the sense of being in a group and chose to use the gallery view to view more participants in the class. For instance, the following exerciser mentioned that *"I just used to always default to the instructor [the speaker view]. And then I don't know maybe the last month or so I was like, let me put all the people on it. It just seemed more fun and more like a group class."* However, this goal would not be achievable if most exercisers in class were not willing to turn on their cameras. The challenge then became how to balance the preferences of different exercisers.

Many of exercisers took the effort to scroll through the thumbnails of participants. For instance, the following exerciser (E13) mentioned, *"I know that there are other people there, because it is often a question in my mind. I wonder who showed up today. And I'll scroll in the beginning to see who's there."* Similarly, the instructors also needed to take action to scroll through the Zoom attendees to recognize who came late to the class, whereas they could easily spot the exercisers walking into the classroom in the in-person classes.

The concerns about negative self-presentation and social comparison motivated some exercisers to turn off their cameras. For instance, the following exerciser (E5) was in a class with other younger exercisers, and the exerciser felt self-conscious as she cannot perform as well as others, thus she chose to turn off her camera, *"There are different age groups in there, and just different fitness levels. I'm more middle-aged, so I can't do what other people younger people that are more in shape can do, or even what some of the all the instructors can do. There's an A pregnant instructor that can do more. But they're used to it. And I don't have quite all of the fitness level they have."*

Some exercisers were self-conscious about not having a tidy room as the following instructor (C5) mentioned. They received comments from many exercisers about this concern, *"I know a lot of people mentioned to me that they didn't want their camera on because their apartment was messy, or the light wasn't good or something like that."*

Not turning on the camera created a barrier for the instructors. Visual cues as feedback were especially important for instructors in the exercise context. The instructors were concerned about the exercisers' safety. Different from the formal learning classroom context, the exercisers were in constant movement while taking the exercise classes. They could be alone in a room that nobody would be there to help if an accident happens. Thus, being able to see how the exercisers were doing was crucial to the instructors. For instance, the following instructor (I8) explained that, *"If they're struggling, if they don't have the appropriate equipment, if they're doing something that's unsafe, let's say they have weights in their hand, and they're doing something without shoes on. There could be circumstances where you as the instructor would, if you were in person, you could say, go grab some shoes. It could be really detrimental if you drop a weight on your toe."* Besides safety concerns, the instructors would also like to gain visual feedback from the exercisers' facial expressions and movements. If they noticed that the exercisers were not following along, they might slow the pace. For instance, the following instructor (I9) mentioned, *"[During the in-person classes], you get a lot of visual feedback just from looking around the room and you can find out how the room is feeling. If they're really enjoying something or something is just*

not going well. Maybe you ask them to do something and you realize, okay, this isn't going to work, but just try and change it. And then being virtual, you don't really get as many of those visual feedback cues." A lack of visual feedback also made some instructors feel that they were teaching to the computer, which was less fulfilling than teaching to a group of people.

Interestingly, the options for the exercisers to hide may benefit those who were new to the class or new to fitness. For instance, the following exerciser (E11) mentioned that, *"During this time, other people are not observing me. I've been more a little bit more willing to try new exercises that are presented to me because people can't see me."* Similarly, some instructors mentioned that they heard that some of their exercisers were anxious to join an in-person gym, but the online classes allowed them to build confidence in routine exercise and to transition to the in-person gym later. For instance, the following instructor (I8) mentioned that, *"they might not be as comfortable coming in person. The longer they did online classes, the more comfortable they felt coming in person. So I had a member that was disabled. And they never really wanted to come into the gym because they felt so threatened and very discouraged whenever they came into the classroom. And this provided them an opportunity to build that confidence without having to actually come to the gym. And actually, this week, they were in the gym for the first time ever."*

4.2. Social interaction among exercisers

The direct social interaction among exercisers happened mostly within a few minutes before and after the classes, but the interactions during the exercise were fully removed. In the in-person classes, the exercisers had the options to chat with other attendees when they were on their way to class, waiting in the lobby, taking a water break during the classes, and heading out of the classroom. There was no intentional time allocation for these interactions. These in-person interactions were also semi-private, where multiple conversations could be happening at the same time before the class starts.

Many instructors recognized the benefits of these social interactions, and wanted to carry them over to the online space, but it required some intentional plannings. Zoom rooms are not always open like a gym room. Zoom rooms are similar to locked physical rooms, only the instructors who are hosts of the room had the keys to the room, and they can open the room to allow others in. Some instructors recognized the limitation of the online space, and allocated time before and after the classes just to chat with the exercisers. This allowed exercisers to chat with one another. The exercisers valued the chatting time and it motivated them to sustain their participation. Social time was especially beneficial during the isolated pandemic time, because they were eager to connect with others outside of the household. These social interactions helped them to gain some normalcy during this uncertain time. The following exerciser (E5) elaborated on how having social interactions was important for their sustained participation, *"[One reason to attend the class is] just to have that connection with people. I really cherish that six to seven o'clock hour where I can actually talk to people and have that connection..."*

The Zoom environment provided some advantages for connecting the exercisers online. Firstly, more exercisers could join the classes from different locations. Previous members that moved away can stay connected. For instance, the following exerciser (E5) was sad to see her classmates moving away, but was happy to re-connect through the online class, *It's interesting because a classmate moved to [city name] last year, we were all sad to see her leave the class. But once everything moved online in March, and she started working from home, she joined the class again. It's just been really fun to reconnect with people that way. I feel like this is my tribe that is getting me through this dark time.*

Secondly, the *name display* on the thumbnail helped the exercisers to remember each others' names. In the in-person classes, it is inconvenient to wear or display a name tag, but in the online context, the feature was feasible and helpful. The following exerciser (E6) recognized the value by comparing the in-person classes with the online class social

interaction, “[For the in-person classes] I’m just walking into the gym, or walking out waiting for the bus. Just chit-chatting with [other exercisers] when we’re getting our stuff together. And a lot of times I don’t know their names, but I know their faces. Now I’m learning their names, because I can see their names across the top [on the screen].”.

Thirdly, the mode of communication on Zoom was either fully public (i.e. only one person can talk, and everyone can hear them) or fully private (i.e. chat in a breakout room). The positive side about being public was that the exercisers were implicitly forced to choose and share personal information about themselves with the whole group. Many exercisers who were not speaking would be listening to the only conversation that was happening in class. Thus, when there was one conversation happening, others got to listen and passively learned more about one another without taking the initiative to start a conversation. For example, the following exerciser (E1) mentioned that she was not familiar with many classmates in the in-person classes, but she was able to pick up information from the conversations between others in the online classes, “Because of Mike [the instructor], I got to know some of these people a whole lot better than I did before. Now Matt [one classmate] comes on. I know he’s a [occupational title]. Its just getting to know more information about people.”

Although the advantage of fully public communication also had its downside. As mentioned previously, many social interactions in the in-person classes were semi-private where multiple conversations could happen simultaneously. However, there could only be one conversation on Zoom, which may not be the most efficient way to engage more exercisers. For instance, the following exerciser (E4) pointed out this constraint when she compared the social time in online classes to in-person classes, “If you have a group of 10, whoever is speaking is the only person speaking. And everybody else is listening. So it’s different than when you would walk into a gym classroom, and there would be 20 conversations going on now. It’s really just one.”. Moreover, the topics of discussion were reduced, because the exercisers wanted to protect others’ privacy. For instance, the following exerciser (E5) gave an example of why she sometimes preferred private conversations, “So everyone can hear what you’re saying. It’s not as personal. I knew the ones husband had cancer. And so I may have talked to them a little differently, instead of saying ‘Hey, how are you doing now that your husband passed’ in front of everybody.”. The instructors also felt a lack of control over the conversation when multiple exercisers accidentally initiated conversations. For instance, the following instructor (I7) mentioned that, “It’s hard to control. Olivia and Matt are having a conversation, and then they’re interrupting James and Ben. Even though they were very polite.”. Although breakout rooms could be an option for the exercisers to have private conversations, they did not feel comfortable enough to use them.

While the exercisers had opportunities to socialize before and after the exercise, the interactions during the exercise were fully removed. In the in-person classes, the exercisers could high-five with others near them and commiserate. For instance, the following exerciser (E10) compared the interactions that they could have in-person with online while exercising, “When you have water breaks, small breaks between intervals or longer water breaks, you have the chance to talk to people ‘Oh, that was tough, or that was easier. I’m really tired.’ but you don’t really have that opportunity.” Many exercisers did not expect to be able to have conversations with others during exercise because they would need to stop the movement and use their laptop to initiate a fully public conversation on Zoom. Also, they prefer to be muted during the exercise to avoid distraction from others. For instance, the following exerciser (E4) mentioned that it might be awkward to hear others making noise out of exhaustion, “When participants [exercisers] don’t mute, and then the instructor is teaching and then somebody is lifting weight and goes [makes a noise]. Suddenly the focus shifts from the instructor to this person. I find that really distracting.” However, in the in-person setting, they were able to have these semi-private interactions just by turning their head around.

4.3. Social interactions between instructors and exercisers

4.3.1. Instructors’ role and technology features

The instructors expressed that having the Zoom option allowed them to continue their job during the pandemic and have social interactions with exercisers. Although the conversations were fully public, they were better than other platforms (e.g. Facebook live or Instagram live) where no verbal or written communication could be easily achieved. Zoom helped them to have a two-way street to teach and to hear from the exercisers. We observed a shift of responsibilities for the instructors. The instructors were taking on more tasks to facilitate social interactions as well as encourage good performance.

Compared with the in-person classes, the exercisers relied more on the instructors to facilitate social interactions and to motivate the performance. The instructors also valued building connections with the exercisers. In the in-person classes, the instructors could easily approach exercisers waiting in the lobby before the classes started or after class ended. As mentioned in the previous section, some instructors attempted to replicate those interactions and intentionally allocated time to start the classes earlier and end the classes later to allow chatting time before and after. In the online classes, before the class started, the instructors would greet the exercisers and ask them how they were doing. After the exercise ended, the instructors would sometimes ask for feedback or music request. These seem to be similar to the in-person setting, but it would not be possible if the instructors or class schedulers were not aware of the potential of leaving the Zoom room open for extra time. For instance, one instructor (I6) was not sure how to better connect with their exercisers, and due to the back-to-back classes, they did not have time to allocate time between classes for casual social interaction. They were attributing the decrease in the attendance to a lack of social engagement, “But typically we were on a schedule. And for example, we only had one account for our studio. So we had to stay on our schedule so that the next class could start on time. I wonder if that’s why attendance started to decrease, because there was no social”.

Several features on Zoom could be utilized to facilitate the social interactions between instructors and exercisers, but they were not often used. For instance, the chat feature was useful in the formal learning context (Chen et al., 2021), and the instructors also recommended using the *private chat* to communicate concerns such as exercise restrictions or injuries, but some exercisers expressed that they were not comfortable using the private chat. They were concerned that the setting was not correctly set and they might have messages sent to the whole group or the wrong person. The *public chat* was used to mostly report technical issues such as slow internet connection, which was a challenge that the participants didn’t have in the in-person classes. Especially in the beginning of the transition to online classes, the instructors were concerned about internet connectivity, and they were not sure if the exercisers experienced any video or audio lags. This challenge made the online classes not the most ideal context to hold classes that require music synchronization. The *public chat* was also not frequently used during the exercise, because the exercisers felt that they could chat verbally before or after the class, and they did not want to stop the movement and type on the chat where nobody was monitoring at the moment. For instance, the following exerciser mentioned that during the exercise (E5) was not the preferred time to use the chat feature, “I have [used the chat] at the end of class, I’ve gone in and made a comment. But I wouldn’t stop in the middle of an exercise and go in the chat and do something.”. The *reaction* feature was sometimes used to engage in light-weighted interactions. This feature was also not used often by the exercisers, but some exercisers mentioned that if nobody was typing or talking to respond to the instructors, they would use reactions (e.g. thumb up) to respond. It was described as a more lightweight way to communicate with the instructors compared with the chat.

The exercisers also relied more on the coaches to motivate exercise performance compared with in-person classes. In the in-person context, the exercisers were able to see others around them easily. The

motivation to keep up with the performance came from both the instructors and other exercisers. However, in the online classes, the limited visual cues made it more difficult to view other exercisers and feel the motivation from their peers. Thus the instructors took more responsibility to encourage the exercisers, and to help them perceive a sense of being in a group. For instance, the following instructor (I7) would give acknowledgment even to the exercisers who did not turn on their camera to help them feel that they were noticed by the instructors, *"I'm looking at the group that's in the studio, and they are working hard. Those of you at home, come on, we expect you to do your part too. And just simply that little bit of recognition there. Maybe the person at home thinks, oh, my goodness, she was talking to me."*

Despite the social interactions that the instructors were able to have now, there is still a need for the instructors to gain more connections and interactions with the exercisers. Some instructors were not sure what else they should do, while others were concerned about bringing too much burden on the exercisers. For example, the following instructor (I9) mentioned that, *"I think online, there would be a huge benefit if they could interact more. I just think that it can be tough because sometimes I know people can be uncomfortable interacting with people that they don't know, especially online. So that could definitely be a struggle too."*

However, we found that the exercisers were very understanding of what the instructors have been trying in this transition and process. One exerciser's (E2) group even gave their instructor a gift basket during the holiday season to appreciate his hard work. For instance, the following exerciser mentioned that, *"We decided to do something for him, because he really went above and beyond. We all pitched in money, and bought him some gifts and surprise him."*

4.3.2. Interactions and teaching for different needs

Different from the online learning context where students have similar learning goals and knowledge levels. The exercisers may have different exercise goals, fitness levels, and available supplies. Some wanted to just stay active, others might want to improve strength. Different from the in-person classes where the instructors could easily observe exercisers' movements and speak with individuals to gain feedback, the instructors for the online classes didn't have an easy option. If there was no previous relationship, the instructors would not know everyone's fitness level and need, or how to better cater to them. Thus, the instructors attempted to handle these challenges in several ways.

Firstly, compared with the in-person classes, the instructors lowered the intensity level of the exercises and tend not to introduce new movements. They wanted to be conservative on the intensity to ensure the safety of exercisers with all fitness levels. The exercises were catered more to the people who were satisfied with repetitive movements and lower intensity workouts. Thus, the performance of online exercise classes may not be as intense as the in-person class either. For instance, the following instructor (I3) made the comparison between the in-person and online classes *"when I can see everybody the whole time, I feel like that gives me a little more, I could sort of lean into something a little more challenging, or maybe something a little bit new. But when it's online, I feel like I don't have that I'm a little less likely to try something that's like totally new, or that might be a little riskier or something like that."* However, despite the lowered intensity level, the exercisers were glad that they could at least stay somewhat active during this time, as they could have been trapped in the house without many alternative ways to exercise and had excessive food consumption while staying at home. For instance, the following exerciser (E5) expressed her needs to engage in exercise, *"Getting a workout is beneficial, because I'm drinking more than I used to, I'm eating a lot more cookies than I used to. That's how I'm dealing with my stress."*

Secondly, the instructors gave the exercisers more autonomy to decide what they need in class. Some instructors allowed the exercisers to choose their own music as background, they wanted to give exercisers autonomy because they were not sure what they would like for the

music. Also because the online environment allowed the exercisers to be muted. Another example was that some instructors asked the exercisers to let them know if they did not want to receive feedback from the instructors. They were concerned that the fully public feedback may make some exercisers uncomfortable. For instance, the following instructor (I5) mentioned that *"I try to avoid one on one call-outs. I would give comments that are more positive or encouraging."* Unfortunately, that was the only feasible feedback option that the instructors had. There was no option to give hands-on feedback like in the in-person classes. For instance, the following instructor (I6) mentioned that *"In the studio, I can do more hands-on type of correction. But on zoom, those types of cues were more difficult."*

Thirdly, some instructors changed their usual teaching style that they provided demonstrations then started walking around the classrooms to move along with the exercisers through the whole class. Many instructors felt awkward stopping exercise and staring at the laptop to observe the exercisers. They were concerned that it might make the exercisers feel more self-conscious. They thought the observation was unnecessary because they did not intend to give feedback to individuals. For instance, the following instructor (E2) mentioned that *"I'm getting started, and then I would stand up, and I'd walk around and check on them. But for me to stand up and then go and check on the computer, it just doesn't seem it doesn't seem right now."*

Moreover, some instructors allowed equipment leasing from the gym to make sure that the exercisers had the access to necessary equipment such as a bike. However, this happened only in the group that had pre-existing social connections and for exercisers that were in the same region as the gyms. For instance, the following exerciser (E2) described his way of obtaining an exercise bike, *"So [the instructor] has been really a great facilitator, because he has allowed a couple of us to lease a bike. So I was able to bring home a high-quality bike. We know each other really well. So make it possible for me to do the spin class"*. For exercisers who were in different locations, loaning equipment such as a bike or treadmill might not be as feasible. Thus, some instructors recommended common supplies that exercisers may have at home as weights. One instructor (I11) mentioned that he has seen exercisers using creative objects as equipment such as their pets, *"If you have dumbbells at home, try and use something that's about 10 to 15 pounds. if not, I put four of my yearbooks in the backpack, and we're about to use them today. I was able to kind of figure out the things that would work and substitute for that. So that was one thing that I guess got better as we progress through it. We kind of learned how to make do with what we have. I've seen an exerciser doing squats with their golden retriever."*

Finally, the instructors needed to satisfy the needs of both in-person and at-home exercisers. As the pandemic got better, many exercisers were open to attending the in-person classes, while others were still more comfortable attending class virtually. For instance, one instructor (I4) pointed out that he needed to consider the needs of both groups, *"If we have classes in person that are also virtual, we can satisfy fulfill both those needs. I'm still learning that part of it. Because Initially, it was all virtual. So I could just stream everything. Now, I have people in person, people at home, how do I satisfy everybody gets a good quality of instruction and music, but not have a whole bunch of feedback in the sound system with that type of stuff. I'm still learning that type of stuff. I'm not great with it, but working on it."* This format of the classes could be a popular format even after the pandemic runs its course. The exercisers would like to still have an option to take classes virtually when they cannot make it to the in-person classes or due to its convenience. For instance, the following exerciser (E10) mentioned that for people with young children at home, this could be a great option to stay active *"I definitely think it's a great idea. That's just one example of someone even when in-person classes are back to where they were previously, before the pandemic. I think that there will be a huge demand for people just looking to be able to exercise, because of how convenient it can be, and the time that it maybe save them."*

4.4. Interactions with other household members

After the exercise classes were moved to many instructors and exercisers' homes, there were also some changes for social interactions with others in the same household. Having others in the same household also influenced how they participated in the exercise classes.

Firstly, the instructors and the exercisers both mentioned the convenience of not needing to commute for exercise. They had more time to be home with their children, and they reduced spending on daycare for children. One instructor (I3) mentioned that when they were teaching in-person classes, daycare was an extra spending that they could avoid now, *"When it's time for me to start the class, I just walk down the steps and I'm good to go. I am here with an eight-year-old. And so I don't have to think about childcare. They're safe, they're in the house."* Similarly, one exerciser (E3) enjoyed exercising near their children and being a role model to them. Sometimes the children could also casually exercise near her, *"I have a daughter, and I want her to have a healthy perspective on a healthy body image perspective. I want to make sure I'm modeling that for her. [I would tell her] This is mommy time, you're welcome to join, you know, sometimes my daughter will sort of jump in for a couple of minutes or maybe the whole time."* Another exerciser (E8) attended a dancing class, and he invited his mother as a dance partner for a dance class, and it made the experience more fun for him, *"I actually had my mom was my [dancing] partner. It's kind of funny. It was even more fun. Because that's the point of dancing is that you have a partner [to work with]."*

Secondly, the instructors were able to invite family members and friends who were not in the same regions to participate in the online classes. They could help them to stay active and socialize with them. For instance, the following instructor (I3) mentioned that, *"People who don't live in the area are now doing it again. My mom and my mother-in-law, who don't live here are now taking classes. Friends that I met through yoga who lives in a different state are now taking classes. We have some former students who have moved away that are now back online with us. It's pretty great."*

Besides the ability to help other household members to stay active, living with others also influenced the options to participate in terms of time and space. For instance, for the in-person classes, the exercisers could choose a time to exercise fully based on their own schedule. It could be early in the morning or late in the evening. However, the exercisers needed to take other household members' schedules into considerations. For instance, they might not choose to exercise early in the morning to avoid disturbing other members' sleep schedules. The following exerciser (E2) mentioned that, *"But some of it might be because we're living in a house, I think it's challenging to be in my house at six in the morning and exercising, that might be too loud. And I don't really want to do it in my garage, or basements."*

The exercisers also took other members' privacy into considerations during the classes. Some exercisers were hesitant to turn on their camera due to concerns about other household members being in the camera frame. For instance, the following exerciser (E10) did not want to turn on their camera due to this reason, *"I normally have my camera off just because, you know, I have a roommate, and my house is sometimes messy. And when you have the camera off, and then the instructor can't see you. I think it's not as personal as a real life experience."*

5. Discussion and design implications

In this section we present the discussion and the design implications to realize the opportunities and reduce the challenges that the online group exercise context presented. These discussion points and implications aim to improve the online group exercise experiences through providing social interactions at appropriate timing, supporting feedback exchange between instructors and exercisers, and allowing more types of social interactions while protecting privacy of those who do not want to engage. These considerations can still be helpful even in the post-pandemic time, as many gyms and health clubs plan to continue online classes as options. For instance, it has been almost two years since

the pandemic started, and the YMCA still provides online group exercise classes nationwide.

5.1. Support interactions in different phases

Unlike the in-person classes where the exercisers have casual interactions throughout the classes, the online class exercise classes require intentional plannings to enable social interactions. The awareness of benefits for pre-exercise and post-exercise is essential for instructors to allocate time for social interactions. Moreover, while direct interactions were eliminated during the exercise in the online context, the exercisers had the option to engage in indirect interaction through visual cues. They could decide whether to make themselves visible to others by turning the camera on or off. The options to be visible or invisible satisfied needs of different types of exercisers. These different needs for interactions in pre-exercise, during exercise, and post-exercise, present opportunities to improve the current designs to better support the needs of different exercisers in different phases.

5.1.1. Support social interactions during three phases of classes

Our finding identified the needs for three different phases of social interactions: pre-class, during-the-class, and post-class interactions. In the in-person exercise classes, the exercisers were able to engage in some level of interactions throughout these three phases. In the online classes, exercisers could lose social interactions for all three phases. For instance, among our participants, some instructors did not start the classes early or end the classes later, which could be due to a lack of awareness of the positive effect of the interactions and a lack of time in between classes. Due to the social isolation of the pandemic, exercisers who had the opportunity to have the pre-exercise and post-exercise social interactions valued it even more than the in-person classes. They appropriated the exercise classes as an outlet to gain normalcy of social interaction during this uncertain time of the pandemic.

In the in-person group exercise classes, there are often breaks in-between exercises. There are fewer barriers for exercisers to interact such as giving a quick high five or comment on how they feel to the person next to them. Less effort is needed to quickly interact with others next to them. These casual interactions may help them to gain camaraderie and motivate them to keep up with the exercise. However, these direct interactions were lost in the online context, which created a barrier to help the exercisers to feel the presence of others. This challenge was similar to previous studies in MOOCs online learning context where not knowing the presence of peers hinders the motivation to sustain participation (Zheng et al., 2015). In the online learning context, students could use the chat feature anytime during the lecture. Chat is a useful feature to ask questions and interact with other students (Chen et al., 2021). Students are often sitting still in front of the screens, and they can easily interact with their devices during classes. For exercisers, they learn through observing and replicating the movements. They did not want to step away from their exercise to interact with their devices. Previous studies investigating the group exercise context provided ways to have direct interactions while exercising. For instance, providing audio feedback to joggers and recognizing the effort that others are putting into the exercise (O'Brien and Mueller, 2007). However, such direct interactions worked well in a dyad group, but may not work in a group with multiple exercisers. The exercisers in our study explicitly mentioned that they preferred being muted during the exercise to avoid any distractions from others. Thus, different from online learning or the dyad exercise context, we identified that chat or audio interactions during the exercise would not be the most appropriate way to connect for online group exercise. The exercisers need other lightweight ways that would not disturb the exercise to interact with others.

Design Implications: Platforms should raise awareness of the positive effect of the pre-exercise and post-exercise social interactions. The system should also help the instructors to understand the resources available to support social interactions. For instance, the system can prompt

the instructors to schedule classes including additional time dedicating for interactions, and explicitly provide the timeline of three phases of the classes. The designs can also be used by gym managers who create the class schedules. The platforms can encourage the managers to block time out before and after classes for social interactions, as opposed to scheduling classes back to back. In the during-the-class interactions, platforms should provide opportunities for exercisers to engage in lightweight interaction with little effort. For instance, the system could remind the exercisers to allocate short time for a short water break. Having synchronized breaks may help exercisers to have the chance to quickly reflect on the workout by giving a thumb up while drinking water. The reaction feature on Zoom can also be promoted as a lightweight interaction. It allows more emotional expressions such as feeling sweaty, excited, or tired. Using the emojis, the exercisers also do not need to turn on the camera if they don't want to.

5.1.2. *Balancing being together and being invisible during exercise*

Our findings revealed that the online context provided exercisers an option to be present while being invisible to others. The exercisers had the option to turn off the camera online. This mode of presence could be beneficial to those who were concerned about presenting themselves in front of a group. This echoes the findings in the formal learning context, where students did not want to show themselves due to the concerns about how they looked and how their rooms looked (Chen et al., 2021). However, in the exercise context, the exercisers had more concerns about their performances. In the online learning context, the students' performances are usually evaluated through quizzes, homework, or exams. In the exercise context, the performances are the movements of exercisers, which can be easily revealed through camera views. Having an option to turn off the camera can even be beneficial in a post-pandemic world, when many people, especially those who are new to fitness, would be anxious to attend in-person gyms. This alleviates the stress that one needs to face in the in-person classes where they have no option but to be visible and engage in social comparison to others (Vartanian and Novak, 2011). It allows the exercisers to escape from the pressure from social comparison. Upward comparison (i.e. compare with others who are at a higher fitness level) may bring stress to them if it is unwanted (Mollee and Klein, 2016). This option provides an alternative for the exercisers who are beginners to learn the movements and gradually feel confident about their performance.

However, having the option to turn off the camera would be a hindrance for exercisers who enjoy seeing the visualization of the group. In the in-person context, the exercisers can easily view others around them and be motivated by them due to the presence among others, which could be explained by the social facilitation theory (Strube et al., 1981). Many exercisers chose to turn on their cameras because they want to position themselves in a situation that their movements were visible to others, which may help them feel more accountable. These exercisers would like to view others' movements as well to feel that the group is moving together and to gain a sense of being in a group. If many exercisers choose to turn off the camera, the view of group exercise would not be as salient. They rely on other exercisers being willing to be visible to the group to gain the visual cues of togetherness. These two groups of exercisers' needs are entangled and present trade-offs that need to be made.

The concept of socially translucent systems can be utilized to improve the interactions during the classes (Erickson and Kellogg, 2000). These systems support social interactions by presenting visual cues of others, raising awareness of others' presence, as well as holding the users accountable by exposing their presence to others. These systems support the indirect interactions among users, but also need to balance the needs between visibility and privacy. We argue that future systems in the online group exercise context should also embrace these characteristics. Different types of fitness information can be shared to inform presence. For instance, previous studies have utilized fitness tracker data and shared it among exercisers to increase the visibility of

others' presence (Chen et al., 2017; Mauriello et al., 2014). However, not all exercisers would be comfortable sharing their performance data with others, especially sharing with strangers (Chen et al., 2017). While previous studies focused on sharing data as performance sharing, we identified that some exercisers were not comfortable to reveal their performance through the camera views. Future designs need to find different ways to satisfy various levels of presence. While some would like to give full visual presence, others were only willing to reveal their names.

Finding a balance between having a sense of group and having an option to be invisible can be applicable for the bigger scale context where camera views are not available. Commercial fitness products or programs such as Peloton, Apple Fitness, and Pure Barre do not have visual views from the participants. The only visual views are from the instructors. These services provide different levels of information sharing to create a sense of group. Peloton displays individuals' progress on the screen, Apple Fitness used aggregated data to inform individuals of their standing in the group, Pure Barre classes display participant users' names and cities. Based on our findings, these different types of information sharing may be beneficial for different types of participants. For exercisers who would like to be more invisible, the aggregated data may be a better way to help them see others in the groups, but also hide their performances. For exercisers who want to see the visualization of the groups, presenting some information about individuals' effort may be more attractive. To provide satisfying experiences and attract different types of participants, we could consider giving participants options to choose the types of data sharing that are the most comfortable and beneficial for them.

Design Implications: Online group exercise platforms need to provide a sense of togetherness while preserving the freedom to be present and invisible. The online group exercise may be an alternative to an in-person gym for exercisers with lower fitness levels. However, while benefiting those who enjoy the mode of being present but invisible, the online platform also needs to cater to those who enjoy having a sense of togetherness via visual cues without jeopardizing the need to be invisible. For instance, the camera view could be made blurry for those who do not want to present themselves fully. These designs can be helpful even in a post-pandemic time. They can help people who are anxious to go to an in-person gym build their confidence in a virtual and more private setting.

5.2. *Helping instructors to understand exercisers' needs*

Instructors took on more responsibility in the online class context. The exercisers relied more on them to engage in social interactions as well as feel motivated in class. Instructors needed to know when to allocate time for social interactions. They also often felt responsible for facilitating the conversations. Some instructors still felt a lack of opportunities to build a connection with the exercisers. Also, due to a lack of sense of being together, the instructors became the primary source of motivation during exercise, and exercisers relied on them to feel a sense of being in a group.

5.2.1. *Informing instructors of exercisers' performance*

A lack of visual cues created barriers for seeing exercisers' performance. Many instructors were guessing along the way or using more conservative measures (i.e. lower intensity and more repetitive movements) and giving more autonomy to the exercisers to ensure a wide range of the exercisers that can benefit from it. The changes in teaching style made the exercise more attractive to exercisers who were more likely to enjoy lower intensity exercise as well as repetitive exercise. This made the classes less enjoyable for exercisers who enjoy high-intensity workouts. The instructors also used strategies such as giving positive compliments to exercisers even without a camera view. Moreover, the instructors also became more reluctant on giving individual feedback due to a lack of visual cues and concerns about privacy. Some instructors

even changed the teaching style from giving instruction, then giving feedback, to exercising along with the exercisers.

Other indicators of exercisers' performance can be used to inform instructors. There are more needs to view the body movement in the exercise context compared with the formal learning context, especially due to safety concerns. Previous studies utilized light projections (Turmo Vidal et al., 2020), heart rates (Moreno et al., 2019; Mueller et al., 2012), and steps (Attig and Franke, 2019; Chen and Pu, 2014; Esakia et al., 2020) to share exercise performances within an exercise group or with the instructors. These studies either allowed data sharing among participants with pre-existing relationship or found that sharing performance data to generate competition scenarios is not preferred by all exercisers. Similarly for commercial products, the most common metric to share performance is heart rate. However, commercial products such as Peloton and Apple Fitness only allow performance sharing among exercisers, and do not use the performance data to inform the instructors. There is essentially no communication between instructors and participants. Our study found that instructors have a need to understand how exercisers are doing in the Zoom classes, especially for safety concerns. We argue that the same concern may also exist in larger-scale classes such as Peloton and Apple Fitness classes, where communication between exercisers and instructors is more restricted. We argue that the exercisers should not only have control over the level of presence they would like to be (i.e. having a clear camera view or a blurry camera view) as mentioned in the previous section, they should also have control over who they would like to share personal information with in the class. Thus, there could be a balance between providing instructors with necessary information to ensure safety, offering guidance, and helping exercisers feel comfortable sharing their performance.

Design Implications: Designs should be used to help instructors to understand exercisers' performance and provide efficient motivation while exercising. For instance, a heart rate monitor can be used to present the effort of the exercisers' movement. The instructors can utilize those numbers to set goals and encourage exercisers. To take privacy into consideration, the system could provide different levels of visibility of heart rates such as visible to 1) instructors only, 2) exercisers I know in the class only, 3) everyone in the class. Thus, the instructors can receive more information about the performance without requiring the exercisers to turn on their cameras. If exercisers feel motivated to present their heart rate to others, they would have the option to do so as well.

5.2.2. Enabling feedback exchange between instructors and exercisers

Instructors changed in several ways to support online exercise and they also faced new challenges that they didn't have in the in-person context. One main challenge is that they lack feedback from the exercisers to understand their needs and how they feel. There is a loss of casual social time as well as visual cues during the exercise. The instructors wanted to know if the classes were helpful to the exercisers, and they enjoyed hearing appreciation from the exercisers to feel that their effort has been paid back. The indicator that the instructors looked for was the participation rate, where there may be other ways with richer content to inform them of their work. We also found that many exercisers understood the challenges that the instructors were facing, and they appreciated the effort that the instructors put into this transition. This finding indicated that there is a need for instructors to receive feedback from the exercisers, and some exercisers were willing to show appreciation towards the instructors as the reassurance of their good work.

Feedback exchange has been explored in previous studies. For instance, in the online learning context, designs were used to support feedback exchange among students (Krishna Kumaran et al., 2017; Sun et al., 2019a). Also, designs that supported feedback exchanges for instructors utilized automation. For instance, designs used audio recordings to capture different types of discourses such as giving instructions and asking authentic questions (Jensen et al., 2020). In the

exercise context, the designs focused on supporting instructors to provide feedback to the exercisers (Turmo Vidal et al., 2018; 2020). For instance, designs used lights attached to bodies to reflect the movement positions on the wall or floor, which was used to compare with the standard position to provide feedback (Turmo Vidal et al., 2020). Our study pointed out that it could be beneficial to allow feedback and appreciation from exercisers to instructors as well. The instructors would like some reassurance of how their work is doing, and the exercisers would like to have more casual interactions with others. Giving appreciation can benefit both the appreciation receivers and the givers (Emmons and McCullough, 2004). Providing a platform to prompt feedback and appreciation could help with these needs. In future work, we also plan to explore the experiences of appreciation and feedback exchange among exercisers, which was an opportunity that was not fully explored in this study.

Design Implications: Future designs should provide a bridge to better communication between the instructors and the exercisers. Zoom provided some opportunities for two-way street communication, but more support is needed to help the exercisers to understand the benefits of their feedback to the instructors. For instance, future designs could encourage exercisers to give acknowledgment to the instructors to help them feel appreciated and reassured.

5.3. Extending range of interactions

We found that the opportunities of having some level of social interactions was one main reason why the instructors chose to use Zoom, and why the exercisers chose to participate in Zoom exercise classes. However, there is still a lack of support to carry over different forms of interactions from the in-person classes. Also, the online exercise brought more stakeholders (i.e. other household members) into the experience, which presented new challenges and opportunities for design to improve.

5.3.1. Support social interactions in a more nuanced way

Our findings identified the preferences of using the communication features on Zoom. There are only two modes of conversations on Zoom, fully public or private. The public mode of Zoom communication was great to learn about others' backgrounds, but it also eliminated the opportunities to have private or semi-private conversations.

Previous work has proposed suggestions to help participants to feel a sense of co-presence through direct or indirect interactions in the online learning environment (Joyner, 2020). For instance, providing aggregated performance to help students understand how others were performing in the class. This approach aimed to enhance the visibility of others while requiring less effort from the students. This approach is appropriate for large-scale online communities where direct interactions are not as feasible. Unlike the large-scale online formal learning context, this scale of the online exercise classes is much smaller, which presents opportunities to engage in direct interactions, and some exercisers would like to have more direct interactions.

Studies in the exercise context tested the effect of public displays of heartbeats in a jogging group (Mauriello et al., 2014), tested direct support messages (Chen et al., 2017), as well as a public discussion forum (Mailey et al., 2016). These studies tested different types of interactions in exercise groups. However, we argue that all modes of interactions: indirect, public, semi-private, and private have their pros and cons which can be used to satisfy different needs. For instance, the exercisers got to feel a sense of togetherness through the visual cues of other exercisers' movement, they got to learn more about others in the online environment due to the full public conversations, they miss the opportunities to have multiple conversations happening before they wait in the lobby, as well as to engage in casual conversations on 1:1 basis due to concerns of privacy.

Design Implications: Future designs should provide support to engage in different forms of interactions including making the semi-private and

private interactions available, as well as allowing engagement of other household members while protecting their privacy. For instance, designs should allow exercisers to have multiple conversations and to easily accessible space for private conversations among exercisers.

5.3.2. Supporting boundary and engaging others at home

The convenience of staying at home was enjoyed by many exercisers and instructors, but concerns arose regarding personal space and shared space with household members. This finding echos to previous studies about how the boundary between work and life were blurred in the online learning context (Chen et al., 2021). Students in digital fabrication classes needed to take others' schedules into considerations while planning for their tasks (Benabdallah et al., 2021). For children at elementary school age, their parents became more involved when the school moved to a virtual environment (Cumbo et al., 2021). In this case, the boundary was not only blurred, but more stakeholders were involved in this context. Parents faced more challenges in supporting their children at home. Similar to these contexts, the exercisers also needed to take their household members' schedules into consideration when planning their exercise schedule. For instance, the exercisers were concerned that having the camera on would invade the privacy of the household members. However, besides the challenges, we found that some exercisers took the advantage of the context and engaged other household members to stay active with them. Thus, there could be a way to turn the constraint around and utilize it as an opportunity. For instance, an exerciser could be a role model to her daughter and can help her to stay active.

Design Implications: Designs should make the opportunity more visible to engage other household members for those who would like to take advantage of it, while also helping to reduce the risk of privacy concerns for those who do not want to be engaged. For instance, the platform can acknowledge the exercisers by presenting encouragement such as "You are not exercising just for yourself, you are also exercising for your children in the next room." Hopefully, it will help them to realize the possibility to have an impact on their families' lives and help more people to stay active. The platform can also provide blurry filters that blur out the background of the exerciser, so others can only see the exercisers themselves clearly.

6. Limitation

This study was conducted during the Covid-19 global pandemic. The exercisers' practices and needs to interact with others may be influenced by this context. However, we did find a continued interest in participating in online group exercise classes after the pandemic ends. The insights from this study can be expanded to understand online group exercise classes during other times. Moreover, the participants from this study were all from the United States. The findings might not be transferred to other cultures. Future studies can further investigate the practices of online group exercise in other cultures. This study only interviewed exercisers and instructors who attended the online exercise classes. We found challenges and opportunities from participants who had at least some experiences with the new format. Future study can recruit exercisers or instructors who did not try any online group exercise classes, and understand what stopped them from transitioning to the new format.

Conclusion

We conducted interviews with 13 exercisers and 11 instructors who participated in online group exercise classes hosted on Zoom to understand exercise experience in the emerging online group exercise context. We identified different types of social interactions in online group exercise classes, as well as how technology influenced participants' social interactions. We reported an increase in responsibilities that the instructors took on. Also, the online context expanded the stakeholders

involved in the social interactions. We contributed to the HCI community by presenting how social interactions occur with the influence of technology in the online group exercise context, reporting the challenges and opportunities in transitioning social interactions from in-person to the online context, as well as proposing design implications to alleviate these challenges and realize the opportunities of the online context.

CRediT authorship contribution statement

Fanlu Gui: Conceptualization, Project administration, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Chun-Hua Tsai:** Supervision, Validation, Investigation, Writing – review & editing. **Alexis Vajda:** Formal analysis, Writing – review & editing. **John M. Carroll:** Supervision, Validation, Investigation, Resources, Writing – original draft.

Declaration of Competing Interest

None.

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