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YAMOVE! A MOVEMENT SYNCHRONY GAME THAT CHOREOGRAPHS SOCIAL INTERACTION

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Abstract: *This paper presents a design case study of Yamove!, a well-received dance battle game. The primary aim for the project was to design a mobile-based play experience that enhanced in-person social interaction and connection. The game emphasized the pleasures of mutual, improvised amateur movement choreography at the center of the experience, achieved through a core mechanic of synchronized movement. The project team engaged techniques from the independent ("indie") game development community that proved valuable in tempering the constraints to which technologically driven design can sometimes fall prey. Contributions of this work include (a) presentation and discussion of a polished digital game that embodies design knowledge about engaging players in mutual physical improvisation that is socially supported by technology, and (b) a case study of a design process influenced by indie game development that may help others interested in creating technologies that choreograph pleasurable intentional human movement in social contexts.*

Keywords: *technology-supported social play, meaningful and natural movement-based interaction, suppleness, sociospatial context, sociotechnical design, indie game development.*

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INTRODUCTION

Our research team is interested in expanding the social and emotional palette of everyday experience with technology—rethinking and redesigning the ways in which technology augments what people do together in more supple and graceful ways that better support physical and social engagement. We have found games and play to be a fruitful area in which to operate. The design of games and the development of gaming technologies privileges in-the-moment experience and allows for the deep relevance of positive emotional and social experience in evaluating success (Isbister, 2010; Isbister & Schaffer, 2008). Games are meant to be fun, thus good games have structural characteristics that promote the experience of fun, as has been noted by well-regarded sociologists and psychologists (e.g., Csikszentmihalyi, 1990; Goffman, 1959).

This paper presents a case study of the design of a particular game: Yamove! The project began in collaboration with Yahoo Research scientist Elizabeth Churchill, who was interested in exploring novel ways to use mobile technology and services to enhance in-person social interaction and connection. Our group had already been investigating the potential of physical play to encourage in-person social connection (Isbister, Rao, Schwekendiek, Hayward, & Lidasan, 2011). We therefore submitted a proposal to Yahoo Research to create a game prototype exploring the experiential potential of copresent movement-based social gaming. The target use scenario was casual play that would be accessible to a wide range of participants. Our goal was to create an experience that could support in-person social engagement between friends and families, as well as facilitate social connection among people who were less familiar with one another in contexts such as conferences or game exhibitions. Ideally, the game would be playable by a wide range of people of varying ages and movement capabilities.

The Yamove! project was originally meant to span half a year, culminating with in situ testing of the game in social settings such as academic conferences and company team retreats. What actually transpired was an 18-month process that deeply engaged independent ("indie") game development and playtesting strategies, leading to a final play experience that surpassed initial ambitions. Yamove! was featured at NYU Game Center's No Quarter exhibition. It was also an IndieCade finalist (the premier peer-reviewed venue for independent games in the United States of America). The game was also written up by game cultural critics (e.g., Narcisse, 2012).

What follows in this article is a description of the design process that led to this positive public reception. The case study draws attention to issues that arise when designing complex interplays of humans and technology in movement-based sociotechnical systems and highlights helpful work practices to address these challenges. Thus this case study can have value for researchers and practitioners interested in choreographing human–technology interaction both within and outside game contexts.

BACKGROUND

There is extensive research and design literature to draw upon concerning the shaping of rich physical and social experiences in collocated games (e.g., Bianchi-Berthouze, 2013; Hummels, Overbeeke, & Klooster, 2007; Isbister, Karlesky, & Frye, 2012; Isbister, 2011; Isbister et al., 2011; Johansson et al., 2011; Lindley, Le Couteur, & Berthouze, 2008; Mueller et al., 2011; Mueller, Gibbs, & Vetere, 2010; Mueller & Isbister, 2014 Simon, 2009; Tholander & Johansson, 2010). New technologies introduced within the last 10 years, such as movement sensors, have facilitated social and physical play, opening new markets and inspiring much research (Márquez Segura & Isbister, 2015). Yet, the dramatic initial public enthusiasm for commercial motion games seems to have dissipated over time (Moscaritolo, 2014; Tanenbaum & Tanenbaum, 2015).

Some researchers attribute this loss of enthusiasm to the constraints inherent in the technologies that were released, which narrowed the space of possibilities for movements and social dynamics (Benford et al., 2005; Loke, Larssen, Robertson, & Edwards, 2007; Márquez Segura, Waern, Moen, & Johansson, 2013) or "instrumentalized" the body too much (Höök et al., 2015). Other researchers point out that the typical technology-oriented approach to this design space omits important interactional issues (O'Hara, Harper, Mentis, Sellen, & Taylor, 2013; Tanenbaum & Tanenbaum, 2015). Trying to solve the representational problem of movements by focusing solely on being able to sense and model movements as accurately as possible (O'Hara et al., 2013) may not result in a better overall experience. Also, letting technology constraints overly determine the design process can lead to considering bodily aspects too late in the design process to make substantial changes (Tanenbaum & Tanenbaum, 2015). Limitations of a technology-oriented design approach are likely to be at least partially responsible for the dearth of examples of successful commercial movement-based social games that work well in a collocated social space.

Another facet of designing systems to support physical and social play is the social context where play takes place. Researchers have worked to understand how social context influences play and the play experience. Drawing from social psychology, research has shown how the sociospatial context influences the engagement of players, their excitement, and their perception of fun (Mandryk, Inkpen, & Calvert, 2006; Ravaja et al., 2006). It also impacts players emotionally (Jakobs, Manstead, & Fischer, 1996; Manstead, 2005). Finally, it shapes their perception of themselves, positively and negatively (De Kort & Ijsselsteijn, 2008), which, in turn, relates to players' performance (De Kort & Ijsselsteijn, 2008; Jakobs et al., 1996).

This stream of research has improved understanding of the social affordances of situated interactive play (De Kort & Ijsselsteijn, 2008; Jakobs et al., 1996; Magerkurth, Engelke, & Memisoglu, 2004). Yet there is still very little work that uses this knowledge as a generative tool for design (Márquez Segura et al., 2013). Yamove! is an example of a game that directly builds upon this body of literature.

METHOD

The work presented in this article lies at the intersection of design-oriented approach and research-oriented design (Fällman, 2003). The ultimate goal of the project reported here was to create a collocated social game that worked well for players; hence, the research conducted mainly targeted the refinement of the game application (research-oriented design). However, the iterative design process also yielded interesting insights that are applicable not only to the game design at hand but also to others in a similar design domain, which is characteristic of design-oriented research (Fällman, 2003). These insights are grounded in the empirical material, as well as in underlying theories, and are presented in this article in the form of design values and takeaways.

The design-oriented research process followed in this project resembled the classic iterative design process (e.g., double diamond design process model, n.d.). This process is characterized by alternating design loops, each involving a phase of divergence and one of convergence. In the former, several design aspects are considered, some of which are later implemented and tested in the convergent phase. Ensuing design loops further refine and polish the design.

The design process in Yamove! was characterized by rapid design-iteration loops, which meant frequent playtesting sessions. During the course of the project, nine playtests involving people outside the research team were conducted, as well as many regular internal playtests. It is not possible in the scope of a journal article to present the participants and procedures for each of these playtests in detail. Instead, an overview of methods used is presented here. Playtests generally took the form of informal evaluation sessions in which participants (internal to the group, or external) played the game and provided feedback. Playtests can be grouped into the following categories:

- Purely internal testing. Our project team playtested the design periodically throughout the process and intensively (i.e., every week) for several consecutive months.
- Lab-based testing. We staged events and conducted invited play sessions with external playtesters from the lab.
- Semipublic venue testing. We brought the game to design-testing environments where designers bring games in development for evaluation.
- Public exhibition. We brought the game to events where the public was encouraged to experience works in progress.

Data collection at each playtest included questionnaires distributed to the players, as well as informal interviews. (The latter were also conducted during demonstrations of the final design.) Both survey methods involved a mix of targeted questions (many in the form of Likert scale items on, e.g., the level of enjoyment or fun) and open-ended questions (e.g., eliciting strengths and weaknesses of the game, suggestions to improve the game). In addition, the playtest sessions were video-recorded for later analysis.

The video analysis performed was influenced by ethnomethodological approaches in sociology, such as conversation analysis (Atkinson & Heritage, 1984; Liddicoat, 2007) and interaction analysis (Jordan & Henderson, 1995). Thus, we focused on analyzing the sequences of actions and on details of the face-to-face social interaction in a fine-grained manner, such as the mechanisms that players used to accomplish joint action. For this, basic proxemics measures were noted (e.g., bodily orientation, distance between players and between players and screen, players' gaze; Marquardt & Greenberg, 2015). Finally, the video analysis used Laban Movement Analysis (LMA) to note basic information about the types of movements performed and their qualities (Guest, 2005; Newlove & Dalby, 2003).[1]

Two primary guiding design values framed the Yamove! design process from the beginning: suppleness and natural movement-based interaction. These were taken from our prior experience researching and creating games and other technology-mediated experiences to support social interaction. We also drew from others' findings in the domain of movement-based interaction.

Suppleness

Isbister and Höök (2009) previously introduced suppleness as a use quality to help guide the design and evaluation of interactive technologically mediated experiences. Suppleness is characterized by

- Subtle social signals. A supple interface is one that enables and possibly enhances subtle social signals that users engage in. A supple system could be viewed as a social/emotional ‘‘dance’’ with the end user.
- Emergent dynamics. A supple system fits smoothly and gracefully into a person’s social and situational context as he/she acts and interacts with the system. The system is able to adapt to and enable human improvisation.
- Moment-to-moment experiences. Supple systems privilege the quality of moment-to-moment experience in terms of both the design and the user’s evaluation of design’s success (e.g., a focus on engagement, pleasure, rapport). This requires flexibility in establishing the exchange between user and system.

Meaningful and Natural Movement-Based Interaction

Because we wanted to encourage and enable successful amateur movement choreography (i.e., improvised brief moves performed easily and successfully together), our work on Yamove! was also shaped by the guiding value of enabling meaningful and natural movement-based interaction. In our research, *natural* does not refer specifically to movements typically found in everyday life. Rather, it refers to movements that are easy to learn and execute and do not feel so awkward or arbitrary that they detract from the experience. Many scholars discuss the concept of natural interaction (Buxton, 1988; Isbister & Mueller, 2015; Norman, 2010; O’Hara et al., 2013; Saffer, 2009; Wigdor & Wixon, 2011). Although there is no commonly accepted definition of what *natural* means (O’Hara et al., 2013), the guidelines in Wigdor and Wixon (2011) were found helpful in shaping the movements parameters for Yamove! Some key guidelines are to

- create an experience that feels just as natural to a novice as it does to an expert user,
- create an experience that is authentic to the medium, rather than purely mimicking real world motions and interactions,
- build a user interface that considers context, including the right metaphors, visual indications, feedback, and input/output methods for the context,
- avoid simply copying existing user interface paradigms,
- leverage the user’s innate talents and previously learned skills,
- consider the context of use carefully (including spatial and sociocultural factors), and
- be mindful in social contexts of the need to support multiple people working closely and collaboratively together toward a common goal.

RESULTS AND DISCUSSION

Because of the iterative nature of the Yamove! design process, our results and discussion are presented together in one section. Appendix 1 provides a table with a complete timeline of all playtests, together with brief details of each venue, version of the game, players, and method, as well as a summary of the main observations and points for action. The table highlights the experiential qualities and observations related not only to the design of the application, but also to the particularities of the settings where Yamove! was playtested.

What follows here are highlights that illustrate the evolution of the design process and thinking on the project, providing the most relevant information for others in the research and design community. We will gladly provide more information to interested readers about any of the playtests that were conducted. Results are presented in two design phases. These phases were not planned ahead of time but rather reflect two distinct mindsets regarding the design process. The second phase was marked by the inclusion of a new team member and accompanying new ways of working (described in greater detail below).

Phase One: Playtest, Iterate, Exhibit

The first version of Yamove! was a cooperative, two-player game app for iOS devices such as the iPhone and iPod.[2] Players launched the app and then were instructed through on-screen text on their mobiles to quickly choreograph and perform a move together—a set of motions tracked by the mobile devices' accelerometers. They were prompted by a suggestion, such as "Make it Rain," and then had to perform this move simultaneously and as similarly as possible during a short, timed round; they could communicate verbally and nonverbally to achieve this. Players were scored on how well they synchronized their moves, with some upward adjustment of their score based on keeping up movement intensity. Figures 1 and 2 show a screen-by-screen overview to give the reader a detailed understanding of interaction flow for Yamove! 1.0.

The initial research plan was to playtest this prototype and make refinements to the game, with the goal of conducting a public exhibition a few months later. The first public playtest was held at Eyebeam, an art and technology gallery in New York City. Thirteen people agreed to try the game[3] (see Figure 3). We made video recordings of these play sessions and players completed a brief Web-based survey about the game afterward. In addition to general questions about the gaming experience, this survey included questions aimed particularly at providing social support

Figure 1. Screenshots of the steps taken to initiate play in Yamove! 1.0. Players first launch the app, then pair their devices. Next they select a movement prompt (Make it Rain or Disco Inferno—see first screenshot). Then they see more details about that movement prompt (second screenshot). If they have decided this is the movement prompt they want to use for improvisation, they click "We are ready." At the next step, players click "Start countdown" to begin their movement session. The last screenshot shows the time clock running down while the players are moving together during the play round.

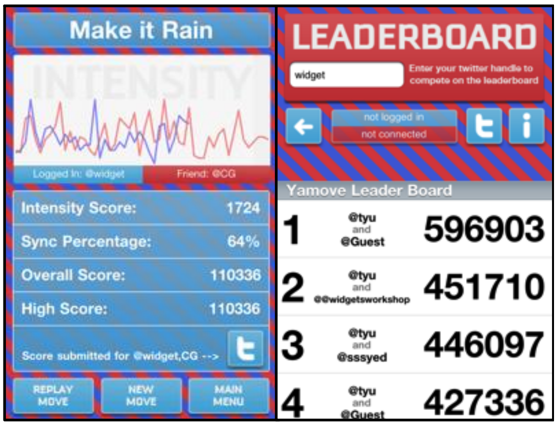

Figure 2. Further screenshots of the Yamove! 1.0 interface. When the round is over, players see the game results screen on the left, which includes their intensity score, sync percentage, overall score (i.e., the intensity score multiplied by the sync score), and a detailed graphic showing the intensity data for both players in different colors. The right image presents a leaderboard, reachable from the Main Menu, which gives a list of the top 10 all-time scores from any pair of players who has ever interacted with the game.

Figure 3. First playtest of Yamove! 1.0 at Eyebeam. Though players reported enjoying engaging in the joint performance, once they began and were able to synchronize improvised movements (see left image), the moves appeared somewhat socially awkward (see, for example, right image).

for gameplay. In their responses, players noted some usability issues with the game's interface and some issues with the deployment of the game, especially in terms of setting up game sessions and in understanding scores. Overall, they reacted positively to the central activity—choreographing movements together. Video data provided evidence of laughter and engagement; survey responses included comments such as, "*We had fun moving together and sharing enthusiasm for the game*." There were many suggestions for providing better social support within the game. For example, players suggested adding a location-based system that could alert a player when another potential player was nearby. They also suggested providing social rewards, such as a buddy pyramid system displaying the evolution of social connection with dancing partners. They also recommended adding public scoreboards that could be shared on platforms like Twitter and Facebook.

Considering the project team's guiding design values of suppleness and naturalness, we found a mix of positive and negative takeaways from this playtest. Players were readily able to improvise together and visibly enjoyed it; thus the central activity of making up moves was working well. There were user-requested changes aimed at improving the flow of the application itself. Upon reflection, the core game experience appeared somehow socially awkward.

Onlookers were not entirely sure of what was going on, and each player pair needed to be coached on what to do, at least to start. The game did not seem to encourage ready participation through observation. As a result, the research team thought that adding social support features within the app could help to address this.

The next iteration of the game integrated a Twitter-based leaderboard that could be accessed via the Web, to encourage extended social interaction around the game. Further, the graphics and interaction processes were streamlined and modified to address some basic usability issues. The team worked toward a summer release of the game on the app store, along with some public displays and feedback. Someone connected with our lab noted an upcoming event at a local indie games collective, F*%k the Screen, which was focused on collocated social play experiences. As the name of the event suggests, the theme of the curated collection of games was play experiences aimed at avoiding the typical gaming situation in which people sat and stared at screens without interacting closely with one another. The event organizers offered to include Yamove! in the event.

The game was demoed there for several hours alongside other featured games. Attendees could move freely between all the games, playing whatever they liked for as long as they liked. In this environment, the problem of social awkwardness identified in the first public playtest was even more pronounced, despite the addition of the Twitter leaderboard. Playtesters had to actively recruit players and walk them through what they needed to do. In contrast, large enthusiastic crowds formed around other games at the exhibition.

From observing and analyzing the differences between Yamove! and other games available that night, the research team had two insights about what Yamove! seemed to be missing. First, Yamove! was not a legible spectacle in the sense that it was not addressing the broader set of people in the room—observers and potential future participants (Reeves, 2011; Reeves, Benford, O'Malley, & Fraser, 2005). New players of other games at the exhibition were readily able to sort out what to do by observing the players' actions, and the performance of the game was an engaging spectacle in and of itself. In Reeves et al.'s (2005) terminology, the other games included "expressive interfaces" in which actions and effects were clear to the audience. Playing in a public setting is always also a performance (Dalsgaard & Hansen, 2008; Reeves, Sherwood, & Brown, 2010), and the other games at the event included design elements that presented play as performance and spectacle for the audience better than Yamove! did.

The second insight was that, even though the exhibition was organized as a rebellion against overreliance on screens, all of the games except Yamove! made use of a large shared screen as one component of the player feedback system. The exclusively small-screen interface for Yamove! meant that players spent significant time looking not at their coplayer but rather at their individual devices to take actions and figure out what was going on, which negatively impacted gameplay. Moreover, this made Yamove! less transparent to spectators and therefore less apt to generate and maintain collective attention. These two insights also led us to identify and incorporate a third design value moving forward: designing technology-supported play in a sociotechnical space of affordances.

New Guiding Design Value: Technology-supported Play in a Sociotechnical Space of Affordances

Márquez Segura and Isbister (Isbister, 2012; Márquez Segura & Isbister 2015; Márquez Segura et al., 2013; Mueller & Isbister 2014) and many others (see, e.g., De Kort & Ijsselstjein, 2008; Ducheneaut, Yee, Nickell, & Moore, 2006; Voida & Greenberg, 2009; Zangouie et al., 2010) have been researching and designing social play experiences that are augmented by technology. In the course of our research, however, an important design value emerged: technology use to support rather than entirely sustain social interaction and play (Isbister & Mueller, 2015; Márquez Segura, Turmo Vidal, Rostami, & Waern, 2016; Márquez Segura et al., 2013). This concept comes originally from Waern (2009). The intention is to use technology as one of many elements in the service of the overall target experience for players. Tholander and Johansson (2010) noted how a game experience sustained only by the technology can result in a very artifact-focused interaction, with everyone's shared attention fixated on the technology rather than one another. As the design of Yamove! moved forward, we wanted to make sure to support and sustain the players' mutual attention and their and the prospective players' (i.e., spectators) engagement.

As pointed out in Márquez Segura et al. (2013) and De Kort and Ijsselstjein (2008) regarding designing social games, it is important to include sociospatial elements as design material. Such elements involve, for instance, the spatial configuration of players, assigned roles for players and spectators in enacting the game, physical artifacts, and the play space itself. Hence, the technology is only one among many elements that are orchestrated in the final design of the play experience. But if the technology is just one designed element, what else could and should be designed?

De Kort and Ijsselsteijn's (2008) concept of sociospatial characteristics emerged as a useful frame for understanding the influence that contextual physical and social circumstances have on play and the play experience in Yamove! This concept relates to Dourish's notion of space, as presented in his book *Where the Action Is* (Dourish, 2001). Both of these texts point to how social and spatial features create a space for interaction with sociotechnical affordances that shape interaction. Elements such as the presence and position of others in relation to the user, everyone's bodily orientations, and the surfaces and digital and physical objects present in the activity shape the perceived affordances for action, and hence behavior. As Dourish put it,

> "Space" is largely concerned with physical properties (or metaphorical physical properties). It concerns how people and artifacts are configured in a setting, how far apart they are, how they interfere with lines of sights, how actions fall off at a distance, and so on. By configuring the space in different ways, different kinds of behaviors can be supported. (Dourish, 2001, p. 89)

But behavior is also influenced by the designed aspects of the game itself, such as the rules and goal of the game, the roles of the players, player interaction patterns supported in the game, and particularities of the game interface, such as input/output mechanisms and controllers. All this shapes the social affordances of the situation (De Kort & Ijsselsteijn, 2008), as they "allow for social interaction processes such as awareness, monitoring, mimicry, reinforcement, verbal communication and nonverbal immediacy behaviors (i.e., approach behaviors that reduce psychological distance (Mehrabian, 1981)" (De Kort & Ijsselsteijn, 2008, p. 5). Both the sociospatial context and social affordances form the "sociality characteristics" of a game, a term that De Kort and Ijsselsteijn (2008) borrowed from Jakobs et al. (1996), and which in turn impacts the play experience.

Phase Two: Re-envisioning and Iterating Using an Indie-Influenced Design Process

Working with our new guiding design value, we made the decision to focus further on the in-person social context for gameplay, rather than supplementing one-on-one interaction through social media interventions such as the Twitter scoreboard. We invited Syed Salahuddin, one of the founders of Babycastles,[4] the organization that had curated the F*%k the Screen event, to collaborate with us on reimagining the game in a way that better supported copresent social interaction and engagement.

In addition to design insights, Syed brought a work practice to the project derived from his experience in the indie game development community. As others have observed (Simon, 2009, van Best, 2011), indie game design follows a participatory-culture-like bricolage approach. Indies also make use of a bottom-up crafting approach to design and development, working from materials and skills that are ready-to-hand rather than beginning from user/player needs and use cases (Westecott, 2012). This shifted our subsequent design practice toward these ways of working, including

- a design and development process shaped and focused through frequent reference back to the target aesthetic experience for players;
- a more crafts-like view of technology as the means-to-the-end experience and with a willingness to revisit (and abandon, if necessary) technologies and designs that were not working well in serving the desired player experience;
- a design process that considers the social, spatial, and cultural context as design material;
- a multifaceted participatory culture approach to playtesting and iteration, with frequent internal testing, critical workshop sessions with peers, semipublic peer critique, and continued refinement through public exhibitions; and
- pushing design and development toward a high degree of polish through repeated exhibitions, culminating in peer-reviewed exposure of the work itself.

These process techniques proved to be very supportive in achieving the design values we had set for ourselves in moving forward on development.

In brainstorm sessions following the F*%k the Screen event, Syed suggested a better framing for the core synchronous movement mechanic by embedding it in a classic b-boy style dance battle.[5] Making the game into a dance battle had the potential to address two major problems that surfaced at the exhibition: It would make the gameplay more legible and comprehensible to spectators, and a face-off between two pairs of dancers would provide better direction for the collective attention of players and spectators. B-boying is highly improvisational in nature, so this frame was a good fit for the amateur choreography activity already in place. Syed also proposed the use of a large shared screen to post information about the players as they danced so that they and the spectators could get a sense for who was dancing better during the ongoing round and to increase excitement and suspense.

These ideas resulted in radical changes to the design and the technical infrastructure of the game. The final version of Yamove! is a four-person dance battle game, with two pairs of players alternating in performing improvised moves over three rounds[6] (Figure 4). Instead of reading a text description of moves to perform, players make up their own moves to music that is curated by a live MC (Master of Ceremonies, a term used in the dance battle culture).

Each player uses a dedicated mobile device, but we constructed a means for the device to be strapped onto the wrist to make free movement easier (Figures 4 and 5). The two pairs face off on a dance floor in front of a large screen that is designed as part of the game. This screen updates how the players are doing both within and after rounds (Figure 6). The mobile device interface was greatly simplified to minimize the amount of time that players would need to look at the small screen (see Figure 7). In practice, players are not expected to look at the in-game countdown nor at the large screen during play because they are receiving verbal feedback from the MC about how they are doing during and after rounds.

From a technology perspective, the game is no longer packaged as a pure mobile app. Instead the game is played using a combination of software. There is still a mobile app that each

Figure 4. The 2.0 version of Yamove!, shown during the World Science Festival public exhibition. The dance space was demarcated by colored areas on the floor, and dance pairs faced one another in front of a large shared screen. The MC worked at a table to the right, selecting music and calling out instructions to players. The left figure shows how the dedicated mobiles were worn on the players' wrists, while the right figure shows a full dance battle with the teams facing off.

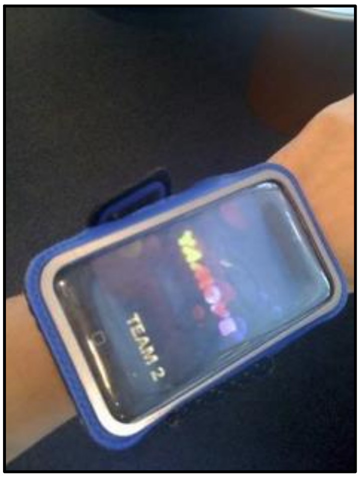

Figure 5. In the 2.0 version of the Yamove! game, the dedicated mobile device was worn on the wrist in a holster secured over a sweatband.

Figure 6. During Phase 2 in the development of Yamove!, a large shared screen was added to the gaming environment. The left screenshot shows feedback on the active team's progress during the round. When the round was complete, the right screenshot provided each team's dance outcome in regards to creativity (variation in moves), intensity (speed of moves), and synchrony of moves, all as calculated by the device.

Figure 7. Screenshots of the mobile interface for the 2.0 version of Yamove! that the active player pair would see during a round. Left, the mobile's screen indicates which team is currently active. The second left screenshot shows a quick countdown toward the beginning of the active team's dance round. The center screenshot indicates the countdown of the seconds left in the active team's round. The screenshot in the 2nd to right position provides a play-in-progress screen that bridges the end of the round and the display of the calculated score for the active team. The right screenshot displays a simplified final score screen. The 60 is a rating from 1 to 100, derived from a weighted combination of the three scoring factors (see Figure 6 for those factors).

player launches, but the dance rounds are controlled with a moderator app driven by an iPad interface. There is also a Web-server-based display app used to drive what is shown on the large shared screen. The moderator app was implemented on an iPad for easier managing by the MC or another operator.

The final version of Yamove! is an engaging experience for both players and spectators. The player's attention is focused on his/her partner during the dance round or on the competitor team, instead of on the small screen. The dance battle is a social frame that works for players and spectators, and well-curated music and artful emceeing creates a lively and festive atmosphere for play. Staging the game involves other atmospheric elements to heighten the sense of a dance battle, such as dance platforms and lights. The core coimprovisational amateur choreography activity that was fun and well-received in the first version of Yamove! remains, with additional social framing to make the performance comprehensible in a social sense and workable as an engaging spectacle. Feedback to players and spectators is optimized in managing attention so that the spotlight is on the players and their moves.

What follows next are some highlights from the iterative design process in the second phase of development that took Yamove! to completion. We have organized the results and discussion from the extensive series of playtests in Phase Two around three overarching design themes: optimizing feedback for social suppleness, from mobile to wearable, and shaping the social atmosphere.

Optimizing Feedback for Social Suppleness

The design team made many large and small changes to Yamove! to optimize in-play feedback for players, thus creating maximal suppleness in social interaction. For example, the metaphor of the b-boy dance battle led to the insight of adopting of a human MC to give players instructions and feedback. In the first implementation of the MC concept, an automated voice was used to vocalize tips for improving the scores presented on the shared screen (and tested in the Halloween lab and the playtests at Parsons; see Appendix). However, players had difficulty discerning this verbal feedback over the music. Then, during a weekly internal playtest at the lab, the design team experimented with calling out instructions over a microphone and discovered this improved players' understanding and ability to adjust to during rounds. The game was revised to include a live MC role.

During weekly internal playtests, we compared Yamove! with a commercial dance game, Just Dance, to see whether Yamove! produced observably more supple social interactions. Twenty students in a Human Computer Interaction class at our university[7] took part in an exercise in which each student tried out each game for one round. Conducted in our user research lab, the test allowed students to choose their partner for each round of Yamove! gameplay and when to step in for a battle. For the Just Dance play, songs were selected that allowed four players to dance at once, with each student taking part in dancing through one song. This test was videotaped, and we analyzed the interaction patterns that emerged.

Just Dance is a Kinect-based game in which dancers line up and try to mimic the dance moves modeled by an on-screen avatar (see Figure 8). Players must closely watch the avatars in order to make sure that they are keeping up with the moves. Each player has an individual score, so the reward mechanism is very different than the team-based score in Yamove!

The Yamove! version tested had a only single round, but we had already integrated the big screen feedback and the MC role. We expected that Yamove! would result in more player and spectator attention on the dancers rather than the screen, which is what we found. With Just Dance, the players and audience primarily stared at the screen throughout the round. However, Yamove! players usually were looking at the opposing team, one another, or sometimes at the spectators; the spectators mostly watched the dancers. Sometimes, when the pair was not actively dancing, they looked at the scoring on the screen or at the MC; other times they would rehearse and not pay attention to the active round.

In this particular test of Yamove!, in addition to the MC, we had a dance model performing moves that the players could imitate if they wanted. Our analysis showed that a slight majority of

Figure 8. Just Dance, a Kinect-based dance game, requires the player to imitate the moves of an on-screen avatar.

Yamove! players (6 out of 10 pairs) would take up the suggested move, but some would then give it a twist (4 out of 6 pairs). For example, the dance model might call out *Swim!* and show the players a breast stroke, but the pair would end up doing the crawl stroke together instead. As the round proceeded, half of the pairs danced moves not suggested by the dance model. At this point their attention was focused on one another. The data show that, typically, one person would initiate moves in leading the dance and the other would adapt to these moves. The leader then readapted moves based on what the two could pull off together. This process led to close mutual attention upon one another, one of the goals of our core game mechanic. Sometimes the leader looked out at the audience as she/he improvised, seeming to gauge the crowd reaction to a particular move. With one dancer, this came at the expense of turning his back toward his partner, but this was atypical. Overall, four pairs seemed to primarily mirror the dance model; four pairs seemed focused on one another, with one person as the clear leader; and two pairs were so in sync that it was difficult to tell who was leading. Interestingly, these same two pairs also did the most rehearsal before their rounds.

At the end of a Yamove! battle, most eyes would turn to the screen to see the final tally, but during the action, the focus was on the dancing itself. The Yamove! feedback system was working to keep spectator attention on the dancers and to keep dancers' attention on one another. Both actions demonstrated the increased overall suppleness and social engagement of the experience.

An unexpected result was that the quality of the movements was quite different between the two games. Yamove! movements were less jerky, more smooth, and more complete and graceful than moves performed with Just Dance. Therefore, the Yamove! dancers made for a more enjoyable spectacle and a greater appearance of mastery. Most Yamove! pairs (7 of 10) used primarily upper body movements, with less footwork. Their moves were large scale and determined looking and more fully and frequently synchronized, with only one pair performing vague and imprecise movements. Movement changes were caused both by the dance model giving a new cue (aimed at allowing pairs to improve their diversity score) and by one of the dancers spontaneously doing a new move. Yamove! players were able to improvise moves they could do well and could set the pace for their moves; adjusting as needed to one another's performance helped make each look good. Thus, Yamove!'s feedback systems had the added benefit of enabling more supple individual dance performance.

The Just Dance play was structured very differently. Although the game presented paired figures on-screen, suggesting teams, and the choreography often had moves designed to look good between a pair, the game scored each person individually and showed an individual winner of each round based on accumulated points. So the core game mechanic was really individual performance. Each group of four would choose a track to dance to, and each track had different choreography and imagery to suit the music. Silhouettes of dancers on screen were meant to map to the four players; the dancers needed to keep their attention on the screen in order to closely imitate what their own avatar was doing. Therefore, Just Dance player movements looked quite vague, indecisive, half-formed, and often a bit rushed, with an emphasis on the end pose or distinctive features of a movement rather than on the qualities and nuances of that movement. Most players were just going through the motions and trying to keep up, rather than putting a performative spin on their movements. Each round lasted for a 2- to 3-minute song and the choreography was repeated within the songs. Players seemed to perform moves with less intensity and enthusiasm as the choreographic moves came around again and again. Some of the moves were pretty easy for players to pick up—usually moves that were slow, had symmetry in the body, or used some anchoring reference in the song (e.g., drawing a star when a star was mentioned). Other moves seemed embarrassing to the dancers to perform (e.g., lying down and swinging one's legs). Players would simply skip these moves and wait for the next one. Sometimes this embarrassment seemed to be gender specific. For example, male players did not perform a sexy shoulder shake but the one female player did perform it.

Dance steps that required footwork or moving around on the floor were not fully executed. Players would shift their weight to mark these moves in some way but would not do the required detailed footwork. This could be due in part to the fact that the four dancers were crowded side by side to be within range of the Kinect. But, in general, complex moves were simplified as players focused on keeping up with the avatar on screen. Moreover, there was little in the way of mutual movement. Some of the on-screen choreography created pair focus, for example, with one avatar leaning in toward another, pretending to tell a secret. The dancers made half-hearted attempts at these maneuvers, but it was hard to execute them well.

Our conclusion from this comparative playtest was that we succeeded in engineering a better pair experience, as well as improving the social experience around the game. Yamove! pairs were more attuned to one another and produced more decisive and fully articulated movements together, which made for a more interesting group spectacle. The moderate use of the big screen did not seem to pull the attention away from the dancers, as what happened with the Just Dance players. Dancers were able to use the dance model as a starting point, but felt free to switch over to their own moves when it was comfortable, something impossible for players within the core design construct of Just Dance. In essence, Just Dance (and other games in this genre) forces players to adapt themselves to the on-screen avatar and prearranged choreography in order to succeed; players have no room or encouragement for individuation. And there is very little chance for any pair synchrony or bonding, given that everyone's attention has to be riveted to the screen at all times in order to keep up. No matter what was happening among the players, the onscreen avatars in Just Dance always overacted the moves they showed players with high enthusiasm. This could be off-putting to players if they were struggling just to master a move. In contrast, the human dance model for Yamove! could adjust suggestions for players, and the impromptu leader within the pair could further modulate these move choices to ensure the dance was achievable and enjoyable for both players. Although these adaptations might not have impacted the final score, which is based on intensity, diversity, and synchrony rather than complexity or precision, it improved the player and spectator experience. In essence, Yamove! had built-in flexibility to adapt to dancer ability and the general mood of the crowd.

The many changes we made during the course of the second phase of design dramatically increased the social suppleness of the game. The feedback systems, incorporating human feedback as well as machine feedback, and the judicious use of the large shared screen created a more engaged and connected experience for players.

From Mobile to Wearable

The final version of Yamove! positions a mobile device on the player's wrist in a holster that is worn over a sweatband. During the November and December playtests at Parsons, we noticed that players' movements seemed a bit awkward because they had to hold the dedicated mobiles. In the lab, a team member who used a mobile holster when jogging suggested trying out whether these could work for the game. Multiple trial and error play sessions led to the decision to put the holster on the wrist, with a sweatband beneath to hold it in place. In testing at public exhibitions, differently colored holsters were used to make it more clear which devices were paired for the dance battle. Strapping the holsters on was an exciting suiting-up ritual for game play and readily set players apart from spectators. Wearing the device in this manner also seemed to discourage players from engaging it as they would their own smartphone or iPod, making it less likely that they would poke at the small screen or fixate on the data and options available there. Instead, they limited their attention toward the mobile's screen to brief glances in between rounds to see their round score before it had made its way to the big shared screen. With the revised design, we essentially ignored most of the mobile's interaction capabilities, using it instead as a wearable sensor with a nice display screen. This was a radical departure from the Phase One design, and one that would have been very difficult to come to without using the indie strategy of bricolage and repurposing technologies and of freely adding unorthodox elements to get to the target aesthetic experience.

Shaping Social Atmosphere

Once we shifted to the dance battle frame for the gameplay, we began incorporating elements of a dance party into the design of the gameplay setup. For example, in the first playtest of the new concept, conducted at an open house party in the lab, we set up special lights, curated spooky dance music, and added a special Halloween splash screen for the app (see Figure 9). However, only a few people came to the party, and we ended up with stilted social interactions around the game—one or two people waiting for others to show up to play, lab visitors feeling awkward playing with one another, and pauses in the action as the equipment had to be restarted due to glitches. (In this playtest, we only had two devices that had to be reset between rounds, which took time and dampened enthusiasm.) This test demonstrated the need to carefully frame the experience for players, building excitement and enthusiasm through a well-paced experience. We also realized the game needed a critical mass of willing players in a social setting where they could feel comfortable dancing with one another.

Figure 9. The Halloween playtest had some, but not enough, of the social atmosphere elements for successful engagement by potential game players.

Our next two playtests were at Parsons/The New School. The first was for a Game Club night; the second was for an open playtest for designers in a graduate program. For these tests, we had four devices ready so the play was not delayed for resetting between pairs. We also introduced a list where people could sign up for a round with a friend, which also allowed them to prepare for participating. The outcome from both tests was encouraging: Players engaged the game with enthusiasm and, at times, it was difficult to get them to stop dancing at the end of a round. Several players reported feeling more energized and positive after playing. We attributed the smoothness in the flow of these playtests to the decision to explain the game in advance and to encourage participants to sign up for slots, which framed the experience for them ahead of time and created a steady flow of dance teams.

In early April, the team invited a group of b-boys and b-girls into the lab to try out the game (see Figure 10). They really pushed the capacity of the sensors with their extreme dance moves. Watching them play the game was exciting and dramatic. Because of their prowess, we invited them to demonstrate the game at a lab open house, helping other players see the possibilities in the game. We worked with them to commission an MC who could perform at two future upcoming public exhibitions, as well.

Figure 10. Two b-boys demonstrate synchronicity in Yamove! gameplay as part of a playtest by a group of b-boys and b-girls.

Later that month, we had the opportunity to bring the game to another Eyebeam playtest. We decided to attend even though all the party elements would not be in place for this test (e.g., lights, elaborate sound system). For the first time during a test of the game, a couple of teams started to do very vigorous calisthenic-style movements instead of dance moves. They exhausted themselves halfway through the rounds, resulting in a poor experience for the users. This outcome highlighted for us the importance of the social elements framing the best way to play the game.

The staging of the game at the final events (i.e., No Quarter, World Science Festival, and IndieCade) involved a live MC who was also mixing music, trained dancers who could help model moves, and excellent sound and lighting. The positive impressions that players of these final events had of the game benefitted from these carefully sculpted social atmosphere elements.

IMPLICATIONS FOR APPLICATION TO DESIGN

One key implication of this case study is the value of collaborating with individuals and communities of practice who bring complementary expertise to a complex design task. In our case, the task was choreographing human interaction in a sociotechnical space composed of digital, physical, and social artifacts and actors. This implication resonates with previous findings in design research (see Fällman's, 2003, characterization of design-oriented research as one that seeks to explore possibilities beyond current paradigms). For designers, this requires being open to adjusting stated design objectives as the project goes along and to supplementing familiar design methods with additional methods and strategies. As noted by Stolterman (2008), design complexity is of a special nature (compared to scientific complexity) because design problems are often underdefined, and because it is impossible to explore all possible options or achieve a unique optimal solution. This is known in design research as a messy or wicked problem (Buchanan, 1992; Rittel & Webber, 1973; Stolterman, 2008). A valid type of inquiry to address this type of complexity is to be open to adjusting the problem framing during the process, as possible design solutions are generated (Bardzell, Bardzell, & Koefoed Hansen, 2015; Fällman, 2003; Schön, 1984).

In the case of Yamove!, including Syed as a collaborator helped address the wicked problem of designing an engaging collocated social movement experience. Syed's indie way of working was a fresh influence on the project. He encouraged us to broaden the technological frame in service of the experience—weaving other devices into the project in addition to the mobiles and changing our way of working with them. We were encouraged to ruthlessly iterate the game and our vision as designers through extensive and robust playtesting and assessment, working toward a level of polish that enhances the experience. This polishing of the game experience requires attention to and enhancing not only the technology used but also the social atmosphere that surrounds the interactive game. This is an important design element that facilitates engagement of both players and spectators.

Another takeaway from this case study is the benefit of the design values outlined in this article: the guiding use quality of suppleness, the guiding value of enabling meaningful and natural movement-based interaction, and the guiding approach of using technology to support rather than entirely sustain social and physical interaction and play in a sociotechnical space of affordances. These can be of use in focusing the design of both game-based and nongame technological support of in-person social interaction. Of particular importance is highlighting the third value: technology-supported play in a sociotechnical space of affordances. Although adopted in the middle of the Yamove! design process, it served as both a generative and an evaluative tool for design, helping us to continually refocus on whether and how the technology supported the core experience and what other nontechnological design elements could be leveraged to reach our intended gaming experience.

CONCLUSION

We have presented a design and process case study of Yamove!, a technology-supported dance battle game. This paper clarified the evolution of our team's design values and methods as the process unfolded. Changes included adopting an additional guiding design value and engaging in a much more varied and frequent schedule of playtests, evaluations, and design changes in the second phase of the project. These shifts were heavily influenced by the addition of a new collaborator with a complementary design practice and community. Overall, the changes in approach helped us better achieve and refine the design challenge and guiding design values that were in place at the start of the project. The changes also led to a novel final design that differed dramatically from the original game, exceeding the design team's expectations in terms of player and critical reception.

Yamove! began as a mobile-only app to support in-person social play and evolved into a multiperson, multitechnology dance battle game that included a live MC as well as a carefully crafted social atmosphere. The final version of Yamove! works quite differently from commercial games such as Just Dance by embracing the three guiding design values for the project—suppleness, meaningful and natural interaction, and technology-supported play in a sociotechnical space of affordances. Yamove! frames the mutual choreography created by dance pairs to shape an engaging and enjoyable play experience and social spectacle.

The outcome of our team's game design process—from establishing and adapting, as needed, guiding design values to incorporating an open, collaborative, and iterative testing and redesigning process—offers key contributions for consideration in future game design research and practice.

ENDNOTES

1. To simplify the wording in this article, we have opted not to include specific terminology included in LMA.
2. This project was built upon an existing game prototype created by master's students at Carnegie Mellon University's Entertainment Technology Center (Miller, 2010; see also www.youtube.com/watch?v=Ald-24xdzvo&feature=player_embedded).
3. See www.youtube.com/watch?v=PZBPj3_ew60 for an edited sample of some of the playtest rounds.
4. Babycastles is an indie game developers collective based in New York that promotes a crafting culture in game design and that has a strong influence from the broader art community in New York. This collective advocates for the identification, support, and exposure of new game design voices around the world (See http://babycastles.com/about.html). Babycastles events are attended by arts and indie game experts and they typically include music, dimmed lights, and cheap beers.

5. B-boying is a dance form that evolved in the 1970s in New York City. It arose at the same time as scratching/mixing records and rapping, and the forms were initially intertwined, co-existing at parties of the era. B-boying emerged from showy dancing to the between-lyrics music on records that a dj would scratch and mix at a party (Gorney, 2009; Vibe, 1999). Most people associate the terms b-boying and b-girling with improvisational dancing down on the floor, including spinning on one's head. However, the classic forms of hip-hop dance that are a part of the overall genre—including styles such as up-rocking, popping, and locking—are performed upright.
6. See the final version of Yamove! at https://www.youtube.com/watch?v=cpZ28lr9BqI
7. NYU (New York University) Polytechnic School of Engineering in Brooklyn (http://engineering.nyu.edu/)

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Appendix

As a word of caution, although this table is ordered chronologically, design iterations did not always follow the stereotypical design-test-analysis-implement sequential order. Sometimes, quick system iterations took place before there was an opportunity to fully scrutinize material from the most recent playtest.

Name, Date, Test Type	Playtest Details	Findings → Insight
Move It! playtest February Semipublic test	Version: original app Venue: Eyebeam/COAP monthly playtest event Goal: uncover strengths and weaknesses of the app Players: Other game designers and the public; 13 participants Method: video recorded pair play, followed by a Web-administered survey that focused on general experience and details of the interface	+ Amateur movement choreography core mechanic pleasurable + Participants enjoyed making up moves. - Missing social context - Confusion about effects, in particular the scoring mechanism -Screen-focused interaction - Not enough flow to support the core mechanic (menus and setting hindered flow) → Design value: social frame
F*$% the Screen! event July Public exhibition	Version: Yamove! 1.0 with refined graphics and scoring. Social frame built using social media. Add-on layer to the game included a Twitter-like leaderboard and log-in feature for the players so that they could share the outcome of the game in their social media. Venue: Babycastles[4] public exhibition playtest (see Phase One for description). Goal: evaluate social frame Players: 10 Indie designers and aficionados Method: Video recorded play sessions as they occurred.	+ Fun for those playing + Core mechanic + Sought bodily orientation (i.e., towards one another) instead of towards a big screen, like other games in this event. - Not as compelling as other games at exhibition - Challenge in recruiting participants - Failed to provide a legible (understandable) spectacle for audience - Failed to manage collective attention well - Compared to the other games at the exhibition, game triggered less expectation, less curiosity, less engagement for players, and less rich physical and social experience. → Re-framing the experience as a dance battle → Inclusion of new team member from indie scene → Design value: technology-supported → Design goal: sociotechnical space
Halloween test October Semipublic test	Version: First tests of new dance battle theme and some elements (music, dance pairs, dance atmosphere). Activity socially-sustained in part by: (a) creativity score awarded by audience on white boards, (b) experimenter resetting and handling devices, and (c) players selecting music. Artifact-focused interaction addressed by giving tips for improving dance technique using an automated voice from the application. Venue: Halloween lab party test Goal: check the dance-battle theme. Test implementation of social context with a Halloween themed party atmosphere. Players: 9 Lab members and visitors/Parsons students	- Significant awkwardness in players joining the game - Particularities of the room (only one entrance) caused a bottleneck for attendees, which did not allow attendees to see the ongoing activity inside the room. Curious attendees who came in further would suddenly find themselves in the spotlight, without many options to be in background and still watch the game. - Weak spectator-to-participant transition; people hovered but hesitated to participate (and many did not participate) - Music selection process (i.e., participants choosing a music track) disrupted the game flow because participants hesitated much - The automated MC voice-over implemented in the game faded in with the music

	Method: video recordings, participant observation, informal interviews	Participants exhibited more enjoyment and less awkward movements when rehearsing as compared to performing. Thus, while rehearsing: + Player configuration changed to a close bodily formation (Marquardt & Greenberg, 2015) facing one another in mutual orientation, which happened before and after the game. This formation allows the participants to act as if they were less in the "spotlight" because their actions are directed towards one another (and mostly visible by them), instead of and not towards the audience. This resulted in the participants looking more at ease with their performance. + Movements just "marked" and agreed-upon, not fully performed + The activity of coming up with movements was interesting for our team because of the type of interaction, communication, and closeness observed between players. → Contextual elements working well → Need to fine-tune the social support → Arrange space to avoid congestion → Create a more casual stage → Technologically, devices required less preparation from the team, which improved the flow of the game. Extra devices needed to smooth transitions even more.
Parsons test 1 November Semipublic test	Version: Same version as in Halloween test but with big screen for scores to invite participation and competition. No theme added. Venue: Parsons/The New School game club night, for designers to test games with club members, peers, and students. Games were playtested in rooms adjacent to the main open space where students are typically working. Rooms had see-through walls. Goal: Evaluate dance-battle theme Players: 12 designers, students, and members of the club Method: Participant observation, with recordings	+ Players enjoyed moving together + Use of displays for awareness (leaderboard) improved awareness and sparked competition - Participants shy and hesitant in general, but primarily at the beginning of the game - Players slow in formulating moves during competition - Slow management of turn-taking → Need to address the hesitation of players and the general feeling of awkwardness, which we associated with a disruption of the flow of interaction due to slow turn-taking.
Parsons test 2 December Semipublic test	Version: Same version as Parsons test but used 4 devices to smooth transition. Scores were normalized within a range from 1 to 100. Whiteboard provided for signups of pairs or individuals, with slots for competition times Social support: (a) experimenter with iPad to control the rounds among the devices (i.e., which devices were paired together and on for each round); (b) active recruiting through explaining game's goal and the possibility to sign up, and (c) experimenter as a dance partner when needed for solo participants interested in a battle. Venue: The same as in Parsons test 1, but students were having final exams, which made a more challenging playtest environment (and the reason why the whiteboard sign up option was included). Players: 12 design students and friends	+ Smoother flow of rounds between teams + Stronger responses to scores + Coordination cues happening well + Players so engaged that they didn't realize when it was time to stop round - Automated MC voice-over still faded with the music + Requests for more rounds within party-like atmosphere (dj, drinks, etc.) + Impromptu participation of those observing through the see-through walls + Participants reported enjoying the game, dancing with one another + Participants reported postcompetition positive feelings, e.g., energized + Some participants rehearsed before and after rounds + Participants' theatrical engagement (victory signs, teasing the other team) + Fun, laughter, celebrated victories

	Goal: Check smooth transition between rounds and games Method: Participant observation; no video. Brief paper survey about general aspects of the experience, the app, and the game as a whole.	+ Four-player spatial pattern enhanced competition and improved flow → Framing experience beforehand was valuable (signup slots, active recruiting and explanation) → On the right track towards a dance battle game → Need for further refinement of party atmosphere (e.g., lights, beverages) → Design cues to clue round ending → Consider other human facilitators (e.g., dj) → Consider other methods to reduce barrier to stepping in, other than sign-up method, to support spontaneous participation → Consider spaces more open and visible to passers-by
Weekly internal lab tests to prepare for No Quarter exhibition January- May Purely internal tests	Version: Start with same version as Parsons test 2; small changes introduced following every playtest Venue: Weekly internal playtests (held during lab group meetings) Goal: Fix miscellaneous deficiencies, mostly in terms of technology Players: Lab group members (designers, researchers) Method: testing and informal discussion afterward	(Issue addressed → Strategy) - Awkward movements from holding device →Moved iPods to wrists - Social and physical awkwardness → Designed clearer structure to guide play - Improved game strategy → Design of multiple rounds for the dance battle - Simplified scoring → Focus on meaningful features: synchrony, intensity, and the diversity or range of different movements - Lacking player feedback system (e.g., voice-over tips lost or demanding too much attention → Improve social support through human facilitator for simple feedback at specific moments
Comparison with Just Dance March Lab-based test	Version: Game version similar to Parsons test 2; A single round of dancing; operator-controlled round, timed with an iPad, with additional social support from a person calling movements (instead of automated voice-over), the intensity/synchrony/creativity scoring system, in-the-moment feedback on the screen, and wrists holders for the iPod app devices. Venue: At the lab Goal: Comparison between in-progress Yamove! prototype and commercial dance game Just Dance Players: 20 students from an HCI class Method: Video-recordings of the activity. Video analysis based in interaction analysis: coded player bodily interaction patterns, bodily orientation, coarse body movements (i.e., body part moved), expressivity, and movement quality. Coded also general attention of the audience.	+ Attention of players and audience more on players with Yamove! versus on screen with Just Dance + Better articulated moves in Yamove! players + Improvisation in Yamove! players vs. mimicry in Just Dance players → Confirmed the design was working well through this internal playtest in preparation for No Quarter Exhibition
B-boy/B-girl lab test Early April Lab-based test	Version: same as in the Just Dance comparative test but improved use of shared screen (e.g., implemented countdown to start rounds and feedback between rounds) Venue: The lab's "living room" (i.e., a more casual and playful open space) Goal: Revisiting the theme of framing the experience with dance experts (b-boys and b-girls) Players: 6 B-boys or b-girls (i.e., people familiar	+ Players very comfortable with the dance experience, their bodies, the space (except non-b-girl, who was more shy) + Impromptu performances before, during, and after the game + More frequent footwork and floor work, i.e., dancing at various height levels + Vigorous movements, to the point of saturating sensor readings + Shifting roles of leadership (i.e., different than previous tests, where one person usually took

	with the dance battle form of Yamove!) and one non-b-girl friend of the participants Method: Video recording of playtest and informal interviews afterward; video analysis similar to the comparison study	leading role) + Players invested in scoring: commenting on scores, celebrated victories. + Liked room for creativity with the moves. + Good feedback about the game structure (rounds, sense of competition, scores) + Reported the game captured well the canonical b-battle style: spatial orientation and scripted turns - Players had difficulty synching movements during play because this is not common to their dance practices - Movements easier at the beginning, more complex as game unfolded - Bodily orientation toward the spectators, less attentive to their partners - Tendency toward "solo" types of movement not meant to be followed by the partner An exception to the later negative points happened in a case when one b-boy partnered with a novice. + Our team found the expert dancer role inspiring and useful as guide for the novice dancers + Different bodily orientation: towards one another, which we associated with an easier synching of movements + The expert dancer was observed to gauge the novice dancer abilities to follow; he progressively increased the difficulty of the dance, building from simple steps to more complicated movements. He used several strategies to scaffold difficulty, like using symmetric movements + Lots of laughter, smiles, teasing → Research team influenced by the observed role of coach to considered incorporating social mediator (i.e., choreographer to propose movements if active players become "stuck"). → Researchers asked b-boy/girl crew to participate in an open house and No Quarter playtests to encourage people to dance.
Eyebeam revisited April Semipublic test	Version: Resulting version from internal lab test, including improvements regarding holding of the iPods, rounds, scoring, and feedback system. Venue: Eyebeam/COAP revisited (same event as in the Move It! playtest): Open space in brightly lit warehouse Goal: Focus on testing the technological, design variations from internal lab tests Players: 15 expert users/designers Method: Video analysis similar to the comparison study: coded player bodily interaction patterns, bodily orientation, coarse body movements (i.e., body part moved), expressivity, and movement quality	+ Participants eager to play the game (e.g., difficulties with getting the music system working at the beginning of the playtest, yet players started to play the game anyways) Outcomes similar with and without music: - Calisthenic behavior instead of dancing - Music neglected, as players moved not in synch with the music's beat - Movements repeated - Focus on "scoring" through vigorous but simple movements - Less fun - Movements less likely to be in sync - Rehearsed and performed movements very similar (as compared to other playtests where performing brought in more expression and passion) - No dancing/party atmosphere - Reported enjoying moving together, but not really motivated to dance - Reported need of more game structure, more guidance → Reinforced importance of setting an atmosphere:

		establishing “the magic circle” (i.e., the dance floor) as something distinctive and separated from normal activity outside → Structured action both with technology design and social support
Lab open house Early May Public exhibition	Version: Inclusion of a human dance model. This role involved calling moves (like the MC) but also performing them so to inspire the participants (positioned next to the big screen). Several dancers, positioned next to the players, would copy the dance model’s move to inspire the players Scripted “funny” moves, some of them complex involving several steps, e.g., fishing: gesture representing preparing to throw fishing line, throwing line, and reeling in Venue: Lab “living room” Goal: Testing the idea of using dancers as models to make improvising moves easier and more fun; fine-tuning game for upcoming exhibition Players: Members of university community and the public invited to try out different demos from people in our lab Method: Participant observation	+ Festive environment. + Reframed activity looked like a dance class + Interesting and fun dynamics when dance partners were experts - Complex moves suggested - Players focused more on following the model and less on coordinating with dance partner → Fine-tune role of the human dance model to offer inspiration instead of specific moves to follow → Use dance experts as dance partners?