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Let's Get Physical! In, Out and Around the Gaming Circle of Physical Gaming at Home

ALLISON SALL & REBECCA E. GRINTER
Ivan Allen College and College of Computing, Georgia Institute of Technology, 85 5th Street, NW, Atlanta, GA, 30332, USA (E-mail: all-is-on@dearhuman.com)

Abstract. Physical gaming is a genre of computer games that has recently been made available for the home. But what does it mean to bring games home that were originally designed for play in the arcade? This paper describes an empirical study that looks at physical gaming and how it finds its place in the home. We discuss the findings from this study by organizing them around four topics: the adoption of the game, its unique spatial needs, the tension between visibility and availability of the game, and what it means to play among what we describe as the gaming circle, or players and non-players alike. Finally, we discuss how physical gaming in the home surfaces questions and issues for householders and researchers around adoption, gender and both space and place.

Key words: collaborative play, exergaming, physical games, spatiality

1. Introduction

In the last decade, collaborative technologies have left the office and entered new settings. Two trends within this migration have been domestic collaborative computing (i.e. using the computer at home for non work purposes) and gaming (i.e. computer interaction is organized around the playing of, and being in the game). CSCW research has grown to incorporate the study of these trends, broadening and deepening collective knowledge about the adoption, use and design of technologies for living and playing (see for example, Harrison and Dourish, 1996; Muramatsu and Ackerman, 1998; O'Brien et al., 1999; Cummings and Kraut, 2002; Frohlich et al., 2002; Grinter et al., 2002, 2005; Grinter and Palen, 2002; Tolmie et al., 2002; Crabtree et al., 2003, 2004; Harper, 2003; Crabtree and Rodden, 2004; Ducheneaut and Moore, 2004).

Yet, while our knowledge of domestic life and gaming has deepened, much less is known about a trend that merges these two trends: the increasing adoption of physical gaming technology in the home. Physical gaming is a genre of games that uses individual player's physical movements as input for gameplay. Unlike traditional console games, where players use finger and wrist movements to operate a hand-held controller, physical gaming uses

full-body motions as input into a variety of devices (such as, but not limited to floor pads and drums). For example, players stomp, jump, and slide on floor pads in Dance Dance Revolution (DDR), hit and pound drums in rhythm to compete in Taiko Drum Master.

Although the history of physical gaming begins in the late 1980's, when Exus released a foot pad controller for the Atari 2600, it was not until the late 1990's that physical gaming became popular (Bogost, 2005). Specifically, the popularity of physical gaming rose when Konami launched their DDR product (known as Dance Staging in Europe) (Wikipedia, 2006). Originally designed for and played in arcades, DDR, is a series of music video games where the objective is for one or two players to dance to the music by coordinating their foot movements with a series of arrows that they see on the screen. In the arcade, DDR consists of players dancing on a hard platform footpad that uses sensors to detect when the appropriate foot presses have been made. To play, individuals stand on the footpad and dance to step instructions that scroll up the video monitor in sync to a chosen song. Success is measured by how accurately the player hits the proper sensors in tempo to the monitor's cues.

As games such as DDR gained popularity in the arcade, their manufacturers pursued opportunities to migrate them into the home. Tying play to physical exercise – a trend known as exergaming – as well as the increasing market for home-based gaming consoles, Konami and others designed versions of their games for use with Nintendo, Sega, Playstation, GameCube and Xbox platforms. This was further fueled by the development of floor mats and other input devices targeted at the home market (typically ranging in price from \$10-\$100, €7.9-€79).

The migration of physical games designed for "sweat producing" arcade play into the home raises a new question: what does it mean to game at home and within the home, as both a collaborative activity involving those who play and those who do not within the household? Unpacking this question involves exploring the nature of collective and individual action in the home and the relationship between gameplay and the use and configuration of space within the house. The process of making physical gaming "at home" involves bringing in and incorporating it into the routines and practices of the home.

In this paper, we describe the findings from an empirical study that investigates how physical gaming is incorporated into the domestic landscape among the people, the place and the things that surround it. We describe the experience of making room for the space that the games demand (both for the game and the movements of playing), and how that led to negotiating its appropriateness among the other items in its vicinity. Further, we explore what it means to use gaming, a collaborative activity, among players and

non-players alike. Finally, we discuss how physical games at home surface questions and issues about adoption, gender, space, and place.

2. Related work

The arrival of physical games in the home touches on three sets of related work. First, gaming studies provide important context for understanding the uptake and adoption of these technologies. Second, studies of domestic routines have much to offer our understanding of how physical games fit in or disrupt the rhythms of the household. Third, studies involving space and place lend an understanding to the cultural significance of the home setting. In this section we review each of these areas in turn.

2.1. GAMING

CSCW has a long history of studying games and gameplay. One genre of gaming studies focuses on the Massively Multi Online Role Playing Games (MMORPGs). The attraction of these games is obvious, they provide a rich arena to watch social interaction taking place in a virtual world. They offer the opportunity to explore questions (e.g. questions about identity management) that have also been investigated in studies of older games, such as MUD's and MOO's (Reid, 1991; Curtis, 1992; Muramatsu and Ackerman, 1998; Cherny, 1999). However, unlike text-based MUD's and MOO's, MMORPGs support investigating other types of virtual gestures through the rich interactive experience that they provide. These questions have also been the subject of on-line gaming and virtual world studies (Bowers et al., 1996; Ducheneaut and Moore, 2004). Finally, MMORPGs support rich player communications, which have been shown to not only support the "work" of the game (e.g. missions), but also the social life of the game (Ducheneaut and Moore, 2004). Despite the diversity of this research, the common focus has been on interaction within the game itself – what happens inside the system rather than within the homes where these games are played.

A second theme within collaborative research on games has explored mixed-reality gaming. Most, if not all of these games, have been designed to take place in a public setting, either a public building or out on the streets itself (Flintham et al., 2003; Reeves et al., 2005). The reports of these gaming experiences have not only taken a within-game interaction perspective, but have naturally explored the question of fit between the virtual and the physical. Insights from these experiences show that even in cases when the match appears problematic – such as the difficulties with GPS positioning – people can strategically exploit the differences between the physical and the virtual (Flintham et al., 2003). Indeed, some of these issues echo previous experiences with performances – not all games, but certainly

entertainment – which attempted to blend an online and physical component (Benford et al., 2000).

Setting a context for both types of game-based research, are the studies of game adoption that suggest with whom and how the gaming industry is growing. The Pew Internet and American Life project for example, found in their reports that college students (who also happen to make up a big subset of our data sample) routinely integrate computer-based gaming into their daily lives (Jones, 2003). Sixty-five percentage of college students report being regular gameplayers, with many of them weaving gameplay into their routines, such as between classes, while IM-ing friends, and as a means of taking a break from homework assignments. They also found that college students chose to make home their "primary gaming environment."

2.2. ADOPTION AND USE OF COMPUTING IN THE HOME

As computing has migrated into the home, CSCW research has produced a body of knowledge about domestic collaboration. Broadly speaking, these studies have had two foci. First, they have examined household routines and the roles that technology play or could serve within those patterns of action and interaction. Second, they have examined the adoption and use of Internet-based technologies by the household.

A focus on domestic routines and the role that technologies play in those patterns has a long history. From the introduction of electricity and plumbing to the technologies (such as washing machines) that were made possible by that infrastructure, researchers have critically examined whether or not appliances improved the lives of householders. They have often concluded that new technologies have not always improved the lives of householders, particularly women (Schwartz Cowan, 1983; Strasser, 2000). In reporting these findings, these studies sought to open up the home to critical inspection, examining the individual and collaborative patterns by which a household shares the physical home.

More recently, as computing technology has migrated into the home, CSCW researchers have sought to better understand patterns of action and interaction, not just around the computer itself, but sometimes searching for opportunities to computerize household "work" (Hindus, 1999; Edwards and Grinter, 2001; Harper, 2003). Studies have shown a variety of routines that exist in the homes. For example, complex routines surround the processing of inbound and outbound communications in the home (Crabtree et al., 2003, 2004; Crabtree and Rodden, 2004), with individual householders working independently and jointly to manage the process. In this particular line of work, these studies highlighted how physical objects, such as tables and mantles, became a site of collective action and also one that may be accessed over a temporal span by individuals acting alone. Other studies have

shown that technologies, when successfully adopted (although not perhaps in ways that their designers imagined) can "disappear" into the routines of the household (Tolmie et al., 2002). This is not always the case, as some technologies remain to be worked into the household, often due to their complexity (such as home networking (Grinter et al., 2005), or set-top boxes (O'Brien et al., 1999)). Finally, other studies have taken up questions that surround home and household. Homes vary dramatically, not just nationally (size, dominant type of living accommodations – apartments or single-family residences), but culturally (in terms of what happens within the home in relationship to outside it), and locally (through the different patterns of households, sometimes referred to as a moral order) (Bell et al., 2005).

Another area of focus for CSCW studies has been the use of the Internet. Arguably, it was the rapid uptake of Internet-based technologies that fueled the growth of the domestic computing market. Early studies of domestic computing adoption found that computers were being used to support work at home, most notably telecommuting (Vitalari et al., 1985). However, as applications and Internet usage expanded, alternate patterns of domestic computing emerged. Communications and entertainment were identified as dominating more recent studies of domestic technology uptake (Venkatesh, 1996). In one study on the competing uses of the Internet, web-based activities versus communications (most notably email), suggested that communications tended to drive Internet use (Cummings and Kraut, 2002). More recently, studies focused on computing usage at home have begun to chart a progression (for those families able to afford the necessary equipment) from a single difficult-to-share machine, toward a network of devices with the associated difficulties that it in turn brings (Frohlich et al., 2001; Grinter et al., 2005).

2.3. SPACE, PLACE, AND GAMING AT HOME

A final set of related literature has looked at the place of games and other technologies within the home. In this section, we use the term place, following Harrison and Dourish (1996) who argue that place defines a set of relationships and social meanings that surround a physical space. Place frames the types of behavior that the environment supports, as well as determining what types of actions and interactions might be inappropriate.

In a seminal ethnographic study, Flynn (2003) reports findings on the location and consequent use of console-based video games in the home. She argues that games are positioned to reinforce the visions of the home as a mechanism that allow players to communicate out of the house and in the game-world that is connected to the home. Games do not bring families together, but occupy the attention of individuals within the home. She also reports a gender-bias in advertisements, showing men playing Mortal

Kombat while women are relegated to the shadows, and finds through her observation of homes that men dominate the place of gameplay. This gender imbalance echoes through other studies on the technologies that often surround and connect to video games, such as audio-visual systems. Similarly, they argue that these technologies are gendered objects in their promotion, designed to appeal to male-dominated activities (Taylor, 2001).

All the console games in Flynn's study required a physical connection to the television, a technology that's place in the home has been well studied. These studies argue that with the migration of work out of the home during the Industrial Revolution, the home changed into a place of leisure (for at least some of its occupants) (Rybczynski, 1986). Spigel takes up this theme and shows how that transformation opened an opportunity for television (like radio before it) to move into the home, and find its place (Spigel, 1992). Yet, the place for television was and remains challenging. For example, Adams (1992) argues that television creates an us versus them relationship where viewers ''orient themselves experientially'' to the program, rather than other householders. Within the CSCW research community, studies have shown that the place for television has not been resolved within all households. For some, television viewing (in particular individual watching) requires physical furniture rearrangement (O'Brien et al., 1999) or remains a source of ongoing negotiation determining its appropriate use of certain household space (Grinter et al., 2005).

It is into these households that physical games have arrived. Given their design roots, in arcades, specialized places devoted to public performance and gameplay, we wondered how users would incorporate these systems into the places of the home, and whether the design of the artifact itself would create complications. In the remainder of this paper we report findings from a study of physical gaming use in the home. In the next section we describe our methods and participants. In the results section we focus on four themes: differences between the visions driving adoption and actual usage, the challenges of working gaming into an already ''overloaded'' space, a tension between game availability and the desire to make it invisible when not in use, and relationship between the household and the gaming circle of players. We conclude with a discussion of the questions and issues that physical gaming in the home creates for householder and researchers in the areas of adoption, gender, place and space.

3. Methods and participants

In this section we describe the methods we used to conduct the study. We also describe the participants who we recruited.

3.1. METHODS

To gain insights into the relationships that exist with physical gaming in the home, we conducted a qualitative study involving participants who both owned and actively played physical gaming devices; the most commonly played being DDR. The study took place in two parts. First, a game log was distributed to the participants. Next we arranged a home visit where we conducted a written exercise, a semi-structured interview, and a home tour. We looked specifically at the spaces in which the games were played, how the devices were stored, and the types of activities performed in relation to physical gaming.

We recruited 7 households, with a total of 10 participants in the Atlanta, Georgia region. At the start of the study, each household was given a game log to self-report on their gaming activity for one week. The logs were used to understand how the participant's gaming routines fit into broader household activities. Each page of the game log was designed for one entry of game use. On one side, questions were aimed to get a sense of how participants used physical gaming in their daily routines. Questions asked who played, what was played, where was it played, what motivated play, and what happened just before playing. The next sheet of paper was left mostly blank, save for single instructions: ''Please use this page to sketch or write anything else you would like to share with us.'' It was our hope that providing an unstructured page would allow the participant to share what was significant to them about their gaming experiences.

After the week was through, the game logs were ideally collected before the home visit so that interview questions could be tailored to the participant's entries. Sometimes, the participant did not deliver the logs until the day of the interview. In this case, the researcher would leaf through the game log along with the participant before beginning any of the home visit activities. The researcher would ask questions related to the log as they seemed relevant. The log worked better with some participants than with others. In successful cases, participants filled out a dozen or more entries and used the blank page to make drawings and lengthy descriptions. In less successful cases, participants might only make one or two entries. We suspected that the irregular success of the game log was due to our asking the participants to incorporate an additional practice into their already established routine. When we asked them to talk about their experiences with the game log, some participants commented that they had to make extra effort to remember to fill out the log, and most entries were made retroactively. Two participants commented that they felt uncomfortable with the question that asked what motivated them to play. They observed that answering that question was harder than answering questions about what they were doing just prior to the start of play.

One week after distributing the game log, we arranged a home visit where we conducted a written exercise, a semi-structured interview, and a home tour. Each visit would begin by asking the household members to sit with the researcher at a table. The researcher would spread out an array of pens and markers, a stack of white paper, and sticker labels. The participants would then be asked to use these resources to draw the spaces where they play games. When finished, the labels were used to name the drawings. Names varied from simply ''Entertainment Space'' to more provocative titles such as ''The Hole'' or ''Game Time Emporium.'' The drawings served as a device for the researcher to understand the individual participant's perceptions about their gaming spaces. Additionally we thought that the process of drawing would provoke the participants to think about how they used their spaces.

As each drawing was completed, the researcher would ask questions about their drawings and represented places. The participants often used their drawings as a tool in explaining their thoughts. Each participant typically created two to three drawings. Sometimes the process of explaining one drawing would lead to producing more drawings to further explain their ideas. For instance, a participant would typically begin by drawing their current gaming place, then as they explained that drawing they might move to draw the last place that they lived, their family home, or as in one case, an arcade. Each of these drawn places provided different gaming opportunities. One couple drew the gaming places in their home as well as a separate drawing of a loft where they used to live. In contrast to their well-furnished modest home, the loft was an ideal location for the couple to host gaming parties. It offered large blank walls to project the game screen onto, and areas of unobstructed space for dancing. During the fourth interview, a participant asked if she could draw her ideal space. Similar to the drawings that depicted previous living situations, the drawing of the ''ideal space'' opened an opportunity to discuss what concepts were desired but were not supported in the current home. The practice of drawing the ideal space was integrated into the interviews that followed. Resulting drawings varied from the practical, which depicted more comfortable couches or larger simplified spaces, to the fantastic that featured an arcade-style DDR console incorporated into the living room.

We found that the discussion about the drawings naturally led to the semi-structured interview where we discussed the participant's spaces. When possible, interview questions were tailored around the game log entries. In one instance a participant's log revealed that she would often game in one room in between doing errands, while her husband played computer games in a separate room. In the interview we were able to speak directly to this occurrence and probe further into how gaming was shared within the home.

At the conclusion of the interview, participants were asked to lead the researcher on a tour of their home gaming spaces. In most instances, the tour

took place in the same room in which the interview was conducted. Questions were asked toward the functionality of the spaces, and chronicling specific games. With the permission of the participants, the entire visit was audio recorded and digital photographs were taken of the home spaces.

3.2. PARTICIPANTS

The study involved 10 participants who owned and played at least one of the most popular home versions of physical gaming for a year or more. Nine of the participants owned more than one physical gaming device and commonly played physical games as well as other types of video and/or computer games. Dance games such as DDR and the similar computer based StepMania, were most prevalent among the participants, seen in six out of the seven homes visited. We posit that the prevalence of DDR stems from the length of time that this game has been on the market, as well as its visibility in the media as a physical gaming product. Drum games, such as Taiko Drum Master and Donkey Conga were next in popularity, existing in three homes. At the time of this study the guitar emulation game, Guitar Hero, had recently been released and was coveted by many but only owned by two participants. Finally, games such as Pop'n Music, Karaoke Revolution and the video peripheral, Eye Toy were seen among the landscape of games but were not as popular as the other physical games mentioned above.

The participants varied in their ages from 18 to their late 20s (for more detail see Table I). They all lived in Atlanta, Georgia. The 2000 US Census, characterizes Fulton county (the county in which most of the City of Atlanta is located) as having a median age of 32.7, and homes having typically 5 rooms (US Census, 2000). All of our participants were younger than the median, and many lived in dwellings that had less than five rooms. Half were students, both graduate and undergraduate, and the other half held positions as both technical and non-technical professionals. Among the participants were a newly married couple who shared a small house that they owned, another couple lived together in a rented apartment, and the remaining participants had platonic relationships as roommates in rented apartments and student dormitories. While most played casually in home setups, two participants (both students who lived in dormitories) played at home and regularly participated in physical gaming competitions staged in arcades outside of their home environment.

4. Results

In this section, we discuss the findings from this study by organizing them around four topics. First, we discuss the adoption of these technologies by the participants in our study. Second, we focus on the spatial needs that our

Table I. Participant demographics

Interview	Participant	Sex	Occupation	Type of residence	Years of use	Type of physical gaming (pg)	Location of physical gaming in the home
1	P1	F	Graduate student	Rented two BR apartment	4	Guitar hero DDR StepMania	Living/diningroom
2	P2	F	Non-technical professional	Own one BR house	1	Karaoke revolution DDR	Living/diningroom
	P3	M	Non-technical Professional	Own one BR house	1		
3	P4	M	Undergraduate student	Dormitory	4	DDR Taiko Drum Master Pop'n Music Guitar Hero StepMania Beatmania	Living/dining room
4	P5	F	Graduate student	Rented one BR apartment	2	DDR Taiko Drum Master Eye Toy	Living room/TV room/ work space
	P6	M	Technical professional	Rented one BR apartment	N/A	Donkey Conga StepMania	
5	P7	M	Technical professional	Rented two BR apartment	4	DDR Taiko Drum Master	Living room/TV room
	P8	M	Technical professional	Rented two BR apartment	3		
6	P9	M	Undergraduate student	Dormitory/family home	2	DDR StepMania	Basement Rec room/ dormitory bedroom
7	P10	M	Undergraduate student	Dormitory	2	Taiko Drum Master	Dormitory bedroom

participants dealt with in order to accommodate and find the place for physical gaming in the home. Third, we highlight how visibility and availability of the game affected its use by the participants. Finally, we show how gaming is affected by living with and around other people.

4.1. ADOPTION

Adoption of exergames, while not a significant topic within CSCW research, has recently become more visible in the popular press within North America. With an increasing emphasis on doing something to reduce the percentage of obese members of the population, exergaming is sometimes looked towards as a means of making exercise fun. For example, websites such as "getupandmove.com" market DDR as a fun way to lose weight, and get a cardio-vascular workout. Recently, the state of West Virginia adopted DDR in all of its schools with the purpose of encouraging children to exercise and lose weight (Kim, 2006).

During the early stages of this research project, we searched for evidence online of exergaming. We thought that online forums and chat rooms would potentially provide us with topics for discussion with our participants. It also served to sensitize us to the culture of exergame play (such as the terminology used, the types of games available, preferred play modes, variants of systems and so forth). Our own investigations seemed to confirm that exercise was a significant reason to purchase and use an exergame. In some forums we found testimonials, similar to those seen for weight reducing diets and supplements, which explained how a particular exergame helped its owner lose weight. This further fueled our interest to find out more about this topic with our own participants.

During the interviews we asked our participants what inspired them to purchase a physical game. All participants mentioned exercise as a beneficial side effect of the game, and three participants described it as a driving motivator to purchase the game. Participant 8 was introduced to DDR at a friend's house. He was shy at first, but once he warmed to the game he soon purchased it for his own use. He explained:

> It was so much fun. I was like, oh I play so many video games, maybe it would be nice to get some exercise. (P8).

However, as seen in previous studies of adoption, such as those by Palen et al. (2000), the initial reasons for purchase may not always be good predictors of the game's eventual routine use. For example, when asked if they played the game for exercise, most admitted that they did not use it as a regular routine workout, but instead they played it occasionally for fun. Participant 2 was given DDR as a birthday gift from her brothers, on the

condition that she would use it to workout. She explains with her husband (Participant 3) how that usage differs from her current use of the game:

> P2: Yeah, because my brothers said that they would get it for me IF I PROMISED that I would use it for exercise. And I did.
>
> P3: You promised. Not (that you) used it for exercise... (correcting her)
>
> P2: (laughs) I did it for a while.(defensive) But, you know depending on what state the room was in. And you can't get the stuff out, and now the table. (P2 and P3).

In this case, what had begun as the original reason had turned out to not predict eventual use. Moreover, this example begins to point to one of the reasons why physical gaming might begin with the vision of being an exergame, but ultimately did not find its place in the home in the presence of competing activities and objects in the space. It is this that we take up in the next section.

4.2. ONE SPACE WITH MANY FUNCTIONS

Pictures of the home, as found in home furnishing catalogues and magazines, project idealized portraits of homes, stripped of their clutter. These contemporary advertisements are targeted toward middle-income households, and are meant to conjure the ideals of comfort and wealth. This same projection of an ordered, depersonalized place is used in the process of "staging" a home for sale, a trend that has been gaining in popularity in the United States. In staging a home, the number of objects in each room of the house is reduced. In a successful staging, most of the items that make a home unique are removed (such as pictures of the current occupants, and books that convey a particular political message), until the remaining space is either placeless or entirely normative. This invites potential new owners to envision the space as if they lived there, and thereby removing any presence of the current owner. Both marketing pictures and staging are attempts to conjure up the ideals of clean, neat houses and empty environments, an imagery that removes the awkwardness of living (Rybczynski, 1986). Similar to home advertisements, physical games that are marketed for the homes are displayed stripped of their context within the home. They are instead set against white backdrops or the neon screenshots from the games. Yet in our study, physical gaming found its place in homes that were filled with human presence, limited space, and messy objects.

Our participants tended to have smaller than average homes (according to US Census information for Atlanta (US Census, 2000) often with rooms that served multiple purposes such as a living room, dining room, office, and play

Figure 1. Participant 2 and 3's living room from both angles.

space. As a consequence of living in a small residence, most felt limited by the amount of room available, and spoke of desiring a larger home or better organization. The only participants who didn't speak to the struggles of living in a limited space were two roommates who didn't own furniture in their shared living area.

A common feature of all the spaces was the presence of the television. Our participants used the television set as the game output device, i.e. the means by which they saw their progress in the game, and the instructions/feedback on what to do next. The connection to the television pulled games into the room that was most overloaded with functions: the living, dining, and office space. Consequently, physical gaming seemed to be adding yet another function to a multi-function space.

For example, participants 2 and 3 live in a modest home (see Figure 1). Their living room is the only common space and is filled with furniture and objects to suit their lifestyle including a couch, a dining room table and chairs, exercise equipment, games, peripherals, and a large television. With their television positioned as the center point of the room, there is little opportunity for the space to be flexible. Participant 2 laments,

> We are going to have to find something that works a little bit better for how we live which is mostly by ourselves, you know one person playing a game or two people playing a game or whatever. And this is kind of a hallway now, we can't put anything down. (P2)

Be it a house, apartment, or dorm, participants perceived their homes as transitional spaces that were "good for now" but were not considered their permanent living situations. We hypothesize that this might be a result of the average ages of the participants, most being younger than 30. Whether or not our sample of participants is unusual we are less sure. While gaming is often associated with youth, it is clear that gaming technologies are bought and used by a large audience.

Participants tended to use their common living space for a spectrum of activities in addition to gaming such as eating, studying, working on the computer, and watching television and films. These activities may be done independently as well as simultaneously. In the case of Participant 6, it was important to him to have easy access to both the computer and the television at the same time. Participant 5 and he had evolved their living room setup so that his computer was connected to the television. With this technique, they were able to quickly switch their attention between the television and the computer monitor. He explained,

> (There is) kind of like multi-media multi-tasking going on here. So it's important that I can be at the computer and look at the TV if I need to without having to really change what I'm doing. (P6)

Participant 6 touches on a frequent theme by which participants placed an emphasis on having their spaces adapt to fit their needs rather than changing their person, position or routine. The size of the space was less of a concern than its flexibility.

> I like the coziness of a space this size. And I might like it to be a little bit bigger, but ideally I would rather have one space that that could transform itself into several ideal configurations of a space. (P6)

In another example, Participant 5 drew her ideal space in the same architectural framework in which she currently lived (see Figure 2). Instead of

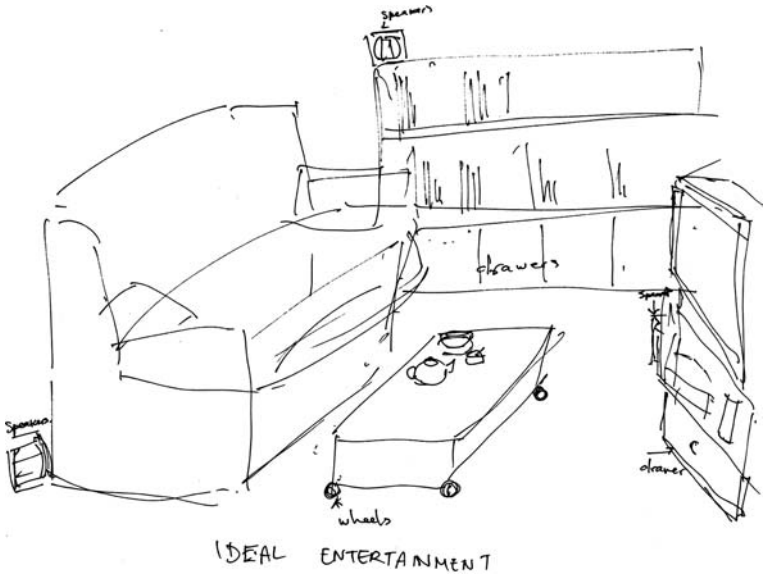

Figure 2. Ideal entertainment space drawn by Participant 5.

shifting the architecture, she drew furniture so that it would adjust to meet the demands of different kinds of activities that took place there. She drew a table with casters on the bottom so it could be moved depending on what she was doing. In the middle of the room was a comfortable couch, and drawers to store games and peripherals when not in use.

> Because we use this space for so many things you also want it to transform, you want it to change. So-I thought of the wheels like immediately... I just want to be able to move it around, and depending on what we're doing if it's like watching a movie, we can change also the configuration of it with playing video games. (P5)

Participant 5 distinguishes between the needs of watching a movie and playing video games on a television. In so doing, she highlighted another characteristic shared by most of the participants in this study; in addition to playing physical games they also played video games. In their limited space, making room for gaming meant making appropriate places for both video and physical gaming. How players arrange themselves in the space is often dependent on the game. Participant 5 elaborated,

> Some games you can kind of just sit down and play like a movie. But some you might not want to sit as close to the screen. (P5)

In line with Flynn's (2003) finding that the optimal distance for playing games is different than the best position for using a computer and watching television, we found that physical gaming has yet another preferred location. Not only did participants describe different distances for forms of play, they also talked about different configurations of furniture. Participant 3 preferred playing in a chair that usually belonged next to the dining table in the same room. When playing games, he would scoot the chair close to the television and then move it back after he finished. Participants 7 and 8 are roommates with similar preferences. When interviewed, they emphasized that sitting on the floor was the preferred choice for video gaming.

> P7: When we entertain people it generally revolves around movie watching or video games.
>
> P8: We've always sat on the floor when we played video games.
>
> P7: Yeah, even when we had the couch. We would sit in front of the couch on the floor. (P7 and P8).

In all the homes in our study, the participants owned corded game controllers. A further limitation on spatial arrangements came from the fact that they could only sit as far away as the cord allowed. Accommodating physical gaming called for a new arrangement in the households of our participants.

Given that the input devices for physical gaming are larger in size than handheld controllers, they have different spatial demands. Specifically, our participants had to make space in front of the television (typically occupied by a coffee table) to make a place for physical gaming. In her preparation for playing DDR, Participant 1 has to move the table around in order to gain the correct distance from the screen:

> Usually I have to move the table back a bit 'cause otherwise I'm standing too close to the TV...the table is kind of constantly getting moved back and forth 'cause my roommate does exercises over on that end. He'll push it this way and it gets shoved back when I'm gaming. (P1).

Moving sofas and tables to accommodate the distance and space of the DDR dance pad was common among the participants, but also mentioned was the need to make room for the hand and foot movements inspired by the game.

> Yeah you want to be able to have space – No, but like when you move on the dance pad, there are times when you are moving your hands too. So you don't want to have stuff around, in case you break something (P5)

Participants 5 and 6 structured their layout to include non-permanent furniture that could be moved easily to fit their needs (see Figure 3). They had a bean bag for video games, pillows that could be tossed in different arrangements on the floor, and a foldable card table where they ate meals and then concealed when not in use. They spoke to the strategy behind using a table that could easily be collapsed.

> P6: I mean the reason it's a card table is so we can put it away. 'Cause technically we would put it away whenever we are not using it. But, you know. We tend to use it so we just leave it out.

Figure 3. Living room and work space of Participants 5 and 6.

Figure 4. Two views of Participant 9's recreation room where he played DDR.

> P5: Yeah, and if people come over – it depends on what we do. If people come over and we're having dinner or whatever it stays, but if ... people have come to play games it usually (goes) away. (P5 & P6)

Some furniture is manageable and can be moved; in other instances there may be permanent fixtures or items that are too heavy to rearrange. These objects must be worked around or incorporated into the game. Participant 9 split his time between his family home and university dormitory. At his family home, he played DDR in the basement recreation room, which he shared with his brother who mainly used the space to play computer and pool games. When Participant 9 wanted to play DDR, he would move a couch and a coffee table to the side, but the pool table was too imposing to budge (see Figure 4). To compensate for the lack of space, he chose to incorporate the pool table into his game.

> Sometimes I kind of pull the pads up to the pool table so that I can kind of grab onto it for more physically demanding routines. (P9).

In arcade versions of DDR, the dance pad has a bar on the back of the platform, which some players grab onto to support their weight while they move their feet. This participant transformed his home gaming experience to incorporate the pool table as a back bar.

In their study of Instant Messaging (IM), Grinter and Palen (2002) argue that one reason IM was adopted among teens was that it provided a means by which they could communicate silently (unlike voice calls). Likewise, gamers spoke of their need to fit play into household routines, and described steps they took to be as unobtrusive as possible. For example, when Participant 9 left his home for his university dormitory, the space and the presence of many people severely restricted his DDR play.

However, he still wanted to practice so he set up Stepmania, a DDR-like simulation game, on his laptop and then configured it to play itself. As the

Figure 5. Participant 4's common room in his dormitory, and his physical games.

arrows moved on the screen, he would follow hitting the steps on the floor (with no dance pad). By stepping quietly on the floor, in time to the self-playing game, he was able to practice and work around the space and presence of others.

Similarly Participant 4, who had a wide selection of physical games (see Table I), faced space and noise constraints when he hosted parties in his dorm room (see Figure 5). To solve these problems he explained that he favored Beatmania, a DJ type game, over his other games. Beatmania's controller is about the size of an electronic keyboard, and can be held on the lap, making it, as he put it "*a little easier to keep it more contained*" (P4)

In summary, the process of finding a place for physical games for our participants was one of creating another function in a typically multi-function space. It was also the process of working the game into the furniture arrangements of the space, and into the household routines of the people they shared these gaming spaces with. Although participants employed some similar strategies, such as positioning the game relative to the television, we also found a wide variety of unique and creative solutions, such as incorporating the pool table into play.

4.3. AVAILABILITY AND VISIBILITY

Previously we described how gamers make space, and place, for physical gaming as an activity. However, even when the game is not being played the peripherals still make their presence felt in the home. As we discovered, this is another challenge for gaming. In this section, we explore a tension between keeping peripherals available for play and invisible for domestic-aesthetic reasons.

In his study of how people configure the contents of their home, Forty (1999) explored how the presentation of artifacts presented messages about appropriate activities in the home as well as hiding inappropriate ones. The

idea that householders "stage" their own homes – projecting some facets of household life while hiding others – for visitors and other householders has been reported in other studies (Rybczynski, 1986; Bell et al., 2005). In our study, we found a tension between a desire to have play "ready to hand" and the need to make gaming hardware disappear.

As you might expect, we found that the patterns of play varied from participant to participant (even within households). Both of the participants who lived in the dorm rooms (Participants 4 and 9) stated that they played physical gaming daily. The rest of the participants admitted to having a more erratic physical gaming schedule.

> I'll definitely go through a period where I'll dance you know maybe once every two days or something for a couple weeks and then I'll get tired and I won't touch it for another 5 months. Then I'll go back and forth. (P1)

Common in all households, the games that are current in rotation are left visible, and the games not being played are stored. One reason that games tended to get stored when not in use was due to the sheer number of controllers (input devices) associated with each game, and each type is distinct, making it impossible to share them among consoles and games. As Participants 5 and 6 described:

> P5: Yeah one thing that we have, I don't know how to do it. If you look there, we have all these controllers and it's the same in the bedroom, it's like they are hooked up. That's P6's very neat way of putting the controllers, but we have the extras. The spare controllers are all like in a pile there.
>
> P6: Yeah, there are spare controllers back there... (behind the television).
>
> P5: Yeah, and in the other room. It's kind of the same and we have the – um – the Dreamcast, we have a microphone for the Dreamcast and we have rumble pads or whatever. And those are like they're not part of the controller. And we also have lots of controls for the Dreamcast. I don't know it's just crazy. So it's like piles and at times it's like this could be neatly put in boxes or something like that. That's a problem with controllers. (P5&P6)

The effort of keeping the space around gaming tidy extended beyond the input devices to all peripherals associated with the game itself. For example, as one of the daily players explained:

> Yeah to keep it a little more tidy I guess we only keep whatever game we are playing right now.... We just put it next to the console. Xbox games next to the Xbox, game cube and so on. (P4).

Figure 6. Storing Physical Games in the Dormitory.

Participant 10 chose a different approach. He played Taiko Drum master in his dormitory bedroom. When not in use, he stored his Taiko Drums in his closet. Much like clothes that are hidden under a bed, the drum's resting place is concealed behind a stack of games (see Figure 6).

Stored games and their parts provided a more presentable area, but perhaps obviously, the process of storing these games reduced their visibility. This seemed to create a tension for some of our participants. The reduced visibility created a house that suggested typical living room activities occurred in that space, and that the householders upheld certain levels of tidiness through the removal of game "clutter". Yet, the loss of sight tended to reduce the level of play. Out of sight seemed to also imply out of mind.

More specifically, out of sight also meant that in order to play again, the game and its parts would need to be set up again and furniture moved. Making space for physical gaming did not seem to be a one time event for some of our participants. For example, participants 2 and 3 commented on the difference between having DDR readily available, to when the game is stored:

> P2: (when they are plugged in) you just switch it on. Where as now it's like. . .Oh yeah. . .they're over there in the corner. I didn't even draw them. (referring to the written exercise).

> P3: Here, it's like oh yeah, we have to unfold them, plug 'em in, move furniture to make room for them. (laughs). (P2&P3).

A loss of availability is less desirable as it requires more effort on the part of the player. Participant 5 discussed her experience with a stored Taiko Drum Master game,

> Um, you need that motivation it's not the same. It's like you have to get out the controller and all that. And the problem is that you have to motivate yourself, ''okay I can get out the controller, and set everything up. (P5).

Participants proposed two possible solutions for the struggle between visibility and availability. One approach was to use the existing architecture of the space and contextually place the peripherals. For instance, placing the DDR dance pad under the television cabinet offered the potential advantage of providing easy access when play was desired.

> Ideally I'd love to have the dance pad actually under the TV and then you could just kind of pull it out...but I don't think ours is quite shaped right for that and then you have the problem of putting the controllers down there. And because we have controllers with wires we like to kind of stick the wires under there. (P6)

However, in both cases where this tactic was discussed the actual dance pad was too large to be placed under the existing furniture.

Another solution called on the desire to keep the games separated to their own dedicated space, such as a television or recreation room. This approach provides a scenario where the peripherals are easily accessed, readily available, yet out of view in the common area.

> If we had like a separate TV room I think that we would probably use them (dance pads) a lot more because they wouldn't be in the middle of everything. But here in this house I mean there's literally – you pull out the game pads and they'll take up this entire space. So it really has to be like an actual event for us to pull them out and use them these days because they're just in the way when we use them. (P3)

This vision echoes the participant's desire for more space, discussed in the previous section. Ultimately, the participants' struggle in finding a balance between visibility and availability reveals that they are both valued features of physical gaming.

4.4. AWARENESS OF OTHERS: INSIDE AND OUTSIDE THE GAMING CIRCLE

Households are typically collaborative places, as people live together and around each other. In our study we learned that physical gaming often

brought an awareness of other householders. Analogous to Spigel's (1992) description of the advertisements used in the 1950's, which pictured smiling families gathered in a circle around the television, we wondered whether households embraced physical gaming collectively. Taking up her notion of a *family circle* and the concepts of togetherness and involvement, we employed the idea of the gaming circle. We use the gaming circle to describe the individuals who are involved in the gaming experience either in the capacity of directly affecting the game (as a player) or by watching (as a spectator).

4.4.1. *Inside the gaming circle*

Games such as DDR are designed to be social games. They incorporate different play modes to support multiple players. With more than one dance pad, players may either compete against each other, or, multiple players of different skill levels can play the same song non-competitively. Both modes provide an opportunity for players to be engaged with the game whether competing with each other or competing with themselves. Participant 8 explains,

> Its not really so much competing against each other because our skill level would vary so much that it wasn't really fair to have a competition. George would be next to me doing the same song on like standard or hard or whatever and I would be doing it on light and struggling. But it would just be the opportunity for two people to do it at the same time. (P8)

Most participants spoke fondly about playing with other people. In this manner, the presence of a gaming circle reinforced enjoyable play. In extreme cases, the gaming experience was only complete when other players were involved. For example, the married couple in this study (participants 2 and 3) would only play when they were playing competitively against each other.

Participants often used the term ''performance'' to describe their physical gaming experiences. The presence of others cast in the role as spectators became necessary to transform the player into the performer.

> It's fun for exercising but it's not as much fun like as in a group. You really need people standing around and cheering you on and stuff. And it's fun to watch other people do it. It's definitely more of a social game than like burnout, which you can easily play by yourself. (P1)

Participant 5 made a similar observation in her game log, where she described the experience of playing Karaoke Revolution at home on her own. The experience was incomplete without other people watching.

> I was on my own, and it felt kind of weird. I love singing, and I usually sing along to my music, but it's weird to do sing and dance on my own in front of the T.V. I need friends to feel it's fun (it would also feel weird in front of strangers). (P5)

In another example where the game becomes a performance, Participant 9 drew an arcade as his gaming place. He noted that he played on different DDR platforms depending on whether or not people were present. The arcade he described has a layout where a sofa is placed closer to one platform than the other. He explained that when people were present, he would choose the platform near the sofa so that he could be closer to the audience. When not performing, Participant 9 referred to his home play as practice.

The participants sometimes discussed hosting parties at which physical gaming became the center of attention. Parties are an opportunity to be outside normal conventions. When asked what guests would do at the parties, Participant 3 explained,

> Drinking, hanging out, watching. Most people would just sit and watch. And that's the thing that was so cool we found about the Karaoke revolution games... people who would sing on a Karaoke revolution game probably would never even consider doing that in a bar. But because no one is really paying attention to them, and watching the screen instead. I mean people who are really really shy would try it anyway. People who are really horrible singers would try it too which is also very entertaining. (P3)

Parties were also an opportunity to convert friends into the gaming circle. As with Karaoke, drinking helps lessen performance anxiety. When introducing physical gaming to new or shy players, alcohol was often used to alleviate any self-conscious feelings they might have. Participant 1 describes how alcohol enhanced playing DDR:

> People get on this game and they're stepping on squares like they're trying to crush bugs. You know, if they had a drink or two they tend to get more into the music, and so get arm movements and stuff. Especially with a large group of people it's more of a performance than a game. (P1)

Participant 8's initiation to DDR also involved alcohol:

> I don't understand why people are so shy about playing DDR. Like, the first time you guys got me to play, I had to get drunk first. (laughs) And then after that I wasn't ever shy. (P8)

When people are inside the gaming circle, they enhance the experience of the game by their acceptance as a player or as a spectator.

4.4.2. *Outside of the gaming circle*

Gameplay can be adversely influenced by those positioned on the outside of the gaming circle. The Gamer identifies people as existing on the outside if they don't play games, and therefore the gamer perceives that they wouldn't

appreciate them. Perhaps the gamer may feel too self-conscious to perform in front of them, or the gamer may also feel that the non-gamer would be intolerant of the noises and inconvenience produced by the game.

In student dormitories, individuals often become roommates with people who they don't know. Two participants discussed how they didn't play because they didn't know their roommates well enough. Participant 5's bedroom in the dorm was too small in which to play DDR, but the common area was too socially uncomfortable.

> Basically I had my television, but I had to move it to the living room where my roommates were. I didn't feel very comfortable leaving gaming stuff with my roommates. They didn't care about games as far as I know. But still, even though these kind of games are made for sharing and party thing. Probably because I didn't get along so well with my roommates, it was something that was for me – I didn't want to have them watching around. (P5)

This suggests that in order to play physical gaming in the home, a player must be comfortable with the company they keep. This quote also addresses the concept that simply watching is not the same as being a spectator.

O'Brien et al. (1999) write about how different areas of the home have ownership attributed to different members of the home. This notion of ownership is echoed in the case of a participant 9, who played DDR in his family home. He was aware of the potential disruption that playing would cause, and as a result would relocate to his own area of the house. He explains that his preferred location is

> down in the basement, that's usually one of the best places to do it since there's no –ah – you don't have to worry about stomping on the floor and like distracting anyone. And there's a lot more room down there since usually no one's down there. (P9)

For participant 1, the basement also proved to be a more appropriate gaming location and provided an escape from the prying eyes of parents:

> Yeah, my parents usually spend time in the living room with the big screen TV, and when we had friends over you'd go down to the basement cause you have a little mini kitchen and so it was like a party room. We'd usually go down there when we didn't want the parents hovering over you. (P1)

People outside of the gaming circle don't always need to be in the same physical space to have an influence on the game. Participants who lived in apartment buildings were often aware of their nearby neighbors and cited their neighbors' wellbeing as reasons to adjust their physical gameplay. Participant 7 describes the experience of playing Taiko Drum Master in his

new apartment as being too loud. He comically remarked about the potential consequences from his neighbors:

> I like this game, but like playing it in here especially, it echoes really loud . . .yeah, I'm kind of leery about playing it too much because I don't want our downstairs neighbors to come up here with like pitchforks. . .and torches to drive us out. (P7)

Participant 7's roommate describes how he adjusted his usual gameplay in order to quell the noise he created while playing DDR.

> I played it today but I try not to stomp. And on my jumps – I kind of like come down on my toes instead of on my heels. (P8)

Participant 5 had similar observations that she reported in her game log:

> It's a problem to play a bongo / drum rhythm game late at night. It's easier to play when you actually thump on the controller. I've managed to play more softly, but then the game isn't as fun. I've had a similar problem in the past with dance mats – you can't really play DDR past a certain hour, the game makes you jump and stomp, and if you live in an apartment floor it's very easy to disturb your neighbors. Conversely, playing more softly allowed me to play longer this time.

Even in the privacy of the home, playing physical games can be a performance. The success of the performances is deeply influenced by its surroundings. In discussing the patterns of play influenced by those inside the gaming circle and out, it becomes clear that other people contribute to setting the stage of physical gaming just as the furniture and space around it.

5. Discussion: the state of physical gameplay at home

In this paper we described the results of our investigation into physical gaming at home. Initially, we were motivated to explore this topic because of the increased media reports about the exergaming phenomenon. We also saw a potential disconnect between devices that had been designed for the arcade, and their use at home. As we learned from our participants, the incorporation of physical gaming into the home creates new challenges for householders, beginning from the moment of adoption. In other words, physical gaming provides a lens through which to examine household technologies.

CSCW research has a long history of examining adoption of computing technology, initially in office settings and more recently in other settings. One theme of previous work has been the difference between people's reasons for purchase, and the actual use of the device. For example, Palen et al.'s (2000) study of mobile phone users showed how many participants purchased the

phone for safety, but ultimately incorporated the technology into their lives for other reasons.

Physical games seemed to follow a similar trajectory for our participants. Many of them referred to exercise as being the reason to purchase the game and its peripherals. Over time other reasons came to dominate actual play. For some of our participants it was opportunities to be social, to spend time with other householders sharing an activity together, for others it was also an opportunity to organize gaming parties. For others still, the physical game experience was an opportunity to practice; home play was connected to a bigger context of play that included other people's houses and the arcades.

Like the domestic adoption of computer applications, such as email and the World Wide Web before it, physical game adoption at least for some of our participants illustrates another set of places through which computing activities move. In previous discussions of computing technologies, the places through which computing activity has moved have largely been offices and homes. For example, the early adoption of computers by American households in service of telecommuting has been described as blurring the boundaries between home and office work (Nippert-Eng, 1995; Vitalari et al., 1985). Physical gaming for some of our participants connected private – practice – spaces of their homes, with public – performance – spaces of others homes and arcades.

This connection between gameplay at home and outside raises questions that stem from our sense that the division of gameplay, private and public, home and other homes/arcades, probably turns on a variety of cultural practices. The spaces available for the different types of play seem inherently grounded in a variety of norms. For example, in studies of both North American (Grinter and Palen, 2002) and British (Bell et al., 2005) homes, the practice of individual householders carving out private spaces (separated from the rest of the household physically) comes up as a theme of the ways in which technologies can be appropriated. But, much less is known about whether the same is possible either physically or socially in other homes in other cultures. As we continue to expand the options for entertainment, answers to these questions are likely to offer valuable insights into who, how, and where gaming systems can be used.

Another theme of adoption literature, although less so in CSCW than in other disciplines, concerns the gendered nature of appropriation. Studies of the rhetoric surrounding the adoption of a variety of appliances often focused on arguments that said that women's work would be reduced with the introduction of a new technology. Yet, studies have shown that those arguments did not always bear out in practice (Schwartz Cowan, 1983; Strasser, 2000). Studies of video games have also reported strong gender imbalance, not just in statistics but in the environment and culture of play (Flynn, 2003).

In our study, the majority of participants were men. Yet, we have little explicit insight into the gender dimensions of physical gaming. This leaves open questions for future exploration. First, given that physical games in the home rely on platforms that have their roots in gendered practices surrounding console games, have gendered uses already been established, and do they migrate into physical games? Second, physical games (again like their predecessors) are typically connected into audio-visual systems. In our study all of our participants used the television, a central component of an audio-visual system, to get feedback and instructions during gameplay. Yet, audio-visual systems have also been shown to be highly gendered, in both their marketing and subsequent use (Taylor, 2001). Does it follow that these influences will infuse the adoption and use of physical games, particularly those in use in the North American homes that have been the subject of all these studies?

The relationship between place and space has also been the subject of CSCW research (Harrison and Dourish, 1996). Physical gaming provides a useful lens through which to examine this relationship, and highlight the role of objects. By objects we mean the possessions that the householders keep in their house, including but not limited to the items associated with the game itself.

Like previous reports of the arrival of computers and televisions into the home (see for example, Spigel, 1992; Venkatesh et al., 2003; Grinter, 2005), physical games required that householders find an appropriate place for the technology. In the case of physical games, we saw that householders took a variety of issues into consideration, including the noise of the game itself. Ultimately though, one of the most significant constraints on positioning the game was the location of all the other resources required to make the game function: the television, the gaming device, and the sound system.

In other words, physical games need to be situated within a network of devices. In order to be used at all, the game place has to provide sufficient "in-home" networked resources. This in-home network need has only just started to infuse computing adoption, as families now own multiple devices and peripherals that they desire to connect together and to the Internet connection. As studies of networked devices show, in-home networking (both computing and audio-visual types) remains a non-trivial task (Grinter et al., 2005).

However, during the course of this study it was the spatial and object arrangements that physical gaming really highlighted. All of our participants, some through their ideal gaming spaces, drew our attentions to the inadequacies of their current game room. In addition to juggling the fact that those rooms were functionally overloaded – in part a consequence of the fact that those spaces leveraged the same networked resources for different activities such as watching movies – participants described a type of physical overload.

Physical games conflict with furniture and other objects sufficiently that most of our participants described pre-game tasks that included moving stuff

around in order to make space for the game. Of course this was in part due to the peripherals associated with the game itself. Chairs and tables gave way to floor pads and drums. In the homes of our participants, a variety of objects competed for the television's front row (Spigel, 1992).

After the game was done, objects were often reconfigured again, to make way for the next activity and to make the room "tidy" as participants explained. For now, in the homes we visited, physical gaming peripherals seemed to fall into the category of "clutter." Indeed, despite the potential loss of opportunity for play, for the majority of our participants, putting play away was important. In the case of the disappearing computing game (Tolmie et al., 2002), invisibility largely seemed to be triggered by the sense that this place within the home needed to appear tidy, not just to the occupants, but also potentially to visitors. Physical gaming seemed tethered (via cords) to technologies such as televisions that were typically present in places within the home, common for entertaining guests.

6. Conclusions

In this paper we described the findings of our empirical study on physical gaming in the home. We sought to understand what it means to game in the setting of the home and how the collaborative activity of gaming changes in the presence of those who play, and those who don't. Bringing physical gaming home magnifies an existing set of issues and practices belonging to the home. Specifically, the process of playing physical gaming highlights the limitations of space, the desired projected image of the home, and the influence other people have on the game.

This study is just a small part of a larger scheme in understanding the influences that gaming takes on in the home setting. Our findings come from a small sampling of physical gamers in the South East region of the United States who primarily played DDR. Despite the small scope, the study has begun to reveal the challenges and opportunities that exist for gaming in the home.

Future studies involving participants with a more diverse demographic makeup, who live in permanent setups, play a wider set of physical games, and those who play together as a family have the potential to offer a greater understanding into design opportunities in making physical games that better meet the needs of the home and its players.

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