International Survey on the Dance Dance Revolution Game

JOHANNA HÖYSNIEMI
University of Tampere, Tampere, Finland

Despite the growing popularity of physically interactive game-playing, no user studies have been conducted on dance gaming (one of the most popular forms of playing via full-body movements). An online questionnaire was used to study various factors related to *Dance Dance Revolution (DDR) gaming.* In total, 556 respondents from 22 countries of ages 12 to 50 filled in a questionnaire which examined the players' gaming background, playing styles and skills, motivational and user experience factors, social issues, and physical effects of dance gaming, and taking part in dance-gaming related activities. The results show that playing DDR has a positive effect on the social life and physical health of players, as it improves endurance, muscle strength and sense of rhythm, and creates a setting where new friends can be found.

Categories and Subject Descriptors: H.5.2 [**Information Interfaces and Presentation**]: User Interfaces--*Evaluation/methodology*; *Input devices and strategies*; *Interaction styles*

General Terms: Human Factors

Additional Key Words and Phrases: Dance gaming, Konami's Dance Dance Revolution (DDR), music and rhythm games, online survey, game research

1. INTRODUCTION

In the last couple of years, a number of physically interactive computer games that require physical effort to play have been developed, published, and marketed to the general public. Subcategories of the genre include *computer vision-based games* [Smith 2004; Hämäläinen and Höysniemi 2002; Hämäläinen et al. 2005; Creative WebCam Game Star 2005]; *rhythm and music games* [Andamiro Pump It Up 2005; Konami Dance Dance Revolution 2005]; and *sports simulators* [Radica Play TV® 2005; Cateye GameBike Fitness; Powergrid Kilowatt 2005]. Instead of controlling the game events with traditional game input devices such as mouse, keyboard, or game pads, physically interactive games employ various novel input techniques like Web cameras, dance pads, and simulated sports gear such as computer-attached skateboards, exercise bikes or devices based on isometric exercise. As playing these games is based on large body movements, the game control itself is of interest not only to players but also to a possible audience intrigued by the player's skilled movements. Compared to traditional game controls, the physical interaction style often requires (and it is claimed to develop) complex motor skills and endurance, in addition to providing more versatility for personal playing styles such as improvised dance or martial arts moves [Konami Dance Dance Revolution 2005; Hämäläinen et al. 2005]. In addition to engaging in physical exercise, players often train and compete together in a sport-like fashion, a phenomenon that has interesting social implications.

Author's address: Tampere Unit for Human-Computer Interaction, Department of Computer Sciences, University of Tampere, Finland; email: johanna@cs.uta.fi

The research on physically interactive games has mainly focused on the design and evaluation of computer vision-based games [Höysniemi et al.2005; Hämäläinen and Höysniemi 2002; Hämäläinen et al. 2005; D'Hooge 2001] or on the design and analysis of physically controlled peripherals [Johnson et al. 2002; Exertion Interfaces 2005; [Hämäläinen 2004; Chi et al. 2004; Chua et al. 2003]. Nevertheless, many studies reference dance gaming as one of the most popular forms of physical game-play, but until now, research related to dance gaming has been scarce. This study attempts to fill the gap by exploring the nature of dance gaming, focusing especially on Konami's *Dance Dance Revolution* game (DDR, known as *Dancing Stage* in Europe) and on the vivid game culture blossoming around it. In wake of DDR's release in 1998, arcades all over the world have begun offering dancing games where one has to perform combinations of steps in the rhythm of the music being played. Since then there have been various versions of the arcade cabinet, several releases of console titles and dance pads, as well as releases of other dance games competing with DDR for market share. In the beginning of 2005, cumulative worldwide sales of the *Dance Dance Revolution* series had exceeded 7.5 million units [Game Press 2005].

A massive fan base has grown around DDR in Asia, USA, and lately in Europe. The popularity of DDR manifests itself in competitions and game events, enthusiastic discussions on forums dedicated to DDR, and growing press coverage. The most passionate players have even developed dedicated DDR simulator software, built their own dance pads, and composed new music to the game.

This article addresses the following research themes: DDR players' background and playing habits, motivational and learning factors related to DDR gaming, DDR gaming experience, and its social and physical effects on the players' lives. In this article, the concept of the *Dance Dance Revolution* game and the background of dance gaming is first introduced, followed by the details and results of the study, and finally we give a summary of findings along with proposals for future research.

2. DANCE DANCE REVOLUTION: INTERFACE AND INTERACTION

The idea behind *Dance Dance Revolution* is fairly simple: it combines upbeat music, stepping in rhythm, and physical exercise. The DDR set-up consists of a game pad or platform with four arrows (up, right, down, and left), a screen, and loudspeakers as shown in Figure 1 (left). The arcade machines have two pads side by side to allow two-player gaming as well as a single player using two pads – a mode called *double.* A home set-up, on the other hand, usually makes use of one or two pads attached to a gaming console. The arcade machines also have a bar behind the player that can be used to ease game-play.

There are four stationary arrows at the top of the screen, as well as arrows that scroll upwards from the bottom of the screen and pass over the stationary arrows (Figure 1, right). The aim of the game is to step on the corresponding arrow on the dance pad when a scrolling arrow overlaps the stationary arrow. The more precise the timing, the better the rating for that step. The ratings from best to worst are: perfect, great, good, boo, and miss. However, the scale differs slightly among the different versions of the game. At the end of the song, the player is given a final score based on the number of correct steps and the timing accuracy of the steps. A performance of over 90% perfects will give a score of "AA". If every single step has the perfect rating, the final score is "AAA," which is the ultimate goal for most players.

Each DDR version contains a selection of songs that often feature a heavy beat. The tempo of the songs ranges from slow to fast, and a song may even include changes in

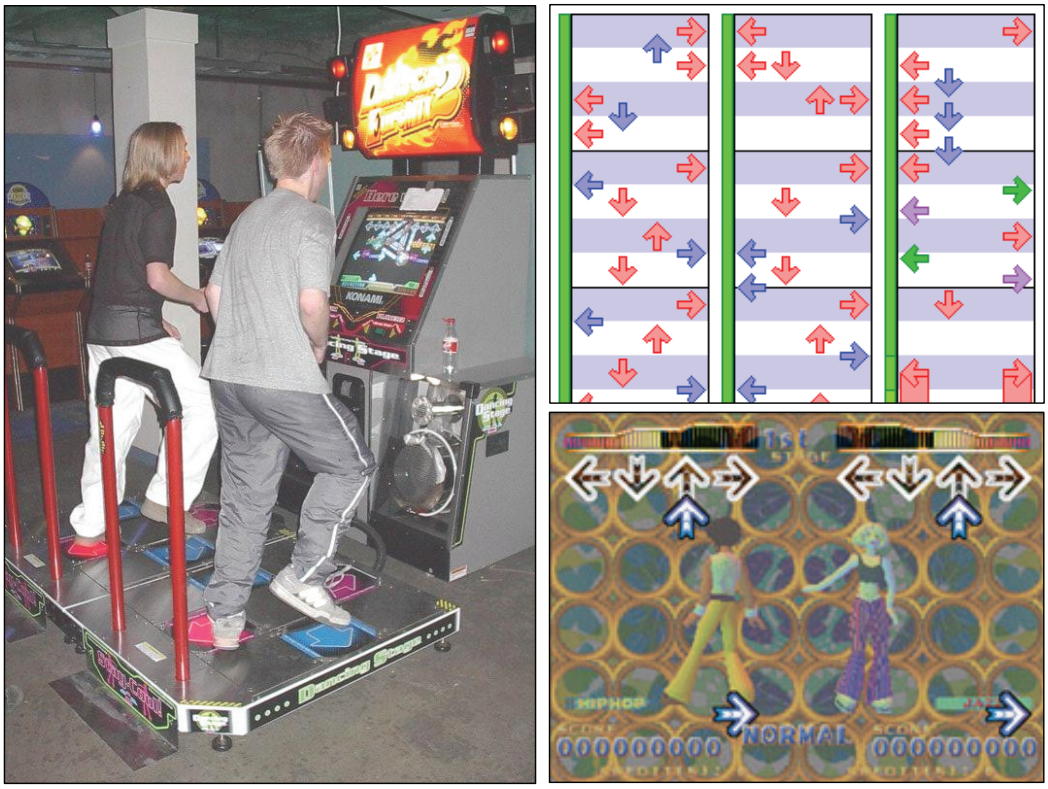

Fig. 1. Two players playing the game together (left, photo courtesy of Positive Gaming AS); a part of the step chart of MAX 300 Maniac (top right, source: www.ddrfreak.com); and a screenshot of the game (bottom right).

tempo. Arrows fall on the beat of the song (1/4 notes) or exactly in between (1/8, 1/16, and 1/32 notes). As the game is based on the precise timing of steps, it requires a good sense of rhythm, as well as the ability to coordinate the movements of one's body in anticipation of rhythmic repetition and alteration.

Each game is based on a predetermined set of steps (Figure 1, right), i.e., the arrows scroll at a set rate depending on the beat of the song and the level of difficulty determined by the step pattern of a song, with a rating ranging from 1 to 10 *feet*. The lowest, 1-3 foot patterns are meant for beginners, whereas the 9-10 footers require excellent physical endurance, coordination of movement, and sense of rhythm as the step patterns become more elaborate and faster.

The game set-up also consists of different *modifiers* that affect either the visibility of the arrows (e.g., all arrows appear in the same color regardless of the beat); the direction of the arrows' movement (e.g., arrows scroll from top to bottom); or the orientation of the arrows (e.g., arrows are rotated 180 degrees). *Speed modifiers* can be used to make sight-reading easier by speeding up or slowing down the arrows to *n*-times their normal speed.

Beginners usually stand in the middle of the pad and only use one foot at a time to press the arrows, or return their feet to the middle of the pad after each step. However, there is no penalty for pressing an arrow unnecessarily, which enables fluent movement across the pad. Skillful players employ special techniques such as (to name a few): *crossovers* (to hit the left-down-right arrow combination, the player does the steps left-

right-left while simultaneously turning to the right); *hand plants* (player uses his hand to hit a panel); and *jumps* (player jumps and presses two arrows simultaneously).

There are two main forms of playing DDR: (1) *attacking,* which aims for a perfect timing of steps, i.e., highest scores or number of Perfects; and (2) *freestyling/improvising*, where the aim of the player is to dance as expressively as possible, i.e., perform using a personal style. Freestyling is based on a routine to perform during a song, while improvising is based on making up a routine on the spot without prior practice. Tournaments are held world-wide, and usually include a competition series for "Perfect Attackers" (PA). Freestyling tournaments are less common. In addition to playing with feet, many DDR players do so by tapping keyboard keys with their fingers.

3. RELATED WORK

3.1 The Evolution of Dance Games and Peripherals

Dance games originated in 1998 when Konami launched the *Dance Dance Revolution* cabinet in Japan, where it immediately became a big hit in arcades. However, the idea of controlling a video game with feet had already been applied in several games and peripherals including *Joyboard* (1983, Amiga for Atari 2600) and *Roll and Rocker* (1989, LNJ for NES), which can be considered an ancestor of modern skateboard controllers. Moreover, in 1987, Exus Corporation developed two games, called *Jogger* and *Reflex* for the Atari 2600 console. The games were sold together with the *Foot Craz Activity Pad* (i.e. 24" x 30" foam pad that had sensors beneath five color-coded spots). The same year, Nintendo launched the *Power Pad* that was used by pressing the buttons with feet. Modern soft dance pads can be considered descendants of those early pads.

Music and rhythm games have strong roots in Japan, and most of the games in this genre were first launched there. The music and rhythm games genre started in 1996 when *Parappa the Rapper* was launched for the Sony Playstation [Fisher 1994]. The aim of the game is to repeat its rhythmic pattern by pressing controller buttons to match onscreen cues and the rhythm of the song [Fisher 1994]. Two years later Konami released *Beatmania* in Japan as an arcade cabinet. Both DDR and *Beatmania* belong to Konami's *Bemani* series where "the premise of the game is to follow scrolling cues on the screen and hit the button on the interface that corresponds to on-screen cues at the appropriate time as indicated on-screen" [Liu 2002]. The game idea in all *Bemani* games is similar, but the physical peripheral and its use differ between the games. For example, the game might be controlled by a combination of keyboard-like keys and a turntable (*Beatmania*), a dance platform with directional arrows (DDR), a simulated guitar controller (*GuitarFreaks*), nine big buttons (*Pop'n Music*), or infrared sensors (*Para Para Paradise*). Further information on the history of DDR cabinets can be found in Arcade History Database [2005]

Most of the dance games are first released as arcade cabinets, but then turned into home versions that are played either with soft or hard pads attached to a video game console. The number of different DDR titles, also called mixes, is vast. The game is available for various consoles, and even for Nintendo's *Game Boy Color*. There are also mixes that are specifically developed for particular consumer markets and segments, for example, DDR USA in the United States, or DDR Disney Mix, aimed at younger user groups. The biggest competitors of DDR are Andamiro's *Pump It Up* (released in 1998) and Roxor Games' *In The Groove* (2004). Konami has also taken legal measures against its competitors and sued both Roxor and Andamiro for infringing its patent rights.

In addition to original Konami DDR titles, there are simulators such as Stepmania [Stepmania 2005] and Dance with Intensity [Dance with Intensity 2005] that emulate

DDR and other dance games on PCs. The simulators have become increasingly successful for several reasons: they are free of charge, they contain several modes, players can download a large selection of songs and step patterns, they can be played either with a dance pad or a keyboard, and players can edit and create new step charts.

3.2 The DDR Phenomenon

The popularity of DDR varies from country to country and from continent to continent. When DDR was released in Japan, it immediately became a big hit, but its popularity has declined since its glory days. David Liu has written an insightful report on how DDR became successful in the United States [Liu 2002], the obstacles that had to be overcome to bring DDR to the American market and the measures Konami took to promote the game to players. Although DDR is doing well in the USA, it is possible that DDR might experience a similar drop in popularity in Northern America as happened in Japan. Nevertheless, the European DDR scene is still relatively fresh and the number of players is growing rapidly. Unfortunately, there are no studies on how DDR game culture has evolved in Europe, probably due to the diverse nature of computer gaming and arcade cultures in the different European countries. For example, in Finland there exist only four DDR cabinets, two of which are located in the lobbies of movie theaters instead of arcades. Norway has been one of the most progressive European countries in terms of DDR. The game received the status of an official sport in 2003 in Norway, and the Norwegian fan base is strong and active.

3.3 State of the Research on Dance Gaming

Although there are vast numbers of Internet articles about DDR and dance gaming in general (as well as lively discussions in forums dedicated to DDR), systematic user studies of the dance gaming phenomenon have not been undertaken so far. More and more small polls and surveys appear in discussion forums (e.g., http://www.ddrfreak.com/statistics.php) when members of the DDR community are themselves carrying out informal research to find out more about their favorite game and game community.

There is little scientific research done on any form of dance gaming. Studies to date have dealt with issues such as the reasons behind the success of DDR in the United States [Liu 2002]; a case study of the development of the DDR community [Chan 2004]; a study of DDR and music video game fan cultures [Smith 2004]; and genetic algorithms for determining optimal step patterns in DDR [Nogaj 2005]. Some studies are currently underway to evaluate whether DDR could be used as treatment for obesity and to motivate children and teenagers to exercise. For example, West Virginia University and West Virginia Public Employees Insurance Agency (PEIA) are carrying out a “Games for Health” study aimed at 7- to 12-year old obese children [PEIA 2005]. The purpose of the study is to determine the effects of a home-based exercise program on cardiovascular risk factors in children.

4. STUDY

This section describes how the questionnaire was designed, pilot-tested, and delivered to the participants and how the data was collected. Moreover, the chapter contains details of the participants and discussion about how the participants of this study match the overall player population.

4.1 Designing the Questionnaire

The design of the questionnaire was based on extensive study of the history of music and rhythm games, research on dance gaming, scanning through discussions on DDR forums,

interviewing DDR players, and studying the effects of computer games and game research methods. Based on the study, a list of themes and related question sets were created according to guidelines for doing survey research [Kitchenham and Pfleeger 2002a; 2002b; Babbie 1973].

Finally, the questionnaire was pilot-tested and reiterated with three passionate Finnish DDR players and three researchers in HCI, to both validate the content and ensure that the survey would be understandable to prospective participants. Then, a system of gathering and storing the data was implemented and tested to ensure that there were no errors in handling the data.

4.2 Final Questionnaire

The survey contained a broad range of questions that aimed to gather reliable and objective data on various aspects of the DDR phenomenon. The questionnaire can be found on-line at: http://www.cs.uta.fi/~johanna/DDRS/questionnaire.html. This article focuses on reporting the results of the following themes (in parentheses) and related questions:

- Where and how often do players play DDR? Are there established playing conventions? How much money have players spent on DDR and do they play other music and rhythm games as well? (*Dance gaming background*).
- What are the main reasons why people begin to play DDR? What aspects of the game keep them interested in it? What factors in game-play are the most difficult to learn and what learning measures are typical among players? (*Motivational factors and learning to play*).
- What factors are important in creating a pleasurable dance gaming experience? What can decrease it? (*Positive and negative player*).
- Does DDR gaming promote social relationships? What forms of socialization exist? What are the main DDR gaming-related activities that players take part in? (*Social issues of dance gaming*).
- How big a part does dance gaming contribute to the players' physical exercise? According to players, what positive and negative physical effects does DDR gaming have? (*Physical effects of dance gaming*).

The results are categorized by the themes listed above; throughout the treatment the players are given a voice through quotes.

4.3 Call for Participation

The questionnaire was published on April 6, 2005, and closed a month later on May 3, 2005. A *call for participation* that explained the background of the study and contained the URL of the online questionnaire was submitted to the most popular DDR forums (www.aaroninjapan.com , www.ddrfreak.com ; www.bemanistyle.com ; www.positivegaming.com ; www.ddronline.net/world/) as well as several national DDR sites (Finland: www.ddrfi.net ; Italy: www.ddrplanet.it ; Norway: www.ddrnorway.no ; Spain: www.ddrspain.com ; Sweden: www.ddrsverige.com ; UK: www.ddruk.com). Since DDR players frequently follow discussions in DDR forums, DDR forums were used to recruit the participants. Several respondents also replied to the call for participation message, and said that they had informed their friends and local players to take part in the study.

4.4 Participants

Between April 6 and May 3, there were 562 responses submitted, 6 of which had to be rejected due to incomplete answers. Thus, the complete responses of 556 DDR players

(12.6% females and 86.4% males) were analyzed. Most of the respondents live either in Europe (46.8%) or North America (50.1%); the distribution of the respondents' nationalities is shown in Figure 2.

Although DDR was originally released in Japan, and has been very popular in Asian countries, the questionnaire drew only a few responses from that region. This may be due to two reasons: Asian DDR players have their own forums and the *call for participation* message did not reach them, or that DDR is already a passing phenomenon in many Asian countries, and has been replaced by other forms of dance-gaming. Thus, while examining the results of this study, we should keep in mind that the results are based on answers given mainly by European and North American DDR players. From this point forward, the respondents of the study are called DDR players, players, or simply respondents.

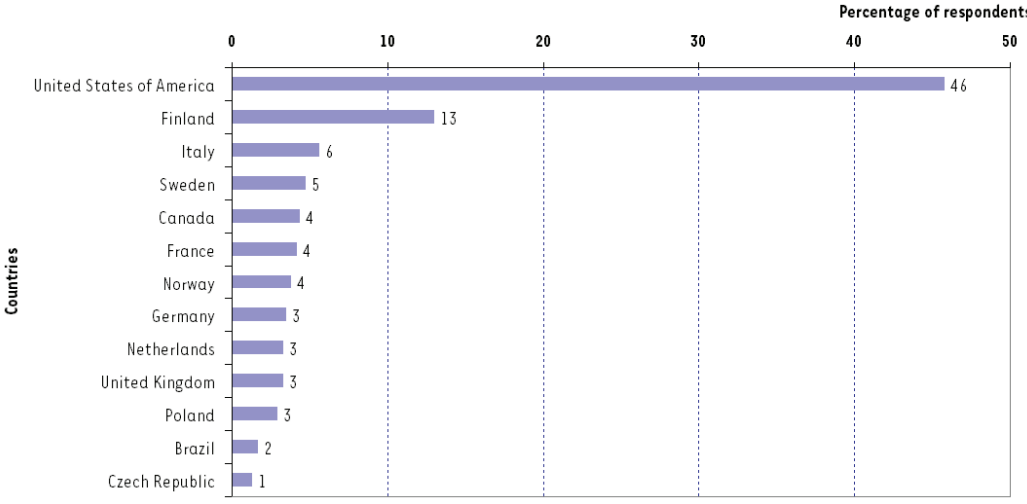

Fig. 2. Respondents' nationalities. The following countries are included in the "Others" category: Australia, Belgium, Switzerland, Chile, Ireland, Japan, Latvia, Peru, and Slovakia, each contributing less than one percent of all respondents.

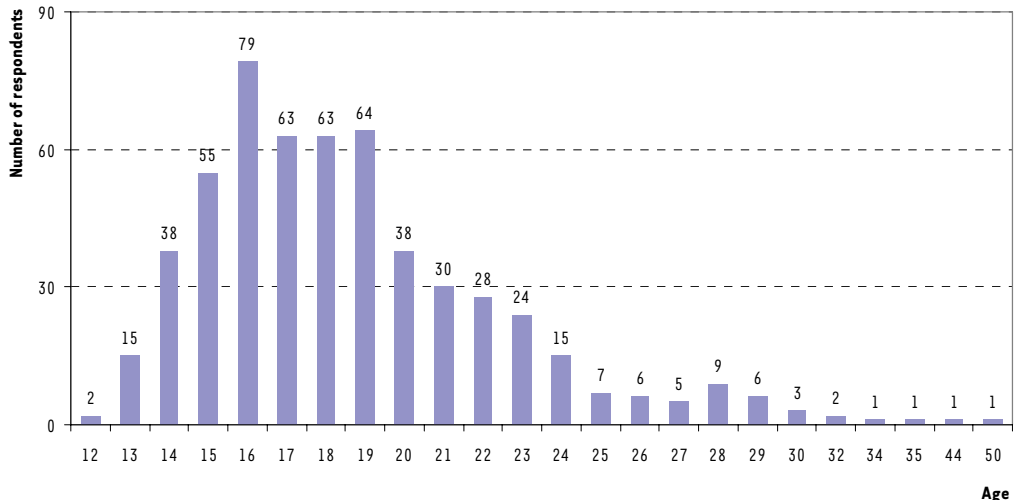

Fig. 3. Histogram of the respondents' ages.

DDR is popular mostly among teenagers and young adults, as seen in Fig. 3. The average age of a respondent is 18.7 years (SD = 4.15). Based on the background research, there are younger DDR players as well, but due to the nature of the study they could not be reached easily. As the game interaction and idea is fairly simple and the game content is suitable for everyone [Entertainment Software Rating Board 2005], even young children can play the easiest game levels successfully. For example, the obesity study conducted at West Virginia University [PEIA 2005] carries out the research with children as young as seven, but even five year-old children were reported to play the game.

The respondents' current skill levels (i.e., the level of difficulty a player can pass successfully) were quite high -- 80.2% reported that their skill level was 4, the highest game level (e.g., Maniac/SSR in DDR, Heavy in Stepmania and DDR extreme, and Expert in DDR USA and Euromix); 14.6% said they were on level 3 (i.e., Another/Trick, Standard, or Difficult, respectively); only 4.8% respondents were beginners on levels 1 or 2.

5. RESULTS

5.1 Dance Gaming Background

This section lists the key details of the respondents' playing habits, including how long they have been interested in DDR; how often they play the game; where the play sessions take place; and how long the sessions last. The most common playing styles are discussed, along with other music and rhythm games DDR players play, and how much money they spent on their hobby.

5.1.1 *Characteristics of Playing Habits*. The respondents were interested in DDR for the following amounts of time: six months to one year (19.1%); one to two years (25.0%); and two to three years (21.0%). There were 13.1% beginner respondents who played DDR less than six months; 21.8% respondents were familiar with the game for more than three years.

A majority of the respondents played the game frequently: 31.0% of the respondents practiced DDR two to three times a week, but "hard core" players may play the game four to six times a week (22.6% of respondents), or even daily (17.4%); 16.6% of players played the game once a week; and 12.4% once in two week or less often.

Players also spent a considerable amount of time playing *Dance Dance Revolution*. The length of an average play session, including breaks and waiting for one's turn, varied, mostly between half an hour and two hours. The statistics for lengths of play sessions were less than 15 minutes (2.0% of respondents); 15 to 30 minutes (8.0%); 30 to 60 minutes (22.2%); 60 to 90 minutes (19.5%); 90 minutes to two hours (16.6%); two to three hours (12.0%); three to four hours (10.2%); and more than four hours (9.5%).

The game is played most often either in arcades or at home (15.2% play only in arcades; 66.2% play both in arcades and at home; and 8.8% play only at home), but increasingly also in mixed settings such as a friend's or relative's home, at conventions, LAN parties, schools, as well as churches and clubs that organize free-time activities for children and teenagers.

5.1.2 *Scoring with Feet.* The majority of players (76.9%) are *scorers* who aim at perfect timing of steps and do not include freestyling in their play routine. However, 13.0% of respondents are pure *freestylers* or *improvisers* whose main reason for playing

is to dance expressively either with or without having practiced a routine; 10.1% of respondents reported being both scorers and freestylers.

In addition to stepping on the dance mat, DDR can be played by tapping the keyboard (e.g., to play the Stepmania simulator or by using a hand-held game device like the Nintendo Game Boy Color). Most of the players (91.2%) played with their feet, but 54.1% of respondents also reported that they played with their fingers. There are also small numbers of players (8.8%) who did not stomp to the beat at all, but used only manual input to play.

There is a set of established DDR movements that players use frequently to hit the panels; Table I lists those movements. A short description of the movements can be found in parentheses.

Most of the freestyle players (63.6%) used common freestyle moves. Nevertheless, 13.7% of freestylers also borrowed movements from real dance styles. One of the main

Table I. The Most Common DDR Movements Used by Respondents

DDR movement	Percentage of players using the movement
Crossover (rotating, i.e., to hit the L-D-R arrows, the player steps L-R-L and turns right)	69%
Jumping	61%
Double step (using the same foot to hit two different consecutive arrows, often considered a bad movement)	57%
Butterfly turn (a sequence of U-R-D-L steps, i.e., basic turning)	50%
Slide (using one foot to press one panel and then another without lifting the foot off the pad)	33%
Spinning (pivoting 360 degrees on a single foot)	23%
Using hands to make the game play more dance-like	23%
Hand plant (using a hand to hit the panels)	22%
Knee drop (using a knee to hit the panel)	19%
Left or right foot only (using only left or right foot to hit all the steps)	15%
Using one foot at a time to press a panel while the other foot remains in the middle of the pad (typical for beginners)	9%

purposes of freestyling is to entertain and impress the audience. And many freestylers commented that they want to make the crowd laugh, and so made up all sorts of funny moves and crazy stunts. Some respondents (6.9% of them) mentioned that they liked to improvise and come up with new moves as they play. As the aim of this study is to take a broad look at the dance gaming phenomenon, an in-depth analysis of dance gaming styles is not the main focus of this study.

> *Depends if i want to show my skills or not... If i just want to make a good score then i usually use common DDR movements...* (Male, 16)

I usually make funny moves and stuff like that. I love to impress the audience! (Male, 28)

To be blunt--I make it up as I go along. I don't really create a routine of any kind, or rehearse it. I get an idea of what I want to do in my head, and I do it. (Male, 20)

I use both common DDR movements and real dancing moves, with quite a bit of my own flavor. (Male, 14)

5.1.3 *Players and Other Rhythm and Music Games*. A minority of respondents (6.3%) reported having played other dance and rhythm games before playing DDR. Conversely, the results also show that when players get involved with DDR, they tend to try other rhythm and dance games as well. An astonishing number of respondents (97%) reported trying out at least one other dance and rhythm game (the 15 most popular are shown in Fig. 4). In total, 59 different game titles were mentioned in the answers.

Dance game simulators such as *Stepmania* and *Dance with Intensity* are popular; but the biggest competing titles to DDR are also well-liked, as almost half the players have tried out *Pump It Up* (49% of respondents) or *In the Groove* (32%). There are also musical controllers used by players such as *Donkey Konga, Taiko Drum Master,* and *Taiko no Tatsujin*, all of which employ drum-like controllers that need clapping to the rhythm of the music. The rest of the games above are other Bemani games, except Harmonix's *Amplitude and Frequency*.

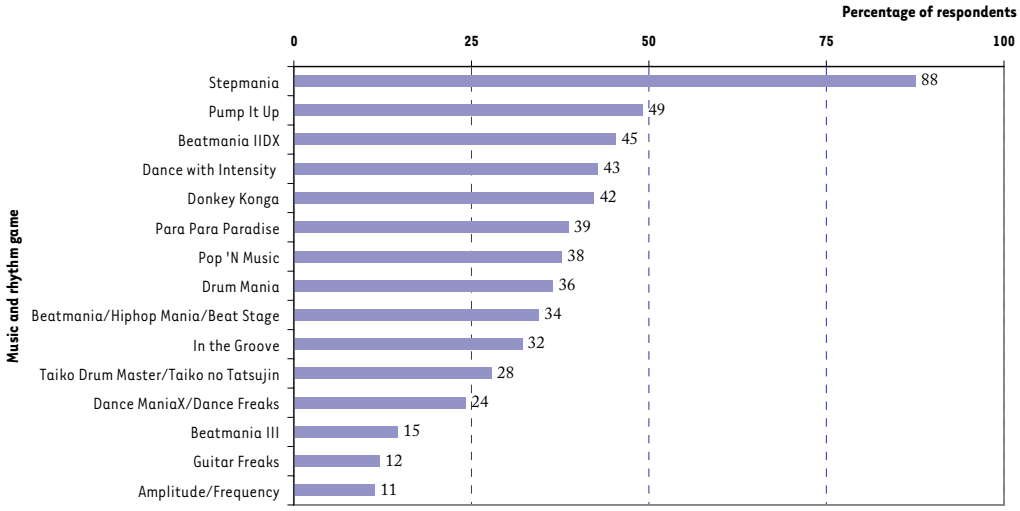

Fig. 4. The 15 most common dance and rhythm games and simulators.

5.1.4 *Not Necessarily a Cheap Hobby*. Respondents were asked to estimate how much money they had spent on dance games in total (including arcades, hardware, software, trips, etc.); the results are shown in Figure 5. Although many players preferred playing the game in arcades, high fares and distant locations induced some players to play at other locations as well.

There were 40% of players who reported purchasing either hardware or software to play DDR. Typical investments for home equipment include a video game console or PC, one or several dance pads, an adapter for dance pads, and a selection of game titles (some imported). Even though home versions of the game are rather inexpensive (approximately $25 to $50 for a game bundle), players often wanted to purchase a higher-quality dance pad that might cost up to $300, as well as other accessories to enhance game-play. The

majority of players had at least one soft pad (88%); but hard pads were becoming increasingly popular, as 41% players owned at least one; 13% of respondents built their own pads; and 2% of respondents purchased an arcade cabinet for their own use. Players reported that 82% of pads had broken down; Due to the poor durability of soft pads many players had to buy several mats.

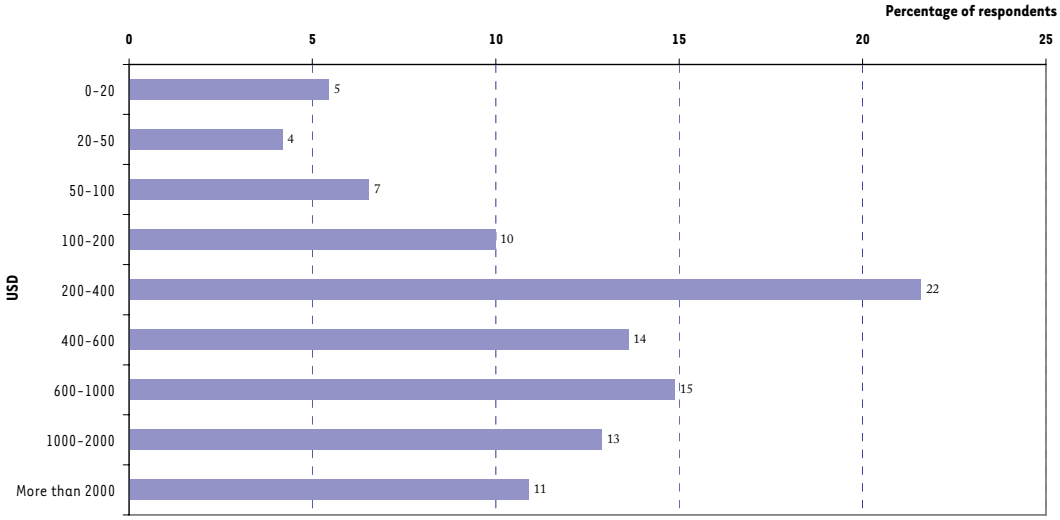

Fig. 5. The estimated total amount spent on dance gaming.

5.2 Motivational Factors and Learning to Play DDR

This section discusses the initial reasons why the respondents began playing the game and how the reasons have changed over time. In addition, the learning aspects of DDR are discussed, along with measures that players took to improve their skills.

5.2.1 *Other People*: *The Number One Reason to Play DDR*. More than half of the respondents (50.2%) reported that the game was originally recommended or introduced by their friends or relatives. They were invited to play by their friends either at home or in an arcade, or saw the game being played by other people.

The *spectator experience* was emphasized explicitly in many answers; players said that their motivation to try the game blossomed after seeing others play and being intrigued by their skills. The performance of other players challenged the respondents and made them want to become as skilled as the fluent players.

> *I watched people play it in the arcade and I liked the rhythm of the song and was amazed by the ability to dance to it. I played it a few times and liked it but never thought I could be really good. When I realized my friends had home versions of the game, and after playing at their houses, I had to own it. So I first tried out DDR because I saw people doing it and it looked like fun. I had never seen a dancing game before. I was thrilled with the idea. So I tried it out hoping to get a crowd.* (Male, 15)

> *I'd heard about it but never knew where I could find one. When I saw someone play I was amazed that humans were capable of moving that fast, so I decided to become like that.* (Male, 17)

> *I saw people who looked good and thought it'd be fun to be that good. I saw a review of DDR in a gaming magazine, with equipment prices and got it later that year as a "family Christmas present".* (Male, 17)

The second biggest reason given for playing DDR was the *novelty factor*: 19.5 % of respondents mentioned that they were fascinated by the game concept first, one that mixed music and rhythmic movement and was played with one's feet. DDR provides an original gaming experience, and most importantly, looks like fun.

> *When I saw the game for the first time, I thought it was so unique and challenging I just had to give it a try. It was not like the other video games, and that was appealing to me, since I'm an active person (that is, always doing some sort of physical activity).* (Male, 24)

> *The concept seemed unique and interesting.* (Male, 20)

Some players (7.8%) said they became interested in the game when they first heard about it in the media (e.g., TV, films, articles, and reviews), but the most influential motivation came from watching freestyling videos on the Internet. A small number of players (3.4%) said they had a passion for dance music, dancing, and Japanese culture, which eventually got them interested in DDR. The health benefits associated with DDR did not play a significant part in the decision to begin playing the game. Only 1.5% of respondents reported health as a reason to play the game, and even fewer because it helped them to lose weight (0.9% of the respondents).

On many occasions the first encounter with the game was at small social events like birthday parties, where the game was installed because it is fun; or when a friend took a novice to the arcade, or let the novice borrow dance game equipment. Sometimes, the first play was involuntarily or a joke, but even then many players said that they very soon got hooked on it, even when they first thought the game ridiculous. Some respondents (11%) mentioned that they were introduced to the game by a friend in an arcade; in half of the cases they did not know what the game was when they first saw the arcade console. After the first play session at an arcade, many beginners purchased their own dance-gaming equipment and practiced at home until they became comfortable enough to show their skills in public again. In 6.3% of the cases the players already had experience with other dance and rhythm games and then moved on to DDR. A background in dance and rhythm gaming most often involved playing DDR simulators with the fingers. In 5.9% of the cases, organized events such as exhibitions, tournaments, conventions, and LAN parties were reported as the places where players first encountered the game.

5.2.2 *Fun, Exercise, and Challenges*. But once players got involved in playing *Dance Dance Revolution*, the initial reasons for playing it did not apply anymore. When players were asked why they played dance games, they were very specific in describing their main reasons. **Six** distinctive categories emerged from the answers:

The entertainment factor. For 65.6% of the players, the entertainment factor (i.e., playing because it is fun, amusing, and cool) was one of the main reasons.

Health benefits. Although health benefits did not play a significant part in the initial decision to play, the *physiological benefits* (e.g., feeling well and relaxed after playing and a sense of improved coordination and rhythm) were mentioned by 55.2% of respondents as reasons for continuing to play. Additionally, many players mentioned that DDR was their only form of exercise (discussed in more detail in Section 5.5).

> *At the beginning i play DDR just for fun, but now, that i am a very good player (one of the best in europe) i intend DDR as a Sport, so i have to train on it, i have to improve my skill for compete in the tournaments.* (Male, 16)

Challenging oneself. For 23.9% of the players the personal challenge (e.g., playing a difficult game, improving as a player, feeling good at something, seeing results, possibility of competition) was the third most common category.

> *I like competing against my own limitations to become more adept at it.* (Male, 23)
>
> *It's also great to watch myself improve slowly but surely, getting better and better scores on harder songs.* (Male, 19)

Socialization. As reasons for playing, interactions with people, such as making new friends and being part of the community, were mentioned by only 18.5% of respondents. This is surprising, since more than half the time the initial encounter with the game happened through other people. ***Music*** was mentioned by 18.7% of players; ***performance*** (e.g., the possibility of performing, show of skill, and entertaining a crowd) was reported as a reason to play in 5.7% of the answers. Thus, we can already see a slight shift from being a spectator to becoming a performer, a phenomenon strongly associated with DDR game-play. (The social aspects of the game are discussed further in Sections 5.3.2 and 5.4.)

> *It's fun and I want to get better so I can show off for people at the arcades. It's also good that you get better health of dancing and it helps me for my Street Dance lessons.* (Male, 16)
>
> *Why do I play dance games? The first thing that attracted me to dance games was the music. I've always liked electronic music and that's what dance games offer. The music featured in a dance game is upbeat, vibrant, diverse, interesting, and fun. You will find an occasional slow song, but they usually have something special about them that will force you to enjoy them also. Another factor that has drawn me toward music-oriented games is their fun factor. Dance games have created a fun way to past time, play a game, and not be on your butt the whole time. The final, yet important factor about dance games is the fitness factor. Although fitness isn't my main focus when playing DDR or another dance game, I have to admit that dance games offer a fun way to exercise. They force you to build endurance, stamina and, create, or enhance, one's sense of rhythm.* (Male, 16)

In addition to these main categories, there are minor ones, like the uniqueness of dance games (mentioned by 3.1% of respondents); killing time (2.8%); a free selection of dance styles (1.3%); and a break from other games, especially violent ones (1.1%).

5.2.3 *Learning to Play*. Novice players easily grasp the idea of DDR; it is even possible to play the game successfully after a short learning period. Nevertheless, the game provides continuous challenges even for experienced players by offering many game levels and options that put the player's physical ability to the test. Additionally, the large selection of songs and step patterns suits the tastes of a large player population. To find out what aspects of game-play are the most challenging skill-wise, players were asked which factors they considered the most challenging; the answers are shown in Fig. 6.

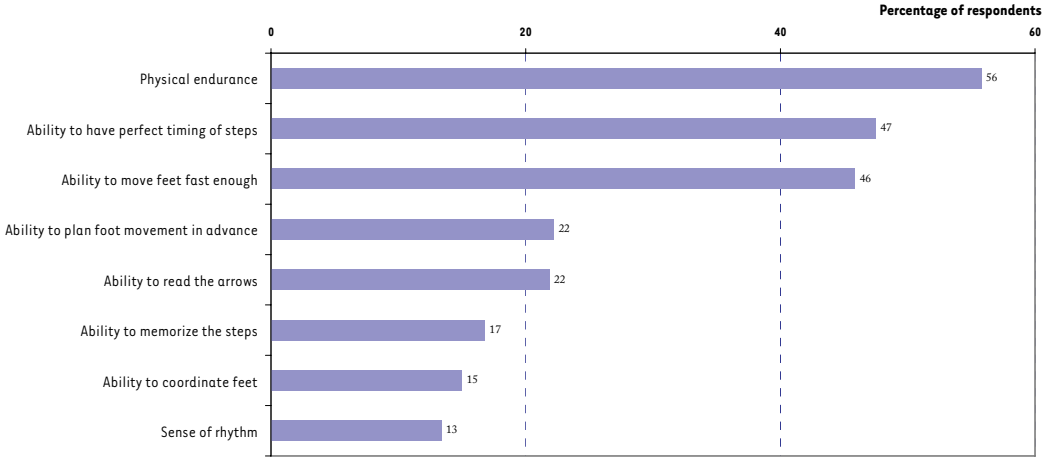

Fig. 6. The most challenging factors.

The most challenging factors are related to human performance and motor skills, including physical endurance, perfect timing, and the ability to move one's feet quickly. Playing DDR does not require complex cognitive skills or problem-solving abilities that are essential in many other game genres. Moreover, compared to traditional games, the core of dance games is to measure and score the player's physical performance and sense of rhythm. The player testimonials show that dance gaming can teach valuable motor skills, and measure the player's ability to score and master even more difficult game levels. The physiological benefits of dance gaming are discussed in detail in Section 5.5. It is important to note that the skills mentioned above apply mainly to tech players who aim to achieve a perfect score. However, players did not report on the challenges in learning to freestyle better.

The motivation to become a better dance gamer manifests itself in various ways, as seen in Table II, where the measures players took to learn to play and enhance their skills are listed. In addition to the predefined categories listed above, the respondents also provided additional factors. The answers reveal three supplementary activities for becoming a better player: (1) study step charts and think about how to realize the steps; (2) practice with Stepmania or another DDR simulator with a keyboard or a pad; and (3) listen to DDR music and learn the rhythm and tempo changes in the songs.

> *Checked stepcharts on different websites (www.ddrfreak.com) so I can go through the difficult parts of a song.* (Male, 19)

> *Watching really advanced step combinations and thought out in my head before I play in which order I would step on the arrows (and which foot to use).* (Male, 18)

Table II. Measures for Becoming Better Dance Players

Measures taken to become a better dance gamer	**Percentage of players taken the measure**
Playing dance games regularly	93%
Watching other people play	75%
Asking for tips or instructions on DDR forums, IRC or similar sources	38%

Shadowing (i.e. trying to follow other players' moves while they are playing)	25%
Borrowing movements from other people playing dance games	23%
Watching DDR freestyle videos	23%
Watching music videos and adopting professional dancers' movements	12%
Asking someone to teach	11%
Practicing movements in front of the mirror or filming one's own playing and analyzing it later	8%
Taking part in dance classes	2%

5.3 Positive and Negative Player Experiences

The gaming experience forms an integral part of game-play, and without examining it any investigation of the game itself would be incomplete. This section focuses on the factors that are important in creating a pleasurable dance gaming experience and lists the issues that decrease the pleasure. The results are a combination of the answers in the predefined categories shown in Figure 7 and the players' opinions on both positive and negative aspects of the dance gaming experience.

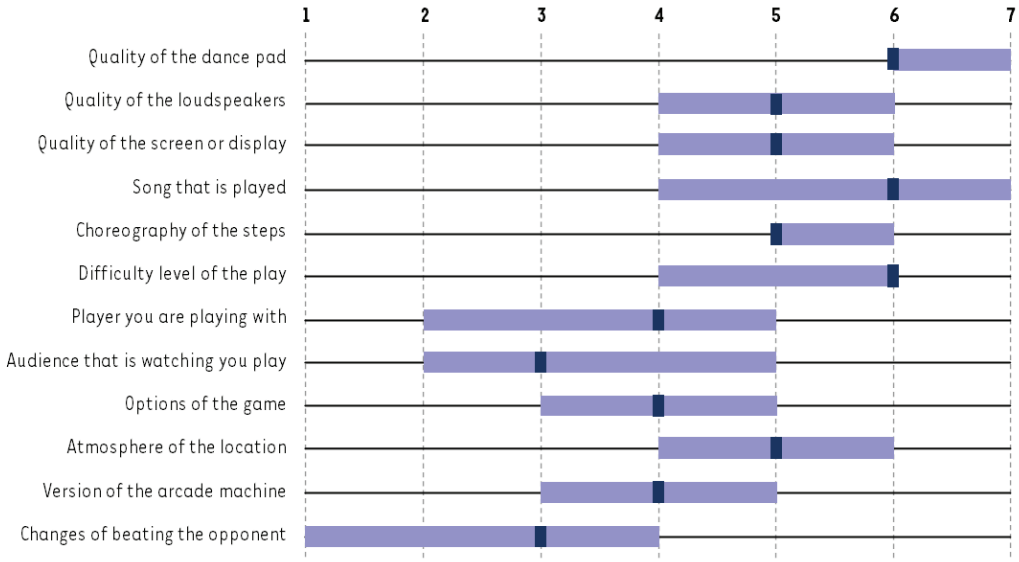

Figure 7. The ratings of DDR gaming related factors based on how important DDR players view them in creating a good dance gaming experience (1= not important at all to 7 = the most important factor). The light blue bars denote the region between the first and third quartile (50% of responses) and the darker blue dots are the median values. For all factors the answers ranged from 1 to 7 (thin black line).

5.3.1 *Technological Quality*: *The Dance-Gaming Equipment.* The results show that the technological quality of the dance-gaming equipment (i.e., dance pad, loudspeakers, display, and the machine itself) constitute a large part of both positive and negative gaming experiences. The most important part of game-play is the functionality of the input devices, i.e., the dance pad and the system that registers steps -- even a slightly poor dance pad might ruin the whole experience. The most common problems with pads are

broken or stuck arrows (panels), nonresponsive pads, and a slipping pad. All of these defects make the steps either inaccurate or delayed, or only partially registered. This can be catastrophic, since in most cases the main aim of game-play is to have the best possible score for each step. The quality of the loudspeakers is vital for hearing the beat properly and for experiencing the song. The volume of the arcade machine should be adjusted so that players can hear the song properly but do not need to shout over it. The display should be bright enough and the room properly lit so that the arrows are clearly visible. Problematic issues are screen glare or dimness, both make it difficult to see the arrows properly. The volume of the loudspeakers was considered more important than the quality of the audio equipment itself.

> *Good quality equipment is the single most important factor. It is incredibly frustrating to miss steps because the pad does.* (Male, 23)
>
> *If the arrows on the machine are broken in some way. Nothing kills a game faster then what the machine stops registering what you're doing*. (Male, 18)
>
> *Nonresponsive gamepads are a HUGE annoyance! I don't mind the quality of the pad in the sense of it being a flat cheap plastic one or an arcade pad, but they have to respond to the hits. (Male, 22)*

5.3.2 *Socialization and Behavior.* DDR is a very social game that draws the attention of bystanders and has a strong fan base, but this also causes some side-effects, which we discuss next. The role of co-players and the audience divided the respondents' opinions. At first this appears strange, but a deeper look at the factors that constitute a negative experience shows that many players have experienced inappropriate behavior from the audience during public play sessions. However, playing with friends and making new friends, as well as a supportive audience, were mentioned as positive experiences by 22.0% of players. Although the competitive aspect of the game was not very strong for all players, respondents mentioned that comparing scores with friends and gentle competition made the game-play more interesting. The players also mentioned that a positive attitude made the atmosphere more relaxed and encouraging.

> *Playing with people who like dancing games and people who are willing to enjoy the dancing game. I guess the person's attitude is important.* (Male, 20)
>
> *The local DDR/In The Groove community is one reason I play in arcades exclusively, so that's a pretty big point of enjoyment for me.* (Male, 19)
>
> *Having support. If people laugh or boo you when you make a mistake, what is the point of playing? DDR is meant to be fun.* (Male, 16)

Almost half of all the comments (47.3%) that dealt with negative gaming experiences were about how *bad player and audience behaviors* decreased the quality of the experience. A large number of players (65.3%) witnessed anti-social behavior meant to distract them. This might have contributed to a lower positive rating for the presence of an audience (Figure 7). The most frequently reported bad player and audience behaviors follow:

- *Disturbing and interfering with play*, which manifests itself in the following ways: jumping and stomping on the other pad or stepping on the pad where the play is going on; shadowing without permission; talking during play; stomping or clapping so loudly that the player cannot hear the beat; moving around the arcade machine in order to obstruct the play; standing too close to the player; and throwing things at the player. In many cases this kind of behavior is deliberate, and causes friction and arguments in joint gaming sessions.

- *Making fun of the player* is the second biggest category of anti-social behavior. Many respondents commented that both spectators and other players made insulting comments or laughed if a player made a mistake. Many players found it annoying to be called names by nonplayers just because they played DDR.
- *Children* often made game-play less likeable because they crowd around the player and do not realize that it interferes with play. Children also have a tendency to run around the arcade and jump on the pads. Hence the players' comments were not very child-tolerant.
- *A bad atmosphere* was mentioned several times by players, including unsupportive audiences, rude arcade managers, and the space itself; troublesome environmental issues are discussed later on.
- *Discourteous co-players* who are too egoistic and only want to show off annoyed many players. Some players do not wait for their turn or ask the other player about the song or options for the joint game. An overly competitive atmosphere at some locations reduced the gaming experience significantly for those players who just wanted to have fun.
- *The size of the audience* can be either too big or too small; but it was impossible to define the optimal size of the audience based on the answers in the questionnaire.

> *People walking/running in front of the screen, standing too close beside the pad so I can see them in my wide view and feel I'm gonna hit him or something, ppl shouting/making noise to distract...* (Male, 26)
>
> *People shadowing without permission. People trying to shadow while I play doubles. People who play for the sole purpose of showing people up.* (Male, 19)
>
> *When people begin to laugh watching you dance.* (Male, 19)
>
> *Annoying little kids running around either in front of you or behind you, having other people watching you and then make fun of you cause you look stupid, not enough ventilation in the room.* (Male, 19)
>
> *Arrogant players, most often ones that brag loudly about how well they play. If a player is really good, he should only have to play the game and everyone else will decide how good the player is from there.* (Male, 21)
>
> *Playing next to someone who wants to "win". I don't view it as a competitive sport, it's just about having fun and doing your best.* (Female, 23)

The DDR arcade communities are highly diverse in gender and in race [Chan 2004], but also in that players have very different personal motivations and goals. The competitive aspects of the game and "egoistic" players are considered a negative issue by people who play the game just for the fun of it. Players have commented that the competitive environment degrades the atmosphere in arcades and promotes negative behavior towards less skillful players.

> *Playing excessively in a competitive environment tends to make the player more competitive themselves like many other games, dance games can promote a sense of hostile "elitism" that discourages positive interaction.* (Male, 19)
>
> *Some people take the game too seriously, try to get over-competitive and/or develop a real bad ego. Also, some people worship other players almost religiously. It really looks bad to a 3rd person.* (Male, 28)
>
> *Competitiveness gets out of hands sometimes.* (Male, 14)

5.3.3 *The Game Environment.* The game environment, including the atmosphere, the qualities of the game space, as well as available services are important for players, especially for those who spend a lot of time in arcades. The problem with many arcades is that originally they were not designed for exercise purposes. For example, the temperature and humidity of the play space might be too high and the quality of the air bad. Air-conditioning is often poor, which causes sweating and discomfort in general. To overcome this, some players have installed fans near the arcade machine, or at home, in the room where they play. Some arcades also allow smoking, which makes exercising more wearing and unhealthy.

Some arcades forbid drinks in the play area, which complicates the situation, as players need to balance their fluid intake in order to continue playing. Thus, the availability of water and soda as well as restrooms are greatly valued by players.

Opinion about the time spent waiting for a turn to play was divided: some players found it a good opportunity to chat with friends and watch others play, but other players found the long queue really annoying. Respondents also reported that properly instructed and customer-friendly staff and well-maintained machines made game-play more enjoyable.

Loud talk, noise from surrounding machines, and the overall audio environment in arcades make it difficult for players to concentrate and hear the songs (also, the volume of the DDR machine is often turned too low). At home the problems are somewhat different. Many players commented that the stepping causes so much noise that family members or neighbors complain. Also, the room where playing takes place might not be suitable, or may be difficult to modify to suit the needs of the player. The most typical modifications done at homes consist of moving the furniture, fixing a pad on the floor, installing a new sound system, and setting up a fan to cool the room.

5.3.4 *Content*. In creating a positive gaming experience, the content of the game, including selection of songs and step patterns, is the second most important factor for players, who also want a large selection of songs, including popular tunes. Players also appreciate a good collection of step patterns that have character and are not repetitive. The home versions, especially DDR simulators, often have a larger selection of songs and step patterns than arcade cabinets do. The most negative aspect of songs and steps occurs when songs are out-of-sync. This, along with a nonresponsive input device, makes it almost impossible to play the game as designed. In terms of positive or negative game experience, the game options are rather neutral factors -- nevertheless, experienced players value a greater level of difficulty than novices do. In addition, for some players the possibility of adding new content to the game and modifying it is important.

> *Hard to say... that the steps got the same character/atmosphere/feeling as the music of the song itself got.* (Male, 22)
>
> *Good mix of songs. The problem with DDR now is the songs are starting to sound alike, instead of having a unique sound like it did back in the days of 2nd mix, 2rd mix, and 4th mix.* (Male, 19)
>
> *Poor song selection, lack of interesting stepcharts, and bad interfaces all ruin a game experience.* (Male, 14)
>
> *Off-beat songs that is song's footing just feels wrong when you play it…* (Male, 15)

5.3.5 *Personal Achievement*. According to the players, personal achievement contributes to a positive gaming experience to some extent. Players (7.6% of them)

mentioned that perfect play, learning something new, and performing a song that was unattainable before are some of the biggest motivational aspects of game-play. However, beating an opponent at a game was not very important, since in many cases the competition takes place while comparing scores after the game. Also, an opponent might hinder successful play by stomping really loudly, or a player may be so focused on his or her own game as to be oblivious to what the other player is doing.

> *To not miss any step! It's really something you are proud of when you do it! Also, finishing a song that you weren't able to pass before is something really nice.* (Male, 22)
>
> *I think an important thing for me is to see myself progress. It's simply a great feeling to suddenly be able to clear a song you couldn't dream of clearing a month ago.* (Male, 22)

5.4 Social Issues of Dance Gaming

According to David Liu, one of the most significant aspects of DDR is the player community that exists both online and offline [Liu 2002]. Liu continues, saying that "The duality of domain in the DDR community had a self-strengthening effect as friendships in real life at the arcade could be further developed on the message boards, until the next time they met at the arcades when social bonds would be further developed, creating a cycle of online and offline social bonding." Alexander Chan, on the other hand, asserts that "the DDR community is unique in that it was not formed through interactions within the game, but rather through interactions around the game at the arcades." [Chan 2004]. As case studies on DDR communities already exist, this section focuses on describing the numbers of players who participated in DDR activities both via the Internet and face-to-face.

5.4.1 *A Socially-Activating Game Form.* DDR-related social activities have many forms, of which the most important is people playing together. Joint game sessions take place at arcades and tournaments, but also at smaller events or at home. The majority of the respondents (92.4%) played, at least occasionally, with other people. Only 7.6% of respondents played the game alone. Most often play took place with a group of friends (64.0% of respondents) or with a friend or relative (48.9%). One third of the players (32.9%) belonged to a DDR team that trained together. Additionally, one third of the players shared a game with a stranger (34.2%), most often at public locations.

There are several reasons why DDR enables face-to-face socialization: One reason may be that the player's initial, as well as continual, contact with the game occurs through friends or relatives. The experience of being a spectator or a performer is important in fostering social gatherings around the game. The set-up of the game, especially the physical appearance and audio-visual effects of the DDR cabinet, draws the attention of the audience – discussed further in Chan [2004]. He also explains why an arcade game with no massively multiplayer option, which is usually required for a game community to form, has nevertheless fostered such a game community [Chan 2004]. Chan suggested that the DDR community can be divided into three diverse but overlapping subcommunities: the arcade community, tournament community, and online community [Chan 2004]. He also characterized casual players as a group that does not belong to the mainstream DDR community, but one that plays DDR in their own homes.

The DDR community in the United States began as an arcade community [Chan 2004; Liu 2002]. But the numbers of casual players grew along with the release of DDR for home use. Although in many European countries the casual play culture has existed in parallel to the arcade one from the beginning. There may be several reasons for this.

Although DDR is becoming increasingly popular in Europe, relatively few arcade cabinets exist, so instead of playing in arcades, many players have taken a "shortcut" and play the game with home versions and simulators first. Also, with the help of online forums, players have better access to DDR-related information than was available when DDR landed in the United States. European players tend to play the game at home more than players in North America do, as seen in Fig. 8. However, it will be interesting to see how the "arcade culture" will evolve in Europe during the next few years as more and more cabinets appear. In addition, the players are increasingly beginning to play the game online via *Stepmania* and DDR *Ultramix*. On the other hand, this may reduce face-to-face interaction between the players.

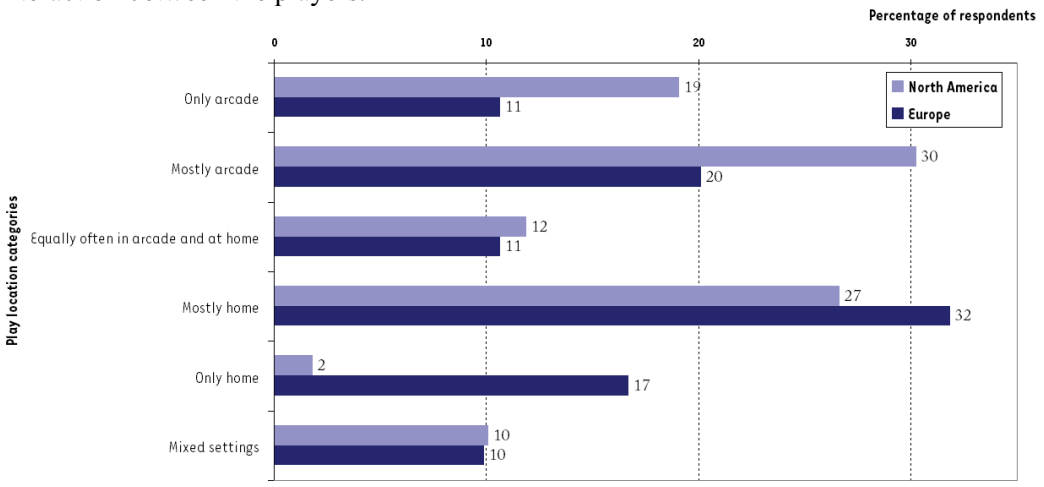

Fig. 8. Where the game is played in North America and Europe.

Playing DDR also provides opportunities to get acquainted with new people. As stated by McKee [2000] "people who might not otherwise spend time together become friends through DDR." 85.2% of respondents said that they had met new people through DDR. More than half the players (51.9%) meet regularly with others to play DDR. In addition, 35.0% of respondents made arrangements to play with others, at least occasionally.

> *The rush of the game makes it easier to communicate with other people, e.g., in competitions or other events.* (Male, 21)
>
> *I'm more social with others, I guess. I used to be pretty shy, but when it comes to DDR, I'm one of the most vocal persons there is.* (Male, 17)
>
> *It's really uplifting when you get a good score on a song, and i met several of my friends through ddr. it provides a great social network.* (Female, 18)
>
> *Socialness has increased, more friends.* (Male, 13)

The growing number of new players may be due to the willingness of experienced players to teach beginners; 58.1% of respondents have taught at least one other person to play DDR. However, the number of pupils per instructor varied greatly, from a one person to more than one hundred.

Chan [2004] mentions that participating in competitions and belonging to the tournament community is a big part of DDR. More than half of the respondents in this study (55.8%) attended at least one competition. The percentages of the number of competitions participated in are as follows: 38.3% participated in one to four

competitions; 9.9% in five to nine competitions; 4.0% in ten to fourteen; 1.5% in fifteen to nineteen; and 2.2% in more than twenty competitions.

In addition to actually playing DDR, players took part in various other DDR-related activities, as listed in Figure 9 in order of their popularity. Most often, to seek and exchange game-related information, nongaming activities took place online, by interacting directly with other players via IRC or chat rooms, or just getting new songs and steps. As of today, there are almost 55,000 registered user names in www.ddrfreak.com and thousands more in other well-known DDR sites, including www.aaroninjapan.com and www.bemanistyle.com. Furthermore, regional sites are important in building local DDR communities and bringing people together to play and take part in tournaments.

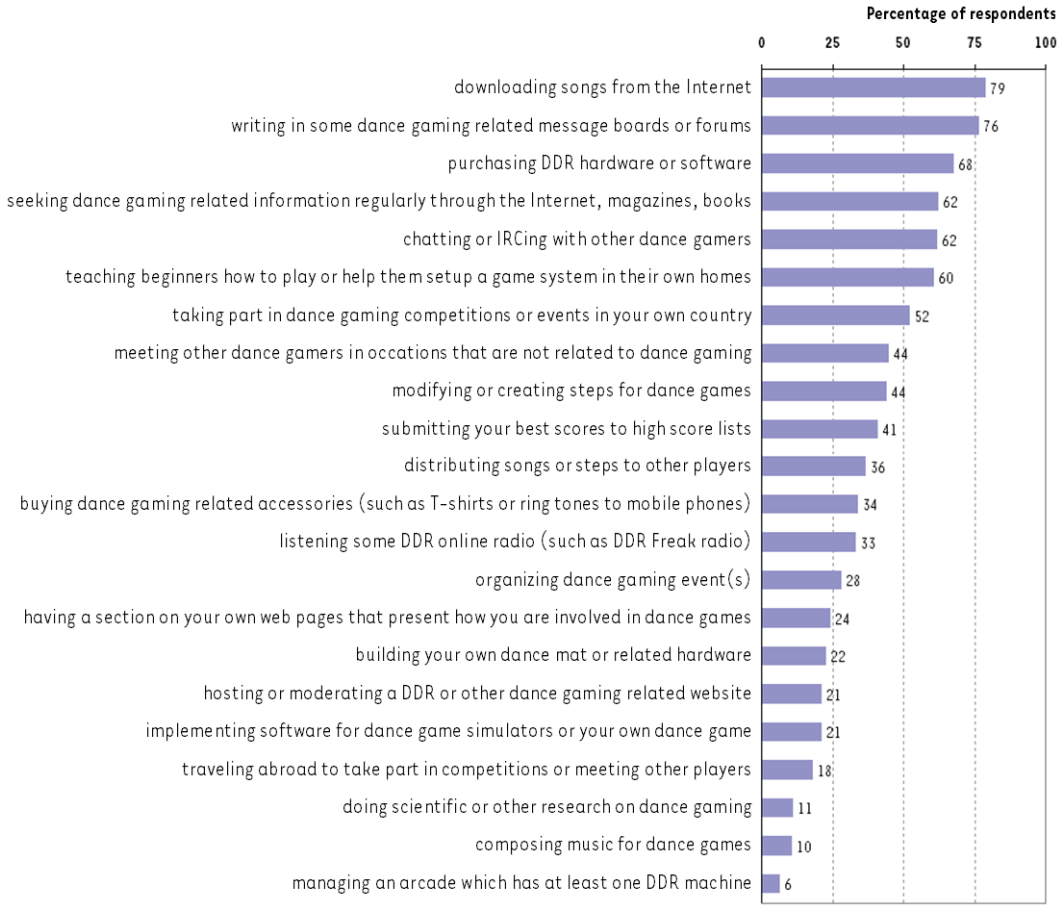

Figure 9. DDR related non-gaming activities.

5.5 Physical Effects of Dance Gaming

It is often claimed that computer games have a negative effect on players' health and development. Studies show that excessive playing of traditional computer games promotes a sedentary lifestyle and causes obesity [Henry J. Kaiser Family Foundation 2004]; repetitive stress injuries, eyestrain, and dry eyes [Cordes and Miller 2002]; video-induced epileptic seizures [Badinand-Hubert et al.1998]; sleep disturbances, neglecting personal hygiene, and regular eating habits [Cordes and Miller 2002]; as well as postural,

muscular, and skeletal disorders such as carpal tunnel syndrome or nintenditis, an injury which causes severe pain in the extensor tendon of the thumb due to repeated button presses [Brasington 1990]. Many of these problems are related to excessive gaming, but also to game input techniques that require players to sit passively in front of the computer using hand-held game-control devices.

However, due to the interaction style of dance gaming, its physical effects are different from games played with keyboards or game pads. DDR play is considered serious exercise by its players (this aspect has drawn a lot of attention). DDR was officially registered as a sport in Norway in 2003, making it the world's first computer game to receive such a designation. This section takes a look at how large a part dance-gaming contributes to the players' physical exercise; the positive and negative physiological effects of DDR gaming are also discussed.

5.5.1 *Dance-Gaming as Physical Exercise.* The results of this study show that DDR not only promotes serious exercise, but makes people who would not otherwise work out do so. In our study, 41% of respondents said that they do not engage in any sport other than DDR. Moreover, the game is not only liked by "non-exercisers" but also enjoyed by people who frequently engage in other sports. In this study, 33% of respondents can be characterized as "active exercisers," i.e., those who play sports (not including DDR) either every day, four to six times a week, or two to three times a week. Fig. 10 shows how often DDR players practice other sports and how often they play DDR. In general, DDR players spend more time playing the game than engaging in other sports. The correlation between the amount of time spent on other sports and on DDR is an issue for further study.

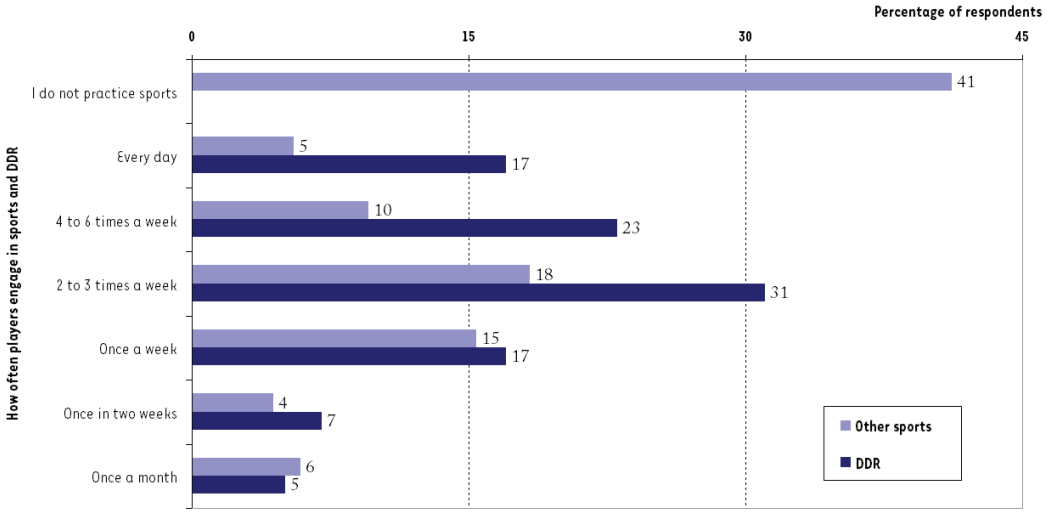

Fig. 10. Amount of time spent playing DDR (dark blue bars) and other sports (light blue bars).

5.5.2 *Positive Physiological Effects*. The health benefits associated with DDR are one of the key motivations for players when deciding whether or not to continue playing the game, as discussed in Section 5.2.2. Most players believe that dance-gaming is good for their health; see Figure 11. DDR game-playing resembles endurance training, which is generally considered an efficient way to lose weight. The results show a positive

correlation between weight control and dance-gaming, as 87.5% of overweight respondents (23.0% of all respondents, i.e., those who self-identified as such) said they lost weight due to dance-gaming. Even those players who did not consider themselves overweight reported losing weight by playing DDR. Thus, we are justified in assuming that DDR could be used to benefit overweight children and teenagers, especially those who enjoy computer games and do not voluntarily engage in any other sport.

Players believe that the most positive physical effects of playing DDR are increased endurance and leg strength, as well as an improvement in their sense of rhythm. Respondents also claimed that due to dance-gaming, their coordination had improved.

> *I was able to run 3000 meters in Cooper's test just by practicing DDR.* (Male, 18)
>
> *During a physical my doctor noted how smoothly and clear I breathe. I attribute this to playing DDR*. (Male, 20)

Respondents also described other positive physiological effects they attributed to playing DDR. Their answers revealed four distinct categories, which we list in order of their popularity. Playing DDR (1) relieves stress, helps players relax and sleep better, and makes them more energetic; (2) improves the players' self-esteem by improving their "body image" and by achieving new goals; (3) improves reaction time; and (4) leads to improved stamina and better muscle condition.

> *Exercising makes you feel good about yourself, and it reduces stress. It also helps me sleep better*. (Female, 16)
>
> *I feel more energetic than I felt before I started to play dance games.* (Male, 17)
>
> *It has made me more fit and toned as well as confident with myself.* (Female, 17)
>
> *The physical feeling of accomplishment after beating a new goal is so much different than in regular games. It's not just in your mind, you can feel it.* (Male, 19)
>
> *My reaction rate increased to a point where everyday life simply became easier. It taught me discipline in physical exertion.* (Male, 17)
>
> *Was previously never able to keep a beat (clap or tap foot along with a song) but mastered it very quickly in my early days of DDR.* (Male, 24)

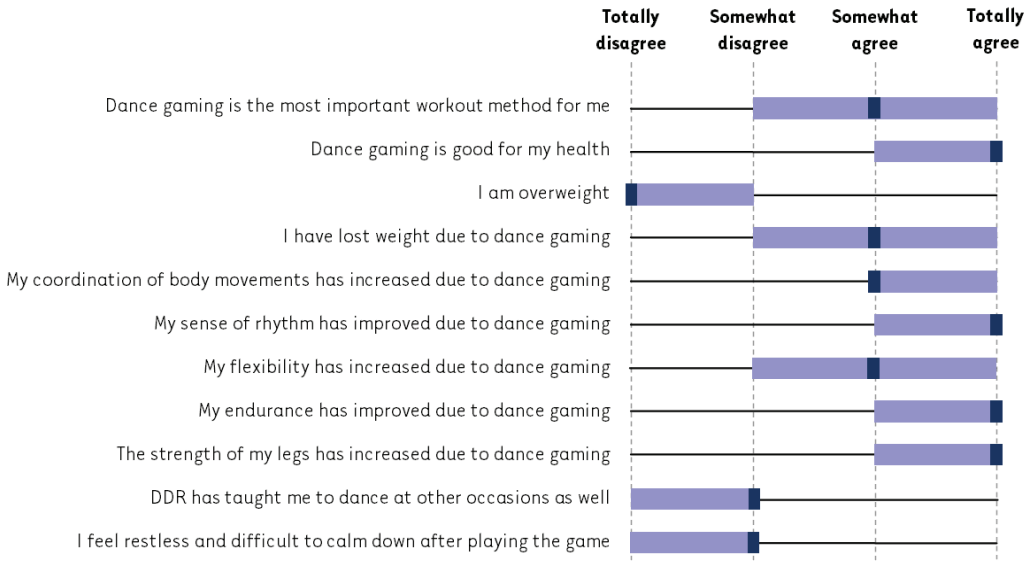

Figure 11. Players' opinions about DDR and the game's effects on their physical condition. The light blue bars denote the region between the first and third quartile (50% of responses) and the darker blue dots are the median values. For all factors the answers ranged from 1 to 7 (thin black line).

DDR players seldom have a background in other dance forms, and those who do are mostly involved in break-dancing, ballet, modern dance, or have taken lessons in classic dance. 84.5% of respondents did not have any formal or informal education in dance. Only 2% of DDR players took dance courses to improve their play. Although the game is about "dancing" it has little to do with real dancing, especially when aiming for perfect attack. This is why many players do not think that playing DDR really teaches people how to dance.

5.5.3 *Negative Physiological Effects of DDR*. The most serious ill effects due to playing DDR are strains to players' leg muscles and joints as well as to their backs. As a form of exercise, DDR has little effect on upper-body strength, except when hands are used in dance moves or during hand-plants and hand-stands. The most frequently mentioned lower-body problems follow:

- pain in joints, especially in the knees
- pain in the ball of the foot
- skin problems: the skin under the sole gets damaged, blisters and calluses appear
- cramps in leg muscles, muscle soreness and stiffness after game-play
- athlete's foot, charley horses, shin splints
- pain in the spine and back
- dehydration

The main causes for these problems are (1) playing on hard surfaces without proper cushioning; (2) .twisting the knee; (3) bad foot placement and technique; (4) insufficient time to warm-up; (5) excessive play; and (6) insufficient fluid intake.

> *Aching leg muscles if played without warming up, or for too long, blisters/calluses on feet after extended sessions.* (Male, 16)

My feet occasionally get sore from excessive playing, especially when I wear worn-out shoes. (Male, 19)

Some players also worry that playing DDR can cause serious injuries.

I believe the movements are in some cases very forced and only few players take this into account. In the end, I have seen it cause sore muscles, various types of pain in the legs and dizziness, though I play too little to experience any myself. While they are not a major issue of worry, I believe there to be several potentially harmful health consequences of ddr. (Male, 25)

I think on the long term DDR might damage my knees. They sometimes hurt after a long session. (Male, 27)

In addition to general health consequences related to foot-based exercise, players reported several types of accidents while playing DDR. 38% of the respondents had hurt themselves; but the level of injury varied a lot. Table III lists the most common causes of DDR-related accidents and the main types of injuries linked to their causes. The most frequent causes of accidents are: playing too long, falling off the pad, and getting hurt while doing knee-drops.

Table III. The Most Common Causes of Accidents and Related Typical Injuries

Cause	Percentage of accidents	Types of injuries
Playing too long	26%	Pain in legs and joints, muscle cramps, blisters and calluses on feet, nausea, dizziness, loss of consciousness
Falling off the pad	24%	Spraining or twisting an ankle or wrist, bruises, cuts, broken bones, concussion
Falling on knees	14%	Bruises and cuts on knees
Hitting the screws, bolts, or sharp panel of the pad	9%	Cuts on knees, soles, toes, or palms
Slipping or slippery pad	8%	Scrapes, bruises, spraining or twisting ankles or wrists
A bad foot placement while playing	6%	Spraining or twisting an ankle
Hand-planting	5%	Cuts, bruises, blisters, and calluses on hands, broken fingers
Freestyling/ stunts	4%	Cuts and bruises, broken bones, sprained back, sprained ankle, concussion

Fortunately, the majority of the accidents and related injuries were not very severe. Only 9% of injured players visited a doctor. In addition, the recess after an injury was most often only a few days (74% of cases); one week (12%); two weeks (6%); two to four weeks (3%); and over one month (2%); 2% of injured respondents have not played since the accident.

Many of the negative effects could be reduced fairly easily. Taking a break every once in a while could prevent some accidents; good shoes could prevent foot pain and fatigue and dampen the hits. Warming-up, cooling-down, and stretching are as essential for DDR players as for athletes. Improving foot placement could help with knee-related problems, which are often caused by twisting the knee during rotations and jumps. Excessive endurance training, sweating, warm play conditions, and insufficient liquid intake cause dehydration; some respondents said that they had blacked out while playing.

Thus, more attention should be paid to play conditions and opportunities for sufficient liquid intake at arcades.

5.5.4 *Addiction and Negative Emotions*. One quarter of responses related to the negative physical effects of DDR were about the players' addiction to DDR and its role in their daily lives. Players commented that playing DDR obsessively displaced other activities and caused negative emotions. Yet some of these comments suggest that players were somewhat proud of their obsession with the game.

> *I've seen many people become addicted to the game, and I honestly say that I, myself, am addicted.* (Male, 18)
>
> *The game is really addictive. Sometimes when I'm supposed to be doing something else but I find myself playing DDR instead. It's common problem with video games in my life.* (Male, 21)
>
> *I can't pay attention in class sometimes because I'm thinking about what I need to improve about myself when it comes to DDR.* (Male, 14)
>
> *I'm addicted to it as in, I play every day (either on a pad or by Stepmania) and I cannot really stop when I'm playing unless it's time for me to leave or I am too tired to stop playing (which almost never happens).* (Male, 14)

There is no previous research on how many players are addicted to DDR. In our study, 5.6% of respondents specifically criticized the addictive nature of the game or claimed that they were addicted to it. However, further studies are needed to investigate the number of players who are addicted to DDR and its affect on their lives. Research on game addiction suggests that most addicted players are males [Griffiths and Davies 2005]. In this study, the comments that discuss DDR addiction are largely given by male players; which supports the results of other studies.

Due to the game's musical content and its physically active interaction style, it is reasonable to believe that the effects of addiction to DDR may be somewhat different than addiction to, e.g., violent video games or those played with manual control devices. It is unlikely that playing DDR will increase hostile behavior or aggression *per se*, factors that are linked to addiction to violent games [Dill and Dill 1998]. However, excessive DDR gaming is likely to cause stress injuries, negative feelings after failing to score as expected, and displacement of other activities, although not necessarily the social ones. DDR also shares with other computer games several characteristics said to cause dependency [Griffiths and Davies 2005; Fisher 1994]. These characteristics, reported in Griffiths and Davies [2005], include the following requirements:(1) response to predictable stimuli that are governed by a software loop;(2) the total concentration and hand-eye coordination (in DDR's case, foot-eye coordination); (3) speedy play negotiable to some extent by the skill of the player; (4) visual and aural rewards for winning moves; (5) an incremental reward (points in DDR) for a winning move that reinforces "correct" behavior; (6) digitally displayed scores of "correct behavior"; and (7) opportunity for peer group attention and approval via competition. The last characteristic is very important in DDR game-play.

Respondents also commented that playing badly affects their emotional state. Personal achievement is an important positive gaming experience for DDR players. Playing DDR stretches players' capabilities to the limit, but this can have a counter-effect, in that a player who does not score well may become upset. People who mock players are another cause for negative feelings. Nevertheless, none of the comments imply that these feelings will last a long time.

I can get in a bad mood if I have a particularly bad DDR day. (Male, 20)

Frustration from repeating one song which I want to do better and I keep trying without any advance. (Male, 16)

Playing DDR may have a surprising side-effect: "seeing or dreaming about the arrows while not playing". Some players also report that they tapped their feet or fingers in a step pattern on other (nongaming) occasions.

Songs get stuck in my head. When I close my eyes I can sometimes see arrows going up. I need to tap on whatever surface I am near. (Male, 14)

Seeing arrows scrolling when not playing. (Male, 30)

Tapping my fingers in a keyboard arrow pattern. (Male, 16)

6. SUMMARY AND FUTURE WORK

There have been no previous user studies of the *Dance Dance Revolution Game*, despite its long-lasting and ever-growing popularity. The aim of this article is to explore the DDR phenomenon from the point of view of the player population, its playing habits and styles, motivational and user experience factors, as well as social and physical effects of dance gaming on players' lives. The survey was used as a research method to gain a broad view on the research themes mentioned above. 556 respondents, most of them males, took part in the study; the percentage of female participants was only 13%. The questionnaire attracted most answers form North America and Europe, and the ages of most respondents varied between 14 and 22 years. It is important to note that the participants of this study were by and large skilled players, but casual home players took part in the study also.

DDR playing habits can be characterized as playing frequently in both arcades and homes, but also increasingly in other locations like schools and youth centers. European players tend to play more at home than their North American fellows do, probably due to the small number of arcades with cabinets and the long distances between them. Respondents play the game frequently and play sessions usually last from half an hour to two hours. Most players aim at perfect scoring in their play, but some also aim at playing expressively. Both of these game styles have a set of established play movements, of which the most elaborate require complex motor skills and coordination. Once players get into dance gaming, they often seek out other music and rhythm games as well, which could help them in mastering precise movements that match the rhythm of the music.

Novices mostly begin to play the game when they become impressed with its performance or the game is introduced to them by other players. The user interface and the novelty of the interaction style also cause people to take an interest in the game. But the reasons for deciding to continue to play are fun, exercise, and to have something challenging to do. Due to the simplicity of the idea behind it and its intuitive game controls, the game is easy to learn and provides continuous challenges, even for experienced players. The most challenging factors in becoming a better player are related to human performance and motor skills, as the most difficult songs require perfect coordination and fast reaction times. The dedicated players seek out ways to improve their skills, and their learning activities can be summarized as learning from observation, imitation, peer-learning, and teaching both online and offline, studying step patterns and songs, and playing regularly.

A positive DDR gaming experience requires good gaming devices, in particular a flawless game pad, a large selection of songs and step patters, and a pleasant gaming environment that allows physical exercise. In joint game sessions, a supportive audience and friendly co-players enhance the game experience even more. On the other hand, bad behavior by player and audience is the single biggest reason for a negative gaming experience. And a broken pad can ruin the game play altogether. In addition, noisy surroundings, an unsuitable play environment, and a small selection of songs -- especially if they are out-of-sync -- deteriorate the overall gaming experience.

In contrast to most other arcade or video games, DDR promotes both face-to-face socialization and physical exercise. The majority of respondents played the game with other people at least occasionally, but more importantly, DDR provides a social setting where new "offline" friends can be found. Many players reported that playing DDR has made them more social and more confident in performing in front of other people. Additionally, the wide-spread DDR online community brings people who share the same interests together and allows them to exchange information and experiences about DDR.

Several studies show that traditional game-playing causes health problems and obesity due to sedentary game-play, whereas DDR has many positive physical effects: it motivates people who do not like exercise to move; it works the big muscle groups in the legs; it helps in losing weight because serious exertion is needed to pass the difficult songs; and it improves endurance, muscle strength, and sense of rhythm. DDR game-play has similar effects as other sports as well, for example, it helps players sleep better and improves their body image. Although DDR has positive physical benefits, there are negative aspects as well: e.g., excessive game-play, unsuitable gaming equipment, including bad shoes, and accidents, which may cause injuries and health problems requiring medical attention. In addition, this study shows that players can indeed get addicted to DDR; but further investigation is needed to examine DDR addiction and its effects.

In the course of this study it became evident that more research is needed to understand the complexity of the DDR gaming culture, the effects of game-play, and whether other dance gaming forms have similar or different characteristics as DDR. Further research on the following topics should be encouraged:

- How has European DDR culture evolved and how does it differ from Japanese and American DDR cultures? What is the DDR lifecycle among players?
- In-depth investigation of freestyling and tournament culture
- Social conventions in joint game sessions
- Experimental research on physiological effects of DDR to verify the effects players reported
- DDR game addiction and how it manifests itself
- User studies on other dance-gaming forms

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