Children's and Parents' Perception of Full-Body Interaction and Violence in a Martial Arts Game

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Abstract

This paper presents a study of children playing a full-body-interactive mixed-reality martial arts game. The user interface of the game is multi-modal and unencumbered – any number of simultaneous players can fight collaboratively against the virtual enemies using body movements and voice.

The contribution of the paper is two-fold. Firstly, based on our observations, interviews, and an earlier study of the game with martial artists, we discuss the challenges of designing full-body exertion interfaces for children. Secondly, there are no previous studies of the combined effects of full-body interaction and violence, although interaction design for children and the effects of media violence are active fields of research. In this paper we propose that when assessing the level of violence in interactive media such as games, both user input and system output should be considered. The realism of user's actions and the audiovisual output both contribute to the overall realism of the user experience.

Keywords

Children, Entertainment, Games, Interaction Design, Input, Usability Research, User Experience, User Interface Design, User Research, User Studies.

Figure 2. A split kick in the air.

Figure 3. Playing together.

Figure 4. An acrobatic kick

Figure 1. Kick Ass Kung-fu played by martial arts practitioners. Left: A typical setup of two projected screens and a playfield in the middle. Right: A screenshot of a player kicking a virtual enemy.

Problem statement

This paper continues our research in mixed-reality martial arts training and entertainment. Previously, we have created "magic mirror" visualization systems for martial arts training, aiming to optimize the learning process with novel visual feedback [14]. We have also designed Kick Ass Kung-Fu, a full-body fighting game that can provide intensive physical exercise and motivate more serious training [15]. In the Kick Ass Kung-Fu game, any number of players can fight collaboratively against virtual enemies using kicks and punches as well as acrobatic moves such as cartwheels. The game uses a video camera, real-time image processing and computer vision to embed the image of the player inside 3D graphics. This is shown in Figures 1-4.

In this study, we aim for a better understanding of the design issues and effects of full-body interaction in digital games for children. We report observations and interviews of children and parents playing Kick Ass Kung-Fu in an art gallery where the game was exhibited for two weeks in February 2005. Although the game was originally designed for teenagers and adults, it became a hit among children and parents, and children came to play the game daily. However, on observing the children, we noticed cognitive and motor control problems and playing patterns that differed from those reported in our previous study with adult martial artists [15]. We were also concerned about the combined effects of the full-body interaction and violence, for example, whether the violent physical behavior gets transferred outside the game.

Background

Video games and movies such as "Karate Kid" have demonstrated martial arts in fascinating ways which are imitated by young children on playgrounds, schoolyards or at home with siblings [12]. Visually, martial arts appear violent, but they are generally intended to promote respect between opponents and unnecessary harm is discouraged. It is argued that the benefits of martial arts training include increased self-esteem, increased self-discipline and improved ability to deal with conflicting situations [22] in addition to many positive physiological effects.

Digital fighting games are either directly or remotely rooted in real life martial arts practices. The genre arose in the mid-1980s with the release of Street Fighter II. The recent best selling titles include, for example, Dead or Alive, Soul Calibur and Tekken, which are mostly rated suitable for teens ("T", 13+) [10]. Fighting games usually portray martial arts in a dramatic setting and offer a range of impossible actions – these special actions typically include chi-energy blasts and physically impossible mid-air acrobatics. Many games emphasize the violence by involving blood, death and screams. Most fighting games discard the philosophical aspects of martial arts so that the goal of the player is simply to cause as much damage to the opponent as possible.

In most digital fighting games, the player controls an avatar with sequences of button presses, which results in a user experience that is far removed from the kinesthetic joy and physical exercise of practicing martial arts movements in real life. Fortunately, thanks to novel input devices, such as dance mats that register footsteps [19], and cameras that can be used to track the user's body movements [4, 16, 24], physically interactive digital games are a growing phenomenon. For example, in our previous game, QuiQui's Giant Bounce, a dragon can be made to fly as a result of the player moving his or her hands like wings [16]. The dragon also breathes fire when the player shouts with the sounds being detected using a microphone. Physically interactive digital games can provide novel forms of physical exercise and support the development of children's motor skills.

In addition to our past research [14, 15], previous experiments with digitally enhanced martial arts include Tai Chi training in virtual reality [5] and impact-registering body protectors for TaeKwonDo sparring [2]. There are also simple fighting games for the Eye-Toy camera for PlayStation 2 console [24] and Creative WebCam Game Star for PC which includes two Karate games [4].

Challenge

Although the earliest computer vision based games date back to the 1980's [20] there is still a lot to study in terms of challenges that the body movements pose for game design, natural interaction styles and playing patterns. As playing conventions for these games have not yet been established, there is further research required in the fields of playability, interaction design and evaluation methods for these interfaces with specific target audiences. Studies to date in this area have dealt with issues such as intuitive game gestures [17], principles of game design from the point of view of child users [7] and guidelines for usable perceptual user interfaces [6].

There is a large body of research into the effects of violence in video games, particularly focusing on the relationship between violence and aggression [1]. However, this research has mainly focused on the amount of play time and the content of the games [11], there is no previous research on the combined effects of the full body interaction and violence.

Violence has always had an important role in computer games and fighting games are no exception. Although there are many challenging non-violent games, there are also a lot of games available for children and teenagers where violence is either the sole purpose of the game or is a significant part of it. Recent analysis shows that up to 89% of games contain some violent content [3], however, the form of violence varies hugely - from Super Mario's fairly harmless comic mischief and cartoon violence to games with blood and gore; Mortal Combat Deception and Resident Evil are examples of these game types.

The violence in video games is considered to have more impact on children and adolescents than other media forms for the following reasons: (a) the violent behavior of the player is simultaneously rehearsed, rewarded and reinforced in various ways including the addition of extra points, sounds and game levels [8], (b) video games do not create realistic consequences for the aggressor [11], (c) they support negative stereotypes, for example portraying minorities and women as helpless victims [23], (d) the player is actively making aggressive behavioral choices and carrying them out [8], (e) realism of violence and the identification with the game character make the experience more real [11], and (f) parents do not play with their children, this making it hard for them to monitor the game contents [8].

Based on official video game rating systems [10, 21], Kick Ass Kung-Fu could be considered suitable for 7 years old children, thanks to the cartoon visuals with no blood. Considering commercial camera-based games, Eye Toy: Play [24] has a lower rating (3+ according to [21]) and Creative Game Star [4] has no official game rating at all even though both the titles feature violent mini games.

The game ratings are mostly based on the level of realism of harmful content. However, they seem to neglect that there are more dimensions to realism than audiovisual output. In interactive media, both the user's actions and the system output contribute to the user experience. Thus, a central concept of this paper is *user interface realism* or *action realism*. With computer vision and other modern input technologies, realistic embodied interaction is no longer limited to simulators with dedicated control devices.

Study setup and procedure

This chapter describes the test system and the study procedure. Note that we only give a brief overview of the Kick Ass Kung-Fu system. A detailed description of the game, and a user study with martial artists, can be found in Hämäläinen *et al.* [15].

Test system

We used a typical Kick Ass Kung-Fu setup for the study as shown in Figures 1-5 and 7. The game uses a video camera to embed the player inside the game graphics so that the player can fight virtual enemies with kicks and punches, as well as carry out acrobatic techniques

Figure 5. Five 2 to 6 year olds playing the game together.

including cartwheels. The camera is at the player's side, providing a profile view suitable for viewing many martial arts techniques. The two projected screens let the player fight multiple enemies that attack him from both sides. The game analyzes the impacts of kicks and punches and the virtual enemies react accordingly. Any number of players can play collaboratively against the virtual enemies and can also use weapons, such as swords and nunchakus (a pair of sticks joined by a chain or cord). To prevent injuries in collaborative play, we let people use only soft weapons, such as the styrofoam batons shown in Figure 5.

The visual style in Kick Ass Kung-Fu is pseudo-3D in that the player's video avatar is a 2D plane inside a 3D arena. Since there is no depth information, the player can only move sideways and not back and forth. However, the view zooms and tilts dynamically, which gives a convincing 3D look and feel. Videos and images of the game can be found at the website *www.kickasskungfu.net*.

The interaction design of Kick Ass Kung-Fu aimed for the game to be both educational and fun, and can be characterized as *action hyperrealism*. A game can be considered educational if it develops skills that are usable in real life, outside the game context. This is often related to the level of realism. Kick Ass Kung-Fu is realistic in that you perform kicks and punches for real and get visual feedback of your technique, for example, in the form of slow-motion replays of successful techniques. On the other hand, the experience is pushed beyond realism to motivate the player – motion is exaggerated so that you jump higher and move faster on-screen. Because collisions with virtual objects don't hurt, you can apply flamboyant, acrobatic fighting techniques that would be otherwise too dangerous.

In addition to a camera that captures the user's movements, Kick Ass Kung-Fu uses a microphone to detect shouting. Shouting (kiai) is an important part of various martial arts. It is used to intimidate the opponent, show good fighting spirit and also to prepare your body for impact when you get kicked or punched. In the game, you can pose and shout to gather chi energy for a devastating special attack. When you shout, you begin to glow with the energy, which then explodes away with your next attack, flinging the target far away.

Procedure

The study was carried out during one week in February 2005 in an art gallery where the game was displayed. The research methods included both observations of

"You get to work up quite a sweat." Girl, 10

"You can jump and twirl and hop around – you can really do all kinds of stuff." Girl, 10

"If you knew some karate, you could be good right from the beginning." Girl, 8

"You don't need to stare at a tiny screen and it's also a sports game of a sort." Boy, 10

"It was really fun when you got to kick stuff for real and not just click with a mouse." Girl, 10

"It was awesome to see a representation of yourself fight... I mean, on the screen. It immediately got me thinking what kinds of clothing you could develop." Man, 25

"It feels great to see, when you jump, to see the character jump up really high. And when you're up in the air, you can do all kinds of stuff, even if you're really on the ground already." Boy, 14

children's game play and semi-structured interviews of both children and their parents about various aspects of the game. The field study was also accompanied by an email follow-up study to evaluate whether the violence in the game got transferred outside the game and into children's behavior in real-life settings.

The themes of the interviews of both the children and parents covered the following topics: (a) the physical interaction in the game and play patterns, (b) the violence in the game, and (c) design suggestions on how to make the game more child-appropriate in the future. As the game contains violence, all participation in the study was voluntary; parents brought their children to the gallery and observed the situation. The gallery management made the decision that the installation was open to everyone. It is important to note that we did not invite the children to play and we also explained the background of the game to parents. Children and their parents were also asked for permission to record the game playing on video. The information about the installation in the gallery was quickly passed around the local children and many asked their friends to join them to play together. The parents also informed one another and made arrangements to meet in the gallery.

For data analysis, the interviews were first transcribed using Transana tool [25]. The transcribed interviews were then studied to find important themes and, after marking the themes, the themes were collected from all participants and the differences and similarities were analyzed. Observations were studied by using the videos and notes gathered from children's play sessions.

Participants

In total 38 children and young adults of ages 2 to 25 were observed playing the game. Additionally, 23 children (ages 3 to 14, distributed as shown in Figure 6.) and 4 young adults (ages 19 to 25) were interviewed using questions designed for child players. In addition, 15 adults were interviewed using questions designed for parents who brought their children to play the game. In addition to on-site interviewing, 9 parents with 14 child players (of ages 2 to 12) volunteered to take part in a follow-up study by answering questions delivered by email few days after the play session took place.

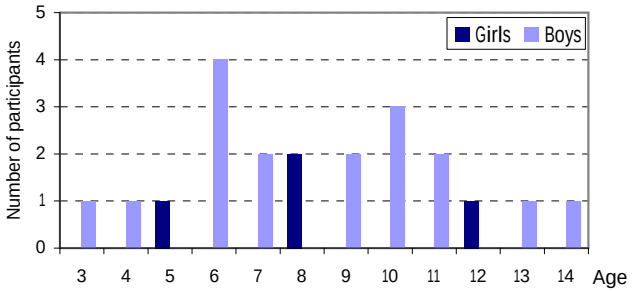

Figure 6. The ages of children who were both observed and interviewed.

Results

In general, children's answers and spontaneous comments during the game play indicate that children enjoyed the full body interaction of the game. The interviews also suggest that both the children and the adults found the game versatile in terms of allowing variety of movement and they liked having the possibility to also learn new movement skills. Additionally, children liked that they could see

"If you get stuck inside the guy, you can t hit him." Boy, 10

"It s sometimes kind of difficult to judge distances... The sword comes in really handy, because it s so long. Just swing it around, and you can get [them] really easily." Girl, 10

"It was hard to stay in the right place. If you sit down, they can t hit you, but you can get them using the red swimming aids." Boy, 7

"At first [it was difficult] to figure out what kind of angle and what kind of kick or jump would give the best results." Girl, 12

"It s really kind of two-dimensional at the moment – you can t go around the opponent, just straight through." Male, 25

"Sometimes you get a little disoriented, when you need to move forward, even though it s right beside you." Girl, 10

"It was funny with the camera, when you move forward, because then you really move to the side – but it was quite easy to figure it out." Girl, 5

"I had great difficulties in figuring out my orientation... It felt like I was kicking in the wrong direction all the time." Male, 25

"Sometimes the guy disappears and you can t see where he is or what he s doing." Girl, 8

"It s really stupid when the enemies leave – I can t hit them if they run away." Boy, 6

themselves in the game world and that there were no traditional game controlling devices or small displays. Especially young adults commented that their movements looked better because of the exaggerated motion.

All parents thought that the best part of the game was its sportive nature. They liked the fact that the game made children move, sweat, and try out versatile and energetic movements. Parents commented that, through movement, the game supported their children s natural exploration of their own bodies and their worlds, and they believed that the full-body interaction could relieve the tension that is built up when playing action games. The interaction style was also considered to make the game feel more real, although it was considered important that the players only fought air in order that nobody would get hurt in the real world.

In the following section, we go through the findings in more detail. The results are divided into three main topics: (1) challenges and problems related to full-body interaction, (2) social gameplay, and (3) violence.

Full-body interaction challenges

Successful playing of Kick Ass Kung-fu requires several fundamental motor and cognitive skills of which the most important ones are listed in the following: (1) Locomotor skills (that move the body from point A to B) are needed to move forward and backward on the playfield, (2) Non-locomotor skills (e.g. balance and body stability) such as turning and rotating the whole body towards the most appropriate screen, for example, when the opponent appears in the back of the avatar, (3) Manipulative skills (i.e. controlling objects using the limbs) which include handling the weapons such as the batons, (4) Movement awareness (the ability to conceptualize then respond to a stimulus), for example the ability to move forward in order to position one s self to deliver a kick from the right distance at a right time, (5) Body awareness (knowledge of one s body and it s parts and their movement capabilities) is needed to estimate how far kicks and punches reach, kicking backwards of the body (6) Spatial awareness (being aware of one s body and it s movement and orientation in space) how the player is located in the playfield, (7) Focusing attention and distinguishing one s own avatar from the rest of the visual information, (8) Observing the visual feedback of the game and planning actions, (9) Ability to do 90 degrees remapping of one s movements, i.e., moving forward to move the avatar to the right.

Young children are still in the process of developing the abovementioned skills which could be seen in the game play. Instead of using articulated martial arts movements, children used generic kicks such as swinging the feet forward, and loose but quick punches that somewhat resembled boxing techniques.

ESTIMATING AND FINDING THE RIGHT DISTANCE

Children s limbs are relatively short meaning that kicks and punches have to be delivered within close range of their opponents. This may make the game play more frightening and promotes using weapons that allow the player to stay farther away from the enemies. Additionally, when the player is close to the enemy, small movements can cause the video figure and the enemy to overlap, which users generally found confusing.

As children's limbs are growing, and their body awareness is constantly developing, estimating the right distance between the avatar and moving opponents is a challenging task. When children's kicks and punches did not hit the target, they moved forward a bit and tried again. Some children commented that estimating the speed of the opponents was somewhat difficult and thus, positioning the avatar is challenging. Children also said that dodging the opponent's hits is tricky and that it was difficult to circle around the opponents due to the 2D nature of the game. These problems escalated when players faced more than one opponent at the same time.

Profile view

Previously, we have found that the profile view of the game helps in spotting errors in pose and technique [15]. Compared to practicing with a mirror, the player can see his kicks from the side while being able to maintain focus in the attack direction. However, this creates cognitive challenges since one has to remap one's directions. The player has to kick forward or backward even though the enemy appears at his side on the screen. The concept of remapping the directions was clear to children, but compared to adults, it takes them longer to learn to move accordingly. After a few games, most children were fluent in kicking towards the screen and moving in line between the screens, but some still occasionally kicked towards the camera.

We noted that when attacking opponents with spinning kicks and other circular motions, the visual feedback could be ambiguous, that is, even if the attack is initially targeted in a wrong direction, it will be picked up by the camera at some phase of the movement. For instance, one child successfully beat the enemies, slashing around with a plastic baton, but still tried in vain to kick straight towards the camera.

Changing attack direction

To make the game more immersive and varied, the Kick Ass Kung-Fu uses two projected screens facing each other. If the opponent appears behind your back, you can turn towards the other screen, or can use movements that are directed backwards. Compared with adults, children have more problems with understanding the location and orientation of the opponents and in knowing when to turn towards the other screen. Some children commented that they "forget to watch the other screen", although it contained the same information as the screen they were already looking at. In addition, children did not use movements that were directed backwards; this is a clear difference to behavior noticed with martial artists.

Turning around in the game needs time getting used to, as when the player loses visual contact with one screen, he needs to refocus his gaze on the other screen and reevaluate the game events. Partly because of this, children preferred playing together with a friend, having their backs facing each other, and with each handling the enemies at their side. This is shown in Figure 7.

"When you play alone, you don t always remember to look at the other screen." Girl, 8

"It s easier to play together with someone, because if you play alone you need to think about which opponent to take first if there s two." Girl, 8

Figure 7. Two 8 year old girls playing with their backs facing each other as both handle the enemies at their side.

UNDERSTANDING THE LIMITS OF THE CAMERA VIEW

When you move too far, the parts of the player that get outside the camera view disappear in the game world. This is a common problem in computer vision based games where the player can fly or otherwise move differently than is possible in the physical space [16]. In Kick Ass Kung-Fu, the physical space is defined by the screens, but the screens must be framed out of the camera view, since the computer vision requires a static background. After a few failed attacks, adults usually learn to stay in the visible area, but children seem to have more problems. In chaotic situations as shown in Figure 5, pre-school children apparently did not necessarily connect with their video representations, and they could play along happily even though they were not visible on the screens.

In the current version of the game we have improved the design of the enemy Artificial Intelligence (AI) so that if the player moves close to the limits of the camera view in pursuit of an enemy, the enemy does not back away but instead jumps over the player to lure him back.

Multimodal interaction in a social setting

The computer vision technology in Kick Ass Kung-Fu enables collaborative game play by sharing an input device, allowing easy turn-taking and enabling unlimited movement (as there are no cumbersome sensors attached to children s bodies). According to our observations, children liked having the possibility to play together and they collaborated in the following ways: (1) playing physically together, (2) helping a player by shouting to gain chi-energy, and (3) giving instructions and praise.

Children mostly played in pairs, but, in one instance, we counted as many as seven players sharing the playfield. Compared to adults, children can more easily share the same playfield due to their smaller sizes and their less effective techniques. Although children were careful not to harm one another, it was possible for accidents to happen, especially during intensive game events when the children were especially busy in playing the game.

Children created fairly elaborate rules for the play situation spontaneously without the help from adults. In fact, the interference of the adults often made the situation more disorganized and confusing. The rules children created included, for example, turn-taking policies, how to wait one s turn in the line, selecting a play mate, negotiating game strategies such as "In this

"The fact that two can play together makes the game somehow more sympathetic, when you can give a duo treatment to all those ridiculous opponents." Mother of 3 and 5 year old boys

"Once when there were lots of people playing – there were small kids there as well – my friend accidentally kicked someone in the face." Boy, 9

"The advanced stages really make you work, you need to rest every once in a while." Boy, 10

"Yelling gives you lots of energy [in the game], and then you can fling your opponent really far and then they die from one blow." Girl, 5

"You really got to kick ass without hurting anybody." Boy, 10

"I like violent games." Boy, 3

"You get points for kicking." Boy, 5

"It was fun to kill the others." Boy, 4

"You can be aggressive towards the opponent and not your little sister." Boy, 10

"You could hit and kick those guys." Boy, 7

"You get to hit a virtual opponent... It's good fun when someone doesn't really get hurt." Man, 19

"It is violence in a funny way." Man, 21

round we lie on the ground and only use the batons to hit the enemies", and ways to prevent other children disrupting the game play. These rules were also made clear very quickly for the newcomers.

A large amount of observational learning takes place in situations where children play physically interactive games together. Children observe other children, borrow game styles and refine them in their own play. When there are lots of children waiting for their turns, the length of the game round is crucial. We estimate that three minutes is a sufficiently short time period for next turn-taking (i.e. children feel their turn is approaching as the line moves on) and that three minutes is a long enough time for the players to feel they have played enough for a while and are willing to take some rest.

Children behave quite differently than adults when activating the supercharge effect by shouting. Adults were seen to be shy at first, but once someone had the courage to pose and shout, the other adults cheered and applauded, and following this, the adult players were seen to use the feature now and then to show off. Children were less reserved, even to the extent that they shouted constantly to get higher scores, annoying and embarrassing the people around. In the study described here, the gallery personnel eventually forbad the shouting, resulting in a new method of collaborative play where children gathered close to the microphone and hummed to "supercharge" the player.

Children's and parents' experiences of game violence

DID CHILDREN LIKE THE VIOLENCE IN A GAME?

42 % of 2 to 18 year-old players prefer action or combat games over sports (41%) or adventure (36%) games [18]. Children have also reported liking the pleasures of fighting especially against a friend in a multiplayer match [9]. Our study showed similar results; when children were asked what they liked most about the game - more than half of the players spontaneously mentioned liking the violence and being able to hurt virtual enemies without getting hurt themselves.

Children's and parents' answers were in line with those reported in a study by Ermi and Mäyrä where it is noted that "Few children were interested in violence per se, but rather felt that violence made the game experience more exiting. Children who played violent games stated that excessive, mindless violence against people is not what they want to have in games, but they rather face various kinds of monsters and non-human characters. The plot of the game also has an important role here and children want to see the violence as a part of the struggle and adventure of the game, not as a separate element." [9]

HOW VIOLENT WAS THE GAME CONSIDERED?

Children considered the game less violent than other games they had played or have seen played. 18 out of 23 children thought the game was less violent than, and 2 thought it was as violent as, other games. Three of the youngest children (3 and 4 year olds) had no opinion. Children and parents were also asked to explain why they thought Kick Ass Kung-Fu was not that violent and the explanations were largely consistent among the participants. Most answers were directly related to game concepts and contents, as described in the following:

- The way the opponents can be attacked: the game does not require "brainless beating", opponents

"What I find really horrifying about the game is that you kick and hit [the opponents] and you get points when you land your blows." Mother of 3 and 5 year old boys

"The only real drawback is the violence – when they play in the yard, the kicking and hitting gets incorporated into normal play." Father of 7 and 11 year old boys

"My son told me: 'Mom, please don't be stupid, of course I won't kick anybody, they might get hurt. It's only a game, you know." Sometimes I think they really can tell the difference... Kids are really smart and you tend to be a little overzealous yourself." Mother talking about her 6 year old son

"It is the parents 'responsibility to make their kids understand you can't really do that stuff even if you could. You just can't. It's a matter of empathy." Father of a 7 year old boy and a 10 year old girl

are fairly easy to compete against, you can dodge the opponent's hits, you cannot shoot the opponents or rip off their body parts, you just flail in the air without actually hurting anyone.

- How the opponents "die": there is no blood visible (which was the most common answer of both the children and the parents), the opponents simply fall down and fade out, the opponents do not seem to "die" as they reappear in the next level.
- Visual realism of the game: the opponents are viewed as paper dolls or cartoon figures and their movements are unrealistic, the game seems imaginary.

There were, however, several issues that made the younger children feel the game was violent or frightening. In one instance, it proved difficult to beat an opponent floating in the air and shooting at the player. In addition, children commented that "it is scary when angry opponents attack you from both sides and you feel that they are crowding you and then you die instantly". It is worth mentioning that these frightening aspects were often related to the realism and the action that the game provided. Some children also argued that the game might frighten child players when they enter the playfield for the first time and opponents suddenly appear without them knowing whether or not they are going to hit them. One seven year old girl even ran out of the room screaming when she got frightened by her image on the playfield and saw the opponents that were hitting her image on screen.

The possibility to use the plastic batons or any other weapon divided children's opinions. The batons made it easier for the children to try out the game for the first time but they seemed to then quickly get bored with the game as it made beating the enemies quite easy. Children also invented new weapons and new ways to use them. For example, children held their socks and shoes in their hands, threw soda bottles at the opponents, and swirled their shirts and scarves above their heads to fling the bad guys off their feet. Some children thought that hitting with a baton was more violent than just using bare hands and feet - one 6 year old boy even commented that: "I think you should get rid of those 'lötköpötköt' [soft styrofoam batons]. Do you know why? Because you might in real life grab a sword or something and hit someone... I think you should only use your hands."

The adults were more critical about the violence in the game. Although the characters and game events were considered milder than cartoons that their children watch on TV, parents complained that the violence should not be rewarded with points. They also questioned whether young children really understand the fictional nature of the game and they would have liked to have seen a clear story behind the events and not just fighting. On the other hand some parents mentioned that after the game play, as they discussed the game with their children, they were surprised at how well their children could differentiate between game events and what is appropriate behavior in real life. Some parents, however, mentioned that fighting in a game might promote fighting in children's play. They also emphasized parental responsibility and media education to safeguard the children from the negative effects of game violence.

AGE RATINGS

We asked both the parents and children to define a suitable age limit for the game and explain why. We compared the answers to the Pan European Games

"When we got back home, our son demonstrated his exciting gaming experience by hitting his father with closed fists. I believe he just really didn t understand why he couldn t hit his father just like he did the life-like virtual character. He did realize the difference after we explained it to him. We haven t really seen any residual effects, although he talked about the game for several days after the experience. He was especially taken by the fact that he could beat the bigger opponents in the game." Mother of a 4 year old boy

"[The playing experience] got transferred to their playing at home, but it was a lot more peaceful and they didn t hit each other once, even by accident. They did stage shows for each other." Mother of 7 and 9 year old boys and a 12 year old girl

"We had a discussion stressing that you can t hit other people for real. My six year old son found this self-evident and doubted my ability to distinguish between the game and reality (Well of course you can t hit other people, they might die...)." Mother of a 6 year old boy

Information (PEGI) age rating system [21] which comprises two separate but complementary elements; age rating and game descriptors. The PEGI age bands are: everyone "E", 3+, 7+, 12+, 16+, 18+. The game descriptors describe the type of content to be found in the game and indicate elements in a game that may have triggered a particular rating or may be of interest or concern. It is important to notice that the embodied interaction style is not included in any of the current rating systems. The results concerning the age ratings of the Kick Ass Kung-fu game are shown in Figure 8.

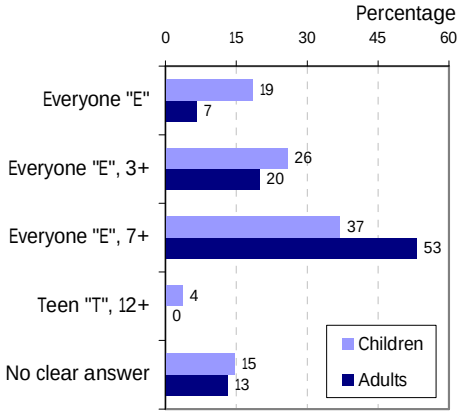

Figure 8. Age ratings given by the children and adults.

According to PEGI classification system, the content of the game suggests that the correct age rating would be 7+. This agrees with the median of the parents ' answers, as well as the median of children s and parents 'answers combined. The average of the combined answers is 6.08 years, sd=3.41 years. Parent s explanations were related to the type of violence the game portrays and the fact that children of that age are already at school and understand better the difference between real and fictional worlds.

Although many parents felt that age seven would be a sensible limit, they considered that children younger than that age could play the game if parents were supervising the situation.

Unexpectedly, parents were not much more conservative than the children. 37 percent of children suggested that the age when you go to school is a nice limit for the game. However, children s answers revealed a clear correlation between the age of the respondent and the suggested age limit as 20 children out of 23 said a child of their age could play the game. This does not necessarily imply that children are incapable of estimating the appropriate age but it shows that children think the game would also be suitable for their peers as they were able to play it themselves.

DID CHILDREN BEHAVE MORE AGGRESSIVELY AFTER PLAYING?

Current research literature suggests that playing violent video games leads to violent behavior in real life [1, 8]. The email follow-up study was carried out to assess whether playing the Kick Ass Kung-fu game made children carry out similar actions at home. Note that parents responded a few days after visiting the gallery, and more research is needed to examine the long-term effects.

8 out of 9 parents reported that there was no noticeable difference in their children s aggressive behavior as compared to their normal day-to-day behavior; this included the incidences of play fighting that is common with this age group, especially between boys. Nevertheless, one four-year-old boy started to punch his father at home when he wanted to show what kinds of moves he had done in the game. He

"Why couldn t they be like attacking robots, so I could save the world? " Boy, 7

"I thought the kids would be restless or even aggressive after having played the game, but it seemed it was "just a game" for them and not the kind of action that would be so exciting or enticing as to make them feel as if they were a part of it. The game was lacking a story and a hero to imitate in their own games. The playing experience involved more pure action and sheer physicality, rather than an interesting story element. You got bored with it rather fast. Kids don t really appreciate kicking and fighting, they admire and look up to courageous heroes, close shaves and magnificent successes, just like we adults. "Mother of a 2 year old girl and a 6 year old boy

clearly did not understand that the punching could hurt. On the other hand, one parent told us that three of her children had shown the movements, and demonstrated the game play enthusiastically, to their relatives but did not hit or kick anyone.

In the situations where more than one child is playing and others are watching and shouting comments, the game can make children very excited, to the point where they appear to be almost out of control. However, we do not know whether this excitement is due to the violence in the game or just the physically activating nature of it. Some parents were worried that children might be restless and difficult to calm down after the game play but the follow-up study did not show evidence of that.

Conclusions and future work

Kick Ass Kung-Fu can be considered as a digital sport. At their best, sports are social, good for your health, educational and both fun to participate in and watch. In digital sports, the spectator sport aspects can be enhanced with special effects. For the player, the computer can manage complex rules and coach with real-time feedback. As real-world physics don t apply in virtual space, it is possible to do impossible stunts. Having said that, most of the design challenges we have encountered are related to differences between the real and the virtual. According to our results, the challenges are also more difficult when designing for children than those that are encountered when designing for adults.

Children had problems remembering that they had to move within the camera view even though the virtual space continued infinitely. There were also difficulties for the children caused by using both screens to play, in estimating distances, and in remapping directions as required by the profile view. The profile view provides valuable visual feedback if the game is used for martial arts training, but it seemed cumbersome for a children s game. Unless the goal is to learn three-dimensional body awareness by viewing yourself from different angles, a mirror view with the user facing the camera seems more suitable for children.

Considering our earlier experiences with adult players, the same problems can be noticed but adults were able to adapt to the situation faster. This is related to children s developmental phase and, thus, the problems cannot easily be removed. However, we aim to try to find visual or aural cues that will make the direction of the opponents more clear. The ends of the play area should also be made clearer so that the player doesn t fall out of the camera view by accident. For example, the virtual arena could be a platform high in the air so that the player would have to stay in the camera view to avoid falling down.

Our conclusions on violence also revolve around realism and the differences between the real and the virtual. Video game violence is considered harmful since there are seldom any realistic consequences for the aggressor [11]. Kick Ass Kung-Fu provides incomplete feedback in that you can learn to perform a move correctly based on the visual feedback, but in real-life, more negative feedback inhibits violent behavior. Because it is difficult to hurt yourself or others when punching air in the game, you don t necessarily understand the impact your punches would have in the real world. This was demonstrated by the four-year-old boy who punched his father when telling him about the

game, although no harm was apparently intended. Young children, who do not clearly understand the differences between the real and the virtual should not play physically interactive games without adult supervision. The differences between virtual and real worlds should also be discussed with children.
The presently used video game rating guidelines should be updated to include the realism of the user's actions, at least when considering violence. The game rating guidelines are partly based on similar guidelines for movies, which explain why they are focused on the audiovisual output of games. In interactive media, both user input and system output contribute to the user experience. It seems that to minimize harm, the input and output should be consistently realistic or unrealistic. It is relatively harmless to play a game with unrealistic cartoon violence using a game pad, but as the realism of the user's actions increases, so does the importance of realistic consequences.

Despite the play problems and violence concerns, children found Kick Ass Kung-Fu fun and parents liked the way that the game made children sweat and explore their body movements. The design is perhaps most successful in its social aspects. The large screens make it easy to observe others and try to mimic and improve their playing styles during play. In the gallery, several children played at the same time and the game became a digitally augmented play space, which was enhanced by improvising weapons and coming up with new rules of play. Children can even be too social and uninhibited - although adults were shy about shouting to activate the supercharge effect of the game, children shouted so much that this action was eventually forbidden by the gallery personnel. The design should be fine-tuned for children, for example by limiting the amount of supercharges.

This study has shown that there are many areas for future research in physical computer games for children and adults. Future work will examine some of these aspects including physiological effects, social implications and guidelines for physically interactive game design and input techniques.

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Acknowledgements

We would like to thank all the children and parents who took part in this study. The study was financially supported by the Graduate School in User-Centered Information Technology (UCIT) and Helsinki Graduate School in Computer Science and Engineering (HeCSE). We are also grateful to Janet Read for her valuable comments.