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ON AN ROLL:
A JOINT STUDY OF SUPER MONKEY BALL

Simon Egenfeldt-Nielsen
Keep the Monkey rolling:
Eye-hand Coordination in Super Monkey Ball

Troels Degn Johansson
Vertigo and Verticality in Super Monkey Balls

Lisbeth Klastrup
"You can't help shouting and yelling":
Fun and Social Interaction in Super Monkey Ball

Susana Tosca
The appeal of cute monkeys

The four following papers each address the game *Super Monkey Ball* from different perspectives. The papers are written by researchers at the Center for Computer Games Research at the IT University of Copenhagen. They present the outcome of an explorative study which had as its primary goal to study a single game from a variety of perspectives and through this practice to cover as many aspects of the game experience as possible while exploring the reasons behind the spectacular success of a game which the researchers themselves have all enjoyed playing. Secondly, the researchers wanted to explore the potentials in approaching one game as a group over a period of time and to learn from this process. Thus, part of the research presented here refers to a number of small pilot studies of players playing *Super Monkey Ball*, conducted in unison by two or more researchers in the group.

Super Monkey Ball (SMB) was developed by Sega for the Nintendo Gamecube and was launched in late 2001. So far, it is estimated that almost 1 million copies of the game have been purchased worldwide. SMB is primarily a single player game, but comes with a number of "party games" for up to four players that have proven more popular than the main game itself. SMB tends to be placed in the classical platform genre, but contains elements of action & skill and race games as well. Each player of the game controls a little monkey in a ball, up and down narrow tracks which can move, be full of holes or bumps. The party games allow for competition between the players by making their monkeys race, box, or play golf among other games.

Following the success of the first game, *Super Monkey Ball* 2 was released in august 2002, now with a storyline included. However, the papers here primarily deal with the first SMB game which is more easy to learn and to play, especially for inexperienced players, who were part of the target group in our user tests.

29. KEEP THE MONKEY ROLLING:
EYE-HAND COORDINATION IN SUPER MONKEY BALL

Simon Egenfeldt-Nielsen

ABSTRACT
This paper examines the relation between eye-hand coordination and computer games, specifically Super Monkey Ball. The study is exploratory and focuses on theoretical background and method problems. At the end of the paper the results from the pilot study is briefly presented. The results from the study are inconclusive in regard to the two main questions: Is there a connection between good skills in playing computer games and eye-hand coordination? Do avid computer game players have better eye-hand coordination than others?

KEYWORDS
Super Monkey Ball, games, study, learning, educational, eye-hand coordination, visual, motor, skills, children

INTRODUCTION

In the public debate eye-hand coordination is often cited as the most important skill for playing action games and becomes the first line of defence for the position that you can learn from games [4][12][19].

The question of whether computer games can enhance eye-hand coordination is not new in the public debate nor in game research but dates back to early games like Flight Simulator, Battlezone, and Marble Madness [22][26]. Ronald Reagan is often cited for commenting on the popular flight simulator games saying: "I recently learned something quite interesting about video games. Many young people have developed incredible hand, eye and brain coordination in playing these games. The air force believes these kids will be our outstanding pilots should they fly our jets." This quotation has over the years been supported by regular stories on the military using games for teaching specific skills.

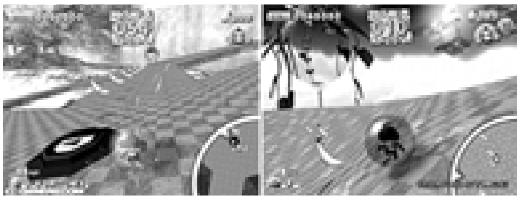
Despite early research interest in eye-hand coordination and a clear public interest in a potentially positive effect of computer games, actual research progress remains limited. The reasons for the lack of substantial studies are probably a combination of different factors. First of all, the development of game research in the direction of the humanities has not favoured studies of computer games and cognitive skills including eye-hand coordination. Instead the focus has been on games from a literature and film perspective. Secondly, the mix of game genres and grow in the technological complexity of games has made it hard for researchers to identify appropriate titles for studies which do not introduce other confounding variables and are customisable. For example, it was quite easy for Thomas Malone in the early 1980s to alter a simple Dart game to fit his needs to examine the importance of different variables in games for player's motivation [16]. Thirdly, the general focus in learning theory has moved away from a cognitive perspective and towards a broader approach encompassing socio-cultural factors [8].

This paper takes an explanatory approach to the question of eye-hand coordination by observing a group of children aged 10-13 years play Super Monkey Ball. This paper will focus on the methodological problems that became apparent in this pilot study due to the nature of computer game playing and the wish to perform the study in the children's natural environment. The results will be mentioned briefly only, as they are flawed by methodological problems, and these should be taken into consideration when reading the results. However, the questions that were examined, and which will hopefully in a later study be answered were: Is skill level in Super Monkey Ball related to eye-hand coordination, and do avid computer game players have better eye-hand coordination?

THE SUPER MONKEY BALL GAME

Super Monkey Ball on the GameCube platform is about controlling a ball with a monkey running inside it. The handling and steering of this ball builds on a constant flow, adjustment, and interaction between what you see on the screen and what you do with the controller. It is this control that is the premise for initially exploring eye-hand coordination in Super Monkey Ball.

In the main game you advance through different levels of varying difficulty, where you must pick up bananas, avoid falling and complete the level within a certain time limit. Besides the main game there is party games and mini games which are highly popular – often they are preferred to the main game[1]. The party games and mini games are usually built on a classic game concept like in Monkey Race, where it is a classic racing game. The party games and mini games still retain the same settings and controls.



Images 1 & 2: Two different levels from Super Monkey Ball main game.

THEORETICAL BACKGROUND

In game research, the knowledge of earlier research is often limited due to structural problems. In the latest study of visual skills [9] and video games, no prior research of visual ability, spatial skills, and computer games is cited. However, this is hardly an accurate picture of the situation. It is true that research into the domain of spatial and visual ability has been lim-

1 This was apparent from the empirical data in this study and supported by the two other play sessions held by Lisbeth Klastrup, Susana Tosca and Simon Egenfeldt-Nielsen.

ited since the productive years in the mid-1980s and the mid-1990s, but important studies were conducted in those years, and should not be forgotten.

Earlier studies of cognitive skills have dealt with a wide variety of skills. However, eye-hand coordination in one form or the other has from the start been one of the most interesting studies owing to the public common-sense approach to the effect that computer games involve heavy use of this skill. The question has been heavily debated although gamers are apparently approaching the debate with some scepticism and an ironic distance. Apparently a lot of gamers are not convinced that game skills can be transferred to other areas of life [1][5].

The definition of eye-hand coordination differs between people, gamers and researchers. The question of eye-hand coordination comes within the broader definition of cognitive skills in relation to video games (but also encompass motor skills), which covers spatial ability, visualization, thinking, reasoning etc. There are several definitions of eye-hand coordination. Laypersons often refer to eye-hand coordination as the application of vision to control and guide arm movements. A more accurate definition is "the process of coordinating movements of the eyes and hand/arm system so that they both move toward the same target"[2: p.1]. It is the latter definition that is used in studies of computer games and eye-hand coordination, where interaction and feedback mechanism between eye and hand is the focus.

Some studies have been conducted of eye-hand coordination in computer games although the number is small and often the studies involved a limited number of participants. I will focus on the studies of spatial, perceptual, and eye-hand coordination, as they are to some degree inter-connected. The area of spatial ability is better researched than the question of eye-hand coordination. From the start, studies of eye-hand coordination in video games yielded negative results in the sense that video games did not seem to improve eye-hand coordination. On the other hand, spatial skills have been found to be affected by video games on a long- term basis [7][9][10][14] and can be improved through video games [3][7][9][14][20][26]. There are some contradictory results [20][23], which could be attributed to the measurement of different areas of spatial skills. One of the major controversies is the issue whether you can transfer skills learned in video games to areas outside video games, and this discussion is echoed within the research of spatial skills. Still, a frequent source of error in these studies remains: The test of spatial skills is conducted on a computer screen, which is the same platform as video games. Hence, the test is administered in an environment favoured by the game players and the results could also be a consequence of familiarity with the test platform instead of the issue of eye-hand coordination.

The studies of eye-hand coordination are very limited but add up to the following conclusion: There does not seem to be any differences between non-players and players in respect to eye-hand coordination [6][7][11], and therefore it has not seemed relevant to study whether video games may potentially improve eye-hand coordination. One study with a limited number of participants did find a relation between eye-hand coordination and computer games but it has not had a great impact on the research community [17]. The study examined a group of 7-8 years-old children, who - according to the article - are in an important eye-hand coordination developmental phase. Overall, the number of studies are quite limited and dated (the last

Table 1: An overview of previous research into eye-hand coordination (N = number of participants in the study).

Author(s)	Year	N	Skills	Results
Lowery & Knirk	1982	-	Spatial visualisation	The researchers conclude that there is indeed "strong circum-stantial evidence" that video games support spatial skills.
Griffith et.al.	983	62	Eye-hand coordination	No found relation between how much you played computer games and your eye-hand coordination.
Gagnon	1985	58	Spatial visualisation	Eye-hand coordination The female participants improved on spatial visualisation probably as a conse-quence of less skill initially. No change in eye-hand coordination.
Dorval & Pepin	1986	70	Spatial visualisation	Spatial visualisation can accord-ing to this study be improved by playing video games.
McSwegin et. al	1988	30	Eye-hand coordination	Video games can improve eye-hand coordination and reaction time over a period of time.
Keller	1992	127	Eye-hand coordination	The study did not find a relation between eye-hand coordination and video game playing.
Funk & Buchman	1995	-	Eye-hand coordination	The meta-study found research to be "surprisingly inconclusive". The connection is weak between games and eye-hand coor-dination Subrahmanyam & Greenfield
1996	61		Spatial ability	Found that playing a video game improves spatial ability especially subjects with initial low spatial ability
Okagaki & French	1996	57	Spatial ability	Spatial ability improved but only for male subjects and only to close-ly related spatial ability tasks.
Greenfield, Brannon & Lohr	1996	24	Spatial ability	Found a relation between good video game player and high scores on spatial ability. A long-term rela-tion but no short-term.
Scott	1999	21	Spatial ability	The study did not find that video games improved spatial ability in the short term.
Green & Bavelier	2003	8-10	Perceptual and motor skills	Found that video games have bet-ter skills, and it is possible to train these skills through video games in a way so the transfer to other tasks.

experimental study dates back to 1992 and the last meta-study is from 1995). It would therefore seem appropriate to approach the area once more, researching it more thoroughly, especially given the continuing uncertainty in the public eye in relation to the beneficial and problematic consequences of computer games.

METHOD

The procedure was quite informal, observation, test and interviews running over approximately 3 hours. The session took place in a natural environment for the children to gain as valid data as possible [24]. The setting was an After School centre, where the participants normally have access to a PC room and a Playstation 2 room. The free environment meant that the participants were not confined to the game room for a specific period of time or had to complete specific tasks. This also meant that I only obtained the required data for less than 20% of the children that were at some time involved in the game session. In practice it turned out to be hard to keep the same participants playing for more than 15-20 minutes. After this period new players took over the controllers or other activities took their attention. This made it quite hard to measure game skills, and likewise obtain other data. Therefore, the data on game skills were obtained in a variety of ways: observation based on winnings in games, observed mastery of game, learning curve, and comments from other players, both during and after the game.

The test and interviews were conducted in a room separate from the game room, which was an absolute necessity to keep the children concentrated on the test and interview. It was first attempted to perform the test and interview in the game room but with very poor results. The final set-up was for one group to receive the test before playing and one after playing, both in a separate room. This was done out of practicality, to keep the children concentrated, and to see if the test results of the before- and after-playing groups would differ.

The test used was Test of Visual Motor Skills where you draw a number of figures as accurate as possible. The results are interpreted and the score is adjusted in accordance with age and norms. The test is able to measure your level of eye-hand coordination, and has been developed over several years [18].

Participants

The sample consisted of 7 boys aged 10 to 13 from a low-class/middle-class urban area in Copenhagen, Denmark. The sample was selected so the participants knew computer games, could be measured by test (between 2-13 years), and to avoid gender. The children all had prior game-playing experience with a game console and were avid computer game players. They did not play one specific genre although action was the preferred genre. The most popular playing platforms were PC and Playstation 2.

Methodological problems

As already mentioned, the set-up gave rise to several problems. One problem was the sampling of the participants which was contaminated by self-selection. This meant that the participants were all computer games players, interested in the game initially and highly motivated. It also meant that the participants measured didn't know the game beforehand.

The participants who knew the game were not as inclined to play the game. They did hang around the room but usually did not engage in the game, being thus not included in the sample. It was obvious that the children who knew the game hanged around acting as an active audience. They wanted to show their knowledge by referring to other levels in the game, and by giving small game related comments.

The children that were playing, and didn't know the game used this knowledge as an excused to keep them out of the game – stating that the children that had already played the game could not expect to play it on this occasion. One should be aware of such group dynamics when operating in a natural environment, where self-selection is a given condition. Potentially there could be other factors that might contaminate the results as a consequence of unknown factors underlying the self-selection. For instance, parallel with the game session there was a baking activity and role-playing activity. The participants might be the ones that didn't want to bake or role-play and they might deviate in some way from a normal group.

Initially the set-up was selected to ensure a genuine and realistic game environment, where the participants felt comfortable. As mentioned above, this resulted in problems of keeping the experimental room controllable and manageable. Still, the criterion for realism and authenticity was met which was considered important. In the specific interviewing, another problem arose. It seemed like some of the participants in the interviews were a little too eager to talk about addiction and health hazards in an adult discourse. These subjects were brought up spontaneously by the participants, and the statements were often followed by a close examination of the interviewer – was that what he really wanted? Earlier studies have confirmed this problem as a real threat to studying media habits [25]. In another Danish study the participants all seem to think they played less that there peers, and this was especially so for girls. This could indicate that the adult discourse was also at work here [4][28]. The influence of a grown-up discourse could very well influence the reporting of game usage, thus making the connection between game usage and eye-hand coordination impossible to test without observation in the home or at least some other validation of children's self-reporting.

The environment also proved to be quite hectic and noisy, which was especially a problem in respect of interviewing and testing. The participants were interrupted and sidetracked. Furthermore, the noise and hectic activity impeded the observation of the children and obtaining the necessary data. One distinct influencing factor was some of the girls' comments.[2] These statements were often delivered in passing but clearly had an effect on the male participants. In the game room, the girl shouting resulted in a marked decline of intensity, communication, and cheerfulness. In the test room the impact was harder to assess, but the test manual [18:p. 22-23] would definitely consider it problematic. The conflicts mentioned are related to the clash between girls and boys and is clear from that fact that at no point did boys and girls engage in game activities together. The girls did at no point approach the game. The gender dynamics should also be taken into consideration when conducting studies in computer game setting, as it is still present, despite attempts to close the gender gap in computer use.

[2] One dominating girl shouted, "Don't you have a life?" into the game room and in another case two girls invaded the test/interview room with a comment like "Do you give them the test to see if their brains have been damaged after playing".

The stressfulness of the environment was apparently more than averagely intense, according to the recreation centre teacher at the place. From one perspective it could be said that these noise and stress levels are a natural part of an After school and should not be eliminated. On the other hand, they seriously undermine the validity of the data acquired. The problem is not really a solvable one, but certainly one you should keep in mind when setting up a study. The problem is not unique to games but is a general predicament in studying children's cultural behaviour.

RESULTS

The game was well received by all participants and was played with great enthusiasm, especially the party games called *Monkey Race* and *Monkey Fight*. The results are summarised below. Overall, they are not strong enough to support the public beliefs regarding computer games and eye-hand coordination mentioned in the introduction. However, below I shall discuss the results more closely. The table is divided into two groups in accordance with the time of testing: A group (1-3) where the test was administered after the game session, and a group (4-7) where the test was administered after the game session. Game usage was first measured in hours but then converted to high as all players reported playing above 2 hours

	Test time	Age	Game Usage	Game Skills	Test-score: Raw	Test-score: Scaled	Perc.
1	Before	10	High	Bad	35	10	45th
2	game	13	High	Good	40	9	39th
3	session	10	High	Average	36	10	47th
4	After	11	High	Average	50	13	82nd
5	game	13	High	Good	52	12	75th
6	session	11	High	Average	33	9	32nd
7		12	High	Average	51	12	79th

Table 2: The Results of the Current Study of Eye-hand Coordination.

each day. The raw test score is the test result before it is adjusted for age, and the scaled test score is the score after age is applied. The last column indicates what percentile the player is in for his age group. For example player 1 ranks among the 45% worse players whereas player 4 is in the top 18%.

In the group of participants where the test was administered before the game session, the good player scored lower than both the average player and the poor player. The pattern is a little different for the group where the test was administered after the game session. Here, the good player is in the best group but he is not better than the other players. Furthermore, one of the players who played Super Monkey Ball is in the 32nd percentile, the lowest of the sample. If there were a relation between playing and eye-hand coordination we would not have expected to find the lowest score in the after playgroup.

The other question in this pilot study is whether game usage in general is related to eye-hand coordination. The test could lend some support to this claim as the two groups in average rank in the 57th percentile, which is a little above expectations. We would have expected a percentile mean of 50. However, the number of participants is too small to constitute any solid evidence.

If we look at the difference between the test results of the before and after group there is some indication that you may actually improve from playing the game as the test score mean is higher for the after game session group. Furthermore, one of the players in the after game group ranks very low which could indicate more fundamental problems with eye-hand coordination, which could not be improved through the game. However, such a finding would need a real experimental set-up with a control group, pre- and post-test to be studied appropriately.

The results support earlier studies of eye-hand coordination where no clear connection between good computer games skills and good eye-hand coordination skills was ascertained.

CONCLUSION

The study uncovered a lot of methodological problems concerning the conduct of an eye-hand coordination test in a natural environment: Among these a potential problem with the validity of self-reporting, the impact of a stressful environment, and the importance of group dynamics. These problems should be taken into consideration when designing a more comprehensive study. The results do not support any connection between eye-hand coordination skills and computer games but the general claim for a connection between eye-hand coordination and games cannot be rejected altogether either. However, with the present study and earlier studies in mind it seems premature to argue for the existence of a connection between eye-hand coordination skills and computer games.

One might ask why eye-hand coordination remains a popular skill to associate with computer games. One reason is probably that the idea is deeply entrenched in the public sphere by early anecdotes of military simulators that train eye-hand coordination. Despite the fact that the military's first attempts at using games for eye-hand coordination improvement with Battlezone failed [15], the continuing use of computer games for other purposes was interpreted as the training of eye-hand coordination. Apparently, it is easier for a lay person to conceive of eye-hand coordination in relation to military simulation-training than to team tactics, conflict resolution or strategy, which is the real rationale for using Doom, Delta Force 2, Sense and TopScene in the military [21][15].

However more important than the military anecdotes is the general wish to rationalize over the usage of computer games, and to identify educational potential of new media. There seem to be a desire for not just engaging in leisure activity but too make it meaningful at a higher level – it is not enough to have fun. A rhetoric that is well known from play theory [27], and is certainly also clear in the edutainment wave. We will need more than a few studies and anecdotes to establish whether computer games can support eye-hand coordination, and even more to alter public opinion in this area.

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