Bachelor Thesis

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Encouraging Collaboration in Hybrid Therapy Games for Autistic Children

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I. Abstract

Social competence and communicative skills of children with autism spectrum disorders (ASD) are supported by behavioral therapy. "Serious games", especially therapeutic games on hybrid interactive surfaces, have been proven to serve as a useful tool for behavioral therapy. In this work, I describe the design process of acquiring and implementing requirements for such a hybrid therapy game: "Invasion of the Wrong Planet". I then use the game to measure collaborative behavior in two consecutive studies with 16 children without developmental disorders and 9 children with ASD at the University of Konstanz and a therapy centre in Freiburg respectively. In these studies I contrast the design principle of "Encouraged Collaboration" (ECC), which I derived from specific aspects of behavioral therapy, with the design principle of "Enforced Collaboration" (EFC), which has been used in recent work in this area of research. Based on the findings of these studies, I show that ECC in contrast to EFC leads to a higher amount of motivation, while at the same time providing a comparable amount of collaboration between the players. In this regard, ECC may enhance effectiveness of games used as a tool for behavioral therapy fostering social competence and communicative skills of children with ASD. To conclude this work I discuss how this design principle can be generalized and be applied to other fields of behavioral therapy and how effectiveness of serious games in general can be improved.

II. Acknowledgements

III. Publications

Parts of this work have already been published in:

- **Marwecki et al. 2013:** Marwecki, S., Rädle, R., Reiterer, H.: Encouraging Collaboration in Hybrid Therapy Games for Autistic Children. *ACM Intl. Conf. Human Factors in Computing (CHI 2013), Work-In-Progress*. 2013.

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VII. List of Abbreviations

ANOVA...Analysis of Variance
AS.. Asperger Syndrome
ASD ....Autism Spectrum Disorders
ECC .... Encouraged Collaboration
EFC...Enforced Collaboration
HCI .... Human-Computer Interaction
HFA ....High Functioning Autism
LFA .... Low Functioning Autism
MBAS .... Marburger Beurteilungsskala zum Asperger-Syndrom
MFA .... Medium Functioning Autism
SDQ...Strengths and Difficulties Questionnaire
SOKO ....Soziale Kompetenz Training

1 Introduction[1]

In this chapter, the term autism and the forms of therapy are explained and summarized. The concept of using games as a tool for such therapy is introduced. Furthermore, it is depicted what hybrid games are and how they can improve effectiveness of therapy games.

1.1 Autism Spectrum Disorders

Autism is a complex developmental disorder. Symptoms of autism become apparent before the age of three. Regarding the American Psychiatric Association (2000) children with autism have impairments in social interaction and communicative skills and show stereotyped or repetitive behavior. These impairments in social interaction may include a lack of understanding or inappropriate use of non-verbal behavior. They also may include the inability to develop peer relationships or the lack of need to share interests or enjoyment with others. Communication skills are limited due to the incapability to initiate or sustain conversations. Spoken language, if present at all, is delayed. The range of interests is narrowed to just a few topics or activities. The preoccupation with these interests is very stereotyped, inflexible, and often abnormally intense. Affected children also often have poor motor skills and coordination as well as impairments in their cognitive skills.

These impairments vary for each individual and can cover a wide range of manifestations, which is referred to as "autism spectrum disorders" (ASD). ASD can be recognized at all levels of intelligence. Depending on an intelligence threshold, the spectrum is often divided into low, medium, and high functioning autism (LFA, MFA, HFA). Children with "Asperger syndrome" (AS) do not demonstrate such severe limitations in their communicative skills and cognitive abilities and can be compared to autistic children with HFA. In addition, they often have extremely developed abilities in certain cognitive, mathematical or musical areas.

Another criterion that also summarizes behavior that is seen as typical for children with developmental disorders like autism is described in the *Theory of Mind*. This theory has been introduced by Premack & Woodruff (1978) and refers to the ability to attribute certain mental states like thoughts or feelings to others. Baron-Cohen (1992) describes this ability to be the key aspect of social behavior. People with autism are "oblivious to the guesser's state of knowledge or belief. In this sense, they failed to employ a theory of mind." (Baron-Cohen 1992: 12). This also makes it extremely difficult for an autistic person to understand thoughts

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[1] Parts of this chapter are directly obtained from Marwecki et al. (2013).

and feelings that are communicated nonverbally. This includes facial expressions, gestures or the tone of voice, as well as irony.

ASD are not curable. The main goals of therapy are to decrease the symptoms, help affected persons to accept their situation, and provide support for their families. Through behavior therapy, one can condition desired behaviors and develop strategies to overcome his or her deficits. Intervention strategies are generally very structured and support the visual way of thinking, which is immanent to people with autism. The *Treatment and Education of Autistic and Related Communication Handicapped Children* (TEACCH) introduced by Mesibov et al. (2004) is based on such behavioral therapy. Through TEACCH children and adolescents with ASD are taught ways of social interaction and communication. One Element that uses the concepts of TEACCH is the so called *Soziale Kompetenz Training*[2] (SOKO). Developed by Häußler et al. (2008) SOKO introduces methods of social interaction and communication.

1.2   Therapy Games

There are various methods, mostly provided in a playful manner, that use the concepts of SOKO and TEAACH. An easy way to maintain a visual structure, which is needed for those therapies, is through so called "therapeutic games" or "health games". These games are a subcategory of a spectrum of games that is often referred to as "serious games"[3]. Examples of therapy games for autistic children and a detailed descriptions of them are given by Häußler et al. (2008) (Figure 1).

Figure 1: *Examples of current therapy games for ASD*
(From left to right: "Watte-Picken", "Smiley-Domino", "Schnipp-Schnapp")

In current therapy games for children with ASD, multiple players who play simultaneously need to collaborate to achieve the goal of the game. Also these games are mostly are hand-crafted and consist of analog components such as wood or paper.

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[2] This can be translated as "Training of social competence".
[3] For an overview of the broad scope of serious games, one can for example refer to Susi et al. (2008).

1.3 Hybrid Games

Serious games potentially offer a high grade of intrinsic motivation and combine this motivation with an extrinsic gain. This gain, in this case a therapeutic effect, can be improved by the usage of a hybrid medium. Games on such a medium are often referred to as "hybrid games" (lat. "Hybrida" - mixture, combination). Hybrid games are based on hybrid technology, such as hybrid interactive surfaces.[4] Kirk et al. (2009) define them as "interactive systems combining techniques of direct-manipulation multi-touch surface interaction with elements of tangible user interfaces" (Kirk et al. 2009: 1).

Regarding Magerkurth et al. (2004) hybrid games have the means to blend together digital and analog advantages.[5] In games on hybrid interactive surfaces haptic and social elements of analog games are combined with the audiovisual possibilities of digital games. With the help of digital computing power and ways of controlling the digital environment the flow, the "state of effortless concentration and enjoyment" (Csíkszentmihályi 1997: 1), can be enhanced. Routine tasks, like preparing the game, which keeps the players from experiencing flow and motivation, can be reduced to a minimum. The rules of the game become obvious through gameplay and tutorials.

This combination of analog and digital advantages can now be used for therapeutic games for children with ASD. Players are motivated and feel secure in the digital setting, as found out by Piper et al. (2006). At the same time, the form factor allows a face-to-face communication between the players, which fosters social interaction, a crucial element to therapy approaches like TEACCH and SOKO.
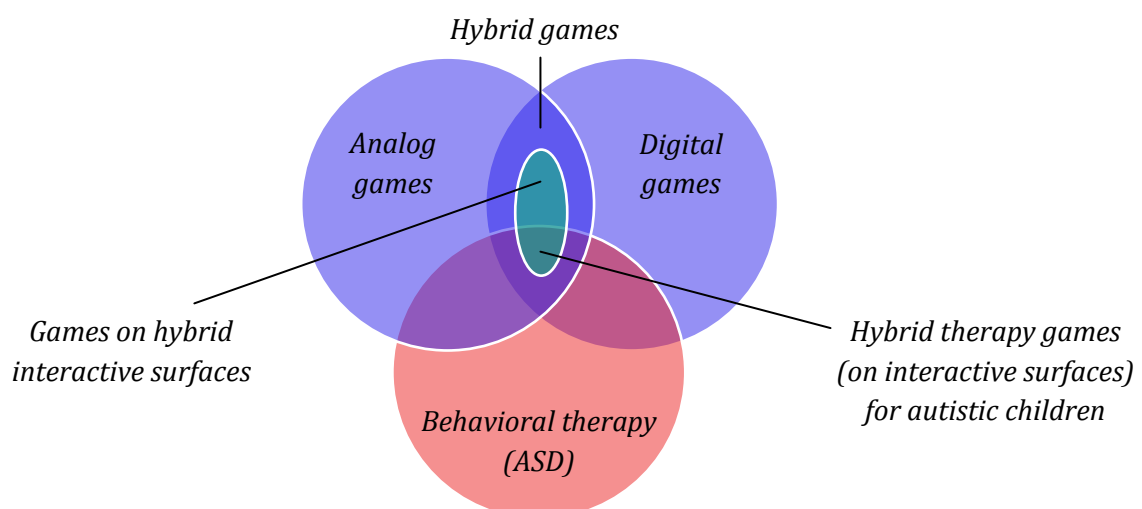
Figure 2: Overview of the field of research

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[4] Please refer to Marwecki (2012) chapter 3.2.2.
[5] Please refer to Marwecki (2012) chapter 2.

2 Hybrid Therapy Games - Research Approach

In this chapter, hybrid therapy games for autistic children are illustrated by examples from different studies. Based on this work the research question is derived and explained.

2.1 Related Work

The idea of hybrid therapy games is not new. Recent studies have proven the potential of using hybrid interactive surfaces for therapy games to treat HFA and AS.

Piper et al. (2006) developed a game called *SIDES* on the *DiamondTouch*[6] for children and adolescents with HFA or AS "to supplement current social skills group therapy techniques" (Piper et al. 2006: 8). Players were to cooperatively lay out a path of lily pads to help a frog cross a pond. Each player had different lily pads so the players had to work together. The better the path was, the more points the players collected. This game proved to serve as a meaningful tool for group therapy. The digital setup in an analog context was proven to provide a significant benefit, as "these adolescents find comfort in the consistency of automated game rules, where as [sic] rules enforced by a human moderator may be more subjective and add challenge to an already difficult task" (Piper et al. 2006: 9).

Gal et al. (2009) developed *Story Table*, in which players invent stories together. While players could separately decide on some images or audio snippets the story should contain, they had to agree on certain elements like the background image of the story. Originally developed for improving oral speech, it showed to be effective as a tool for group therapy for children with HFA and AS. This game was also implemented on the same hybrid interactive surface, the *DiamondTouch*. As with *SIDES*, this was done with the intention to refer in-game actions to the player. By this, cooperation could in certain situations be enforced. They named this principle "Enforced Collaboration" (EFC).

Battochi et al. (2010) developed a *Collaborative Puzzle Game* in which players were also forced into collaborative actions, as they were to drag puzzle pieces together in order to move them. They also implemented the principle of EFC.

Giusti et al. (2011) developed a set of games in order to show how games can support therapists in their use of Cognitive-Behavioral Therapy. In these games, children with HFA "were able to attain the game objective [...] only if they play[ed] collaboratively [...]" (Giusti et al. 2011: 4). Again, this "Join-In Suite" was implemented via *DiamondTouch*.

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[6] Due to the technology of the *DiamondTouch*, single users can be identified and every action in the game can be ascribed to the specific user. For more information on the *DiamondTouch*, please refer to Dietz et al. (2001).

2.2 Deriving the Research Question

Hybrid therapy games are an effective instrument for therapists in group therapies for children with ASD. They are even more effective than common analog therapeutic games, as they provide a higher level of motivation and involvement. In aforementioned studies, players were always forced into collaborative actions in order to foster social behavior and communication. To maintain the therapeutic goal, the games always implemented the design principle of EFC. Overall, EFC was proven to indeed have a meaningful therapeutic effect. However, it can be assumed that this design principle can be elaborated further and there are two reasons for that.

The first reason for doubting effectiveness of EFC is derived from aspects of behavioral therapy. According to prevalent behavioral therapies, desired behavior should never be enforced but encouraged and rewarded, while undesired behavior is penalized. Considering this, there is reason to doubt whether EFC is the best possible design solution for hybrid therapy games which specialize in supporting therapists in behavioral therapy.

The second reason is a question of motivation and appropriate positive feedback. In the games presented in the last chapter, a game level can mostly only be completed by passing a certain collaborative threshold. After that, the players either succeed or fail the given task in the game. While this certainly results in a certain training effect, players might feel a lack of motivation since the main principle of a game, the "Voluntary Participation" (McGonigal 2011: 21) is violated. Players are forced to cooperate, otherwise they fail. They have no choice on how to best solve the game. This is a general contradiction of serious games which all follow a certain purpose and also care for the fun aspects. How do we maintain motivation without neglecting its purpose? And when does a game start to be too serious?

There is however, a solution to this problem. In this paper, a design principle called "Encouraged Collaboration" (ECC) is proposed. In behavioral therapy, desired behavior is encouraged and not enforced. Therapeutic games are instruments of behavioral therapy. That being said, therapeutic games should provide the means to encourage collaboration, instead of enforcing it. A game that leads its players into voluntary collaborative actions may provide a higher level of motivation and therefore a better long-term aid in transferring social behavior and communicative skills into everyday life.

Players should always feel free to choose their way to a solution of a problem in the game, i.e. acting or not acting together, to ensure motivation. By this, the players still act on a

voluntary basis. Still, the therapeutic effect should be maintained, that is to say, collaboration should be rewarded. This can be achieved by a more continuous feedback system (Figure 3).
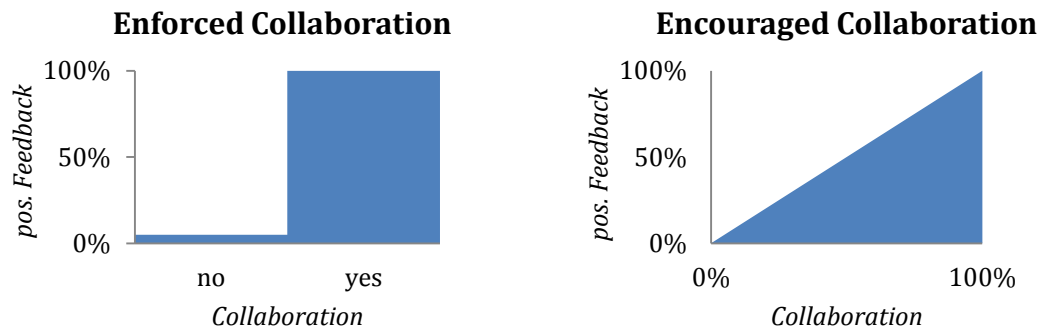
Figure 3: *Reward systems of EFC and ECC*

Instead of achieving the goal of the game by passing a collaborative threshold, the game should reward any amount of collaboration in the process of achieving the goal of the game. ECC in contrast to EFC therefore differentiates between goal and purpose of a game. While the goal, the narrative task of the game, can always be achieved to ensure motivation, acting towards the purpose, the training of desired behavior, is provided with a high amount of positive feedback.

The question is, whether or not this continuous positive feedback minimizes therapeutic effectiveness and really fosters motivation. This leads us to the following research question:

> **Research Question:** *Does encouraged collaboration offer a better way of motivation than enforced collaboration while providing the same amount of collaborative behavior?*

The hybrid therapy game *Invasion of the Wrong Planet*, which was developed in order to prove the importance of ECC, should serve a tool for a study which answers the research question and provide a basis discussion on how game design for hybrid therapy games in general can be improved.

3 Development

This chapter gives a detailed description of the iterative development of the hybrid therapy game *Invasion of the Wrong Planet*. This includes development of the first milestone, as well as a subsequent evaluation and development of the second milestone.

3.1 First Milestone

This chapter gives a brief summary of the development of the first milestone of the game. The way of generating and covering the necessary requirements is explained and an overview of the game is given. While this chapter provides an overview of the development work done in order to finish the project and should answer all relevant questions, it is strongly advised to refer to Marwecki (2013) for a detailed description of the development of the first milestone and to have a look at the presentation videos. Both the description and the videos can be found in Appendix 24.

3.1.1 Development Tools

The project was implemented via *CSharp* and *WPF* on the *Samsung SUR40* (Figure 4) with *Microsoft PixelSense*[7]. Based on this hybrid interactive surface, the game provides face-to-face communication and a possibility for social interaction within the comfortable and controllable digital setting.

Figure 4: The Samsung SUR40[8]

Development environments were *Microsoft Visual Studio Ultimate 2010* and *Microsoft Expression Blend 4*. Next to the *.NET* Framework, *XNA* libraries were used for the sound effects. The tokens were modeled with *AutoCAD* and *Autodesk Inventor*.

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[7] http://www.microsoft.com/en-us/pixelsense/default.aspx (last access date on July 25th, 2013).
[8] http://www.samsunglfd.com/upload/product/img/Surface[1294390605622product].jpg (last access date on July 25th, 2013).

In the design process of the interface a child of the postulated age made plasticine models of the tokens. Using these models, the computer model and the plexiglass model were made respectively (Figure 5). The tokens are provided in four different colors (red, green, blue, yellow) and are 115x68 millimeters in size. Detailed measures of the finished game token can be found in Appendix 4.
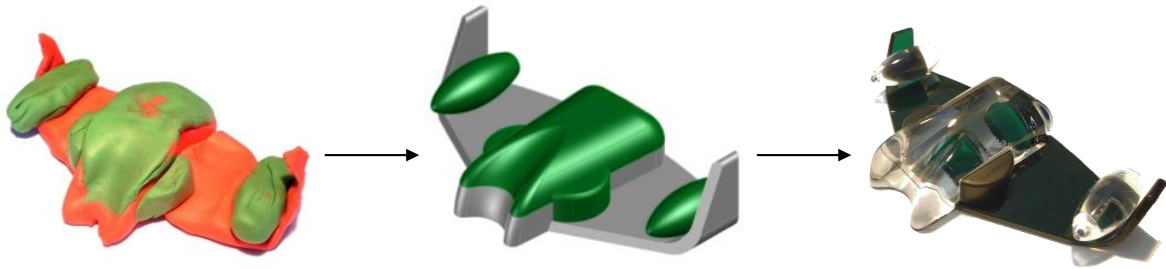
Figure 5: *Development of the game token*
(From left to right: Plasticine model, computer model, finished model)

3.1.2   Requirements and Implementation

The requirements for this project were generated from literature and interviews with user surrogates[9]. These user surrogates were two educational advisers for ASD and one therapist with several years of experience in the diagnosis and treatment of ASD. Appendix 1 contains the questionnaire for these interviews. The results derived from these interviews with the advisors and the therapist can be found in Appendix 2 respectively Appendix 3. Eight requirements were defined. In the following, these eight requirements are listed separately and a description of their implementation is given.

Requirement 1.1: *The game should be designed for children with either HFA or AS between the ages of eight and twelve years. Since the prevalence for autism is significantly higher for boys than for girls, the narrative structure of the game should focus on boys.*

In *Invasion of the Wrong Planet*, the players have the task of defending the earth (the "wrong planet"[10]) from alien invaders. In order to achieve this, each player has a token with the form of a spaceship (Figure 5). The players can move their ship through space by moving

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[9] A method introduced by Constantine & Lockwood (2006). Due to the lack of real users or the incapability of real users to generate requirements for a project, domain experts are interviewed in order to collect all necessary requirements.

[10] The name of the game is based on the term "wrong planet syndrome", an alternate description of ASD. Children, though possibly aware of their situation, perceive themselves as normal and their surroundings as all the more odd. They feel like they are on a "wrong planet".

the tokens across the screen. They can then shoot enemies by pressing the virtual button in front of their token (Figure 6). The familiarity of the setting is intentional, for it may provide a motivation similar to commercial games played at home on consoles or the computer. Also it reduces the cognitive affordance of the game contents. Nevertheless, the cognitive level is too high to be easily understood by children with LFA or MFA. The game serves as a motivator and basis for group discussions in group therapy sessions for children with HFA or AS. It should be mentioned that this project may only serve as a tool for group therapy; it is not meant to replace a therapist.

Figure 6: *Players controlling their tokens*

Requirement 1.2: *Communication and social interaction must happen on a game-based level with relation to the goal of the game.*

The game consists of different levels, i.e. solar systems, from which the players are allowed to choose (Figure 7). Depending on the level, the players are confronted with different tasks best to be solved collaboratively. These tasks consist of eliminating different alien ships together. Each of these enemy ships (Figure 8) requires a different strategy which the group has to figure out through discussion. Each strategy involves the players in collaborative actions. When the players eliminate an enemy ship, they collect points. When the players fail to eliminate all enemies of one of the enemy waves, these enemies invade the earth and points are subtracted from the score of the players.

Figure 7: *Choosing the game level*

Requirement 1.3: *The game should encourage collaborative behavior of the players, but not enforce it. Collaboration on the part of multiple players should therefore be rewarded more than the actions of one individual player. Feedback should be provided in a timely manner and condition the desired behavior.*

Utilizing the concept of encouraged collaboration, all game elements encourage communication and social behavior. A single player can eliminate each enemy (Figure 9). However, players who act collaboratively will do so in less time and achieve a significantly higher score (Figure 10). The game provides strong visual and acoustic feedback when the players receive a higher score through collaboration (Figure 11, Figure 12). Due to the strong audiovisual feedback, players receive an immediate response to their actions and are motivated into collaborative behavior.
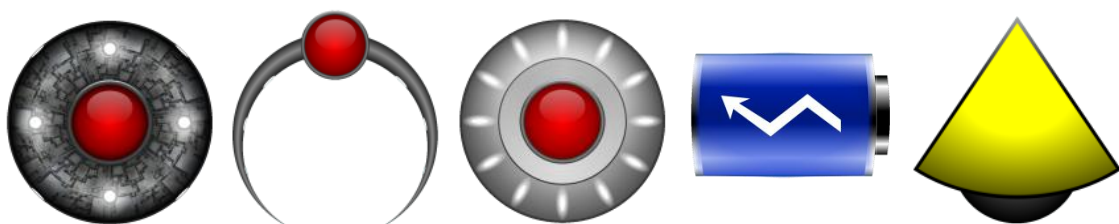
Figure 8: *The different elements in the game*
(From left to right: Raider, Neutralizer, Teleporter, Energy Battery, Supply Drone)

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Figure 9: *Uncollaborative approach to eliminating the "Raider" (player attacks on his own)*
Note: This is a screen image. The token was included afterwards.

Figure 10: *Collaborative approach to eliminating the "Raider" (players attack together)*
Note: This is a screen image. The tokens were included afterwards.

Some ships, called *Raiders* (Figure 8, first from left), can be destroyed by a single player. However, when multiple players agree to confront the enemy at the same time, the time required to eliminate the ship shrinks exponentially and more points are given.

Figure 11: Strong audiovisual feedback is provided when players act collaboratively
Note: This is a screen image. The tokens were included afterwards.

Figure 12: Higher reward mechanisms come into effect when players act collaboratively
Note: This is a screen image. The tokens were included afterwards.

The *Neutralizer* (Figure 8, second from left) catches a player and prevents him from shooting. If the player asks another player for help, the *Neutralizer* can be defeated very easily. Both communication on the part of the first player and collaborative behavior on the part of the second player are rewarded.

The *Teleporter* (Figure 8, third from left) changes color and position. The player with the displayed color does significantly more damage to this enemy. Players who discuss their strategy will save time and gather more points.

When a player runs out of energy to shoot, an *Energy Battery* (Figure 8, fourth from left) appears on the other end of the screen. The player can then either reach for the battery or can ask another player to send the battery over to him. This is done by an easy swift gesture. The second option is far more efficient and will lead to more points.

Players can collect the *Supply Drone* (Figure 8, fifth from left) by touching it with a finger. By doing so, the players win additional time. Dividing tasks between the players will lead to a higher score.

Requirement 1.4: *The progress, structure, and goal of the game should be clear and easy to understand. This is best done in a visualized and structured manner similar to the TEACCH approach.*

The game offers the possibility of an explanation, a hint, when a new game element appears in the game (Figure 13). In accordance with the TEACCH approach, visual explanation was used wherever possible. The time remaining is visualized in a pie chart next to the score display. The game provides audiovisual feedback after each of a player's actions.

Figure 13: *Hints are provided at the beginning of the game and before each new enemy*

The whole game uses strong audiovisual feedback extensively, because "aesthetics are an incredibly important aspect of game design since they have the most direct relationship to a player´s experience. [...] (The aesthetics) reinforce the other elements of the game [...]" (Schell 2008: 41).

Requirement 1.5: *The game should not penalize players limited in playing skills, that is to say cognitive and motor skills. The game should never penalize the group because of the misdoings of one player.*

The game does not require the players to perform complex movements. The cognitive affordance changes slowly with each game level, but is low at the beginning. The only obstacles for the players to overcome are impairments in social interaction and communication. Thus, the difficulty of the game lies in overcoming those impairments in collaborative behavior. The difficulty does not lie in solving cognitive tasks like in many other games. The more the players wish to collaborate, the more they will be rewarded.

Requirement 1.6: *The difficulty of the game should be variable.*

To keep the players motivated, they never need to be challenged too little or too much. They need to be in a constant state of flow. To achieve and maintain a state of flow, the difficulty should be variable.

Figure 14: *The options menu (oriented towards the therapist)*

The difficulty of the game lies in overcoming impairments in collaborative behavior. The therapist can adjust the level of required minimal collaboration in the options menu (Figure 14). The higher this level is set, the more time is needed to eliminate the enemies on ones own, and the more the players need to cooperate.

The game also seeks to reward knowledge of the game and to surprise the player with new elements; players not only need to be in a state of "collaborative flow" (the game difficulty), but also in a state of "cognitive flow" (the attractiveness of the game). This is achieved by offering them the choice of the game level (Figure 7), which affects the number of different enemies. Since the elements of the game all encourage communication and social behavior, the therapeutic aspect is not influenced by the number of game elements. The higher the game level is set, the higher the cognitive affordance. By increasing this affordance, players stay motivated and curious. However, players who are new to the game should always start with a low cognitive affordance. This may lie within the responsibility of the therapist.

Therefore, the flow of the game is structured in two layers: the collaborative difficulty set by the therapist and the cognitive affordance set by the players. This "two-dimensional flow" allows for strong motivation and, at the same time, does not neglect the therapeutic effect.

Requirement 1.7: *The length of the game should not exceed a timespan of ten minutes. The therapist must have the opportunity to reflect on the contents of the game together with the children to provide a transfer between the game and reality.*

Figure 15: *The players can write down their name for a record in the highscore list*

Figure 16: *Highscore list*

Every round of gameplay lasts three minutes. Taking possible explanation time into account, the estimated time needed to play is five minutes. After playing the game, the therapist should initiate a group discussion. The game provides a basis for such discussion after each level (Figure 15). Additionally there is the possibility for the players to fill in their name when they reach a highscore. By this, the players are encouraged to play again and beat their own score or the ones of other groups (Figure 16).

Requirement 1.8: *Dominant behavior of a single player should be prevented. Every player must have the opportunity to integrate him- or herself in the process of the game.*

Using cognitive tasks as gaming obstacles may lead to dominant behavior by a single player. When a cognitive task is solved by a single player, the other players will become a hindrance to him.[11] He may then apply dominant behavior to speed up the game process. As mentioned above, the main difficulty of this game does not lie in overcoming cognitive obstacles, but in performing collaborative actions. Dominant and uncooperative behavior is penalized and discouraged because it leads to a lower score.

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[11] For an example see Piper et al. (2006). In *Sides* each player has an amount of unique tiles, which makes him valuable to other players. The game however, can be solved analytically by a single player. In this regard, the other players may become obstacles by themselves, which have to be overcome in the process of obtaining the necessary tiles. This completely defeats the purpose of enforced collaboration.

3.2 Second Milestone

This chapter explains the first evaluation of the game and describes the changes made in order to achieve an even more presentable second version of the game. New requirements are introduced and an explanation is given on how they are covered.

3.2.1 Evaluation of the First Milestone

After finishing the first milestone of the project, evaluation of the prototype was needed. To achieve this, a second round of interviews with user surrogates was conducted. The persons interviewed were Andreas Wacker and Andreas Targan, the therapist and one of the educational advisors, with whom the requirements in the first round of interviews were generated. In addition, a set of further expert interviews was conducted. These experts were Steffen Bogen, a lecturer in game analysis and professional game designer of children's games and Margarita Stolarova, a lecturer in early childhood development and education.

The interviews were of qualitative nature. The game was presented to each one of the interviewed persons and discussions were held freely. To those who did not attend the first round of interviews, a brief introduction was given. The interviews were recorded. These recordings can be found in Appendix 24. The results of the interviews are presented in appendices Appendix 6 to Appendix 9.

3.2.2 Additional Requirements and Implementation

Overall, the aspects of encouraged collaboration and two-dimensional flow were received positively. The structure and setup of the game were estimated to be easy to understand. In its current form, the game was deemed to be ready to be used as a motivator and basis for discussion at the end of group therapy sessions.

However, while finding their requirements matched by the game, there were still issues for discussion and improvement. These additional requirements were generated together with the reviewers. As in the last chapter, eight requirements were defined. And, also parallel to the last chapter, in the following these eight requirements are again listed separately and a description of their implementation is given.

Requirement 2.1: *The performance of the game should be improved.*

After finishing the project, there were some performance issues. Solving this problem seemed to be mandatory. Using libraries from *Expression Blend* and the *.NET* Framework

resulted in a certain lack of performance. While the fixing of this issues took quite an amount of time, the explanation on how this was achieved should not, since the focus of this work is of theoretical nature and not of a technical one. In summary it can be said that the use of bitmap caches and the reassembly of certain user controls like game elements and levels into less complicated structures. The performance issue was fixed. The game now runs far more smoothly than before.

Requirement 2.2: After playing the game, a basis for group discussion should be provided. Feedback regarding the performance of the players should be given. Players should have the opportunity to learn from their mistakes and communicate different strategies and approaches to the solution of the game obstacles.

In order to cover this requirement, the amount of collaboration for each enemy was displayed in the victory screen after completing a game level. The screen displayed a percentage of the players acting collaboratively and offered suggestions for improvement. This usage of a percentage still seemed to be too abstract and too hard to be grasped by children, so this percentage was translated into a number of stars, which the players achieved (Figure 17, Figure 18).

Figure 17: *Each star represents an enemy eliminated collaboratively*
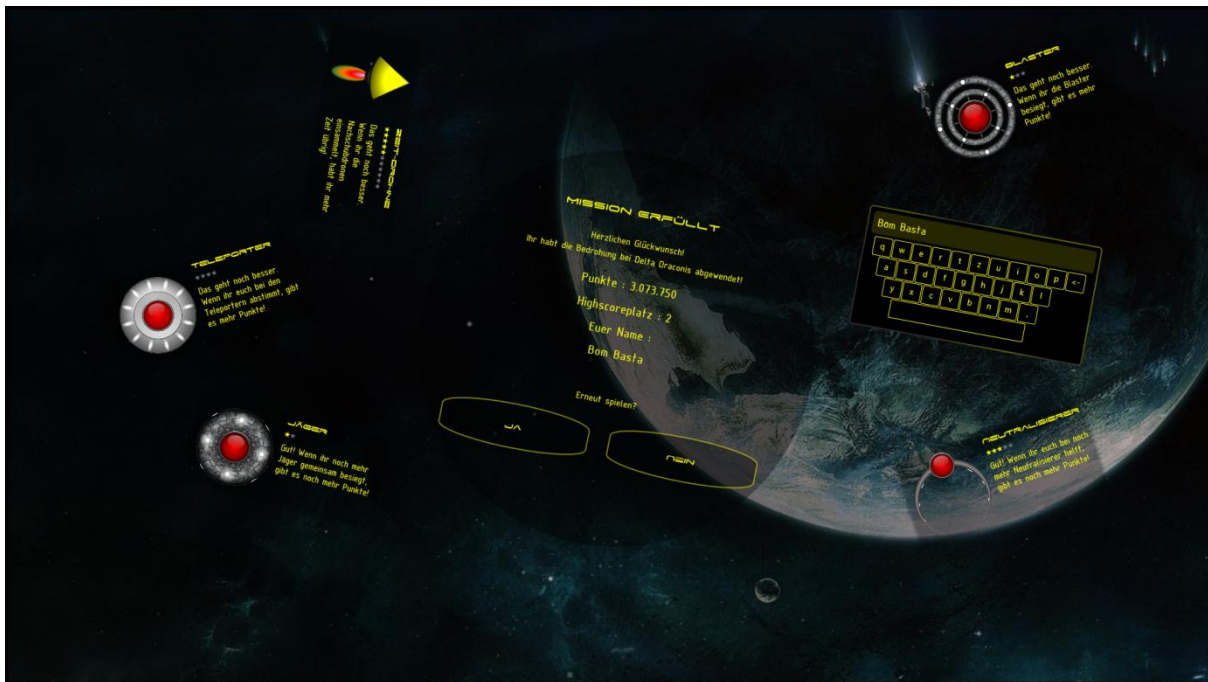
Figure 18: Information on players collaborative behavior at the end of the game

Requirement 2.3: The hints at the beginning of the game and those for new enemies should be provided in a more visualized way and should not contain too much detail. Text should be used sparingly, if at all. The visualization of the hints should be adjustable by the therapist. Multiple hints should be provided, if players would like to read the hints on their own.

To provide multiple hints at the same time, an additional feature was implemented. The players can now pull one hint apart to copy it and read it by themselves (Figure 19). To reduce the cognitive affordance of the hints, the text was replaced with a storyboard. This storyboard consisted of two pictures which described the game element and provided information on how to solve the game task. This storyboard however seemed to offer too less information. The hints should be more explicit. One of the user surrogates argued, that a minimum of text can be used, roughly one small sentence for each picture. A second storyboard with three pictures and a minimum amount of text was created (Figure 20).

Requirement 2.4: Players, especially children with cognitive dysfunctions, would benefit greatly, if enemies were easier to distinguish.

The enemies sometimes could not be easily differentiated. To fix this issue, higher contrasts and more saturated colors were applied to the game elements. In addition, each enemy got its own way of movement. This also led to a more intuitive perception of the different game elements.

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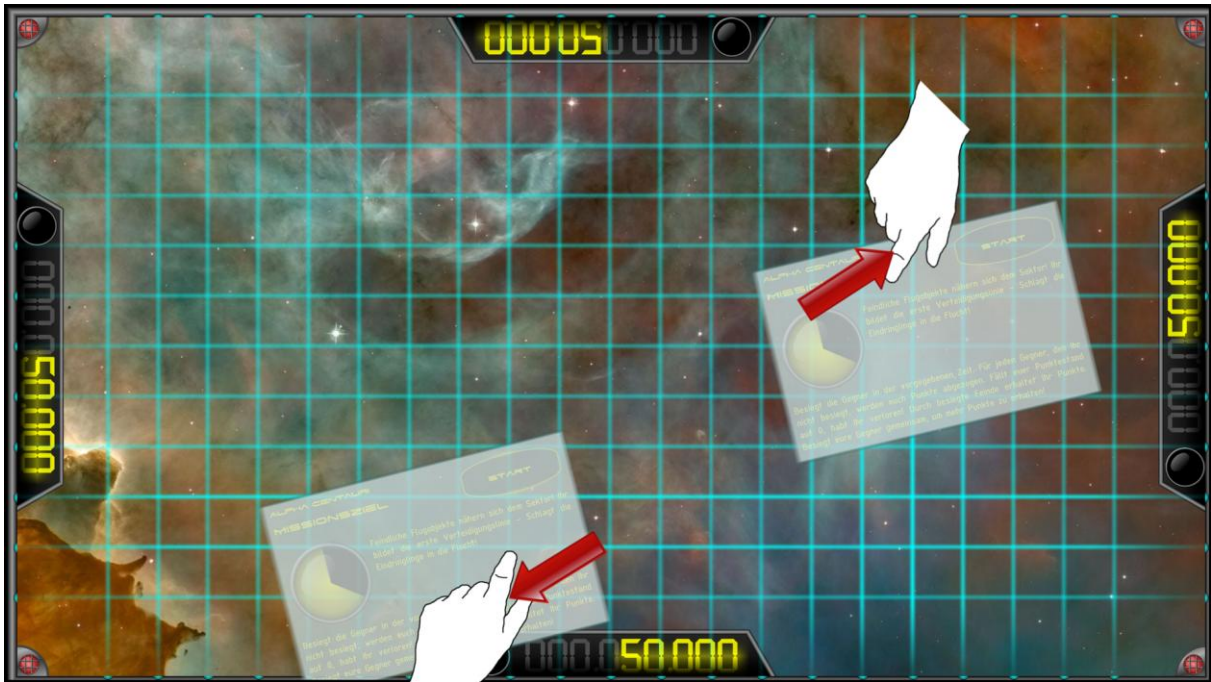
Figure 19: Pulling a hint apart creates a copy of that hint for other players
Note: This is a screen image. Pictures of hands and arrows were included afterwards.
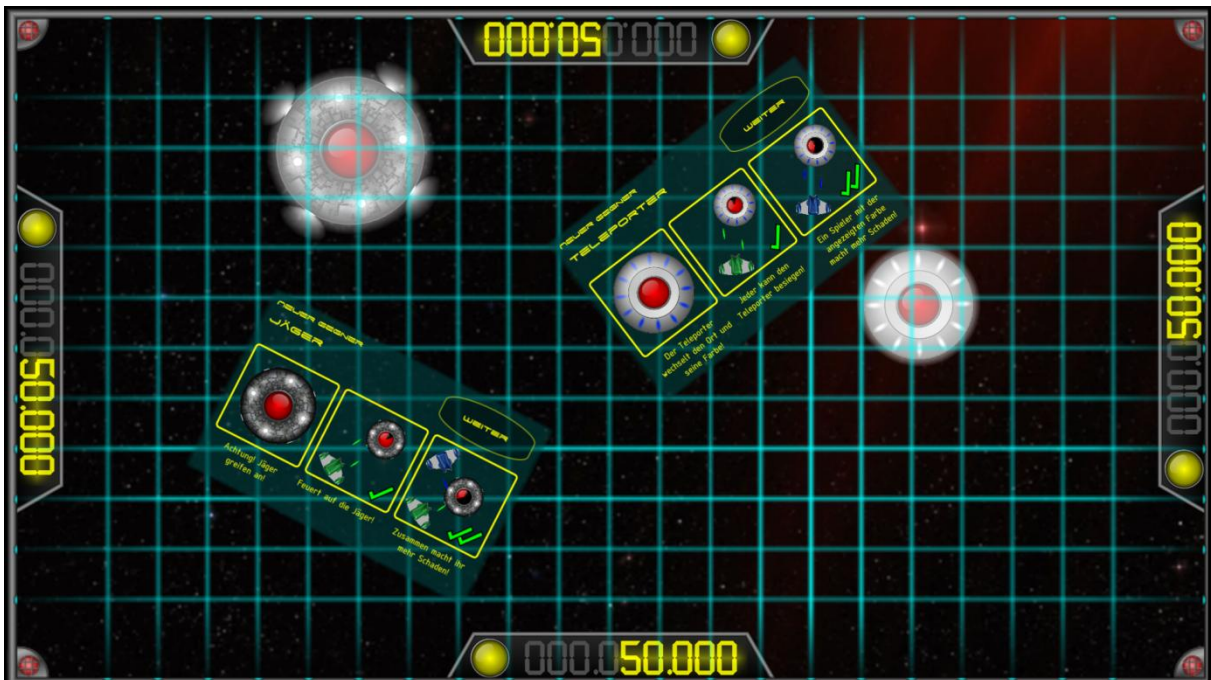
Figure 20: The final hints of the game

Requirement 2.5: *The token should be used more often and in different contexts. Motor requirements can afford to be little higher.*

It was argued that the players should need to move their token more often and extensively. Tasks requiring touch gestures on the other hand, are not supported by the narrative

background and should be replaced. Players now collect the "Supply-Drone" with their spaceship by moving their token over it. By doing so, the players win additional time.

Requirement 2.6: The range of the shots should be increased drastically. This could enable the players to develop shooting and movement strategies.

The range of the shots have been increased. Players can now shoot targets from the other end of the screen.

Requirement 2.7: Game elements should be introduced consecutively. Introducing the different game elements too quickly leads to a higher cognitive affordance.

The basic elements of the game – limited time and energy – are now introduced one after the other in the first game level, the one with the least cognitive requirements.

Requirement 2.8: The option menu provided for the therapist should be revised. Providing fewer options for the grade of difficulty and naming these options appropriately would simplify this task for the therapist.

The possibility of setting the difficulty in a continuous spectrum between zero and a hundred percent was perceived as impractical. There are now four distinct and discrete options for choosing the grade of difficulty (Figure 21).
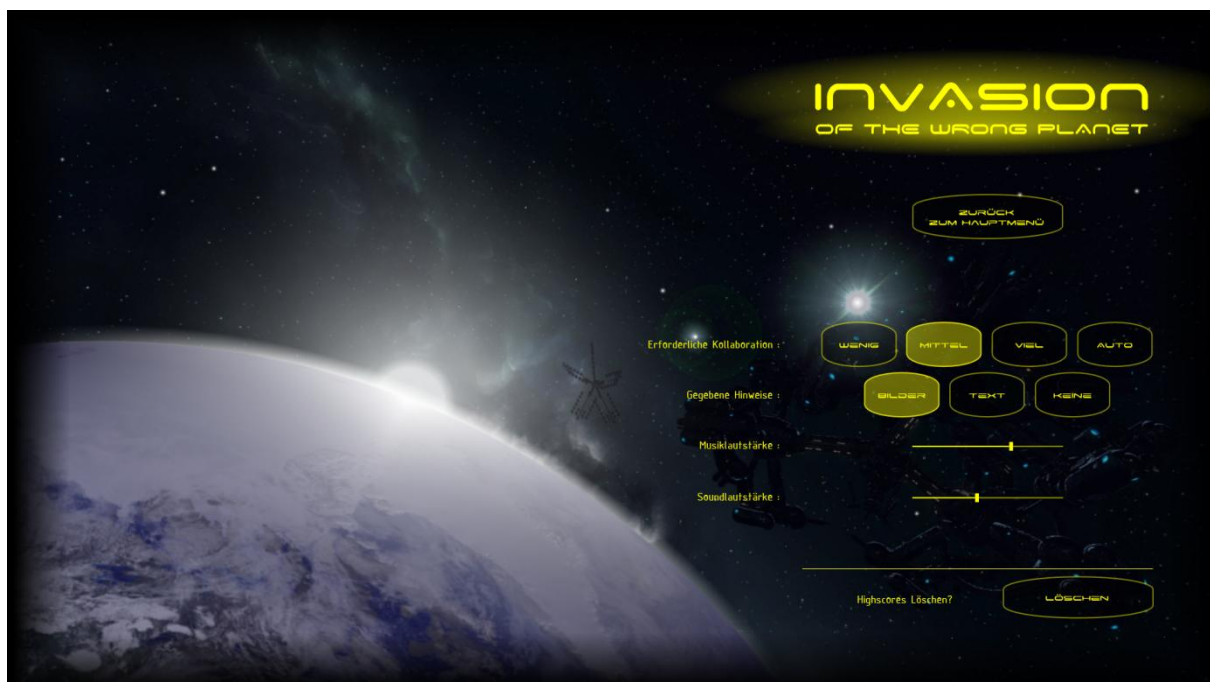
Figure 21: New options menu (oriented towards the therapist)

Some suggestions made during the interviews were not considered in the requirements for the second milestone of the game. These included the issue of the amount of game elements which could be developed further. This would increase the need for discussing strategic issues. Various ideas for new enemies have been proposed. However, while a wider range of enemies allows for a broader scope of game levels and a higher long term motivation, it is not needed for the conduction of the study. When planning to form this game into a commercial product for therapy sessions, this thought should be reconsidered.

3.3   Evaluating of the Second Milestone in a Pilot Study

After finishing the second milestone of the game, an evaluation was needed before conducting the study. For this, three children between the age of eight and twelve were asked to play the different levels of the game (Figure 22). After playing for 40 minutes, the players were asked to comment on what they liked and did not like about the game. The game was received very positively and the children were eager to play the game again. However, while they did not have any complaints about the game, some observations concerning the difficulty of the different game levels, enemies and enemy waves have been made. Overall, this led to an adjustment of timespans to defeat certain enemies and lengths of game waves. All in all, not many changes have been made and the project seemed ready for conducting the study.

Figure 22: *Children playing the game in a pilot study*

4   Research

This chapter describes the main focus of this thesis. The research question is evaluated in two consecutive studies and implications of the resulting findings are discussed.

4.1   Study Design Overview

The research question inquires into how ECC may be useful to improve games which aim at fostering collaborative behavior. More specifically, it reads as follows.

> **Research Question:** *Does encouraged collaboration offer a higher level of motivation than enforced collaboration while providing the same amount of collaborative behavior?*

It is assumed that ECC leads towards more motivation and therefore implicitly greater effectiveness. So instead of only focusing on children with ASD, the research question is applied in a broader sense. A first study was conducted to answer the research question with regard to normally developed children. Afterwards a study with autistic children was conducted to evaluate whether the findings can be applied to the actual target group of children with ASD.

In a first step, measurable hypotheses and variables are defined. These variables include collaboration and motivation. A detailed description of these variables and hypotheses as well as their operationalization is given in 4.2. Since collaboration and motivation are to be measured, the center of this study's design is the game itself, as it can be used as a tool to measure collaboration and to contrast the design principles of enforced and encouraged collaboration. The method of collection of the necessary data through the game itself is depicted in chapter 4.3. After the general procedure is explained in chapter 4.4, both studies are described in detail. Chapter 4.5 contains all information about the first study with normally developed children, while chapter 4.6 provides all data on the second study consisting of children with ASD. These chapters describe the set-up, procedure, data preparation and the participant of the particular study. The results concerning the generated hypotheses as well as further findings follow in the next chapter. These results are then discussed in chapter 4.8 and implications on general game design principles for hybrid therapy games are outlined.

4.2   Operationalization

In this chapter the dependent and independent variables are defined and the research question is operationalized into two hypotheses, each of which will be verified further on.

4.2.1   Independent Variables

To examine the different design principles, the two-factorial variable *Type of Collaboration* (*IV*) is needed. The two factors of *IV* are "Encouraged Collaboration" (ECC) and "Enforced Collaboration" (EFC).

The game should measure and compare the effectiveness of *IV*. In order to compare these design principles, there are two game elements, each implementing one of the two factors of *IV*. The *Raider* (Figure 8, first from left) implements the design principle of ECC. As explained in requirement 1.3 in chapter 3.1.2, the *Raider* rewards collaborative behavior. When multiple players attack at the same time, less time is needed and more points are given. The *Blaster* (Figure 23) was created especially for this study in order to implement the design principle of EFC.
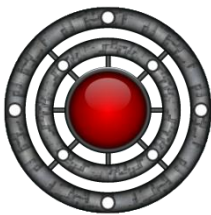
Figure 23: *The "Blaster"*

The *Blaster* is an exact copy of the *Raider* in size, sound effects, movement speed and behavior, with two exceptions. First of all, when a single player attacks the *Blaster*, no damage is dealt to it. In this way, the *Blaster* forces players to collaborate in order to defeat it. The second difference is that the *Blaster* is visually distinguishable from the *Raider*. In this way, there are two game elements allowing for their comparison with regard to the dependent variables defined below.

4.2.2   Dependent Variables

There are two dependent variables needed to measure the impact of *IV* on therapeutic effectiveness; *Amount of Collaboration* (DV_1) and *Motivation* (DV_2).

DV_1 is measured as the relation between the time players interacted collaboratively with a specific game element and the overall time of interaction between players and that game element. Players interact with instances of a game element by shooting at it. When they hit

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that instance, the time it takes to fire that shot is added to the time the player interacts with that specific element. When this shot is fired in an interval of one second maximum after another player fires at that instance, the time of interaction is also added to the time interacted collaboratively with that game element. This ratio results in a measure of how much the players collaborate. Since Gentile et al. (2009) state that collaboration in games foster social interaction, it can be argued that this measure also represents therapeutic effectiveness.

$$IV = Type\ of\ Collaboration$$
$$IV = Enforced\ Collaboration\ |\ IV = Encouraged\ Collaboration$$

$$X = Game\ elements\ implementing\ IV = \{Blaster, Raider\}$$
$$x \in X, x = Blaster\ |\ x\ =\ Raider$$

$$DV_1\ =\ Amount\ of\ Collaboration\ (IV)$$
$$DV_1(x) = \frac{Time\ interacted\ collaboratively\ with\ instances\ of\ x}{Time\ interacted\ with\ instances\ of\ x}$$

DV_2 on the other hand is measured as a rank order of the game elements. After playing the game, each player ranks all six game elements (*Raider*, *Blaster*, *Teleporter*, *Neutralizer*, *Energy Battery*, *Supply Drone*). This results in a relative measure of preference of different game elements, explicitly the *Raider* and the *Blaster*. These two elements differ in visualization and behavior. Since Andersen et al. (2009: 4) found that "[...] a minor gameplay modification affected player retention more than aesthetic variations [...]", it can be assumed that DV_2 is measured with regard to the behavior, the gameplay modification *IV*, and not the visualization.

$$y \in X, y \neq x$$
$$preference(x, player) = \begin{cases} 1, iff\ Rank(x, player) > Rank(y, player) \\ 0, else \end{cases}$$

$$DV_2\ =\ Motivation\ (IV)$$
$$DV_2(x) = Amount\ of\ players\ preferring\ x\ over\ y$$
$$DV_2(x) = \sum_{player=1}^{Amount\ Players} preference(x, player)$$

4.2.3 Hypotheses

With regard to the research question and the operationalized variables, the following hypotheses can be itemized:

H_1: *IV* (*Type of Collaboration*) has no influence on DV_1 (*Amount of Collaboration*)

H_2: *IV* (*Type of Collaboration*) has an influence on DV_2 (*Motivation*)

In other words: Encouraging Collaboration instead of enforcing it is assumed to have a positive influence on motivation, while it does not change the amount of collaboration.

4.3 Data Collection

All events of the game and all actions of the players were logged by the game itself. These log data included placement and movement of the game tokens, interaction with enemies and general game state changes. The following table gives a detailed overview of the log entries.

Table 1: *Description of log entries*

GameID	Unique identifier for a game instance, these identifiers later were renamed to match the according group and iteration of game play
LogNr.	Unique identifier for the log entry regarding the GameID, ascending number
TimeYear	The year the log entry was logged
TimeMonth	The month the log entry was logged
TimeDay	The day the log entry was logged
TimeHour	The hour the log entry was logged
TimeMinute	The minute the log entry was logged
TimeSecond	The second the log entry was logged
TimeMillisecond	The millisecond the log entry was logged
SettingsDifficulty	The difficulty set for the game. Entries may be: • Low • Medium • High • Auto (Automatically adapting difficulty)
SettingsDifficultyFactor	The difficulty set for the game. Entries may be: • 0.5 for low difficulty • 0.66 for medium difficulty • 0.75 for high difficulty • Value ranging between 0.1 and 0.9 for automatic difficulty This factor of damage dealt to enemies that is subtracted if players

	are not acting collaboratively. The higher the difficulty, the less damage players deal to enemies when not acting together.
SettingsTutorial	The type of tutorial provided. Entries may be:
	• Pictures • Text • None
LevelName	The name of the level played. Entries may be:
	• Alpha Centauri • Beta Pegasi • Gamma Cassiopeiae • Delta Draconis
LevelWaveNr.	Ascending number starting from 0 (before the game starts), each level has a different amount of waves and therefore different wave numbers
Actor	The cause for the log entry. Entries may be:
	• Game • Player
ActorAction	The action performed by the actor. For the game entries may be:
	• GameStart • GameEnd • TutorialStart • TutorialEnd • WaveStart • WaveEnd
	For players entries may be:
	• PlacesToken • MovesToken • RemovesToken • HitsEnemy • ObjectChangedState
ActorActionTime	The time it took for the actor to perform the action in milliseconds, empty when no time was needed
PlayerName	The name of the player, provided the actor was a player. Entries may be:
	• Red • Green • Blue • Yellow
	The player's names were later renamed to match the according group.

PlayerPositionX	The position of the player on the x-axis in pixels, provided the actor was a player
PlayerPositionY	The position of the player on the y-axis in pixels, provided the actor was a player
GameObjectName	The name of the game object, provided a game object was included in the action. Entries may be: • AmmunitionBattery • Blaster • Neutralizer • Raider • Teleporter
GameObjectID	Unique identifier for the game element, provided a game object was included in the action
GameObjectState	The state the game object was in, provided a game object was included in the action. Entries may be: • Default • Collected • Fled • Shot
GameObjectPositionX	The position of the game object on the x-axis in pixels, provided a game object was included in the action
GameObjectPositionY	The position of the game object on the y-axis in pixels, provided a game object was included in the action
CollaborativeAction	The rating whether the action was collaborative or not, provided the action involved a player and an enemy. Entries may be: • True • False
ActionInitiatedBy	The name of the player, provided a player initiated the action
ScorePointsGivenOrTaken	The score given or taken as a result of the action
ScoreAcute	The current sc ore of the game
LastGameEntry	The last action done by the game

Whenever a player hits an enemy (indicated through the entry "HitsEnemy" in the field "ActionType"), a log entry was generated in which the player ("PlayerName") and the game object ("GameObjectName") were specified. From there, it was possible to compute the total amount of collaborative time ("ActionTime") for each player, wave or game level, as can be seen in Appendix 24.

4.4 Procedure

To best measure the effect of a game and game designs, a very natural setting for the game should be ensured. The players should primarily enjoy playing the game and a study participation atmosphere should be minimized as far as possible. An impression of "Voluntary Participation" (McGonigal 2011: 21) and "The Feeling of Freedom" (Schell 2008: 283) should be maintained.

The study is therefore designed into two parts. In the first part the participants play the first level of the game. During this first round of gameplay a controlled setting for the study is provided. All players are by then familiar with the narrative setting of the game and the game controls, but have yet to play the game. The first level is divided into four enemy waves. In the first wave, four enemies appear, one for each player. These enemies are of the same type, either *Raider* (A) or *Blaster* (B). The second wave is the same as the first wave, but time is limited. In the third wave the enemy type changes. The fourth wave combines the two enemy types. This level serves as a basis for a within-subjects design, since the second and third wave provide both necessary enemy types. The sequence in which the enemies show up can also be adjusted in order to provide the means for a counterbalanced between-group design, in which DV_1 can be measured. Since the second and third wave of the first level provided a controlled setting, only the log data of these waves were used to specify DV_1.

$$First\ group\ setting\ = (A) - A - B - (A\ and\ B)$$
$$2nd\ Wave: Raider, 3rd\ Wave: Blaster$$

$$Second\ group\ setting\ = (B) - B - A - (A\ and\ B)$$
$$2nd\ Wave: Blaster, 3rd\ Wave: Raider$$

After completion of the first level, the players enter the second part of the study in which they are able to choose freely between game levels. By this they can choose the appropriate cognitive workload. During this time of open play the players come to know the different game elements and familiarize them in various contexts and constellations. Thus they are able to rank them after the game, which allows measurement of DV_2.

4.5 Study with normally developed Children

In this chapter, the research question is evaluated. For this, *Invasion of the Wrong Planet* was tested with children without developmental disorders.

4.5.1 Set-up

The study took place in the media room of the University of Konstanz. The *Samsung SUR40* was placed horizontally in the middle of the room. The light in the room was dimmed, because of the light sensitivity of the *Samsung SUR40*. An examiner was continually present during the study. Two cameras with microphones were installed in the room, one to provide a top down view on the screen, tokens and hands of the players and one to provide an overview of the players' movement around the table.
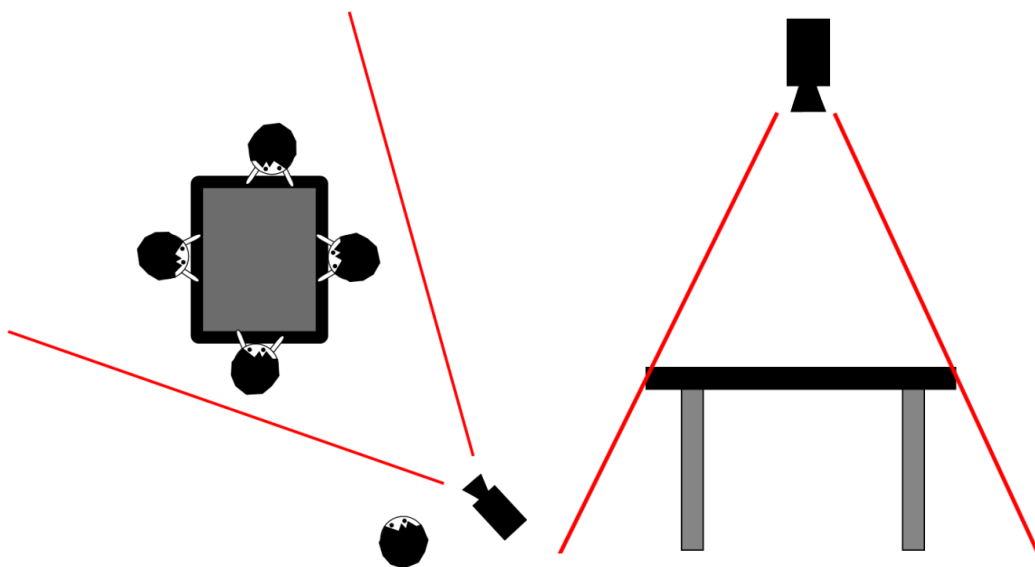
Figure 24: *Set-up of first study*

4.5.2 Schedule

Following the outlined procedure, the study was divided into a controlled section and an open section of gameplay. However, before the participants began to play, it was necessary to inform the parents on the exact procedure and intention of the study. After providing all information, the parents were guided out of the rooms to fill out a simple questionnaire on relevant information about the children. After approximately half an hour of gameplay, the parents were again allowed to re-enter the room. Each participant then received a small gift, for which the parents needed to sign a confirmation of receipt. Some minutes for further questions and feedback from the children were scheduled to round up the study. The detailed schedule of the first study is outlined in the following table.

Table 2: *Time schedule of first study*

Introduction	15 Minutes • Welcoming the participants (Appendix 10) • Letting parents sign the informed consent (Appendix 11) • Handing out the questionnaires to the parents (Appendix 12) • Guiding the parents out of the room • Turning on cameras • Setting game options (Medium difficulty, First level) • Handing out Tokens
First Part – Controlled Setting	5 Minutes • Letting participants play the first level • Providing feedback after level is finished

Second Part – Open Play	25 Minutes
	
	• Multiple rounds of gameplay
	    o Letting participants choose between game levels
	    o Letting participants play the game
	    o Providing feedback after level is finished

Finishing the study	15 Minutes • Letting the children rank the game elements (Appendix 13) • Letting parents enter the room • Letting children choose a small reward and parents sign confirmation of receipt (Appendix 14) • Answering open questions, letting participants comment on the game

4.5.3 Data Preparation

The answers to the questionnaires were digitalized manually. Together with the recorded logging data, they formed a single *Excel* file, which can be found in Appendix 24.

The log data presented in chapter 4.3 was used as a basis to compute DV_1. One time it occurred that a participant arrived too late for the study while the other players had already finished the first level. In that session, the players needed to replay the first level, in order to log and compute DV_1 of the participant arriving later.

The information of the rankings of the game elements by the players served as a basis to determine DV_2 as outlined in chapter 4.2.2.

4.5.4 Participants

16 participants took part in the first study (Table 3). Of these 16 participants four were female (25%) and twelve were male (75%). The average age was 9.63 years (SD = 1.9). One participant visited the first grade, two visited the fourth grade, while the second, third and fifth grade were each visited by three participants and the sixth by four. All participants except one were right-handed. Two participants had impaired sight and wore glasses. While all participants were assumed to have no developmental disorder, one of them did not provide information on it. Two participants had minor difficulties in spoken German language. The participants were all rather experienced with technological devices such as PCs and laptops as well as touch sensitive displays with each showing an average experience rank of 3.69 on a five-point Likert scale (SD = 1.08 respectively 1.14) with none of them having no experience whatsoever.

Table 3: *Information provided by parents of participants in first study*

Amount	16
Sex	4 female (25%), 12 male (75%)
Age	Mean = 9.63 (SD = 1.9)
Grade	1 first grade (6.25%), 3 second grade (18.75%), 3 third grade (18.75%), 2 fourth grade (12.5%), 3 fifth grade(18.75%), 4 sixth grade (25%)
Handedness	1 left-handed (6.25%), 15 right-handed (93.75%)
Sight defects	2 with slight defects, wearing glasses (12.5%), 14 without defects (87.5%)
Developmental disorders or other deficits	2 with slights deficits in German language (12.5%), 13 without deficits (81.25%), 1 without specification (6.25%)
Experience with PCs and Laptops	3.69 (SD = 1.08), ranging from 1 (no usage) to 5 (daily usage)
Experience with touch sensitive displays	3.69 (SD = 1.14), ranging from 1 (no usage) to 5 (daily usage)

These participants were divided in four groups of four players each (Figure 25). Therefore each setting of the between-group design contained two groups.

Figure 25: Children without developmental disorders were divided in groups of four

4.6 Study with Autistic Children

The game was evaluated with autistic children by applying the same study design. This study serves as a more qualitative approach than previous studies for comparing the design principles of enforced and encouraged collaboration with regard to the actual target group. While collection and measurement of the data are identical, a controlled setting between the groups remained challenging. However, the study was conducted successfully and generated some reasonable findings, as explained in the following.

4.6.1 Set-up

The study was conducted in the therapy centre for autism in Freiburg, Germany[12]. A designated room was provided over the three days in which the study took place. The *Samsung SUR40* was again placed horizontally in the middle of the room of which again the light was dimmed. In addition to two examiners, the therapists of the children were continually present during the study. Furthermore, parents were present, if they so wished. This way, a situation closely similar to normal group sessions could be created.

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[12] http://www.autismus-freiburg.de/therapiezentrum/index.php (last access date on July 25th, 2013).

Since the rooms ceiling was too low to install a camera above the surface, two cameras catching an isometric perspective were installed in two corners of the room. These cameras again recorded video as well as audio material.
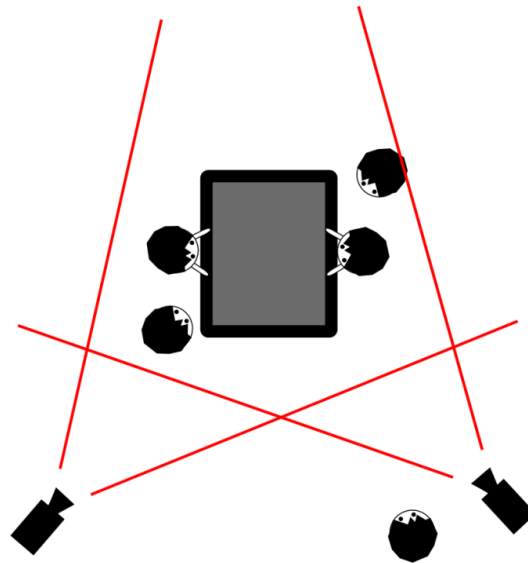

Figure 26: Set-up of the second study

4.6.2 Procedure

To measure the participants degree of autism, documents of the therapy centre concerning each child were requested. In addition, parents were asked to fill out the MBAS[13] questionnaire beforehand to evaluate the severity of their child's disorder. Furthermore, the SDQ[14] was filled out by the parents and the clients' therapist. This questionnaire also served as an approach to estimate the severity of behavioral issues. This estimation, derived from the SDQ and MBAS questionnaires, enabled a higher degree of comparison of the participants various degrees of autism.

Parallel to the former study, this study was again divided into two parts – a part of controlled gameplay and a part of open gameplay. After approximately half an hour of gameplay the SDQ for children and a vocabulary test[15] were filled out. The vocabulary test served as a tool

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[13] The MBAS (Marburger Beurteilungsskala zum Asperger-Syndrom, engl.: "The Marburgs Rating Scale for Asperger's Syndrome") is an "instrument for screening and generating tentative diagnoses of high-functioning autism" (Kamp-Becker et al. 2005). A copy of the MBAS can be found in Appendix 19.

[14] The SDQ (Strength and Difficulties Questionnaire) is intended to be a behavioral screening questionnaire. Its outcome provides information about abnormalities in terms of emotional, attentive or social symptoms. First valid findings have been proposed by Goodman (1997). The SDQ is provided in three forms: as a self-assessment questionnaire for children, as well as for parents and teachers. Copies of these different forms can be found in Appendix 20, Appendix 21 and Appendix 22.

[15] This vocabulary and numerical sequence test WS/ZF-R ("Wortschatztest und Zahlenfolgetest - Revision") is part of the intelligence test CFT 20-R ("Grundintelligenztest Skala 2 - Revision") to measure cognitive skills. A copy of the vocabulary test as a part of the WS/ZF-R is attached in Appendix 23.

to measure cognitive abilities and faculty of speech. After a consecutive study[16] each participant then received a small gift. Some minutes for further questions and feedback from the children were scheduled to round up the study. All together the study took 60 to 90 minutes. Variations of this timeframe were expected due to different cognitive abilities of the participants. The detailed schedule of this second study is outlined in the following table.

Table 4: *Time schedule of second study*

Introduction	2 Minutes • Welcoming the participants • Collecting filled out questionnaires and informed consent (Appendix 18, Appendix 19, Appendix 20, Appendix 21) • Turning on cameras • Setting game options (Medium difficulty, First level) • Handing out Tokens
First Part – Controlled Setting	5 Minutes • Choosing the first game level • Letting participants play the first level • Providing feedback after level is finished

Second Part – Open Play	20 Minutes
	• Multiple rounds of gameplay
	    o Letting participants choose between game levels
	    o Letting participants play the game
	    o Providing feedback after level is finished

Questionnaires	15 Minutes • Letting the children rank the game elements (Appendix 13) • Letting the children fill out the SDQ questionnaire (Appendix 22) • Letting the children fill out the vocabulary test (Appendix 23)
Conducting further studies	15 Minutes • Letting the children take part in an additional study consisting of three parts. This study was led by Margarita Stolarova and is not part of this work.
Finishing the study	3 Minutes • Letting children choose a small reward • Answering open questions, letting participants comment on the game

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[16] This test was a cooperative work done together with Margarita Stolarova, who is researching in the field of "Early Childhood Development and Education" at the University of Constance. Her work, though interesting, is not topic of this thesis.

4.6.3   Data Preparation

As in the last study, the recorded logging data and the digitalized questionnaires were stored in the *Excel* file (Appendix 24).

While DV_1 was computed as before, the controlled part this time was not counterbalanced in regard of the sequence of enemies showing up, since the last study showed that this factor had no effect on the outcome of the data, as will be mentioned in chapter 4.7.1.

DV_2 as well was determined in the same way as before by letting the players rank the game elements and comparing how many preferred one design principle over the other.

4.6.4   Participants

Nine participants took part in the second study (Table 5). It is to be noted that the circumstances in the therapy centre did not always allow for a totally controlled setting. Two participants and their therapist had not had enough time to fill out all questionnaires and one participant abandoned the study while filling out the first questionnaire. In addition to that, one child failed to attend the study and two children who originally were not planned to attend the study unexpectedly took part. While one of them just wanted to play the game together with his therapist, the other one insisted in playing together with one of the dyads, which his therapist supported. As parents and therapists were present during the study in order to provide a comfortable and controllable setting, the children sometimes wanted their therapists to play with them. Overall, these issues resulted in groups of varying size and a lack of data on some participants. Not all participants specified their age and at least three did not provide information on the MBAS, the SDQ or the vocabulary test. Therefore this study cannot be a basis for comparing collaborative behavior between normally developed children and those with ASD. It is a case study to provide evidence for the importance of ECC in therapy games fostering collaboration.

All of these participants were male. This focus on male participants was to be expected, since the gender ratio of ASD in general is estimated to be roughly four to one. Furthermore, female autistics tend to have more severe mental disabilities which makes the gender ratio of children with HFA or AS even more inhomogeneous. The average participant was 10.46 years old (SD = 1.59) with three participants providing no information of their age. The children were all clients of the therapy centre and estimated to have a disorder in the autistic spectrum. Diagnoses on the participants confirmed this; on the four participants, who provided information on their diagnosis, four had attested childhood autism or AS.

Further diagnoses on these children included nonorganic enuresis and encopresis as well as disorders in motor function and mild mental retardations. Results of the screening questionnaire MBAS showed that five participants had noticeable deviations from the norm values, which suggests disorders in terms of AS. While three participants did not fill out this questionnaire, one participant surprisingly showed average values. This participant was also the only one who received an average result from his therapist in the SDQ. The four other participants who were judged by their therapists got noticeable results. However, the participant who did not show deviations in the MBAS and the SDQ of the therapist received marked results in the SDQ filled out by the parents and in the self assessment of the SDQ. Six participants received noticeable results in the SDQ filled out by their parents. Five children who did the self-assessment SDQ showed noticeable deviations, one only showed slight deviations. Three participants neither filled out the SDQ for self-assessment nor had their parents filled them out. Four clients finished the vocabulary test. While one child showed slight and one showed noticeable deviations in the vocabulary test, two children even achieved an above average score. This and the fact that these children got noticeable results in the MBAS and SDQ's indicates high cognitive skills which are characteristic for HFA.

It could be argued that some of the participants did not match the prerequisites for the study. However, since the participants show a wide spectrum of abilities and many different severities of disorders, they represent the wide spectrum of autistic disorders, which typically can be found in such therapy centers. Therefore, data on all participants have been considered in the evaluation of the hypotheses.

Table 5: *Client data of participants in second study*

Amount	9
Sex	0 female (0%), 9 male (100%)
Age	Mean = 10.46 (SD = 1.59) (2 participants without specification)
Diagnose	1 participant with ICD-10: F84.0 (Childhood autism) and ICD-10: F70.1 (Mild mental retardation) 2 participants with ICD-10: F84.5 (Asperger syndrome) and ICD-10:F98.0 (Nonorganic enuresis) 1 participant with ICD-10: F84.5 (Asperger syndrome), ICD-10: F98.0 (Nonorganic enuresis), ICD-10: F98.1 (Nonorganic encopresis) and ICD-10: F82.0/F82.1 (Specific developmental disorder of motor function) 7 participants without specification

MBAS	5 participants with noticeable deviations (measured value above 103) 1 participants without deviation (measured value equal or below 103) 3 participants without specification (Mean = 110.83, SD = 14.55)
SDQ Children	5 participants with noticeable deviations from normal value (measured value above 19) 1 participant with slight deviations from normal value (measured value above 16, but below 19) 0 participants without deviations (measured value equal or below 16) 3 participants without specification (Mean = 20.67, SD = 2.16)
SDQ Parents	6 participants with noticeable deviations from normal value (measured value above 19) 0 participant with slight deviations from normal value (measured value above 16, but below 19) 0 participants without deviations (measured value equal or below 16) 3 participants without specification (Mean = 22.67, SD = 3.98)
SDQ Therapist	4 participants with noticeable deviations from normal value (measured value above 19) 0 participant with slight deviations from normal value (measured value above 16, but below 19) 1 participant without deviation (measured value equal or below 16) 4 participants without specification (Mean = 20.60, SD = 6.58)
Vocabulary Test	1 participant with noticeable deviation from normal value (below 40) 1 participant with slight deviation from normal value (measured value above 40, but below 50) 2 participants without deviations (measured value equal or above 50) 5 participants without specification (Mean = 51.25, SD = 12.84)

Originally the participants were to attend the study in dyads. However, alterations of this set-up were to be made due to above mentioned circumstances. Therefore the participants were divided into four groups of varying size (Figure 27). The first group consisted of two children with ASD, the next two clients played together with their respective therapist, the fourth and fifth group consisted of three respectively two children of which both were accompanied by a therapist. These alterations of group size is to be considered when comparing the results of the first and second study.

Figure 27: *Children with ASD played in groups of varied size together with their therapists*

4.7 Results

Both hypotheses from chapter 4.2.3 were evaluated in each study. The findings made during those two studies in regard to these hypotheses and further analysis are presented on the next pages.

4.7.1 Result First Hypothesis

The hypothesis H_1 states that *IV* hast no influence on DV_1. The method to compute the appropriate measure has been explicated and specified in chapter 4.2.2. The SPSS output of the data of the first and second study can be found in Appendix 15 respectively Appendix 16. Analysis of the log data of both studies led to the following results (Figure 28). In the first study with normally developed children the design principle EFC led to an approximate average value of 88.18% (SD = 7.85%), while ECC reached a average of 77.77% (SD = 18.22%). In the second study, autistic children achieved an average value of 83.82% (SD = 10.74%) when collaboration was enforced and 78.36% (SD = 15.51%), when it was merely encouraged.
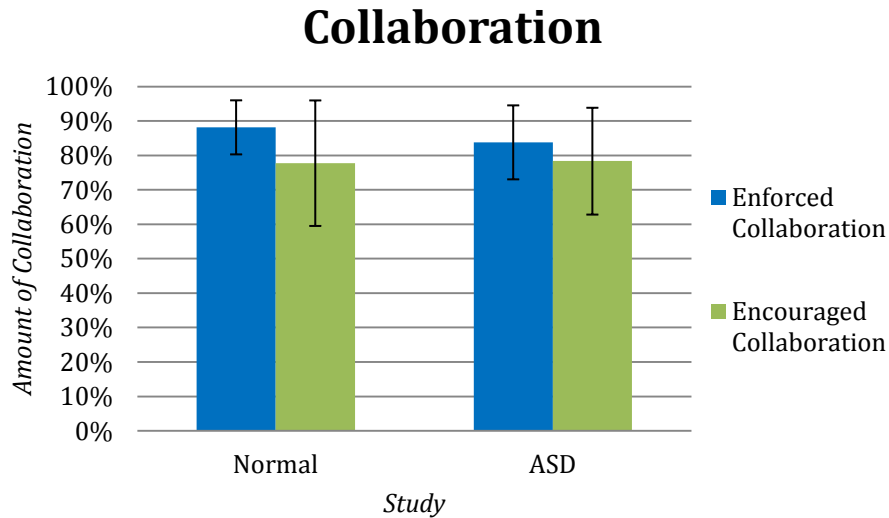
Figure 28: DV_1 with regard to IV in controlled setting (both studies)

At first it was necessary to show the independence of the different group setting i.e. the sequence of enemies. Using a two-factorial ANOVA in the first study, this variable showed to have no significant effect on the outcome (p = 0.306). This outcome was expected due to the utilization of a counterbalanced study design.

In the following the null hypothesis, whether there was a significant difference of DV_1 in view of the different design principles can also be negated for both study iterations (p = 0.077 respectively p = 0.270). EFC and ECC seem to have a comparable influence on collaborative behavior (Table 6). Therefore, according to this data and assuming an alpha value of 5%, H_1 can be accepted – The *Type of Collaboration* has no influence on the *Amount of Collaboration*. Please note that this outcome is later discussed in chapter 4.8.

Table 6: Outcome null hypotheses (IV has influence on DV_1)

Enforced Collaboration	First study: Mean = 0.8818, Variance = 0.0062, SD = 0.0785
	Second study: Mean = 0.8382, Variance = 0.0115, SD = 0.1074
Encouraged Collaboration	First study: Mean = 0.7777, Variance = 0.0332, SD = 0.1822
	Second study: Mean = 0.7836, Variance = 0.0241, SD = 0.1551
Degrees of freedom	1
F-Value	First study: 3.59
	Second study: 1.55
P-Value	First study: 0.077
	Second study: 0.270
Critical F-Value	First study: 4.54
	Second study: 5.59

4.7.2 Result Second Hypothesis

In H_2 it was assumed that *IV* has a positive influence on DV_2. The appropriate measure has been presented in chapter 4.2.2. The data (Table 7, Figure 29) showed that 13 participants (81.25%) of the first study iteration preferred ECC over EFC, while three participants (18.75%) preferred the design principle of EFC. In the second iteration seven participants preferred ECC (87.5%), while just one participant (12.5%) ranked the enemy implementing EFC over the other. Two participants from the first study were excluded from the evaluation. One of them did not fill out the form correctly and the other misinterpreted the game mechanics of one game element, the *Blaster*, of which he thought it would intentionally fly over other enemies and therefore shield them from the players. In the second study one participant was excluded, since he could not fill out the whole questionnaire.

***Table 7:** Ranking of different players (red ones are excluded from evaluation)*

Participant\ Enemy Type	Neutralizer	Raider	Blaster	Teleporter	Battery	Drone
(Normal) YE_g1	1	5	6	4	3	2
(Normal) BL_g1	4	5	6	3	1	2
(Normal) GR_g1	1	2	3	6	5	4
(Normal) RE_g1	6	2	1	5	3	4
(Normal) YE_g2	5	2	3	6	1	4
(Normal) BL_g2	6	2	3	6	1	1
(Normal) GR_g2	6	3	4	5	2	1
(Normal) RE_g2	5	4	1	6	2	3
(Normal) YE_g3	6	4	5	3	2	1
(Normal) BL_g3	5	4	6	3	2	1
(Normal) GR_g3	6	4	3	5	2	1
(Normal) RE_g3	6	1	5	4	3	2
(Normal) YE_g4	6	4	5	2	3	1
(Normal) BL_g4	1	2	5	3	4	6
(Normal) GR_g4	3	1	2	4	6	5
(Normal) RE_g4	5	2	3	6	4	1
(ASD) EG_p1	5	3	4	6	1	2
(ASD) AS_p1	6	4	5	3	1	2
(ASD) AM_p2	6	1	2	5	3	4
(ASD) T_e	3	2	1		4	
(ASD) TS_p3	5	2	3	6	4	1
(ASD) SR_p3	6	3	5	4	1	2
(ASD) DR_p3	6	3	5	4	1	2
(ASD) EE_p4	2	3	4	1	6	5
(ASD) BK_p4	4	2	1	5	6	3

This data was evaluated with a binomial test and showed a highly significant difference between these preferences in the first study and a significant difference in the second (p = 0.0065 respectively p = 0.0352, alpha = 5%). According to this data, H_2 can be accepted – the *Type of Collaboration* has an influence on the *Motivation*. This outcome is discussed further in chapter 4.8.
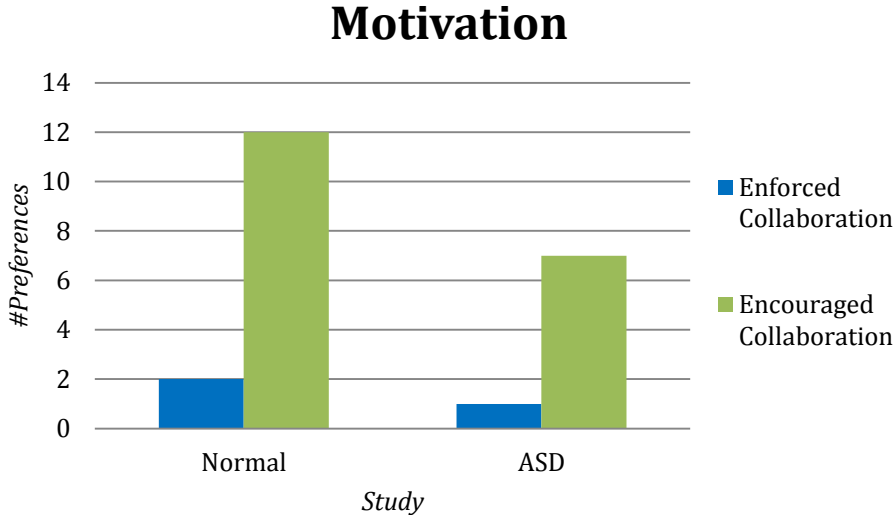

Figure 29: *DV$_2$ with regard to IV*

4.7.3   Additional Results

In addition to the above findings, further analysis of the available data has been made. While *DV$_1$* was calculated during the controlled, counterbalanced first part of gameplay, one can take a closer look at the second part of open gameplay. Interestingly enough, the data showed an even further decrease of difference between the collaboration types (Figure 30).
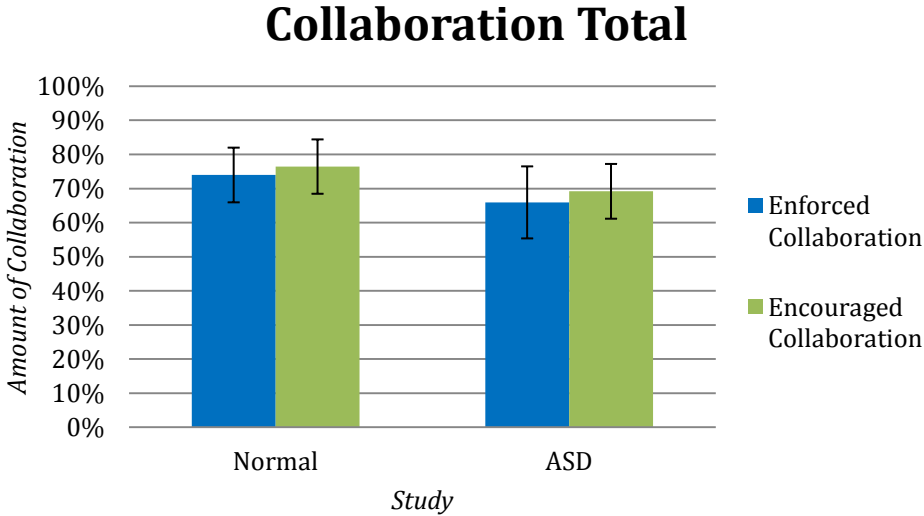

Figure 30: *DV$_1$ with regard to IV after total game time in both studies*

This result, while of course not totally representative since gameplay was not based in a controlled setting, serves to underline the fact that acceptance of H_1 was correct. As a side note it could be mentioned that all in all, children without ASD seem to collaborate slightly more often. There is however no significant difference. One could assume that this correlates with the fact that therapists played alongside with their clients. An absence of the therapists might have led to an even lower amount of collaboration between children with ASD so that the game in this regard might even be used as a diagnostic tool.

Going further, there seemed to be a high variance of DV_1 regarding single players (Figure 31, Figure 32). This variance is rather marked and should be evaluated in later research. Additional research questions as to how game design principles might adapt to players behavior might be concluded.
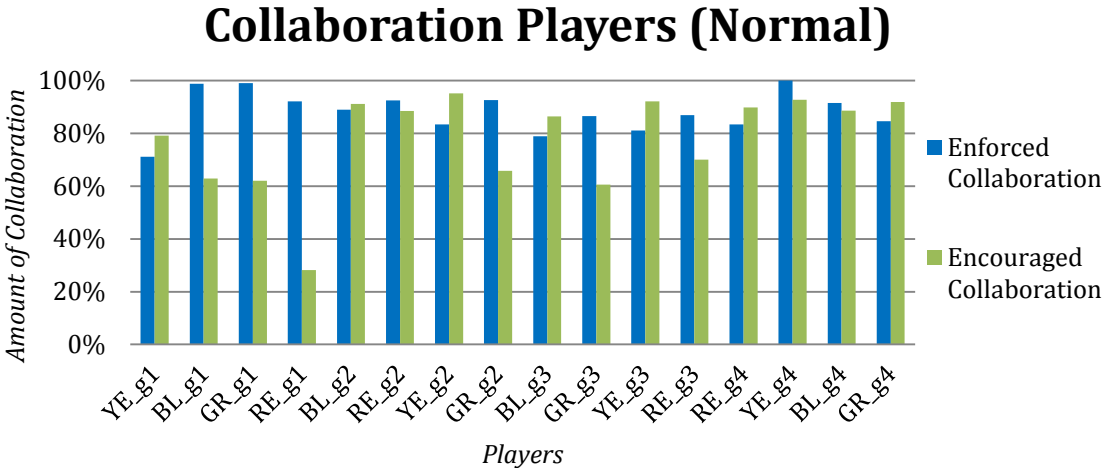

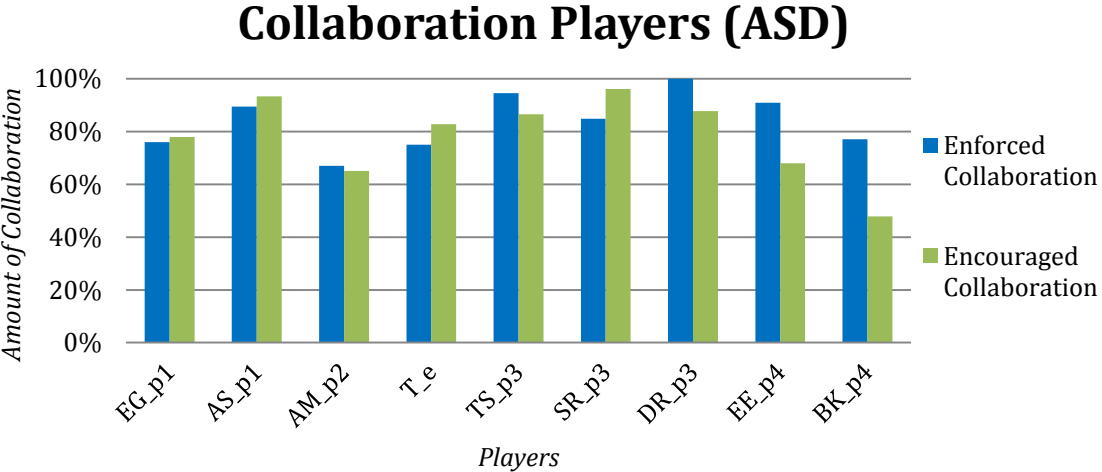**Figure 31:** *DV_1 of each player in controlled setting (first study)*

Figure 32: *DV_1 of each player in controlled setting (second study)*

The variance of DV_1 regarding single players however seems to decrease when taking a look at the overall game time (Figure 33, Figure 34).

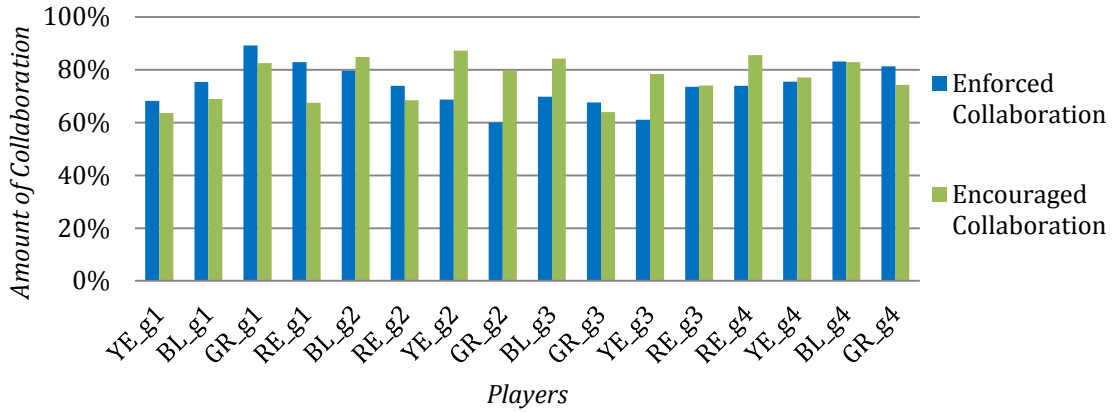## Collaboration Players Total (Normal)

Figure 33: *DV₁ of each player after total game time (first study)*
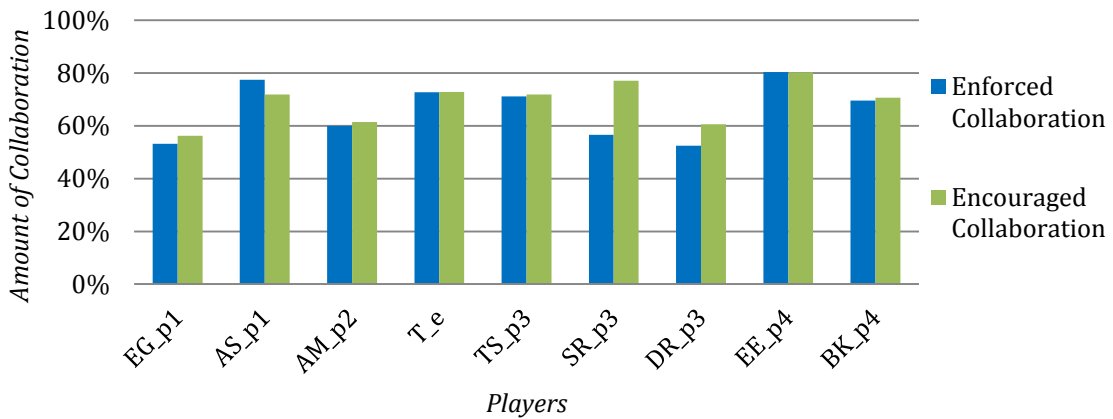
Collaboration Players Total (ASD)

Figure 34: *DV₁ of each player after total game time (second study)*
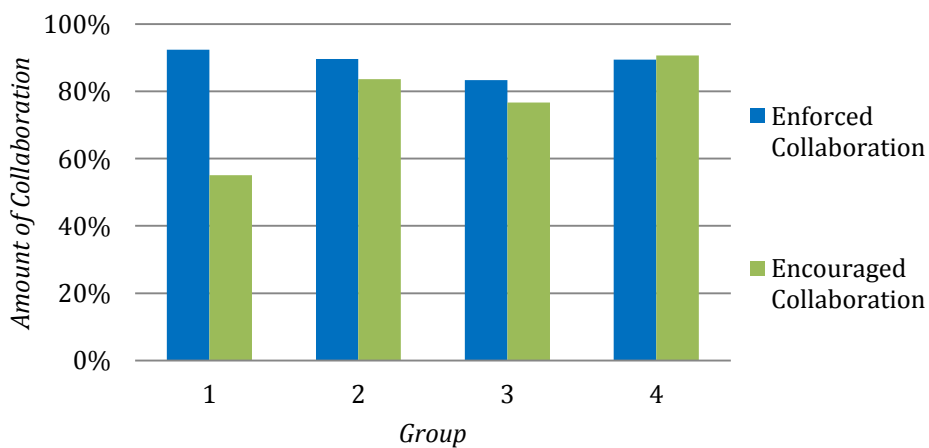
Collaboration Groups (Normal)

Figure 35: *DV₁ with regard to the different groups of the first study*

When comparing the different groups in the first study, a certain variance in behavior regarding the different collaboration types can be seen (Figure 35). Considerations on how these differences might occur can hardly be made due to the low amount of participants. However, it can be speculated that different groups might profit from varying game design principles. Analysis of the groups of the second study are not included here, because the number of therapists playing alongside with their clients might have modulated the results. Looking at the development of collaborative behavior, one can see that the development of ECC seems to be rather stable in both studies, while the value of EFC seems to decrease (Figure 36, Figure 37).
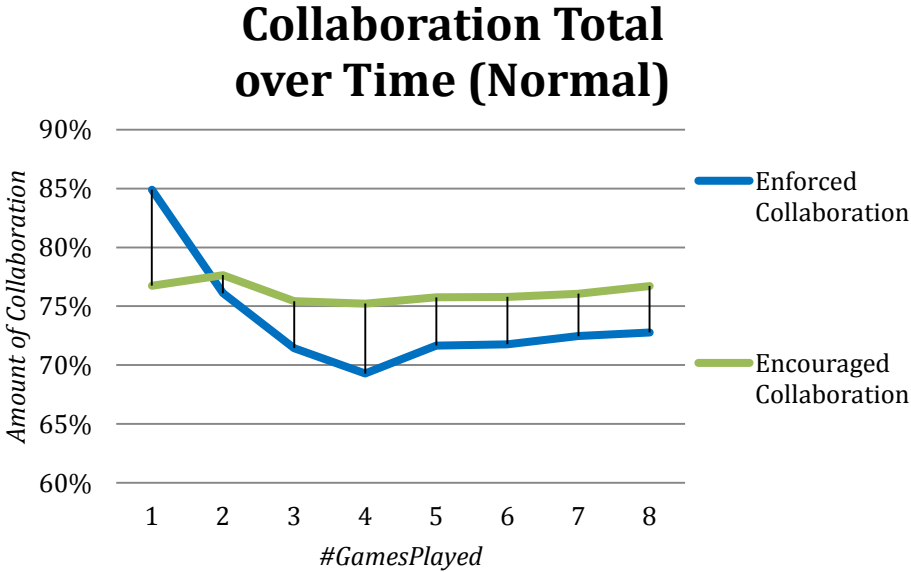
Collaboration Total over Time (Normal)

Figure 36: *DV$_1$ with regard to IV during total game time*
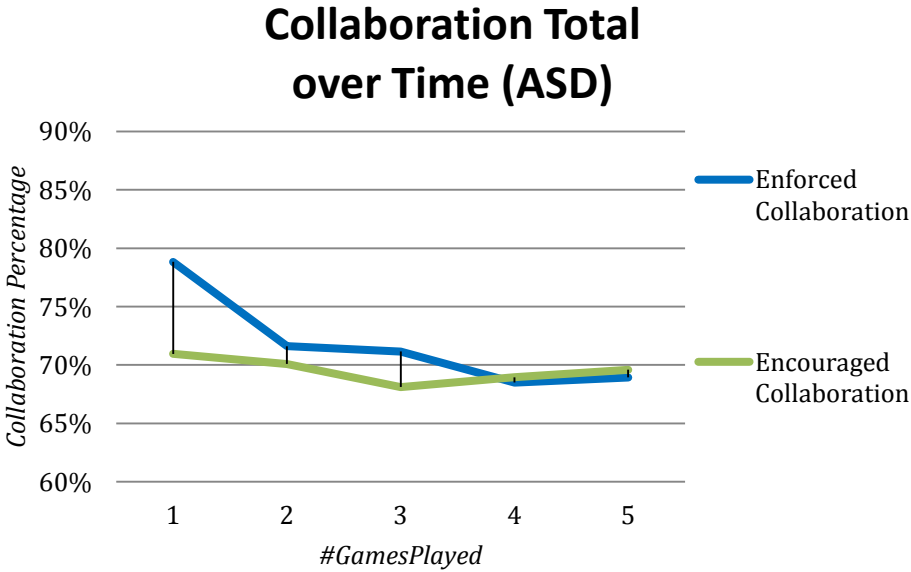
Collaboration Total over Time (ASD)

Figure 37: *DV$_1$ with regard to IV during total game time in second study*

Surprisingly over time the players occasionally tended to neglect the necessity of acting together when EFC actually forced them to act collaboratively. Looking at Figure 38, one can see that DV_1 varies with each game level. By this one can see that additional cognitive workload of managing multiple enemy types influences the collaborative behavior. Details of this possible correlation cannot be derived from this analysis and might be subject to further research.
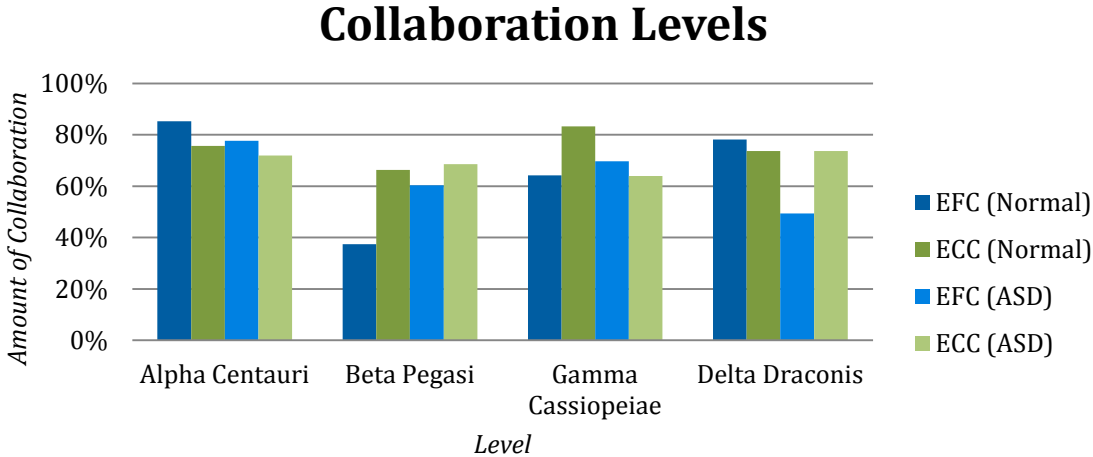
Collaboration Levels

Figure 38: DV_1 *with regard to the different game levels*

Analyzing the rank order of different enemy types led to some noticeable results (Figure 39, Figure 40). While the *Drone* got the best average ranking in both studies, most of the actual enemies *Blaster*, *Teleporter* and the *Neutralizer* received poorer results, with the *Raider* being an exception. This seems to be true for children with as well as without ASD. The *Teleporter* and the *Blaster* got a noticeably widespread ranking spectrum. The *Neutralizer* on the other hand was either very well or, more often, very negatively received. The latter is true especially for children with ASD. The results of the *Battery* are also very different between the groups. Either very negatively or very positively reviewed by children with ASD, it was comparably well received by children without any disorders.

With these results, it firstly can be concluded that the *Teleporter* as well as the *Neutralizer* might both need some revision. Secondly, helping behavior, which is implemented by the game elements *Neutralizer* and *Battery*, tends to divide the minds of autistic children. Further research in that area might be of good use.

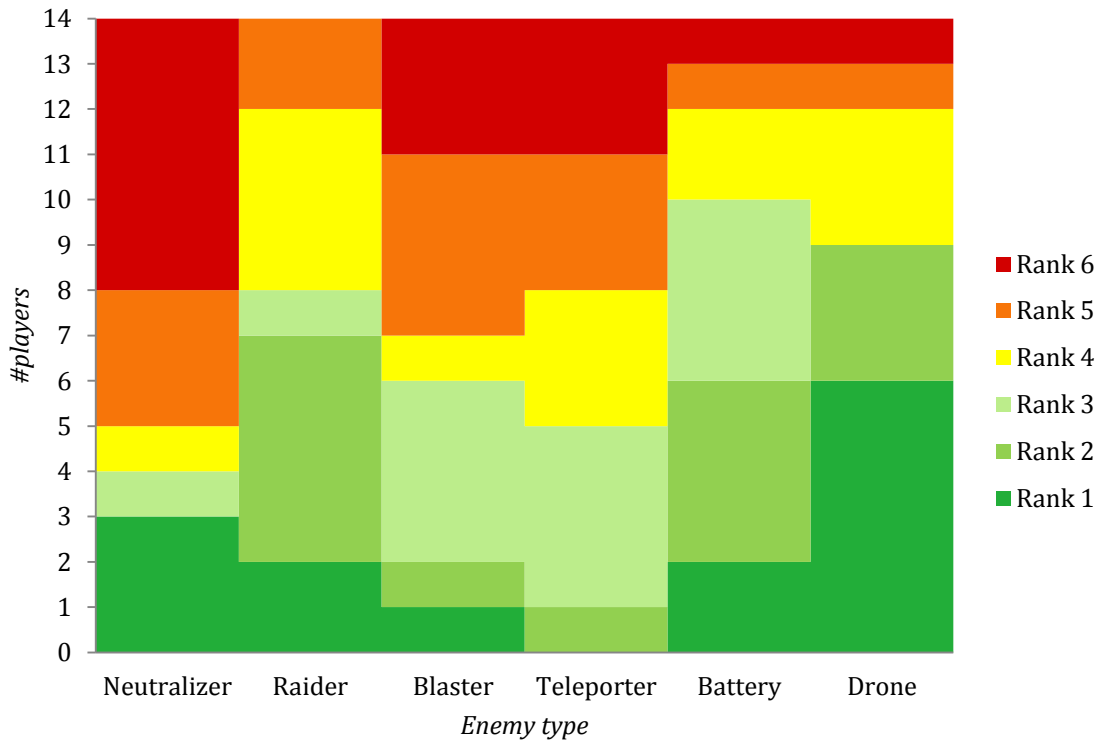# Players ranking of enemy types (Normal)

Figure 39: Ranking of enemy types (first study)

Players ranking of enemy types (ASD)
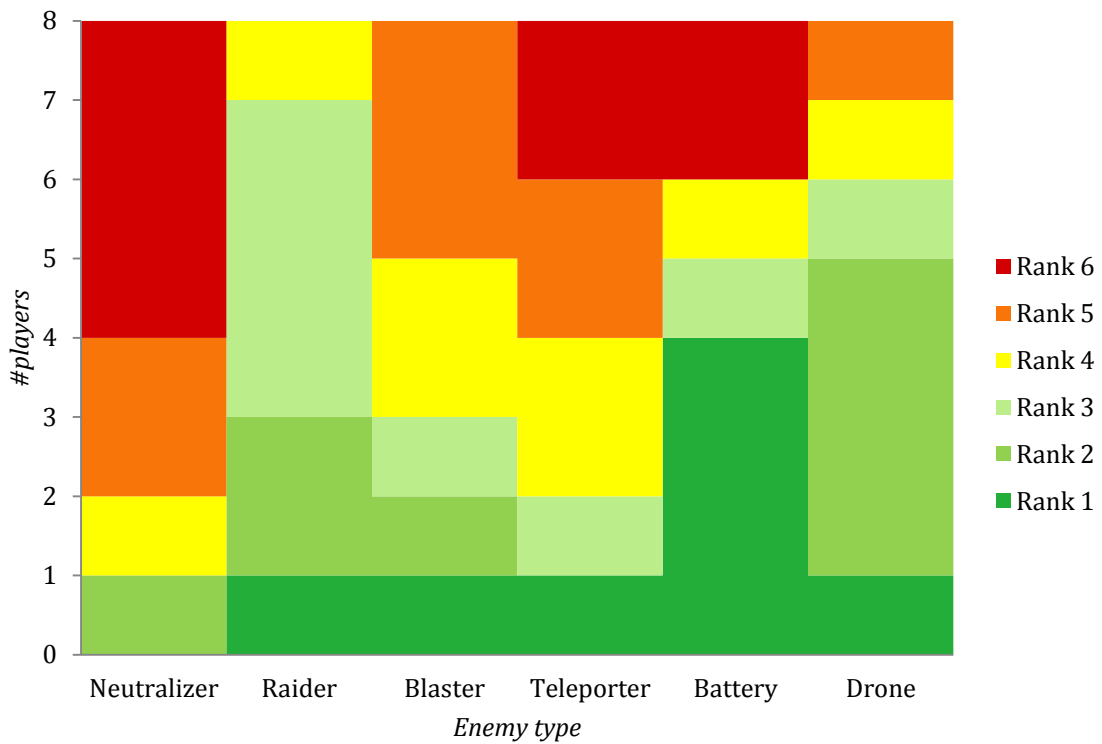
Figure 40: Ranking of enemy types (second study)

To substantiate the fact of the game fostering social interaction, heat maps of each game have been drawn. These heat maps represent the movement of the game tokens during each round of gameplay.[17]
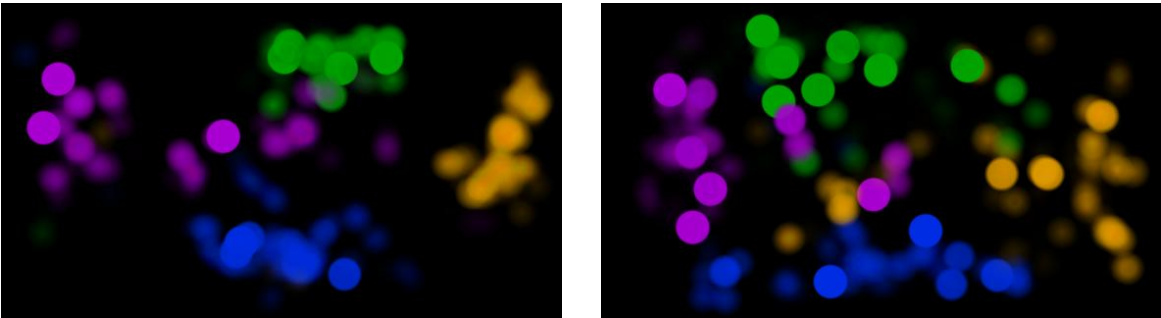
Figure 41: *Heat map of movement data 1st study 1st group*
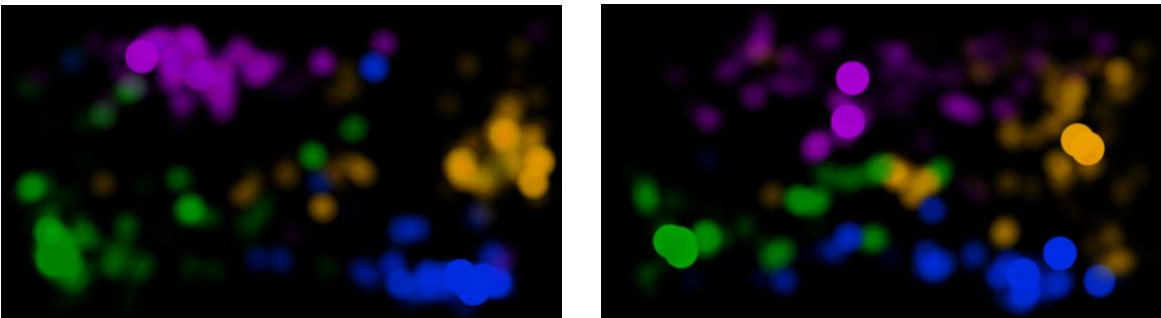
Figure 42: *Heat map of movement data 1st study 2nd group*
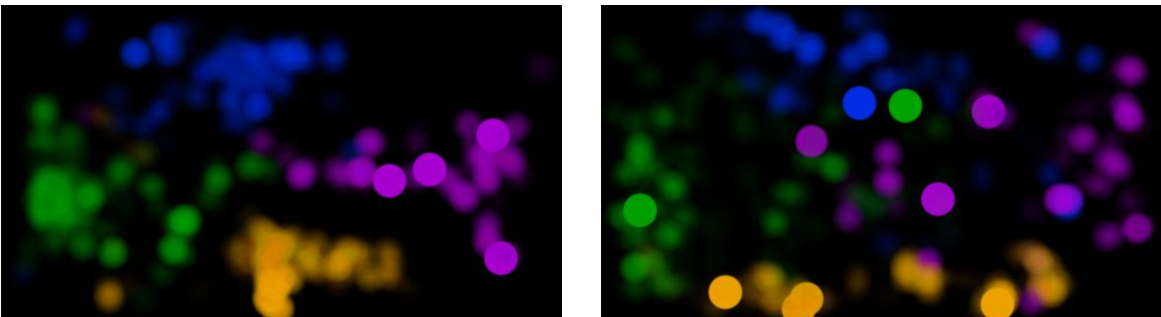
Figure 43: *Heat map of movement data 1st study 3rd group*
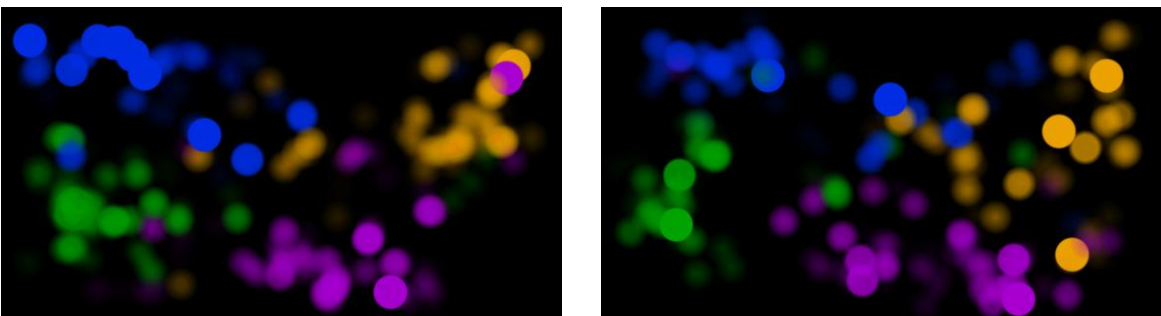
Figure 44: *Heat map of movement data 1st study 4th group*

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[17] The images of the heat maps are 1920 and 1080 pixels in width and length respectively. Each color (green, orange, blue, magenta) represents a player taking part in the game. The circles represent the time players remain at a specific location. The diameter of these circles ranges from 0 to 120 pixels and increases linearly over time, with 120 pixels being used as a maximum value when players stay 10 seconds or more. The transparency of the circle ranges from 0% to 100% and also increases over time parallel to the circles diameter.
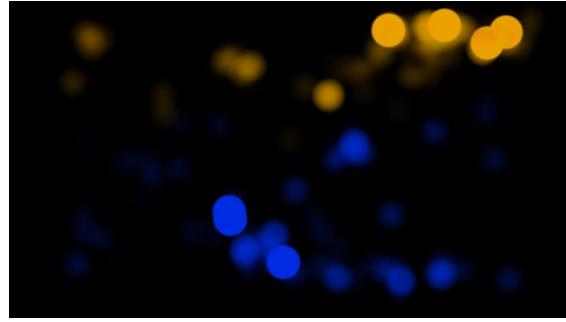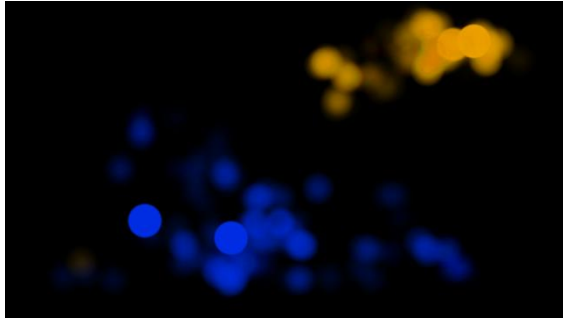
Figure 45: *Heat map of movement data 2nd study 1st group*

Figure 46: *Heat map of movement data 2nd study 2nd group (magenta = therapist)*
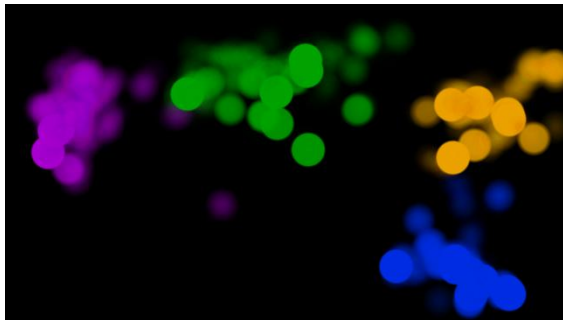
Figure 47: *Heat map of movement data 2nd study 3rd group (blue = therapist)*
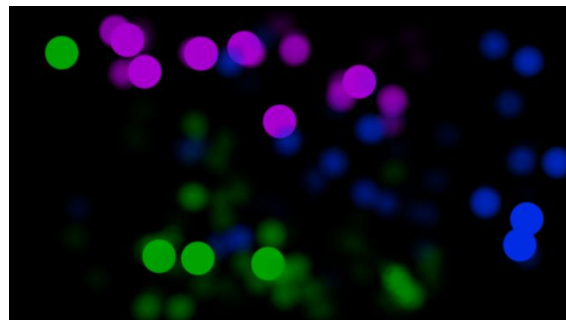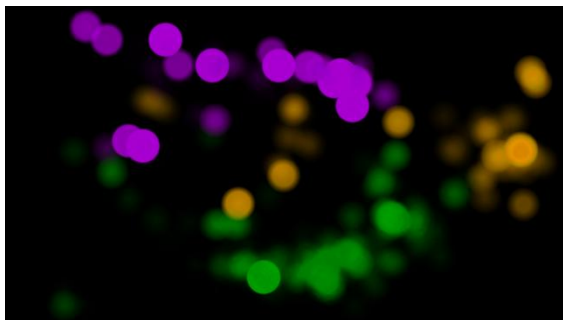
Figure 48: *Heat map of movement data 2nd study 4th group (yellow, blue = therapist)*

When comparing this movement information, interaction seems to increase over time and players tend to cover a wider area of the surface after some rounds of gameplay (good example: Figure 47). While this is certainly not sufficient to provide any verifiable outcome, it is enough to put even more emphasis on the fact that this game is meant to serve as a tool to encourage social behavior. It should be noted that the visualized heat maps are derived from the first and last game that was actually finished by the players.

4.8 Discussion and Implications

Both hypotheses have been proven for normally developed children as well as autistic ones. The game seems to work as a tool in group therapy for autistic children. Regarding the data generated during the study, ECC seems to provide higher motivation, while maintaining a similar amount of collaboration. This seems to be true for both children with and without ASD. Nevertheless, there is reason to question these outcomes. The number of participants, though high for typical studies in human-computer interaction, is not necessarily adequate for a representative evaluation of different game design principles. Furthermore, the outcome of both studies cannot be compared to each other, because of the diverging group size and the participation of therapists in the second study. One can however find enough indications that current design principles of therapy games, especially those fostering collaborative behavior, can be improved further and that ECC might offer a good approach for this.

5   Conclusion

After summarizing this thesis and reflecting on possibilities for improvement, a broader perspective on the subject and resulting future work is described.

5.1   Summary

This work emphasizes the importance of encouraged collaboration in therapeutic games which aim at fostering social interaction and communication. While a therapy game should always provide and maintain a high level of motivation, the game needs to focus on its main therapeutic goal. This has recently been done by applying a principle called "Enforcing Collaboration". By developing a hybrid therapy game and conducting two consecutive studies with children with and without ASD I have shown that this design principle can be improved by applying basic rules of behavioral therapy. Therapeutic games which are based on such behavioral therapy should encourage desired behavior instead of enforcing it. This leads to an increase of motivation, while maintaining a similar amount of collaborative behavior. Therefore "Encouraged Collaboration" may increase long-term effectiveness for therapy games fostering social interaction and communication, such as therapy games for children with autism.

5.2   Lessons Learned

The project was realized with *WPF*. When it comes to the development of digital or semi-digital games however, the possibilities this framework offers are limited and usage of this framework does not lead to an optimal performance of the system. Utilization of frameworks actually meant for game programming purposes, like the *XNA* framework, would solve this problem. In addition, the token recognition of the *Samsung SUR40*, though sufficient for conducting the study, seems to be erratic at the most. Losing contact with the tokens and misinterpreting positions of them seemed to be the rule rather than the exception. Next iterations of the project should use other hardware solutions, if possible.

Acquiring participants also took quite an amount of time. While a balanced group of children is generally hard to find, the acquisition of the autistic children was almost too time consuming for including the findings of the second study into this work. Providing a controlled setting also was rather difficult. Some children wanted or needed their therapist to play alongside with them, while others unexpectedly failed to attend the study. Changing

the measurement of desired behavior to fit case studies like these would be necessary for generating even more valid findings.

5.3   Future Work

In this work I mainly focused on measuring collaborative behavior, since I worked on the question how games fostering collaborative behavior could be enhanced. The presented findings can now be abstracted and put into a more general context; games for therapeutic purposes might have a higher training effect when encouraging desired behavior rather than enforcing it. This refers to the thoughts explicated in chapter 2.2. Differentiating between the goal and purpose of a serious game offers the possibility of increasing players motivation to play the game while conditioning desired behavior in the progress of gameplay. This desired behavior could also include principles of social behavior like turn-taking or helping others. These principles are already implemented in the game, namely through the *Teleporter* and *Neutralizer*. Further research could include contrasting encouragement and enforcement of these principles by comparing motivation and performance of variations of these different game elements. Since there hardly seemed to be any differences in the outcome regarding whether or not children have or do not have developmental disorders, future studies might not necessarily focus only on affected children. Taking in a broader view on the subject of serious games, studies should also include people of all ages. Results of such studies would lead to conclusions on how effectiveness of therapy games fostering social interaction and communication as well as serious games in general can be improved. This concluding thought leads me to the prospective research question for my master thesis:

> ***Further Research Question:*** *Does "Encouragement of Desired Behavior" (EDB) in serious games offer a better way of motivation than the general approach of enforcing desired behavior while providing the same training effect?*

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7   Appendices

Appendix 1   Questions for Initial Requirement Analysis (German)

- Über welche Teilbereiche des Autismus-Spektrums klären Sie auf?
- Mit welchen Teilbereichen des Autismus-Spektrums haben Sie vornehmlich zu tun? (Wie hoch ist der Grad der Erkrankung üblicherweise?)
- In welchem Alter befinden sich die Kinder und/oder Jugendlichen, mit denen Sie sich beschäftigen?
- Wie hoch sind die geistigen Kompetenzen der betroffenen Kinder und Jugendlichen? Wie hoch ist ihr Abstraktionsvermögen?
- Wie gehen die Familien der Betroffenen mit der Situation um? Werden betroffene Kinder und Jugendliche von ihren Familien / Eltern anders behandelt? Wenn ja, wie?
- Welche Spielzeuge und Spiele stehen Kindern und Jugendlichen mit ASS zur Verfügung? Welche sind digital, welche analog? (Welche Art von Konsole etc. wird verwendet?)
- Würden Sie das Spielverhalten von Kindern und Jugendlichen mit ASS als anders bezeichnen? Wenn ja, warum?
- Ab welchen Grad der Erkrankung gilt ein Kind / ein Jugendlicher als therapiebedürftig? Welche Art der Therapieform empfehlen Sie in welcher Situation?
- Wie alt sind Kinder, wenn sie mit Therapien beginnen? Wie alt sind sie bei Gruppentherapien?
- Entwickeln Kinder und Jugendliche mit ASS ein Bewusstsein für ihre Krankheit? Wenn ja, unter welchen Umständen und in welchem Alter?
- Entwickeln Kinder und Jugendliche einen Willen zur Besserung ihrer Krankheit? Wenn ja, unter welchen Umständen und in welchem Alter, wie bringt sich dieser Willen zum Ausdruck?
- Denken Sie, dass Spiele ein geeignetes Medium sind, um Inhalte in Therapiesitzungen zu vermitteln? Wenn ja, welche Art von Spielen sind das?
- Welche Chancen sehen Sie in der Anwendung eines solchen Therapiespiels?
- Welche Risiken sehen Sie?
- Welche Kompetenzen und Eigenschaften sollten und könnten Ihrer Meinung nach durch ein solches Spiel gefördert werden?
- Könnten betroffene Kinder und Jugendliche Schwierigkeiten im Verstehen von Spielszenarien haben? (Gegenüberstellung: Metaphern – Erfundene Szenarien)
- Denken Sie, dass eine Zusammenarbeit unter den Spielern durch das Spiel erzwungen, oder lediglich belohnt werden sollte?
- Wie könnte man den Transfer der geförderten Kompetenzen in den Alltag gewährleisten?
- Wären bei einem Einsatz eines solches Spieles Therapeuten anwesend? Wenn ja, inwiefern sollten diese den Spielverlauf koordinieren?
- Sollten Therapeuten am Spiel selbst teilnehmen? Wenn ja, welche Rolle nähmen sie ein?
- Sollten Therapeuten Inhalte des Spiels steuern können (z.B. Schwierigkeitsgrad)? Wenn ja, bis zu welchem Grad?
- Wie viel Feedback sollte vom Spiel gegeben werden, wie viel vom Therapeuten? Welche Art von Feedback wird vom Therapeuten gegeben und wann?

Appendix 2   Interview with Andreas Wacker (July 3rd, 2012)

Summary

- Experience: Primarily Andreas Wacker has experience with slow learning adolescents between the ages of 13 and 17 and with children with intellectual giftedness. In addition to that he led two group therapies for children with ASD which each lasted one year.
- Diagnose: A valid diagnose of ASD can occur from the age of eight. One should strive for an early detection so that children can attend group therapies as soon as possible.
- Awareness: In early years children are not aware of their situation. However, when children grow up, they develop such an awareness. Sometimes this can lead to a depression.
- Empathy: Children and adolescents with ASD do not show any interests in other participants of group therapy sessions or their therapists. After one year of therapy they did not even know the name of their therapist.
- TEACCH approach: Focus of this approach is improving abilities to structure ones thoughts and processes. This therapy is oriented towards rituals and strict procedures. Everything must be predictable for the children and planned beforehand.
- Visualization: It is of advantage to visualize procedures in group therapies (e.g. line with pictures). In each training session visualizations should be used in an elementary way.
- Games used: "Time Timer" - Each participant/player draws a card of a specific coler, either green, yellow or red. This color indicates how much time he or her wants to have in order to talk about him- or herself. The remaining time of all participants is indicated via a slider or clock. The participants learn time perception, social interaction and communicative skills.
- Analog and digital: All games in group therapy sessions as well as every tool for such therapy are analog. Digital tools are only used for diagnostic purposes (e.g. "digital facial recognition").
- Digital approach: Using digital tools in therapy sessions provides certain advantages, mainly regarding motivational aspects. Children and adolescents with ASD are often quite drawn to technology.
- Physical constraints: Children and adolescents are often limited in their motoric skill set ("Typische Tollpatschigkeit" - "typical clumsiness"). Eye-hand coordination is not affected.
- Facilities: There are no particular limitations regarding the surroundings of group therapy sessions.
- Length of therapy sessions: A single therapy sessions takes approximately 90 minutes.

Game Design Conclusions

- Structure: The therapy game itself does not need to regard principles used in TEACCH, since the game would just be an element of a therapy session. As a single element, the setting of the game is clear. Surprises in the game itself are not seen as a derivation from the structure of the therapy session.
- Presentation: Children and adolescents with ASD have the same amount of experience in videogames than those without any disorder. A digital therapy game has to compete with these games and satisfy players expectations. Visualizations, though cost-free, are

to be well-versed. The narrative setting of the game should be easy to understand, it should be conceived as typical for videogames and motivate the players.

- Length: The game would be used as a central element in group therapy sessions, so there would be a timeframe of approximately 30 minutes in which the game could be played. A round of gameplay however should be shorter than that, so that the game can be played a couple of times. One should aim at roughly 10 minutes of gameplay. Intervals between these rounds of gameplay should be used to reflect on the game and to transfer social competence into everyday life.

- Transfer: The game should train social competence in a way that players can reflect upon their actions and transfer learned abilities into everyday life. To achieve that, involving the therapist into the game is mandatory. The therapist should have the opportunity to discuss contents of the game together with his clients. The game is not to replace a therapist, but to serve merely as a tool for him.

- Control: The therapist should have control over the length the game is played. Whether or not the therapist should actively be involved in the process of gameplay is yet to be discussed.

- Collaboration: Cooperative work between the players should be rewarded by the game. In doing so collaboration should not be enforced. Egocentric behavior should lead to obvious lack of points and positive feedback.

- Abilities: Although progress abilities in playing the game should be rewarded with regard to motivational aspects, the priority should always be the conditioning of social competence. Players and above all the group should never be punished because of the motoric and cognitive impairments of another single player.

- Conditioning: Social competence should be conditioned through rewarding specific actions. The game is to provide audiovisual feedback in a timely manner.

- Motoric efforts: Odds are that players have deficits in their gross motor skills. The game should not punish actions, that can be attributed to this deficits.

- Game tokens: The tokens of the game should have a haptic value. Since there are quite some ambiguities regarding the sensory skills of children with ASD, there are no specific requirements for consistency, form or color of the tokens. However, when designing them one should take the low motoric performance of the children into account.

Appendix 3   Interview with Katharina Lilje and Andreas Targan (July 16th, 2012)

Summary

- Experience: Katharina Lilje as well as Andreas Targan are two educational advisors from the regional association "Regionalverband Bodensee e.V.". They organize and lead group sessions for informing affected people about ASD. During six years of professional experience Katharina Lilje advised teachers and pupil at schools in Constance. She lead single, as well as group sessions and has knowledge of all parts of the autistic spectrum.
- Supervised Children: The regional association has approximately 60 members. At school in and around Constance 80 to 90 pupils are in need of advice. Usually these children have AS.
- Diagnose: A diagnose of an autistic disorder should be made as soon as possible. Counseling usually start with homogenous groups of eight-year olds.
- Self-perception: Children and adolescents with ASD do not perceive themselves having any disorders. With their altered point of view they merely perceive their surrounding differently und react in another way to it. In that sense they also cannot be "cured".
- Parents behavior: Parents of affected children adapt to the behavior of their kids. The daily routine is strictly planned, rituals are to be kept. Disagreements between them are bound to occur. Vacations are hardly possible.
- Toys: Toys and games are not different from those normally developed children use. Books however are mostly non-fiction.
- In-game behavior: The in-game behavior of children with ASD is comparable to those without deficits. They like to play in groups or in the family. The fun aspect of most games is however depleted at some time and the children then fall back on computer games for one player.
- Gender ratio: The ratio of boys and girls with disorders in the autistic spectrum is roughly eight to one. Boys are thereby way more affected than girls.
- Structure: Structure and rituals of processes in general is important - in daily life as well as in therapy sessions. TEACCH offers an approach for solving this problem.
- Need of therapy: As a result of the knowledge to have ASD children and more often adolescents suffer from depressions. Such depressions, but anxieties and restraints that emerge in the daily routine, should be subject to individual therapy. In such therapy children and adolescents are taught to accept their special circumstance as a part of themselves. Social competence in taught in group therapy.
- Aim of group therapy: Autism is not curable and therefore cannot just vanish. Therefore group therapies aim at integrating affected children and adolescents into everyday life, help them to accept their situation and provide support for their families

Game Design Conclusions

- Autism Spectrum: The game should be suitable for children and adolescents with either HFA or AS. For children and adolescents with MFA or LFA, the complexity of the game might be too high.
- Game Structure: Generally, almost every game for children of this age are appropriate for training of social interaction. Nevertheless, certain points have to be considered. It is beneficial, if the game follows a set flow of events, for example it could be turn-based.
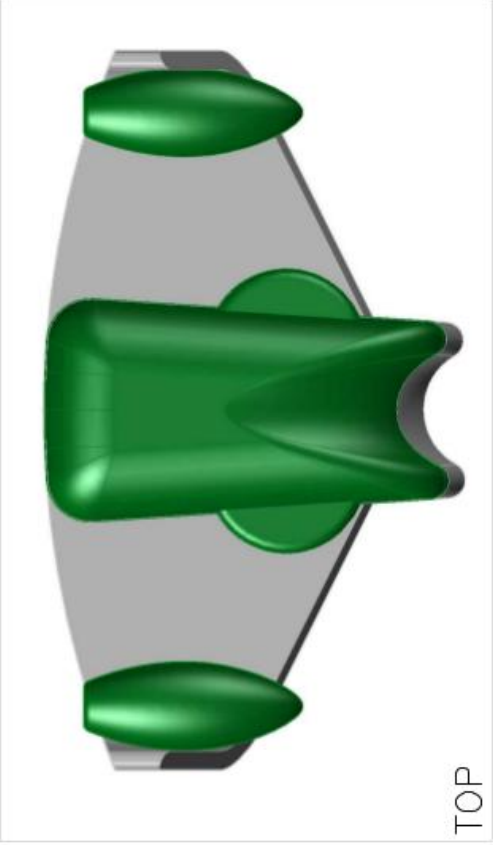
- Goal of the Game: The goal of the game has to be clear at every time (game is over after level X or after the players reaches X points, etc.)
- Context: The narration of the game should not leave its natural context. Communication and interaction must happen on a game-based level.
- Dominance of Players: Is must be considered, that some players might apply dominant behavior in order to reach the goal of the game. At every time, every player should have the opportunity to integrate him- or herself in the process of solving the game.
- Collaboration: Players should never be forced to work together. Players should merely be get a high reward, when they do.
- Transfer: The game automatically provide the means for transferring experiences from the game to the real world, when they actually have fun during gameplay. The game can be used as a motivating tool for a following group discussion.

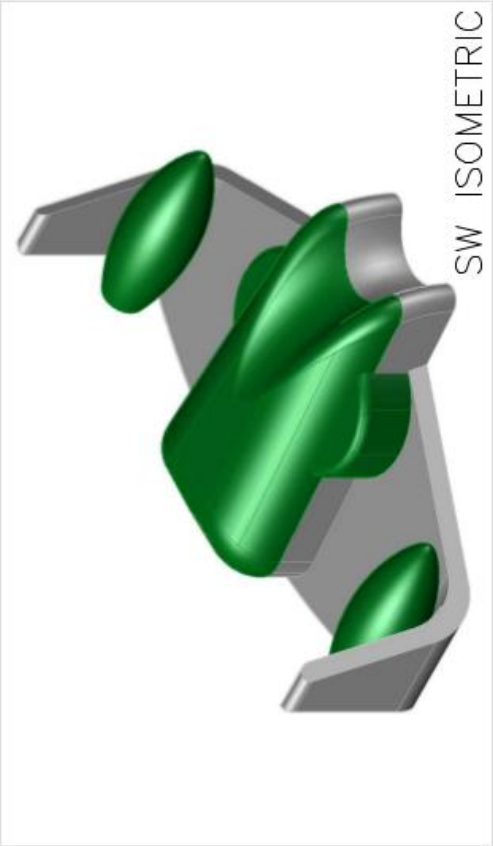## Appendix 4   Technical drawing of game token (AutoCAD)

Sebastian Marwecki
BA – Information Engineering
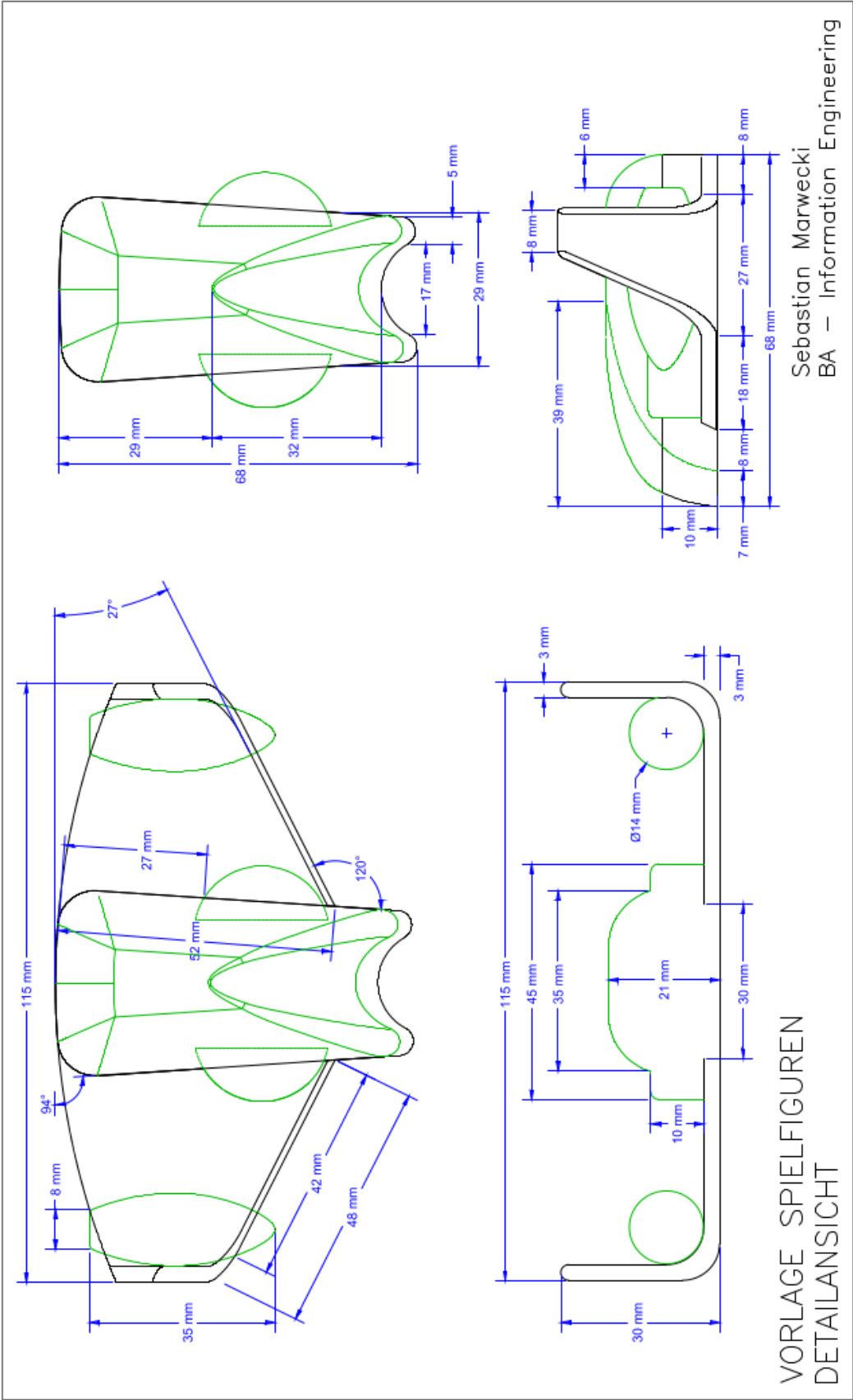
VORLAGE SPIELFIGUREN
DETAILANSICHT

TOP

SW ISOMETRIC

FRONT

Sebastian Marwecki
BA – Information Engineering
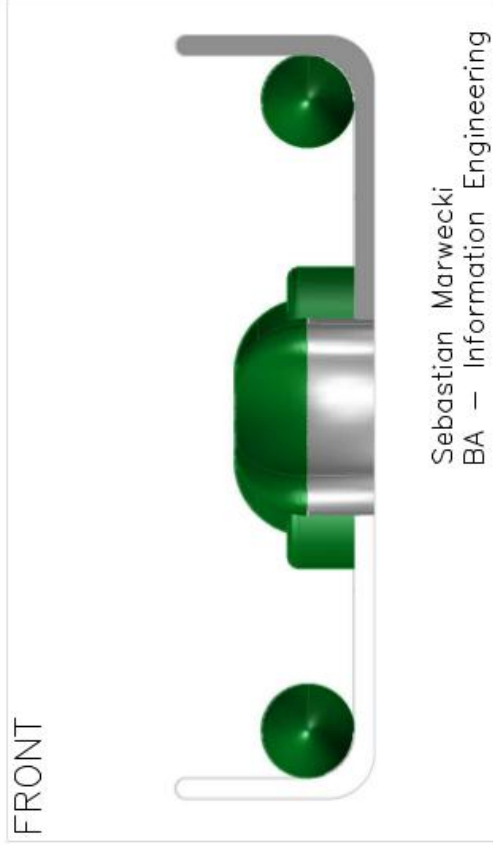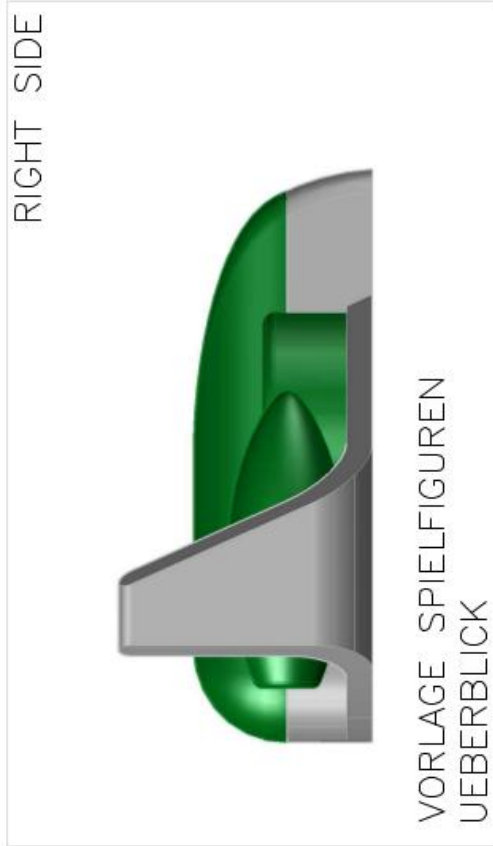
RIGHT SIDE
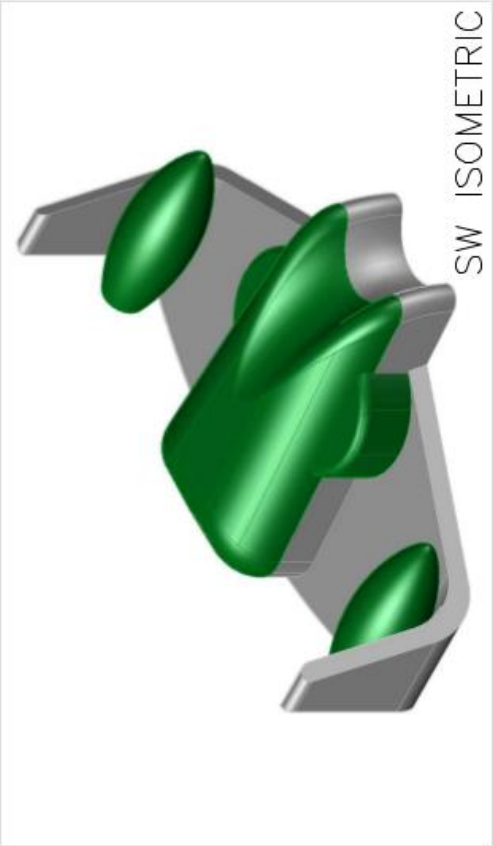
VORLAGE SPIELFIGUREN
UEBERBLICK

Appendix 5   Questions for Secondary Requirement Analysis (German)

- Finden Sie, dass das Interface einfach zu nutzen ist? Verstehen Sie die Menüführung und die Sprache?
- Lässt sich das Programm in der Form in Therapiestunden nutzen? Wenn nein, wo liegen inhaltliche oder formale Fehler?
- Was würden Sie noch ändern wollen? Was haben Sie für Verbesserungsvorschläge?

Appendix 6   Interview with Andreas Wacker (November 27th, 2012)

- The hints given at the beginning of the game and those for new enemies should optionally be displayed for the several players at the same time.
- The hints given should be visualized in a more direct way. For example, storyboards or videos could be implemented to foster understanding of the game contents. Texts should be displayed sparingly, if at all.
- The way of representing of the hints could be categorized so it can be set therapist before the game. The same goes for the amount of hints given.
- The performance of the game should be improved.
- The range of the difficulty of the game is too diverse. Providing less options for the difficulty and naming these options appropriately would simplify this task for the therapist.
- The enemies cannot be differentiated fast enough. Higher contrasts or different coloration should prevent that. Higher differentiation of the game objects will lead to a better understatement of the required gaming tasks.
- The game should be used at the end of therapy sessions as a kind of reward.

Appendix 7   Interview with Andreas Targan (December 3rd, 2012)

- The hints given at the beginning of the game and those for new enemies should not contain too much detail. A purposeful aid should give reason for group discussion. Too much help would lead to less communication.
- The amount of help given, and the way of representing the hints should be adjustable.
- The total amount of game elements should be increased. Due to the number of combinations of the game elements, there is a higher amount of tactics, the game would require.
- After one round of the game (a single game level), material for discussion should be provided by the game.
- It should be visible, how much the players would benefit from a higher amount of collaboration. E.g. the percentage achieved could be displayed.

Appendix 8   Interview with Steffen Bogen (December 5th, 2012)

- Usage and metaphor of the "spaceship"-interface should be reinforced. The players should need to move their token more often and extensively.
- The "Supply Drones" are collected via a single touch-gesture. That might be in contrast to the usage of the interface. The drones should be collected by ones spaceship, meaning by moving the token over them.
- The movement of enemies should be more clear to the player. A light signal or other visual feedback could indicate the movement direction of the enemies, namely the "Raider" and the "Blaster".
- As an additional game element there can be obstacles, which hinder the player to move freely. That can be understood as a cognitive task, which enhances immersion of the player into the game world. In the games narrative these game elements could be mines or some sort of fog.
- Players might have the possibility to move their spaceship to a docking-station in front of them to recharge their batteries, which are needed for shooting. The "Batteries" in the game could increase the total amount of energy (shots) players have.
- The range of the shots should be increase drastically. That could enable the players to develop shooting and movement strategies.

Appendix 9   Interview with Margarita Stolarova (January 27th, 2013)

- The hints given at the beginning of the game and those for new enemies should be more explicit. A minimum of text can be used, roughly one small sentence for each picture.
- Removing the token from the surface should be discouraged.
- Game elements should be introduced consecutively. For example, the element of limited time can be introduced during the second wave of the first level, the element of limited energy for shooting in the next wave, etc.

Appendix 10   Parent Information First Study (German)

Willkommen!

Zunächst möchten wir uns herzlich bei Ihnen bedanken, dass Sie sich bereit erklärt haben, an unserer Untersuchung teilzunehmen. Bevor es nun gleich losgeht, wollen wir Ihnen mit Hilfe dieser kurzen Einführung vermitteln, um was es uns bei dieser Studie überhaupt geht und welche Rolle Sie und vor allem Ihr Kind dabei spielen.

In der Arbeitsgruppe Mensch-Computer Interaktion beschäftigen wir uns unter anderem mit der Fragestellung, inwiefern Menschen mit körperlichen Einschränkungen geholfen werden kann. Dies beinhaltet auch die Entwicklung von Therapiemitteln, etwa für Gruppentherapien für Kinder mit eingeschränkten Fähigkeiten in sozialer Interaktion und Kommunikation, wie etwa Autismus-Spektrum-Störungen.

Wir haben ein Spiel entwickelt, welches dafür gedacht ist, in Gruppentherapien für solche Störungen eingesetzt zu werden. Diese Studie dient als Voruntersuchung mit dem Zweck, das Spieldesign zu überprüfen und das Spielverhalten von Kindern ohne Einschränkungen der sozialen Fähigkeiten vergleichend zu untersuchen. Gleichzeitig prüfen wir, wie sich das Gemeinschaftsverhalten der Spieler bei verschiedenen Spielmechanismen verändert, etwa bei unterschiedlichen Spielaufgaben oder durch wechselnde Belohnungen durch Punkte.

Das Spiel wird auf einem „Computertisch" gespielt und heißt „Invasion of the Wrong Planet". Es geht darum, dass die Spieler die Erde gegen Außerirdische verteidigen. Dazu bekommt jeder Spieler eine Spielerfigur in Form eines galaktischen Raumschiffs mit dem er oder sie durch den Weltraum fliegen kann, indem die Figur über den Tisch bewegt wird. Das Raumschiff feuert mit seinem Laser, indem der virtuelle Knopf vor der Spielfigur gedrückt wird. Dadurch kann die Erde vor den außerirdischen Raumschiffen verteidigt werden.

Das Spiel soll durch gemeinschaftliche Aufgaben und verschiedene Gegnertypen das Gruppenverhalten der Spieler fördern, also die kommunikativen Eigenschaften und das soziale Interaktionsverhalten anregen. Ihr Kind hilft uns dabei, das Spiel zu überprüfen. Denken Sie bitte daran: Nicht Ihr Kind wird getestet, sondern das Spiel! Ihr Kind kann also nichts „falsch" machen. Jedes Verhalten hilft uns, das Spieldesign zu verbessern.

Bisher hatten unsere Testgruppen viel Spaß an dem Spiel. Wir gehen davon aus, das auch Ihr Kind daran Freude haben wird. Wenn Sie oder auch Ihr Kind dies jedoch möchten, können Sie die Studie jederzeit ohne Nennung von Gründen abbrechen, ohne dass dadurch für Sie Nachteile entstehen.

Ein Versuchsleiter wird bei dem Spieldurchlauf anwesend sein. Das Verhalten Ihres Kindes wird aufgezeichnet und später anonymisiert ausgewertet. Die Aufzeichnungen umfassen Video- und Sprachaufzeichnungen sowie das Interaktionsverhalten (Logging). Zur unverfälschten Analyse des Spielverhaltens würden wir Sie bitten, während der Zeit in einen separaten Raum zu gehen und dort einen Fragebogen auszufüllen.

Die Studie ist zeitlich wie folgt eingeteilt:

- Begrüßung und Erklärung der Studie (etwa 15 Minuten)
- Kinder: Gemeinsames Spiel, Eltern: Ausfüllen eines kurzen Fragebogens, jeweils in einem separaten Raum (etwa 30 - 35 Minuten)
- Verabschiedung (10 Minuten)

Nach der Studie erhalten Sie von uns ein kleines Dankeschön Ihrer Wahl. Zudem ist Ihnen natürlich unser Dank und auch das Gefühl gewiss, etwas Gutes für die Kinder in Gruppentherapien geleistet zu haben.

Abschließend wünschen wir Ihnen viel Spaß und möchten uns noch einmal für Ihre Teilnahme bedanken!

Sebastian Marwecki, Roman Rädle

Arbeitsgruppe Mensch-Computer Interaktion, Universität Konstanz

Appendix 11   Informed Consent First Study (German)

Einverständniserklärung der Eltern

Sehr geehrte Eltern,

Vielen Dank dafür, dass Sie sich bereit erklärt haben, mit Ihrem Kind an dieser Studie teilzunehmen. Wie bei jeder Studie üblich, werden wir die von den Teilnehmern der Studie erzeugten Daten analysieren und diese eventuell in späteren Publikationen anonymisiert veröffentlichen. Wir garantieren dabei absolute Diskretion und es wird zu keinem Zeitpunkt Rückschluss auf Sie als Person möglich sein.

Die durch Sie generierten Daten enthalten ort- und zeitabhängige Informationen und umfassen folgende Punkte:

- Text
- Fotos
- Sprachaufzeichnungen
- Videoaufzeichnungen
- Interaktionsdokumentationen
- Fragebögen

Ich habe die von Sebastian Marwecki / Roman Rädle gegebenen Informationen erhalten und verstanden. ☐ ja ☐ nein

Ich bin mit der Teilnahme meines Kindes an der Studie einverstanden. ☐ ja ☐ nein

Ich bin mit der anonymisierten Aufzeichnung und Weiterverarbeitung der oben genannten Daten im Rahmen der wissenschaftlichen Auswertung einverstanden. ☐ ja ☐ nein

Ich bin mit der anonymisierten Nutzung von Folgendem zum Zwecke wissenschaftlicher Veröffentlichungen einverstanden.

☐ Fotos ☐ Videos ☐ Internetpublikation Fotos ☐ Internetpublikation Videos

Ich möchte über die Ergebnisse der Studie informiert werden. ☐ ja ☐ nein

Ich möchte weiterhin beim Netzwerk KIND teilnehmen. ☐ ja ☐ nein

Ort, Datum: _____

Emailanschrift: _____

Name des Kindes: _____

Unterschrift der Erziehungsberechtigten: _____

Appendix 12   Questionnaire Parents First Study (German)

Teilnehmernummer: _____

Fragebogen für die Eltern

Bitte beantworten Sie die folgenden Fragen:

Hat Ihr Kind Erfahrung mit der Bedienung von Laptops oder Desktop-PC's?

☐ gar nicht   ☐ kaum   ☐ gelegentlich   ☐ oft   ☐ täglich

Wie intensiv gebraucht Ihr Kind Geräte mit berührungsempfindlichen Displays, wie Smartphones oder Tablets (iPad etc.)?

☐ gar nicht   ☐ kaum   ☐ gelegentlich   ☐ oft   ☐ täglich

Welche Händigkeit hat Ihr Kind?

☐ Links   ☐ Rechts   ☐ Beides   ☐ Keine Angabe

Hat Ihr Kind eine Sehschwäche (z.B. Rot-Grün-Sehschwäche)?

☐ nein   ☐ keine Angabe

☐ ja, und zwar: _____

_____

_____

Hat ihr Kind entwicklungsspezifische Besonderheiten?

☐ nein   ☐ keine Angabe

☐ ja, und zwar: _____

_____

_____

Bitte füllen Sie folgende Angaben zu Ihrem Kind aus:

Alter: _____

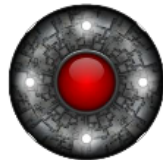Klassenstufe: _____

Geschlecht: ☐ männlich   ☐ weiblich

Teilnehmernummer: _____

Fragebogen für die Kinder

Welche Gegner und welcher Nachschub hat dir am meisten Spaß gemacht?

Dabei bedeutet 1 = Am meisten Spaß, 6 = Am wenigsten Spaß. Du kannst jede Zahl nur einmal benutzen!

Appendix 14   Acknowledgement of Receipt First Study (German)

Studie zur Untersuchung von kollaborativen Verhalten in hybriden Therapiespielen
Arbeitsgruppe Mensch-Computer Interaktion, Universität Konstanz

Bestätigung Aufwandsentschädigung

Wir bedanken uns bei Ihnen, dass Sie den Aufwand betrieben haben, um uns bei unserer Studie zu unterstützen. Unterschreiben Sie, um den Erhalt eines kleinen Dankeschöns zu bestätigen.

Hiermit bestätige ich, dass ich für die Teilnahme an der

„Studie zur Untersuchung von kollaborativen Verhalten in hybriden Therapiespielen"

Einen Buchgutschein über acht Euro und ein kleines Geschenk erhalten habe.

Ort, Datum: _____

Name des Erziehungsberechtigten: _____

Unterschrift der Erziehungsberechtigten: _____

Appendix 15 SPSS Results of Collaboration Values First Study (German)

Deskriptive Statistiken

	Mittelwert	Standardabweichung	N
EFC	.88183038638	.078476767614	16
ECC	.77771627963	.182248739243	16

Schätzer

Maß: MASS_1

IV	Mittelwert	Standardfehler	95%-Konfidenzintervall	
			Untergrenze	Obergrenze
EFC	,882	,020	,840	,924
ECC	,778	,046	,681	,875

Paarweise Vergleiche

Maß: MASS_1

(I)IV	(J)IV	Mittlere Differenz (I-J)	Standardfehler	Sig.[a]	95% Konfidenzintervall für die Differenz	
					Untergrenze	Obergrenze
EFC	ECC	,104	,055	,077	-,013	,047
ECC	EFC	-,104	,055	,077	-,221	,139

Tests der Zwischensubjekteffekte

Maß: MASS_1

Transformierte Variable: Mittel

Quelle	Quadratsumme vom Typ III	df	Mittel der Quadrate	F	Sig.
Konstanter Term	22,033	1	22,033	1458,739	,000
Reihenfolge	,017	1	,017	1,128	,306
Fehler	,211	14	,015		

Appendix 16   SPSS Results of Collaboration Values Second Study (German)

Deskriptive Statistiken

	Mittelwert	Standardabweichung	N
EFC	,83823732000	,107431374000	9
ECC	,78355662689	,155126107673	9

Schätzer

Maß: MASS_1

IV	Mittelwert	Standardfehler	95%-Konfidenzintervall	
			Untergrenze	Obergrenze
EFC	,838	,036	,756	,921
ECC	,784	,052	,664	,903

Paarweise Vergleiche

Maß: MASS_1

(I)IV	(J)IV	Mittlere Differenz (I-J)	Standardfehler	Sig.[a]	95% Konfidenzintervall für die Differenz[a]	
					Untergrenze	Obergrenze
EFC	ECC	,055	,046	,270	-,052	,161
ECC	EFC	-,055	,046	,270	-,161	,052

Basiert auf den geschätzten Randmitteln

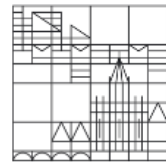a. Anpassung für Mehrfachvergleiche: Bonferroni.

Appendix 17 Parent Information Second Study (German)

Roman Rädle
Arbeitsgruppe Mensch-Computer-Interaktion
Dr. Margarita Stolarova
Arbeitsgruppe Frühe Kindheit
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78464 Konstanz
Tel +49 7531 88-3763
+49 7531 88 2868
margarita.stolarova@uni-konstanz.de
roman.raedle@uni-konstanz.de
20.06.2013

Universität Konstanz, 78457 Konstanz

Studie zur Förderung von

kollaborativem Verhalten

Liebe Eltern,

Wir bedanken uns für Ihr Interesse an unserer Studie. Im Folgenden wollen wir Sie über die Hintergründe, Ziele und den konkreten Ablauf der Studie informieren.

Wir haben ein Spiel entwickelt, welches dafür gedacht ist, in Gruppentherapien eingesetzt zu werden. Diese Studie dient als Voruntersuchung mit dem Zweck, das Spieldesign zu überprüfen und das Spielverhalten der teilnehmenden Kinder zu untersuchen. Gleichzeitig prüfen wir, wie sich das Gemeinschaftsverhalten der Spieler bei verschiedenen Spielmechanismen verändert, etwa bei unterschiedlichen Spielaufgaben oder durch wechselnde Belohnungen durch Punkte.

Das Spiel wird auf einem „Computertisch" gespielt und heißt „Invasion of the Wrong Planet". Ziel des Spiels ist es, die Erde gegen Außerirdische verteidigen. Dazu bekommt jeder Spieler eine Spielerfigur in Form eines Raumschiffs mit dem er oder sie durch den Weltraum fliegen kann, indem die Figur über den Tisch bewegt wird. Das Raumschiff feuert mit seinem Laser, indem der virtuelle Knopf vor der Spielfigur gedrückt wird. Dadurch kann die Erde vor den außerirdischen Raumschiffen verteidigt werden.

Das Spiel soll durch gemeinschaftliche Aufgaben und verschiedene Gegnertypen das Gruppenverhalten der Spieler fördern, also die kommunikativen Eigenschaften und das soziale Interaktionsverhalten anregen. Ihr Kind hilft uns dabei, das Spiel zu überprüfen, kann also nichts „falsch" machen. Jedes Verhalten hilft uns, das Spieldesign zu verbessern.

Die Studie dauert etwa 80 Minuten. Zu Beginn spielen die Kinder etwa 35 Minuten am Computertisch. Danach wird Ihr Kind gebeten, einen Fragebogen zur eigenen Person ausfüllen, um die am Computertisch gesammelten Daten durch eine Selbstauskunft zu ergänzen. Anschließend absolviert ihr Kind an einem Computer einen kurzen Test zum Erkennen von Hilfebedürftigkeit. Dabei sieht ihr Kind eine Reihen von Comic-Zeichnungen von Menschen und Vögel und muss jeweils angeben, was es darauf erkennt. Das Verhalten Ihres Kindes wird während der Studie aufgezeichnet und später anonymisiert ausgewertet. Die Aufzeichnungen umfassen Video- und Sprachaufzeichnungen sowie das Interaktionsverhalten (Logging).

Im Vorfeld werden sie als Eltern gebeten, zwei Fragebögen zu Ihrem Kind auszufüllen, die es uns ermöglicht, seinen aktuellen Entwicklungsstand einzuschätzen. Ebenso werden diese Fragen auch vom Therapeuten ihres Kindes beantwortet.

Alle „Tests" und Fragebögen werden von geschulten Testleitern (Psychologie und Informatik) erklärt. Ihr Kind erhält ausführliche Informationen zu den Aufgaben und hat durchgängig Gelegenheit, Fragen zu stellen.

Die Studie wird von drei Wissenschaftlern der Universität Konstanz durchgeführt: Roman Rädle und Sebastian Marwecki sind vom Fachbereich Informatik der Universität Konstanz und Forschen im Bereich der Mensch-Computer-Interaktion. Dr. Margarita Stolarova ist Psychologin am Zukunftskolleg der Universität; ihr Forschungsschwerpunkt liegt auf entwicklungspsychologischen Fragestellungen.

Freiwilligkeit und Anonymität
Die Teilnahme an der Studie ist für Sie und Ihr Kind freiwillig. Der verantwortungsvolle Umgang mit Kindern steht für uns an oberster Stelle, deshalb werden wir die Studie jederzeit abbrechen, wenn sich Ihr Kind nicht wohl fühlt. Wir achten zudem auf strenge Anonymisierung der Daten. Sie können nach Unterzeichnen der beiliegenden Einverständniserklärung jederzeit ohne Angabe von Gründen Ihre Einwilligung zur Teilnahme zurückziehen.

Wir danken Ihnen sehr herzlich für Ihre Teilnahme!

Mit freundlichen Grüßen

Roman Rädle   Sebastian Marwecki   Dr. Margarita Stolarova

Appendix 18   Informed Consent Second Study (German)

Zukunftskolleg
frei • kreativ • verbindend

Universität Konstanz, 78457 Konstanz

Universität
Konstanz
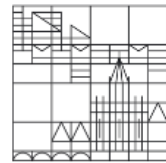
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20.06.2013

Studie zur Förderung von

kollaborativem Verhalten

ID des teilnehmenden Kindes:_____

Einwilligungserklärung der Eltern im Rahmen der
„Studie zur Förderung von kollaborativem Verhalten"

Inhalt, Vorgehensweise und Ziel der oben genannten Untersuchung wurden mir schriftlich erläutert. Ich hatte ausreichend Zeit, mich für oder gegen die Teilnahme meines Kindes im Rahmen der oben genannten Studie zu entscheiden.

Ich bin darüber informiert und damit einverstanden, dass während der Teilnahme meines Kindes Videoaufzeichungen, Fotoaufzeichnungen, Sprachaufzeichnungen und Logdaten der Bedienung des Comptertisches gesammelt werden.

Ich bin darüber informiert, dass die Teilnahme an dieser Studie freiwillig ist und dass ich mein Einverständnis jederzeit ohne Angabe von Gründen und ohne, dass mir dadurch Nachteile entstehen, widerrufen kann.

Alle MitarbeiterInnen unterliegen der Schweigepflicht und alle erhobenen Daten werden streng vertraulich behandelt. Die erhobenen Daten werden in anonymisierter Form gespeichert und weiterverarbeitet. Sie werden nicht an Dritte weitergegeben und dienen ausschließlich dem Zweck wissenschaftlicher Datenanalyse und Veröffentlichung.

Eine Kopie der Elterninformation und der Einwilligungserklärung habe ich erhalten.

O   *Ich bin einverstanden*, dass mein Kind an oben genannter Studie teil nimmt.

O   *Ich möchte nicht*, dass mein Kind an oben genannter Studie teil nimmt.

....
Ort, Datum   (Unterschrift)

partnerhochschule
des spitzensports

....
Ort, Datum   (Unterschrift)

Verwendung der Video- und Fotodaten, Speicherung von Kontaktdaten

Besonders gelungene Videoaufzeichnungen und Fotos der Studie sind im Rahmen wissenschaftlicher Weiterbildungen und bei wissenschaftlichen Veröffentlichungen sehr hilfreich. Dabei werden natürlich keinerlei Namen genannt; die Aufzeichnungen dienen lediglich Demonstrationszwecken über den Ablauf und die Ergebnisse der Studie.

O   *Ich damit einverstanden*, dass Videoaufnahmen und Fotos, auf denen mein Kind zu sehen ist, zusätzlich im Rahmen wissenschaftlicher Weiterbildungen und Veröffentlichungen gezeigt werden.

O   *Ich möchte nicht*, dass Videoaufnahmen und Fotos meines Kindes im Rahmen wissenschaftlicher Weiterbildungen und Veröffentlichungen verwendet werden.

O   *Ich damit einverstanden*, dass meine Kontaktdaten gespeichert werden, um mir Ergebnisse der Studie zukommen zu lassen.

Email: _____ und/oder

Postanschrift: _____

_____

....
Ort, Datum   (Unterschrift)

2

FRAGEBOGEN

MBAS
Marburger Beurteilungsskala zum Asperger-Syndrom ©

Inge Kamp-Becker & Helmut Remschmidt

Die **Marburger Beurteilungsskala zum Asperger-Syndrom** ist ein Instrument für Personen zwischen 6 und 24 Jahren mit durchschnittlichen kognitiven Fähigkeiten, das helfen soll, Kinder und Jugendliche mit einem Asperger-Syndrom zu identifizieren. Es ist gedacht als ein Screeningverfahren und als Hilfsmittel zur Diagnostik, das auf gar keinen Fall eine genauere psychiatrisch-psychologische Diagnostik ersetzen kann.

Der Fragebogen enthält eine Reihe von Beschreibungen, die durch eine Bezugsperson eingeschätzt werden sollen. Die einschätzende Bezugsperson sollte nach Möglichkeit täglich mit dem Kind/ Jugendlichen zusammen sein und mit dem üblichen Verhalten des Kindes/Jugendlichen vertraut sein.

Der Aufbau und die Fragen dieses Instruments orientieren sich an den diagnostischen Kriterien für das Asperger-Syndrom, die durch die beiden gebräuchlichen Klassifikationssysteme (ICD-10 und DSM-IV) festgelegt sind[1].

Name der Person, die den Fragebogen ausfüllt	
Beziehung zu der Person, über die der Fragebogen handelt (z.B. Mutter, Vater, Erzieherin/in)	
Name des Kindes/des Jugendlichen, über den der Fragebogen ausgefüllt wird	
heutiges Datum:	
Geburtsdatum des Kindes/Jugendlichen:	
Lebensalter des Kindes/Jugendlichen:	

---

1 Die Pronomen „er/ ihn" werden hier vereinfachend benutzt, da die Mehrheit der Personen mit einem Asperger-Syndrom männlich sind und die Benutzung von männlichen und weiblichen Pronomen an jeder Stelle diesen Fragebogen unnötig verlängern würde.

Anweisung: Schätzen Sie jede Frage danach ein, wie häufig das umschriebene Verhalten bei der zu beurteilenden Person vorkommt. Nehmen Sie dabei Folgendes als Richtlinie:

0   niemals
1   selten
2   manchmal
3   häufig
4   immer

Kreuzen Sie die Zahl, die am besten Ihre Beobachtungen zu dem typischen Verhalten dieser Person unter normalen Umständen beschreibt, an (z.B. an vielen Plätzen, im Zusammensein mit bekannten Personen und bei alltäglichen Aktivitäten). **Bitte lassen Sie keine Frage aus!**

Bitte beantworten Sie jede Frage und kreuzen Sie nur eine Antwortmöglichkeit pro Frage an. Sollten Sie sich nicht entscheiden können, lassen Sie die Frage nicht aus. Kreuzen Sie die Antwortmöglichkeit an, die Ihnen noch am ehesten zutreffend erscheint. Denken Sie bei der Beantwortung der folgenden Fragen vor allem an das letzte halbe Jahr.

	niemals	selten	manchmal	häufig	immer
1. Zeigt er Interesse an anderen Kindern/Menschen?	0	1	2	3	4
2. Hat er Freunde?	0	1	2	3	4
3. Hat er irgendwelche besonderen Freunde, oder einen besten Freund?	0	1	2	3	4
4. Zeigt er Interesse an dem, was andere sagen oder interessant finden?	0	1	2	3	4
5. Versucht er Sie zu trösten, wenn Sie traurig oder verletzt sind?	0	1	2	3	4
6. Haben Sie den Eindruck, dass er mitbekommt, was andere Menschen denken, beabsichtigen oder sich vorstellen?	0	1	2	3	4
7. Hat er Schwierigkeiten, die Gefühle anderer zu verstehen?	0	1	2	3	4
8. Nimmt er die Bedürfnisse von anderen nicht wahr und/ oder ist diesen gegenüber unempfindlich?	0	1	2	3	4
9. Schaut er seinen Gesprächspartnern direkt ins Gesicht?	0	1	2	3	4
10. Kann er beispielsweise Freude, Trauer, Wut, Furcht mimisch ausdrücken?	0	1	2	3	4
11. Erkennt man an seinem Gesichtsausdruck wie es ihm geht?	0	1	2	3	4

Zwischensumme

A	B	C	D

	niemals	selten	manchmal	häufig	immer
12. Verwendet er auffällig wenig Gestik, um seine verbalen Äußerungen zu unterstreichen?	0	1	2	3	4
13. Ist sein Gesichtsausdruck gewöhnlich passend zu der jeweiligen Situation?	0	1	2	3	4
14. Sind seine Gefühlsäußerungen der jeweiligen Situation angemessen?	0	1	2	3	4
15. Ist er daran interessiert, dass Sie an seiner Freude teilnehmen (z.B. wenn ihm etwas gut gelungen ist)?	0	1	2	3	4
16. Erscheint er interessiert an den Kommentaren und Bemerkungen des Gesprächspartners?	0	1	2	3	4
17. Fragt er nach oder nimmt Stellung zu Gedanken oder Einstellungen des Gesprächspartners?	0	1	2	3	4
18. Ist seine Sprachmelodie sehr monoton, hat er eine sehr hohe Stimme oder ähnliches?	0	1	2	3	4
19. Ist seine Sprache übergenau oder pedantisch?	0	1	2	3	4
20. Spricht er förmlich oder wie ein wandelndes Wörterbuch?	0	1	2	3	4
21. Nimmt er alles sehr wörtlich?	0	1	2	3	4
22. Hat er Schwierigkeiten zu verstehen, wenn er verspottet oder gedemütigt wird oder wenn man sich über ihn lustig macht?	0	1	2	3	4
23. Hat er Schwierigkeiten, eine Konversation zu beginnen und weiterzuführen?	0	1	2	3	4
24. Stellt er häufig unangebrachte Fragen, die beispielsweise nicht zu der aktuellen Situation passen?	0	1	2	3	4
25. Redet er exzessiv über Lieblingsthemen, die bei anderen Personen nur von begrenztem Interesse sind?	0	1	2	3	4
26. Macht er unangemessene Bemerkungen, ohne sich bewusst zu sein, dass diese Bemerkungen verletzen könnten?	0	1	2	3	4
27. Beschäftigt er sich mit speziellen Gebieten oder Dingen in einer auffälligen Intensität oder Akzentsetzung?	0	1	2	3	4
28. Zeigt er ein überdurchschnittliches Wissen oder Fähigkeiten in einem speziellen Gebiet?	0	1	2	3	4

Zwischensumme

A	B	C	D

	niemals	selten	manchmal	häufig	immer
29. Liest er Bücher vorrangig zur Information, wie beispielsweise Lexika oder Sachbücher, ist aber wenig an altersgemäßen Abenteuergeschichten, Romane interessiert?	0	1	2	3	4
30. Gab es Dinge, die er in einer speziellen Weise oder Reihenfolge ausführen musste, oder Rituale, die Sie für ihn ausführen mussten?	0	1	2	3	4
31. Zeigt er eine starke Reaktion auf Veränderungen in seinem gewohnten alltäglichen Ablauf?	0	1	2	3	4
32. Wird er ängstlich oder panisch, wenn außerplanmäßige Ereignisse auftreten?	0	1	2	3	4
33. Zeigt er ungeschickte und unkoordinierte motorische Bewegungen?	0	1	2	3	4
34. Hat er einen merkwürdigen, auffälligen Gang?	0	1	2	3	4
35. Flattert/e er auffällig mit den Händen z.B. bei Aufregung?	0	1	2	3	4
36. Zeigt/e er andere auffällige Bewegungen, z.B. drehende Bewegungen oder wiederholtes Auf- und Abspringen oder Schaukeln mit den Armen?	0	1	2	3	4
37. Scheint er ein besonderes Interesse am Anblick, am Berühren, an Geräuschen, dem Geschmack oder am Geruch von Dingen oder Menschen zu haben?	0	1	2	3	4

Zwischensumme

A	B	C	D

Für manche Verhaltensweisen ist es sehr hilfreich, sich auf die Zeitspanne zwischen dem 4. und 5. Lebensjahr zu konzentrieren. Sie können sich vielleicht besser erinnern, wie Ihr Kind sich zu dieser Zeit verhalten hat, wenn Sie diese Zeit in Zusammenhang mit Schlüsselerlebnissen wie Kindergarten, Umzug, Weihnachten oder anderen wichtigen Ereignissen, die besonders unvergesslich für Sie als Familie waren, bringen.

Sollten Sie sich nicht entscheiden können, lassen Sie die Frage nicht aus. Kreuzen Sie die Antwortmöglichkeit an, die Ihnen noch am ehesten zutreffend erscheint.

	niemals	selten	manchmal	häufig	immer
38. Hat er im Alter von 4 bis 5 Jahren versucht, Sie zu trösten wenn Sie traurig oder verletzt waren?	0	1	2	3	4
39. Schien er im Alter von 4 bis 5 Jahren interessiert an anderen Kindern seiner Altersgruppe, die er nicht kannte?	0	1	2	3	4
40. Hat er im Alter von 4 bis 5 Jahren Ihnen gewöhnlich direkt in das Gesicht geschaut, wenn er etwas mit Ihnen gemacht oder mit Ihnen geredet hat?	0	1	2	3	4
41. Konnte er im Alter von 4 bis 5 Jahren Freude, Trauer, Wut, Furcht mimisch ausdrücken?	0	1	2	3	4
42. Konnte man im Gesicht erkennen wie es ihm ging, als er 4 bis 5 Jahre alt war?	0	1	2	3	4
43. Hat er im Alter von 4 bis 5 Jahren auf Dinge um ihn herum gezeigt, einfach um Sie auf etwas aufmerksam zu machen (nicht weil er etwas haben wollte)? Z.B. „Schau mal!", „Guck´ mal da!"	0	1	2	3	4
44. Hat er im Alter von 4 bis 5 Jahren zurück gelächelt, wenn er von jemandem angelächelt wurde?	0	1	2	3	4
45. Hat er im Alter von 4 bis 5 Jahren Ihnen angeboten, Dinge mit Ihnen zu teilen (z.B. Essen oder Spielsachen)?	0	1	2	3	4
46. Schien er im Alter von 4 bis 5 Jahren daran interessiert, dass Sie an seiner Freude teilnehmen (z.B. wenn ihm etwas gut gelungen ist)?	0	1	2	3	4
47. Hat er im Alter von 4 bis 5 Jahren, Sie oder andere Personen spontan nachgeahmt (wie z.B. Kochen, Gartenarbeit, Sachen reparieren)?	0	1	2	3	4
48. Hat er sich im Alter von 4 bis 5 Jahren spontan an Gruppenspielen mit anderen Kindern beteiligt?	0	1	2	3	4
49. Spielte er im Alter von 4 bis 5 Jahren ausgedachte Spiele mit anderen Kindern im Sinne von imaginären Spielen („So tun als ob") oder Rollenspielen (z.B. „Mutter-Vater-Kind")?	0	1	2	3	4
50. Spielte er im Alter von 4 bis 5 Jahren kooperativ bei Spielen mit, bei denen man mit anderen Kindern eine Gruppe bilden muss, wie z.B. Verstecken oder Ballspiele?	0	1	2	3	4
51. Schien er im Alter von 4 bis 5 Jahren mehr an einem bestimmten Teil eines Spielzeugs interessiert (z.B. die Räder eines Autos drehen) oder eines Gegenstandes, als daran, das Objekt für seinen eigentlichen Zweck zu nutzen oder damit zu spielen?	0	1	2	3	4

Zwischensumme

A	B	C	D

	Ja, trifft zu	Nein, trifft nicht zu
52. War Ihr Kind zwei Jahre oder älter als es die ersten Wörter gesprochen hat?	☐	☐
53. War er drei Jahre oder älter, als er anfing erste sinnhafte kleine Sätze (3 bis 4 Wörter) zu bilden?	☐	☐
54. Wiederholte er jemals häufig Wörter oder Sätze immer wieder, direkt nachdem er es gehört hatte (z.B. wie ein Echo das letzte Wort, das Sie gesagt haben)?	☐	☐
55. Wiederholt er zur Zeit und/oder wiederholte er als er jünger war häufig Wörter oder Sätze (echohaft) immer wieder, nachdem er sie irgendwann einmal gehört hatte?	☐	☐
56. Verwechselt er zur Zeit oder verwechselte er früher die persönlichen Fürworter, das heißt, „du" oder „er" zu sagen anstelle von „ich"?	☐	☐
57. Hat er jemals Wörter benutzt, die er selber erfunden hat, (z.B. „heißer Regen" statt „Dampf")	☐	☐

Bitte überprüfen Sie noch einmal, ob Sie alle Fragen beantwortet haben.
Vielen Dank!

	A	B	C	D
Zwischensumme				
Gesamt				

Appendix 20   Questionnaire SDQ Parents Second Study (German)

Fragebogen zu Stärken und Schwächen (SDQ-Deu)   Eltern 4-16

Bitte markieren Sie zu jedem Punkt "Nicht zutreffend", "Teilweise zutreffend" oder "Eindeutig zutreffend". Beantworten Sie bitte alle Fragen so gut Sie können, selbst wenn Sie sich nicht ganz sicher sind oder Ihnen eine Frage merkwürdig vorkommt. Bitte berücksichtigen Sie bei der Antwort das Verhalten Ihres Kindes in den letzten sechs Monaten.

Name des Kindes ....   Männlich/Weiblich

Geburtsdatum ....

	Nicht zutreffen	Teilweise zutreffend	Eindeutig zutreffend
Rücksichtsvoll	☐	☐	☐
Unruhig, überaktiv, kann nicht lange stillsitzen	☐	☐	☐
Klagt häufig über Kopfschmerzen, Bauchschmerzen oder Übelkeit	☐	☐	☐
Teilt gerne mit anderen Kindern (Süssigkeiten, Spielzeug, Buntstifte usw.)	☐	☐	☐
Hat oft Wutanfälle; ist aufbrausend	☐	☐	☐
Einzelgänger; spielt meist alleine	☐	☐	☐
Im allgemeinen folgsam; macht meist, was Erwachsene verlangen	☐	☐	☐
Hat viele Sorgen; erscheint häufig bedrückt	☐	☐	☐
Hilfsbereit, wenn andere verletzt, krank oder betrübt sind	☐	☐	☐
Ständig zappelig	☐	☐	☐
Hat wenigstens einen guten Freund oder eine gute Freundin	☐	☐	☐
Streitet sich oft mit anderen Kindern oder schikaniert sie	☐	☐	☐
Oft unglücklich oder niedergeschlagen; weint häufig	☐	☐	☐
Im allgemeinen bei anderen Kindern beliebt	☐	☐	☐
Leicht ablenkbar, unkonzentriert	☐	☐	☐
Nervös oder anklammernd in neuen Situationen; verliert leicht das Selbstvertrauen	☐	☐	☐
Lieb zu jüngeren Kindern	☐	☐	☐
Lügt oder mogelt häufig	☐	☐	☐
Wird von anderen gehänselt oder schikaniert	☐	☐	☐
Hilft anderen oft freiwillig (Eltern, Lehrern oder anderen Kindern)	☐	☐	☐
Denkt nach, bevor er/sie handelt	☐	☐	☐
Stiehlt zu Hause, in der Schule oder anderswo	☐	☐	☐
Kommt besser mit Erwachsenen aus als mit anderen Kindern	☐	☐	☐
Hat viele Ängste; fürchtet sich leicht	☐	☐	☐
Führt Aufgaben zu Ende; gute Konzentrationsspanne	☐	☐	☐

Gibt es noch etwas, das Sie erwähnen möchten?

Bitte umblättern

Würden Sie sagen, dass dieses Kind insgesamt gesehen in einem oder mehreren der folgenden Bereiche Schwierigkeiten hat: Stimmung, Konzentration, Verhalten, Umgang mit Anderen?

	Nein	Ja, leichte Schwierigkeiten	Ja, deutliche Schwierigkeiten	Ja, massive Schwierigkeiten
	☐	☐	☐	☐

Falls Sie diese Frage mit "Ja" beantwortet haben, beantworten Sie bitte auch die folgenden Punkte:

• Seit wann gibt es diese Schwierigkeiten?

	Weniger als einen Monat	1-5 Monate	6-12 Monate	Über ein Jahr
	☐	☐	☐	☐

• Leidet das Kind unter diesen Schwierigkeiten?

	Gar nicht	Kaum	Deutlich	Massiv
	☐	☐	☐	☐

• Wird das Kind durch diese Schwierigkeiten in einem der folgenden Bereiche beeinträchtigt?

	Gar nicht	Kaum	Deutlich	Schwer
MIT FREUNDEN	☐	☐	☐	☐
IM UNTERRICHT	☐	☐	☐	☐

• Stellen die Schwierigkeiten eine Belastung für Sie oder die gesamte Klasse dar?

	Keine Belastung	Leichte Belastung	Deutliche Belastung	Schwere Belastung
	☐	☐	☐	☐

Unterschrift:...   Datum: ....

Anzahl der wöchentlichen Klassenstunden mit diesem Kind?

Vielen Dank für Ihre Hilfe

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Appendix 21   Questionnaire SDQ Therapist Second Study (German)

Fragebogen zu Stärken und Schwächen (SDQ-Deu) Lehrer [4-16]

Bitte markieren Sie zu jedem Punkt "Nicht zutreffend", "Teilweise zutreffend" oder "Eindeutig zutreffend". Beantworten Sie bitte alle Fragen so gut Sie können, selbst wenn Sie sich nicht ganz sicher sind oder Ihnen eine Frage merkwürdig vorkommt. Bitte berücksichtigen Sie bei der Antwort das Verhalten des Kindes in diesem Schuljahr.

Name des Kindes ....   Männlich/Weiblich

Geburtsdatum ....

	Nicht zutreffen	Teilweise zutreffend	Eindeutig zutreffend
Rücksichtsvoll	☐	☐	☐
Unruhig, überaktiv, kann nicht lange stillsitzen	☐	☐	☐
Klagt häufig über Kopfschmerzen, Bauchschmerzen oder Übelkeit	☐	☐	☐
Teilt gerne mit anderen Kindern (Süssigkeiten, Spielzeug, Buntstifte usw.)	☐	☐	☐
Hat oft Wutanfälle; ist aufbrausend	☐	☐	☐
Einzelgänger; spielt meist alleine	☐	☐	☐
Im allgemeinen folgsam; macht meist, was Erwachsene verlangen	☐	☐	☐
Hat viele Sorgen; erscheint häufig bedrückt	☐	☐	☐
Hilfsbereit, wenn andere verletzt, krank oder betrübt sind	☐	☐	☐
Ständig zappelig	☐	☐	☐
Hat wenigstens einen guten Freund oder eine gute Freundin	☐	☐	☐
Streitet sich oft mit anderen Kindern oder schikaniert sie	☐	☐	☐
Oft unglücklich oder niedergeschlagen; weint häufig	☐	☐	☐
Im allgemeinen bei anderen Kindern beliebt	☐	☐	☐
Leicht ablenkbar, unkonzentriert	☐	☐	☐
Nervös oder anklammernd in neuen Situationen; verliert leicht das Selbstvertrauen	☐	☐	☐
Lieb zu jüngeren Kindern	☐	☐	☐
Lügt oder mogelt häufig	☐	☐	☐
Wird von anderen gehänselt oder schikaniert	☐	☐	☐
Hilft anderen oft freiwillig (Eltern, Lehrern oder anderen Kindern)	☐	☐	☐
Denkt nach, bevor er/sie handelt	☐	☐	☐
Stiehlt zu Hause, in der Schule oder anderswo	☐	☐	☐
Kommt besser mit Erwachsenen aus als mit anderen Kindern	☐	☐	☐
Hat viele Ängste; fürchtet sich leicht	☐	☐	☐
Führt Aufgaben zu Ende; gute Konzentrationsspanne	☐	☐	☐

Gibt es noch etwas, das Sie erwähnen möchten?

Bitte umblättern

Würden Sie sagen, dass dieses Kind insgesamt gesehen in einem oder mehreren der folgenden Bereiche Schwierigkeiten hat: Stimmung, Konzentration, Verhalten, Umgang mit Anderen?

	Nein	Ja, leichte Schwierigkeiten	Ja, deutliche Schwierigkeiten	Ja, massive Schwierigkeiten
	☐	☐	☐	☐

Falls Sie diese Frage mit "Ja" beantwortet haben, beantworten Sie bitte auch die folgenden Punkte:

• Seit wann gibt es diese Schwierigkeiten?

	Weniger als einen Monat	1-5 Monate	6-12 Monate	Über ein Jahr
	☐	☐	☐	☐

• Leidet das Kind unter diesen Schwierigkeiten?

	Gar nicht	Kaum	Deutlich	Massiv
	☐	☐	☐	☐

• Wird das Kind durch diese Schwierigkeiten in einem der folgenden Bereiche beeinträchtigt?

	Gar nicht	Kaum	Deutlich	Schwer
MIT FREUNDEN	☐	☐	☐	☐
IM UNTERRICHT	☐	☐	☐	☐

• Stellen die Schwierigkeiten eine Belastung für Sie oder die gesamte Klasse dar?

	Keine Belastung	Leichte Belastung	Deutliche Belastung	Schwere Belastung
	☐	☐	☐	☐

Unterschrift:.. Datum: ....

Anzahl der wöchentlichen Klassenstunden mit diesem Kind?

Vielen Dank für Ihre Hilfe   © Robert Goodman, 2005

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Appendix 22   Questionnaire SDQ Child Second Study (German)

Fragebogen zu Stärken und Schwächen (SDQ-Deu)

Bitte markiere zu jedem Punkt "Nicht zutreffend", "Teilweise zutreffend" oder "Eindeutig zutreffend". Beantworte bitte alle Fragen so gut Du kannst, selbst wenn Du Dir nicht ganz sicher bist oder Dir eine Frage merkwürdig vorkommt. Überlege bitte bei der Antwort, wie es Dir im letzten halben Jahr ging.

Dein Name ....   Männlich/Weiblich

Geburtsdatum ....

	Nicht zutreffen	Teilweise zutreffend	Eindeutig zutreffend
Ich versuche, nett zu anderen Menschen zu sein, ihre Gefühle sind mir wichtig	☐	☐	☐
Ich bin oft unruhig; ich kann nicht lange stillsitzen	☐	☐	☐
Ich habe häufig Kopfschmerzen oder Bauchschmerzen; mir wird oft schlecht	☐	☐	☐
Ich teile normalerweise mit Anderen (z. B. Süssigkeiten, Spielzeug, Buntstifte)	☐	☐	☐
Ich werde leicht wütend; ich verliere oft meine Beherrschung	☐	☐	☐
Ich bin meistens für mich alleine; ich beschäftige mich lieber mit mir selbst	☐	☐	☐
Normalerweise tue ich, was man mir sagt	☐	☐	☐
Ich mache mir häufig Sorgen	☐	☐	☐
Ich bin hilfsbereit, wenn andere verletzt, krank oder traurig sind	☐	☐	☐
Ich bin dauernd in Bewegung und zappelig	☐	☐	☐
Ich habe einen oder mehrere gute Freunde oder Freundinnen	☐	☐	☐
Ich schlage mich häufig; ich kann Andere zwingen zu tun, was ich will	☐	☐	☐
Ich bin oft unglücklich oder niedergeschlagen; ich muss häufig weinen	☐	☐	☐
Im allgemeinen bin ich bei Gleichaltrigen beliebt	☐	☐	☐
Ich lasse mich leicht ablenken; ich finde es schwer, mich zu konzentrieren	☐	☐	☐
Neue Situationen machen mich nervös; ich verliere leicht das Selbstvertrauen	☐	☐	☐
Ich bin nett zu jüngeren Kindern	☐	☐	☐
Andere behaupten oft, dass ich lüge oder mogele	☐	☐	☐
Ich werde von anderen gehänselt oder schikaniert	☐	☐	☐
Ich helfe anderen oft freiwillig (Eltern, Lehrern oder Gleichaltrigen)	☐	☐	☐
Ich denke nach, bevor ich handele	☐	☐	☐
Ich nehme Dinge, die mir nicht gehören (von zu Hause, in der Schule oder anderswo)	☐	☐	☐
Ich komme besser mit Erwachsenen aus als mit Gleichaltrigen	☐	☐	☐
Ich habe viele Ängste; ich fürchte mich leicht	☐	☐	☐
Was ich angefangen habe, mache ich zu Ende; ich kann mich lange genug konzentrieren	☐	☐	☐

Unterschrift ....   Datum ....

Vielen Dank für Deine Hilfe

Appendix 23   Vocabulary Test WS/ZF-R (German)

Wortschatz – Testheft Form A _____ WS/ZF-R

Name: _____

Geb. Datum:
(Monat/Jahr) _____

Schule: _____ Klasse: _____

Alter:
(Jahre/Monate) _____

Schulart: _____

Testdatum: _____

Schulort: _____

Muttersprache: _____

Übungsbeispiele:

Erstes Beispiel

Acker   a) Pferd   b) Traktor   c) Landwirt   d) Feld   e) Kartoffel

In dieser Reihe ist „Feld" die richtige Lösung, weil es am ehesten das gleiche bedeutet wie „Acker". Deshalb streicht ihr den Buchstaben d) durch.

Zweites Beispiel

Moped   a) Verkehr   b) Führerschein   c) Kraftfahrzeug   d) Motor   e) Fahrrad

Drittes Beispiel

rein   a) gelb   b) sauber   c) kalt   d) durchsichtig   e) sparsam

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Auf der folgenden Seite findet ihr 30 Wörter-Aufgaben. Dabei sollt ihr immer das eine Wort herausfinden, welches die gleiche oder eine sehr ähnliche Bedeutung hat, wie das linke Wort.

AUSWERTUNG

	RW	Alter				Schulart			Bemerkungen
		T	PR	IQ		T	PR	IQ	
Wortschatz									
Zahlenfolgen (12')									
Zahlenfolgen (16'–20')									

Bitte nicht umblättern bevor dazu aufgefordert wird!

Wortschatz – Testheft Form A

AUFGABEN	ANTWORTEN
1) *Besteck*	a) Hecke b) Löffel c) Steckdose d) Teller e) Hindernis
2) *Bluse*	a) Hemd b) Wind c) Anzug d) Apparat e) Stärke
3) *Laune*	a) Zauberei b) Verständnis c) Krankheit d) Traum e) Stimmung
4) *informieren*	a) zusammenstellen b) verändern c) Auskunft geben d) aufpassen e) genehmigen
5) *Garderobe*	a) Fahrzeug b) Kirche c) Truppe d) Kleideraufbewahrung e) Gegensatz
6) *Prozess*	a) Gebühr b) Umzug c) Rechtsstreit d) Schöffe e) Fund
7) *Patient*	a) Kranker b) Gruppe c) Pille d) Verwandter e) Kunde
8) *Schal*	a) Möbel b) Raubtier c) Halstuch d) Mantel e) König
9) *Zweifel*	a) Ärger b) Unsicherheit c) Vertrauen d) Gewissen e) Hoffnung
10) *Phantasie*	a) Form b) Grundsatz c) Trugbild d) Vorstellungsgabe e) Verstand
11) *Anwalt*	a) Scheidung b) Landschaft c) Gehalt d) Ansicht e) Verteidiger
12) *Miete*	a) Wohnung b) Schwäche c) Haus d) Geldbetrag e) Gewinn
13) *Athlet*	a) Maske b) Gewicht c) Bergkuppe d) Komiker e) Sportler
14) *Paragraph*	a) Schreibzeug b) Gesetzesabschnitt c) südamerikanisches Land d) Erklärung e) Gegensatz
15) *Symphonie*	a) Zusammenfassung b) Versammlungshaus c) Takt d) Musikstück e) Zuneigung
16) *Bewusstsein*	a) Wachheit b) Religion c) Schlaf d) Geiz e) Gewissen
17) *Vergnügen*	a) Schönheit b) Bequemlichkeit c) Freude d) Bescheidenheit e) Liebe
18) *Rabatt*	a) Empfangsbescheinigung b) Menge c) Begrenzung d) Briefmarke e) Preisnachlass
19) *Aggression*	a) Angriff b) Strafe c) Verteidigung d) Hoffnung e) Hemmung
20) *Genuss*	a) Kunst b) Sucht c) Honig d) Abenteuer e) Wohlbehagen
21) *Urteil*	a) Ergebnis b) Hinweis c) Schiedsspruch d) Abneigung e) Neid
22) *Existenz*	a) Vertrauen b) Dasein c) Gewinn d) Ansicht e) Verbannung
23) *Resultat*	a) Schwingung b) Vortrag c) Ausweisung d) Ergebnis e) Wiederherstellung
24) *Chaos*	a) Durcheinander b) Beschädigung c) Währung d) Ärger e) Demonstration
25) *Sehnsucht*	a) Liebe b) Gewinn c) Wunsch d) Freude e) Glück
26) *Charakter*	a) Anmut b) Unzuverlässigkeit c) Fleiß d) Eigenart e) Kategorie
27) *konsumieren*	a) genießen b) verbrauchen c) süchtig d) versuchen e) zusammenzählen
28) *Droge*	a) Betäubungsmittel b) Reitertruppe c) Apotheke d) Getreide e) Spritze
29) *ironisch*	a) böse b) spöttisch c) uneinig d) humorvoll e) einfühlsam
30) *dementieren*	a) abordnen b) zurücktreten c) vorführen d) zerstören e) widerrufen

RW

Appendix 24   Description of attached USB Content

Please find the following data on the attached USB flash drive:

- **Finished Prototype:** The finished prototype of the game "Invasion of the Wrong Planet" (runs on Samsung SUR40 with Microsoft Pixelsense)
- **Presentation Videos:**
  - ➢ **"InvasionOfTheWrongPlanet_Presentation_V1.avi":** A presentation video of the system with grown-ups
  - ➢ **"InvasionOfTheWrongPlanet_Presentation_V2.mp4":** A presentation video of the system with normally developed children (FOR ACADEMIC PURPOSES ONLY! DO NOT PUBLISH OR SHOW TO THIRD PARTIES)
- **Previous Work:**
  - ➢ **"Ausarbeitung Bachelorseminar_2_26_2012.docx":** Analysis of the field of research and related work (German)
  - ➢ **"Bachelorprojekt_2_4_2013.docx":** Technical description of the development process (German)
  - ➢ **"InvasionOfTheWrongPlanet_CHI2013.docx":** Works-In-Progress Paper presented at CHI Conference in Paris 2013
- **Project Development:**
  - ➢ **Interviews Audio Recordings:** Audio recordings from interviews with Andreas Targan, Katharina Lilje and Andreas Wacker
  - ➢ **Interviews Questionnaire:** Discussion guides for the interviews
  - ➢ **Interviews Project Proposals:** Two proposals for possible projects - "Krimikry" (detective puzzle game) and "Invasion" (cosmic shooter)
  - ➢ **Token Development:** Pictures of plasticine models designed by an eight-year old child and corresponding technical drawings of this model (AutoCAD, Inventor)
- **Study:**
  - ➢ **Documents:** All documents needed for conduction of both studies
  - ➢ **Heat Maps:** Visualization of movement information from both studies, derived from the logging data
  - ➢ **LogData:** Logging data of both studies as described in chapter 4.3
  - ➢ **Video Recordings:** Video recordings of both studies, downscaled (FOR ACADEMIC PURPOSES ONLY! DO NOT PUBLISH OR SHOW TO THIRD PARTIES)
  - ➢ **"Data and Results.xlsx":** The Excel file for analysis of the logging data, contains logging data, results from questionnaires and all information from both studies
- **"Bachelorthesis_7_25_2013.docx":** The digital form of this thesis
- **"Contents.txt":** A description of contents