Bachelor Thesis


THE USE OF GAMIFICATION IN
INTERVENTIONS FOR CHILDREN WITH
AUTISM: A SYSTEMATIC REVIEW

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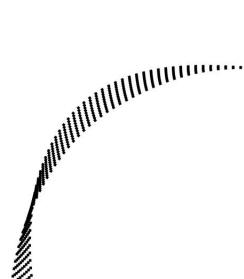
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# Abstract

*Introduction*

Technology is applied regularly in mental health care. One way to do so, is the use of gamification; applying game design elements in non-gaming contexts. Autism is a developmental disorder that is fairly common and creates severe difficulties for patients. The current treatment for children with ASD is intensive, and some parts of this treatment can potentially be executed using gamification. The aim of this review is to create an overview of the existing interventions for children with autism using gaming or game-elements. Furthermore, the goal is to evaluate whether or not these games or game-elements could be effective in treating children with autism and to assess whether or not this could potentially be used as (part of) a treatment program for children with ASD.

*Methods*

This review is a continuation of previous research conducted by other students from the University of Twente in 2013. They created a database containing 362 articles by collecting scientific information regarding the use of gamification in healthcare. The research that is now presented continues by collecting literature within this database. Inclusion criteria were keywords "Autism", "Asperger", "Children", "Adolescents" and "Young Adults". Furthermore, articles were excluded if they did not propose a game developed specifically for children with ASD, did not propose an intervention and/or did not present any (preliminary) results. This resulted in seven articles to be reviewed. The articles were compared based on game characteristics, intervention characteristics and the effectiveness of the intervention.

*Results*

The reviewed interventions vary in both game characteristics and intervention characteristics. Most of them are designed for PC or tablet, and most are focused on training social skills. The effectivity is often unknown, but most interventions seem promising.

*Conclusion*

The use of gamification for children with ASD seems promising, but there has to be more research concerning the effectiveness of the interventions to be able to assess the usability of the interventions as (part of) a treatment program for children with ASD.

# Introduction

*Technology and gamification*

The role of technology in our lives grows fast. Especially in healthcare, technologies nowadays have a very important role, and has been proven to be helpful (Watbled, 2009; Øvreveit et al., 2007). One way in which technology can be used in healthcare, both for professionals and patients, is gamification. Deterding et al. (2011) defined gamification as "the use of gamedesign elements in non-game contexts". This refers to videogames, which are computer programmes designed to entertain, and are based on the interaction between the individual and the device used to play the game (Aparicio et al., 2012). Specifically, 'games with a purpose', games that are designed to educate people or change behaviour, have been proven to improve health by integrating software design and gaming elements with treatment of people with a variety of diseases, risks or unhealthy behaviours (King et al., 2013). The difference between "serious games" and gamification, is that in serious games, a game is provided to serve a certain goal. In gamification, however, elements associated with gamedesign have been used (Deterding et al., 2011; King et al., 2013).

There are two main areas of serious gaming in health care: for health care professionals or health care students, or directly for patients (De Wit-Zuurendonk & Oei, 2011). Gamification can not only be used as a treatment, but there are serious games that, for example, prevent obesity and type 2 diabetes by educating potential patients about nutrition and exercise (de Wit-Zuurendonk & Oei, 2011). Gamification can also be applied in mental healthcare. An example of gamification in mental healthcare is treating autism by letting children with an Autism Spectrum Disorder (ASD) play educational games, teaching them social skills, emotion recognition, or other skills they find difficult (Tanaka et al, 2010; Hiniker et al, 2013; Kandalaft et al, 2012; Beaumont & Sofronoff, 2008; de Silva et al, 2007; Yan, 2011; Cai et al, 2013). This is the focus of this review.

There are several advantages to gamification. First of all, characteristics of gaming in general (fun and interactive) have a positive influence on participation and engagement (Aparicio et al, 2012; Singh, 2012). Secondly, because the patients that play the games are motivated intrinsically, gamification can motivate people to do certain activities which they usually don't particularly like to do (Aparicio et al,2012; King et al, 2013; Singh, 2012; Andrade & de Carvalho, 2013). Furthermore, the learning process is optimized and maximized because of the engagement environment and because information is provided both visually and verbally. Finally, the players 'Learn by doing', which can improve teamwork, social skills, leadership and collaboration (de Wit-Zuurendonk & Oei, 2011; Mayer, 1997; Andrade & Carvalho, 2013). However, disadvantages have been named regarding gamification. One fairly common opinion is that using this type of technology is expensive (Watbled et al, 2009). Others claim that because of its recent

development, it has not been tested enough, since there has not been enough time to evaluate long term effects of this type of intervention (Hiniker et al, 2013; Kandalaft et al, 2012; Yan, 2011). Because of these varied opinions, the general aim of this review is to create an overview of and evaluate the effectiveness of the existing interventions that apply gamification in mental health care. Since Autism is a developmental disorder that presents children with many challenges, this review is specifically focused on interventions designed for children with ASD. It is of interest to investigate, by evaluating the effectiveness of the intervention, whether or not these interventions can be used as (part of) a treatment for children with ASD.

*Autism Spectrum Disorder*

Mental illness is currently one of the greatest social and economic challenges worldwide (WHO, 2008). With this being such a big challenge, it is no surprise that innovations used in regular healthcare are also translated to mental healthcare. For example, video games can be helpful in developing social and spatial ability skills for children with a learning disability or developmental problems. One of these problems is autism, a mental developmental disorder which affects many young people and is fairly common: in 2010, 60 to 100 in every 10.000 people suffered from some type of Autism (Trimbos, 2010). There are different types of autism, but they all have some aspects and symptoms in common. These different kinds of autism are commonly called Autism Spectrum Disorder (ASD). These disorders are associated with 'Theory of Mind', the ability to explain one's own and other people's actions in terms of beliefs, desires and goals (Baron-Cohen, 1995). Whereas people in general tend to do this naturally, individuals with ASD have difficulty understanding other people's intentions and beliefs. Many of the symptoms of ASD are associated with these types of difficulties (Baron-Cohen, 1995).

Following this Theory of Mind, there are three main symptoms that all types of ASD have in common. The first symptom is a significant impairment in the social interaction, shown in an impaired ability to both use and understand non-verbal communications and emotions. Associated problems are difficulties developing new relationships and an inability to spontaneously show and share interest in others. Secondly, individuals with ASD have an impairment in social communication. Problems associated with this are a delay in developing language without non-verbal compensation, problems with starting and maintaining conversations, lack of imaginative play and a repetitive and stereotyped use of language. Finally, individuals with ASD have a restricted repertoire of behaviours, interests and activities. This means that individuals with ASD tend to over focus on certain topics that they are very interested in, and that they have a tendency to develop non-functional routines with certain stereotyped motor mannerisms and sensory abnormalities such as hypo- or hypersensitivity (Charman & Baird, 2002).

*Current treatment of Autism Spectrum Disorder*

When looking at gamification as a way to assist children with ASD or even as a complete treatment or therapy, it might be interesting to research the way ASD is usually treated nowadays. ASD's are often

diagnosed at a very young age (Cox et al, 1999; Stone et al, 1999), which means that the treatment has to relate to the world of a young child (Charman & Baird, 2002). What makes treating ASD's difficult at any age, whether they are young children or adolescents, is the fact that there are significant differences between the patients. This is due to the fact that they all have different levels of cognitive and language skills (Lord & Bishop, 2010).  This means that the treatment has to be developed accordingly, based on how severely the patient is influenced by the disorder (Lord & Bishop, 2010).  Treatment of children with autism spectrum disorder is mainly focused on three aspects: making the children more socially involved, treating behavioural problems and treating anxiety (Bauminger, 2000; Bergman & Gerdtz, 1997; Hare, 1997; Szymanski et al, 1998). There are three main types of interventions to treat ASD: Focused intervention practices, comprehensive treatment and psychopharmalogical treatment (National Autism Center, 2009; Odom et al, 2010; Szymanski et al, 1998). Focused interventions are designed specifically to address one type of behaviour in a relatively short period of time. Comprehensive treatments are a set of practices, which are designed to address various aspects of the ASD. These treatments are intensive and take a lot of time and effort (Handleman & Harris, 2008; Odom et al, 2010), which makes it worthwhile to explore another option. Since gamification can be used to alter behaviour and educate people (de Wit-Zuurendonk & Oei, 2011), it can potentially also be used to teach children with ASD new, useful patterns of behaviour. Furthermore, gamification can be used to train social skills and collaboration to children in a fun way in which they learn by doing (Andade & de Carvalho, 2013). This makes gamification a potentially suitable way to treat or assist children with an ASD.

Different interventions using gamification in mental health care, and specifically for children with ASD, have already been developed (Tanaka et al, 2010; Hiniker et al, 2013; Kandalaft et al, 2012; Beaumont & Sofronoff, 2008; de Silva et al, 2007; Yan, 2011; Cai et al, 2013). These interventions focus on different types of autism, are executed on different devices and are varied in duration. Furthermore, there are interventions focused on different symptoms the patients may experience, such as social impairments or difficulty recognizing emotion in others. Thus, there is a large variety in the interventions that are momentarily available. Several advantages and disadvantages of gamification in mental healthcare and in general have been named in the previous text. The variety of interventions and the mixed opinions about the use of gamification make it desirable to create a complete overview of the literature on this subject. Looking at the interventions that already have been made and comparing these interventions, will show as accurately as possible the research that has already been carried out. Because of the severe difficulties children with ASD have to face, this review is also aimed at assessing the usability of gamification as (part of) a treatment for children with ASD. The literature will be compared based on 1) the characteristics of the game that has been developed, 2) the characteristics of the intervention that has been proposed and 3) the effectiveness of the intervention.

The interventions that exist will be compared based on the following research questions and sub-questions:

1. Which game characteristics are present in the momentarily available interventions using gamification for children with ASD?

- What platform or device is used to execute the game that is (part of) the intervention?
- How does the player progress through the game?
- What skill does the game train?
- Which gamedesign elements are used?

2. What are the characteristics of the momentarily available interventions using gamification for children with ASD?

- What is the target group of the intervention?
- What is the duration of the intervention?
- What study design is used to evaluate the intervention?
- Which tests are used in the intervention?
- Of what elements does the intervention consist? (e.g. group sessions, playing individually)

3. How effective are the interventions that are momentarily available using gamification for children with ASD?

# Method

*Search Strategy*

*Phase 1*

This review is a continuation of previous research conducted by other students from the University of Twente in 2013. They researched the use of gamification in healthcare, collecting scientific information and creating a database for later research into this subject. Their goal was to gain insight into how games and gamification can be integrated in health related interventions. To do so, they used four scientific databases: PsycINFO, ScienceDirect, SciVerse Scopus and Web of Knowledge. They created four constructs, each consisting of several related keywords: (1) the "technical construct", including terms from the technical sector, (2) the "game construct", including terms that ensured the use of some kind of game in the intervention, (3) the "health construct", including medical terms to ensure that the interventions were aimed

at maintaining or improving health and (4) the "procedure construct", including the terms "therapy" and "intervention" to ensure a description or proposition of some kind of intervention in the literature. A combined search was then executed, meaning that the yielded articles included at least of the terms from each of the previously mentioned construct. This was too ensure that the search covered a broad range of studies holding relevant information to this topic. This initially led to 4556 articles that were relevant in terms of the search construct. After removing duplicate articles, 3205 publications remained. These remaining articles were screened with regard to the relevance of the content. The criteria for the inclusion of the publication were as follows:

1. The articles had to include some form of intervention, application or therapy approach;
2. The included intervention was aimed at patients or people with health issues;
3. The intervention was aimed at the promotion of such health issues;
4. The intervention had to work with some form of game or at least with game elements; and
5. The intervention was made available by digital means.

Articles were excluded if they:

1. Included no information about the design of the interventions/application/therapy or,
2. If they were reviews, which means they included no discrete research (Knüwer, 2013)

After screening the 3205 publication using these criteria, 362 articles remained that were relevant and fulfilled the requirements.

*Phase 2*
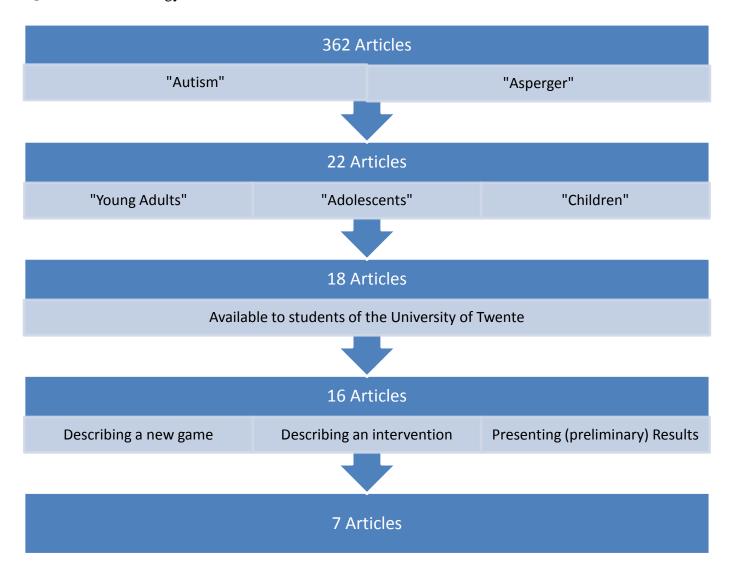
Continuing with this database with 362 articles about gamification in healthcare, the ones that were useful for this review of literature were derived.

Articles were included if they:

1. The keywords "Autism" and/or "Asperger" were present in either the title or abstract,
2. The keywords "Adolescent(s)", "Children" or "Young adults" were present in either the title or abstract,
3. The articles were available for the University of Twente,
4. The article described a newly developed game, found in the "methods" section of the article,
5. The article proposed an intervention, also found in the "methods section of the article, and
6. The article presented some (preliminary) results, found in the "results", "conclusion" or "discussion" section of the article.

The keyword "Autism" resulted in 21 articles. The keyword "Asperger" resulted in 3 articles, one of which was not included in the "autism" search. Adding this to the articles with the "autism" keyword resulted in 22 articles about ASD. Because ASD is often diagnosed at a young age, the decision was made to focus on children and adolescents, leaving 18 articles to use for this review. Since not all articles were available, 16 articles remained to be reviewed. Excluding the articles that did not describe a newly developed game, meaning they used an existing game that was not modified to fit children with ASD, and also articles that did not propose an intervention and/or did not present any (preliminary) results, left seven articles to be reviewed. This search strategy is shown in figure 1.

*Figure 1*  Search Strategy

| 362 Articles | |
| --- | --- |
| "Autism" | "Asperger" |

| 22 Articles | | |
| --- | --- | --- |
| "Young Adults" | "Adolescents" | "Children" |

| 18 Articles |
| --- |
| Available to students of the University of Twente |

| 16 Articles | | |
| --- | --- | --- |
| Describing a new game | Describing an intervention | Presenting (preliminary) Results |

| 7 Articles |
| --- |

## Data Extraction

The interventions that were used in this research, were compared based on the game characteristics, the intervention characteristics and the effectiveness of the intervention.

### Game Characteristics

First of all, a short summary of each game is presented. To compare the game characteristics of the reviewed interventions, they will be evaluated based on the platform used, the way the player progresses through the game, the skill the game is supposed to train and the gaming aspects that are used in the game.

### Summary

The summary that is presented of each game contains a short description of the storyline or purpose of the developed game. The information used for these summaries is found in the "methods" sections of the reviewed literature.

### Platform

De platform is the device used to execute the game. This information is typically found in the "methods" sections of the reviewed literature, and will be displayed in a table in the results section of this review.

### Progressing through the game

The way the player progresses through the game includes the use of minigames and levelling or one storyline the player has to follow. This, too, is typically found in the methods section of the reviewed articles and found by looking for the following keywords: "minigame", "storyline", "level" and "progress". This is presented in a table in the results section of this review, where the options "single storyline", "minigames" and "leveling" are either checked or not. If neither is present or mentioned in the article, it is considered to be a single storyline.

### Trained skill

The skills that are trained with the game are not always found in the same section of the literature, although they are often found in the introduction as the goal of the research. Keywords such as "skill" or "ability" and "aimed at improving" or synonyms of these keywords are important. The trained skills are displayed in a table in the results section of this review, where the used skills are checked if the game is aimed at that specific skill. Social skills, one of the options, also includes nonverbal communication. Emotion recognition and expression of emotion are considered to be part of the same skill in this review, and are therefore checked in the same column in the table.

### Gamedesign elements

Because of the variety in this category, an instrument is applied to present a structured overview. Reeves and

Read (2009) created the "ten ingredients of great games". The methods in the reviewed literature have been coded accordingly. To review the code for the ingredients, see table 1. In the results section of this review, the used ingredients are checked in a table. If it was unknown whether or not an ingredient was present (in case it was not mentioned), it is listed as not present in the table.

Table 1.1

*Code scheme for "ten ingredients of great games"*

| Code | Ingredient of great games |
| --- | --- |
| 1 | Self-Representations with Avatars |
| 2 | Three-Dimensional Environments |
| 3 | Narrative Context |
| 4 | Feedback |
| 5 | Reputations, Ranks and Levels |
| 6 | Marketplace and Economies |
| 7 | Competition under Rules that are Explicit and Enforced |
| 8 | Teams |
| 9 | Parallel Communication Systems |
| 10 | Time Pressure |

*Intervention Characteristics*

The intervention characteristics are compared based on the target group, the duration of the intervention, the study design, the tests used and the elements of the intervention.

*Target group*

The target groups for the different interventions are presented in a table. The information used for this table is typically found in the title of the article. If not, it is likely to be mentioned in the abstract.

*Duration*

The duration of the intervention is typically found in the methods sections of the literature, by looking for keywords "month", "week", "duration", "length" and synonyms of these keywords. This, too, is presented in a table. Not every article mentioned a specific duration for the proposed intervention; in these cases, it is listed in the table as "not specified".

*Study Design*

Some articles were not clear about the study design used in testing their intervention. If those cases, the design most similar to what the researchers executed, is listed in the table. Evaluation from a therapist, parent or teacher, is considered a pre-test or a post-test (depending on whether it is executed before or after the intervention), making those types of studies a pretest-posttest design.

*Tests used*

Each study used different tests to evaluate the participants. Because of the variety in this subject, the used tests are summed up in a table rather than creating a table using boxes that are checked if the test was present. The information was found throughout the used articles, but often present in the methods section.

*Elements of the intervention*

The elements of the intervention include whether or not there are therapy sessions, group sessions, a therapist is present during the game or that the game is the sole element of the intervention. A table is created using these options, checking the boxes if the element is present. It is considered "playing individually" if there is no teacher, parent or therapists necessarily present during the playing of the game. This does not mean that they are not allowed to be present. If the child has the option to play the game in a classroom, it is still considered "playing individually", even if there are other classmates and a teacher present in the same room. "Therapy sessions" are considered the sessions a child has with a therapist and optionally one or both parents present. This might include playing the game. The presence of other children with ASD makes it a "group session". A therapy session with both parents and siblings, is still considered a regular "therapy session". This information is typically found in the methods section of the literature.

*Effectiveness*

Morrison et al (2012) proposed a model to evaluate the effectiveness of interventions. The interventions are coded in more effective, less effective or ineffective. Table 1.2 below shows the criteria on which the evaluation is based.

Table 1.2

*Criteria for evaluating effectiveness of interventions as created by Morrison et al (2012)*

| Intervention Code | Criteria |
| --- | --- |
| More effective | The intervention led to improvement on the majority of outcome measures |
| | The intervention was at least as effective as comparison groups |
| | The intervention was more effective than waiting list or no intervention control groups |
| Less Effective | The intervention led to improvement on a *minority* of outcome measures |
| | The intervention was *not necessarily as effective* as comparison groups |
| | The intervention was *more effective* than waiting list or no intervention control groups |
| Ineffective | The intervention *did not lead to improvement* on any of the outcome measures |
| | The intervention was *no more effective* than waiting list or no intervention control groups |

The criteria from table 3.1 have been used to evaluate the reviewed studies. If a study does not present results and therefore can not be evaluated, or can not be evaluated for another reason, they are listed in the table as "Unknown, <reason>".

# Results

Table 2.1 shows an overview of studies used in this review. The reviews have been coded, and from now on these codes will be used for referencing.

Table 2.1

*Overview of used studies*

| Author | Title | Year | Code |
| --- | --- | --- | --- |
| Allen, T.T., Chapman, S.B., Didehbani, N., Kandalaft, M.R. and Krawczyk, D.C. | Virtual reality social cognition training for young adults with high functioning autism. | 2013 | S1 |

| Beaumont, R. and Sofronoff, K. | A multi-component social skills intervention for children with Asperger syndrome: the junior detective training program | 2008 | S2 |
|---|---|---|---|
| Brown, C., Cockburn, J., Herlihy, L., Kaiser, M.D., Klaiman, C., Koenig, K., Schultz, R.T., Stahl, S., Tanaka, J.W. and Wolf, J.M. | Using computerized games to teach face recognition skills to children with autism spectrum disorder: the *Let's Face It!* program | 2010 | S3 |
| Cai, Y., Chia, N.K.H., Kee, N.K.N., Thalmann, D., Thalmann, N.M. and Zheng, J. | Design and development of a virtual dolphinarium for children with autism | 2013 | S4 |
| Daniels, J.W., Hinniker, A. and Williamson, H. | *Go Go Games:* therapeutic video games for children with autism spectrum disorders | 2013 | S5 |
| De Silva, P.R.S., Higashi, M., Lambacher, S.G. and Osano, M. | Monitoring of emotion to create adaptive game for children with mild autistic | 2007 | S6 |
| Yan, F. | A Sunny Day: Ann and Ron's world an iPad application for children with autism | 2011 | S7 |

## Game Characteristics

*Summary of the game*

*S1: Virtual Reality Social Cognition Training*

In the existing game 'Second Life', the researchers created an island that is used solely for the participants of the training. The island is not accessible for other players. On the island there is an office building, pool hall, a fast food restaurant, a technology store, an apartment building, a coffee house, an outlet store, a school, a campground and a central park. The participants had to create an avatar that looked similar to them

by changing some features and clothes. Facial expressions and arm movements were limited, and could not be personalized to match the participant. The participants are guided by their therapist to social encounters in the game, and persons with whom they have to interact. The purpose of this game is to challenge children with ASD to encounter day-to-day situations in a safe environment.

### S2: The Junior Detective

The game is set in the year 2030, where postnatal genetic screening is used to guide people to the job that matches their individual talents. The participant turns out to be a talented secret agent, specialised in remote viewing. Playing through different levels, the participants practice recognizing facial expressions, body postures and prosody of speech, in which they learn to recognize complex emotions. They also practice recognizing emotions based on nonverbal and environmental cues, and finally they practice collaborative play, trying new things and dealing with bullying.

### S3: Let's Face It!

This game consists of seven minigames, aimed at different face processing skills, which are divided in face subtests and object subtests; face dimensions, immediate memory for faces, matching identity masked features, expression, parts/whole identity, house dimensions and immediate memory for cars. The purpose of the game is to learn different skills that are associated with face-processing in order to improve social interaction.

### S4: Virtual Dolphinarium

Since therapy with dolphins had proven to be effective, but expensive, these researchers created a virtual way to train with dolphins. The children are asked to enter a room with a 320-degree 3D-screen, with a Kinect system from Microsoft. In the game, the environment is recreated and the virtual dolphins react like real dolphins would to their trainer. The participants get six tasks before entering this room, teaching them how to train the dolphins. The purpose of this game is to communicate with the dolphins in a fun way whilst learning nonverbal communication skills

### S5: Go Go Games

The game consists of several minigames in which the participants practice multiple cue response. One of these games asks children to recreate a train by choosing the right carriages, another asks the children to recreate a robot by choosing the right parts, and another makes them choose where a car has to drive. The differences between the options get progressively smaller as the participants advances through the game. The purpose of this game is to improve multiple cue response by repeatedly playing the minigames.

*S6: Emotion-Based Interactive Game*

This game is designed for two players. One of them suffering from ASD, the other does not have any developmental difficulties. Both children play from a different computer. They each have control of one line, moving through a square. The goal is to create the longest line before crashing into each other. The speed with which the line moves is determined by the intensity of emotion, forcing the participant to express emotions in order to win the game. For each emotion the researchers selected 30 active gestures, which were measured by a motion capture system that was linked to the computer and measures upper body movement. The purpose of this game is to train expression of emotions. The goal is to express emotions as good as or better than the child without developmental difficulties.

*S7: A Sunny Day*

The game consists of several minigames. The participant can choose an assistant, Ann (female) or Ron (male). The game is being played on iPad, so the player can touch objects on the screen, triggering an animation. The explanation of the games are spoken to improve communication skills. Five out of seven minigames concern day-to-day activities. The player can choose between daytime, school time and night-time. Each time setting gives a different choice of minigames. The time of the day is chosen after the assistant is chosen. The purpose of the game is to live a structured in-game life whilst training social skills, attention and concentration.

*Platform*

Most of the games are played on PC (S1, S2, S3, S6). Two others are played on iPad (S5 and S7) and one of them, S5, is played on the 320-degree 3D screen at Nanyang Technological University (NTU). Table 2.2 shows an overview of the platforms on which the games are playable.

Table 2.2

*Platform on which the game is played*

| Study | PC | iPad | Other |
|-------|----|------|-------|
| S1 | X | | |
| S2 | X | | |
| S3 | X | | |
| S4 | | | X immersive room at NTU |
| S5 | | X | |
| S6 | X | | |
| S7 | | X | |

*Progressing through the game*

S3, S5 and S7 use minigames, with a variety in the amount of minigames used. S3 and S7 both use seven minigames, S5 contains three minigames.

The use of leveling to increase the difficulty of the game is present in three games, S2, S3 and S5. S2 contains three levels, each training a different skill that is more difficult than the last. S3 has at least 24 levels per minigame and S5 is not clear about the amount of levels, but the levels get more difficult based on the amount of cues the participant has to recognize. Table 2.3 shows an overview of whether or not the studies use minigames or leveling.

Table 2.3

*Progressing through the game*

| Study | Minigames | Leveling | Single Storyline |
|-------|-----------|----------|------------------|
| S1 | - | - | X |
| S2 | - | X | - |
| S3 | X | X | - |
| S4 | - | - | X |
| S5 | X | X | - |
| S6 | - | - | X |
| S7 | X | - | - |

Most of the games focus on the ability to express and/or recognize emotions (S1, S2, S3, S6). Social skills, too, are often the subject of the game (S1, S2, S3, S4, S7). The majority of the games focuses on more than one skill. S5 and S6 are the only two games that focus on only one skill. Other skills that are being addressed in these games are: recognizing identity (S3), attention (S4, S7), awareness of the surroundings (S4), motor skills (S4), multiple cue response (S5) and imaging capacity (S7) In Table 2.4 below an overview is presented of the skills that are being trained by the games.

Table 2.4

*Trained Skill*

| Study | Social Skills | Emotion recognition and expression | Recognizing identity | Attention and concentration | Awareness of surroundings | Motor skills | Multiple Cue Response | Imaging Capacity |
|-------|---------------|------------------------------------|----------------------|-----------------------------|---------------------------|--------------|-----------------------|------------------|
| S1 | X | X | | | | | | |
| S2 | X | X | | | | | | |
| S3 | X | X | X | | | | | |
| S4 | X | | | X | X | X | | |
| S5 | | | | | | | X | |
| S6 | | X | | | | | | |
| S7 | X | | | X | | | | X |

An overview of the used game ingredients is presented in table 2.5 below

Table 2.5

*Game Ingredients*

| Study | 1 Avatar | 2 3D Environ-ment | 3 Narrative Context | 4 Feed-back | 5 Ranks, Levels | 6 Market-place | 7 Comp-etition | 8 Teams | 9 Commu-nication | 10 Time | Amount used |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | + | + | + | - | - | + | - | - | + | - | 5 |
| S2 | - | + | + | + | + | - | - | - | - | - | 4 |
| S3 | - | - | - | + | + | - | - | - | - | - | 2 |
| S4 | - | + | + | + | - | - | - | - | - | - | 3 |
| S5 | - | - | - | + | + | - | - | - | - | - | 2 |
| S6 | - | - | - | + | - | - | + | - | - | + | 3 |
| S7 | - | - | + | + | - | - | - | - | - | - | 2 |
| Times used | 1 | 3 | 4 | 6 | 3 | 1 | 1 | 0 | 1 | 1 | |

*Note. An overview of the ingredients can be found in table 1.1*

**Intervention Characteristics**

*Target Group*

Three studies have been focused on children with ASD in general, meaning they did not focus on a specific type of ASD (S4, S5, S7). Three studies have used a more specific target group, focusing on a specific type of ASD; a mild form of autism (S6), high functioning autism (S1) and Asperger Syndrome (S2). Five studies focused on children (S2, S4, S5, S6, S7), two studies focused on young adults (S1, S3) and one study focused on adolescents (S3).  This is shown in table 3.1

Table 3.1

*Target group*

| Study | Target Group |
|-------|--------------|
| S1 | Young adults with high functioning autism |
| S2 | Children with Asperger Syndrome |
| S3 | Adolescents and young adults with ASD |
| S4 | Children with ASD |
| S5 | Children with ASD |
| S6 | Children with mild ASD |
| S7 | Children with ASD |

*Duration of the intervention*

Not all studies mentioned a specific amount of time the intervention should last (S4, S5, S6, S7). The first study, S1, proposed an intervention which includes ten sessions in five weeks, which means two sessions per week. In these sessions, the participants will practice with the game and receive therapeutic feedback. The second study, S2, proposed an intervention with a duration of seven weeks. S3 varied the amount of time spent on the intervention, with an average duration of 19.1 weeks significantly longer that S1 and S2. S6 states that the participants have to play at least twenty games, but they do not specify whether or not there has to be a certain amount of time between the games and whether or not they have to be played in one day. They do mention that the more the participants play the game, the bigger the improvements made on their emotion recognition and emotion expression skills.

Table 3.2

*Duration of the intervention*

| Study | Duration of the intervention |
|-------|------------------------------|
| S1 | 10 sessions in 5 weeks |
| S2 | 7 weeks |
| S3 | Average of 19.1 weeks |
| S4 | Not specified |
| S5 | Not specified |
| S6 | >20 games, preferably more |
| S7 | Not specified; average 3.7 months |

*Note. This is the duration of the intervention as it is proposed in the literature.*

The studies that have been reviewed were mainly focused on describing a process, and therefore used the single-group pretest-posttest design. Others used an experiment using a control or waitlist group (S2, S6) as they were interested in the results. One of the studies used a quasi-experiment design, where they had some influence on whether the participants were assigned to the active treatment group or the control and/or waitlist group.

Table 3.3

*Study Design*

| Study | Experiment | Quasi-Experiment | Single-group pretest-posttest |
|-------|------------|------------------|-------------------------------|
| S1    |            |                  | X                             |
| S2    | X          |                  |                               |
| S3    |            | X                |                               |
| S4    |            |                  | X                             |
| S5    |            |                  | X                             |
| S6    | X          |                  |                               |
| S7    |            |                  | X                             |

Most of the testing was done on both the children and the parents, teachers and therapists, because they have the opportunity to evaluate the behaviour of the child (S2, S4, S5, S6, S7). Some studies did not use execute any tests before or after the intervention, and relied solely on reports from parents and on the progress the participant made in the game (S3, S5, S6, S7).

Table 3.4

*Testing*

| Study | Test(s) used |
|-------|--------------|
| S1 | WASI, SP(subtests), EKMAN60, Reading the Mind in the Eyes, Triangles, SSPA |
| S2 | Diagnosis from therapist, WISC III, DHQ, CAST, DBT, SSQ, ERSSQ, APEFE, APEPC, JMT |
| S3 | In-game progress |
| S4 | TONI-3, GARS |
| S5 | Therapist and parent evaluation |
| S6 | Therapists, in-game progress |
| S7 | Parents, teachers and therapist evaluation |

*Elements of the intervention*

Three studies had a therapist present during the game and/or therapy sessions to complement the game (S1, S4, S6). S2 had the most elaborate intervention, using group sessions, parent training and teacher hand-outs to educate and train all individuals involved in the behaviour of the child. Most interventions allowed the children to play individually, without therapeutic supervision whilst playing. For an organized overview, see table 3.5 below.

Table 3.5

*Elements of the intervention*

| Study | Therapist | Group Session | Parent Training | Teacher Hand-outs | Playing Individually |
|-------|-----------|---------------|-----------------|-------------------|----------------------|
| S1 | X | | | | |
| S2 | | X | X | X | X |
| S3 | | | | | X |
| S4 | X | | | | |
| S5 | | | | | X |
| S6 | X | | | | X |
| S7 | | | | | X |

**Effectiveness**

Two studies did not present the results and could therefore not be evaluated (S5, S6). S5 created a game that was available to Apple-users, making it anonymous and therefore the progress could not be evaluated.

Following the criteria proposed by Morrison et al (2012), S1 and S2 have been categorized as more effective, S4 and S7 are less effective, and S3 was scored more effective on the object subtests, and less effective on the face subtest.

Table 4

*Effectiveness*

| Study | Effectiveness |
| --- | --- |
| S1 | More |
| S2 | More |
| S3 | More on object subtest, less on face subtest |
| S4 | Less |
| S5 | Unknown, no results to compare |
| S6 | Unknown, no results to compare |
| S7 | Less |

*Note. For the criteria used to determine the effectiveness, see table 1.2*


An overview combining all previously mentioned result can be found in Appendix A.

# Discussion

The general aim of this review was to create an overview of the existing interventions using gamification for children with autism and to evaluate the effectiveness to investigate whether or not games could be used as (part of) a treatment for children with ASD. A comparison was made of seven interventions, examining game characteristics, intervention characteristics and the effectiveness of the proposed intervention.

The interventions that have been reviewed were mainly for either PC or iPad. There was a lot of variety in the way the player progresses through the game. The options of levelling, minigames and using a single storyline were equally popular. Based on this review, it is not possible to tell which of these options is most effective, since the most effective interventions (S1, S2, S3) each used different ways to progress through the game. Most of the interventions were aimed at training social skills and emotion recognition and expression. Two interventions (S5, S6) were focused on improving one skill, making them Focused interventions. The other interventions focused on more than one skill, making them Comprehensive treatments (National Autism Center, 2009; Odom et al., 2010). There was also a great variety in the applied game ingredients. All interventions used two to four of the ingredients. However, the use of teams was never applied. Additionally, self-representation with avatars, Marketplace and Economies, and Parallel Communication Systems are used only once. Feedback was used in every game but one, only S1 used no feedback system.

With regard to the latter, not all game ingredients might be suitable for children with autism, for example, children who experience difficulty with collaborative play and social skills (Charman & Baird, 2002), might not enjoy playing in teams. This is likely to be a reason that some of the ingredients are rarely used. Therefore, the interventions should not be valued too much based on the used ingredients.

The choices made in designing the interventions are rarely well-substantiated. The demands of the participants are not taken into account in the articles that have been reviewed (S1-7). This creates a gap between participant demands and technology. An example of this gap, can be found in the virtual dolphinarium (S4). The children are supposed to wear 3D-glasses when they use the immersive room. This turned out to be problematic, because the glasses were considered uncomfortable by some of the children. This type of gap between the intervention and the demand of the participants, can potentially decrease the adherence of the intervention (Kelders, 2012). It is important to ensure adherence, because it prevents the participants from quitting the intervention and therefore improves the benefits of the intervention (Kelders, 2012). Therefore, it is recommended to carry out more research into the demands of the children and designing the interventions in a more user-centered way.

The majority of the interventions use either the PC or the iPad as a platform for the game. This is relatively old-fashioned, since technology moves fast and there are more gaming consoles to choose from.

For example, elderly people already use the Nintendo Wii to train their balance (Griffiths, 2005). The Virtual Dolphinarium (Cai et al, 2013) uses software from Microsoft's Kinect to turn the motions of the participant into behaviour of a virtual dolphin. This is one example of the way technology could be used. Since nonverbal communication is an important skill for children with autism (Charman & Baird, 2002), it would make sense to create more interventions using this type of technology to train these skills. This is because technologies that register movement are better at teaching children nonverbal communication and motor skills, than a regular game without registration of motor movement.

It is recommended to utilize more of the different technologies that are momentarily available. Interventions should also be designed for other devices. These more advanced technologies can be promising in teaching these children nonverbal communication.


Most interventions were focused on children of all ages with all types of ASD. Three of the interventions were focused on a specific type of Autism, and two interventions were focused on a more specific age group. Not all interventions had a specified duration in which the program has to be executed. The ones that do specify the duration vary from five to nineteen weeks. The two interventions with the shortest specified duration, S1 and S2, did prove to be more effective than the interventions with a longer specified duration. Only two of the interventions used an experimental research design. Four of the interventions used a single-group pretest-posttest design, with very little testing that has been done. Some interventions use a lot of tests, but most of them rely either solely or partially on in-game progress and teacher, parent or therapist evaluation. Most interventions included playing individually. The use of other intervention elements was varied.

Most articles do not substantiate the decisions that have been made during the development of the intervention. For example, it is typical to have more treatment sessions in one week for children with ASD (Lord & Bishop, 2010; Beaumont & Sofronoff; 2008), so it would make sense if the intervention was designed that way. However, there is only one intervention designed that way (S1), and the others do not give any arguments concerning the choice they made. Furthermore, it is typical for focused intervention practices to be executed for a short period of time (National Autism Center, 2009; Odom et al., 2010). However, the two focused interventions (S5, S6) did not specify the duration of the interventions they proposed. Since it has been proven to be effective, it is recommended to have a shorter duration for focused intervention practices and invest a longer period of time for comprehensive treatment. In both cases it is recommended to have more than one session per week.


With regard to the effect of the intervention on the different skills associated with ASD, there was an equal amount of more effective (S1, S2, S3) and less effective (S3, S4, S7) interventions. However, these evaluations are often based on a small amount of participants in the pilot study. Some of the articles (S5, S6)

did not present any results concerning the effectiveness of the proposed intervention. Not one article presents any long-term results of the intervention that is being proposed. S1, S2 and S3 are considered the most effective interventions. These are all focused on improving social skills and emotion recognition and expression. It can be assumed that gamification is an effective way to teach these skills to children with ASD.

One aspect deserves attention when it comes to the effectiveness of the intervention. There has been little research concerning the effectiveness of the proposed intervention. The effectiveness is essential in determining whether or not the intervention can be used as (part of) a treatment program for children with ASD, so the absence of the tests creates some doubt as to whether or not the interventions could or should be applied. It does stand out that only two of the reviewed interventions use an experimental research design (S2, S6). One of these, S6, is a self-proclaimed experiment, yet does not present any results. S2, which is a proper experiment, does show that the intervention has been more effective in helping children with ASD.

To assess the usability of the interventions as (part of) a treatment program for children with ASD, it is recommended to evaluate the effectiveness of the interventions for children with ASD in a more elaborate manner than has been done so far, and to research long-term effects the interventions have on the participants.

One of the limitations of this review is the fact that the games were extremely varied, making it difficult to give a good comparison. However, using tools like the one from Morrison et al (2012) and Reeves and Read (2009) provided the structure needed to make the review as objective, unbiased and complete as possible. Another limitation is that is likely that not all the existing literature on this subject has been reviewed, since the database that has been used, has been created in 2013. This means that literature published in the last year has not been included in this review.

The overall conclusion is that gamification could potentially be helpful in treating children with ASD, but more testing is required. The aspects of both the game and the intervention are diverse, but there has not been sufficient testing as to which aspects work better or worse than others. However, the recent developments in this area of expertise present a positive outlook for future research.

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## Appendix A: Overview of the results

| Study | Platform | Structure of the Game | Skill | Applied Game Ingredients | Target Group | Duration of Intervention | Study Design | Test used | Intervention Elements | Effectiveness |
|---|---|---|---|---|---|---|---|---|---|---|
| S1 | PC | | Social skills, emotion recognition | 1, 2, 3, 6, 9 | Young Adults with High Functioning Autism | 5 weeks | Single-group pretest-posttest | WASI, SP(subtests), EKMAN 60, Eyes, Triangles, SSPA | Therapy | More |
| S2 | PC | Levels | Emotional understanding, Social skills | 2, 3, 4, 5 | Children with Asperger Syndrome | 7 weeks | Experiment | WISC-III, DHQ, CAST, SSQ, DBT, ERSSQ, APEFE, APEPC, JMT | Group sessions, parent training, teacher hand-outs, playing individually | More |
| S3 | PC | Minigames, levels | Emotion recognition, recognizing identity, social skills | 4, 5 | Adolescents and Young Adults with ASD | 19.1 weeks | Quasi-experiment | In-game subtests | Playing individually | Less on face subtest, more on object subtest |
| S4 | Immersive | | Attention, | 2, 3, 4 | Children | Unknown | Single- | TONI-3, | Therapist | Less |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Room at NTU | | awareness of surroundings, motor skill, social skills | | with ASD | | group pretest-posttest | GARS | | |
| S5 | iPad | Minigames, Levels | Multiple cue response | 4, 5 | Children with ASD | Unknown | Single-group pretest-posttest | Therapeutic evaluation | Playing individually | Unknown |
| S6 | PC | | Emotion recognition and expression | 4, 7, 10 | Children with mild ASD | >20 games | Experiment | Therapeutic evaluation | Therapist, playing individually | Unknown |
| S7 | iPad | Minigames | Concentration, imaging capacity, social skill | 3, 4 | Children with ASD | Unknown | Single-group pretest-posttest | Therapeutic and parental evaluation | Playing individually | Less |

*Note: a description of the game ingredients can be found in table 1*