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Computer-Assisted Technology as a Means of Improving Facial Emotion Recognition and Social Skills in Children with Autism Spectrum Disorder

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The goal of this literature review based bachelor's thesis is to examine how computer-assisted technology is used to teach facial emotion recognition to children with autism spectrum disorder (ASD), as well as to evaluate whether improvement in facial emotion recognition supports the social and emotional life of a child with ASD. This research topic is important because people with ASD often have difficulties in social interaction situations, which tends to have a detrimental effect on their quality of life. According to researchers, practicing facial emotion recognition with computer-assisted technology can improve the self-confidence and reduce the anxiety of individuals with ASD, which can improve their quality of life by enabling more successful interaction and relationships with other people.

The theory portion of this thesis starts with the exploration of basic knowledge and cognitive developmental theories of ASD. This is followed by a chapter addressing how ASD is/will be diagnosed in the future, after which there is a chapter presenting the development of autism research and exhibiting how the understanding and attitudes towards ASD have changed over time. This is succeeded by a brief explanation about the evolvement and role of technology in ASD research and treatment. Next, the four studies chosen for closer inspection and analysis are presented. These studies were chosen because they are fairly recent and at least some of the authors, such as Simon Baron-Cohen, are renowned autism researchers. In addition, there was not an abundance of recent research that would have related directly to the topic of this thesis. Therefore, it was also relatively easy to choose the articles, as the number of suitable alternatives was not very high.

In all four studies children who received the intervention improved their emotion recognition skills. Also, in the two studies that investigated the effects of the interventions on children's social skills, improvements in these skills were documented. The social skills improved in classroom, recess and home settings, as evaluated by teachers and parents. Although the results of these studies are promising, they all have limitations that must be considered when analyzing the generalizability and reliability of the results. For instance, the number of participants in the studies was quite low and the ages and educational backgrounds of the children could have been more diverse. Also, a question left unanswered in these studies is whether the social skills that the participants acquired would generalize into other contexts, where the children would interact with random people instead of individuals they know. Furthermore, two of the studies lacked control groups, which reduces their reliability. More information is needed also regarding the retention of acquired skills after longer periods of time, for example several months or years after the intervention. Lastly, a larger number of studies with a more diverse length is needed to find out if similar or better results can be achieved with shorter or longer interventions.

Keywords: autism spectrum disorder, computer-assisted technology, facial emotion recognition, social skills

Oulun yliopisto
Kasvatustieteiden tiedekunta
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Tämän kirjallisuuskatsauksena toteutetun kandidaatintutkielman tavoitteena on selvittää, miten tietokoneavusteista teknologiaa käytetään opettamaan tunteiden tunnistamista kasvoilta lapsille, jotka sijoittuvat autismin kirjolle, sekä arvioida tukeeko kehittyminen tunnetilojen tunnistamisessa kasvoilta autismin kirjolle sijoittuvan lapsen sosiaalista ja emotionaalista elämää. Aihe on tärkeä, koska autismin kirjolle sijoittuvilla yksilöillä on usein vaikeuksia vuorovaikutustilanteissa. Tutkijoiden mukaan tunnetilojen kasvoilta tunnistamisen harjoitteleminen tietokoneavusteisella teknologialla voi kohentaa autismin kirjolle sijoittuvien itseluottamusta ja vähentää heidän ahdistustaan, mikä puolestaan voi parantaa kyseisten yksilöiden elämänlaatua mahdollistamalla menestyksekkäämmän vuorovaikutuksen ja siten merkityksellisempien ihmissuhteiden luomisen.

Tämän tutkielman teoriaosuus alkaa katsauksella autismin kirjon perustietoon ja kognitiivisiin kehitysteorioihin. Seuraavassa luvussa perehdytään siihen, miten autisminkirjon häiriö diagnosoidaan nyt ja tulevaisuudessa, minkä jälkeen seuraa kappale, jossa esitellään autismitutkimuksen kehitystä sekä sitä, miten ymmärrys ja asenteet autisminkirjoa kohtaan ovat muuttuneet aikojen saatossa. Tämän jälkeen tarkastellaan teknologian roolia autisminkirjon tutkimisessa ja hoidossa, jonka jälkeen esitellään tutkimukset, jotka on valittu tarkempaa tarkastelua ja analysointia varten. Tutkimukset valittiin suhteellisen tuoreuden ja merkittävien autismitutkijoiden, kuten Simon Baron-Cohenin, osallisuuden vuoksi, mutta myös siksi, ettei tämän tutkielman tutkimusaiheeseen suoraan liittyvää tuoretta tutkimusta ollut paljoa saatavilla, mikä helpotti valintaa.

Kaikissa neljässä tutkimuksessa lapset, jotka osallistuivat interventioon, kehittivät tunteiden tunnistamistaitojaan. Lisäksi kahdessa tutkimuksessa, jotka tarkastelivat intervention vaikutusta lasten sosiaalisiin taitoihin, kehitystä näissä taidoissa havaittiin. Sosiaaliset taidot kehittyivät luokkahuoneissa, välitunneilla ja kotona, opettajien ja vanhempien arvioiden mukaan. Lupaavista tuloksista huolimatta tutkimuksissa on rajoitteita, jotka on huomioitava analysoitaessa tulosten yleistettävyyttä ja luotettavuutta. Esimerkiksi tutkimusten otanta oli melko alhainen ja osallistujien ikäjakauma sekä koulutustausta olisivat voineet olla laajempia. Tutkimukset jättivät avoimeksi myös sen, siirtyvätkö osallistujien oppimat sosiaaliset taidot myös tilanteisiin, joissa nämä ovat tekemisissä itselleen entuudestaan tuntemattomien ihmisten kanssa. Lisäksi kahdessa tutkimuksessa ei ollut kontrolliryhmää, mikä vähentää tutkimusten luotettavuutta. Tarvitaan myös lisää tietoa interventioiden seurauksena opittujen taitojen pysyvyydestä pidempien aikojen, kuten useiden kuukausien ja vuosien, kuluessa. Lisäksi tarvitaan lisää erimittaisia tutkimuksia, jotta voitaisiin saada parempi käsitys siitä, voitaisiinko samankaltaisia tai parempia tuloksia saavuttaa lyhyemmillä tai pidemmillä interventioilla.

Avainsanat: autisminkirjon häiriö, tietokoneavusteinen teknologia, tunteiden tunnistaminen kasvoilta, sosiaaliset taidot

Contents

1 Introduction

The goal of this thesis is to examine how computer-assisted technology is used to teach facial emotion recognition to children with autism spectrum disorder, as well as to evaluate whether improvement in facial emotion recognition supports the social and emotional life of a child with autism spectrum disorder. Furthermore, this thesis aims to propose themes and variables that should be addressed in future research.

I became interested in autism spectrum disorder (ASD), and more particularly in social skills training of individuals with ASD through personal experiences. In the summer of 2017, I worked as a camp counsellor at a children's summer camp in Croatia. I was told that there were going to be two boys in my group at different times during two consecutive weeks who were on the autism spectrum. I was also instructed to pay special attention to these boys. I did not have notable prior experiences of working with children with autism spectrum disorder and I did not know very much about autism. As the days went by, I observed the boys' behaviour and social interaction. I noticed that often they were not interested in common social activities. The other boy did, however, frequently want to join in on different games and sports. It was obvious though that his social competence was not at the same level as that of the other children, and this caused a lot of misunderstanding and controversy. I was thinking to myself if it would be possible to integrate these boys into the camp experience in a more meaningful way and to support them more effectively.

Around half a year later I attended the Autismin talvipäivät (The Winter Days of Autism) event in Oulu, where ASD professionals from different fields as well as individuals with ASD themselves shared their knowledge and experiences. I had already thought earlier that I would be interested in writing my thesis on something related to supporting the social and emotional competence of children with ASD. At this event, after discussions with experts from the ASD field, I decided to write this thesis about the role of technology in supporting individuals with ASD. As I started reading some articles covering ASD, I started thinking that the topic I had chosen was quite good. The role and possibilities of technology in supporting individuals with ASD have increased enormously in recent times, so it is a very current field to investigate. There are also not too many studies and theses written about how teaching facial emotion recognition with computer-assisted technology (CAT) to individuals with ASD affects their emotion recognition skills, and if this has some kind of impact on their social and emotional life on a broader level. This gives value to my

thesis, as it is important to draw conclusions about recent research in order to understand the impact of current support mechanisms and interventions designed for individuals with ASD.

This bachelor's thesis has been conducted as a literature review and it aims to analyze and compare relevant international studies in order to bring about an understanding of present research and knowledge. Four studies have been chosen for closer investigation and largely based on them the research questions are answered. Other relevant literature is also addressed in order to create a more holistic picture of the subject. The purpose of this thesis is to demonstrate an understanding of contemporary research on the subject as well as uncover issues that reveal the need for future research.

In the following section the methodology of this thesis and the research questions will be presented. After that basic knowledge and cognitive developmental theories will be explored. These will be followed by a chapter addressing how ASD is/will be diagnosed in the future, after which there is a chapter that presents the evolvement of autism research and exhibits how the understanding and attitudes towards ASD have changed over time. Next there will be a brief explanation about the evolvement and role of technology in ASD research and treatment. These aforementioned chapters are part of this thesis because they provide the reader with relevant background information on ASD. This information may help the reader to understand the research analysis chapter, which compares and analyzes four contemporary studies, better. The chapters leading up to the research analysis chapter may also help the reader to create a better understanding about the significance and purpose of exploring the use of CAT as a treatment method for children with ASD. The research analysis chapter will be followed by a discussion chapter on the studies, after which the thesis will end with an overall concluding chapter.

2 List of Abbreviations

AD = autistic disorder

APA = American Psychiatric Association

AS = Asperger's syndrome

ASD/s = autism spectrum disorder/s

CAT = computer-assisted technology

fMRI = functional magnetic resonance imaging

HFA = high functioning autism

LFA = low functioning autism

PDD = pervasive developmental disorder

TD = typically developed

ToM = Theory of Mind

WHO = World Health Organization

3 Method and Research Questions

Baumeister argues that literature reviews are important because they gather together data from various different studies. This increseases their worth as it is more sensible to trust a large amount of studies indicating something than to base one's analysis and conclusions on a single study. Furthermore, literature reviews make it possible to ask bigger questions. It is very difficult to draw a conclusion about a broad topic based on a single study, as studies tend to always be somehow limited in terms of their methodology. Therefore, having several studies to support one's conclusions is often necessary in order to produce credible conclusions about broad topics. (Prinstein, 2013, 119-120.) The literature review conducted in this thesis can be regarded as a descriptive literature review as prior rerearch, its scope, quantity and depth is portrayed (JAMK). The descriptive literature review suits the purpose of this thesis as it enables providing information about past research and gives an idea of the overall situation of research produced on the topic. This thesis aims to answer the following research questions:

1. How is computer-assisted technology used to teach facial emotion recognition to children with autism spectrum disorder?

2. Does improvement in facial emotion recognition support the social and emotional life of a child with autism spectrum disorder?

Most of the articles referred to in this thesis were found in *ProQuest's Eric* database. Search words such as "autism", "computer", "emotion recognition" and "social skills" were used. The four articles chosen for closer inspection were chosen because they were fairly recent, at least some of the authors, such as Simon Baron-Cohen, are renowned autism researchers, most articles were cited by fairly many researchers and because all articles were peer-reviewed. In addition, there was not an abundance of recent research that would have related directly to the topic of this thesis. Therefore, it was also relatively easy to choose the articles, as the number of suitable alternatives was not very high. In addition to articles this thesis refers to books about autism. Many of these books have been written in order to provide readers with basic information about autism and can be found from the library at the University of Oulu and/or public libraries in Finland.

4 Theory

4.1 Basic Knowledge and Cognitive Developmental Theories of ASD

Autism spectrum disorder (ASD) is a term that refers to all the different variations of autism (Ploog, Scharf, Nelson & Brooks, 2013, 301). Autism can be defined as a pervasive developmental disorder (PDD) characterized by problems in reciprocal social interaction as well as in verbal and nonverbal communication. Other notable characteristics are the lack of imaginative play and repetitive and restricted solitary activities. (Tanaka et al., 2012, 1259.) Autism is also described as a neurological condition (Perkins, Stokes, McGillivray & Bittar, 2010, 1239). All children with ASDs have common basic deficiencies, but there are significant differences in abilities between individuals (Laushey, Heflin, Shippen, Alberto & Fredrick, 2009, 1435).

The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision explains the difference between two major forms of ASDs. It is stated that basically the difference is that in Asperger's syndrome (AS) language development is not impaired as is the case in autistic disorder (AD). The term high functioning autism (HFA) is used when an individual with AD has typical intellectual abilities. (Perkins, Stokes, McGillivray & Bittar, 2010, 1239.) Commonly individuals with an IQ of over 70 are considered high functioning (HF) (Laushey, Heflin, Shippen, Alberto & Fredrick, 2009, 1435). Klin, McPartland and Volkmar (2005) state that children with low functioning autism (LFA) differ from children with high functioning autism (HFA) in their lower cognitive and formal language capabilities (Lopata et al., 2012, 963). A meta-analysis including 43 studies estimated that 0,13% of the total population has AD, while 0,03% would have AS (Perkins, Stokes, McGillivray & Bittar, 2010, 1239). Autism is also highly heritable (Tanaka et al., 2012, 1259) and tends to be considered a chronic, lifelong condition (Kuusikko et al., 2008, 1697-1698).

Kerola and Kujanpää (2009) state that there are different theories that describe the cognitive development in autism. According to the Theory of Mind (hereafter ToM) a person with ASD struggles to understand another person's mind, thoughts and emotions. (Kerola, Kujanpää & Timonen, 2009, 23.) Typically developed individuals usually master ToM abilities already when they are four years old. Children with ASD develop significantly slower and tend to be 9-14 years old before demonstrating ToM abilities. (Lubetsky, Handen & McGonigle, 2011, 276.)

Let us have a look at the social implications of ToM deficits that Cumine, Leach and Stevenson (1998) have listed. Firstly, individuals with ASD tend to struggle to anticipate others'

behaviour and therefore often stay away from circumstances which cause them anxiety. Furthermore, people with ASD are also impaired in their ability to perceive the intentions of others and in comprehending motives of others. Individuals with ASD also often have difficulties explicating their own actions as well as comprehending emotions. Because of this people with ASD are often viewed as lacking empathy, even when that may not be the case. (Lubetsky, Handen & McGonigle, 2011, 276.)

People with ASD also often lack the ability to understand how their behavior makes others feel or what others think of their behavior. Because of this, others tend to perceive that individuals with ASD do not have a conscience or that they do not want to make others feel good. Individuals with ASD also have problems in taking into consideration what knowledge others possess or generally would be expected to possess. This results in confusion and an appearance of disorganized behaviour in social interaction. (Lubetsky, Handen & McGonigle, 2011, 276.)

Another typical social implication of ToM deficits for individuals with autism spectrum disorder is that they are not able to perceive when the listener is not interested in the topic of conversation. So, an individual with ASD may talk about something and would not change the topic of conversation even if nobody was interested in it, because he/she could not notice the listeners' lack of interest. Related to this, people with ASD have problems in dividing their attention. The deficient social interaction skills of individuals with ASD result in problems for these people when engaging with others and forming friendships. In addition, people with ASD also have problems in comprehending pretending and being able to perceive what is true and what is not. Related to the previous point, individuals with ASD cannot deceive others or comprehend deception. (Lubetsky, Handen & McGonigle, 2011, 276.)

The Theory of Weak Central Coherence explains that individuals with ASD perceive their surroundings in details and are incapable of constructing a holistic picture of these perceptions, and also lack the ability to build holistic pictures in their thoughts (Kerola, Kujanpää & Timonen, 2009, 23). Cumine et al. (1998) have listed social implications of central coherence deficits. One of these deficits is that an individual's attention is focused in an unusual way. Another very common deficit for people with ASD is that they may find it very difficult to break away from strict daily routines, which also often leads to a lack of attentiveness towards new activities. Decision-making and prioritizing can also be very difficult for individuals with ASD, as can being organized in one's life in general. Yet another typical deficiency is that of not understanding social connections, which results in poor generalizing skills and problems with knowledge. It is also typical for individuals

with ASD to not follow rules and instructions that they do not comprehend. (Lubetsky, Handen & McGonigle, 2011, 276-277.)

The Theory of Executive Dysfunction explains the difficulties people with ASD have in conducting their actions (Kerola, Kujanpää & Timonen, 2009, 23). This can externalise as problems in planning and self-monitoring. Other challenges include the lack of capability to restrain one's responses in social settings, being flexible in one's behaviour and being able to logically and proficiently manipulate and convey information. Ozonoff (1995) has listed social contexts in which executive functioning problems can be seen. Perceiving emotions of others, following the social behavioural patterns displayed by others and getting involved in pretend play are all situations which are challenging for individuals with ASD. Planning, organizing and prioritizing can also be challenging for people with ASD. Individuals with ASD also tend to find it difficult to begin and end activities, behaviours and thoughts. (Lubetsky, Handen & McGonigle, 2011, 277.)

Another theory, the Theory of Empathising-Systemising, attempts to explain the struggles of people with ASD in social interaction situations. The theory proposes that individuals with ASD have deficient empathic abilities compared to typically developed (TD) individuals, but that their systemising abilities are on par, if not above, those of TD individuals. (Lawson, Baron-Cohen & Wheelwright, 2004, 307.) Systemising can be understood as a "drive to analyze or build systems to understand and predict behavior and underlying rules" (LaCava, Golan, Baron-Cohen & Smith Myles, 2007, 179). It should be noted that the problems that individuals with ASD have in social development, communication and imaginative thinking transform through learning into autistic behaviours. With treatment targeted at influencing learning it is possible to alleviate these behaviours. (Kerola, Kujanpää & Timonen, 2009, 23-24.)

All of these theories propose that individuals with ASD have deficits in their cognitive development and abilities and because of this these individuals behave and view the world differently from typically developed individuals. This causes problems in the relationships between individuals with ASD and TD individuals because individuals with ASD are often incapable of the kind of behaviour and communication that the society, constructed and controlled by TD individuals, is expecting of them. Knowing about these theories is useful for everyone, but especially for teachers and other educators. When teachers understand the cognitive development of individuals with ASD they can more meaningfully support their learning and wellbeing. From the point of view of inclusion and integration, knowledge about the cognitive development of individuals with ASD may also motivate teachers and give them ideas on how to raise awareness of

ASD in mainstream classrooms and schools. This can lead to TD individuals' increased tolerance and understanding towards children with ASD.

While it is extremely important to understand common deficiencies and challenges that individuals with ASD have, it is equally important to realize that they also have abilities, which in some cases are superior to the abilities of typically developed individuals. Parents, teachers and any other people involved in the education and upbringing of individuals with ASD need to be aware of the individual strengths they possess. In this way these abilities can be supported, which is good for the self-esteem and development of individuals with ASD. As mentioned earlier, the systemising skills of individuals with ASD are often at the same level, or even above, those of TD individuals (Lawson, Baron-Cohen & Wheelwright, 2004, 307). This allows individuals on the autism spectrum to concentrate intensely on a task, especially one that they are interested in. Furthermore, some individuals with ASD have an exceptionally good memory, which can allow them to very accurately remember things they have heard or seen. Some individuals on the autism spectrum also have special interests and skills. For instance, they may be fascinated by music, mechanics or mathematics, and can display exceptional levels of excellence in their field of interest. (Timonen, Hämäläinen, Kastikainen & Paakkolanvaara, 2019, 115.)

4.2 Diagnosing ASD

In Finland, the ICD-10 classification, which was developed by the World Health Organization (hereafter WHO), is used as a tool for identifying and diagnosing autism. The diagnosis is usually done in a group that consists of professionals from different fields. Diagnosis methods include using lists of symptoms to screen and evaluate the individual. Additionally, interviews and different kinds of measurements are carried out. The most essential determiners for forming the diagnosis are communication, social interaction and areas of interest. The individual's entire life journey should be taken into account as the diagnosis is being formed. (Autismiliitto (I), 2018.) Most often the autism diagnosis is carried out when the child is around 18 months old. Early diagnosis is beneficial for the individual because then also the treatment measures can begin early. (Autismiliitto (II), 2018.)

There will be a change in the diagnosis of ASDs. The WHO is working on the ICD-11 which is due to replace ICD-10 from the beginning of 2022. A notable change concerning the diagnoses will be that pervasive developmental disorders such as autism and Asperger's syndrome

will no longer receive separate diagnoses, but instead will all be diagnosed under the name autism spectrum disorders. We cannot yet know exactly how the ICD-11 will be like, but by looking at the DSM-5, which has been used in the United States since 2013, we might get some idea of what to expect. The American Psychiatric Association (APA), who created DSM-5, has stated that it has attempted to bring the ICD and DSM classifications closer to one another so it could be expected that ICD-11 would be similar to DSM-5. (Autismiliitto (III), 2018.)

Happé (2011) points out that there are three main reasons why in the DSM-5 it was decided that a diagnosis would only be given as a broad ASD instead of for example autism or Asperger's syndrome. One reason is that the clinicians who made diagnoses felt that the subcategories of ASD were too inflexible. Sometimes it happened that individuals with similar symptoms received a different diagnosis depending on the clinician, which obviously led to people receiving unfitting diagnoses. Another reason was that many researchers felt that the subcategories did not take into consideration differences between individuals and changes in the individuals' performance levels well enough. Finally, a lot of researchers argued that there is not enough scientific evidence to justify a division into several subcategories. For instance, Happé (2011) has stated that while comparing autism and Asperger's syndrome, there is no absolute difference between the causes of symptoms, structure and function of the brain, intelligence etc., so the only clear difference is the degree of difficulty of the condition. (Smith, 2018, 4.)

Individuals with ASD and their relatives have expressed concerns regarding the upcoming change in diagnosis. It is still uncertain if individuals will lose their old diagnosis as the change will take place and if they must go again to a medical examination. Some people are also afraid that the change will increase bureaucracy and lead to services that fail to address the needs of the individual, as everyone with a diagnosis of ASD would get similar help. Furthermore, concerns have been voiced that the new diagnosis could create confusion and misunderstanding and increase labeling and discrimination. Especially people with Asperger's syndrome are afraid that, in people's minds, they will be associated with individuals with severe autism and that the features of these individuals will also be attached to people with Asperger's syndrome. Another concern for people with Asperger's syndrome is that their symptoms will not be noticed and attended to due to the new diagnosis. (Smith, 2018, 21-22.)

At the moment it is impossible to know what the extent of the problems as well as positive changes will be after the new diagnosis comes to effect. However, it is important to maintain dialogue on the topic so that there will be a better understanding about possible threats of

the diagnosis change. This allows for preparation and therefore more efficient and meaningful intervention if and when it becomes necessary to help the situation of individuals with ASD.

4.3 Evolution of Understanding and Attitudes Towards ASD

It is possible that autism spectrum disorders have existed since the beginning of humanity. In the past the symptoms may have been viewed for example as signs of madness. The term autism spectrum disorder was invented in the latter half of the 20th century. (Juhola, 2018, 21.) The two pioneers of autism research, Dr. Leo Kanner and Dr. Hans Asperger began exploring the topic in the 1930s (Feinstein, 2010, 9). Kanner's case series, published in 1943, that analyzed 11 children presented the core autistic features to the world for the first time (Silverman, 2012, 32). Kanner found that the most significant of these features was the children's inability for normal social interaction from the beginning of their lives (Silverman, 2012, 35). Psychiatrists that succeeded Kanner agreed that he managed to identify the most significant features of autism, an accomplishment which can be considered to be his greatest contribution to autism research (Silverman, 2012, 34).

One year after Kanner's publication Asperger published an article describing children he had been researching. The children in Asperger's study were similar to those that Kanner had been observing. However, there were a couple of notable differences. The children observed by Asperger expressed themselves linguistically fluently and had an exceptionally good memory. Later it was concluded that these children had a similar but slightly different neurobiological disorder to those in Kanner's study. The disorder was later named Asperger's syndrome. (Juhola, 2018, 22.)

Kanner never provided a clear opinion about the cause of autism, although he did seem to support the idea that it was neurobiologically based (Silverman, 2012, 34). Then again, Kanner did also make claims suggesting that environmental factors played a significant role in the development of autism. Kanner described the parents of the children he was studying as being cold and emotionally distant, implying that their behaviour had an effect on the development of their offspring's autistic condition. Kanner used the term "refrigerator mother" to describe mothers that in his view did not respond to the emotional needs of their children. Some people believe Kanner had a negative influence on autism research because of his statements regarding cold parents. It is possible that Kanner's comments were influenced by the political atmosphere in the United States at the time. Some individuals felt that explaining behaviour through genetics was flirting with the

Nazis' racial laws. In 1969 Kanner gave a public speech at a conference for parents of individuals with autism where he argued he never meant to blame the parents and that he was often misquoted. (Feinstein, 2010, 33-34.)

In the 1960s the theory of autism's neurological basis became the dominant theory among researchers and practitioners utilizing behavioural therapies. However, the psychogenic theory remained popular among the general public, even in the medical field to some extent, especially among professionals who were not psychiatrists. Bruno Bettelheim had a huge impact on the popularity of the psychogenic theory with his 1967 bestseller *Empty Fortress: Infantile Autism and the Birth of the Self*. (Silverman, 2012, 38.) Bettelheim borrowed Kanner's term "refrigerator mother" and described how autistic parents did not care about their children and even wished that they did not have them (Juhola, 2018, 22). Bernard Rimland strongly disagreed with Bettelheim. In his own research Rimland found that individuals with autism had so many neurological deviations that it was not scientifically reasonable to claim that these would have resulted merely from environmental factors. Nevertheless, Bettelheim's position of authority and broader media coverage meant that researchers such as Rimland did not receive major recognition until decades later. (Juhola, 2018, 25-26.)

As Kanner and Asperger had started to conduct their research on autism they had both decided to use Bleurer's concept, autism, that he had used to describe individuals with schizophrenia (Feinstein, 2010, 26). In 1971 Kanner founded the *Journal of Autism and Childhood Schizophrenia* to allow professionals from the fields of child psychiatry, psychology, psychometrics and neurology to share their ideas and knowledge amongst each other. In the first few decades of autism research, Kanner and other researchers applied the concepts childhood schizophrenia, autism, psychosis and infantile autism interchangeably. From the 1940s to the 1970s autism was rarely diagnosed. Especially professionals that did not exclusively focus on autism tended to prefer labels such as childhood schizophrenia or mental retardation "with autistic features" instead of diagnosing autism. (Silverman, 2012, 39-40.)

By the end of the 1970s, however, consensus had been achieved and the difference between autism and schizophrenia was widely accepted and clearly defined. Another view that was rapidly gaining support was that autism should be acknowledged as a lifelong developmental disorder. Due to these reasons, Kanner's journal was renamed *Journal of Autism and Developmental Disorders*. At this point in time the journal's editors also acknowledged that autism manifested itself in a variety of forms each requiring distinct means of intervention. (Silverman,

2012, 39-40.) Nowadays it is commonly believed that autism can be mitigated but not entirely cured. (Silverman, 2012, 36.)

After WWII, the general view was that disabled people were less worthy than others. In Finland in 1958 a law was executed that declared that all "feebleminded" individuals should be put into institutions designed specifically to isolate them from the rest of the community. It was believed that people with disabilities could not be integrated into society. However, the situation started to change already during the next decade. Ideological changes could be seen in the language when terms such as feebleminded were replaced by words such as disabled, which was deemed less offensive. In 1969 Swedish Bengt Nirje created the normalization principle, the idea of which was to carry out inclusion and integration measures instead of shutting individuals out of the society. This meant that things restricting disabled individuals' lives were to be removed in order to ease their daily life and provide them with the same opportunities that others were enjoying. In Finland in 1978 a law came into effect that recommended non-institutional care as the first choice for disabled individuals. (Juhola, 2018, 26-27.)

Along with inclusion arrived the concept of treatment, which was given so that individuals could learn skills and abilities needed to function in the society. In the United States the idea of normalization sometimes went so far that it was deemed possible to bring all disabled people to the same level as the rest of the population if the support measures were adequate. In the Nordic countries normalization of the individual was viewed slightly differently, the goal being to get the full potential out of the individual's abilities without attempting to reach ability levels of the majority population if that was not deemed to be a realistic goal. (Juhola, 2018, 28.)

4.4 The Role of Technology in Autism Research and Practices

The development of technology has been crucial to research methodology and to the substantial increase in autism research. Significant advances have taken place from the 1960s onwards and in the beginning of the 1990s the technological development soared unprecedentedly. This development has notably increased our knowledge about autism and enabled individuals with autism to lead a more versatile life. One fundamental advancement was the introduction of functional magnetic resonance imaging (fMRI) which made it possible to distinguish between autistic and non-autistic brain activity by studying the functioning of individual brain areas. Another important event was the introduction of modern genetic methods such as recombinant DNA

technology. With these new methods individuals on the autism spectrum could be differentiated from typically developed people by examining their respective DNA structures. Genetic testing also made it possible to spot more subtle differences between individuals with ASD, which enabled the creation of personalized prognoses. Neurogenetic research implies that certain genetic errors can cause autism. However, behavioural intervention can help in reducing autistic symptomatology. (Thompson, 2013, 87-90.)

Keintz et al. (2013) listed the different forms of technological interactive interventions intended for individuals with autism: PCs, internet, mobile appliances, shared active surfaces, virtual reality, sensor and wearable technologies, robotics and natural user interfaces. There are also speech generating devices for verbally impaired individuals. In the past video-cassette recorders were utilized for video modelling, but nowadays more modern solutions, such as tablets and smartphones, are more popular for that purpose. Computers were among the earliest technological applications for interventions for people on the autism spectrum and they remain significant, for example in developing social abilities. Also, with the arrival of telecommunication systems such as Skype, it has become possible for individuals living in secluded areas to participate in interventions. (Odom et al., 2015, 3808.)

5 Presentation of Main Studies

5.1 Computer-Assisted Face Processing Instruction Improves Emotion Recognition and Social Skills in Students with High-Functioning Autism (2015)

A study conducted by Rice, Wall, Fogel and Shic (2015) explored the effects of the FaceSay computer programme on the affect recognition, mentalizing and social skills of 16 elementary school aged children with high-functioning autism. The skills that were trained by FaceSay included eye gaze, joint attention and facial emotion recognition. The study included a control group of 15 students. These students attended to the SuccessMaker computer programme, which was designed to improve its user's linguistic abilities, while the intervention group worked on FaceSay. The control group's children were also autistic and classified as high functioning, as the research participants were randomly allocated into intervention and control groups. The intervention lasted 10 weeks with every child taking part in one 25-minute meeting each week. The participants advanced in the three games on FaceSay at their own speed and were always accompanied by a trained supervisor who helped the children to maintain focused on the task but did not help or interfere in any other way. (Rice, Wall, Fogel & Shic, 2015, 2176-2181.)

The first of the three games on FaceSay is called Amazing Gazing, and it teaches the player to follow the eye gaze of an avatar and to react to joint attention. In this game there are objects, faces and numbers around an avatar. The participants had to follow the eye gaze of the avatar to determine which object, face or number it was looking at. A correct response was rewarded with verbal praise from the game. In the event of an incorrect answer, the correct answer was revealed. The second game was Band Aid Clinic. The idea of the game is for the users to learn to utilize more comprehensive facial recognition methods. In the game the player has to place the correct band aid on a covered part of a face to construct it correctly. The game is meant to improve the abilities of recognizing different facial features and perceiving where they are located. There are also different difficulty levels in the game. The third intervention game was Follow the Leader. In this game children practiced recognizing and identifying emotions from faces, concentrating mainly in the eyes and how small changes in the eyes convey different kinds of emotional information. The children had to find and pair together identical faces and later they had to choose a pair of eyes for a given avatar in an attempt to make it identical with a given example avatar. This game also involved different difficulty levels. (Rice et al., 2015, 2179.)

Both before and after the intervention, the emotion recognition and mentalizing skills of the intervention participants were assessed by the researchers by one-on-one interviews, which lasted around 20 minutes. The social skills of both the intervention and control group children were measured by observations made by a teacher during lessons as well as by two observers during recess both before and after the intervention. These observers collected their data at different times. The teachers and observers did not know which children belonged to the intervention and which were part of the control group. (Rice et al., 2015, 2181.)

The study found that the intervention group improved significantly in all three main categories, which were affect recognition, mentalizing and social skills. More specifically, improvement was observed in the children's abilities to identify basic emotions and in their Theory of Mind abilities. In addition, teachers reported a notable decrease in autistic symptoms observed during the lessons. Despite increased results in all the other tests, the hypotheses of more positive and less negative social interactions observed during recess post-intervention compared to pre-intervention were not entirely supported. One of the most important findings of the research was that it provided implications that it is possible to achieve more holistic positive social outcomes by conducting an experiment where face processing is the main focus. (Rice et al., 2015, 2182-2183.)

5.2 Improving Social Skills in Students with High- and Low-Functioning Autism through a Computer-Based Intervention (2011)

Another study by Hopkins, Gower, Perez, Smith, Amthor, Wimsatt and Biasini (2011) examined, as did the aforementioned study by Rice et al. (2015), the effects of the FaceSay computerized training programme for children on the autism spectrum. As in the study by Rice et al. (2015), differences in emotion recognition and social interactions were measured. Contrary to Rice et al. (2015), however, this research did not investigate changes in mentalizing but rather incorporated facial recognition as the third area to be studied. Like the study by Rice et al. (2015), this research was also a randomized controlled study. (Hopkins et al., 2011, 1543.)

A significant difference to the Rice et al. (2015) study is that in this research by Hopkins et al. (2011) there were children with autism who were classified as high-functioning as well as children with autism who were classified as low-functioning. The classification was done simply according to Kaufman Brief Intelligence Test IQ scores so that children scoring IQ scores of over 70 were classified as having HFA and children with scores below 70 were classified as having

LFA. (Hopkins et al. 2011, 1546.) It is typical to classify individuals with an IQ score of over 70 as high functioning (Laushey et al., 2009, 1435). All participants completed the intelligence tests as part of the study. There were 49 participants out of which 24 were placed into the training group and the remaining 25 into the control group. 24 children were classified high-functioning and 25 low-functioning and the HFA and LFA diagnosed students were fairly evenly distributed into the training- and control group. The students were 6 to 15 years old. (Hopkins et al., 2011, 1546-1547.)

The control group participants worked on the Tux Paint drawing software while the training group received the intervention. All children completed a facial recognition- as well as an emotion recognition test pre- and post-intervention. Additionally, the parents of the participants filled in the Social Skills Rating System questionnaire pre- and post-intervention. The parents were unaware of whether their children belonged to the training- or to the control group. This differed to the Rice et al. (2015) study where the social skills were rated by teachers instead of parents. As in the study by Rice et al. (2015), social skills observations took place for all children pre- and post-intervention. A noticeable difference to the Rice et al. (2015) study was that the observation time per one session was 10 minutes in the Rice et al. study and 5 minutes in this research by Hopkins et al. (2011) The intervention lasted 6 weeks with each participant attending two 10-25-minute sessions per week. This was slightly different from the study by Rice et al. (2015) in the sense that that intervention lasted a bit longer. However, in the Rice et al. (2015) study the intervention frequency was lower as the children had only one session per week. As FaceSay was used also in the Rice et al. (2015) study, the tasks the students worked on were the same and included following the gaze of the avatar, constructing a face puzzle and the matching and manipulation of facial expressions. (Hopkins et al., 2011, 1547-1549.)

The results of the study supported the hypothesis of significant improvement in social interactions for the training group. The social skills of both HFA and LFA diagnosed students improved substantially according to parent observations as well as according to observations performed at school during recess or free time. Furthermore, emotion recognition skills of HFA and LFA diagnosed children alike improved notably. Contrary to the hypothesis of the study, however, the facial recognition skills improved significantly only among children with HFA. The lack of improvement of the participants with LFA in this area was the only result not expected by the researchers. This was also the only field in which all training group participants did not improve from their baseline results. (Hopkins et al., 2011, 1550-1552.)

5.3 Using Assistive Technology to Teach Emotion Recognition to Students with Asperger Syndrome (2007)

A research conducted by LaCava, Golan, Baron-Cohen and Smith Myles (2007) investigated the effects of the Mind Reading: The Interactive Guide to Emotions computer programme on the emotion recognition abilities of eight 8-11-year-old children with Asperger's syndrome (AS). This study differs with those by Rice et al. (2015) and Hopkins et al. (2011) notably in that in those studies the participants had autism, more specifically either HFA or LFA, whereas LaCava et al. (2007) investigated effects on individuals with AS. Secondly, in the current study voice emotion recognition was studied in addition to facial emotion recognition, whereas studies 1 and 2 concentrated solely on facial emotion recognition. (LaCava et al., 2007, 174.)

Another clear difference to the aforementioned studies is that the current study did not include a control group (LaCava et al., 2007, 179). A factor that should also be taken into account is the number of participants in the studies. There were fewer participants in the current study than in the ones discussed above. Furthermore, the computer software utilized in this research was different to the one used in the studies by Rice et al. (2015) and Hopkins et al. (2011). All the participants were tested prior to the intervention to confirm their earlier diagnoses of AS. All children also completed the emotion recognition pre- and post-tests individually on a computer. The tests took around 45 to 90 minutes depending on the child's pace. (LaCava et al., 2007, 175-178.)

The Mind Reading software includes three main areas which are emotions library, learning center and games zone. In the emotions library there is an abundance of different emotions presented in a variety of formats ranging from photographs and videos to audio tracks. The emotions are also linked to a context to aid emotion recognition. The learning center is a learning and practice area that provides different kinds of lessons and quizzes. The users practice connecting facial expressions and sounds with the corresponding words describing the emotions. Children are further motivated by a built-in reward system that gives them for example vehicles or animals for right answers. The games zone has interactive games in which users must guess and connect emotions. Evaluating actual faces is also included in the games zone. The participants were instructed not to spend more than a third of their time in the games zone. This was done to make sure that the other sections would be utilized as well. (LaCava et al., 2007, 177.)

The intervention lasted 10 weeks with five participants completing the intervention tasks at home and three at school. During the intervention, the researchers performed several check-ins either by calling or physically visiting the participants to ensure they were making progress and

to offer help and guidance if necessary. The children used the Mind Reading software on average for 10,5 hours during the intervention period. (LaCava et al., 2007, 176-178.)

The results showed that participants improved both facial and voice emotion recognition abilities when tested for emotions that were included in the Mind Reading software. This was true for both basic and complex emotions. Additionally, the children improved in recognizing complex emotions from voice samples that were not in the Mind Reading software. (LaCava et al., 2007, 179.)

5.4 Computer Training Programme Intervention Develops Facial Emotion Recognition and Self-Expression of Facial Emotions in Children with ASD (2014)

A study by Russo-Ponsaran, Evans-Smith, Johnson and McKown (2014) explored the effects of a computer training programme called MiX on the emotion recognition and emotion self-expression abilities of three 8-14-year-old children with ASD. All participants had an IQ above 80. This study differs from the others examined here in the sense that it is the only study which examines the changes in children's self-expression of emotion in addition to emotion recognition. Furthermore, as in the research by LaCava et al. (2007) this study did not have a control group, whereas the studies by Rice et al. (2015) and Hopkins et al. (2011) both had control groups. Also, the number of participants in this study is clearly lower than in the ones discussed earlier, although even those studies did not have very large numbers of participants. The pre- and post-intervention tests as well as the intervention were all conducted with the MiX programme. (Russo-Ponsaran et al., 2014, 173-174.)

The duration of the intervention was eight weeks, which is similar to the studies discussed above. There were two sessions per week. A clear difference to the studies 1 and 2 is that the time allocated to one session was around one hour in this study, whereas it was no more than 25 minutes in studies 1 and 2. In study 3 participants were free to use the programme, so no time for the length of single sessions was defined. All intervention sessions had the same structure. First, a video teaching about the emotion under examination was played on the MiX. After that the participants were shown video footage concentrating on different facial regions and what happened to these regions during the emotion that was studied. At this point an assistant would put a specific cover over the screen. The purpose of this was to hide all areas except for the one being under examination, so that the children could more easily focus on that specific region, for example only

the eyes or only the mouth. Straight after studying the specific regions the participants moved on to attempt to replicate the facial expressions. The imitation happened so that the children were able to see their face on the computer screen via the web camera while they attempted to mirror the expressions they had just viewed. Each emotion was studied and practiced in this way during each session. (Russo-Ponsaran et al., 2014, 176.)

Following the imitation phase, the children moved on to complete a practice test and then a proficiency test. In these tests the idea was to see how the participants had progressed in their learning. The tests consisted of images of a variety of human faces and the children had to link the correct emotion word to the faces. The presentation speed of items for the participants in the MiX programme was set based on each individual's personal needs. At first it was half a second per item, but the time was dropped as the children achieved good results. The speed was also slowed down for those who had more problems in the tasks. If a participant achieved less than half correct answers during a session, then in the beginning of the next meeting the child would view again the instructional video addressing that particular emotion before continuing with the regular session routine. (Russo-Ponsaran et al., 2014, 176-178.)

All participants developed their facial emotion recognition speed and accuracy as well as their self-expression of facial emotions. The maintenance tests showed that the children managed to produce results similar to their post-intervention results. In some areas their maintenance test results were better than their post-intervention results. In some areas there was regression from post-intervention, but the maintenance tests produced still clearly better results than the pre-intervention tests. (Russo-Ponsaran et al., 2014, 182.)

6 Discussion

All four studies discussed here explored the effects of computer training programme interventions on the facial emotion recognition abilities of children with autism spectrum disorders. In all four studies children who received the intervention improved their emotion recognition skills. The studies by Rice et al. (2015) and Hopkins et al. (2011) also investigated the effects of the computer programmes on the social skills of the children. Also, in these two studies that investigated the effects of the interventions on children's social skills, improvements in these skills were documented. The social skills improved in classroom, recess and home settings, as evaluated by teachers and parents. For instance, teachers reported a decrease in autistic symptoms in the children's behaviour (Rice et al., 2015, 2182).

In the study by Hopkins et al. (2011) children with high functioning autism had an increase in positive social interactions, meaning that they initiated interaction with others for example by sharing experiences or toys with them. Children with low functioning autism on the other hand showed less negative behaviours post-intervention as opposed to pre-intervention. An example of this is that after the intervention the children were more likely to have a positive social reaction to a peer's attempt to make contact with them. According to parents' reports the children's assertiveness, self-control and ability to take responsibility increased during the intervention. (Hopkins et al., 2011, 1552.)

Although the results of these studies are promising, they all have limitations that must be considered when analyzing the generalizability and reliability of the results. For instance, the number of participants in the studies was quite low. In the study by Rice et al. (2015) the authors suggest that their study could be repeated with more participants and the ages and educational backgrounds of the children could be more diverse. For example, it was mentioned that the study could include children from preschools, secondary schools and special educational settings instead of only elementary school students. (Rice et al., 2015, 2184.) Furthermore, the studies by LaCava et al. (2007) and Russo-Ponsaran et al. (2014) did not include control groups. As stated in the study by Russo-Ponsaran et al. (2014), this affects the reliability of the results, because factors such as developmental changes in the children's skills cannot be excluded as having influenced the outcomes of the intervention (Russo-Ponsaran et al., 2014, 185). Another question left unanswered in these studies is whether the social skills that the participants acquired would generalize into other contexts, where the children would interact with random people instead of individuals they know (Hopkins et al., 2011, 1553).

Also, in the study by Hopkins et al. (2011) it is mentioned that it is unknown how the duration of the intervention affects the results. The possibility that a shorter intervention period would have produced similar results has to be considered. Also, there is the possibility that a longer intervention would have produced better results. Furthermore, an interesting and important remark by Hopkins et al. (2011) is that there is no knowledge about how the intervention participants will retain the skills they gained from the intervention in the long run. For instance, would the participants produce same, or even improved, results for example a year or more after the intervention? (Hopkins et al., 2011, 1553.) In the study by Russo-Ponsaran et al. (2014) the participants were tested, in addition to the initial post-tests, also several weeks after the conclusion of the intervention. In these maintenance tests the children produced results similar to those of the initial post-intervention tests. (Russo-Ponsaran et al., 2014, 179 & 182.) However, it would be important to find out how the skills can be maintained after longer periods of time.

7 Conclusion

Having analyzed the four studies investigated in this paper, it may be concluded that computer assisted technology is a promising method for teaching facial emotion recognition for children with autism spectrum disorder. Furthermore, the studies by Rice et al. (2015) and Hopkins et al. (2011) provide considerable evidence that using CAT to teach facial emotion recognition to children with autism spectrum disorder enhances the social skills of these children. As mentioned earlier, there are questions related to the generalizability and reliability of the results of the studies examined here. For this reason, further studies need to be undertaken. However, the findings by Rice et al. (2015) and Hopkins et al. (2011) suggest that CAT has potential to improve the social skills of individuals on the autism spectrum in classroom, recess and home settings.

There are also several reasons as to why CAT is appealing and effective for many children with ASD. First of all, children with ASD have usually as good, or even better, systemizing abilities than typically developed children. As mentioned earlier, systemizing can be understood as a drive to analyze or create systems in order to make sense of and to foresee behaviour and underlying rules. This makes it quite natural that computers with their logical, rule-based systems are beneficial for supporting the learning of children with ASD. (LaCava et al., 2007, 179.) Additionally, interacting with computers does not demand as advanced social skills as interacting with other people. Children can also take their own time with computer programmes and work at a difficulty level that suits best their current proficiency. Computer programmes are also often designed to be visually appealing. This can be especially helpful for children with ASD because they often have excellent visual memory (Kerola, Kujanpää & Timonen, 2009, 62).

As mentioned in the study by Hopkins et al. (2011), CAT is only one method used for learning and practicing social skills, as real-life social interactions are regarded as the most significant approach for training. CAT may be especially beneficial when it is used together with more traditional real-life methods and it may be especially useful when utilized at early stages of social skills training particularly if the child gets anxious in social situations. Moreover, CAT provides a safe space for a child with ASD to refine his/her skills in preparation for actual social interaction situations. (Hopkins et al., 2011, 1553.)

CAT can also improve the life of an individual on the autism spectrum by reducing social anxiety. A study by Kuusikko et al. (2008) that investigated social anxiety in children and adolescents found that children with ASD experienced more anxiety on all measures than their typically developed peers (Kuusikko et al., 2008, 1697). Russo-Ponsaran et al. (2014) propose that

practicing facial emotion recognition with CAT can be beneficial for children with ASD because their confidence in their own abilities grows. As the children would gain confidence their anxiety levels would decrease, which would again lead to the children feeling more comfortable in social contexts. This could also allow children with ASD to make friends more easily. (Russo-Ponsaran et al., 2014, 186.) LaCava et al. (2007) have similar conclusions. They argue that increased Theory of Mind abilities could help children with ASD to integrate into school as well as the society in general. This would obviously have positive effects for the children's self-esteem and quality of life. (LaCava et al., 2007, 180.)

Despite the promising results and potential that CAT has demonstrated there are some risk factors that should be considered when it is utilized. As noted earlier, traditional social skills training methods are still considered more essential than CAT. Relying too much on technology and forgetting about real-life social skills training would probably prove counterproductive. Furthermore, there is a risk involved in the application of CAT that the society will become less likely to accept individuals with ASD for who they are. For instance, teachers could start thinking that children with ASD should reach higher levels of facial emotion recognition and social skills than is realistic for them. Teachers would need to remember that it is not fair, realistic or meaningful to expect children with ASD to reach similar levels of competence as their typically developed peers. The child should be always viewed as an individual and the goals that are set for and with him/her should be based on the child's individual condition, personality and historical background.

As mentioned in the discussion chapter, despite the positive results of CAT interventions in improving the emotion recognition and social skills of children on the autism spectrum, there are several factors that require further research. Similar research needs to be conducted in the future, but with higher numbers of children from more diverse educational background, i.e. from kindergarten, secondary school and special educational settings in addition to the elementary school setting, which has been more prevalent in these studies. It is important to include control groups in future studies, which was something that was not done in two of the main studies inspected in this thesis. Furthermore, there is a need for studies where the intervention participants interact with people they are unfamiliar with. In the studies analyzed in this thesis the children only interacted with familiar people, i.e. with classmates, teachers and parents. It is also important to carry out studies with longer as well as shorter intervention periods than in the studies examined in this thesis, to find out if similar results can be achieved in a shorter period of time, as well as to find out if longer interventions can produce more benefits. Finally, skill retention needs to

be studied more, meaning that there is a need for long-term studies that follow the intervention participants for months or even years, to evaluate long-term effects of interventions. It would be possible to continue this bachelor's thesis' topic in the master's thesis. This could be done for example by contacting researchers who work on this topic and asking to participate in field research with them. This would be a good way also for combining theory with more practical personal experience on the subject, which would foster the development of a broader understanding of the topic.

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