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Music therapy for children with Autism Spectrum Disorder

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CHAPTER 2.

Music therapy for children and adolescents with ASS: an overview of the relevant literature

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Abstract

Music therapy is regularly used with children and adolescents diagnosed with autism spectrum disorder (ASD). The question is whether such therapy is effective. This article provides an overview of the latest literature published on this subject. From 1990 to 2016 we found 33 studies which focus on the application and effects of music-based therapeutic interventions: 6 reviews, 12 RCT/CCTs, and 15 studies which were either case studies or used, for example, as pre- and post-measurement while lacking a control group.

Various studies report significant effects with regard to music therapy on children and adolescents with an ASD diagnosis. A significant effect (*SMD* 1.06) is especially reported regarding the aspect of social interaction. In the areas of verbal and nonverbal skills, moderate effects (*SMD* 0.33 and *SMD* 0.73) have been reported.

The evidential value of these results is, however, questionable since the samples are relatively small or because the research design had not always been properly defined. Furthermore, music is offered to the children in many different ways, which raises the question: what can be defined as music therapy and what cannot? Additionally, there is no rationale behind the music therapy: why would music therapy be effective with ASD? It has been demonstrated that music therapy may be an effective intervention for children with ASD, but more research is required to answer the question as to which music-based therapeutic intervention is most effective.

Introduction

An autism spectrum disorder (ASD) already becomes apparent in early childhood and has lifelong consequences, of which inhibitions in social interaction are often the most evident (Wing, 1997). The two main categories of ASD characteristics in DSM-5 are a lasting inhibition in the area of social communication and social interaction in various situations, and the limited, repetitive ways of expression, interests, and activities (APA, 2013). ASD can show itself in a broad range of manners, depending on the severity of the disorder and the person's age (Wing, 1997, 2001). People with ASD need contextual support in different ways, depending on their capability to interact socially (APA, 2013). On the other hand, social interaction often appears to be a skill that is difficult to train and acquire, meaning that it also requires a great deal of creativity from the practitioners. It is, therefore, a major challenge to find a responsive treatment method in order to achieve results (Schertz & Odom, 2007).

Music therapy as an intervention method for children and adolescents with ASD who experience severe challenges in all social areas already has a long-standing history. The first case study dates back to 1940 (Reschke-Hernandez, 2011).

Music therapy is a form of therapy that is part of the so-called non-verbal therapies. This treatment method uses music as a way of offering experiences that stimulate a person's development process. The therapist knows how to identify and interpret the human reaction to music using the musical elements of beat, rhythm, melody, harmony, and sound by making use of musical instruments, the voice, musical games, improvisation, and existing repertoire (Kern and Humpal, 2012).

The underlying objective when offering music therapy to children and adolescents with ASD is often to motivate and stimulate them to interact with others (Gattino et al., 2011). Music is used as a method to help them to make contact and it offers the child unique opportunities for nonverbal communication (Kim et al., 2008) and to alternate between the role of initiator and imitator in a playful setting and manner (Holck, 2004). Children with ASD often find it hard to have direct social interaction. Within the safe setting of music therapy, children can learn to interact in an indirect way through music. At the same time, they enjoy the music and find it relaxing (Geretsegger et al., 2014). The music therapist can create a safe environment by being a predictable and social partner. The music therapy allows the children to familiarize themselves with the new skills through music. During the course of the therapy, the musical aspects can be gradually shifted to the background which will stimulate the children with ASD to use the newly learned skills without music.

Social and health care practices in the Netherlands regularly use music therapy in the treatment of children and adolescents with ASD, in institutionalized environments as well as in special needs education and outpatient care. The number of music therapists who work with this target group in the Netherlands is not exactly known. In 2015, a representative of the Dutch Association of Music Therapists (Nederlandse Vereniging voor Muziektherapeuten) estimated that over two hundred music therapists can be categorized in this target group.

Several studies have been conducted into music-based therapeutic treatments with this target group. However, it is not exactly clear what kind of musical interventions are being used during the treatment, and there is no uniform definition of what music therapy exactly entails (Accordino et al., 2007). This makes it difficult to study the effects of music therapy on children and adolescents with ASD. First, it is important to get an overview of the conducted studies and their results in order to come to a sound substantiation for the use of music therapy. Subsequently, the areas that show results and the treatment methods that are used will be discussed.

Method

For this study, a systematic literature review was conducted, for which the following databases were used: Cinahl, PsycINFO, PubMed, Web of Science, and the Cochrane Library. Additionally, we went *through the Dutch magazine for music therapy (Tijdschrift voor Vaktherapie), British Journal of Music Therapy, Music therapy Review (Musiktherapeutische Umschau), Journal of Music Therapy, and Music Therapy Perspective* to find further literature. Lastly, references and quotes from the selected articles were screened. The review was conducted on studies dating from 1990 to June 2016.

For the search strategy, the following keywords were used: autism, autism spectrum disorder, ASD, music, music therapy, behavior, child, youth, social behavior, PDD-NOS, social cognition.

The screening of the databases resulted in 637 studies. After removing double hits, studies that did not include the target group, studies that did not include music therapy, and studies that did not include music-based therapeutic interventions, 33 studies remained, which can be categorized as:

- 6 reviews;
- 12 randomized controlled trials (RCT) or controlled clinical trials (CCT);
- 15 other studies, in most cases these were case studies.

After a first screening of the studies, it became apparent that the target group is very varied, that there are various objectives and effect variables, and different variations of interventions. Very often the specifications of the treatment were lacking as well. An example of this is the study conducted by Brown and Jellison (2012), which focused on the use of music with children with special needs and a delayed development. They studied a very broad target group and the use of music in a broad sense, without providing a specific definition of the activities. Another example is the review of Srinivasan and Bhat (2013) into the influence of music and movement on children with ASD. Again, the use of music was included broadly: the review included studies into the influence of music, music education, or music therapy, without offering a clear definition. Because these two comprehensive studies did not explicitly deal with music therapy, they were not included. An earlier meta-analysis done by Whipple (2004) does focus specifically on music therapy but the quality of the included studies had not been assessed and showed a large variation of moderators, disciplines, and interventions in the included studies. According to Geretsegger et al. (2014), this meta-analysis also lacked the specifications of the treatment. Strictly speaking, it is debatable whether the study by Whipple could be labeled as a meta-analysis; it actually is 'just' a survey study.

When considering the broad heterogeneity of the target group and the interventions in the studies that have been conducted so far, as well as the serious shortcomings in the definitions of the target group and interventions and the relatively small number of studies, we would need to conclude that there is currently insufficient foundation for a meta-analysis. Such an analysis would result in comparing apples to oranges while, at the same time, the number of studies is too small to make partial analyses of more homogenous groups of studies. Therefore, this publication will only offer a descriptive overview of the studies that were found.

First, an overview is given of the reviews that were found, which included studies from 1940 to 2012, which focus explicitly on music therapy with children and adolescents with ASD. Subsequently, the results of the most recent reviews will be discussed, focusing specifically on studies with a RCT and CCT design. Furthermore, an overview is given of studies that were based on another research design and which included an effect measurement in the area of music therapy with ASD. Next, we offer an overview of the areas in which the use of music therapy for children and adolescents with ASD has proven to be effective. Lastly, we provide a description of the work methods that are used in music therapy treatment for children and adolescents with ASD.

Results: general view

Table 1 gives an overview of the six reviews, focusing on the use of music therapy with people with ASD.

The descriptive survey studies offer details of these studies in music therapy with children and adolescents with ASD from 1940 to 2012. The majority of the studies focus on participants between the ages of three and twelve. Accordino et al. (2007) included four studies in which the participants were older than 21. The most recent review is the one conducted by Geretsegger et al. (2014). They studied the effect of music therapy on adolescents as well as on adults with ASD. Comparisons were made between the use of only music therapy, music therapy in addition to regular care, the same treatment without music or treatment as usual. The duration of the interventions ranged from a week to seven months. In the studies included in this review, they made a distinction between primary and secondary results. The primary results showed that the use of music therapy was more effective than the use of standard care or placebo therapy. Of the selected studies, the standardized mean difference (*SMD*) has been calculated with the corresponding 95% confidence interval (*CI*). Additionally, the results indicated the number of participants on which the calculation was based (*N*=).

In terms of social interaction, a significant effect was measured within the therapeutic context (*SMD* 1.06, 95% *CI* 0.02–2.10, 1 RCT, *N* = 10). In terms of the participants' social interaction in daily life, outside of their therapy setting, a moderate effect was concluded (*SMD* 0.71, 95% *CI* 0.18–1.25, 3 RCTs, *N* = 57). However, the review indicated that the quality of the three included RCTs had been poor because they showed restrictions in the design, such as the lack of a clearly stated randomization and a lack of measures to process the results in a reliable way.

Table 1, Overview reviews (no distinction between/ adolescents and adults)

author(s)	type	included studies	
Whipple 2004	meta-analysis	10	1 RCT 9 case-series/case studies/other design
Wigram and Gold 2006	review	3	3 RCT
Accordino et al. 2007	review	20	20 case series/case studies/ other design
Reschke-Hernández 2011	overview	34 (1940-1989)	0 RCTs 34 case series/case studies/ other design
		16 (1990-2009)	4 RCTs/CCTs 12 case series/case studies/ other design
Simpson and Keen 2011	narrative review	20	4 RCTs/CCTs 16 case series/case studies/ other design
Geretsegger et al. 2014	systematic review	10	10 CTs/CCTs

RCT randomized controlled trials, CCT controlled clinical trials

The nonverbal skills (SMD 0.57, 95% CI 0.29–0.85, 3 RCTs, $N = 30$) and the verbal communication skills (SMD 0.33, 95% CI 0.16–0.49, 6 RCTs, $N = 139$) showed a moderate effect. The evidential value of these findings is low, because only one of the used studies on communication skills showed significant results. The initiating of behavior showed a moderate effect (SMD 0.73, 95% CI 0.36–1.11, 3 RCTs, $N = 22$). With regard to socio-emotional reciprocity, a strong effect was found (SMD 2.28, 95% CI 0.73–3.83, 1 RCT, $N = 10$). Given the fact that these results are based on one RCT with a small sample group, the evidential value of this aspect is low as well.

The secondary skills included social skills, functioning at school, functioning at home, the quality of relationships, and cognitive skills. Geretsegger et al. (2014) concluded that the use of music therapy was more effective on secondary skills than the use of standard care or treatment as usual. With regard to social adaptation, they found that it had a moderate effect (SMD 0.41, 95% CI 0.21–0.60, 4 RCTs, $N = 26$). With respect to the areas of enjoyment (SMD 0.96, 95% CI 0.04 - 1.88, 1 RCT, $N = 10$) and the quality of the parent-child relationship (SMD 0.82, 95% CI 0.13–1.52, 2 RCTs, $N = 33$) they found that it had a strong effect. In a meta-analysis of multiple case studies and controlled studies, Whipple (2004) shows significant results that suggest that interventions with music are more effective than interventions that do not include music. This meta-analysis includes ten studies in which the effects of behavioral interventions, with or without music, (for example, social interaction) were compared to each other. The effect size is depicted in Cohen's d . The effect size of the different studies ranges between $d = 0.09$ (no effect) and $d = 3.46$ (very large effect). The overall effect size of the ten studies is $d = 0.83$ (large effect) with a correlation coefficient of $r = 0.38$ ($p < 0.001$). Each separate study shows that the use of music therapy has a positive effect. However, the homogeneity value Q is not significant ($p = 0.39$), which means that the results of the studies cannot be considered to be consistent. Because the effect size of Wimpory et al. (1995) was considerably higher ($d = 3.36$) (very large effect) and contained only one subject, the overall effect size was calculated again after excluding this study.

This resulted in an overall effect size of $d = 0.77$ (large effect) with a correlation coefficient of $r = 0.36$ ($p < 0.001$). Again, this also resulted in an insignificant homogeneity value Q ($p = 0.83$); the effect size varied between $d = 0.09$ and $d = 1.71$ (very large effect).

The other reviews with a similar nature to that of Whipple (2004) (Accordino et al., 2007; Reschke-Hernández, 2011; Simpson & Keen, 2011; Wigram & Gold, 2006), show that there are indications that the use of music therapy on client with ASD has a positive effect.

The studies included in the reviews were predominantly, but not exclusively, effect studies focused on children/adolescents with ASD. Table 2 gives an overview of the studies with a RCT or CCT design in which this is actually the case. These studies specifically focus on the effects of music in the treatment of children with ASD between the ages of one and twelve. The studies that are included in the review of Geretsegger et al. (2014) are also included in Table 2. Since the publication of this review, one new RCT was conducted, namely by Ghasemtabar et al. (2015). The objective of this RCT was to study the effects of music therapy on the social skills of children with ASD. The results are in line with those of the review by Geretsegger et al. (2014). Ghasemtabar et al. (2015) noticed that the social skills of children with ASD significantly improved when they received music therapy treatment ($d = 0.85$, large effect).

Table 3 gives an overview of the other studies on children and adolescents, and includes a description of the applied intervention and the results. The studies mainly focus on social behavior and communication. All case studies describe a noticeable positive effect when this target group receives music therapy treatment.

Although the studies suggest a positive effect, Geretsegger et al. (2014) remark that the previously published studies included a relatively small study population. Moreover, no conclusions can be drawn about the effects in the long term, because the included studies all cover a short period of time, and that no or only a few follow-up measurements were made.

Accordino et al. (2007) made some critical remarks in their literature review of the study into music therapy with people with ASD, because it is their opinion that too many case studies are being conducted, and not much systematic research in the form of an RCT. For example, Accordino et al. (2007) consider the study conducted by Wigram and Gold (2006) to be insufficiently thorough, because it was based on insufficient systematic research. These researchers criticize Whipple (2004) about the fact that the meta-analysis includes a large variety of studies in which music was used in its broadest sense and exclusively in the form of music therapy. In addition, this review was also based on unpublished studies which are difficult to verify.

According to Geretsegger et al. (2014), there is a need for better research into the complex interventions such as improvising music therapy. It is essential that these studies are specific about the research design that was used, as well as about the effectiveness of the design that was used. They believe it to be important to use larger samples in order to make robust conclusions about a flexible, individualized treatment based on improvisation (Geretsegger et al., 2016).

Table 2, Overview RCT/CCT studies with children/ adolescents

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens <i>d</i> overall effect	criticism
Buday ^a 1995	N=10 aged 4-9	RCT randomize, single blind, crossover	musical training	language training	frequency of imitation on singing and speech	– significant effect ($p < 0.05$) when music was used; music training has a positive effect on the imitation of words. – music vs. Rhythm imitation sung words ($F = 6.54, p < 0.05$) imitation spoken words ($F = 8.33, p < 0.02$)	Cohens <i>d</i> not calculable based on reported data	– no details about diagnostic process – no standardized outcome measure
Farmer ^a 2003	N=10 aged 2-5	RCT randomized parallel group	music therapy vs. no therapy	response during sessions through gestures and verbally	reaction during the session: verbal reaction and non- verbal reactions	– noticeable increase of the verbal reaction with musical intervention – experimental group: $N = 5$, av. 102.70, $sd = 93.26$ – control group: $N = 5$, av. 31.00, $sd = 32.95$	– experimental group vs. control group – Cohens $d=1.03$ <i>large effect</i>	– no details about diagnostic process – no standardized outcome measure
Gattino et al. ^a 2011	N=10 aged 7-12	RCT randomize, single blind, parallel group	relational music therapy vs. standard treatment	verbal, non-verbal and social communi- cation	CARS-BR	the music intervention showed an improvement on nonverbal communi- cation no significant differences measures experimental group: $N = 12$, av. 5.76, $sd = 0.54$ control group: $N = 12$, av. 5.61, $sd = 0.47$	– experimental group vs. control group – Cohens $d=0.30$ <i>small effect</i>	– no details about diagnostic process – no standardized outcome measure

Table 2, Overview RCT/CCT studies with children/ adolescents (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens d overall effect	Criticism
Kim et al. ^a 2008	N=10 aged 3-5	RCT single blind, crossover	improvisation music therapy vs. play sessions	social interaction, nonverbal communication skills, initiating behavior, socio-emotional reciprocity	PDD-BI, ESCS, clinical observations	significant effect ($p < 0.05$) in mutual attention, communication skills and socio-emotional reciprocity during the musical intervention	Cohens $d = 0.63$ medium-sized effect	high 'drop-out' at start $N = 15$ in data analysis $N = 10$
La Gasse 2004	N=17 aged 6-9	RCT	group music therapy and non-musical training of social skills	eye contact, shared attention and communication skills	SRS, ATEC	<ul style="list-style-type: none"> - on shared attention and eye contact significant ($p < 0.05$) differences found to the advantage of the music therapy group - experimental group: $N = 9$, av. 12.20, $sd = 4.030$ - control group: $N = 8$, av. 10.02, $sd = 3.93$ 	<ul style="list-style-type: none"> experimental group vs. control group Cohens $d = 0.55$ medium-sized effect no random allocation of participants to the two separate groups 	

Table 2, Overview RCT/CCT studies with children/ adolescents (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens <i>d</i> overall effect	Criticism
Lim ^a 2010	N=50 aged 3-5	RCT randomize, single blind, parallel group	musical training vs. speech training vs. no interven- tion	speech production	VPES	<ul style="list-style-type: none"> – improvement in speech production with the intervention groups; however, with low functioning participants only in the music condition – difference in pre- and post-measurement – musical condition: $N = 18$, av. 77.47, $sd = 43.09$ – speech condition: $N = 18$, av. 65.33, $sd = 56.89$ – control group: $N = 14$, av. 0.93, $sd = 9.84$ 	<ul style="list-style-type: none"> – musical condition vs. control condition – Cohens $d = 2.45$ <i>large effect</i> – speech condition vs. control condition – Cohens $d = 1.58$ <i>very large effect</i> 	<ul style="list-style-type: none"> no details about diagnostic process no standardized outcome measure
Thompson ^a 2012	N=23 aged 2-6	RCT randomize, parallel group	Family music therapy vs. Standard treatment	<i>social com- munication parent-child relationship</i>	VSEEC, SRS, MB- CDI- W&G, PCRI, MTDA, clinician obser- vation measure	<ul style="list-style-type: none"> – significant difference in primary ($p < 0,001$) outcome measure (VSEEC) in favor of the experimental group; no statistic difference in de other scales experimental group: $N = 12$, av. 181.83, $sd = 52.60$ – control group: $N = 11$, av. 161.65, $sd = 35.51$ 	<ul style="list-style-type: none"> experimental group vs. control group Cohens $d = 0,45$ <i>Small effect</i> 	<ul style="list-style-type: none"> no independent measurement as this is done by the parents of the test persons

Table 2, Overview RCT/CCT studies with children/ adolescents (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens <i>d</i> overall effect	Criticism
Arezina ^a 2011	N=6 aged 3-5	CCT randomized cross-over	music therapy vs. interactive play therapy	shared attention	behavior observation (25 second- partial interval)	<ul style="list-style-type: none"> – significant ($p < 0.05$) more interactions during interactive music therapy – experimental condition: N = 6, av. 10.81, sd = 3.57 – control condition: N = 6, av. 3.78, sd = 3.97 	<ul style="list-style-type: none"> – effect pre- vs. post measurement – Cohens $d = 1.86$ very large effect 	<ul style="list-style-type: none"> – no mention of blinding randomization – no details about diagnostic process – no standardized outcome measure
Brownell ^a 2002	N=4 aged 6-9	CCT randomized cross-over	receptive music therapy vs. storytelling therapy vs. no intervention	repetitive behavior	observation repetitive behavior outside the therapy, in class	<ul style="list-style-type: none"> the conditions singing and reading a story were signifi- cantly better ($p < 005$) in order to achieve intended behavior 	<ul style="list-style-type: none"> Cohens d not calculable based on reported data 	<ul style="list-style-type: none"> – manner of randomiza- tion not defined – no details about diagnostic process – no standardized outcome measure

Table 2, Overview RCT/CCT studies with children/ adolescents

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens d overall effect	Criticism
Ghasemtaba et al. 2015	N=27 aged 7-12	CCT randomized, parallel group	group music therapy vs. no music therapy	Social Skills	Social Skills Rating System (SSRS)	<ul style="list-style-type: none"> - significant ($p < 0.001$) increase in social skills in favor of the experimental group - experimental group: $N = 13$, $av. 30.55$, $sd = 4.00$ - control group: $N = 14$, $av. 27.34$, $sd = 3.54$ 	<ul style="list-style-type: none"> - experimental group vs. control group - Cohens $d = 0.85$ - large effect 	<ul style="list-style-type: none"> - no random allocation of participants to one of the groups
Lim and Drapper ^a 2011	N=22 aged 3-5	CCT randomized, single blind, cross-over	music training vs. speech training vs. no intervention	Speech production	behavioral observation (verbal)	<ul style="list-style-type: none"> - both intervention groups showed a positive effect; no significant difference - musical intervention: $N = 22$, $av. 34.45$, $sd = 14.77$ - no intervention: $N = 22$, $av. 25.22$, $sd = 14.51$ 	<ul style="list-style-type: none"> - effect pre- vs. post-measurement - Cohens $d = 0.63$ - medium-sized effect 	<ul style="list-style-type: none"> - No details about diagnostic process - No standardized outcome measure
Thomas and Hunter ^a 2003	N=6 aged 2-3	CCT Randomized cross-over	music therapy vs. play sessions	Shared attention	Behavioral observation	<ul style="list-style-type: none"> - considerable improvement of social adjustment and the initiation of behavior with musical intervention 	<ul style="list-style-type: none"> - Cohens $d = 0.59$ - medium-sized effect 	<ul style="list-style-type: none"> - manner of randomization not defined - no details about diagnostic process - no standardized outcome measure

^aArticles included in review by Geretsegger et al. Abbreviations outcome measures: ATEC Autism Treatment Evaluation Checklist, CARS-BR Childhood Autism Rating Scale, Brazilian version, ESCS Early Social Communication Scales, PDD-BI Pervasive Developmental Disorder Behavior Inventory, SRS Social Responsiveness Scale, MB-CDI-W&G The MacArthur-Bates Communicative Development Inventories, Words and Gestures, MTDA The Music Therapy Diagnostic Assessment, PCRI The Parent-Child Relationship Inventory, SSRS Social Skills Rating System, VPES Verbal Production Evaluation Scale, VSEEC Vineland Social-Emotional Early Childhood Scales, RCT randomized controlled trials, CCT controlled clinical trials

Results: effect on specific skills

The previous discussion of the studies did not yet offer a distinction between the specific social skills in which an effect is noticeable. The research conducted into music therapy for children and adolescents with ASD that has been published so far focuses predominantly on social interaction and communication skills.

Social interaction

The study published by Ghasemtabar et al. (2015) has shown that the use of music therapy has a significant effect on the social skills of children and adolescents with ASD. This is in line with the results from studies conducted by Edgerton (1994), Gattino et al. (2011), Katagiri (2009), Kern and Aldrige (2006), Kern et al. (2007), Kim et al. (2008), Vaiouli et al. (2015) and Wimpory et al. (1995).

Children with ASD find it difficult to cope with direct social interaction. The safe setting in music therapy offers the opportunity to practice social interaction via a 'detour', namely through music. By conducting a RCT, Kim et al. (2008) demonstrated that the effect of music therapy on the frequency and duration of shared attention is significantly larger than with play therapy sessions. These authors also noticed an effect on the initiation of shared attention, namely eye contact and its interactive effect. For this study, they conducted a comparative study of children with ASD, between the ages of three and five, who were offered improvised music therapy with the same group that received play therapy. The music therapist used, amongst other things, a piano, a cymbal, a xylophone, drums, and other small musical instruments.

The results of the studies in terms of social interaction are consistent with the effect that Geretsegger et al. (2014) concluded based on their review, which was a large effect (*SMD* 1.06).

Table 3. Overview of other intervention studies

<i>author(s)</i>	<i>Sample size</i>	<i>design</i>	<i>intervention</i>	<i>focus</i>	<i>outcome measure</i>	<i>results as reported</i>	<i>Cohens d</i>
Geretsegger et al. 2016	N=15 aged 4-6	feasibility study RCT	improvisation music therapy with three conditions: – 3 sessions per week (total 60) and 3 parent sessions – 1 session per week (total 20) and 3 parent sessions – Standard treatment and 3 parent sessions	social communication	ADOS, Social Responsiveness Scale (SRS)	the 15 participants allocated to one of the three categories did not show significant differences when compared to each other	Cohens <i>d</i> cannot be calculated based on the reported data
Vaiouli et al. 2015	N=3 aged 5-7	case study	Improvised music therapy	eye contact, response to shared attention, initiation of shared attention	observations	– the study showed improvement in social skills and improvement in the shared attention – average improvement compared to baseline: eye contact 1.84 response shared 3.05 initiating attention 1.83	Cohens <i>d</i> cannot be calculated based on the reported data

Table 3, Overview of other intervention studies (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens d
Dezfoolian et al. 2013	N=5 aged 2-12	case study	improvised music therapy (Orff-music therapy)	social interaction, verbal communication, and repetitive behavior	Autism Diagnostic Interview-Revised (ADIR)	the average scores of verbal communication and repetitive behavior improved significantly ($p < 0.05$)	effect pre- vs. post-measurement – social interaction Cohens $d = 3.72$ – verbal communication Cohens $d = 1.46$
Hillier et al. 2012	N=22 aged 13-29	case study	group music therapy	self-esteem, anxiety, and attitude towards peers	Index of Peer Relations (IPR) (participant and parent version) Rosenberg Self-Esteem Scale (SES) State-Trait Anxiety Inventory (STAI)	– after musical intervention: increased self-esteem, reduced sense of anxiety; the participants gave their own self-esteem a significantly higher score – IPR participant version $p = 0.016$ – SES Cohens $d = 0.049$ – STAI $p = 0.004$	effect pre- vs. post-measurement – IPR participant version Cohens $d = 1.44$ – IPR parent version Cohens $d = 0.35$ – SES Cohens $d = 0.34$ – STAI Cohens $d = 0.54$

Table 3. Overview of other intervention studies (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens <i>d</i>
Kalas 2012	N=13 aged 4-6	2 x 2 repeated measures factorial design	simple musical condition, complex musical condition	shared attention	Early Social Communication Scale (ESCS) Responding to Joint Attention (RJA)	<ul style="list-style-type: none"> - the study showed that simple music triggers a response with children with a severe form of ASD, and complex music triggered a response in cases with a mild form of ASD - mild form of ASD simple music $M = 25.07$, $sd = 7.19$ - complex music $M = 19.40$, $sd = 8.66$ - severe form of ASD 	Cohens <i>d</i> cannot be calculated based on the reported data
Finnigan and Starr 2010	N=1 aged 3	case study	offered musical and non-musical intervention	social response and avoidance behavior	observation of eye contact	<ul style="list-style-type: none"> simple music $M = 22.33$, $sd = 7.21$ complex music $M = 15.00$, $sd = 7.95$ <p>the music intervention seems more effective and during the music intervention the client showed no avoidance behavior</p>	Cohens <i>d</i> cannot be calculated based on the reported data

Table 3. Overview of other intervention studies (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens d
Katagiri 2009	N=14 aged 9-15	-	no specific treatment, verbal instruction, background music, singing adjusted songs	learning to understand emotions	coding and assessment of the four emotions: happy, sad, anger, and anxiety	Background music was significantly ($p < 0.05$) more effective than the other three conditions, participant showed improved emotional understanding results pre- and post-measurement no intervention $F = 1.04, df = 3.8, p = 0.43$ verbal intervention $F = 1.21, df = 3.8, p = 0.37$ musical intervention $F = 8.28, df = 3.8, p = 0.01$ song intervention $F = 2.28, df = 3.8, p = 0.16$	Cohens d cannot be calculated based on reported data
Boso et al. 2007	N=8 aged 23-38	case study	musical training	musical skills, autism characteristics	Clinical Global Impressions-Severity (CGI-S) Clinical Global Impressions-Improvement (CGI-I) Brief Psychiatric Rating Scale (BPRS)	After 52 weeks significant noticeable improvement in autism characteristic as well as a noticeable musical progress BPRS rating: from baseline (mean \pm 55, $sd = \pm 3.5$) to T2 (mean \pm 46, $sd = \pm 4.4$) and T3 (mean \pm 45, $sd = \pm 5.2$)	effect pre- vs. post-measurement BPRS Cohens d = 2.26

Table 3. Overview of other intervention studies (continued)

<i>author(s)</i>	<i>Sample size</i>	<i>design</i>	<i>intervention</i>	<i>focus</i>	<i>outcome measure</i>	<i>results as reported</i>	<i>Cohens d</i>
Kern et al. 2007	N=2 aged 3	case study	adjusted songs	social interaction	observation video	<ul style="list-style-type: none"> – the individually adjusted seemed to help the children with ASD when greeting the teacher or classmates, but did not show a significant difference – average response during adjusted musical intervention is 4 – average response during musical intervention is 3.98 	Cohens <i>d</i> cannot be calculated based on reported data
Kern and Aldrige 2006	N=4 aged 3-5	case study	use of 'outdoor music hut' and songs	social interaction with peers	observation video	<ul style="list-style-type: none"> the musical playground did not seem to result in a significant improvement, but it did make it easier for the children with ASD to initiate interaction 	Cohens <i>d</i> cannot be calculated based on reported data

Table 3, Overview of other intervention studies (continued)

author(s)	Sample size	design	intervention	focus	outcome measure	results as reported	Cohens <i>d</i>
Pasiali 2004	N=3 aged 7-9	case study ABAB design	adjusted lyrics to social stories	social skills	observation video	no convincing effects were found for the use of adjusted lyrics, but the researchers indicate that the method could contribute to social development; one individual showed a significant improvement ($p < 0.001$) – Jonny $t = 1.46$, $df = 18.59$, $p = 0.16$ – Peter $t = 3.77$, $df = 23$, $p = 0.001$ – Helen $t = 1.585$, $df = 26$, $p = 0.125$	effect in pre- and post-measurement – Jonny Cohens $d = 0.57$ – Peter Cohens $d = 1.48$ – Helen Cohens $d = 0.60$
Ma et al. 2001	N=6 aged 2-4	case study	interactive group music therapy	communication skills	Rosetti Speech and Language Scale, Music Therapy rating scale (developed for this study)	after the use of music, the children demonstrated improved communication skills	Cohens <i>d</i> cannot be calculated based on reported data

Table 3. Overview of other intervention studies (continued)

<i>author(s)</i>	<i>Sample size</i>	<i>design</i>	<i>intervention</i>	<i>focus</i>	<i>outcome measure</i>	<i>results as reported</i>	<i>Cohens d</i>
Griggs and Wheeler 1997	N=1 adolescent	case study	receptive, active and improvised music therapy	behavior	observation	the music therapist understands the cause and function of the problem behavior better, so the therapy can be used in a better way	Cohens <i>d</i> cannot be calculated based on reported data
Wimporoy et al. 1995	N=1 Aged 3	case study	musical interaction therapy	social interaction, nonverbal communication skills	observation: time without interaction, number of times eye contact per minute, interactive involvement, changes to interaction, symbolic playing	with the use of musical interaction therapy, there was a noticeable improvement in involvement and in making eye contact between the child and the mother	– effect pre- vs. post-measurement – Cohens <i>d</i> = 3.36
Edgerton 1994	N=11 aged 6-9	case study	improvised music therapy	communication	Checklist of Communicative Responses/Acts Score Sheet (CRASS)	the CRASS score showed a significant ($p < 0.001$) in the last session when compared to the first	Cohens <i>d</i> cannot be calculated based on reported data

ASD Autism Spectrum Disorder, ADOS Autism Diagnostic Observation Schedule

Communication skills

Thompson (2012) concludes that music therapy has a positive effect on the communication skills of children with ASD. His study also shows that the use of music therapy has a small effect on the aspects of speech and language ($d = 0.26$). Additionally, the studies conducted by Aldridge et al. (1995), Buday (1995), Edgerton (1994), Farmer (2003), Gattino et al. (2011) and Kim et al. (2008) demonstrated that music therapy has a positive effect on the communication skills of children with ASD.

Gattino et al. (2011) studied the influence of music therapy on the verbal, nonverbal, and social communication of children with ASD. Their study compared a treatment as usual with music therapy treatment. Even though it showed a significant difference on sub-group level, in which music therapy appeared to have a positive effect on the communication skills, the authors indicated that further research needs to be conducted in order to achieve a higher power. They stated, amongst other things, that more precise instruments should be used to get a more exact measurement of the communication skills. Lim (2010) demonstrated that music therapy has a large effect ($d = 1.58$) on the verbal skills of children with ASD. The results of the studies are consistent with the effects that Geretsegger et al. (2014) concluded based on their review, which is that the use of music therapy has a moderate effect on nonverbal skills ($SMD 0.57$) as well as on verbal communication skills ($SMD 0.33$).

Work methods

As described above, the lack of a proper description of the musical interventions that were used, and the fact that a lot of different work methods were used are important restrictions to draw conclusions about which intervention is the most effective. Kern et al. (2007), for example, researched whether music could help children in their morning rituals, if it would be in the form of a song that was specially written for them. It was assessed whether the child, supported by this piece of music, would find it easier to greet the teacher and their classmates. The study conducted by Brownell (2002) focused on using music to tell a story through a song. Boso et al. (2007) used a wide range of work methods, including singing, piano music, and drums. Gooding (2011) used active work methods such as drumming, singing, moving on music, and improvised music. Katagiri (2009) studied the effect of background music and lyrics on the ability to learn emotional concepts.

Accordino et al. (2007) classified music therapy into five categories:

- Receptive music therapy. With this form of music therapy, the client does not have to actively make music. The client listens to the music that is offered by the therapist, which can either be live music or recorded music. This form of therapy was not used very often in the studies represented here. It was used by Brownell (2002), and it was sometimes used as part of more comprehensive studies (Griggs and Wheeler 1997; Katagiri 2009).
- Compositional music therapy. The writing and playing of their own compositions is the main element of this form of music therapy. The music therapist supports the client in composing their own music, thereby focusing on the set treatment goals. This work method was not used in any of the studies reviewed here.

- Improvising music therapy. With this form of music therapy, the main element is improvisation. The therapist challenges the client to improvise, whereby the therapist usually works with the improvisation techniques developed by Bruscia (1987). These techniques give direction to the interaction with the client. Edgerton (1994), Gattino et al. (2011), Geretsegger et al. (2014), Ghasemtabar et al. (2015), Griggs and Wheeler (1997), Kim et al. (2008; 2009), and Saperston (1973) all indicated that they used this form of therapy. These techniques are based on the idea that improvisation will bring out the inner personality of the client. The method triggers an alertness, because the music is constantly changing, which results in an emotional experience and motion (Nordoff and Robbins, 1983). These studies, however, did not clearly indicate which work methods were actually offered to the clients.
- Recreational music therapy. With this form of therapy, the skills to use an instrument also play a role. The therapist actively works on teaching the client to play an instrument. The music-based therapeutic goals are developed via this process. We did not come across this therapy in the reviewed studies.
- Activating music therapy. With this form of music therapy, the client is actively challenged to make music. To achieve this, structured musical work methods are used, such as playing an instrument and singing. This type of music therapy was used regularly in the reviewed studies (Arezina, 2011; Finnigan & Starr, 2010; Hiller et al., 2012; Kern & Aldridge, 2006), or a combination of improvising and activating music therapy was used (Griggs & Wheeler, 1997; Tompson, 2012; Thomas & Hunterm, 2003).

As demonstrated by the study conducted by Kaplan and Steele (2005), the last-mentioned category, activating music therapy, is the form of music therapy that is most often used. This therapy involves an activating work method on instruments, instructions/explanation of the instruments, the choice of instruments, interactive singing, and choosing songs. These forms are used to work on the commonly used goals that appeared to be the focal areas in this study, which are the areas of language and communication (41 %), behavioral and psychosocial goals (39 %), cognitive goals (8 %), musical goals (7 %), and goals on perception and motor skills (5 %).

Conclusion and discussion

The objective of this article was to explore which results about the use of music therapy for children and adolescents with ASD have been described so far, and what type of interventions are used to achieve these results.

Various studies were conducted into music therapy for children and adolescents with ASD. These studies predominantly focused on the social interaction and communication skills of this target group. They provide an indication that music therapy has a positive effect on these children and adolescents. However, based on the studies conducted so far, it is not yet clear which intervention is the most suitable for working with children and adolescents with ASD. There is insufficient information available about why a specific type of music therapy was chosen.

Based on our overview, we need to conclude that many of the studies conducted so far contain a number of shortcomings: the target behavior was not adequately defined, the

description of the intervention was insufficient, and the question arises whether the right research designs were used to study the intervention adequately.

In order to thoroughly study an intervention such as music therapy, it is essential that the target behavior is clearly defined. What is the focal point of the treatment and what are the objectives? There are many studies into the effects of using therapy on communication skills without these skills being clearly defined and operationalized. Additionally, it is important that the target group for the intervention is clearly described (Loon et al., 2015). When these elements have been clearly formulated, it is important to choose the right instruments that can be used to report the effects. It is preferable to use observations and standardized, valid, and reliable measurement instruments. Even though there is a great number of instruments available, it very often turns out that they are not always suitable when used on a specific target group such as children and adolescents with ASD. They also do not seem adequate to measure the target behavior of an intervention (Loon et al., 2015). In order to clarify which measurement instruments and measuring methods would be most suitable for intervention research, it would be advisable to conduct further research into this.

It is also crucial to provide a clear description of the intervention (Kampstra & Langelaan, 2002). With many studies into the use of music therapy it is difficult to ascertain what the intervention included exactly. Within the conducted studies, music therapy had been used in various ways. In terms of the form of music therapy, many studies did indicate whether they used activating or receptive music therapy or improvisation, and also which musical instruments were used. However, it is often not quite clear how the music therapy was used in practice. This is also a point of criticism that was addressed in previous reviews (Accordino et al., 2007; Geretsegger et al., 2014; Kaplan & Steele, 2005). In order to conduct a thorough study, it is important that music therapists offer more insight into which method is used on which objectives and for which target group they can be used. These specifications will also make it easier to carry out meta-analyses on conducted studies.

Although the majority of studies include case studies or multiple case studies, the CCT and RCT designs are increasingly often applied to study the effectiveness of music therapy on people with ASD. These designs also underline the positive effect of music therapy on the social interaction of children and adolescents with ASD. RCTs are often considered to be the golden standard in terms of careful research (Offeringa et al., 2003). Nevertheless, we need to ask ourselves whether this standard is actually suitable for every intervention study. To date, it has been difficult to substantiate non-verbal therapies, such as music therapy, in a scientific way as it is usually not easy to fit these forms of therapy within a research method such as a randomized controlled trial. Within a RCT study, participants are randomly allocated to the research group or control group. To limit the systematic differences to a minimum, the groups need to be as homogenous as possible. When considering the fact that the diagnosis ASD includes such a diverse range of expressions and symptoms, it is difficult to divide a target group into two homogenous groups for a RCT study (Smeijsters, 2008). Another issue is that, for a RCT study, the intervention needs to be offered to the research group in the most standardized form. Because experiential therapy focuses on what is going on with the child or adolescent in

that moment, it is difficult to standardize an intervention and the actions of the therapist. A systemic $N=1$ design would take these aspects into account. $N=1$ studies provide insights into any changes in the individual's condition. It offers the opportunity to measure changes in the day-to-day situation by engaging their social network (e.g. parents, teachers, family). This method allows the therapist to study the target behavior of the intervention with few disturbing factors as possible, in their natural environment, and under the conditions of the intervention (Spren, 2009). The discussed studies were all conducted abroad. What can we say about research carried out in the Netherlands? Here, we have the same issue about the use of a large variety of work methods. In the Netherlands, the practice also shows that there is no clearly defined intervention available. Music therapists often indicate that they work intuitively, whereby they focus on the needs and capabilities of the target group (Pater, 2016). On the one hand, they believe that it is important to base their method on feelings and intuition while, on the other hand, they also have the need for a well-substantiated intervention. The literature and findings resulting from the discussion described in this article offer a good foundation for further research into the definition and substantiation of music therapy for children and adolescents with ASD.

