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How do Animal Assisted Interventions promote well-being of children with autism spectrum disorder? A systematic review

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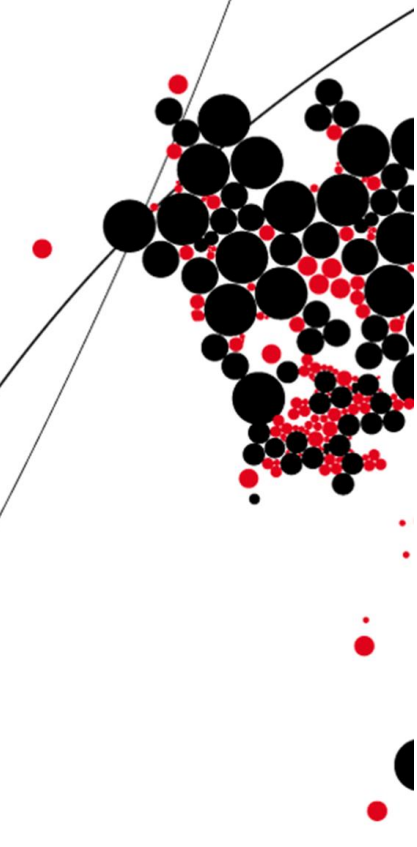

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Abstract

The use of Animal Assisted Interventions (AAI) has been suggested as a possible treatment for children with autism. In this systematic literature review the focus will be on the possibilities to increase well-being of autistic children with the help of AAI. Well-being is a construct from Positive Psychology. Through an increase in well-being people for example are able to better deal with daily struggles and it can work as a protective factor against psychopathology. To measure well-being, the PERMA model will be used with its components positive emotions, engagement, relationships, meaning and accomplishment. This study will thus answer the research questions (1) What are the characteristics of an AAI for children with ASD? (2) What are the characteristics of the studies investigating AAI for children with ASD? (3) Does AAI improve well-being of children with ASD? A literature search was conducted on the 29th October 2018 using 3 databases. Search terms included on one hand terms related to ASD and on the other hand terms related to AAI. Inclusion criteria for all studies were (a) a publication in English in a peer-reviewed journal, (b) the inclusion of an AAI, (c) and that the participants were children diagnosed with one type of autism. Excluded were studies that considered pet ownership. In total 18 studies were identified that fitted the inclusion and exclusion criteria. The results show, that the description of the different interventions varied a lot between the studies. No study replicated the same setting, type of animal, duration or intervention. This was also the case for the methodological approach. Self-reports, observations and surveys were used with different measurement instruments. The methodological quality was weak with no robust study designs. Concerning well-being nearly all outcomes that were investigated in the 18 studies fitted at least one component of the PERMA model. The most outcomes were reported concerning relationship (n=17). Six studies focused on factors contributing to positive emotions. These included factors like decreased anxiety or increased smiling. Six studies found a positive outcome of AAI on engagement and 10 studies concerning accomplishment. The component meaning was only found in one study. In general many positive outcomes from AAI on children with autism were found that can contribute to increase their well-being. These results have to be regarded carefully, due to the poor methodological quality and description of the AAI.

Introduction

It is well known that animals have different positive effects on humans. They are for example able to contribute to a reduction in blood pressure, noradrenaline, adrenaline and cortisol and additionally cause an increase in hormones that are linked to stress reduction (Odendaal, 2000; Odendaal & Meintjes, 2003). Furthermore animals can contribute to psychological benefits like a reduction of depressive symptoms (Souter & Miller, 2007), less self-reported anxiety (Hoffmann et al., 2009; Barker & Dawson, 1998), less loneliness among older persons (Banks & Banks, 2002) and can have a positive effect on mental well-being (Aydin et al., 2012). These findings contribute to a growing popularity in using animals in a therapeutic context these days (Fine & Beck, 2010). This concept is called Animal-Assisted Interventions (AAI). It includes Animal-Assisted Therapy (AAT) and Animal-Assisted Activities (AAA) (Kruger & Serpell, 2010). AAT is a goal-directed intervention in which an animal is an integral part of the treatment process. The intervention has specified goals, objectives and the progress is measured. Furthermore it is directed by a service professional with specialized expertise. In contrast AAA needs no specific treatment goal or objective. Professionals, paraprofessionals and/or volunteers direct the interventions and the aim is to access opportunities for motivational, educational, recreational, and/or therapeutic benefits to enhance quality of life (Delta Society, n.d.).

In a meta-analysis of Nimer and Lundahl (2007) four key areas have been identified, that benefit from AAI. These are autism-spectrum symptoms, medical difficulties, behavioural problems and emotional well-being (Nimer & Lundahl, 2007). Esposito, McCune, Giffin and Maholmes (2011) described autism as a target group for AAI as well. In recent years the diagnoses of autism spectrum disorder (ASD) have increased with currently approximately one in every 88 child being on the spectrum (Centers for Disease Control and Prevention [CDC], 2014). ASD is characterised by social communication deficits and repetitive and unusual sensory motor behaviour (American Psychiatric Association, 2013). Main symptoms of ASD thus could be abnormal speech, a lack of eye contact, impairment in reciprocal social interactions, sensory oversensitivity and constrained repertoire of activities (Grandin, Fine, & Bowers, 2010). ASD often begins in the early childhood, where the first symptom can be that the child is not using words for communication (Lord, Cook, Leventhal, & Amaral, 2000). The lack of social skills becomes more evident as the child gets older and peers start to interact and socialise (Lord et al., 2000). The social component is one striking characteristic of this disorder, which can also be seen in the diagnostic criteria of the American Psychiatric Association (2013). It determines that to be diagnosed with ASD, one

must show deficits currently or in the past in social-emotional reciprocity and non-verbal communication - and have problems with developing, maintaining and understanding relationships. Additionally one has to meet two out of four criteria that concern restricted, repetitive behaviour patterns, interests or activities (American Psychiatric Association, 2013). However it should be noted that autism is a very heterogeneous condition and that characteristics differ from every individual (Lord et al., 2000).

Already in 1989 Redefer and Godman found a positive effect when introducing a dog to autistic children. They observed an increase in social interaction the moment the dog was introduced. After several sessions with the dog, the children showed fewer autistic behaviours such as humming or clicking noises and showed more social behaviours like reaching up for hugs or joining the therapist in simple games (Redefer & Goodman, 1989). Even in the follow up, they could observe increased interaction with adults and decreased isolation (Redefer & Goodman, 1989). With this study Redefer and Godman were the pioneers to investigate the effect of dogs on children with ADS. But it was only in recent years that this field gained popularity (Berry, Borgi, Francia, Alleva, & Cirulli, 2013). Other animals than dogs also play an important role in AAI these days. O'Haire (2013) showed in her systematic review, that the majority of studies investigating the effectiveness of AAI for autistic children were published from 2008 on. An update of this review from 2017 showed, that the amount of research still increased in the years till 2015 (O'Haire, 2017). This shows that AAI for autistic children is a topic of growing interest.

Today there are many different interventions that use AAI for children with ADS. Many of these confirm the positive results Redefer and Godman found in 1989. Bass, Duchowny, and Llabre (2009) for example reported that therapeutic horseback riding could increase the sensory integration, directed attention, social motivation and sensory sensitivity of children with ASD. Another study of Fung and Leung (2014) showed that an Animal Assisted Play Therapy with a dog could increase the verbal social behaviour of autistic children more than a similar Play Therapy with a doll. It is noteworthy that most studies investigate AAI for autism focus on children and not on other age groups. A possible explanation for this was given by Nimmer and Lundahl (2007). They stated that in their study children benefited with regard to all outcome variables, which also included symptoms of autism, whereas other age groups did not show such a consistent benefit from AAI.

To get an overview of the effects of the many different interventions that were carried out for children with ASD, O'Haire (2013) conducted a systematic review of the available AAI and their effects. She compared 14 different studies. Most studies reported an increase in

social interaction (9 out of 14 studies) and increased positive emotional displays (4 out of 14 studies) (O'Haire, 2013). Because of the increasing interest in this topic Davis et al. (2015) conducted another literature review. In this, 20 studies were included. But they narrowed down the variety of factors they wanted to look at compared to the review of O'Haire (2013). In difference to O'Haire (2013) they did not want to include studies that report additional components unrelated to the core symptoms of autism like well-being or stress. Instead they only looked at studies that focus on typical ASD symptoms (Davis et al., 2015). In total eight studies were found that reported positive results, whereas the other 12 studies reported mixed results. Summarizing they concluded, that the evidence for AAI with autistic children is weak. Reasons were for example the many mixed results across studies, the methodological weakness and the insufficient explanation of the procedure (Davis et al., 2015).

Especially the study of Davis et al. (2015) has a strong focus on symptoms instead of positive resources. This is a typical approach of the medical model where the focus is on treating diseases by reducing symptoms and negative effects (Seligman & Csikszentmihaly, 2000). Within this approach, the promotion of positive aspects of functioning has nearly no chance of successfully being implemented in the treatment of mental disorders (Maddux, 2002). This changed when Seligman first introduced Positive Psychology in 1998. Within this model the focus is no longer on just repairing weaknesses and mental problems, but also on the well-being and human functioning (Seligman & Csikszentmihaly, 2000; Mitchell, Vella-Brodrick, & Klein, 2010). In addition to this, the World Health Organisation (WHO) changed their definition of mental health in 2005 and included well-being to stress its importance. Mental health is now defined as "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her own community" (WHO 2005, p. 2). The importance of well-being is also supported by several studies. It is associated with a longer life (Diener & Chan, 2011), can be a protective factor against psychopathology (Lamers, 2012) and supports people to better deal with daily struggles and stressful life events (Cohn, Fredrickson, Brown, Mikels, & Conway, 2009). Thus it seems that well-being is a good protecting factor for children with ASD, as they might have more problems dealing with the stress of daily life. They might for example lack friendships because of their social problems. Green, McGinnity, Mettzer, Ford and Goodmann (2005) reported that over two-thirds of the children with ASD find it harder than the average to make and keep friends. Among the general population only one per cent of the children have no friends at all. Among children with ASD 42 per cent have no friends (Green et al., 2005). Furthermore children with

ASD have a higher risk to develop mental disorders. A study of Simonoff et al. (2008) showed that 70 per cent of their participants with ASD had at least one comorbid disorder like social anxiety disorder, attention- deficit/hyperactive disorder or oppositional defiant disorder. Supporting well-being might thus protect these children from developing mental disorders and could make them more capable to deal with daily struggles and stressful events.

Till now little is known about how to promote well-being of children with autism. Most studies regarding well-being in this domain focus on increasing well-being of the parents of children with ASD (e.g. Jones et al., 2018). O'Haire (2013) found some hints in her study, that AAI might be effective in promoting well-being of autistic children. Studies reported that AAI could increase well-being for autistic children through enhancing mood, motivation and energy (O'Haire, 2013). Using this as a starting point, the current study will investigate whether there are other studies that report increased well-being through the use of AAI. To investigate this effect in more detail a clear definition of well-being is necessary, which is missing in the study of O'Haire.

In general well-being can be seen as "the perception that our life is going well" (Hupert, 2014). But this is a very individual definition and could be affected by the mood of a person at this time (Huppert & So, 2013). To measure well-being a consent definition is needed. This is a big challenge in the field of Positive Psychology (Hupert, 2014). In general well-being is an abstract construct that includes that an individual feels good on the one hand and functions well on the other hand (Hupert, 2014). It is thus a multidimensional construct, which cannot be defined in single terms like for example happiness. One model that measures well-being as a multidimensional construct is the PERMA model introduced by Seligman in 2011. It defines psychological well-being in five domains: positive emotions (P), engagement (E), relationship (R), meaning (M) and accomplishment (A).

Positive emotions in the PERMA model are related to specific feelings of happiness (Seligman, 2011). O'Haire, Mc Kenzie, Becker and Slaughter (2013) for example found that autistic children smile and laugh more often when interacting with guinea pigs, compared to playing with toys. This could be a sign for increased positive emotions.

Engagement in the PERMA model describes that children psychologically connect to activities or organizations (e.g. feeling absorbed, interested or engaged in life) (Seligman, 2011). O'Haire (2013) found studies stating that AAI can motivate children with ASD to engage in everyday activities (Taylor et al., 2012) and to create a generally enhanced motivation and energy. Furthermore Berry, Borgi, Francia, Alleva and Cirulli (2013)

investigated in their study that therapy dogs can increase the social interaction with the therapist. This can be a sign for a greater engagement of autistic patients within the therapy.

Relationship in the context of the PERMA model includes feelings of being socially integrated, cared for, supported by others, and being satisfied with one's social connections (Seligman, 2011). For autistic children this stresses the importance of developing social skills and showing social behaviour. In the review of O'Haire (2013) social interaction was a factor addressed by many different interventions (e.g. Silva, Correia, Lima, Magalhães, & Sousa, 2011). But also the general increase in communication and use of language was investigated (e.g. Sams, Fortney, &Willenbring, 2006; Martin & Farnum, 2002). Because of the great difficulties autistic children have with social interaction, it is of great interest to promote relationships to increase the well-being of children with ASD.

Meaning in the PERMA model describes the belief that one's life is valuable and the feeling of being connected to something greater than oneself (Seligman, 2011). A sense of meaning is expressed by being enabled through family, belonging to an organisation, being part of a community or through just being among others (Positive Psychology Center, 2018). One point that could be enhanced within this domain could be the integration of the autistic child and his family in the community. Berry et al. (2013) stated that dogs could help the whole family to feel more integrated in the community. This might give meaning to autistic children lives as they feel more as a part of a community. Furthermore it could be of interest to see whether AAI might have an effect on the relationships within the family.

Accomplishment within the PERMA model describes the feeling of being capable to fulfil daily activities, making progress towards goals and having a sense of achievement (Seligman, 2011). Children with ASD can reach accomplishment in everything that might be challenging for them, like building up relationships or engaging in every day activities. But accomplishment can also refer to building up new abilities.

Summing up, literature shows that AAI gained more popularity as a treatment for children with ASD recently. Many different studies have been conducted which show promising results, like increased interaction (Redefer & Goodman, 1989), increased verbal social behaviour (Lung, 2014) or an increase in directed intention (Bass et al., 2009). To get an overview two systematic reviews have been conducted by O'Haire (2013) and Davis et al. (2015). The study by Davis et al. (2015) hereby only included studies that looked at ASD symptoms, whereas O'Haire also included additional components like well-being or stress. This is a more holistic approach of the treatment of autism, which better fits the concept of Positive Psychology. Especially the factor well-being is important, because it has many

positive effects on mental health. Therefore this study wants to answer the following research question:

1. What are the characteristics of an AAI for children with ASD?
2. What are the characteristics of the studies investigating AAI for children with ASD?
3. Do AAI improve well-being of children with ASD?

Methods

Search procedure

The current study followed the guidelines of a systematic literature review and meta-analysis (PRISMA). The search strategy is based on the recent conducted systematic reviews of this topic by O'Haire (2013) and Davis et al. (2015).

The literature review at hand involves the search of three databases (Google Scholar, Scopus and Web of Science) and was conducted on the 29th October 2018. Search terms for all data included on one hand terms related to ASD and on the other hand terms related to AAI. Identifiers for ASD included autism OR autistic OR aspergers(s) OR ASD OR pervasive developmental disorders(s). Identifiers for AAI included Animal assisted OR Assistance dog$ OR Canine assisted OR Dolphin assisted OR equine assisted OR Hippotherapy OR Horsebackriding OR Pet facilitated OR Service dog$ OR Therapeutic animal$ OR Therapeutic horsebackriding OR Therapy with animals.

Inclusion and exclusion criteria

To be included in this review the following inclusion criteria needed to be met:
(a) Publication in English in a peer-reviewed journal, (b) including an AAI, which means that at least one animal needs to be included that interacts with the participant, (c) the participant must be a child (under the age of 18) diagnosed with autism, autism spectrum disorder (ASD), autistic disorder, Asperger's disorder or pervasive developmental disorder not otherwise specified (PDD- NOS), (d) and reporting of results for the participant, concerning at least one domain of the PERMA model. Excluded were studies that considered pet ownership where no defined action takes place in the interaction of the child and the animal. Distinct from this the use of service dogs was seen, because they are highly trained and provide assistance to children with ASD.

Data Extraction and Evaluation

Each potential study was tested for the inclusion and exclusion criteria. The independent variables were coded according to the animal used, activities that took place, and treatment fidelity. Dependent variables were coded based on the five domains of the PERMA model. At least one domain of the PERMA model needed to be measured with the dependent variable. The participants of the study needed to be children not older than 18 who are diagnosed with one type of autism. Study outcomes were coded whether they focus on factors concerning the child.

To answer the first research question 'What at are the characteristics of an AAI for children with ASD?' it was examined which participants, animals and settings were used in the different interventions. Furthermore intervention dimensions were compared, concerning the duration of AAI, the training of the animals and instructors and the activities that were taking place during the intervention. At least the designations of the different interventions were compared.

To answer the second research question 'What are the characteristics of the studies investigating AAI for children with ASD?' the study design and assessment type was investigated. Furthermore it was described what outcome was measured within the different interventions.

To answer the last research question 'Do AAI improve the well-being of children with ASD?' it was first examined how these components of PERMA can be measured. After that it was investigated per component of the PERMA model which study found results that contribute to one of the five constructs. To reach this a clear definition needed to be made for the five different components to mark which results and statements refer to a component of PERMA.

Data analysis: Definition of the components of PERMA and how they can be measured

Positive emotions

Concerning the definition of Seligman (2011), positive emotions refer to everything that is related to feelings of happiness. In a more general context positive emotions consist of different components like the affective experience, cognitive changes, action tendencies and

physiological changes (Lucas, Diener & Larsen, 2006). What makes it difficult to assess positive emotions is, that these components are not always correlated (Lucas et al., 2006). But for this study these components are the basis of measuring positive emotions. Every result that refers to one of these components will be seen as contributing to positive emotions.

To measure positive emotions it is distinguished between self-reports and non-self-reports (Lucas et al., 2006). Self-reports might face some challenges concerning the group of children with ASD. This group is known for having difficulties with emotion recognition. It is especially challenging for them to recognize and report feelings in themselves and others (Lickel, MacLean, Blakeley-Smith & Hepburn, 2012). Concerning the non-self-reports one can use observations, facial measurements, emotional tasks or physiological assessment (Lucas et al., 2006). Non-self report measurements should thus be preferred over self-reports.

Engagement

Concerning the definition of Seligman (2011) engagement describes that one psychologically connects to activities or organizations (e.g. feeling absorbed, interested, and engaged in life). Being engaged thus describes a feeling of engrossing and absorbing when doing an activity (Schueller & Seligman, 2010). This state was already 1990 described by Csikszentmihalyi (1990) as 'flow'. Through getting in the state of flow positive resources can be promoted like nurturing talents, cultivating interest, and honing skills (Schueler & Seligman, 2010). But for autistic children the challenges with engagement can start even earlier. It is well known that children with developmental disabilities like ASD have difficulties in engaging with adults, peers and materials on a more basic level than the state of flow (Keen, 2009). Children with ASD tend to be more self absorbed or engaged with objects than with people. This leads to problems, because engagement is an important factor for example for learning (McWilliam & Bailey, 1995), student outcome (Logan, Bakeman, & Keefe, 1997) and to get the opportunities to learn and practice new skills in general (Keen, 2009). Because of these deficits in general engagement a new definition of the construct of engagement will be used in the current study. Engagement can thus be seen as a multidimensional construct that includes behavioural, emotional and cognitive components (Keen, 2009). Behavioural engagement describes the participation in learning activities and tasks. With emotional engagement the willingness and interest in an activity is meant. Cognitive engagement refers to goal direct behaviour and self-regulated learning. It includes the eagerness to accomplish new skills and knowledge (Fredricks, Blumenfeld & Paris, 2004).

The fact that engagement is a multidimensional construct and that many different variables which belong to either behavioural, emotional or cognitive components of

engagement interact in a complex way (Keen, 2009), make it difficult to state a general way to measure engagement. This study will thus stay with a broad definition of engagement and will see everything as contribution to engagement that focuses on at least one of the component of engagement (behavioural, emotional or cognitive).

Relationships

Concerning the definition of Seligman (2011) relationship includes feelings of being socially integrated, cared for, supported by others and being satisfied with one's social connections. This might be of special importance for children with ASD, because they often have smaller social networks, less reciprocated friendships and poorer quality of friendships compared to other children (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011). The reason for this is, that children with developmental disabilities tend to have greater levels of social impairment (Cordier et al., 2015). This is also the case for ASD, where social skill deficits belong to the core features (American Psychiatric Association, 2013). The deficits can occur with: "initiating interactions, responding to the initiations of others, maintaining eye contact, sharing enjoyment, reading the non-verbal cues of others, and taking another person's perspective" (Bellini, 2009). To improve the relationships of children with ASD, the focus thus should be on improving the abilities to interact socially, because social functioning is the basis of developing meaningful relationships and taking part in a community (Cordier et al., 2015). Social functioning is a complex construct, which mostly involves different cognitive, emotional and linguistic skills (Cordier et al., 2015). In most models cognitive and executive functioning play an important role, because it was shown that deficits in these areas lead to poor social outcome (Cordier et al., 2015). Other components are socio-emotional skills, like face-emotion perception, theory of mind and empathy. Additionally linguistic skills have been seen as fundamental to function socially. It is important that children are able to integrate communication. This for example includes verbal and non-verbal language, to detect and interpret the underlying meaning, to respond appropriately to social interaction and to regulate emotions (Cordier et al., 2015).

When trying to measure social functioning it can be distinguished between measuring the broad term of social functioning or target a sub-set of the skills associated with social functioning (Cordier et al., 2015). Through this diversity the instruments that can be used to measure social functioning in one or another way are very diverse.

Meaning

Concerning the definition of Seligman (2011) meaning describes the belief that one's life is valuable and the feeling of being connected to something greater than oneself. This can for example include being enabled through family, belonging to an organisation, being part of a community or through just being among others (Positive Psychology Center, 2018). Meaning thus is a more abstract construct that refers to a feeling of a purposeful life (Schueler & Seligman, 2010). Through positive relationships or connecting to a higher purpose it is possible for individuals to transcend oneself with the help of flow (Seligman, 2002). This all makes it a very individual construct, which is difficult to measure. Additionally the existence of positive relationships to experience meaning makes it very difficult to distinguish what contributes to the component positive relationships and what contributes to the component meaning of the PERMA model. In the current study the focus will thus lie more on the concept Seligman refers to, which include being enabled through family, belonging to an organisation, being part of community or being among others. The focus is not on the single relationship a child develops with a person, but on the general integration in a group or social network.

Accomplishment

Concerning the definition of Seligman (2011) accomplishment describes the feeling of being capable to fulfil daily activities, making progress towards goals and having a sense of achievement. Accomplishment can lead to external recognition and to personal accomplishment (Khaw & Kern, 2014). What makes it difficult to define accomplishment in general terms is, that it is very subjective, and is orientated at personal ambitions, drives and personality differences (Khaw & Kern, 2014). Therefore in this study everything that seems like an achievement or a progress of the participant is seen as contributing to accomplishment.

Results

The literature search resulted in 701 citations. A flowchart of the study selection process can be seen in Figure 1. The final sample included 18 article published between the years 1989 and 2017.

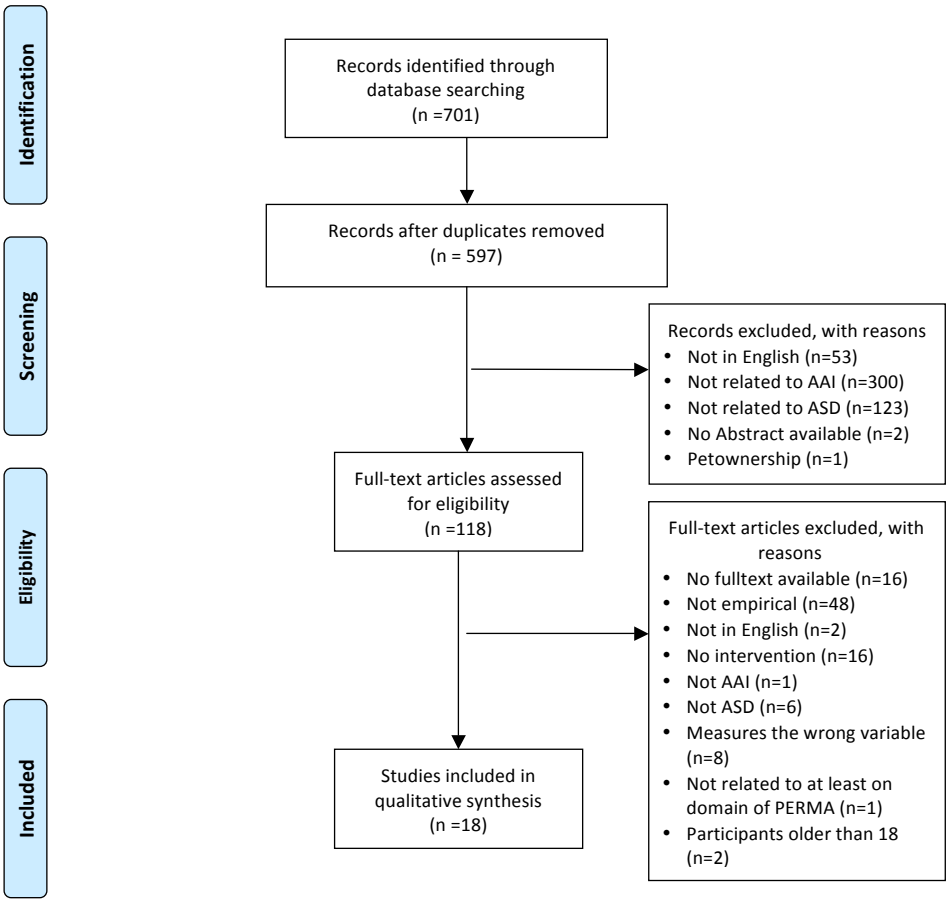

Figure 1. Flow chart of study selection process

Characteristics of the AAI for children with ASD

Participants

The sample size varied across the different AAI from 1 up to 116. The age range was reported by all studies except one, which only reported the average age of participants. The age range differed from study to study but in total ranged from 3-17 years. In all studies more males participated than women. The lowest participation of males was 55,6% and the highest 100%. The characteristics of the participants per study can be seen in table 1.

Little was written about the diagnostic process, severity of symptoms and additional therapies. Only one study conducted an independent assessment of the diagnosis (Stevenson, Jared, Hinchcliffe, & Robert, 2015) and four gave information on other treatments (Bass, Duchowny, & Llare, 2009; Ward, Whalon, Rusnak, Wendell, & Paschall, 2013; Stevenson et al., 2015; Borgi et al., 2016). Only one study described shortly the symptoms of the patient (Silvia, et al., 2011), however this study consisted of only one participant.

Table 1 *Participants characteristics*

First author (year)	Sample Size	Age	Gender (male)
Redefer (1989)	12	5-10	9 (75%)
Sams (2006)	22	7-13	-
Burrows (2008)	10	4-14	7 (70%)
Bass (2009)	34	4-10	29 (85,3%)
Keino (2009)	4	4-17	4 (100%)
Taylor (2009)	3	4-6	-
Kršková (2010)	9	6-13	5 (55,6%)
Silva (2011)	1	12	1 (100%)
Kern (2011)	24	3-12	18 (75%)
Ajzenman (2013)	6	5-12	4 (57%)
Ward (2013)	21	M= 8.1	15 (71,4%)
O'Haire (2014)	64	5-12	50 (78,1%)
Gabriels (2015)	116	6-16	101 (87,%)
O'Haire (2015)	33	5-12	24 (72.7%)
Stevenson (2015)	3	7-14	3 (100%)
Borgi (2016)	28	6-12	28 (100%)
Becker (2017)	31	8-14	28 (90,3%)
Harris (2017)	26	6-9	22 (84,6%)

Animals and setting

The animals included in the studies of this review were mostly horses (n=9) and dogs (n= 5). Other animals were guinea pigs (n=3), llamas (n=1) and rabbits (n=1). The information about the animal selection was limited. Only two studies justified why they had chosen a certain type of animal (O'Haire McKenzie, Mc Cune, & Slaughter, 2014; O'Haire, McKenzie, Beck, & Slaughter, 2015). Furthermore few studies gave a clear description of the animal, it's training or its abilities. Three studies stated that the animals were carefully evaluated or/and had been specially trained, but gave no more detailed information about the

procedure (Keino et al., 2009; Taylor et al., 2009; Borgi et al., 2016). Two studies involving guinea pigs stated to have socialised the animals having contact with children (Kršková, Talarovičová, & Olexová, 2010; O'Haire et al., 2015). Only two studies reported to use animals that were certified through specific organisations like Pet Partners or Assistance Dog International Inc. (ADI) (Silva et al., 2011; Becker, Rogers, & Burrows, 2017). All AAI with horses occurred at riding centres, whereas the other interventions mainly took place at school (n=6). Interventions with service dogs were located at home (n=1) and the remaining took place at treatment centres (n=2). An overview is provided in table 2.

Intervention dimensions

often took place on a weekly basis (n=8). Within the other interventions the frequency varied from two times a week up to one session per month. The AAI sessions lasted on average 53 minutes (SD=54) with the shortest session taking 10 minutes and the longest 240 minutes.

Throughout the studies, no standard for training or knowledge of the instructors can be observed. One interventionist was especially trained as a dog handler (Silva et al., 2011), one was certified as a handler dog team (Becker et al., 2017) one specifically trained as a hippotherapist (Taylor et al. 2009), one trained by the British Horse Society (Harris & Wiliams, 2017) and two were certified as instructors by the Profession Association of Therapeutic Horsemanship International (PATH) (Ward et al., 2013; Gabriels et al., 2015). The instructors came from different occupational areas. Riding instructors held seven of the interventions with horses, whereas the other two AAI with horses were led by an Occupational Therapist and a Pediatric Physical Therapist (Sams, Fortney, & Willenbing, 2006; Taylor et al., 2009). AAI with other animals were led by teachers (n=2), therapists (n=3) or the researchers (n=2). One AAI was conducted by a teacher and a therapist together (Harris & Williams, 2017). An overview is shown in table 2.

The activities of the intervention were described with varying levels of detail. Some described very general activities like holding, petting, engaging with the animals or doing riding activities. Only five studies gave a detailed description of the different activities that were done during the AAI. Three studies gave a short overview of the activities and the aims why they had using them. Non of the interventions had a detailed activity protocol of the activities and aims of each session listed.

One additional factor that stresses the varying descriptions of the interventions is the designations that were used. These were: Occupational Therapy Sessions incorporating animals, service dogs, Psycho-Educational Horseback Riding, Animal Assisted Activities,

Animal Assisted Social Skills Interventions, Horse Riding Interventions (al n=1), Therapeutic Horseback Riding (n=3), Hippotherapy (n=2) and Equine Assisted Therapy (n=2). Several studies did not even use a specific name at all and just referred to the presence of a therapeutic animal (n=3) or the interaction with an animal (n=1). However each study specifies the designation of their study differently. Nine studies specify the construct which the intervention relies on as a therapy, with either Animal Assisted therapy (n=6), Pet Therapy (n=1), Hippotherapy (n=2) or Therapeutic Horseback Riding (n=1). Three studies named the construct Animal Assisted Intervention. One study gives a clear description from several constructs, like AAI, Equine Assisted Activities, Hippotherapy etc. Three studies named no construct at all and just referred to the interaction with animals. Only one study gave a clear definition of AAI, AAT and AAA. This study also clearly classified their intervention as an AAA, and gave an explanation for this (O'Haire et al. 2014).

Table 2 *Overview of AAI characteristics (n=18)*

First author (year)	Animal	Setting	Format	Interventionist	Session		
					Duration (weeks)	Number	Length (minutes)
Redefer (1989)	Dog	Not named	Individual	Therapist		18	20
Sams (2006)	Dog, Llama, Rabbit	School	Individual	Occupational therapist	15	2-12	M=28.5 (SD=5.3)
Burrows (2008)	Service dogs	Home			24-48		
Bass (2009)	Horses	Riding centre	Group of 19	Riding instructor	12	12	60
Keino (2009)	Horses	Riding centre	Individual	Riding instructor	48-148		
Taylor (2009)	Horses	Riding centre	Individual	Paediatric instructor	16	16	45
Kršková (2010)	Guinea pigs	School	Group of 9	Teacher	10	10	240
Silva (2011)	Dog	Treatment centre	Individual	Psychologist	6	6	45
Kern (2011)	Horses	Riding centre	Individual	Riding instructor	24	24	60
Ajzenman (2013)	Horses	Riding centre	Individual	Occupational therapist and assistance	12	12	45
Ward (2013)	Horses	Riding centre	Groups of 4-6	Riding instructor	24	24	60
O'Haire (2014)	Guinea pigs	School	Groups of 3	Researcher	8	16	20
Gabriels (2015)	Horses	Riding centre	Groups of 2-4	Riding instructor	10		45
O'Haire (2015)	Guinea pigs	School	Groups of 3	Researcher	1	1	10

Stevenson (2015)	Dogs	School	Individual	Teacher	10	5	20
Borgi (2016)	Horse	Riding centre	Groups of 3-4	Riding instructor	24	25	60-70
Becker (2017)	Dogs	School	Groups of 4	Teachers and professional therapist	12	12	60
Harris (2017)	Horses	Riding centre	Whole Class	Riding instructor		5-7	45

Characteristics of the studies investigating AAI for children with ASD

Study design

Most studies used a single-subject or within participants design (n=15). Studies had no control measurement at all (n=5), the participants served as their own control group (n=7) or a separate control group was introduced (n=6). When participants served as their own control group, a baseline measurement was used (n=5), or an alternating treatment, where the participants had the same amount of a standard treatment as treatment with animals (n=2) (Sams et al., 2006; Silva et al., 2011). Within the studies that used a control group, four studies used a waiting list as a control and two an alternative treatment, which was once a barn activity (Gabriels et al., 2015) and once social skill training (Becker et al., 2017). Only three of these studies assigned the groups randomly. Two had cluster assignments and one study gave no information about the distribution process. Most studies used a pre-post design (n=6). Other study designs were randomized control (n=3) alternating treatments (n=2), AB (n=2), ABA, ABB, qualitative ethology, within subject design or interrupted time series design (n=1 of each). Only one study had a follow up measurement after one month (Redefer & Goodman, 1989). This makes it difficult to evaluate the AAI outcomes over time. An overview of the study design is shown in table 3.

Table 3 *Overview methodological characteristics of AAI (n=18)*

First author (year)	Study design	Comparison condition	Assessment measurement	
			Type of study	Standardized instruments
Redefer (1989)	ABA	Treatment with no animal	Observation	-
Sams (2006)	Alternating treatment	Treatment with no animal	Observation	-
Burrows (2008)	Qualitative ethology	None	Observation, Interview	-
Bass (2009)	Randomized control	No treatment	Survey	SRS, SP
Keino (2009)	Pre-Post	None	Survey	HEIM scale
Taylor (2009)	ABB	None	Observation	PVQ
Kršková (2010)	AB	Treatment with no animal	Observation	-

Silva (2011)	Alternating treatment	Treatment with no animal	Observation	-
Kern (2011)	AB	No treatment	Survey	CARS, QLES-Q, SP, TPCIS
Ajzenman (2013)	Pre post	None	Survey, Semi-structured interview	VABS-II, CACS
Ward (2013)	Interrupted time series design	None	Survey	GARS-2, SPSC
O'Haire (2014)	Pre post	No treatment	Survey	PDDBI, SSRS
Gabriels (2015)	Randomized control	Barn activity treatment	Survey	PPVT-4, SALT, BIT-2, SIPT, ABC-C, SRS
O'Haire (2015)	Within subject design	Treatment with no animal	Physiological data, survey	SCQ, SSRS, SWQ
Stevenson (2015)	Pre post	None	Observation	ADOS-2
Borgi (2016)	Randomized control	No Treatment	Survey	VABS, TOL
Becker (2017)	Pre post	Treatment with no animal	Survey	CARS-2, CDI-2, RMET, SLDT, SRS-2
Harris 2017)	Pre Post	No treatment	Survey	CARS-2, ABC-C

Assessment type

There were various outcome measures, like quantitative and qualitative observation, standardized surveys, semi structured interviews and physiological data (Table 3).

Seven studies used observation. Out of this, six used observations as the only form of assessment, whereas one study also used interviews (Burrows, Adams, & Spiers, 2008). Six studies used quantitative observations, from which all except for one (Kršková et al., 2010) used several raters to measure rater reliability, which was mediate to high across all studies. Only one study used blind raters (Taylor et al., 2009). This study was also the only one that used a standardized observation form (PVQ). However this study only had a very small sample size of three participants. The lack of blind raters is a limitation of the current studies, as positively bias could occur. Only one study used qualitative observation (Burrows et al., 2008). The author observed and talked to families who had a service dog. However, the results of this study have to be evaluated carefully concerning replicability and generalization, because no standardized techniques were used. Furthermore it was not clearly defined which

factors were observed beforehand. This was different in the other studies that used observations as an outcome measurement. Here it was clearly stated what was investigated. Three studies focused on social behaviour, and two of these additionally investigated isolation (Redefer and Goodman, 1989) and the use of language (Sams et al., 2006). The other studies focused on motivation (Taylor et al., 2009), negative and positive behaviour (Silva et al., 2011) and social interaction and engagement with teachers (Stevenson et al., 2015).

Eleven studies used surveys as the form of data collection. All used standardized instruments, which can be seen in table 3 and 4. Only two studies used blind raters (Kern et al., 2011; Gabriels et al., 2015). A lot of different survey instruments were used in the studies. The Social responsiveness Scale (SRS), Childhood Autism Rating Scale (CARS), Vineland Adaptive Behaviour Scale-II (VABS-II) and the Aberrant Behaviour Checklist – Community Edition (ABC-C) were the only instruments that were used in several studies. Only two instruments are specifically developed for AAI (Heim Scale and MOPI). In general a lot of different concepts were measured like quality of life, interaction between the parents and the child, adaptive behaviour, problem behaviour, social anxiety etc. Only the assessment of autism (n=5), sensory processing (n=3) and language abilities (n=2) were measured with several tests and thus were also measured in different studies.

One study used a combination of surveys and physiological data (O'Haire et al., 2015). Electrodermal, eccrine sweat gland activity was measured using a wireless wristband. In another study Force Plates were used in addition to surveys, to investigate changes in postural control (Ajzenman, Standeven, & Shurteff, 2013).

Different informants were used, with often more than one informant in a study. The most used informants were parents (n=6), then teachers (n=4) and research staff (n=4), and one therapist and riding instructor. The research staff was mostly trained or familiar with the target group. With regard to parents and teachers no information at all was given as to whether they were knowledgeable to fill in the surveys. Only one study reported that parents got help from the experimenters (Keino et al., 2009).

All in all it can be stated that there is a great diversity in outcome measurement in the different studies. Some studies partly investigated the same construct. But even these studies used different instruments to asses these constructs and often additionally focused on other constructs.

Table 4 *Description of the standardized instruments used in the 18 studies*

Instrument	First author (year)	Assessment of
Social responseness Scale (SRS)	Bass (2009), Gabriels (2015), Becker (2017)	Severity of autism spectrum symptoms
Sensory Profile (SP)	Bass (2009)	Sensory processing patterns
Heim Scale	Keino (2009)	Effect of human equine interaction on mental activity
Pediatric Volitional Questionnaire (PVQ)	Taylor (2009)	Motivation
Childhood Autism Rating Scale (CARS)	Kern (2011), Becker (2017), Harris (2017)	Identification of autism
Timberlawn Parent-Child Interaction Scale	Kern 2011	Observation of the interaction of parents and children; Reduced version of the Timberlawn Couple and Family Evaluation Scale
Quality of Life Enjoyment and Satisfaction Questionnaire (QLES-Q)	Kern 2011	Enjoyment and satisfaction in various areas of daily functioning
Vineland Adaptive Behaviour Scale - II (VABS-II)	Ajzenman 2013, Gabriels 2015, Borgi 2016	Adaptive Behaviour
Children Activity Card Sort (CACS)	Ajzenman 2013	Participation in various activities; modified version of the preschool activity card sorting test
Gilliam Autism Rating Scale: Second Edition (GARS-2)	Ward 2013	Screening tool for autism spectrum disorders
Sensory Profile School Companion (SPSC)	Ward 2013	Sensory processing ability
Pervasive Developmental Disorder Behaviour Inventory (PDDBI)	O'Haire 2014	Responsiveness to intervention in children with ASD
Social Skills Rating System (SSRS)	O'Haire 2014, O'Haire 2015	Social skills
Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4)	Gabriels 2015	Measure of receptive vocabulary for Standard American English
Systematic Analysis of Language Transcripts (SALT)	Gabriels 2015	Software that standardizes the process of eliciting, transcripting, analysing language samples
Bruininks-Oseretsky Test of Motor Proficiency Integration and Praxis Tests (SIPT)	Gabriels 2015	Sensory integration
Abberant Behaviour Checklist – Community Edition (ABC-C)	Gabriels 2015, Harris 2017	Problem behaviour of children and adults with developmental disabilities
Social Communication Questionnaire (SCQ)	O'Haire 2015	Screening tool for autism spectrum disorder
Social Worries Questionnaire (SWQ)	O'Haire 2015	Social anxiety
ADOS 2	Stevenson 2015	Diagnosing and assessing autism
Tower of London (TOL)	Borgi 2016	Executive functioning, specially to detect deficits in planning
Children's Depression Inventory Second Edition	Becker 2017	Depressive symptoms

(CDI 2)		
Reading the Mind in the Eyes Test (RMET)	Becker 2017	Deficits in theory of Mind
Social Language Development Test (SLDT)	Becker 2017	Language based skills of social interpretation and interaction with friends
Measurement of Pet Intervention Checklist (MOPI)	Harris 2017	Participants engagement in Animal Assisted Interventions

Effects of AAI on well-being of children with ASD

Measuring well-being

There was no measurement instrument that was specifically developed for measuring well-being. But the constructs of the PERMA model could be detected with some of the used instruments in the reviewed studies.

Positive emotions were generally investigated by observing the participants. The main indicator was smiling. Furthermore, the Timberlawn Parent Child Interaction Scale has a scale for mood and tone and was used in one study (Kern et al., 2011). One study focused on physical arousal, which was measured with skin conduction (O'Haire et al., 2015). A lowered state of arousal is seen as a sign for positive emotions.

Engagement was measured with several instruments. The Pediatric Volitional Questionaire (PVQ) measures the motivation through observation of for example the childrens' curiosity or the willingness to try new things (Taylor et al., 2009). Furthermore the Child Activity Card Sort Test (CACS) used in the study of Ajzenman et al. (2013) examines the participation in typical appropriated daily activities. Engagement specific in the context of AAI was measured with the Pet Intervention Checklist (MOPI) (Harris & Williams, 2017). Other information about engagement was collected through observation. Here the observation focused on the engagement with the teacher or at attending school.

Concerning the factor relationship, the main focus was on social interaction and social abilities of children with ASD. Several instruments like the Vineland Adaptive Behaviour Scale-II (VABS-II), Social Responsiveness Scale (SRS), Social Skill Rating System (SSRS) and the Systematic Analysis of Language Transcripts (SALT) were used to investigate these factors. One study also used the standardized observation form Human-Equine-Interaction on Mental Activity (HEIM) to assess the behavioural improvement during the contact with horses (Keino et al., 2009).

Meaning was not directly assessed with a specific instrument used in the studies. There were only some interpretations of the results that contribute to meaning. Most of these

focus on the family, especially the parents of the children with ASD. Factors concerned the role of the family in the community and the relationship within the family. These results have to be evaluated carefully, because they relay on the interpretation of the researcher (Burrows et al., 2008).

Accomplishment can be addressed in many different ways in these studies, because it includes everything that might be challenging for children with autism. Many different instruments measured factors where children with ASD showed accomplishment. The Tower of London (TOL) detects when children learned to decrease their latency of the first move during the task. This shows an improvement in planning and problem solving abilities (Borgi et al., 2016). With help of the Aberrant Behaviour Checklist – Community Edition (ABC-C) a decrease in hyperactivity could be measured (Gabriels et al., 2015; Harris & Williams, 2017). The HEIM scale can be used to assess an improvement of the ability of imitation, adapting to changes and making eye contact (Keino et al., 2009). The Vineland Adaptive Behaviour Scale – II (VAVS-II) showed improvement in listening and attending (Ajzenman et al., 2013). Furthermore a decrease in ASD symptoms can be detected with the Childhood Autism Rating Scale (CARS) (Kern et al., 2011) and the ABC-C (Harris & William, 2017). In the study of Ajzenman et al. (2013) the postural stability of children with ASD was measured with help of force plates. Additionally several accomplishments were assessed through observation, like regulating ones pace or problematic behaviour (Burrow et al., 2008; Silva et al., 2011).

Positive emotions

Six studies reported about factors that contributed to positive emotions. Parents in the study of Burrows et al. (2008) reported decreased anxiety, more calmness and less dissipated/defused anger. Parents reported that their child "just seemed happier" (Burrwos et al., 2008). Keino et al. (2009) explained that participants positively changed their cognitive and emotional meaning of the stimulus surrounding them. This made it possible for them to improve eye contact, because they were able to experience and interpret the world more positive through the AAI. Furthermore, the experience to be able to express emotions and feelings, because one will get an emotional reciprocity from the parents, makes it possible for the participants to create a "positive field of emotions" (Keino et al., 2009). Silve et al. (2011) and Kern et al. (2011) reported increased smiling, mood and tone. O'Haire et al. (2015) measured the physiological arousal of children when interacting with guinea pigs. The physiological arousal of patients when interacting with peers was lowered in the presence of guinea pigs compared to playing with toys (O'Haire et al., 2015).

Engagement

Six studies reported factors that contributed to engagement. Taylor et al. (2009) detected that the motivation to engage in every day activities of participants with ASD could be increased when participating in Hippotherapy. Furthermore an increase in engagement with the teacher (Stevens et al., 2015), an increased interest in attending school (O'Haire et al., 2014), an increase in attention to sensory input (Ward et al., 2013), participation in daily activities (Ajzenman et al., 2013) and a general increased level of engagement (Harris & Williams, 2017) were found.

Relationships

In all but one study an increase in one or another way of social interaction or social functioning was found (n=17). Social behaviour like interaction, responsiveness, socialisation or general social functioning was found in ten studies. Furthermore a reduction in isolation (n=1), improvement in use of language or communication (n=7), social approached behaviour (n=1), increase in social skills (n=2) and less social withdrawals (n=1) were outcomes of AAI.

Meaning

Outcomes that could contribute to the feeling of meaning in children with ASD were only found in one study (Burrows et al., 2008). The focus was on the relationship between the siblings and the position of the family in society. Siblings of a child with ASD experienced more pride when having a service dog in the family, which could improve the relationship to the autistic sibling (Burrows et al., 2008). Furthermore the whole family gets more positive attention and has fewer difficulties with external relationships (Burrows et al., 2008). This could promote the relationships within the family, but also their role in the community.

Accomplishment

Ten studies found factors contributing to the component accomplishment. Participants accomplished to learn different skills through AAI. They learned to make eye contact (Keino et al., 2009), to listen, attend, follow new instructions (Ajzenman et al., 2013) and their latency increased at the beginning of a task (Borgi et al., 2016). Furthermore their safety, freedom (Burrows et al. 2009) and postual stability (Ajzenman et al., 2013) increased. They also showed less hyperactivity (Gabriels et al., 2015; Becker et al., 2017), less problem behaviour (Silva et al., 2011) and less ASD symptoms (Becker et al., 2017).

General findings contributing to well-being

Burrows et al. (2008) detected that service dogs provided feelings of well-being. No clear definition of well-being was given. In the study it was stated that the increased social interaction, the strengthening of social networks and social provision might be enhanced through pets, which leads to a greater feeling of well being (Burrows et al., 2008). Kern et al. (2011) also detected an increase in quality of life, measured with the Quality of Life Enjoyment Satisfaction Questionnaire (QLES-Q). Just the enrolment in the AAI had an effect on the quality of life of participants and their families (Kern et al., 2011). Burrow et al. (2008) also stated an increase of quality of life based on his impression of the families with a service dog.

Findings that contributed to other factors than well-being

In general few factors that were investigated within the 18 studies did contribute to components not belonging to the PERMA model. Factors that were measured and did not contribute to one component of the PERMA model were treatments satisfactory (Kern et al., 2011), social anxiety (O'Haire et al., 2015) and depression (Becker et al., 2017). Treatment satisfaction was measured with a survey, which included a measurement of the satisfaction with the treatment, the perceived treatment benefit, willingness to continue treatment and the willingness to recommend the treatment (Kern et al., 2011). All average scores were between good and very good, which means that participants in general rated the AAI positive (Kern et al., 2011). Social anxiety was measured with the Social Worries Questionnaire (SWQ) (O'Haire et al., 2015). The scores were compared between children with ASD and typical developing children. It was shown that children with ASD at baseline have greater social anxiety than other children. When getting an AAI the arousal of children with ASD dropped significant whereas the general arousal of children without ASD increased. This shows that the AAI has a better effect for children with ASD than for children who do not have ASD (O'Haire et al., 2015). Depressive symptoms were measured with the Children's Depression Inventory- Second Edition (CDI-2) (Becker et al., 2017). Both groups showed improvement on the scales of this test, but students from the experimental group showed significant more improvement (Becker et al., 2017).

Table 5 *AAI outcome regarding well-being of the participants measured with the PERMA model*

First author (year)	Positive emotions	Engagement	Relationship	Meaning	Accomplishment
Redefer (1989)	-	-	+ Social interaction - Isolation	-	-
Sams (2006)	-	-	+ Use of language + Social interaction	-	-
Burrows (2008)	- Anxiety + Calmness - Dissipated/defused anger + Well-being	-	+ Social recognition & interaction	+ Source of pride for siblings + Positive attention for the family + Easing families external relationships	+ Safety and freedom + New skills like regulating pace
Bass (2009)	-	-	+ Social responsiveness	-	+ Directed attention
Keino (2009)	+ Emotional expression - Fear and nervousness + Positive field of emotions + Experiencing and interpreting the world more positive	-	+ Social interaction + Verbal communication + Human relationships	-	+ Making eye contact + Adaption to changes +Imitation
Taylor (2009)	-	+ Motivation/volition	-	-	-
Kršková (2010)	-		+ Social interaction	-	-
Silva (2011)	+ Smiling	-	+ Social behaviour	-	- Problem behaviour
Kern (2011)	+ Mood and tone	-		-	- Symptoms of ASD
Ajzenman (2013)	-	+ Participation in daily activities	+ Receptive communication + Socialization	-	+ Postual stability + Listening & attending + Following instructions

Ward (2013)	-	+ Attention	+ Social communication	-	-
O'Haire (2014)	-	+ Interest in attending school	+ Social approached behaviour + Social skills - Social withdrawl	-	-
Gabriels (2015)	-	-	+ Social cognition + Communication + Increase in use of words and used new words	-	- Hyperactivity - Irritability
O'Haire (2015)	- Physiological arousal	-	-	-	-
Stevenson (2015)	-	+ Engagement and interaction with teacher + Visual interest	+ Level of interaction + Meaningful vocalisation	-	-
Borgi (2016)	-	-	+ Social functioning	-	- Latency during a first move during a problem solving task + Adaptive and executive functioning
Becker (2017)	-	-	- Social skill deficits + Typical social communication + Playing appropriately + Initiating interaction with peers	-	- Severity of ASD symptoms - Hyperactivity
Harris (2017)	-	+ Level of engagement	+ Social functioning	-	- Severity of ASD symptoms - Hyperactivity

Discussion and Conclusion

This review evaluated 18 studies to investigate which effect AAI have on the well-being of children with autism. Each study was reviewed to answer the questions (1) What are the characteristics of an AAI for children with ASD? (2) What are the characteristics of the studies investigating AAI for children with ASD? (3) Do AAI improve the well-being of children with ASD?

Characteristics of AAI

The description of the different interventions varied a lot between the studies. No two studies replicated the same setting, type of animal, duration or interventionist. The only thing that all studies had in common was the inclusion of an animal. Furthermore, the information about the procedure and the activities were very limited. This leads to insufficient information to replicate the studies. This is consistent with the results O'Haire (2013) and Davis et al. (2015) found in their literature review. Already O'Haire (2013) found no detailed information about the procedure of the AAI and big variation in the key components of the AAI. This has not changed in the study of Davis et al. (2015), which reported that the studies fail to provide detailed information to enable replication. This shows that AAI has not moved out of the first phase of research for new psychosocial interventions for ASD as O'Haire had already stated 2013. Studies still mainly focus on providing "proof of concept" instead of developing manuals and protocols for the process (Smith et al., 2007).

The fact that a detailed description of the different interventions is missing, makes it difficult to conclude weather the interventions fit more to an Animal-Assisted Therapy (AAT) or an Animal-Assisted Activity (AAA) as defined by the Delta Society (n.d.). A classification might be beneficial, to better pin down the goals and approaches of the interventions. For an AAT a specific goal and objective for every participant is necessary, and the process needs to be measured. Although nine studies refer to be a AAT, especially the specific goal and objective for each individual was not stated in any study. Six of these interventions were conducted in groups, in which an overall aim was described, instead of a specific goal for each individual. But also for the individual interventions only an overall goal was described for the whole study. But because of the lack of information that was given in the most studies, it is difficult to make a clear statement that these specific goals are missing. It could be possible, that the general goals were adapted individually, or that there were additional individual goals, that were not descripted in the study. This shows the importance of a

detailed description of the intervention and the used goals and activities. Through this it would be easier to classify the interventions, which could help to compare similar interventions.

Characteristics of the studies

While selecting the studies there was no eligibility criteria with regard to methodological quality. Through this, no specific standard was set for the included studies. Many studies show weak quality with poor study designs. Most studies had only a small sample size. Additionally the characteristics of the participants were poorly described. Furthermore there was a lack of blind raters and researcher-constructed measurements, which might lead to biased information about the child behaviour and treatment outcome. Additionally several studies lacked of an appropriate control condition. In general, it can be stated, that AAI for children with ASD are lacking of a structure for methodological quality and needs to use more comparable study designs in the future. These methodological weaknesses also indicate that AAI are still in the first phase of research for new psychosocial interventions for ASD. To move on to phase two, where the intervention needs to be standardized as a preparation for clinical trails, AAI need to establish replicable and testable protocols. Therefore it is important to create a treatment manual, develop measurements for the treatment fidelity and to test feasibility of the treatment manual with a small group of participants (Smith et al., 2007). This should be the focus of further research to help AAI to become a well-established treatment.

Effects on well-being

The most measured component of the PERMA model was relationship. The reason may be, that social interaction is one of the core problems people with ASD face (American Psychiatric Association, 2013). Therefore, many studies like to investigate this factor to find possible solutions for the problems children with ASD face. Some studies focused on social interaction, others on the use of language and even others on interaction with peers. Although many different concepts of social interaction were used all show an increase through the use of AAI. For these concepts of social functioning many specific measurement instruments were available that directly measure social interaction like the Social Responsiveness Scale (SRS) or the Social Skill Rating System (SSRS). Furthermore one measurement tool was used that was specifically developed for AAI. The MOPI measures amongst others verbal communication.

A component from the PERMA model less addressed by the studies was meaning. Only one study found results that could contribute to this factor (Burrows et al., 2008). Additionally these results have to be interpreted carefully, because the study has low methodological quality and the results mainly rely on the unstructured observations of the researcher. A possible reason that this component was addressed so little could be that it is very difficult to define. The definition in this study was very vague. Additionally it refers a lot to the connection of the participants to other groups or social networks, like the family or a community. However, all studies in this research focus mainly on the participant itself or how he behaved in contact with single persons. This contact to single persons refers more to the component relationship than to meaning. To better measure meaning, studies should use more specific interviews to look at the relationships in the family and their role in the community or other groups.

Positive emotions were mostly investigated through looking at participant's smile or whether their mood increased. Except for one study (O'Haire et al., 2015) none of the studies used an instrument were participants could rate their emotions themselves. This fits to the assumption that children with ASD might have difficulties to recognise and report their own feelings and emotions (Lickel et al., 2015). The one study that encouraged the participants rating their feelings only used a very basic tool. They asked, "How do you feel when you are… " and the children could rate their feeling on a five point Likert Scale with smileys representing the different feelings (O'Haire et al., 2015). It would be of interest to additionally use a non-self reported measurement when using this basic self-report Likert Scale. This would make it possible to investigate whether this tool is basic enough for children with ASD to measure their own feelings and emotions. Through this the results from the self-rating measurement would become more reliable.

Engagement was addressed through an increase in every day activities, contact with the teacher, attending school and attention to sensory input. This shows that AAI can help to increase the engagement of children with ASD in many different areas where they typically have difficulties. Especially the engagement concerning school and teachers could help children increase their ability to learn or to get better students outcomes, because engagement is an important factor that contributes to this (McWilliam & Bauley, 1995; Logan, Bakeman, & Keefe, 1997). Animals in general have a motivational influence, which might be the reason why AAI can improve engagement of children with ASD. The study of Wohlfarth, Mutschler, Beetz, Kreuser and Korsten-Reck (2013) for example showed that dogs can increase the implicit motivation for activities of children. It would be of interest if the increased

engagement can also be detected in follow ups of the AAI or if children only show increased engagement because of their interest and motivation arising from the direct presence of an animal.

Accomplishment was investigated in many different ways. It can include very specific things or tasks children learned or accomplished, like regulating pace (Burrows, et al., 2008) or following an instruction (Ward, et al., 2013). On the other hand there were more general things that children accomplished, like a general reduction in ASD symptoms (Kern et al., 2011; Becker et al., 2017). This proves, that accomplishment is a very individual term and can be seen in many different areas and that AAI can help to achieve accomplishment in many of these different areas. To better measure accomplishment it thus would be important to investigate in more detail the personal problems and challenges of a participant at the beginning of the intervention. Through developing a more personal plan with aims to accomplish, AAI can work more direct on these problems and so achieve accomplishment. But this also shows the challenging to measure accomplishment. Further studies should be aware, that the diversity of measurement instruments for accomplishment is high and that it is necessary to look individually which measurement instrument would fit the best to measure accomplishment in this case.

Almost all components that were measured in the 18 studies could be described with the five components of the PERMA model. Only three studies met additional factors that did not fit to one of the components of PERMA. This shows that the PERMA model is a good manner to investigate the positive effect AAI might have on well-being. One possible reason for this is, that the PERMA model includes components that are important for children with ASD. Especially positive relationship seems to be one important factor that needs to be improved when working with children with ASD. But also engagement, when defined a bit broader than the definition of Seligman, shows to be important and fits to the problems children with ASD face very well. But it became clear that it is important to adjust the definitions of the terms so that they better fit to the target group. Especially when looking at the component accomplishment one should individually define important things for autistic children that should be accomplished with the help of AAI.

Limitations

In general a limitation of this study is, that it uses a vague construct of well-being. None of the studies named explicitly to measure factors concerning well-being or the PERMA model. No specific measurement instruments addressing well-being were used. So the results from all 18 studies had to be interpreted as to they fit to one construct of PERMA. The results

would be more valid if well-being would have been measured directly in the studies. One good example could be the General Health Questionnaire (Goldberg & Williams, 1988). This questionnaire has an equal number of negatively and positively items. By comparing the responses to these items one can measure well-being (Goldberg & Williams, 1998). An alternative could also be the newly developed PERMA-Profiler. (Butler & Kern, 2016). It focuses on the components of the PERMA model and makes it possible to measure well-being across multiple domains. Unfortunately both measurement instruments are only available for adults at the moment.

Furthermore 16 studies that were identified through the literature search were not available at full text. Through this it is possible that studies that might have been relevant, were excluded. This could also be the problem through the focus on only English publications. Non-English literature might have broadened the scope of this review through giving another point of view. Furthermore all studies only reported positive results. This might be an evidence for the 'file drawer effect'. This means, that negative results tend to be filed away rather than being published (Herzog, 2011). Another reason for the positive results can be that many researchers in this field are often interested in this topic because they are pet lovers themselves. The creation of a placebo effect is difficult in this type of area. This makes it especially important that the researchers are objective and vigilant in designing the studies (Herzog, 2011).

Further research

It is important that future research tries to develop standards and treatment manuals to get a more consistent approach. Especially for the training of professionals and animals guidelines should be created and evaluated. But also the creation of a treatment manual is important to get an overview how different problems can be addressed the best. Through the many different settings and professionals that were included one can see that AAI are used in many different areas. It is important to develop different techniques and manuals for the different fields of application. This is also the case for the use of different types of animals. AAI with small animals might consist of different activities as for example AAI with horses.

Concerning the PERMA model further research needs to be done to make the components more specific for the target group of children with ASD. It is important to get a good picture of the target group and the challenges they face. These challenges can then be integrated in the components of the PERMA model, so that children with ASD could increase their well-being as effective as possible.

Concerning the big variation in characteristics of AAI and the methodological criteria, it would be of interest to regard the latest published articles separately from the early articles, to see if an improvement can be detected compared to the earlier studies of O'Haire (2013) and Davis et al. (2015). In this literature review articles were included regardless of the year they were published. Through this, many articles were included that were also part of previous literature reviews. This might have prevented that improvements in methodology and other characteristics of AAI were detected. The improvements might be only small and thus not detected in this study.

Conclusion

This systematic review provides the first overview of empirical research of the effect AAI can have on the well-being of children with ASD. Results indicate, that the inclusion of AAI in the treatment of ASD still lacks of a universal terminology concerning the setting, type of animal, duration, interventionist and activities. The methodological quality is weak with no robust study design. But the results investigating the effects of AAI on the factors of the PERMA model are promising. Most notable improvement was detected for the concept relationship, when focusing on increasing social functioning. All but one study reported improvement on social functioning. The factor that was most difficult to define and was also addressed in only one study was meaning. Because it is such an abstract construct it was difficult to get specific results contributing to this factor. Only one study, with low methodological quality, reported improvement in meaning. But this was based on the interpretation of the author (Burrows et al., 2008). For the other factors (accomplishment, engagement, positive emotions) promising results were found that show that it is possible to improve them with the help of AAI. Positive emotions were mostly based on smiling or an increase of mood. This shows diversity in the manner the constructs were measured in the different studies. Especially for accomplishment positive results in different areas were found which include for example the regulation of pace or a general improvement in ASD symptoms. But this also shows the importance to adapt the concepts of the PERMA model to the personal needs of children with ASD. It is important to focus more on the specific needs and problems children with ASD face to get a good focus for measuring accomplishment. This is also the case for engagement, which was defined differently at the beginning of this study than stated originally from Seligman, to better fit to the needs of the target group. Through this broader definition, it was possible to detect improvements for basic forms of engagement, like the participation in daily life or an increased attention at school. The diversity of possibilities that could be investigated in and where an improvement with the help

of AAI could be accomplish, show the possibilities AAI have. Even if the most studies up to date show weaknesses with methodology and consistent approaches, this field has a lot of potential that should be used and investigated more. Through improving AAI for children with ASD the well-being in their life could be improved and participants thus could contribute from all the positive factors that can derive from a feeling of well-being.

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