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A Review of Studies Conducted with Animal Assisted Interventions for Children with Autism Spectrum Disorder

Otizm Spektrum Bozukluğu Olan Çocuklara Yönelik Hayvan Destekli Müdahalelerle Yürütülen Araştırmaların İncelenmesi

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Abstract

The aim of this study is to examine the studies' effects of the practices offered through animal assisted interventions to children with autism spectrum disorder between 2000 and 2019 in terms of demographic, methodological and results variables. In this context, 11 articles meeting the inclusion and exclusion criteria were reviewed and analyzed descriptively. As a result of the analysis, it was determined that the animal assisted interventions used in all studies except one study had a positive effect on the target skills of the participants with autism spectrum disorder and provided improvement. However, it was determined that most of the studies were designed with single-subject research models such as the AB and ABA models, which were considered to be weak in terms of the most basic and experimental control, and some studies were not reported as reproducible. In this respect, it is thought that more reproducible studies are needed to test the effects of animal assisted interventions, and to report the participant characteristics, baseline and implementation phases in more detail and clearly.

Keywords: Autism, autism spectrum disorder, animal assisted activity, animal assisted therapy, animal assisted treatment

Öz

Bu çalışmanın amacı, 2000-2019 yılları arasında otizm spektrum bozukluğu olan çocuklara hayvan destekli müdahaleler aracılığıyla sunulan uygulamaların etkisini tek- denekli araştırma modelleriyle sınayan çalışmaları demografik, yöntemsel ve bulgu değişkenleri açısından incelemektir. Bu bağlamda yapılan alanyazın taramasında dâhil etme ve hâriç tutma kriterlerini karşılayan 11 makale incelemeye alınmış ve betimsel olarak analiz edilmiştir. Analiz sonucunda, bir çalışma dışında tüm çalışmalarda kullanılan hayvan destekli müdahalenin otizm spektrum bozukluğu olan katılımcıların hedef becerilerinde olumlu etki yarattığı ve gelişim sağladığı tespit edilmiştir. Ancak, araştırmaların çoğunun AB ve ABA modeli gibi en temel ve deneysel kontrol açısından zayıf olarak nitelendirilen tek- denekli araştırma modelleri ile desenlendiği ve bazı araştırmaların yinelenebilir özellikte raporlanmadığı belirlenmiştir. Bu doğrultuda hayvan destekli müdahalelerin etkilerini sınayan, katılımcı özellikleri, başlama düzeyi ve uygulama evrelerinin daha ayrıntılı ve açık bir biçimde rapor edildiği yinelenebilir özellikte daha fazla sayıda araştırmaya gereksinim olduğu düşünülmektedir.

Anahtar sözcükler: Otizm, otizm spektrum bozukluğu, hayvan destekli aktivite, hayvan destekli terapi, hayvan destekli müdahale

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ACCORDING to the theory that supports human-animal interaction, human-animal interaction has positive physical and psychological outcomes. This theory suggests that humans see animals as non-judgmental social interaction partners [Tohum Autism Foundation (Tohum Otizm Vakfı (TOV) 2019]. One of the documented benefits of interacting with animals is the fact that having a pet, and especially being in physical activity with that animal, makes people feel good and has many positive effects, some of which are preventive and some healing (Nimer and Lundahl 2007; VanFleet and Faa-Thompson 2010, O'Haire 2013, Davis et al. 2015, Fine 2015, Hajar 2015, Mey 2017, TOV 2019). In addition to these positive effects, pets provide unconditional love and affection, alleviate loneliness, reduce stress, anxiety and depression, encourage social interaction, exercise and entertainment (Jessen et al. 1996, Headey 1999, Morrison 2007). The beneficial effects of interaction with animals have been documented by both past and present researches, and these studies have been examined in the studies of Morrison (2007) and Purewal et al. (2017). In addition to the findings indicating children who keep pets at a young age have stronger social skills, researches reveal that looking after an animal helps children grow up more actively and safely, and can provide valuable friendships for the elderly and adults [Mey 2017, Purewal et al. 2017, Wanser et al. 2019, Human Animal Bond Research Institute (HABRI) 2020]. So much so that just watching animal activities, playing with animals, loving or caressing them lowers cortisol levels and reduces stress by increasing serotonin production [Centers for Disease Control and Prevention; House and Landis, 1988; Serpell, 1991; McNicholas et al. 2005; Wells,2011, Barton and Behravesh 2017, National Institutes of Health (NIH) 2018, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID) 2019, Casciotti and Zuckerman 2020, HABRI 2020]. Research results reveal that pet owners have lower blood pressure and heart rate than those who do not own one, and people with hypertension have lower blood pressure when petting their dogs (Allen et al 2002, Wright et al. 2007; Levine et al. 2013). As a result of a study conducted by Qureshi et al. (2009) with 2400 cat owners, it was found that cat owners have a lower risk of decease from cardiac disease than people who do not have a cat. Studies have also shown that children who grow up in a home with a dog or cat are less likely to be susceptible to allergic reactions (Hasselmar et al. 1999, Remes et al. 2001, McNicholas et al. 2005; Lodge and Grace 2012, Hajar 2015, NIH 2018, Casciotti and Zuckerman 2020, HABRI 2020). Related to the research results that reveal all these positive effects, efforts are being made to bring specially trained animals at an increased rate to the environments such as educational institutions (Delta Society 2019), hospitals, nursing homes, etc. (Barak et al. 2001, Edwards and Beck 2002, Serpell 2006, Friedmann and Son 2009, Wells 2009, Hajar 2015).

The inclusion of animals in therapeutic activities are comnined under a more general expression, "Animal-Assisted Intervention (AAI)" which includes both animal-assisted therapy and animal-assisted activities (Kruger and Serpell 2010, Griffin et al. 2011, Karayağız-Muslu and Conk 2011, O'Haire 2013). Differences in terms and definitions cause confusion. For this reason, the Delta Society, the largest organization responsible for the certification of therapeutic animals in Australia, defined "animal-assisted therapy",

"animal-assisted activity" and "animal-assisted interventions" to standardize terminology as follows: Animal-Assisted Therapy (AAT) is a target-oriented intervention in which an animal that meets certain criteria participates in treatment as part of the process. Animal-assisted therapies are directed or applied by professionals specialized in this field (Delta Society 2009). Animal-Assisted Activities (AAAs) are activities that provide opportunities for improving the quality of life, education, entertainment and/or motivational therapeutic benefits. Basic features of animal assisted activities are that there are no specific treatment goals, it is voluntary and the visit is spontaneous. It is practiced with specially trained professionals, paraprofessionals and/or volunteers (Delta Society 2009). Animal-Assisted Intervention (AAI) is a target-oriented intervention that deliberately involves animals in health, education and human services for therapeutic gains in humans. In other words, AAI is the conscious participation of animals in a part of the treatment process. AAI brings human-animal teams together in official human services such as AAT or Animal-Assisted Education.

In addition to the psychological (Odendaal 2000), emotional, social (Zasloff et al. Anderson and Olson 2006, Walters et al. 2008) benefits of children's interaction with animals, it also has a positive impact on their physical health (Gee Harris and Johnson 2007) and reduce their aggressive and inappropriate behaviors (Katcher and Wilkins 1998). Studies on the use of AAI in children have focused on Attention Deficit and Hyperactivity Disorder, emotional and behavioral disorders, language and speech disorders, learning disabilities, cerebral palsy, psychiatric problems, children with developmental delay and chronic disease, and Autism Spectrum Disorder (ASD). (Karayağız-Muslu and Conk 2011, O'Haire 2013). As of late, attention has been drawn to the subject that children with ASD may benefit from AAI in their education and daily life (Esposito et al. 2011, Jenkins and Reed 2013, O'Haire 2013). Table 1 summarizes the benefits and effects that interaction with animals provide for children with ASD.

In the report published by the National Autism Center (NAC) in 2015, it was reported that some families with a child diagnosed with ASD could see AAI as an option. It was stated that AAI has begun to be used for individuals with developmental disabilities, which are applied using horses, dolphins and dogs. AAI is used by different disciplines for different purposes. However, in order for the practice to be recommended to families, and educators or experts dealing with children with ASD, a reproducible and sufficient number of studies that reveal the positive findings and effects of AAI are required.

When the studies in the literature are examined; O'Haire (2013), Davis et al. (2015), Srinivasan et al. (2018), Dimolareva and Dunn (2020) examined studies researching the effect of animal-assisted practices on individuals with ASD. O'Haire (2013) examined 14 studies published in peer-reviewed journals and found that animal-assisted practices provide increased social interaction and communication in individuals with ASD, that they lead to a decrease in participants' problem behaviors and stress levels and because the studies were limited by many methodological weaknesses, more detailed and rigorous studies ought to be conducted. Davis et al. (2015) assessed 20 studies in terms of

Table 1. Areas where ASD benefits from animal interaction its effects

Benefiting areas	Effects
Physical, emotional and psychological	The interactions between children with ASD and animals may reduce the perception of physical pain, blood pressure, heart rate, anxiety, depression, cortisol levels and loneliness. In addition, while animals can feel human emotions such as excitement, joy, and sadness, individuals with autism may not be able to perceive these emotions in others. From this perspective, contact and interaction with an animal can help individuals with autism understand emotions and reflect them on to others.
Social interaction	Animals can increase the desire and ability of children to communicate with others by providing a social communication channel for children with ASD. With the presence of animals, the tendency of children to isolate themselves from the social environment can be reduced and their social behavior can be increased.
Encouragement	Animals can provide polarization of attention in children with autism, as they offer powerful and multiple sensory stimuli that counteract the sensory and emotional arousal levels associated with ASD.
Protection	Children with ASD may engage in unpredictable behaviors that put them in danger and cause stress in families. However, animals can oppose the behavior of the child by assuming a protective role in such behaviors. For example, in behaviors such as leaving home and going in traffic, dogs both take on a protective role for the child by opposing these behaviors and allow families to notice the situation and intervene.
Self-help	Interactions such as playing games with animals, looking after or taming animals can improve the motor skills of children with autism and meet their needs in daily life. For instance, the process of taming a dog can teach children skills such as cleaning a food bowl or washing an empty bowl.
Speaking and communication	The presence of animals can provide clear-consistent nonverbal communication cues by reducing physical arousal in the environment. Thus, the level of interpretation and adaptation of children with ASD increases.
Motivation and participation	Animals have the ability to inspire and motivate. Because dogs offer unconditional love and are non-judgmental, they can increase the motivation of children with autism. Especially in animal-assisted treatments, they can increase the motivation of the patient and ensure their participation in the treatment process.
Friendship	The interactions of children with ASD and them playing a role in animal care support the foundations of healthy character development, including trusting, helping, being respectful and responsible. It can also reduce the sense of loneliness in children with autism.

Adapted from Mey 2017

participant characteristics, dependent-independent variables, study results, and evidence precision, and stated that the studies reported positive or mixed results and that there was a methodological flaw in the literature, and this created the need for additional inquiry while determining the effectiveness of the intervention. Srinivasan et al. (2018) examined the studies testing the effects of horse therapy on individuals with ASD and as a result of the examination, they stated that horse therapy has positive effects on behavioral skills and to a certain extent on social communication in individuals with ASD, but there is limited evidence for its positive effects on proprioceptive sense (the sensory system that gives our brain the necessary information about our body position and movements - self-sense), cognitive and functional skills. Dimolareva and Dunn (2020) evaluated 16 studies carried out with 489 participants that are diagnosed with ASD in terms of the therapeutic values achieved and found that the effect size of AAI for the improvement in social interaction and communication and the reduction in ASD symptoms in participants was slight, hence slight improvements in social interaction and communication for children with ASD. Studies in Turkey on the effects of the animal-assisted application on individuals with

ASD have yet to exist. Studies in Turkey about animal-assisted applications are solely information-oriented and based on an explanation of the subject. These are as follows; Cevizci et al. (2009a), Cevizci et al. (2009b), Karayağız-Muslu and Conk (2011), Özkul (2014), Elitok (2017), Akkuş et al. (2018), Demiralay and Keser (2019), Çakıcı and Kök (2020).

The only study on the application of AAI education in Turkey is an international Erasmus+ Project named "Animal Integration in the Educational Program - ZORO" conducted between 2015-2017, aiming to train teachers and other professionals working with people with special education needs in the integration of animals into education. There is no study examining the effects of applying AAI on individuals with ASD. In the literature, it is seen that there is a great increase in studies conducted especially after 2019. However, it is seen that there are methodological inadequacies in existing studies investigating the effects of AAI. In order for the application to be in the category of scientifically based applications, more researches should be conducted by more research groups and more methodically reproducible. Although an increase in studies can be seen in recent years (Akkuş et al. 2018, Souza-Santos et al. 2018, Demiralay and Keser 2019, Kwon et al. 2019, Pan et al. 2019, Çakıcı and Kök 2020, Dimolareva and Dunn 2020), it is thought that it is necessary to examine the use and effects of AAI in children with ASD, guide future researches and provide methodological characteristics suitable for reproducibility and reveal the current situation. Single-subject studies are studies that enable each participant to self-control by making repeated measurements under standard conditions, allowing to change behavior or to demonstrate the effectiveness of teaching practices (Tekin-İftar 2018). Horner et al. (2005) stated that single-subject research models are important and powerful models used to develop applications in the field of special education for individuals with special needs and their families. These models, which enable to examine interventions for exceptional groups such as individuals with special needs, can also provide evidence-based results that can improve special education practices.

For this reason, in this study, it was aimed to make a comprehensive descriptive analysis by examining the studies that test the effect of AAI on children with ASD via single-subject research models in terms of demographic, methodological and findings variables. During the literature review, only one study before the year 2000 was found to be examining the effect of animal-assisted interventions on individuals with ASD and designed with one of the single-subject research methods; the year 2000 was accepted as the beginning since the full text of the literature was not accessible; as the reporting process of the research began in 2019, the included studies were terminated in 2019. Answers to the following questions related to the purpose of the research were sought: (a) What are the characteristics of the participants (age, gender, intelligence quotient, type of disability, problem behaviors)? (b) What skills are aimed to be taught in the interventions? (c) What single-subject research models are the studies designed with? (d) Where, by whom, and for how long the research was generally conducted? (e) What are the characteristics of the animals used in the studies? (f) What are the findings of studies regarding monitoring, generalization, application

reliability/interobserver reliability and social validity? (g) How did the efficacy findings from the studies result?

Method

Literature review process

Two phases were followed in the determination of the articles. In the first phase, electronic databases such as EBSCO, Elsevier, Springer, Sage Journals, TRDizin, Sobiad, ASOS were scanned through the "Trakya University Library Databases Mass Scan" systems. While searching, the keywords "Animal-Assisted and Autism", "Animal Assisted Intervention" "Animal-Assisted Intervention and Autism" were used and 65 results were listed. Of the 65 results obtained 27 articles that are accessible as the full text were found. While three of the 27 articles were anthologies, 16 were experimental studies, eight were studies designed with single-subject research methods, and these were the ones that are included in the study. In the second phase, the bibliographies of the 27 articles found were also scanned, and the articles that were carried out with a single-subject research design were determined, and the articles that could not be found in the first step were searched through Google Scholar. Three more fully accessible articles designed with single-subject research models were reached. As a result, 11 articles that are fully accessible and designed with single-subject research models were accessed and included in the study. The scanning process is given in Chart 1.

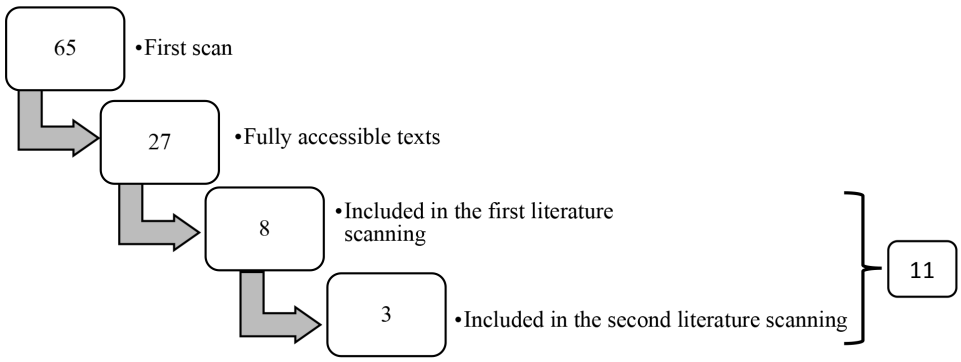

Chart 1. Literature review process

Inclusion and exclusion criteria

The criteria taken into consideration for the inclusion of the articles in the study are as follows: researches published between 2000-2019, published in English and Turkish languages, published in peer-reviewed journals, designed with single-subject research models, participants have ASD diagnoses (those who have an additional disability besides ASD are also included). Prior to the year 2000, only one study that examined the effect of animal-assisted interventions on individuals with ASD and was designed with one of

the single-subject research methods was accessible. Though, since the research is not fully accessible, the 2000s has been chosen as the starting year for researches on AAI, whose visibility has gradually increased in the literature, beginning from the 2000s. Since the reporting process of the research began in 2019, the included studies were terminated in 2019. Since there were pre-DSM-5 diagnoses among the participants in the included studies, diagnoses gathered under ASD such as Pervasive Developmental Disorder, Autistic Disorder, Asperger Syndrome, Rett Syndrome, Childhood Disintegrative Disorder, and Not Otherwise Named Pervasive Developmental Disorders are indicated with their exact same names from the study examined.

The criteria taken into account in excluding the articles are as follows: The studies are not designed with one of the single-subject research methods, the execution of the research is not with an actual therapy animal but with a simulation, animal figure toy, robot, etc... Regarding the inclusion and exclusion criteria, 11 articles that make up the research data were tabulated and described based on their "Findings Regarding Demographic Characteristics, Findings Regarding Methodological Characteristics".

Descriptive analysis process

Determined articles were assessed in terms of demographic characteristics such as age, number and gender, diagnosis, intelligence quotient, problem behaviors; and methodological characteristics such as research model, dependent variable, independent variable, animal characteristics, timespan, environment, practitioner, social validity-permanence-generalization-reliability, results. Assessment results are given in Table 2 and Table 3.

The intercoder reliability

Each of the articles was read and evaluated by the lead author based on the variables included in the descriptive analysis process. Approximately 45.5% (n=5) of the articles examined by the lead author and included in the research process in order to determine the reliability and to prevent any subjectivity or bias that may arise during the descriptive analysis process, articles were examined by the randomly assigned second author in terms of the criteria in the descriptive analysis process. The cohesion level of the results on the records made by the two authors was determined. Intercoder reliability was found to be approximately 88%. In the reliability measurement, [consensus/(consensus + disagreement) x 100] formula was used (Wolery et al.1988).

Results

The findings of 11 studies examining the effects of animal-assisted interventions on children with ASD regarding demographic, methodological and findings variables are explained in detail under the respective titles.

Table 2. Demographic features

Researcher-year	Age	Number-gender	Diagnosis	Intelligent score	Problem behaviours
Martin and Farnum (2002)	3-13	10 (2G 8B)	7 PDD-2asperger-1 ASD	-	-
Sams et al. (2006)	7-13	22 (-)	ASD (+2 serebral palsy)	-	-
Kršková et al. (2010)	7-13	9 (4G 5B)	1 asperger - 8 kanner + intellectual disability	-	-
Viau 2010	3-14	42 (5G 37B)	34 ASD (2 Asperger - 6 PDD)	-	-
Silva et al. (2011)	12	1 (B)	ASD	-	Aggressive behavior, anxiety
Kern (2011)	3-12	24 (6G 18B)	ASD	-	-
Jenkins and Reed (2013)	6-14	7 (1G 6B)	ASD	-	Displaying any destructive behavior (eg aggression, stereotype) that is not suitable for the environment
Holm et al. (2014)	6-8	3 (B)	ASD	-	Tension of facial muscles, fingers closing, face hitting, nose pushing, clapping, echolalia, putting object in mouth
Grigore and Rusu (2014)	7-8	3 (1G 2B)	ASD	85-115	Crying, echolalia, loud noises
Llambias et al. (2016)	4-8	7 (3G 4B)	ASD +2 ADHD	-	-
Fung (2017)	8-10	2 (B)	ASD + intellectual disability	-	-

G: Girl, B: Boy, ASD: Autism Spectrum Disorder, PDD: Pervasive Developmental Disorder, ADHD: Attention Deficit and Hyperactivity Disorder Note: Articles have been listed from past to present by publication year. The "+" sign refers to other disabilities with ASD

Demographic characteristics

Findings regarding demographic characteristics were assessed based on participant characteristics as seen in Table 2, and the information in the table was summarized. When analyzing participant characteristics, variables were considered in four separate categories: age and gender, number and diagnosis, intelligence quotient, and problem behaviors.

Age and gender

The ages of the participants were given in all studies; Information on gender was not given in only one study. When the age group distribution of the participants is examined, it is seen that in all 11 studies ages of the participants are between 3-14. When assessed in terms of gender, apart from the study in which gender information is not provided, it is seen that 22 of 108 participants are girls and 86 are boys.

Number and diagnosis

The number of participants was between 1-3 in four of the studies; between 7-9 in three; 10 in one; between 22-24 in two and 42 in one. When the disability types of the participants are

Table 3. Methodological features

Researcher - year	Research model	Dependent variable	Independent variable	Animal characteristics	Timespan	Environment	Practitioner	S.V.	P.	Gen.	Reliability.	Results
Martin and Farnum (2002)	Repeated measurements	Clapping, touching, laughing, looking, answering, speaking, speaking out of context, answering a question / ignore	Dog	-	45 session/15 weeks/15 minutes(min)	School	Therapist	-	-	-	91.3%	+
Sams et al. (2006)	Alternating treatments	Sensory, motor work, language, social interaction	Llama Dog Rabbit	-	15 weeks (1session per week) /28.5 min	School	Therapist	-	-	-	Language use r =0.98 Social interaction; r =0.91	+
Kršková et al. (2010)	AB	Social behavior	Guinea pig	+	10 sessions 10 weeks /240 min	School	5 Teacher	-	-	-	-	+
Viau (2010)	ABA	Cortisol level	Dog	-	4 hafta	Home	-	-	-	-	-	+
Silva et al. (2011)	AB	Aggressive behavior towards the therapist/objects, smelling, obsessive looking, self abstraction, love behavior visual focus, smiling	Dog	Dişi Labrador retriever	6/6/45 min	Treatment centre	Psychologist	-	-	-	0.9	+
Kern (2011)	AB	Sensory profile	Horse		24/24/60min	Riding centre	Riding instructor	-	-	-	IC 94, IO 71% test-retest correlation coefficient 0.88	+

Table 3. Continued

Researcher - year	Research model	Dependent variable	Independent variable	Animal characteristics	Timespan	Environment	Practitioner	S.V.	P.	Gen.	Reliability.	Results
Researcher - Year	Research Model	Dependent Variable	Independent Variable	Animal characteristics	Timespan	Environment	Practitioner	S.V.	P.	Gen.	Reliability.	Results
Jenkins and Reed (2013)	Multiple baseline	Genel davranışlar	Horse	-	9	Riding centre	Riding instructor	-	-	+	IO 98.4 AR 86.7%	-
Holm et al. (2014)	ABA	A: Tightening the facial muscles, snap finger, verbal communication of requests B: Hitting surfaces with both hands, nose push, whirring A: Echolalia, put objects in mouth, verbal requests	Horse	-	4week for every participants/30-45 min	Riding centre	Riding instructor	-	-	+	IO 0.87	+
Grigore and Rusu (2014)	ABAC and ACAB	Social behaviors	Dog	+ 2 years old male Labrador	10 weeks/ (15 min)	Treatment centre	Therapist	-	-	-	IO 80%	+
Llambias et al. (2016)	Multiple baseline	Participation behaviors	Horse	-	45-60 min	Riding centre	Therapist Riding instructor	+ Subjective	+	+	IO 96.7% AR 93%	+
Fung (2017)	ABA	Social and problem behaviors	Dog	+ 9 years old Golden retriever	23 sessions/ 20 min	School	Therapist	-	+	+	Social behaviors 97.9% Unsocial behaviors 99.3%	+

S.V.: Social Validity, P.: Permanence, Gen.: Generalization, IO: Interobserver, AR: Application reliability, IC: Internal consistency, Note: Articles are listed from past to present by publication year

examined in all studies, the ASD diagnoses of the participants and the additional disability types they had are given in Table 2. The total number of participants in the studies reviewed is 130.

Intelligence quotient

In only one of the studies, the intelligence quotients of the participants were included and it was stated that the intelligence quotients of all participants in that study were between 85-115.

Problem behaviors

When problem behaviors are assessed, only two studies reported problem behaviors, and Table 2 lists what these behaviors are. In the study of Holm et al. (2014), instead of problem behaviors, the target behaviors families want to see in their children were listed. In the study of Fung (2017), it was stated that the participants only exhibited "negative behaviors".

Methodological characteristics

While the findings regarding the methodological characteristics were assessed and analyzed as seen in Table 3, nine separate categories were taken into consideration: research model, dependent variable, independent variable, animal characteristics, timespan, environment, practitioner, social validity-permanence-generalization-reliability and result.

Research model

The AB model was used in three of the reviewed studies, the ABA model in three, repeated measurements in one study, alternating treatment designs in one study, and the multiple baseline designs in two studies. In another study, it was stated that the research was designed using two different models, ABAC and ACAB.

Dependent variable

In three of the studies (Kršková et al. 2010, Grigore and Rusu 2014, Fung 2017) target behaviors are social/communication skills. The behaviors determined as dependent variables in the study of Martin and Farnum (2002) are listed and given in Table 3. In the study of Sams et al. (2006), proprioceptive, vestibular function, sensory-motor work, language, social interaction behaviors make up target behaviors. In Viau's (2010) study, the dependent variable is the cortisol level of the participants. The behaviors that make up the dependent variable were also listed in Silva et al. (2011), and these behaviors are given in Table 3. In Kern's (2011) study, the dependent variable is the sensory profiles of the participants. While the dependent variable in Jenkins and Reed (2013) is general behavior, in Holm et al's (2014) study it is behaviors that families set as goals for their children. In the study of Llambias et al. (2016), targeted participation behaviors formed dependent variables.

Independent variable

In four of the studies (Kern 2011, Jenkins and Reed 2013, Holm et al. 2014, Llambias et al. 2016) horse therapy made up the independent variable. In five studies (Martin and Farnum 2002, Viau 2010, Silva et al. 2011, Grigore and Rusu 2014, Fung 2017) interventions with the therapy dog are independent variables. In the study of Kršková et al. (2010), guinea pig; dog, rabbit and llama assisted program in the study of Sams et al. (2006) is the independent variable.

Animal characteristics used

In four of the studies included in the study (Kršková et al. 2010, Silva et al. 2011, Gigore and Rusu 2014, Fung 2017) the characteristics of the animal used in AAI are given. Among these studies, the guinea pig was used in the study of Kršková et al. (2010), and the dog was used in the other three studies. In four studies where characteristics of the animals were not indicated (Kern 2011, Jenkins and Reed 2013, Holm et al. 2014, Llambias et al. 2016), horses were used in AAI and "Equestrian Training" were introduced instead of the characteristics of the horses used. While the animal characteristics were not included in the studies of Martin and Farnum (2002) and Sams et al. (2006), in the study of Viau (2010) the only given information about the animal was that it is educated.

Timespan

When the number of sessions and timespan of the implementation of the intervention programs, it was found that the animal-assisted intervention program was applied for 15 weeks in the studies of Martin and Farnum (2002) and Sams et al. (2006); 45 sessions of 15 minutes each in Martin and Farnum's (2002) study; 2-12 sessions lasting an average of 28.5 minutes in the study of Sams et al. (2006). In the studies of Kršková et al. (2010) and Grigore and Rusu (2014), it was found that the application took 10 weeks. It was stated that the study of Kršková et al. (2010) consisted of 10 sessions of 240 minutes and that the study of Grigore and Rusu (2014) included 15 minutes of a various number of sessions applied to three separate participants (2/3/3 per week). The timespan of the intervention in three studies (Viau 2010, Silva et al. 2011, Holm et al. 2014) takes 4-6 weeks of time. In Viau's (2010) study, no information was given about the number and length of the sessions. It was informed that the study of Silva et al. (2011) consisted of six sessions of 45 minutes each, and the study of Holm et al. (2014) consisted of 30-45 minutes of separate sessions (1/3/5 per week) for each participant were held for four weeks. The number of sessions of the intervention program applied in the study of Jenkins and Reed (2013) was not revealed, it was observed that 60-minute sessions were applied for nine weeks. In Kern (2011) 24 sessions of 60 minutes for 24 weeks were conducted; In the study of Llambias et al. (2016), it was observed that the number and duration of the sessions were not given, the intervention was applied from the graphs between 26 July and 23 November, and the session lengths were 45-60 minutes. Lastly, Fung's (2017) study was stated to consist of 23 sessions of 20 minutes were applied. Among the interventions applied to the participants, considering the

number of sessions; the shortest intervention program lasted four weeks (Viau 2010) and the longest intervention program lasted 15 weeks (45 sessions) (Martin and Farnum 2002).

Environment

It is observed that animal-assisted interventions with dogs or guinea pigs (Martin and Farnum 2002, Kršková et al. 2010, Silva et al. 2011, Grigore and Rusu 2014, Fung 2017) were carried out in school or treatment center; Interventions with horses (Kern 2011, Jenkins and Reed 2013, Holm et al. 2014, Llambias et al. 2016) were carried out in the equestrian center in parallel. Only in Viau (2010), "home" was chosen as the setting among the interventions with dogs. Sams et al. (2006) used llamas, dogs and rabbits, but researchers still preferred school as the setting.

Practitioner

When the studies were examined in terms of the practitioner variable, it is observed that the practitioner is a therapist in four of the studies (Martin and Farnum 2002, Sams et al. 2006, Grigore and Rusu 2014, Fung 2017), a riding instructor in three of the studies (Kern 2011, Jenkins and Reed 2013, Holm et al. 2014), a teacher in one study (Kršková et al. 2010), a therapist and a riding instructor in one study (Llambias et al. 2016), and a psychologist in another study (Silva et al. 2011). In Viau's study (2010), on the other hand, no information was given on practitioner.

Social validity-permanence-generalization-reliability

Of the 11 studies included in the review, only in one study (Llambias et al. 2016) information on social validity data was presented. It was stated that these data were also collected by subjective evaluation method. Only in two studies (Llambias et al. 2016, Fung 2017), permanence data were collected and it was observed that the intervention effects applied in the studies were permanent. When the studies are examined in terms of inclusion of generalization data, they were included in three studies (Jenkins and Reed 2013, Holm et al. 2014, Llambias et al. 2016) and it was determined that the intervention effects applied in the studies were generalized. Reliability data were not provided only in two of the studies (Kršková et al. 2010, Viau 2010).

Results of the studies

When 11 studies examined in the research were evaluated in terms of the results achieved, it was seen that animal-assisted intervention used in all studies except for one (Jenkins and Reed 2013) and a positive effect and improvement on target skills was observed in the rest of the studies. In the study of Jenkins and Reed (2013), the effects of therapeutic horse riding on the behaviors of children with ASD were examined. As a result of the research, it was observed that therapeutic horse riding did not have clinically significant effects on participant desire, off-task behavior, problem behavior, compliance or language (spontaneous initiations and given responses) during center-based activities and home

observations. Findings from the timeline of the study showed that therapy was not an effective intervention to improve performance on the dependent variable.

Discussion

The aim of this study is to conduct a comprehensive descriptive analysis by examining the effects of the applications offered to children with ASD via AAI with single-subject research models between 2000 and 2019 in terms of demographic, methodological and finding variables, contributing to future researches by revealing the state of the current situation and to evaluate its status within the scope of scientifically based applications. For this purpose, 11 studies that meet the inclusion criteria of the research published in the national and international literature have been examined and described in terms of different variables.

When the 11 studies examined are evaluated in terms of the ages of the participants, it is seen that all studies have been working with participants between the ages of 3-14. This is due to the fact that the skills studied in researches are generally communication and social interaction skills or that individuals in this age group experience a transition period (Gander and Gardiner 2015) that is an open, developing process that includes interaction with the environment, friendship, etc. Among the anthologies examined (O'Haire 2013, Srinivasan et al. 2018), it was observed that the participants of the studies are in the same age group, and that out of the studies examined by O'Haire (2013), only two studies (Keino et al. 2009, Gabriels 2012) appeared to contain participants aged 16 and 17, respectively. Experimental studies involving participants of higher age groups have also been found in the literature. For example, Wijker et al. reported that 72 adults with ASD participated in their research in 2017 and 53 adults between the ages of 18-60 participated in their research in 2020 and stated that AAI improves and can be used in adults with ASD. According to Erikson, conducting studies with the participation of adults and single-subject research designs, such as these studies, enables to see the effects of AAI in terms of problems such as role confusion, isolation, stagnation, and hopelessness (Gander and Gardiner 2015), while contributing to the literature. will also provide. Apart from the study contains no information about the gender of the participants (Sams et al. 2006) 22 of 108 participants in other studies were girls and 86 were boys. The number of male participants is higher than that of girls. It can be explained by the fact that ASD is seen in boys five times more than girls (NAC 2015).

When participants are evaluated in terms of diagnosis and intelligence quotient, it is observed that in four of 11 studies (Sams et al. 2006, Kršková et al. 2010, Llambias et al. 2016, Fung 2017) there are also participants with additional disabilities other than autism. It is seen that autism severity was revealed in two studies (Grigore and Rusu 2014, Fung 2017) and intelligence quotients were revealed in only one study (Grigore and Rusu 2014). However, the intelligence quotient and as O'Haire (2013) stated severity of autism may have affected the results of the intervention, which is a limitation of existing research. Including this information in future researches may provide more inferences about the

effects of interventions.

When participants in studies are evaluated in terms of problem behaviors, it is seen that two out of 11 studies (Silva et al. 2011, Grigore and Rusu 2014) revealed information about problem behaviors. In the literature reviews on the subject (O'Haire 2013, O'Haire et al. 2015, Srinivasan et al. 2018), problem behaviors of the participants were not included in the review criteria. However, the inclusion of problem behaviors can provide inferences about the effects of the intervention on these behaviors or that they may be a source of these behaviors. Thus, researchers can take precautions against the possibility of participants with ASD exhibiting the same problem behaviors in future studies. On the other hand, problem behaviors reduce the acceptance of the individual among one's peers or community interactions and the possibility of initiating an interaction (American Psychological Association (APA) 2013). For this reason, it is of greater importance to include problem behaviors in studies that study social skills.

When the research models used in the studies are examined, it is seen that the most used models were AB (Krško vá et al. 2010, Kern 2011, Silva et al. 2011) and ABA (Viau 2010, Holm et al. 2014, Fung 2017). However, according to Gast and Baekey (2014), AB design is the simplest single-subject research design that does not enable to determine whether the practice is fully effective/ineffective (Rakap 2017). In the ABA model, the cause-effect relationship between the dependent and the independent variables cannot be demonstrated entirely, only the connective relationship between the variables can be explained (Tekin-İftar 2018). From this point of view, there is a need for studies patterned with single-subject models that can demonstrate the effects of AAI on individuals with ASD more effectively. Horner et al. (2005) recommend that single-subject studies should have the following features in order to form a scientific basis for an application: Defining the operation of the application, explaining with whom/in what environment/under which conditions the application will be carried out, showing the implementation of the application was done according to the plan, explanation of the effects of the application on dependent variables in cause and effect relationship form, reproducing of the cause and effect relationships concluded at the end of the study with different researches/research staff and participants (Kırcaali-Iftar 2018). However, based on the comparison of AB models with baseline and implementation data, the functional relationship between dependent and independent variable cannot be revealed (Tekin-İftar 2018). In reviews in the literature (O'Haire 2013, O'Haire et al. 2015, Srinivasan et al. 2018), it is seen that most of the studies examined are designed with an experimental model. Considering the fact that AAI is not yet a scientifically based application (NAC 2015), utilizing more single-subject research designs, especially ones that aren't AB model, in the designing of future studies may provide a stronger scientific basis for AAI.

In terms of dependent variables, it is seen that in the studies examined, dependent variable mostly consists of skills and behaviors that include "social interaction/communication" (Martin and Farnum 2002, Sams et al. 2006, Krško vá et al. 2010, Grigore and Rusu 2014, Llambias et al. 2016, Fung 2017). This can be correlated with the common symptoms of

autism, especially deficits in social communication and interaction (DSM-5). The least studied dependent variable (in a study out of 11 studies (Viau 2010)) appears to be the cortisol levels (stress hormone secretion level) of individuals with ASD. When evaluated in the context of the independent variable, dogs were the most utilized species in animal-assisted interventions (Martin and Farnum 2002, Viau 2010, Silva et al. 2011, Grigore and Rusu 2014, Fung 2017). This is due to the emotional closeness and attachment of dogs to humans (Mey 2017, Çakıcı 2019), and their benefits to individuals with ASD (Mey 2017). This can be correlated with them having characteristics that will improve quality, life and well-being and have positive effects on social, emotional and physiological health (Delta Society 2019). Regarding the characteristics of the animals used in AAI, only four studies revealed information upon the characteristics of the utilized animals (Kršková et al. 2010, Silva et al. 2011, Gigore and Rusu 2014, Fung 2017). In these studies, dogs were used in all but one study. In studies where animal characteristics were not specified, it was seen that horses were used and instructions of "Equestrian Training" were given instead of the characteristics of the horses.

In the 11 studies reviewed, in terms of the number and duration of sessions, it was seen that apart from two studies in which information upon timespan was not given (Llambias et al. 2016, Fung 2017), it was determined that the intervention was applied for an average of 10.7 weeks. In the literature review, it was seen that there was no certain information about the application periods of AAI, and the application periods differed in the studies. In O'Haire's (2013) study, apart from the extreme values of 4-48 weeks of implementation, it was found that the intervention was applied for an average of 12.2 weeks in the studies and it was stated that the applications were generally short-term. On the other hand, Gabriels et al. (2015) evaluated the long-term effects (six months) of their 10-week application with the same participants (Gabriels et al. 2018) and as a result of the research, they found that there was a 0.1 decrease in the aggressive behavior of children in the therapy group and that they continued the important developments they exhibit in their social and communication behaviors.

When the studies are assessed in terms of environment and practitioner, six studies were carried out (Martin and Farnum 2002, Sams et al. 2006, Kršková et al. 2010, Silva et al. 2011, Grigore and Rusu 2014, Fung 2017) in a school or treatment center; four studies in an equestrian center; one study (Viau 2010) at home. It is seen that practitioner is a therapist in four of the studies (Martin and Farnum 2002, Sams et al. 2006, Grigore and Rusu 2014, Fung 2017), a riding instructor in three of the studies (Kern 2011, Jenkins and Reed 2013, Holm et al. 2014), a teacher in one study (Kršková et al. 2010), a therapist and a riding instructor in one study (Llambias et al. 2016), and a psychologist in another study (Silva et al. 2011). In one study (Viau 2010), on the other hand, no information was revealed about the practitioner. Utilization of a guinea pig in one of the AAI applied in the school or treatment center (Kršková et al. 2010); dog-rabbit-llama in one (Sams et al. 2006); a dog in the other four applications applied at home can be correlated with the fact that these animals are suitable for use at school/treatment center/home, depending on their current

size. In addition, programs utilizing dogs in the classroom have important features as they focus on children with reading and writing difficulties but who are not part of a remedial reading program and they aim to improve the confidence, health, and well-being of children by providing an additional learning window (Delta Society 2019). In the other four studies, it is seen that the applications were applied in the equestrian center and accompanied by the riding instructor, due to the use of a horse in the AAI. In this respect, it can be said that AAI, in which horses are used, are more repeatable practices due to the fact that riding centers and rider trainers are more common than and similar to therapy dogs and therapists (O'Haire 2013).

In terms of social validity, permanence and generalization data, it is seen that in only one of the studies (Llambias et al. 2016), all three data were gathered and social validity data were collected by subjective assessment approach. However, as permanence increases social validity, social validity also reveals the principle of practicality, one of the principles of applied behavior analysis, and generalization increases the external validity of the research. The fact that these data were found in only one of the studies clearly shows that the studies are limited because of the methodological weaknesses and that more detailed researches and additional inquiry are needed as revealed by other anthologies in the literature (O'Haire 2013, Davis et al. 2015). In addition, considering that the purpose of every service offered to children with special needs is to make them gain independence at the level closest to their peers, to determine to which extent the skills and behaviors taught in the researches serve the purpose; therefore, it is important to collect social validity data with a social comparison approach (Vuran and Sönmez-Kartal 2008).

When evaluating the reliability data, it is seen that apart from two studies (Kršková et al. 2010, Viau 2010), data upon reliability were given in every study. However, specifying the application reliability data in addition to the inter-observer reliability data will provide clearer information for the application and show that the research data will be revealed more effectively. Because while the inter-observer reliability data represent the reliability analysis for the dependent variable of the study, the application reliability data represent the reliability analysis for the independent variable of the study (Tekin-İftar and Kırcaali-İftar 2017). Therefore, including both reliability data will enable "being technological" principle of applied behavior analysis and will enable the application of research by different practitioners.

When 11 studies are evaluated in terms of the results achieved, apart from one study (Jenkins and Reed 2013), it has been observed that AAI provides positive effects and improvement/progress is made on dependent variables in all studies. Based on the obtained results, it can be said that the application of AAI in individuals with ASD is promising. However, the fact that there are short-term application periods in the studies and lack of obtaining the social validity/ permanence/ generalization data, cause a matter of question in the applications. Therefore, more detailed researches are needed in order to establish a scientific basis. Dimolareva and Dunn (2020), in an up-to-date study in which the researches examining effects of AAI on the behaviors of children with ASD is compiled, states that

there is little evidence that the applied AAI dosage plays a role in the AAI effect size, and emphasized that more data are needed to establish the relationship concretely.

Conclusion

As a result of the literature review, it was seen that all of the studies examined were conducted abroad. A single-subject study in Turkey regarding the issue has not been found. When the findings of all studies included in the study are examined; it was concluded that the interventions provided through the AAI enabled children with ASD to acquire targeted skills in all studies except for one study. Jenkins and Reed (2013) found that therapeutic horse riding is not an effective intervention to improve performance in children with ASD. However, as Cook and Odom (2013) stated, even if it is scientifically based, no application is effective for every student. Considering that AAI is not a scientifically based application yet, the fact that only one of the 11 studies examined has not been found to be effective can be evaluated as the applications involving AAI are promising for the future.

Based on the results obtained, suggestions for further research are as follows: Participant characteristics (ASD severity, intelligence quotients and problem behaviors) can be defined better and more studies could be conducted with adults as a participant group. Studies addressing different dependent variables other than social communication and interaction skills could be conducted. The characteristics of the animals used in research could be given in detail. Studies could be patterned with single-subject research models that are more effective in terms of experimental control, except for AB and ABA designs. Studies could be conducted in which researches are reported in a reproducible manner, in which participant characteristics, baseline level and implementation phases are reported in more detail and clarity.

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