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Coding Human-Animal Interactions in Homes of Children with Autism Spectrum Disorders

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Abstract: Autism spectrum disorder (ASD) is a developmental disorder characterized by differences in social functioning, communication, sensory preferences, and behavior. These differences invite an effort to understand the human-animal bond and its impact on families and children with ASD. The purpose of this study was to determine if the Observation of Human-Animal Interaction for Research (OHAIRE) coding tool can be utilized in a home-based setting to code human-animal interactions in children with ASD. The OHAIRE is a coding tool developed to quantify the behavior of children when interacting with social partners and animals in naturalistic settings. The tool has been tested for reliability and validity within structured, community-based settings; however, it has not been used in home-based settings. This study aimed to analyze the feasibility of utilizing the OHAIRE tool in home-based settings. The second aim was to determine if interrater and intrarater reliability could be reached between coders using data from the home-based videos. Nine minutes of video were obtained for the study. Participant-provided video was challenging to obtain and presented some coding challenges as quality differed from training videos. Participant training and incentives may increase usability of home-based video for coding interactions. Interrater reliability agreement was reached between primary and secondary coders ranging from .842 to .888. Intrarater reliability was met with substantial agreement to almost perfect agreement and ranged from .792 to .929. The OHAIRE coding tool is a promising measure of in-home human-animal interactions that may require adaptations for coding home-based interactions. Further research should include testing in home-based settings with larger and more diverse sample sizes.

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Introduction

Autism spectrum disorder (ASD) is a developmental disorder characterized by differences in social functioning, communication, sensory preferences, and behavior from those without ASD. The Centers for Disease Control estimate that 1 in 54 children are diagnosed with ASD (Maenner et al., 2020). A primary diagnostic criterion of ASD includes deficits in social skills such as social-emotional reciprocity, response to social interaction, and social communication including both verbal and nonverbal cues (American Psychological Association, 2013). Difficulties with social interactions and emotional understanding can lead to academic challenges, increased risk for peer rejection, victimization, social isolation, anxiety, and mood problems (Butterworth et al., 2014). The emergence of social skills and the establishment of interpersonal relationships are important aspects of child development (Fenning et al., 2011). With an increase in the prevalence of children identified as being on the ASD spectrum, there is a growing need to develop effective strategies for children with ASD to improve social interaction skills with peers and adults.

Interventions utilizing human-animal interactions aim to improve social skills in children with ASD and can support physical activity, promote personal growth, and expand occupational skill sets (Fine & Beck, 2010). Literature on human-animal interaction encourages the use of animals to assist with sensory challenges and increase social skills among children with ASD (Grandin et al., 2015; Pavlides, 2008). Guidelines established by Health Resources and Services Administration Autism Intervention Research suggest children with ASD should have access to at least 25 hours per week of nonmedical interventions to encourage social skill attainment (Maglione et al., 2012). In a review of the literature, Cowan and Allen (2007) suggest naturalistic interventions can be a preferred method because of increased duration and frequency of interactions, which increase the overall effectiveness of the relationship for children with ASD. Natural-based animal exposure involves interactions between individuals and owned animals, under ordinary circumstances. Having an animal in the home may provide sustainable effects through continued animal interaction, as animal ownership does not require extensive training or travel to a therapist. Home-based interactions can foster a naturally occurring bond and eliminate the stress of new environments and unfamiliar humans and animals, which is important for a population that relies on consistency and structure (Germone et al., 2019). Research shows the home environment is important for individuals with ASD, as many social interactions happen within the home environment versus community settings (Geisthardt et al., 2002).

Despite the relevance of home environments, there is limited research on the effects of human-animal interaction in home-based settings. In a scoping review of the literature on animal exposure in natural settings, 12 of 13 studies utilized parent report for identifying and quantifying the child-animal relationship (Lisk et al., 2020). Research has shown parent report may not be a reliable or accurate measure for child behaviors (Geiger et al., 2002; Hall & Segarra, 2007), and these surveys may not fully represent the nature of the relationship between child and animal. Studies show observational research allows the researcher to consistently and reliably identify behavior exhibited by children, which provides understanding of behavior frequency and duration, in addition to qualitative descriptors (Aspland & Gardner, 2003; Pesch & Lumeng, 2017). Further, videoed data can limit the interference in-person observation may produce and allow for more accurate representation of natural behaviors within specific environments. Observational research is a becoming a common and preferred method for understanding and measuring behaviors in naturalistic settings.

To fully understand this phenomenon, it is critical to use direct observation to objectively measure the interactions between children with ASD and animals in the home environment. Observation methods have been used in previous research with ASD and animals (Grandgeorge et al., 2015; Grandgeorge et al., 2017); however, no standardized measure is available for this field. The Observation of Human-Animal Interaction for Research (OHAIRE) tool (Guerin et al., 2018) is the first measurement tool available

for research that could be helpful in quantitatively evaluating interactions to determine the effect of the human-animal bond. The OHAIRE measurement tool has the potential to expand current understanding of the human-animal bond beyond parent report by providing reliable, objective observation data.

The OHAIRE tool measures emotional displays, communication, social behaviors, and problematic behaviors within the human-animal interaction. In a review of four published studies, Guerin and colleagues (2018) found the OHAIRE has been used with a total of 201 participants whose ages ranged from 5 to 18. These studies have utilized the OHAIRE with 14 coders and 2,732 minutes of video to code interactions in structured environments such as schools, inpatient hospital settings, group therapy settings, and therapeutic horseback riding programs. The environments included in these studies involved tasks and interactions that were not structured; however, the locations involved controlled, structured settings. While researchers of the OHAIRE coding tool reached interrater and intrarater reliability through these studies, research exploring the use of the OHAIRE tool in home-based settings has yet to be explored. Home-based interactions with animals involve unstructured environments and settings, and therefore look different from other naturalistic settings. Because of these differences, it is important to understand if human-animal interaction looks different in structured settings vs. unstructured, home-based settings.

The primary aim of this study was to determine the feasibility of using the OHAIRE coding tool in a home-based setting to code human-animal interactions in children with ASD. The second aim of this study was to determine if interrater and intrarater reliability could be reached between coders using the data from the home-based setting videos.

Methods

Feasibility studies determine whether an intervention is appropriate for further testing (Bowen et al., 2009). Assessing the feasibility of a study allows researchers to determine whether the ideas and findings are relevant and applicable to the target population. For an intervention to be worthy of testing for efficacy, it must address the relevant questions within feasibility. This information is needed to understand the practical use of this tool for measuring naturalistic home-based interactions for children with ASD and their animals.

Participants

This study used purposeful sampling due to the specific nature of this feasibility study. After IRB approval, recruitment for participants occurred through an email listserv of a voluntary participant directory utilized for ongoing studies. Inclusion criteria for participants included the following: male and female children 17 years of age or younger, a diagnosis of ASD, and care for/live with an animal. Foster children and wards of the state were excluded. Due to limited funding, the researchers did not provide compensation or incentive for participation in this study. Signed consent forms by caregivers or child were required for participation in this study.

Instrument

The OHAIRE was designed specifically to quantify human-animal interactions and has displayed good reliability and validity in previous studies (Guerin et al., 2018). OHAIRE interactions included interactive behaviors (social communication and environmental interactions), emotional display (facial and verbal), and interfering behaviors (aggression, overactivity, and isolation). Social communication is the interaction between the participant and another person. Social communication was coded for behaviors such as talk, gesture, look, touch, affection (e.g., cuddling, nuzzling, holding hands), and prosocial (purposefully helpful) behavior. Environmental interactions are exchanges between the participant and the animal. Environmental interactive behaviors include talk, gesture, look, touch, affection, and prosocial behavior. Researchers coded emotional displays as verbal (positive, negative, and/or none) and facial emotion (positive, negative, and/or none).

Examples of verbal emotional display include verbally expressing happiness, excitedness, joy, disdain, annoyance, irritation, and neutral content with no emotion. Examples of facial emotion include smiling, laughing, frowning, crying, and whining. Interfering behaviors include aggression (e.g., throwing, kicking, swearing), overactivity (e.g., rough play, talking rapidly), and isolation (e.g., silence, nonparticipation). Full details of these domains can be found at www.ohairecoding.com.

Every instance of social communication or interactive behaviors included a target defined as a person, animal, or object. The one-zero sampling method was utilized for coding. For every 10-second interval, if the behavior was present/absent in any part of the interval, the team coded behaviors as either present (1) or absent (0). The frequency or duration of interactions within each interval were not coded. If individuals or animals were not visible in the video frame, the OHAIRE training manual specifies the interaction is not coded. Researchers utilized ELAN (ELAN, 2019) software to cut the videos into 10-second intervals per minute. The team used Qualtrics (Qualtrics, 2020), an online survey software, to enter scores to code data with OHAIRE.

Reliability of data collection can increase consistency and improve confidence and accuracy (McHugh, 2012). Interrater reliability increases trustworthiness across more than one data collector and removes subjectivity from data observation. Intrarater reliability can assess accuracy among raters and address observer drift over time after interrater reliability has been established (Chorney et al., 2015). The researchers in this study were trained consistently on the OHAIRE coding tool to increase reliability and reduce the potential of subjectivity.

Data Collection Procedures

Upon meeting inclusion criteria, caregivers reviewed, completed, and submitted consent forms to participate in the study. Researchers requested a minimum of 10 minutes of film that involved naturally occurring interactions between the child and animal(s) within the home. Researchers directed the participants to interact naturally with their animal in their home environment rather than perform specific tasks. The caregivers were not given instruction on how to record video, as researchers did not want to influence video received; instead, caregivers were instructed to use video to depict typical interactions that occur in the home at any given time. The team asked caregivers to provide video files via secure file transfer. The intent of requesting filmed interactions was to reduce environmental interference of strangers in the home and capture the most natural interactions possible between the child and their animal.

Research Records

The research team collected demographic information and systematically recorded information to inform the feasibility of using the OHAIRE tool in home settings. Records included communication between researchers and participants (frequency and methods), number of participants enrolled and consented, number of participants providing data, and usability of data provided.

Coders

Five researchers acted as coders for this study. One coder was designated as the primary coder, and four were considered secondary coders. The OHAIRE manual instructs the primary coder to code the full set of videos and the secondary coders to code a minimum of 20% of the videos obtained for the study. Because the second aim of the study was to establish reliability, all videos were coded by primary and all secondary coders instead of the suggested minimum 20%.

Training

All coders were trained using the training protocol provided by OHAIRE to learn the coding system. The training began with weekly meetings involving a detailed overview of the manual, along with viewing practice videos to provide examples of each behavior. Once each coder thoroughly read and understood the manual, the primary investigator/coder

taught secondary coders to use Qualtrics to record training data. The training involved practice coding videos independently and discussing behavior definitions within the OHAIRE manual with the primary coder. After training, the secondary coders coded three 1-minute videos provided by the OHAIRE research team and independently entered responses into Qualtrics. Each researcher was required to meet at least .80 reliability across overall categories during training prior to coding participant data.

Data Analysis

To analyze feasibility data for the first aim, the authors used descriptive statistics to summarize research records. To evaluate reliability for the second aim, the authors used the kappa statistic and descriptive statistics including frequencies and percentages. Cohen's kappa is used to determine degree, significance, and sampling stability of the distribution of agreement between researchers, while limiting the chance for random agreement (Cohen, 1960). It is recommended that the kappa result be interpreted as "values ≤ 0 indicating no agreement; .01 to .20 as none to slight; .20 to .40 as fair; .41 to .60 as moderate; .61 to .80 as substantial; and .81 to 1.00 as almost perfect agreement" (McHugh, 2012, p. 278). The OHAIRE training manual provided syntax to run these analyses. SPSS version 25 (IBM Corp., 2017) was used for all data analyses.

Results

Participant Demographic

For this study, six participants enrolled, five consented, and two provided data. Both participants were males with a primary diagnosis of ASD, indicated per parent report. The participants each had presence of a co-occurring condition of attention deficit hyperactivity disorder, and one had a diagnosis of anxiety. The participants were both Caucasian, with family income that ranged from $80,001 to $100,000. The participants' caregivers were asked to describe their child's relationship with their family pets. One participant's relationship was described as "loving and knowing. He is an animal lover, he just knows how to approach and interact with all living things (except bees)." The other participant's relationship was described as "pretty good but sometimes they play too rough." Table 1 displays a summary of participant demographic information.

Table 1 Participant Demographic Information

Characteristic	Participant 1	Participant 2
Age	12	8
Sex	Male	Male
Diagnosis	ASD*	ASD*
Co-occurring Conditions	ADHD** & anxiety	ADHD**
Race	Caucasian	Caucasian
Household Members	3	4
Household Income	$80,001–$100,000	$80,001–$100,000
Animals in Home	2 (cats)	3 (1 dog & 2 cats)
Hours Spent with Pet per Week	40–50 waking hours; 50–60 sleeping hours	3–4

* Autism spectrum disorder

** Attention deficit hyperactivity disorder

Feasibility

A total of nine minutes of video was provided after three requests, and participants stopped responding to requests for additional video after four attempts. The caregiver of participant 1 sent three minutes of video in two separate video segments; the caregiver of participant 2 sent six minutes of video in three separate video segments. Neither family provided the full 10 minutes of video requested by the research team.

The coders found discrepancies between the videos received in home-based settings compared to videos provided in training sessions. Training videos were structured and recorded with a stationary camera, whereas participant videos collected for this study were recorded with mobile devices and frequently moved around to capture the unstructured animal-child interaction. This movement caused distorted and blurry videos at times. Additionally, the distance at which interactions were filmed varied between participants, causing the participant and animal to be out of the frame in some segments. Further, behaviors were displayed in the participant session that did not occur in the training videos, requiring coders to interpret some behaviors. Examples of these behaviors include attempting to feed the animal food it should not eat; limited initiation of interacting with pets; repetitive, nondirective speech; and displaying flat affect for the duration of the videos.

Of the participant videos provided, 18 ten-second segments (38% of total video) included interactions the OHAIRE coding manual required to be coded as "obscured" or interactions unable to be coded. In three separate 10-second segments (6% of total video), the child was out of the frame, and in six 10-second segments (13% of total video), no animal was observed in the frame. In six 10-second segments (13% of total video), the individual filming communicated with the participant in the video. Communication between the person filming and the child participant included comments such as "You might need to go to him [the animal]" and "Don't give the cat pepperoni." In three 10-second segments (6% of total video), the participant was responding to communication from the caregiver.

Interrater Reliability

Cohen's kappa between primary and secondary coders for the OHAIRE coding system and for the four categories of behaviors are presented in Table 2. The kappa values were interpreted using Cohen's statistical measures ranging from no agreement to almost perfect agreement (McHugh, 2012). Overall, interrater reliability was almost perfect with kappa values ranging .842 to .888 for both training and participant sessions.

Emotional display, including both facial and verbal, were coded with substantial agreement ranging from .723 to .874 for both training and participant sessions. Researchers coded the behavior data with almost perfect agreement with scores recorded between .874 to .908 for participant sessions. Environmental interactions coded during the training session were within the almost perfect category, ranging from .822 to .888. The environmental interactions for the participant session were lower compared to the training session, ranging from .774 to .864, which is considered substantial agreement. Social communication was not coded in the participant sessions because social communication requires interaction between two people, and these interactions were limited to those with the caregiver outside the frame or only the participant and the animal.

Intrarater Reliability

Intrarater reliability was used to test how similarly the same rater would code participant data multiple times. Coding occasions were separated by one-month duration and were calculated using all participant video. Total Cohen's kappa ranged from .792 to .929 among the five coders (see Table 3), indicating intrarater reliability was met with substantial agreement to almost perfect agreement for all coders.

Discussion

The primary aim of this study was to determine the feasibility of using the OHAIRE coding tool in a

Table 2 Training and Participant Cohen's Kappa Values for Interrater Reliability

	Primary vs. Coder 1	Primary vs. Coder 2	Primary vs. Coder 3	Primary vs. Coder 4
Training Session				
Total Kappa	.882	.880	.888	.850
Emotional Display	.745	.874	.766	.766
Environmental Interactions	.888	.862	.894	.822
Interfering Behaviors	.987	1.0	.974	.974
Social Communication	.797	.728	.819	.767
Participant Session				
Total Kappa	.842	.881	.872	.828
Emotional Display	.723	.774	.784	.753
Environmental Interactions	.793	.864	.854	.774
Interfering Behaviors	.899	.908	.898	.874
Social Communication	–	–	–	–

Table 3 Cohen's Kappa Values for Intrarater Reliability

	Primary Coder	Coder 1	Coder 2	Coder 3	Coder 4
Participant Session					
Total Kappa	.939	.862	.908	.792	.805
Emotional Display	.983	.829	.914	.772	.655
Environmental Interactions	.910	.818	.865	.667	.732
Interfering Behaviors	.910	.875	.941	.907	.908
Social Communication	–	–	–	–	–

home-based setting to code human-animal interactions in children with ASD. The second aim of this study was to determine if interrater and intrarater reliability could be reached between coders using the data from participant-provided home videos.

Feasibility

Participant recruitment was challenging for this study, which may have been due to the method of recruitment. Participants and their caregivers were recruited through a listserv by email only, and follow-up was provided by phone once interest was established. Yet literature indicates in-person meet and greets, establishing oneself as a caring individual in the community, and attending autism community events are better ways to recruit for research studies (Wright, 2016). Further, this research indicates social media can also expand outreach opportunities to members of the community.

To encourage active participation in research after obtaining consent, it might have been beneficial to

offer a motivating incentive for the participants and their families. Haas and colleagues (2016) conducted a study that aimed to find factors determining successful research participation in individuals with ASD. They found that motivators for the individuals included furthering research for others with ASD, recognition and extrinsic rewards, opportunity for personal development, and being updated on the progress of the study. In contrast, they found that common inhibitors included travel and time commitments. While the families in this study did not have any travel concerns, they did have to commit their time to record and submit the videos with the only motivator being to further research related to ASD.

There were inconsistencies between the training and participant videos in the way they were filmed, including unpredictable filming (close-up or too far away in proximity to the child), blurry images, and participants' lack of appearance in the frame. These inconsistencies could be due to the lack of training or education caregivers received on how to film properly. Training of participants on the use of video recording and equipment, while being careful not to influence video outcomes, is encouraged in participatory video research (Derry et al., 2010; Milne et al., 2012; White, 2003). The underlying aim of participatory methods is to build capacity and empower individuals and families by giving them control of the camera and process, and allowing individual experiences to be visible to researchers (Milne et al., 2012). Some research argues for installing cameras, or environmental sensors, in the home for "raw footage," which involves wide-angle cameras, and allowing panning and zooming to capture events over long periods of time (Derry et al., 2010; Intille et al., 2003). Further, some studies have shown efficacy in multichannel video, which allows for more cameras to capture different aspects of the interactions, as well as backup cameras in place for possible camera malfunction (Asan & Montague, 2014). Video practices such as these can increase validity of the video data and remove coding difficulties from poor video quality and lack of participant appearance.

While all secondary coders reached reliability with the primary coder for training and participant sessions, there were inconsistencies in training and participant videos. Research evaluating instrument development in the human-animal interaction field shows there is no one, universal measure that will suit all research studies (Wilson & Netting, 2012). Such a tool would require so many compromises, it would likely be difficult to implement in any setting. The OHAIRE tool shows promise in that it was feasible to obtain reliability of coders despite new situations arising in the participant videos. Further training videos for home-based settings should include home-based interactions with a variety of scenarios. Training will allow coders to become more comfortable recognizing behaviors seen in this study such as avoiding eye contact, or communicating or interacting with individuals out of frame.

Reliability

Secondary coders reached almost perfect agreement with the primary coder using the OHAIRE coding tool to code unstructured interactions in homes. Though both interrater and intrarater reliability were good, there were some limitations using the OHAIRE tool in homes. The OHAIRE coding tool measures participant and animal interaction, as well as person-to-person interaction. Person-to-person interactions described in previous research included interactions with peers and teachers or therapists as they engaged in a structured activity together (Geurin et al., 2018). However, in this study the participants were observed communicating with the caregiver who was outside of the video frame, which is not coded with the OHAIRE tool. These meaningful interactions between the caregiver and child are not captured (coded) by the current version of the tool. Research on developing and modifying behavioral coding schemes encourage considering an analytic plan when developing a coding tool to determine how natural behaviors will be observed and scored, and the effect this has on the data (Chorney et al., 2015). Further, research suggests it is important to study and understand the behavior in natural settings and *then* develop the technology or tools to capture desired interactions (Intille et al.,

2003). If the OHAIRE coding tool is to be used in home-based settings, it would be important to modify aspects of the tool to capture the meaningful interactions occurring between participants in and out of the frame.

Summary for Practitioners

ASD is characterized by differences in social-emotional reciprocity, understanding social cues, and interfering repetitive behaviors. Researchers began studying the effects animals may have assisting children with ASD in social skill attainment. Home-based interactions can be important to child skill growth, and may be more accessible for families than intervention-based therapies. Despite the relevance of home-based environments, there is limited research on the effects of human-animal interaction in home-based settings. Specifically, there is limited research on quantitatively evaluating the effects of the human-animal relationship. The OHAIRE coding tool is an instrument used to quantitatively measure interactions between humans and their animals. Previous studies have focused on the coding tool's use during controlled activities; the purpose of this study was to evaluate the OHAIRE tool's effectiveness during unstructured interactions in a home-based setting. The second aim of this study was to determine if interrater and intrarater reliability could be reached between coders using data from the home-based videos. Reliability is important to validate the quantitative data obtained from the study. Video that captured the most natural interactions possible between the participant and their animal was requested from caregivers.

Nine minutes of video were obtained for the study. Video was filmed on cell phones and was submitted via secure file transfer to researchers. Participants were filmed engaging in the most natural interactions between child and animal possible. These interactions included children playing with the child indoors, and outdoors in the backyard, sitting and watching TV with the animal, and eating while interacting with the animal. The video from participants was difficult to obtain, and there were differences in the quality of video received. Because video was filmed with cell phones and the children and animal were often moving, there were instances when the child or animal was not in the frame. The OHAIRE manual instructs that these interactions not be coded, and therefore some meaningful interactions were missed. There were also differences in the training video provided by OHAIRE and the video received from participants, which can cause some confusion in coding.

Training participants on video etiquette and providing incentives may increase the usability of home-based video for coding interactions. Though there was some difficulty obtaining usable data, researchers in this study were able to successfully reach interrater and intrarater reliability using the OHAIRE tool to code the home-based participant videos. Interrater reliability agreement was reached between primary and secondary coders ranging from .842 to .888. Intrarater reliability was met with substantial agreement to almost perfect agreement and ranged from .792 to .929. The OHAIRE is a promising tool for quantifying the human-animal bond during naturalistic interactions in home-based settings, and may require adaptations.

Future research should include extensive recruiting and incentivizing caregivers to increase sample size, diversity of sample, participation for the duration of the study, and quality of data/videos. Researchers should provide training for families on video etiquette, which could include meeting parents to guide where to focus the camera or provide alternatives for setting up video in the home. Studies should obtain a larger, more diverse sample size, particularly in terms of ASD symptomology and severity. Although ASD is a spectrum disorder that varies in clinical characteristics and severity, this study did not measure ASD severity or use it as an inclusion factor. Future research may benefit from incorporating severity levels and other characteristics (e.g., sensory preferences, verbal skills, etc.) to further understand the feasibility of coding interactions of diverse populations with the OHAIRE tool to provide more generalizable results.

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