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Social Interaction during Dog and Robot Group Sessions for Nursing Home Residents with Dementia: the Handler Effect.

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As part of an 8-week intervention study in Dutch nursing homes, we used video-analysis to observe the interaction of psychogeriatric participants with either the handler, the stimulus (dog or robot) or other clients during weekly dog, robot (RAI, robot assisted interventions) and control (human facilitator only) group sessions. Additionally, we measured the initiative of the handler to engage participants. Several baseline characteristics, including dementia severity, neuropsychiatric symptoms and medication usage, were recorded as possible confounders.

Participant-handler interaction is increased in all three groups compared to a baseline of no interaction, while inter-client interaction is not. In the dog group participant-handler interaction scores are similar to participant-dog interaction scores, while in the robot group participant-handler interaction scores are significantly lower than participant-robot interaction scores. Handler initiative does not differ between the three groups.

Our results suggest that a handler effect of AAI on social interaction in dementia care does exist and we hypothesize this effect is linked to the required fully embodied, mutual attunement between dog and handler and between dog-handler team and participants. This embodied interaction distinguishes AAI from RAI and when the required attunement is met, AAI can significantly increase the social interaction of people with dementia.

Keywords: animal-assisted interventions, dementia, handler effect, robot therapy, social interaction

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Research suggests that Animal Assisted Interventions (AAI) increase social interaction for people with dementia. It is still unclear, however, to what extent the AAI effect is influenced by the human handler accompanying the animal. In this article, we analyze this handler effect based on the concept of mutual embodied attunement as proposed in the theory of enactive anthrozoology.

In the last decade, Animal Assisted Interventions (AAI) have become increasingly popular in nursing homes as part of the regular activity program, especially in dementia care. A recent survey among Dutch nursing homes shows that a majority of the responding homes offer animal assisted activities, mostly in group sessions and mostly with visiting dogs and predominantly targeted at residents with dementia (Schuurmans, Noback, Schols, & Enders-Slegers, 2019). Animal assisted interventions are defined as "*a goal oriented and structured intervention that intentionally includes or incorporates animals in health, education and human services (e.g., social work) for the purpose of therapeutic gains in humans. It involves people with knowledge of the people and animals involved*" (Jegatheesan et al., 2018, p. 5).

Due to the inherent progressive loss of communicative abilities in dementia, nursing home residents often struggle with a diminished ability to interact with others and baseline social interaction - i.e. social interaction without external prompting - on nursing home wards is often very low or even absent (Harper Ice, 2002). Social interaction is considered as one of the basic human needs and diminished social interaction leads to compromised quality of life (Weiss, 1974). In their theory of personhood and well-being in dementia care, Kitwood and Bredin (1992) argue that these changes in social interaction are not static and can change when the interaction is adapted to the needs of the person with dementia. AAI in dementia care are often aimed at increasing social interaction of the residents by offering other avenues for (non-verbal) interaction through contact with animals. Several (preliminary) studies suggest that AAI do indeed increase social interaction of people with dementia (Bernstein, Friedmann, & Malaspina, 2000; Fick, 1992; Kongable, Buckwalter, & Stolley, 1989; Olsen, Pedersen, Bergland, Enders-Slegers, & Ihlebæk, 2016; Richeson, 2003; Sellers, 2006; Thodberg et al., 2016; Wesenberg, Mueller, Nestmann, & Holthoff-Detto, 2018). In these studies, social interactions are not limited to human-human contact and are defined as clients engaging in behavior, like talking to, smiling or looking at, or touching either other clients, staff, the animal or its handler. Researchers have used the term 'engagement' to describe the level in which people with dementia are involved with their surroundings and in the last decades a lot of research has focused on understanding all the complex variables involved (Brod, Stewart, Sands, & Walton, 1999; Campo & Chaudhury, 2012; Cohen-Mansfield, Dakheel-Ali, & Marx, 2009; Cohen-Mansfield, Hai, & Comishen, 2017; Kitwood & Bredin, 1992; Schroll, Jonsson, Berg, & Sherwood, 1997). Among the variables that are identified to influence engagement are person-person interactions. AAI are especially complex in this regard, because the animals are usually accompanied by a handler who is not a separate non-responsive entity, but as a person also influences the interaction (and possible effects). The handler is primarily responsible for the animal and ensuring human and animal welfare, but often also acts as an intermediary to facilitate participant-animal contact. Any effect of AAI can, therefore, not be viewed without taking this human effect into account. Marino eloquently describes this conundrum as "*the degree to which the purported positive effects of AAI are attributable to contact with the human facilitating the animal interaction*" (Marino, 2012, p. s141). Or, more precisely, is the handler an integral part of the intervention instead of only facilitating it? The unknown extent to which the handler influences the results of the intervention can be translated to the basic question: is there a handler effect on social interaction in AAI in dementia care?

Observing social interaction of people with dementia during AAI activities seems to be the logical first step in examining the possible handler effect. This requires an analysis of the degree to which the effect on social interaction is due to the interaction with the handler (either through conversation or touch) and should also take into account the effort of the handler in trying to engage participants in interaction. Ideally, this involves a comparison of AAI with and without the handler present, but these types of studies are not feasible practically and ethically unadvisable. The reverse comparison of activities with and without a dog present has been studied. Wesenberg and colleagues (2018), for example, examined the additional effect of the animal in AAI by comparing group activities with a visiting dog and handler with similar group activities with a human facilitator only. Their results show the dog has an additional effect on social interaction that is largely attributable to physical contact with the dog. In both groups, however, participants talked longest to the handler/group facilitator.

Other researchers have added robot assisted interventions (RAI) to the comparison. Robots are often used as substitute animals in interventions for people with dementia that are similar to AAI and three studies suggest positive effects of RAI on social interaction (Jøranson, Pedersen, Rokstad, & Ihlebæk, 2015; Libin & Cohen-Mansfield, 2015; Robinson, MacDonald, Kerse, & Broadbent, 2013b). Furthermore, two studies specifically compared individual visitations of a human with a dog and a human with a robot and found a similar effect for dog and robot on social interaction of people with dementia (Kramer, Friedmann, & Bernstein, 2009; Thodberg et al., 2016).

We believe observing interaction during AAI and RAI is especially valuable in examining the handler effect when viewed from the perspective of the recently proposed unified theoretical framework of enactive anthrozoology (Verheggen, Enders-Slegers, & Eshuis, 2017). The basis of enactive anthrozoology is the concept of mutual, fully embodied attunement of behavior between living systems, either human or animal. Verheggen et al. describe embodied attunement as a fluent interaction that is mutually coordinated and acknowledges the autonomy of all the subjects involved. Examples of interactions that require embodied attunement are walking a dog, riding a horse, petting a cat or talking to a person. If the subjects involved in these interactions are not oriented towards one another, the interaction fails or as the authors describe it: *"people will stumble over their dogs, fall from their horses, or pet and talk in the air as a result of non-fluent, awkward interactions."* These awkward interactions are a well-known phenomenon in dementia care: people with dementia are often not able to properly attune to others.

Successful dog assisted interventions in dementia care require attunement on several levels: between dog and handler, between dog and participants and between handler and participants. Verheggen et al. (2017) hypothesize that measuring the different levels of attunement during AAI sessions will help understand AAI efficacy. Similarly, we propose measuring social interaction during AAI sessions in dementia care can be used to evaluate the possible role of the handler during AAI. Even more so when compared to RAI, because mutual fully embodied attunement is by definition not applicable to robots. Robots are not living systems, but respond to the environment with pre programmed behaviors based on sensory input. People with dementia respond to these behaviors, but this cannot be classified as attunement and autonomous robots will not invite an embodied relation (Coeckelbergh, 2011). During RAI only one type of attunement is present: between the human facilitating the sessions (the robot 'handler') and the participants. The effectiveness of RAI therefore does not depend on additional successful attunement between robot and participants or robot and handler but seems to be solely related to the attractiveness of the robot as a stimulus for people with dementia.

Based on the above, we hypothesize it will be possible to examine whether a handler effect exists in AAI by observing the interaction with the handler during AAI and RAI sessions. We expect the additional levels of attunement during AAI will result in more handler-participant interactions and this will reflect the effect of the handler on the intervention. To test this hypothesis we measured social interaction behaviors in weekly group sessions for people with dementia during three different interventions: a dog and handler (AAI), a robot and human facilitator or robot 'handler' (RAI) and a human facilitator only (control). The control group is specifically added to represent the 'human only' interaction without an additional stimulus. For the sake of brevity and clarity we will refer to the human facilitator as a 'handler' in all groups from now on.

Methods

Design

This study was part of a larger Dutch prospective cluster randomized 12-week trial into the effects of AAI in dementia care. The overall study consisted of an 8-week intervention period of weekly group sessions with either a dog (and handler), a robot (and handler) or a handler only (control group) and included a 4-week follow-up. Clients were recruited among 6 nursing homes of De Zorgboog, a large care organization in the Netherlands. Only clients that lived 24/7 in the nursing home with a registered dementia diagnosis could participate. Inclusion also required a written informed consent by the legal representative of the client. Clients were excluded when they had known allergies for dogs or a known fear of dogs. Clients with extreme aggression that could potentially harm other participants or the dogs were also excluded. Regular dog visitation activities – similar between all locations - ceased during the intervention period in all participating nursing homes.

Participants were allocated to the different groups via randomization. All sessions were recorded on video to enable behavioral coding. The study was registered at ISRCTN (reference number: ISRCTN93568533) and approved by the regional committee for medical research ethics (METC Zuyderland).

Participants

Of the 183 eligible patients (i.e. patients without allergies or extreme aggression) 69 were enrolled in the study by their legal representative (38%). We aimed to create groups with a maximum of 10 clients per group, because large groups are known to be impractical in these types of interventions (Kongable et al., 1989). One location provided 28 participants, meaning we could randomize those clients over three groups (one dog, one robot, one control) using computer generated numbers, resulting in a dog group of 9 participants, a robot group of 9 participants and a control group of 10 participants. The 5 other nursing homes provided 41 participants, with no nursing home enrolling more than 10 participants and one nursing home providing only four participants. We therefore chose to treat each of these nursing homes as a unit and randomize the intervention per unit, resulting in two dog groups of 4 and 9 participants each, one control group of 10 participants and two robot groups of 9 clients each. All sessions took place in similar multi-functional activity rooms within the respective nursing home locations.

Clients were asked to participate on a session by session basis. Participants that displayed verbal or non-verbal resistance upon invitation were not forced to attend the session and were again invited the subsequent week. Clients sometimes were indisposed to attend for a specific reason (usually temporary sickness or personal appointments). This meant that the actual group size during sessions could vary from week to week.

Unfortunately, after one session, we lost all but one client of the control group in the larger nursing home location, because those clients all chose not to attend the sessions any longer. They preferred to attend the regular - not animal or robot related - activities (like music, creative activities and sports) that were provided for the residents of that nursing home and when asked answered they thought talking to and drinking a beverage with handlers without additional activities was too boring. Following our policy not to force clients to attend, we accepted their decision, meaning we were no longer able to collect video data for these clients after the first session and thus a substantial loss to follow-up in the control group.

In contrast, the clients in the other control group in the smaller nursing home location, expressed enthusiasm about their weekly gathering with the handlers. We have written about the challenges of including people with dementia in AAI research extensively elsewhere and refer to this article for additional information about these issues (Schuurmans, Noback, Schols, & Enders-Slegers, 2019).

Intervention

During the 8-week intervention period the three dog-groups had weekly sessions with one or two certified AAI dogs and a qualified handler per dog. Smaller groups (less than 5 participants) had one dog, larger groups two. Dog-handler teams did not switch between groups. The three robot-groups had weekly sessions with one or two robots and one handler per robot. The control-group had weekly sessions with one or two handlers only. All groups followed the same standardized protocol and started each session with an introduction-period of approximately 5-10 minutes, in which the dog, robot and/or handler was introduced to the participants, followed by an intervention period in which each participant was allowed an allocated time - in rotation - to interact with the dog or robot individually. Allocated personal time of a participant with a dog or robot was based on handler's discretion, up to a maximum of 5 minutes. The total duration of the intervention period averaged about 30 minutes (depending on the number of participants). Individual activities included petting (dog and robot), grooming (dog and robot), giving treats (dog), puzzles (dog) or exploring functionality (robot) and talking with the handler or other clients (dog and robot). The activities in the control group consisted of small-talk or non-verbal contact with the handlers (up to five minutes per client in rotation) while enjoying a beverage, that was provided by the handler during the introduction period, to simulate the circular introduction of the dog or robot. All sessions ended with a period of leave-taking of approximately 5-10 minutes.

In both the robot and the control group participants were seated in a semicircle at a table to facilitate access to the robot or beverage respectively, while in the dog group participants were seated in a semicircle without a table to facilitate access to the dog.

Dogs, robots and handlers

All participating dogs were checked by a veterinarian and all dog-handler teams were certified for AAI in dementia care. A total of five dogs participated in the study: a Labradoodle, a Kooiker, a Stabyhoun, a Bouvier des Flanders and an Icelandic herding dog. The dogs were primarily kept on a leash unless the type of interaction required otherwise (playing fetch). The well-being of each dog during sessions (through video-analysis) and after sessions (via behavioral questionnaires) was monitored by students and staff of the HAS University of Applied Sciences in 's-Hertogenbosch, who were not involved with the primary study.

The robots used in the study were a specific type of FurReal Friends robot, called Daisy Plays-With-Me Kitty, produced by Hasbro (2019). Daisy had tactile sensors in her front right paw and back as well as movement sensors in her eyes. She responded by moving, jumping, standing, purring or meowing melodically. A cat toy and brush were included in the set. We specifically choose Daisy because of the various options to play with the robot, even though the argument can be made that a kitten cannot be compared to a dog. Previous research with Paro, however, seems to indicate that the recognizability of the animal is not an important factor in a companion robot for people with dementia (Robinson, MacDonald, Kerse, & Broadbent, 2013a; Shen, Xiong, Chou, & Hall, 2018; Shibata & Wada, 2011).

All handlers completed a training to be a volunteer for people with dementia. Control and robot group 'handlers' were either dog-team handlers who did not make the final selection as a dog-team, but still wanted to participate, or psychology master students.

Baseline characteristics

Information about the participants was collected at baseline and included: age, gender, type of dementia, dementia severity (as measured by the *Clinical Dementia Rating scale*, CDR), neuropsychiatric symptoms (as measured by the *Neuropsychiatric Inventory Questionnaire*, NPI-Q) and medication usage. CDR is a classification scale to quantify the severity of the dementia based on exhibited symptoms and cognitive performance and results in a composite score ranging from 0 (no dementia) - 3 (severe dementia), with a high inter-rater reliability both for physicians and non-physicians (Morris, 1993). The CDR scores of all patients were determined by researcher L.S. NPI-Q is a shortened version of the NPI, a validated informant-based (interview) rating scale for assessing neuropsychiatric symptoms in dementia (Cummings, 1997). The NPI-Q measures 12 neuropsychiatric symptoms on both a severity (3-point) and a distress (6-point) scale. Sum scores for each scale can be calculated, with higher scores indicating more neuropsychiatric symptoms or a higher impact respectively. The NPI-Q is validated and compared to the original NPI interview by Kaufer et al. (2000). NPI-Q scores were rated by the primary nurse of the participant.

During the intervention period any changes in prescribed medication (specifically psychotropic drugs) were recorded by researcher L.S. and converted into standardized medication scores using the appropriate doses equivalency tables (Andreasen, Pressler, Nopoulos, Miller, & Ho, 2010; Ashton, 2007).

Video observations

All sessions were recorded on video with at least one, but usually two or three cameras (SONY HDR-CX330) per session depending on the size of the group and the available space in the room. The cameras were operated by research assistants who were instructed not to interact with the participants or interfere with the intervention protocol in any way. The cameras were placed in the room before the participants arrived. The six clients whose legal representative had not given permission for video recording were placed outside camera view and were excluded from the video-analysis for this study.

Data analysis

Behavioral coding has been recognized as a valuable tool to analyze AAI interventions in addition to questionnaires (Thodberg, Berget, & Lidfors, 2014). Similarly to other studies (Olsen, Pedersen, Bergland, Enders-Slegers, & Ihlebæk, 2016; Wesenberg et al., 2018) all first session, middle session (fourth week) and final session (eighth week) videos - 22 videos in total - were analyzed by two trained observers using Solomon Coder (Péter, 2017), coding software for Windows that can be used to quantify behavior. Participant's behaviors related to social interaction were defined in a so-called coding sheet (or ethogram, table 1). Behaviors were measured in either the length of time an element lasted (duration) or the number of times an element occurred (frequency). The items listed in table 1 were chosen based on the items used by other researchers in this field (Bernstein et al., 2000; Fick, 1992; Jøranson et al., 2016; Kongable et al., 1989; Kramer et al., 2009; Olsen et al., 2016; Richeson, 2003; Thodberg et al., 2016). Inter-rater agreement between the two observers was determined by first concurrently coding 7 random clients and calculating Cohen's Kappa coefficient via the statistical software IBM SPSS Statistics Version 25 for Mac (IBM, 2017). The mean overall Kappa was 0,8 for all behavioral elements combined and the per element Kappa varied between 0,7 – 0,9 (see table 1).

All participants in the first session videos were coded (47). We initially enrolled 69 participants. Unfortunately, we lost three clients before the data collection started: one participant died, one person was withdrawn after initial consent and one person fell severely ill before the start and was unable to attend the sessions. A total of 10 participants were indisposed during the first session due to either other engagements or illness, 3 participants refused to attend the first session and 6 participants were placed outside of camera view, because their legal representative did not consent to video analysis and therefore these participants could not be coded.

During the entire study period 7 clients died (2 in dog group, 5 in control group) and 17 clients were temporarily unable to attend due to intermittent illness (8 in dog group, 7 in robot group, 2 in control group). For the middle and last sessions (respectively week 4 and 8) we coded only the participants (34) that attended 4 or more successive sessions during the entire study period. We hypothesized a below 50% recurring attendance will greatly hamper continuity and any follow-up effects (i.e. an increasing familiarity with the intervention) due to repeated exposure cannot be expected in people with dementia that attend sporadically. Even worse, repeated exposure effects will be diluted when including people with effectively no repeated exposure due to a low attendance rate, hence the choice to limit our analyses to those clients with a minimum attendance of 4 or more sessions, even though this decreased the number of clients in the analysis.

Each client was analyzed separately, meaning that a video of 4 participants was coded 4 times, each time focusing on a different participant.

Raw coding sheet data was imported into IBM SPSS Statistics for further analysis. We used a bootstrapped one way ANOVA analysis to compare the baseline variables age and neuropsychiatric symptoms between the three intervention groups and a Fisher exact analysis (due to small sample size) to test for possible differences in dementia severity, dementia type and sex. A mixed ANOVA analysis was used to compare medication scores at baseline and over time and a bootstrapped one way ANOVA to test for the possible fixed effect of which handler was assigned to the group.

Coding variables (either duration or frequency) were standardized as a percentage of the time the stimulus (i.e. dog or robot) was within arm's reach of the person and thus available for interaction (as defined by the 'stimulus' code in the ethogram in table 1). We coded the initiative frequency of each handler as a measure of the effort to engage participants and used the standardized initiative frequency in a bootstrapped one-way ANOVA to test for a possible difference in initiative between the intervention groups.

Table 1
Coding Variables as Defined in the Coding Sheet with Kappa Score for Inter-Rater Agreement.

Coding element	Description	F/D	Kappa
Analysis	*variables coded to aid the statistical analysis*		
Stimulus	location of stimulus relative to subject (i.e. is stimulus within arm's reach of the subject) | *used to standardize coding variables as a percentage of available time for interaction*	D	n/a
Initiative	number of times subject, handler or other client takes the initiative during the intervention | *used to correct for the effort by the handler to engage participants*	F	n/a
Social Interaction	*variables coded to measure various aspects of social interaction*		
Conversation	subject talks to dog, robot, handler or other client	D	0,7
Touch	subject has direct physical contact with dog, robot, handler or other client	D	0,9
Activity	subject is involved in either a predominantly physical (touching/playing with) or predominantly verbal (talking with/about) activity with dog or robot	D	0,8
Social Engagement	subject is involved in either a solitary (stimulus) activity or a (stimulus) activity that also involves a handler or other client	D	0,8

Note. F/D= frequency/duration, n/a= not applicable. All items within a category (e.g. conversation) are mutually exclusive (e.g. a client talks to either dog or handler not both). The different interaction variables, however, are not mutually exclusive and can occur at the same time (e.g. a client can simultaneously touch and talk to a dog). Standardized sum variables (e.g. all interaction with the handler) can therefore exceed 100%.

To measure all interaction with the handler, we combined all separate coding variables that indicate interaction with the handler (i.e. touching the handler, conversation with the handler, engagement with the handler) into one standardized sum variable. Similar sum variables were calculated for interaction with dog, robot or the other clients present during the intervention. Sum variables can theoretically surpass 100% because participants can, for example, simultaneously talk and touch.

Due to the number of initial participants and the subsequent loss to follow-up in later sessions we were unable to accurately compare between the groups beyond a preliminary independent sample t-test, but instead used a bootstrapped one-sample t-test to compare the interaction variables for each intervention group with a hypothetical test-score of 0 (reflecting a score of no interaction) and plotted the results as bar-charts with confidence intervals. As discussed in the introduction, very low levels of social interaction are common in dementia care, hence our comparison with a test-score of zero.

Results

Baseline Characteristics

Baseline characteristics are listed in table 2. Age differed between the three groups due to the inclusion of a small location for people with young-onset dementia, that was randomized in the dog group as a unit (see methods) and resulted in a mean age (M = 76.00, SD = 10.87) that was significantly lower than in the control (M = 82.57, SD = 10.04) and robot (M = 83.69, SD = 6.84) groups, $F(2,63) = 4.433$, $p = .016$, $\omega^2 = 0.09$. There was no significant association between sex and type of intervention (p = .501) or dementia diagnosis and type of intervention (p = .247) Most clients were diagnosed with Alzheimer's disease followed by vascular dementia. The majority of participants suffered from moderate-severe (CDR 2) or severe dementia (CDR 3) with no significant association between CDR and type of intervention (p=.840). The presence of neuropsychiatric symptoms did not differ between the three groups with a mean NPI score in the dog group of 7.36 (SD = 6.54), in the robot group of 3.95 (SD = 4.32) and in the control group of 5.25 (SD = 5.05), $F(2,59) = 2.13$, $p = .128$, $\omega^2 = 0.035$. A mixed ANOVA analysis of standardized medication scores revealed no difference in medication usage between the three groups at baseline (dog M = 1.94, SD = 3.46, robot M = 1.44, SD = 2.63 and control M= 1.70, SD = 3.19, $F(2,47) = 0.114$, $p = .893$) or over time ($F(2.48,58.23) = 0.442$, $p = .687$).

Handler Initiative

Handler interaction cannot be analyzed without taking into account the effort of the handler to initiate interaction. A handler who is more active in engaging clients, will probably yield a higher interaction score. To correct for this possible confounding factor we analyzed the number of times the handlers take the initiative for an interaction during the first session. A bootstrapped ANOVA comparison of the standardized means (dog M = 0.934, SD = 0.83; robot M = 0.91, SD = 0.58; control M = 1.44, SD = 0.30) is not significantly different between the three groups, $F(2,44) = 1.85$, $p = .169$, $\omega^2 = 0.035$. Furthermore, when analyzing the initiative variable for the first session per handler (n=8) we did not find any differences either, $F(7.39) = 1.50$, $p = .198$, $\omega^2 = 0.069$, suggesting all handlers displayed a similar effort to engage the clients, irrespective of the intervention. Due to the significant loss to follow-up in subsequent sessions we were unable to reliably repeat these analyses for the follow-up sessions.

Social interaction variables

We first detailed the standardized means of the different social interaction variables coded during the first session of the dog, robot and control group (table 3). When compared to a test score of no interaction, *touching the stimulus* (i.e. dog or robot) is significantly higher than zero in both dog (p = .013) and robot (p = .006) groups, while *touching handler* and *touching other client* are not. Similarly, the variable *conversations with the handler* is significantly higher than zero in all groups (dog p =.001, robot p = .017, control p = .033), while *conversations with other clients* is not. The activity type variables (i.e. whether the activity is either predominantly verbal or physical) are significantly increased in the dog and robot groups, but with a different pattern: verbal activity is higher in the dog group (p = .005), while physical activity is higher in the robot group (p = .001). When all social interaction variables related to handler interaction are combined to one standardized sum interaction variable (as described in methods) an independent sample t-test shows a significantly handler interaction score in the dog group (M dog = 49.12) compared to the robot group (M robot = 23.99, p = .001).

Table 2
Baseline Characteristics Per Intervention.

Characteristic	Dog (n=22)	Robot (n=24)	Control (n=20)	Total (n=66)
Gender				
female	14	16	16	46
male	8	8	4	20
Age (mean)	76.00	83.69	82.57	81
Diagnosis				
Alzheimer's Disease	11	11	7	29
Vascular Dementia	3	9	8	20
Frontotemporal Dementia	3	0	0	3
Korsakov's Disease	1	0	0	1
Parkinson's Dementia	2	1	1	4
Dementia NOS*	2	3	4	9
CDR**				
0.5	0	1	0	1
1	2	5	2	9
2	12	13	14	39
3	8	5	4	17
NPI (mean)	7.36	3.95	5.25	16.56

Note. *NOS = Not Otherwise Specified, **CDR = Clinical Dementia Rating scale,***NPI = NeuroPsychiatric Inventory.

Table 3
Standardized Mean Duration of Social Interaction Variables in Dog and Robot Groups During the First Session.

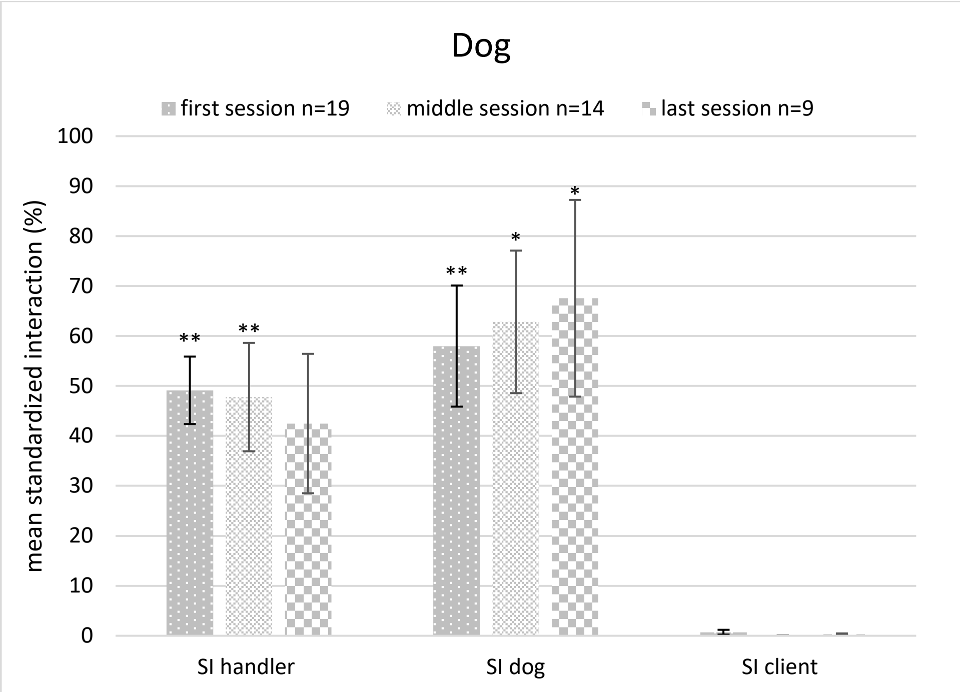
Element	Dog (n=19)	Robot (n=16)	Control (n=12)
social interaction variable			
touching the stimulus	21.78 (24.54)*	29.13 (27.55)**	n.a.
touching the handler	0.36 (1.17)	0.00 (0.00)	7.85 (16.06)
touching other client	0.05 (0.23)	0.00 (0.00)	0.63 (1.80)
conversation with stimulus	5.65 (10.66)	11.88 (21.97)	n.a.
conversation with handler	23.88 (16.41)**	10.14 (10.48)*	22.73 (24.16)*
conversation with other client	0.64 (1.92)	1.41 (1.48)*	3.23 (6.95)
type of stimulus activity			
physical activity	13,97 (18.59)*	21,32 (13.10)**	n.a.
verbal activity	16.58 (15.68)**	14,85 (20.00)*	n.a.

Note. Standard deviation in brackets, n.a. = not available due to absence of stimulus, * = significantly different ($p < .05$) when compared to test value of 0 (no interaction), ** = significantly different ($p < .01$) when compared to a test value of 0 (no interaction).

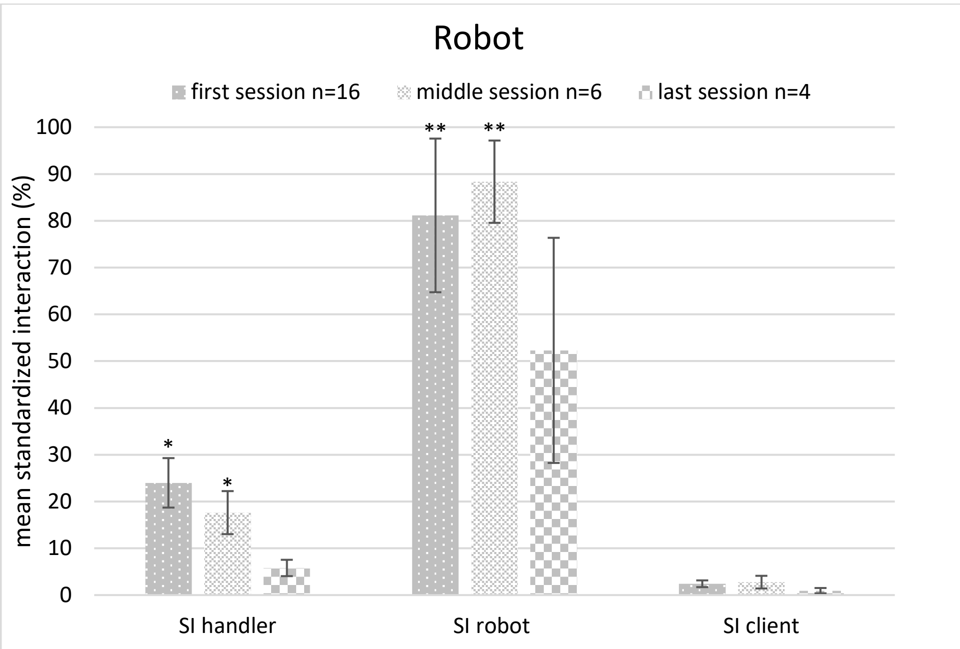
In figure 1, the standardized mean of each sum interaction variable (i.e. handler, dog/robot and other client) is plotted over time for each intervention group separately. In all groups, *handler interaction* is significantly increased while *other client interaction* is not. In the dog group (figure 1A), total interaction with the dog is similar to total interaction with the handler, while in the robot group (figure 1B) interaction with the robot is noticeably higher than the interaction with the handler.

Figure 1
Sum Interaction Variables (SI) for Dog (1A), Robot (1B) and Control (1C) Groups over Time, Depicting Interaction with Handler, Client or Stimulus (dog/robot)

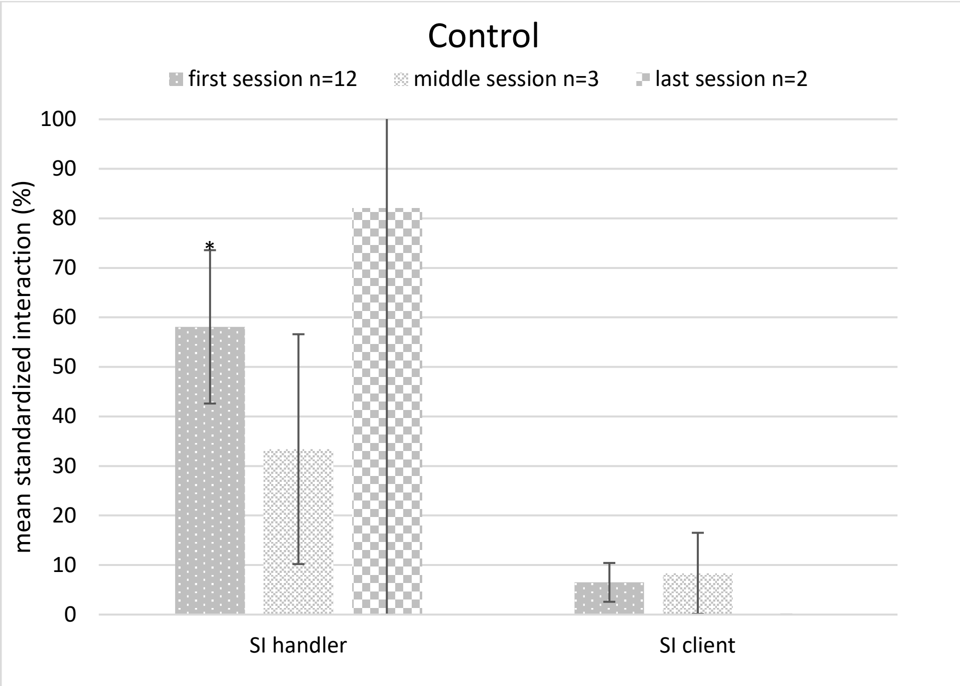
1A



1B



1C



Note. * = significantly different (P < .05) when compared to test value of 0 (no interaction), ** = significantly different (p < .01) when compared to a test value of 0 (no interaction).

Discussion

In an attempt to explore whether the handler is an integral part of AAI in dementia care instead of only facilitating it (a conundrum abbreviated with the term ‘handler effect’) we observed social interaction behaviors in AAI, RAI and a ‘handler only’ control group and were specifically interested in the observed ‘handler interaction’ as a possible measure of the handler effect. A pattern emerges from these observations that seems stable over follow-up sessions. Handler interaction is significantly higher than 0 in all three groups. In the dog group the interaction of the participants with the handler is predominantly verbal and the sum interaction scores are similar to the dog interaction scores, albeit participants interact with the dogs predominantly through touch. Wesenberg and colleagues describe a similar pattern when comparing interaction with a handler and a dog (2018) and Beetz discusses that the ability for non-verbal interaction is one of the major discerning pathways in AAI compared to human interaction (2017).

In the robot group participant-handler interaction is significantly lower than participant-robot interaction. The setup might have preempted this: the participants in the robot group were seated at a table with the robot in front of them and the handler semi-behind, while in the dog group clients were situated on chairs in a semicircle with the dog and handler in front of them, thus possibly stimulating handler interaction. However, handler initiative does not differ between the three groups, suggesting all handlers displayed the same level of effort to engage participants, irrespective of the intervention and their location relative to the participants. In other words, the same level of cueing by the handler led to more client-handler interaction in AAI. This supports our hypothesis that a handler effect in AAI exists and is reflected in the handler interaction scores. A direct comparison between dog and robot groups shows a significant difference in handler interaction, with higher scores for the dog group, but the low sample size of 45 means these results can only be interpreted cautiously.

Kramer et al. (2009) found a similar difference in handler interaction when comparing a human visitor, a human visitor with a dog and a human visitor with a robot (AIBO). Interaction with the human visitor was increased during the dog visits compared to the AIBO visits. In their study, however, visitors accompanied by the dog more frequently initiated contact with the residents compared to visitors accompanied by AIBO and this could have influenced the results.

Interestingly, when analyzing the behaviors that indicate interaction with dog or robot (i.e. touch, conversation, verbal or physical activity) a similar pattern is discernible that further supports the existence of a handler effect: participants in AAI are more engaged in a verbal activity related to the stimulus. Combined with the increased score for ‘conversations with the handler’ it seems a substantial percentage of the increased verbal activity is due to talking about the dog with the handler. In RAI, the situation is reversed: clients are more engaged in physical activity with the robot and talk more to the robot and less with the handler.

In all groups, inter-client interactions are not significantly increased from zero (no interaction). The previously mentioned Kramer et al. (2009) found different results: AIBO induced more interaction between participants. A more recent study compared a resident dog with Paro and found a greater number of residents were involved in discussion about Paro compared to the dog (Robinson et al., 2013b). The novelty of Paro versus the familiarity of the resident dog, however, could have influenced these results.

Robinson and colleagues also reported that clients were more engaged with Paro compared to the dog, but again the novelty effect could have influenced this. Other studies have reported equal levels of engagement when comparing a dog with a robot (Kramer et al., 2009; Thodberg et al., 2016). No study to date has reported less engagement with a robot, compared to a dog, but Thodberg and colleagues did find a decrease in Paro engagement over time, suggesting the robot, with its limited repertoire of interactions, loses its appeal over time, while the dog keeps engaging the participants. Our results show a similar drop in robot interaction in the last session, but the decrease is not significant, possibly due to the low number of participants in the last session.

In our introduction we hypothesized it would be possible to examine whether a handler effect exists in AAI by observing the interaction with the handler during AAI and RAI sessions from the perspective of enactive anthrozoology (Verheggen et al., 2017). We assumed AAI and RAI both require handler-participant attunement, but because in AAI the handler also needs to attune with the dog and the dog needs to attune with the participants, we expected these extra levels of attunement would result in additional handler-participant interactions. Our results support this theory: participant-handler and participant-dog interactions are high and on a similar level, indicating AAI is a combined effort of handler and dog.

In contrast, we hypothesized that the effectiveness of RAI would be solely related to the attractiveness of the robot as a stimulus for people with dementia, because attunement is not applicable to robots. During RAI the only level of attunement that is present is between the robot ‘handler’ and the participants. We assumed this would reflect in less handler interaction and possibly more robot interaction, depending on the attractiveness of the robot stimulus. Our results also support this hypothesis: while handler interaction is significantly increased, it is significantly less so than robot interaction. In fact, robot interaction seems more than double the level of handler interaction, indicating the robot used in our study is indeed a very attractive stimulus for people with dementia and does not require a lot of simultaneous handler interaction.

Strengths & limitations

To our knowledge, no other study has specifically tried to demonstrate the existence of a handler effect in AAI by observing social behaviors and isolating handler interaction during AAI, RAI and a handler only control group. The visitations in the study by Kramer et al. (2009) were of short duration (3 minutes) and not specifically intended as AAI or RAI. The controlled within-subjects study by Wesenberg et al. (2018) did not include a RAI group as a comparison to the dog-stimulus.

Our analyses, however, are hampered by the decreased power to detect effect-sizes in a between group comparison and the loss to follow-up at subsequent sessions – especially in the robot and control groups - further decreased power.

Nonetheless, we were able to observe behaviors within the intervention groups and take into account several, often overlooked, confounding variables, most notably handler initiative, medication usage, neuropsychiatric symptoms and dementia severity.

We have written about the challenges of AAI research in nursing homes, and especially in dementia care, elsewhere and refer to that article for more information about the lessons we have learned during our study (Schuurmans et al., 2019)

Implications for further research and practice

To measure the sole effect of the dog in AAI for dementia care the concept of construct validity requires the comparison of the exact same intervention with and without the presence of a handler. Even though such a follow-up study would be theoretically interesting, it does not seem practically and ethically feasible, not in the least out of an animal welfare standpoint. Our and previous findings could be enhanced, however, by similar follow-up studies with more participants to increase statistical power for between group comparisons or by a cross-over within-subjects design in which the participants are subjected to all interventions and act as their own control. In depth video-analysis of the exact behaviors of both handler and dog that encompass attunement will also help to increase our understanding of the underlying pathways of AAI. The higher attendance in the dog groups over subsequent sessions, even taking into account the patients who died or were unable to attend due to illness, implies a higher compliance to AAI and is another observation that deserves follow-up.

Based on the theory of enactive anthrozoology, we assume the handler effect in AAI for dementia care is universal for all animal interventions and not specific to dogs, but without corroborating research this assumption remains theoretical.

Conclusions

We conclude that the conundrum of the handler effect does exist and that the handler is an integral part of AAI for people with dementia and not merely a facilitator. Dog-handler visitations are a valuable intervention to increase the social interactions of people with dementia, specifically the interactions with the dog and handler, through an embodied interaction that is specific to AAI, but absent in a robot alternative and complementary to a human only control group. We propose any AAI effect should always be considered as a combined effect of dog and handler and selection criteria for AAI teams should, therefore, include criteria that reflect all necessary levels of attunement, including the interaction of the handler with people with dementia, to achieve the best possible results.

The ethical considerations of both AAI and RAI are important and need specific attention. AAI have, rightly so, raised several questions about the welfare of the animals involved. The International Association of Human Animal Interaction Organizations (IAHAIO) has released and recently updated comprehensive guidelines for AAI to address these issues and ensure no animals are harmed during AAI (Jegatheesan et al., 2018). We have followed these guidelines in our research.

The use of robots in dementia care is not without controversy either (Sharkey & Sharkey, 2012). Presenting robots as substitute pets can be seen as deceiving vulnerable clients, while using children's toys can be perceived as infantilization. Furthermore, robots should not be introduced as a substitute for human contact or a way to decrease nursing staff costs. Instead robots must be intended as complementary interventions to increase quality of life of dementia patients (Bemelmans, Gelderblom, Jonker, & de Witte, 2015). As practitioners in dementia care we fully support this viewpoint.

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