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I Prefer to Look at an Animal Rather than at a Human: Visual Attention of Neurotypical Children and Children with Autism Spectrum Disorder (ASD) During One-Time First Exposure to an Assistance Dog

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Abstract: Interacting with animals often provides numerous benefits for children with autism spectrum disorder (ASD). One potential explanation for this is that children with ASD exhibit particular visual attention to animals. This study aimed to characterize the visual attention patterns towards humans and animals in children with ASD compared to neurotypical (NT) children during one-time first exposure to an assistance dog. Forty children participated (18 ASD, 22 NT). The interventions were videorecorded. Three categories of visual attention (gaze, glance, and mutual gaze) directed towards assistance dogs and human professionals were coded using ethological methods. Both the children with ASD and the NT children gazed more frequently at the assistance dog than at the professional. However, although infrequently, both groups shared more mutual gazes with the professional than with the assistance dog. Both the NT children and the children with ASD preferred to gaze rather than to glance at, or share mutual gazes with, the assistance dogs. The attention patterns of the NT children towards the professionals were consistent, whereas those of the children with ASD were not. Statistical linear models revealed that a child's status (ASD/NT) was the only factor influencing the frequency and duration of the visual behaviors observed. These results confirm that individuals with ASD exhibit particularly focused attention towards animals.

Keywords: interspecific; child; autism spectrum disorder; gaze; ethology; animal-assisted intervention

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1. Introduction

Visual attention, for social species such as humans, is a key component of development (e.g., language, interaction skills, attachment (e.g., [1,2]). Directing visual attention towards others enables the detection and understanding of non-verbal information (e.g., gaze, body language, facial expressions), an important aspect of social cognition. In order to interact efficiently, individuals must pay attention to others, particularly through eye contact, and adjust their behavior accordingly. In addition, visual attention and the direction of attention carry numerous cues concerning mental and emotional states [3].

While the importance of gaze in intra-specific human and animal interactions is well recognized, research on visual attention during interspecific interactions between humans and animals is more recent. For example, numerous animals use human gaze to

understand a situation, request food or solve a problem (e.g., dogs, cats, horses, non-human primates [4–7]). Visual attention patterns vary between species and according to context, favoring either short glances or more durable gazes (e.g., non-human primates [8]). The characteristics of the visual attention paid by animals to humans can be more variable as they may be influenced by factors such as familiarity (e.g., dogs; [9]), but there is no evidence that they are influenced by the developmental status of the human concerned (e.g., dogs, cats [10]). For humans, especially children, visual attention is an important part of their interactions with animals [10–12]. Like animals, they use different visual attention patterns (see description in Emery [13]), such as glance, gaze, and mutual gaze, according to the situation. For example, during an encounter with unfamiliar guinea pigs in the presence of adults, neurotypical (NT) children mainly gazed at the animal (approximately for half of the time) and gazed more rarely at humans [11]. This raised the question of the characteristics of visual attention paid to humans versus animals by humans with known atypical visual attention, such as that observed in subjects with autism spectrum disorder (ASD).

ASD is characterised by particularities in social interactions, in both verbal and non-verbal communication, as well as restricted interest and stereotypical behaviors. These behaviors can have various degree of severity, varying among individuals [14]. Individuals with ASD frequently present a deficit in visual attention, particularly for detecting and following an indirect gaze (i.e., directed towards an element in the environment), while they avoid direct gazes (i.e., directed towards them) and cannot really engage in mutual gazes with peers [15–17]. One hypothesis is that they have an aversion to social stimuli, such as human faces, particularly the eyes [18,19], and/or a preference for non-social stimuli [18,20].

While interacting with humans is challenging for people with ASD, engaging with animals appears to be different. For example, interactions with animals, such as in animal-assisted interventions, or with assistance dogs, are known to be beneficial for children and adolescents with ASD [21,22]. Moreover, when given the choice, children with ASD prefer to interact with an unfamiliar dog rather than an unfamiliar human or object [23]. As suggested by a recent literature review [24], differences in visual attention to humans versus animals among individuals with ASD may explain this preference for interacting with animals. Screen tasks showed that children and teenagers with ASD appear to find pictures of animals more attractive than those of humans. Their interest focuses on the animals' eye region (e.g., dogs, cats, and horses in pictures [25,26]). Observations in real-life conditions revealed similar results. For example, during an encounter with an unfamiliar guinea pig, children with ASD gazed first at the animal rather than at their environment or at other humans (at a similar rate to NT children; [27]). Nevertheless, in this "naturalistic" context, NT children displayed more visual behaviors towards the guinea pig than did the children with ASD [11]. In the standardized context of an encounter between assistance dogs and children with ASD in the presence of adults [28], children with ASD spent more time looking at the assistance dogs, and, in particular, at their faces, than at other elements of their environment, which included a parent, an assistance dog, and a human professional. However, these studies focused on the direction of visual attention and not on its type (e.g., glance, gaze [13]). A recent study in a more ecological context (the home) compared the visual attention patterns of ASD child–pet dog and ASD child–pet cat dyads, and highlighted that the children with ASD performed more gazes and glances at their pet cats than at their pet dogs and could even share mutual gazes with them, although these remained rare [10]. Interestingly, there were only small differences in attention structure between the ASD and NT children: the children with ASD paid more visual attention to their pet cat than to their pet dog, whereas the NT children displayed a similar amount of visual attention to both pet species.

Earlier studies showed that different factors can modulate human–animal interactions. Children's age appears a major element. For example, younger children with ASD look less at an assistance dog during a first encounter than do older children with ASD [29].

A possible influence of the gender of ASD individuals is difficult to study due to the unbalanced sex ratio towards males [30]. There is some evidence that gender modulates interactions between NT children and animals [31], but to our knowledge, this has never been tested specifically for visual attention. Overall, at this stage, the literature seems to converge to indicate that animals are more attractive than humans for children with ASD, but more detailed data are needed concerning the visual attentional structures involved, the differences from or similarities with NT counterparts, and the possible factors involved.

The context of animal-assisted interventions (AAI) appears appropriate for exploring these questions, as they constitute a triadic setting involving a beneficiary (here, children with ASD or NT children), a human professional, and an animal [32,33]. The present study aimed to characterize and compare the visual attention patterns (towards humans and animals) of children with ASD and of NT children during one-time first exposure to an assistance dog, as well as to compare their visual attention patterns according to the visual target (human versus animal). First, we characterized the different types of visual attention (i.e., glance, gaze, and mutual gaze) and examined the preferential visual attention target (i.e., assistance dog and human professional) within each group of children (ASD and NT). We hypothesized that the assistance dog would be the preferred target for both groups, with no specific expectations regarding the different types of visual attention used. Second, we explored the differences between children with ASD and NT children in relation to their age and gender. Inspired by the literature (e.g., [24]), we hypothesized that the visual attentional characteristics of children with ASD with humans would different from those of NT children, but that the attention paid by all children to the assistance dog would be similar. Additionally, the children with ASD were expected to direct their visual attention preferentially towards the animal rather than the human. Lastly, we studied the influence of age and gender on our results.

2. Methods

2.1. Ethical Concern

All data were collected between 2013 and 2015. All parents provided free and informed consent for the participation of their child in the study. All human-related methods were performed in accordance with the Declaration of Helsinki (6th revision) and French regulations. Regarding assistance dogs, the study was conducted in accordance with the French regulations governing the care and use of research animals. All procedures were approved by the regional ethical committee (CPP Ouest V).

2.2. Participants

2.2.1. Inclusion and Exclusion Criteria

Children with ASD. To be included, target participants with ASD needed to be (a) between 3 and 18 years old and (b) in receipt of a medical report of ASD using ADI-R [34] made according to DSM-IV [35]. In the absence of a medical report, the parent-reported diagnosis of ASD needed to have been completed by the Social Communication Questionnaire (SCQ) [36], and we included participants with a minimum score of 15, which indicated the presence of ASD (SCQ range between 0 and 39). Participants with ASD were excluded if they (a) had a physical disability that could modify their interactions with an assistance dog (e.g., wheelchair, blindness), (b) had a score of 14 or less on the SCQ, (c) did not complete the whole experimental procedure, or (d) feared dogs.

NT Children. To be included, target NT participants needed to (a) be between 3 and 18 years old and (b) present a neurotypical development. NT participants were excluded if they had a disease, a disability diagnosis, or a physical disability.

2.2.2. Human Participants

Child Participants

The whole cohort was composed of 40 children. Twenty-two NT children (7 girls and 15 boys; mean age, 9.0 $\pm$ 1.5 years old; min–max: 6–11 years old) and 18 children with

ASD (2 girls and 16 boys; mean age, 10.2 ± 3.8 years old; min–max: 3–16 years old) were included in this study. Eight of the ASD group had received a medical diagnosis of ASD; the parents (n = 10) had completed the SCQ with a mean score of 26.0 ± 3.8 for the others. The mean ages of the two groups did not differ statistically (Mann–Whitney test, W = 145.5, p = 0.151).

AAI Professionals

Four different AAI professionals (1 male and 3 females) working for the Handi'chiens association participated in this study. They were professional dog trainers and had extensive experience of animal-assisted interventions, especially with individuals with ASD. They received specific instructions concerning our experimental procedure from one of the authors (MG).

Handi'chiens is a non-profit association that trains assistance dogs (i.e., for youths with ASD and epileptic people, as well as for animal-assisted interventions, such as with the elderly in nursing homes). Professionals in the association train dogs, as well as sometimes proposing animal-assisted interventions.

2.2.3. Assistance Dog

Ten assistance dogs were included: 4 Labrador retrievers and 6 Golden retrievers (8 males, 2 females; mean age ± SD: 26.2 ± 1.0 months). All were trained to be assistance dogs in Handi'chiens association (France).

2.3. Experimental Design

The same experimental AAI session was implemented for all ASD and NT children. Each AAI session lasted 10 min per child and involved a dyad including an AAI professional and an assistance dog from the Handi'chiens association. All sessions had the same goal: to discover the assistance dog, consider what a dog is, and encourage interactions between the partners in the triad (i.e., child, assistance dog, and professional). One non-participatory observer (CJ, IT, YG, or PB) equipped with a camera was present. The observer continuously recorded the session without participating in the interactions [10,11,37]. Children were informed in advance of the presence of an observer and were instructed not to pay attention to him/her. When the subject was a child with ASD, one or two parents were also present (for safety reasons) but did not intervene.

An appointment was set at least two weeks before each experiment. All experiments were performed in a place familiar to the children (e.g., school, ASD facilities). At the time of the appointment, before the AAI, participants were free to play in the room set aside for sessions to facilitate their habituation to this new environment. Next, after being introduced to the assistance dog, the children were guided by the professional to interact with it, either directly or through various objects (e.g., ball). The AAI session lasted 10 min, with the professional mainly encouraging the children to interact with the assistance dog, and vice versa. Note that each child received only one AAI session.

2.4. Data Analyses

All AAI sessions were video-recorded for later analysis. Recordings were analyzed using a focal continuous sampling method, focusing on the visual behaviors of the focal child using Boris software 8.26 [38]. These behaviors were analyzed only when the child, the professional, and the assistance dog were all visible. Occurrences and, when appropriate, durations (in seconds) were calculated for the following behavioral items (according previous studies, e.g., [10]):

- Glances: looking at the other partner at ±5° for less than 1 s [39];
- Gazes: looking at the other partner at ±5° for at least 1 s [39];
- Mutual gazes: the child's attention and that of the partner were directed towards each other [13].

The target was either the assistance dog or the professional. According to Emery [13], several cues could be used to determine the direction of visual attention: when the eyes were small or not visible, the orientation of the head and/or body was used. If the eye direction was not clearly identified towards either the assistance dog or the professional, data were not recorded ("not visible").

Reliability for coding was ensured by training with one senior author (MG) until full agreement was reached during the training phase. Next, data analyses were performed by one researcher (MM), blind to the child's diagnosis. A second observer (AP) double-coded all behavioual items for 17.5% of the videos (n = 7, randomly chosen). Inter-observer reliability was calculated using Lin's Concordance Correlation Coefficient (mean of all behaviors 0.91, with a range from 0.87 to 0.94).

2.5. Statistical Analyses

Statistical analyses were conducted using RStudio software (version 2023.09.0) with a significance threshold of $p = 0.05$. As the duration of the visibility of the child–professional–assistance dog varied between video recordings, we homogenized all data by calculating the number of occurrences (occ) and the durations (dur) per minute.

First, we described the different types of visual attention (i.e., glance, gaze, and mutual gaze) for each group of children (ASD and NT) and established their preferential visual attention targets (i.e., assistance dog and human professional) for each category of behavior recorded. Due to the limited sample size (18 children with ASD, 22 NT children), non-parametric Friedman and Wilcoxon tests were used. Non-parametric Wilcoxon and Friedman tests were conducted using the "friedman.test" and "wilcox.test" functions of RStudio, with application of a Bonferroni-type correction. Second, to determine the effects of group (ASD versus NT), age, and sex on the different visual behaviors (for occurrences and durations), a linear mixed-effects model (using the "lmer" function of the "lme4" package in R) was computed. Models with simple interactions were applied to different subsets: first to all data (age + sex + diagnosis), then to the neurotypical group (age + sex), and then to the ASD group (age only, given the imbalance in the sex ratio). Type II ANOVAs were conducted using the "Anova" function from the "car" package. The model assumptions were systematically checked using the R package "DHARMa", which included tests for residual normality, homoscedasticity (constant variance), residual independence, linearity, and influence of points.

Variables that did not meet the model assumptions were transformed using logarithmic or square root transformations. However, despite these transformations, some variables could not be analyzed by the model: (1) for the NT group, the occurrences of glances at the human professional, and their duration; (2) for the ASD group, the occurrences of glances at and mutual gazes with the assistance dog; and finally, (3) for the entire dataset, the durations of gazes at the human professional.

3. Results

All the occurrences, durations, and statistical values for comparison between the assistance dog and the human professional for the children with ASD and the NT children are in Table 1.

3.1. Children with ASD

The mean occurrences per minute of glances, gaze, and mutual gazes are in Figure 1A. During the AAI sessions, the children with ASD presented different types of visual behaviors, both with the assistance dog and with the human professional. They tended to glance more at the professional than at the assistance dog. They gazed more often and for longer at the assistance dog than at the professional. By contrast, although this was observed rarely, they displayed more occurrences of mutual gaze with the professional than with the assistance dog. Clearly, the children with ASD did not use the different types of visual attention similarly with the assistance dog ($F = 36$, $p < 0.001$), as they gazed more than

glanced at it (V = 171, $p < 0.001$) or shared mutual gazes (V = 0, $p < 0.001$), and their glances were more frequent than their mutual gazes (V = 0, $p < 0.001$). These differences were not observed with the human professional (F = 3.7, $p = 0.157$).

Table 1. Occurrences, durations, and statistical values (Wilcoxon tests) for comparison between assistance dog and human professional for children with ASD and NT children. Level of significance: $p < 0.05$.

			ASD Children	**NT Children**
Glances at (mean ± SD in occ/min)	Assistance dog		1.02 ± 0.61	1.39 ± 0.76
	Human professional		1.37 ± 0.75	1.98 ± 1.17
		V	28	53
		p	0.074	0.031
Gaze at (mean ± SD in occ/min)	Assistance dog		3.87 ± 1.31	4.8 ± 1.17
	Human professional		1.12 ± 0.52	0.91 ± 1.05
		V	171	252
		p	<0.001	<0.001
Gaze at (mean ± SD in sec)	Assistance dog		6.96 ± 3.53	5.27 ± 1.35
	Human professional		3.22 ± 1.78	3.51 ± 5.25
		V	161	228
		p	<0.001	<0.001
Mutual gaze at (mean ± SD in occ/min)	Assistance dog		0.05 ± 0.08	0.29 ± 0.31
	Human professional		0.79 ± 0.72	3.66 ± 2.26
		V	0	0
		p	0.001	<0.001
Mutual gaze at (mean ± SD in sec)	Assistance dog		1.27 ± 1.52	1.56 ± 1.17
	Human professional		1.40 ± 0.81	2.29 ± 0.68
		V	57	62
		p	0.587	0.036

3.2. NT Children

The mean occurrences per minute of glances, gaze, and mutual gazes are in Figure 1B. During the AAI session, the NT children used the different types of visual attention for both the assistance dog and the human professional. They glanced more often at the professional than at the assistance dog. They gazed more often and for longer at the assistance dog than at the professional. By contrast, although this was observed rarely, they displayed more occurrences of mutual gazes with the professional than with the assistance dog. Clearly, the different types of visual attention were not used similarly for the assistance dog (F = 43.52, $p < 0.001$) and the professional (F = 24.36, $p < 0.001$). When directed at the assistance dog, gazes were observed more often than glances (V = 253, $p < 0.001$) and mutual gazes (V = 0, $p < 0.001$), while glances were observed more often than mutual gazes (V = 0, $p < 0.001$). A similar pattern was observed when their attention was directed towards the professional: gazes were recorded more often than glances (V = 253, $p < 0.001$) and mutual gazes (V = 253, $p < 0.001$), and glances were more frequent than mutual gazes (V = 197, $p = 0.02$).

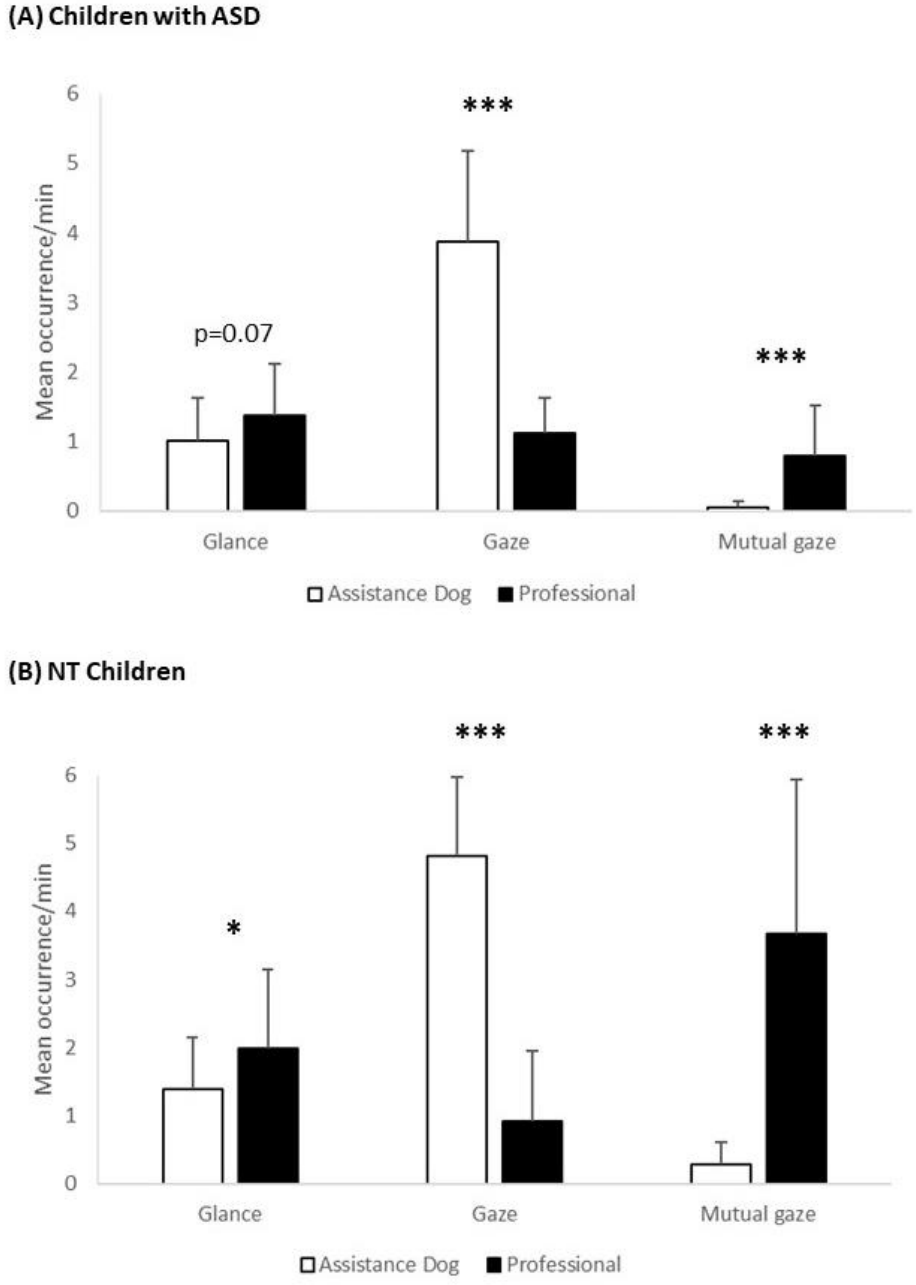

Figure 1. Visual attention of (**A**) the autism spectrum disorders (ASD) and (**B**) neurotypical (NT) groups of children in occurrence per minute for glances, gazes, and mutual gazes. Wilcoxon test. * $p < 0.05$, *** $p \leq 0.001$.

3.3. Comparisons Between Children with ASD and NT Children

Neither a child's gender nor his/her age had a significant effect on the linear model performed (all tests, $p > 0.05$).

When all the occurrences of glances, gazes, and mutual gazes at the assistance dog and the professional were considered, the LM revealed an effect of child group. The NT children (occ: 3.69 ± 1.75) produced more glances than did the children with ASD (occ: 2.77 ± 1.30) (F = 4.42, $p = 0.042$), as well as more mutual gazes (NT, occ: 3.95 ± 2.37; ASD occ: 0.84 ± 0.72) (F = 34.23, $p < 0.001$). No such effect of child group was found for gazes ($p > 0.05$).

Differences were observed concerning the different types of visual behaviors towards the professional. The NT children displayed more glances at the professional than did the children with ASD (F = 4.42 $p = 0.043$), as well as more frequent (F = 31.5, $p < 0.001$) and

longer mutual gazes (F = 12.39, $p = 0.001$). However, no differences in the numbers and durations of gazes between both groups could be evidenced ($p > 0.05$).

Differences were observed between the groups concerning the different types of visual behaviors towards the assistance dog. Whereas the NT children more often displayed gazes at the assistance dog compared to the children with ASD (F = 8.52, $p = 0.006$), the gazes of the children with ASD lasted longer than those of the NT children (F = 4.33, $p = 0.044$). The NT children more often displayed mutual gazes with the assistance dog than did the children with ASD (F = 15.7, $p < 0.001$). However, no significant differences between the groups concerning the occurrences of glances at, or the duration of mutual gazes with the assistance dog could be evidenced (all tests, $p > 0.05$).

4. Discussion

This study aimed to characterize and compare the visual attention (paid to humans and animals) of children with ASD and of NT children during one-time first exposure to an assistance dog, and in relation to the visual target (human versus animal). First, we found that during an AAI session, both the children with ASD and the NT children gazed more at the assistance dog than at the human professional, and although mutual gazes were rare, they were displayed more often with the human professional than the assistance dog. Moreover, the NT children glanced more at the professional than at the assistance dog, although they gazed more often than they glanced at the professional (no differences were observed for the children with ASD for any of these aspects). Both the NT children and the children with ASD looked preferentially at the animal using gazes rather than glances, and displayed few mutual gazes. Second, statistical linear models revealed that the child group (NT vs. ASD) appeared as the only factor influencing the occurrences and durations of the visual behaviors observed. Neither a child's age, nor his/her gender significantly influenced the results.

We highlight here that children with ASD displayed more gazes at an assistance dog than at a human professional, reflecting that animals are attractive visual targets for them. Preference for animals rather than humans in children with ASD has been described previously in other studies, based on several animal species and different contexts [23,27,28,40]. For example, in the presence of unfamiliar humans, objects, and therapy dogs, children with ASD clearly preferred interacting with the latter [23]. In the ecological context of an encounter with an assistance dog in the presence of humans, children with ASD looked more frequently at the assistance dog, especially at the dog's head [28]. This preference is consistent across studies, as in experiments using 2D stimuli pictures of animal faces, these appeared more attractive than pictures of human faces [25,26,41]. Interestingly, our study shows that this preference for visual attention to an animal was also found for NT children, who gazed more at the assistance dog that at the professional. Indeed, it is now well known that dogs, as well as many other pets, are sources of interest [12] and do not elicit social aversion [42], except phobia. Thus, one could argue that we could extend to interspecific situations the fact that in many species, social gazes could reflect friendship or attraction [7,43].

We recorded mutual gazes only rarely, but they were displayed by both groups of children more often towards the professional than the assistance dog. This may be surprising, as children with ASD often present deficits in visual attention and are reported to have difficulties in exchanging mutual gazes with peers [17]. Several elements could explain our finding. First, mutual gazes were rare (less than one mutual gaze per minute). This is consistent with earlier reports on mutual gazes between children with ASD and their pet cats (0.6 occurrences per min), but not with their pet dogs (2.3 occurrences per min) [10]. Methodological differences between studies could be involved here. Indeed, most studies showing little or atypical visual attention among individuals with ASD measured visual attention paid to other humans in the laboratory and/or in experimental contexts, or used questionnaires or psychometric tests [17,44]. Instead, most studies performed in more

naturalistic situations (e.g., free play with adult) and using an ethological approach report that individuals with ASD pay regular visual attention to adult humans [45,46].

Our results showed that, when analyzing their occurrences and durations, the different types of visual behavior (i.e., glance, gaze, mutual gaze) were not used similarly, except by the children with ASD with the professional. On the one hand, this means that both children with ASD and NT children modulate the type of visual attention paid to an assistance dog, thus highlighting their ability to adapt to a non-human partner. Similarly, an earlier study, concerning a different AAI situation, showed that children with ASD are sensitive to social attention and able to adapt their behavior accordingly [47]. This agrees with oral testimonies of speaking individuals with ASD about the ease with which they understand an animal's non-verbal communication cues better than human cues [48]. On the other hand, children with ASD—contrary to NT children—displayed no preferential visual behavior for looking at a professional. This agrees with the well-known literature concerning the atypicality of visual attention in ASD, including a lack of flexibility [17]. Indeed, looking away from or not looking at their partner while speaking seems to be a strategy used to reduce mental load when individuals with ASD have difficulties with encoding social information [49]. AAI may be a situation in which professionals frequently address both the animal and the beneficiary (personal observation), which may be perceived as an invasive action by children with ASD, creating an aversion toward the professional. Conversely, in an experimental AAI situation, when a professional focused his/her attention on an assistance dog, children with ASD oriented their visual attention more towards the professional and the assistance dog [47]. Future studies should question whether individuals with ASD have difficulty in modulating their visual behaviors with a human partner specifically, or whether they have the appropriate skills to modulate them according to the type of partner (animal or human; familiar or non-familiar), and these studies must take the context of the interaction or communication into consideration. In fact, a recent study revealed that eye gazing by adults with ASD is modulated by their communication role in a face-to-face conversation [50].

Our linear models revealed that, contrarily to our expectation, a child's age and gender modulated neither the occurrences nor the durations of the visual behaviors assessed. Indeed, previous studies showed that older children with ASD paid more visual attention to an assistance dog than did younger subjects [29], and that gender influenced the interaction modalities between NT children and animals [31]. We argue that, more specifically, these factors are not important for visual behaviors. In the present case, this may be more due to the limitation of the size of our sample, as gender was not balanced (only two girls, but 16 boys were in our ASD group). Further studies are clearly needed to explore the possible influence of these factors on the modulation of visual attention in children with ASD. However, developmental status appeared to be a powerful factor in our study. Indeed, we confirmed that overall, the visual attention of the children with ASD was less important (in terms of occurrences and durations) than or equivalent to that displayed by the NT children. This is concordant with the literature on ASD that highlights avoidance of eye contact and gaze at face stimuli [44,51] and less visual attention to social cues than non-social cues [18], as well as less visual attention than that displayed by NT individuals [44]. However, our study revealed that these differences were less important when visual attention was directed towards an assistance dog and that the durations of the gazes at assistance dogs of the children with ASD were even longer than those of the NT children. This could be explained by the fact that an animal's, and notably a dog's presence triggers human attention shift [52]. Recently, Valiyamattam and collaborators [53] showed that when an object of interest for children with ASD was introduced while an animal was present, their visual attention to that animal did not decrease (whereas it decreased when the animal was replaced by a human). Moreover, assistance dogs, like other animals, may have several characteristics that can elicit gazes at them, such as neotenic features [54] or eye morphologies that differ totally from those of humans (i.e., white sclera and coloured irises) [24].

Altogether, recent studies (for a review, see [24]), including the present one, reinforce the idea that visual attention could be an underlying mechanism for the observed benefits of human–animal bonds (i.e., animal-assisted interventions [21], assistance dogs [22], and pets at home [55,56]). As children with ASD show greater visual attention to the eyes of animals than to human faces and look more at the relevant facial features of animal faces than of human faces [25,26,41], they may have efficient communication information processing for non-human species. As suggested by recent research [57], children with ASD could then extend and apply the skills they develop and reinforce through interactions with an animal to their interactions with humans. Indeed, having an assistance dog and interacting with it on a daily basis could promote the development of specific visual exploration strategies for the processing of human faces (i.e., more efficient recognition of human facial expressions) [57]. Moreover, children with ASD do not present a deficiency in identifying facial expressions displayed by dog faces, whereas they have difficulties when human faces were presented [58]. Differences between the identification of an animal and a human by children with ASD also exist at the brain level. Indeed, brain area recruitment is altered when processing involves human faces, but it functions much better for animal faces [59]. Further studies should take into account animals' particular status for humans with ASD, whether at the behavioral, cognitive, or brain levels.

Our study has a number of limitations. We focus here only on two targets: a human professional and an assistance dog. One may argue that the rest of the environment, including objects, should be included. These targets were included in the initial project, but they were not retained for the final version of this research, as the interobserver reliability was too weak. Moreover, other visual behaviors could have been measured, such as joint attention [13,47]. Here, again, reaching good interobserver reliability in this ecological context was a real challenge, inducing us to not include this parameter. We cannot exclude that the visual behaviors displayed by the children (either NT or ASD) could have been influenced by the activities proposed with the assistance dogs during the AAI sessions. However, as all the professionals had the same training background and belonged to the same association, their working methods were similar. Moreover, we could not analyze moments when an object, such as a ball, was used, compared to moments without an object. The presence of the ball may have directed the visual attention of the assistance dog to the child, so for further studies, this would be an important variable to consider. Lastly, our sample was small and, in particular, it featured an unbalanced gender ratio among the ASD subjects, who also presented a wide range of severity. Thus, this study would deserve replication with a larger sample.

5. Conclusions

To conclude, for the first time, the visual attention of children with ASD was compared to that of neurotypical children in the simultaneous presence of an assistance dog and a human professional during one-time first exposure to the assistance dog. The results of this study converged with the scientific literature to confirm the existence of the particular visual attention paid to animals compared to humans by individuals with ASD, and that children with ASD have the same visual attention patterns with animals as NT children. The contribution and applicability of this study lie in the direction of planning other AAI sessions according to the attention offered to an assistance dog. This raises a challenging question: does the atypicality in communication and interactions used as a diagnostic criterion for ASD reflect compromised social skills, or only difficulties when interacting with humans?

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