Behaviour and welfare of Swedish school dogs

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Abstract

Animal-assisted education (AAE) involving school dogs has become increasingly common in educational settings. While most research has primarily focused on potential benefits for pupils, less attention has been given to the welfare of the participating dogs. The aim of this study was to assess the welfare of school dogs by analysing behavioural indicators observed during repeated school-dog intervention meetings.

Behavioural data were collected from video recordings and handler-completed behavioural protocols involving eight school dogs and thirteen pupils from six schools in Sweden. The intervention lasted for 20 weeks, during which pupils met the school dogs twice per week in approximately 30-minute meetings. Video recordings were obtained at three time points during the intervention period (beginning, middle, and end of the intervention). The videos were analysed using The Observer XT according to a predefined ethogram, and behaviours were coded for both frequency and duration. Handler-completed protocols were evaluated descriptively and compared with the video observations. Statistical analyses were performed in SPSS using Friedman tests and Wilcoxon signed-rank tests.

Overall, the dogs displayed substantially more positive than negative behavioural indicators during the intervention meetings. Tail wagging showed the highest duration percentage across meetings (Beginning: 27.20 ± 7.16%; Middle: 20.92 ± 5.03%; End: 22.76 ± 8.51%). Physical contact initiated by pupils was also frequently observed (Beginning: 15.04 ± 6.54%; Middle: 14.44 ± 6.13%; End: 6.30 ± 2.61%). Behaviours commonly associated with stress or discomfort, such as avoidance, low body posture, trembling, and tail between the legs, occurred rarely or were not observed. Significant behavioural changes across meetings were detected for following behaviour towards the handler (duration: $p = 0.006$; frequency: $p = 0.015$) and command execution from handler ($p = 0.034$), both of which decreased across the intervention period. Eye contact with the handler tended to increase across meetings. Comparisons between video observations and handler protocols revealed high agreement for conspicuous behaviours such as tail wagging, reward, and contact-seeking behaviour, whereas subtle behaviours including yawning, avoidance, and shaking the whole body were more frequently identified through video analysis.

The findings suggest generally good welfare among the participating school dogs during the intervention meetings. At the same time, the results highlight the complexity of interpreting canine behavioural indicators and demonstrate the value of combining different assessment methods when evaluating welfare in animal-assisted educational settings. Due to the limited sample size, conclusions should be restricted to the dogs included in this project.

Keywords: animal-assisted education, school dog, animal welfare, behavioural assessment, animal-assisted intervention

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Abbreviations

Abbreviation	Description
AAE	Animal-Assisted Education
AAI	Animal-Assisted Interventions
AAS	Animal-Assisted Services
AAA	Animal-Assisted Activities
AASP	Animal-Assisted Support Programs
AATx	Animal-Assisted Treatment
HAI	Human-Animal Interactions
HR	Heart Rate
HRV	Heart Rate Variability
QBA	Qualitative Behaviour Assessment
SE	Standard Error
SPSS	Statistical Package for the Social Sciences

1. Introduction

Animal-assisted services (AAS) is an umbrella term referring to a range of mediated, guided, or facilitator-led practices in which specially qualified animals are intentionally incorporated to support human well-being, while ensuring the welfare of the animals involved (Binder et al. 2024). AAS constitute a distinct subset of human-animal interactions (HAI), which broadly include any form of interaction between humans and animals and may have positive, neutral, or negative outcomes for either party. In contrast, AAS are characterized by structured programs with defined roles, goals, and professional oversight.

Within this framework, Binder et al. (2024) identify three main categories of AAS: animal-assisted treatment (AATx), animal-assisted education (AAE), and animal-assisted support programs (AASP). Animal-assisted treatment (AATx) replaces the earlier term animal-assisted therapy (AAT) and refers to treatment-focused interventions delivered by qualified mental or physical health professionals, in which the integration of animals is a critical component of the therapeutic process. Animal-assisted education (AAE) includes structured educational programs in which animals are incorporated as a core element of an ongoing educational process, with goals that may be academic, social-emotional, psychoeducational, or developmental in nature. Animal-assisted support programs (AASP) contain less formal, often volunteer-led activities aimed at providing comfort, motivation, or general support, without explicit therapeutic or educational treatment goals. Together, these categories illustrate the diversity of AAS contexts, while also highlighting the need to consider animal welfare across different types of interventions.

A particular branch of AAS involves social service dogs, which work together with a trained handler to support individuals in various settings (Lidfors et al. 2021). In recent years, service dogs have increasingly been introduced into environments such as hospitals and schools to support children during medical treatment or learning activities (Barker & Gee 2021; Bidoli et al. 2022). These dogs are expected to provide companionship, emotional support, and calming effects, thereby contributing to improved wellbeing, engagement, and concentration among the children (Braun et al. 2009; McCullough et al. 2018; Miller et al. 2022). However, school and hospital settings can be noisy, dynamic, and difficult to control, and the children involved may present social, emotional, or behavioural challenges (Barker & Gee 2021; Bidoli et al. 2022). As service dogs are repeatedly exposed to these conditions and interactions, it remains unclear how such work affects the dogs' welfare over time (Glenk 2017). Systematic behavioural assessments are therefore needed to better understand the

potential impact of repeated dog–child interactions in these contexts (Miller et al. 2022).

To ensure safe and ethical practice, both the dog and the handler are expected to be appropriately trained, and handlers must be able to guide the dog and interpret its behavioural signals during interventions (Lidfors et al. 2021). In Sweden, several private organisations (e.g. Vårdhundskolan, Svenska Terapihundskolan, Pedagoghundsinstitutet/ SPI, and Hundens Hus) provide training programmes for social service dogs; however, no national standards regulate the content or quality of such training, and external quality assurance is lacking (Lidfors et al. 2021). This lack of standardisation raises concerns regarding both human safety and animal welfare. Against this background, very little research has examined school dogs' behavioural responses across multiple sessions, making it unclear whether repeated participation leads to habituation, increased stress, or stable welfare (Miller et al. 2022).

Although a growing body of research has examined the effects of school-dog and other animal-assisted interventions (AAI) on human participants, comparatively few studies have focused on the welfare of the dogs involved. Existing studies have generally reported low frequencies of stress-related behaviours and limited physiological evidence of stress in social working dogs (Glenk et al. 2013; McCullough et al. 2018). However, many studies are based on relatively small sample sizes or short observation periods, and the long-term effects of repeated participation in educational settings remain insufficiently understood (Miller et al. 2022).

A previous master's thesis performed within this project investigated school-dog interventions for pupils with problematic school attendance and included an initial assessment of the dogs' welfare. The present study builds upon this work by focusing specifically on behavioural indicators of welfare in school dogs during repeated interactions with pupils.

1.1 Welfare assessment methods

To address these questions, reliable and well-established welfare assessment methods are required. Individual dogs may respond differently to varying environments and situations (Miller et al. 2022). In animal-assisted interventions AAI), working dogs may be exposed to multiple stressors, including environmental factors, unfamiliar people, and noise (Miller et al. 2022). Dogs primarily communicate with humans through body language (Mugford 2007), and the effectiveness of this communication largely depends on the level of familiarity between the human and the dog (Wemelsfelder 2007). Consequently, the ability to accurately interpret canine behavioural signals is essential for assessing their welfare status (Miller et al. 2022).

Animal welfare can be assessed through multiple dimensions, including health status, physiological indicators, and behavioural responses (Pedersen & Malm 2025). In the present study, behavioural assessment was conducted using an ethogram, which systematically lists observable behaviours and allows these to be recorded based on video material (Bateson & Martin 2021). Common monitoring methods include direct observation and video recording, both of which can provide valuable behavioural data (Bateson & Martin 2021).

1.2 Ethogram

When using an ethogram, behaviours are recorded based on predefined behavioural definitions, typically quantified by their frequency or duration (Bateson & Martin 2021). Ethograms provide insights into canine behaviour by focusing on observable actions rather than attempting to infer underlying motivations or emotional states (Pedersen & Malm 2025). Their primary purpose is to systematically document behavioural patterns and identify which behaviours occur most frequently in a given context (Pedersen & Malm 2025).

One advantage of ethograms is their ability to generate consistent and relatively reliable data, thereby supporting methodological consistency across observers. However, it should be acknowledged that ethograms do not capture how animals subjectively experience a situation, nor do they explain why specific behaviours are performed (Pedersen & Malm 2025).

1.3 Qualitative Behaviour Assessment (QBA)

Qualitative Behaviour Assessment (QBA) is an observational method that describes an animal's overall behavioural expression using descriptive terms such as "playful," "curious," or "avoidant" (Pedersen & Malm 2025). This approach places greater emphasis on the animal's perceived experience and is typically based on longer observation periods (Wemelsfelder 2007), which may facilitate the detection of subtle changes in body language.

QBA may complement quantitative behavioural observations by providing information about the animal's overall behavioural expression (Wemelsfelder 2007; Pedersen & Malm 2025). However, because assessments rely on observer interpretation, QBA is often used together with other welfare indicators rather than as a stand-alone method (Wemelsfelder 2007; Pedersen & Malm 2025).

1.4 Physiological indicators of welfare

In addition to behavioural assessment, physiological measures are commonly used to evaluate canine welfare. Frequently used indicators include salivary cortisol concentrations, oxytocin levels, heart rate (HR), and heart rate variability (HRV) (Glenk 2017; Miller et al. 2022). Cortisol is commonly used as an indicator of

physiological stress, whereas oxytocin has been associated with positive social interactions and reduced stress responses in dogs (Rossi et al. 2018; Miller et al. 2022). HR and HRV provide information about autonomic nervous system activity and may be used to assess emotional arousal and stress responses (Glenk 2017).

Studies of therapy dogs have generally reported limited evidence of physiological stress during AAI. However, physiological studies specifically focusing on school dogs remain scarce. Most available evidence originates from therapy dog and other AAI settings, where trained dogs have generally shown low physiological stress responses (Glenk et al. 2013; McCullough et al. 2018). For example, Glenk et al. (2013) found no significant increase in salivary cortisol concentrations in therapy dogs participating in interventions with psychiatric patients. Similarly, McCullough et al. (2018) reported that therapy dogs working with paediatric oncology patients showed low levels of physiological stress, although individual variation was observed. These findings suggest that appropriately trained dogs may cope well with intervention work; however, behavioural and physiological indicators do not always correspond directly (Miller et al. 2022). Therefore, combining multiple welfare measures may provide a more comprehensive assessment of canine welfare than relying on a single method alone (Miller et al. 2022; Pedersen & Malm 2025).

Qualitative Behaviour Assessment and physiological measurements were beyond the scope of the present study and are discussed here to provide methodological context for interpreting behavioural indicators of welfare.

2. Aim and research questions

The aim of this master thesis was to assess the welfare of school dogs participating in animal-assisted education by analysing behavioural indicators observed during repeated school-based meetings. In addition, selected handler–dog and pupil–dog interactions were recorded to provide contextual information for the interpretation of the dogs' behavioural responses. Specifically, the study aims to evaluate whether the dogs display signs of positive or negative welfare during the interventions, based on systematic video observations and handler-reported behavioural protocols.

The following questions wereinvestigated:

1) Which behaviours do the dogs display during the meetings, based on video recordings?

2) Do the dogs show behaviours indicative of positive welfare during the meetings?

3) Do the dogs show behaviours indicative of negative welfare during the meetings?

4) Which behaviours do the dog handlers perceive the school dogs to perform during the interventions?

Based on previous studies of therapy and school dogs participating in animal-assisted interventions, it was hypothesised that school dogs would predominantly display behaviours associated with positive welfare and relatively few behaviours associated with negative welfare during the intervention sessions. Furthermore, it was expected that welfare-related behaviours might change across the intervention period. Dogs were expected to show more behaviours associated with uncertainty or stress during the early meetings, when the pupil, setting and interaction routines were less familiar. With repeated meetings, increased familiarity with the pupil and intervention context were expected to reduce stress-related behaviours and support more stable or positive social interactions.

The dogs were also expected to display a higher frequency of behaviours associated with positive welfare, such as tail wagging, play behaviour, contact seeking behaviour, and physical contact, than behaviours associated with negative welfare. Behaviours commonly associated with stress or discomfort, including avoidance, lip licking, yawning, and vocalisations, were expected to occur

relatively infrequently. In addition, some differences between behaviours recorded from video observations and those reported by handlers were expected, as assessments may be influenced by observer perspective, training background, and observation context.

3. Materials

The project used data from a larger school-dog intervention involving 14 schools and 56 participating pupils. Of these, 33 pupils met a trained school dog and its handler, while 23 pupils served as controls. The present work focused only on some of the 33 pupils in the dog-interaction group. A previous master's student had already analysed data from 7 dogs meeting 13 pupils at eight schools. This master thesis continued the work by analysing the remaining 8 dogs meeting 12 pupils from the other six schools. Of these 12 pupils, one had protocol data only and no corresponding video recordings due to limited camera availability at that school. The remaining eleven pupils had both video recordings and handler-completed protocols, although some video recordings were missing for three pupils. This was because video recording depended on pupil consent and willingness to be filmed, meaning that some pupils participated in the intervention but were not video-recorded at all meetings.

All meetings between the pupils and the dogs took place either in a private indoor room or outdoors on school grounds. The descriptions of the rooms from videos were showed in Appendix 1.

Background information of the 8 dogs involved in the intervention is provided in Table 1.

Table 1. Information about the dogs that participated and were analysed in the project. Some dogs met one pupil, whereas others met two pupils; therefore, the number of available video recordings and handler-completed protocols is presented separately for each dog. When two numbers are presented in the video or protocol columns, they refer to separate pupils paired with the same dog. For example, "20 + 20" indicates that the dog had 20 video recordingss with one pupil and 20 video recordingss with another pupil

Dog	Gender	Breed	Year of birth	Castrated	Material available	Video sessions (n)	Protocols (n)
Ia	Male	Australian labradoodle	2018	Yes	Video + Protocol	2 + 2	8 + 5
Ib	Male	Crossbreed/ Australian labradoodle	2021	No	Video + Protocol	3 + 3	20 + 20
J	Male	Labrador retriever	2018	No	Video + Protocol	3 + 3	20 + 20
K1	Female	Crossbreed Finnish Lappish dog/ Great poodle	2013	No	Video + Protocol	3	20
K2	Female	Crossbreed Finnish Lappish Dog/Great poodle * Labradoodle	2017	No	Video + Protocol	3	20
L	Female	Labrador retriever	2018	No	Video + Protocol	2	17
M	Female	Labradoodle	2018	Yes	Video + Protocol	3 + 3	20 + 20
N	Male	Poodle croosbreedud elblandras	2012	Yes	Protocol	/	20

Note: Dogs were identified using the school code (letter) followed by an individual dog identifier when more than one dog participated at the same school. Thus, dogs sharing the same letter originated from the same school and were handled by the same dog handler.

The background information of the 6 dog handlers: teacher and university lecturer, elementary school teacher for preschool and sports, class teacher and first grade teacher, special education teacher, special education and school consultant, and dog psychologist. Two dog handlers worked with two different dogs (one per pupil, I and K in Table 1). The dogs have been tested for suitability to work with children and the dog-teams have been educated and certified by one of the following Swedish educaters: Svenska Pedagoghunds Institutet (3 dogs), Hundens Hus Sundsvall (2 dogs), Hundens Hus Skåne (2 dogs) and Hundens Hus Stockholm (1 dog).

3.1 The intervention design

At each school, four pupils were randomly selected to participate: two who met a trained school dog with its handler, and two who met a special educations teacher or similar staff member (the latter group will not be included in the present thesis). The pupils met the trained school dogs twice a week for 10 weeks in the spring of 2023 and autumn of 2023, with each meeting lasting 30 minutes.

Before the dogs began working in the schools, all handlers completed a formal risk assessment which was approved by the school principals. The risk assessment aimed to identify potential risks, evaluate severity, and formulate preventive actions.

3.2 Method

3.2.1 Protocol

After each intervention meeting, the dog handlers completed a standardized behavioural protocol documenting the dog's behavioural expressions during the meeting. The protocol was developed within the school-dog project and is based on behavioural illustrations by Kindsjö (2014), which draw from several earlier studies on canine stress and behaviour (Appendix 2). The protocol was filled in after the meeting, so the dog handlers could focus on the dog and pupil during the meeting. In addition, handlers could add written comments to provide contextual information or describe events not easily captured by the predefined categories.

The protocol does not require handlers to count behaviours continuously during the intervention. Instead, handlers retrospectively indicate whether specific behavioural expressions were observed during the meeings, based on their overall perception of the dog's behaviour. These protocols capture the handlers' perceptions of the dogs' behaviours across meetings and may include contextual observations not fully visible in video recordings. Although the protocol includes behavioural terms that overlap conceptually with the ethogram used for video analysis, it does not follow the same operational definitions and was not designed as an objective behavioural coding tool. Since handler reports may be influenced

by subjective interpretation and may not align fully with ethogram-defined behaviours, they were not treated as objective behavioural measures. Instead, the handler protocol represents a subjective, experience-based assessment rather than a systematic behavioural measurement.

In the present study, handler-reported data were used to complement the video-based observations and to explore potential consistencies or discrepancies between human perception and ethogram-based behavioural coding.

3.2.2 Video

Each student's meeting was video-recorded at three time points (early, middle and end of intervention). The school-dog intervention itself consisted of repeated meetings between the same pupil and dog over several weeks, typically twice per week. However, only three of these meetings per pupil were video recorded, corresponding to the three time-points.Each recorded meeting had an intended duration of approximately 30 minutes and was filmed using a GoPro Hero10 Black camera (GoPro Inc., China). Due to technical limitations of the recording device, each meeting resulted in multiple video files (usually two to three clips of approximately 10–12 minutes each), although the number and length of clips varied between meetings.

The video recordings were analysed by using Observer XT version 17 (Noldus Technology, Netherlands). Since the software cannot merge multiple clips into one continuous file, clips from the same meeting were coded separately. The main focus of the study was to assess whether welfare-related behavioural indicators are displayed during school-dog interventions. All behaviours listed in the project's ethogram (Appendix 3) were coded for both frequency and duration.

Behaviours were coded as behavioural bouts. A bout was considered to start when the dog first displayed the defined behaviour and to end when the dog stopped displaying that behaviour, changed to another coded behaviour, or redirected its attention or movement away from the relevant target. Repeated movements within the same continuous bout were not counted as separate frequencies. For example, several scratching or licking movements performed continuously were coded as one scratching bout, with one duration and one frequency count. Similarly, a continuous whole-body shake was coded as one bout, regardless of the number of shaking movements within that bout.

To improve coding consistency and analytical flexibility in Observer XT, several behaviours were coded using modifiers rather than being divided into multiple independent behaviours. For example, "contact seeking" was coded as a single behavioural category, while modifiers were used to specify the target of the behaviour (e.g., with pupil, handler, or itself). Similar modifier structures were applied to the following behaviours: reward, execute command, does not execute command, make eye contact, physical contact, play, contact seeking, physical

contact initiated by pupil/handler, avoidance, bark, growl, whimper, snort, stationary attentive, lie on back, and follow. In addition, the behaviours, physical contact with pupil/handler included secondary modifier classifications to further distinguish behavioural subtypes. They were subdivided using modifiers such as pet, hug, pat, kiss, touch nose, and blocking touch.

This modifier-based structure allowed behaviours to be analysed either as broader behavioural categories or as more specific subtypes depending on the analytical purpose, while also reducing unnecessary fragmentation of the ethogram.

To facilitate and clarify the analysis of the material, the behaviours from the protocol and ethogram was divided into categories, as shown in Table 2. The categorisation has been made with regard to the type of context in which the dogs found themselves during the meetings and what was mentioned in the literature (Kindsjö 2014; Johansson 2024). Intervention-related variables were analysed as a separate category because this category included both dog behaviours (e.g. execute command) and interaction variables initiated by pupils or handlers (e.g. reward and initiated physical contact). The category "Other behaviours" included behaviours that were not classified as positive, negative or intervention-related. This categorisation was used for descriptive purposes and does not imply that these behaviours are necessarily welfare-neutral.

Table 2. Classification of behaviours into the categories 'intervention-related behaviours', 'positive indicators', 'negative indicators' and 'other behaviours'

Intervention-related behaviours	**Positive indicators**	**Negative indicators**	**Other behaviours**
Reward	Physical contact (with pupil)	Turn the head away	Explore
Execute command	Tail wagging	Walk away	Stationary attentive
Does not execute command	Play	Yawn	Smack
Make eye contact (with handler)	Lie on back	Lip-licking	Scratch
Pupil-initiated physical contact (blocking touch)	Contact seeking	Show teeth	Lift paw
handler-initiated physical contact (blocking touch)	Eat treats	Low position	Bark
	Make eye contact (with pupil)	Tail between the legs	Whimper
	Pupil-initiated physical contact (pet)	Tremble	Drink
	handler-initiated physical contact (pet)	Excessive activity	Shake the whole body
	Follow (with pupil)	Growl	Physical contact (with handler)
		Pant	Snort
		Avoidance	Cough
		Retch	Follow (with handler)
		Pupil-initiated physical contact (hug, kiss, pat, touch the nose)	
		Handler-initiated physical contact (hug, kiss, pat, touch the nose)	

3.3 Data analysis

Each video clip was coded independently in Observer XT. In Observer XT, each coded behavioural event required a defined start and end point, which allowed both frequency and duration values to be extracted from the video observations. The resulting data were exported to Excel for further handling. For the final analyses, video clips belonging to the same meeting were combined so that each meeting was analysed as one observation. All analyses were performed at the level of the full meeting.

The duration of the video recordings varied. Based on the recorded material, the mean video duration was 1598.59 seconds and the median duration was 1695.70 seconds. The shortest video lasted 760.09 seconds and the longest session lasted 1800.00 seconds. To account for this variation in recording length, behavioural durations were transformed into percentages by dividing the duration of each behaviour by the total meeting duration and multiplying by 100.

The statistical analyses were performed in SPSS (IBM SPSS Statistics 26). For each behaviour, mean values and standard errors for both duration and frequency were calculated. Means were chosen for the descriptive statistics instead of medians because many behaviours had zero values, which made medians uninformative.

In general, frequency measures were considered particularly informative for brief event behaviours, such as yawning and lip licking, whereas duration measures were considered more informative for behaviours that could be maintained over longer periods, such as physical contact or stationary attentive behaviour. However, the choice of outcome variable ultimately depended on the characteristics of each behaviour and the specific research question, and some behaviours were evaluated using both frequency and duration measures.

Inferential statistical analyses were performed only for behaviours that occurred sufficiently frequently across meetings to allow meaningful statistical evaluation. Behaviours that were observed only rarely, occurred in isolated cases, or contained a large proportion of zero values were analysed descriptively only.

Descriptive statistics (means ± SE) were calculated using all available observations for each meeting. Statistical tests were performed only on complete repeated cases, meaning that only pupils with data available from all three recorded meetings were included in the inferential analyses. Consequently, the sample size used for the statistical tests was smaller than that used for the descriptive statistics.

Differences between the three recorded time points, corresponding to the beginning, middle, and end of the intervention, were analysed using Friedman tests. When a Friedman test indicated a significant difference, pairwise

comparisons between time points were performed using Wilcoxon signed-rank tests. A p-value below 0.05 was considered statistically significant.

Handler-completed protocols were analysed separately from the video observations. To account for differences in the number of meetings between pupils, behavioural occurrences recorded in the handler protocols were converted to the percentage of meetings in which each behaviour was reported. To compare behavioural observations obtained from video recordings and handler-completed protocols, only meetings for which both a video recording and a corresponding protocol were available were included in the analysis (n = 27).

4. Result

4.1 The dogs' behaviour in the video

The behaviours with the highest frequencies or longest total durations were explore, pupil- and handler-initiated physical contact (pet), execute command, physical contact, make eye contact, contact seeking, tail wagging, and stationary attentive behaviour.

There were individual differences in both the occurrence and frequency of behaviours between dogs. Some behaviours were observed in all dogs, whereas others were displayed only by a single individual. For example, only Dog K1 displayed showing teeth behaviour during one meeting. Similarly, only Dogs Ia and Id displayed snorting and overactive behaviour, and only Dog J1 displayed retching behaviour during a single meeting.

Several behaviours included in the ethogram were never observed during the video analysis. These behaviours included trembling, low body position, handler-initiated physical contact (kiss), and tail between the legs.

Some behaviours and activities observed in the videos were not included in the ethogram and were therefore not coded. These unrecorded periods often consisted of passive behaviours, such as sitting or leaning against the pupil or handler without actively engaging with them or showing exploratory behaviour. It also occurred that the dogs lay down and slept or remained stationary while staring at the treat container. Detailed analyses of the overall behavioural categories and the four behavioural categories are presented in the following sections.

4.1.1 Overall behavioural categories

Positive indicators accounted for the largest proportion of all recorded behaviours, whereas negative indicators represented the smallest proportion (Figure 1). A corresponding duration-based distribution was not calculated because several behaviours could occur simultaneously, resulting in overlapping durations among behavioural categories.

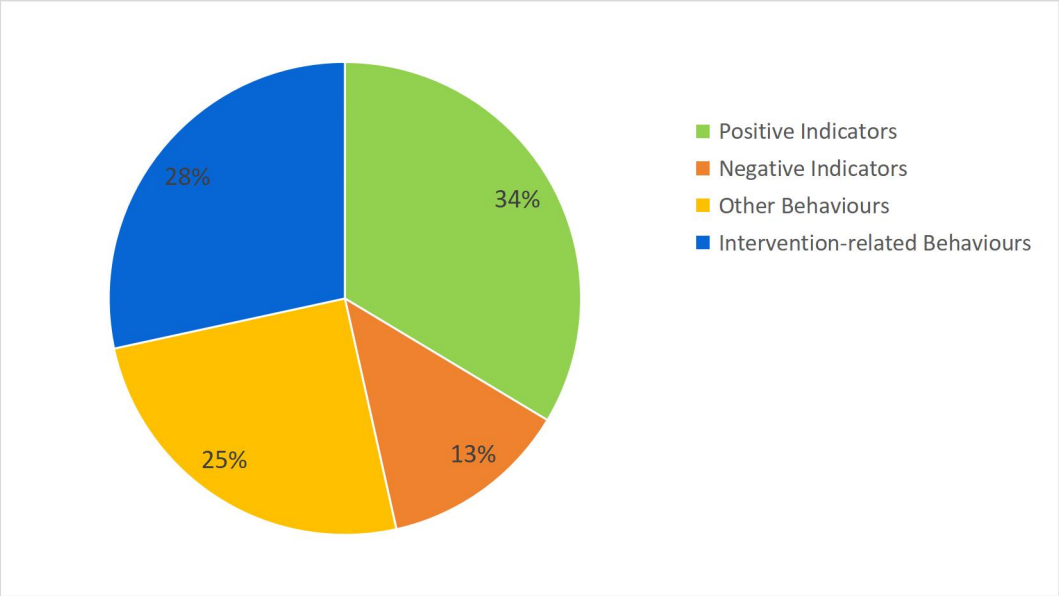

Figure 1. Overall distribution of behavioural categories based on total frequency across three interventions of 20 meetings in school dogs (n = 8) meeting pupils over one semester.

Other behaviours occurred significant less frequent during the Middle than during the Beginning ($p < 0.05$) (Figure 2). No significant differences were detected across interventions for positive, negative, or intervention-related behaviours.

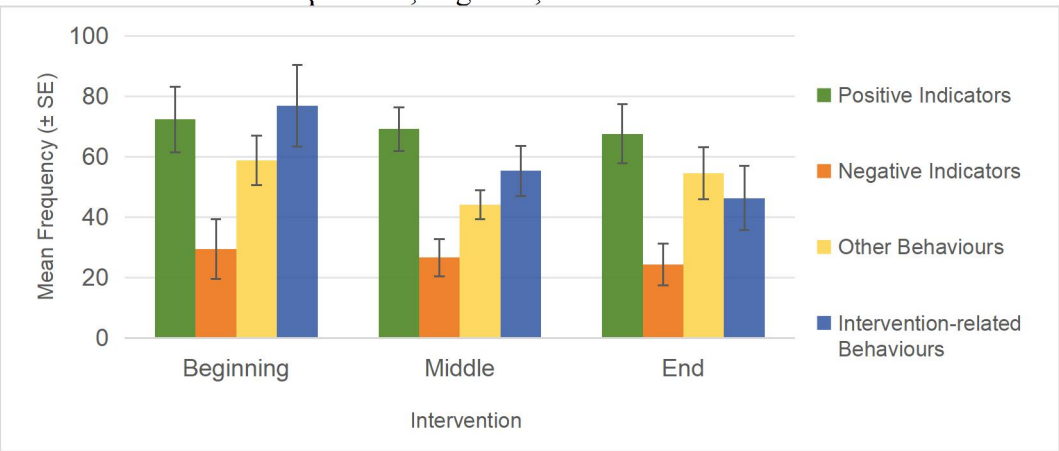

Figure 2. Mean frequency (±SE) during 30 min. meetings of positive, negative, other, and intervention-related behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils over one semester.

4.1.2 Intervention-related interactions behaviours

Intervention-related behaviours included reward engagement (handler/pupil), execute command, does not execute command, initiated physical contact (blocking touch), and make eye contact (handler).

The percentage of duration of reward engagement and execute command(pupil) increased during the Middle before declining again in the End (Table 3). Although

several behaviours showed changes across interventions, no statistically significant differences were detected in their percentage of duration.

Table 3. Percentage of duration during 30 min. meetings (± SE) of intervention-related behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils over one semester

Behaviour	Beginning Mean ± SE	Middle Mean ± SE	End Mean ± SE
Reward engagement (handler)	1.18 ± 0.37	1.00 ± 0.37	0.54 ± 0.28
Reward engagement (pupil)	4.73 ± 2.01	9.71 ± 5.02	6.23 ± 2.46
Does not execute command (handler)	1.36 ± 0.28	0.65 ± 0.15	0.69 ± 0.27
Does not execute command (pupil)	3.09 ± 0.89	1.99 ± 0.50	1.24 ± 0.37

Among all intervention-related behaviours, only “execute command (handler)” differed significantly across interventions ($p = 0.034$). Post-hoc Wilcoxon signed-rank tests revealed significant differences between the Beginning and the End ($p = 0.023$), as well as between the Middle and the End ($p = 0.039$). The duration percentage of this behaviour decreased progressively across the intervention period (Figure 3).

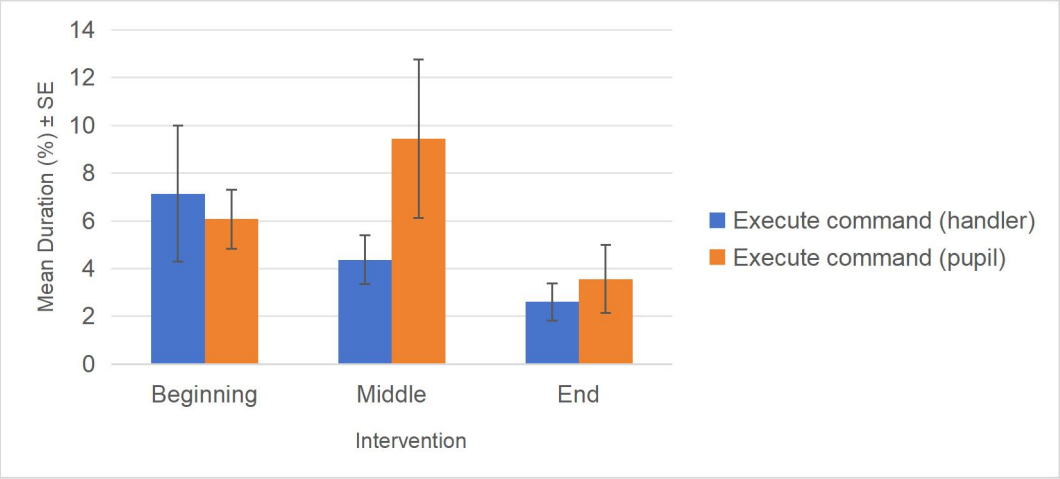

Figure 3. Percentage of duration (%) during 30 min. meetings of execute command behaviour across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupilsover one semester.

No statistically significant differences were detected across interventions for any of the intervention-related frequency behaviours in Figure 3. However, most intervention-related behaviours showed a gradual decrease across the intervention period. Reward engagement and command-related behaviours generally occurred at higher frequencies than non-compliance behaviours throughout all interventions, whereas non-compliance behaviours remained comparatively infrequent.

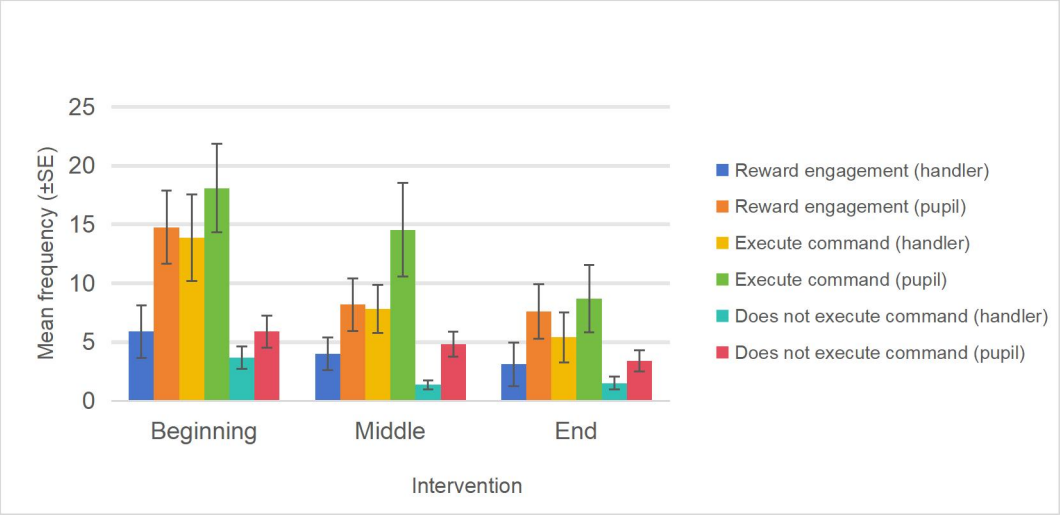

Figure 4. Frequency during 30 min. meetings of reward-, command-, and non-compliance-related behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils (n = 11) over one semester.

4.1.3 Positive indicators

Potential behavioural indicators of positive welfare included physical contact, make eye contact, contact-seeking behaviour, following behaviour, play, tail wagging, and handler-/pupil-initiated physical contact (pet) . The behaviour “lie on back” was recorded only rarely and was therefore excluded from further statistical analyses.

Among the positive indicators, following (handler) was the only behaviour that differed significantly across meetings, decreasing from the Beginning to the Middle and remaining lower than the initial level at the End ($p = 0.006$; Table 4). Tail wagging represented the behaviour with the highest duration percentage throughout the intervention period. Physical contact with both pupils and handlers showed numerically lower duration percentages at the End than at the Beginning, although no statistically significant difference was detected. Make eye contact with the handler was numerically higher during the Middle and the End than during the Beginning, but this difference was not statistically significant.

Table 4. Duration (%) during 30 min. meetings of positive indicators across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupilsover one semester. Differences between meetings were tested using the Friedman test. A dash (–) indicates that the behaviour was not statistically tested because it was recorded in too few dogs

Behaviour	**Beginning Mean ± SE**	**Middle Mean ± SE**	**End Mean ± SE**	**P Value**
Physical contact (pupil)	10.62 ± 4.78	9.91 ± 4.81	3.36 ± 1.82	p=0.657
Physical contact (handler)	3.58 ± 2.94	3.26 ± 1.22	0.87 ± 0.37	-
Make eye contact (handler)	3.66 ± 0.81	7.58 ± 3.03	7.58 ± 2.89	p=0.417
Make eye contact (pupil)	1.61 ± 0.69	3.25 ± 0.74	2.44 ± 0.75	-
Tail wagging	27.20 ± 7.16	20.92 ± 5.03	22.76 ± 8.51	p=0.687
Play	0.45 ± 0.27	0.98 ± 0.55	4.10 ± 3.57	p=0.326
Contact seeking (handler)	1.75 ± 0.96	0.83 ± 0.26	1.43 ± 0.44	-
Contact seeking (pupil)	1.40 ± 0.46	0.60 ± 0.13	1.05 ± 0.23	-
Follow (pupil)	1.01 ± 0.61	0.72 ± 0.30	0.67 ± 0.35	-
Follow (handler)	0.91 ± 0.70	0.12 ± 0.08	0.53 ± 0.26	**p=0.006**

No significant differences were detected across meetings for any of the percentages of durations of behaviours in Figure 5. Descriptively, the mean duration of handler-initiated physical contact (pet) was highest during the Middle meeting, although no statistically significant differences were detected between meetings. Pupil-initiated physical contact (pet) occurred for a longer percentage of duration than handler-initiated physical contact (pet) throughout the intervention period but showed an overall decreasing trend. Numerically, tail wagging displayed a slight decline across interventions, whereas play behaviour was

descriptively higher at the End. However, these patterns should be interpreted cautiously, as there were no statistically significant differences.

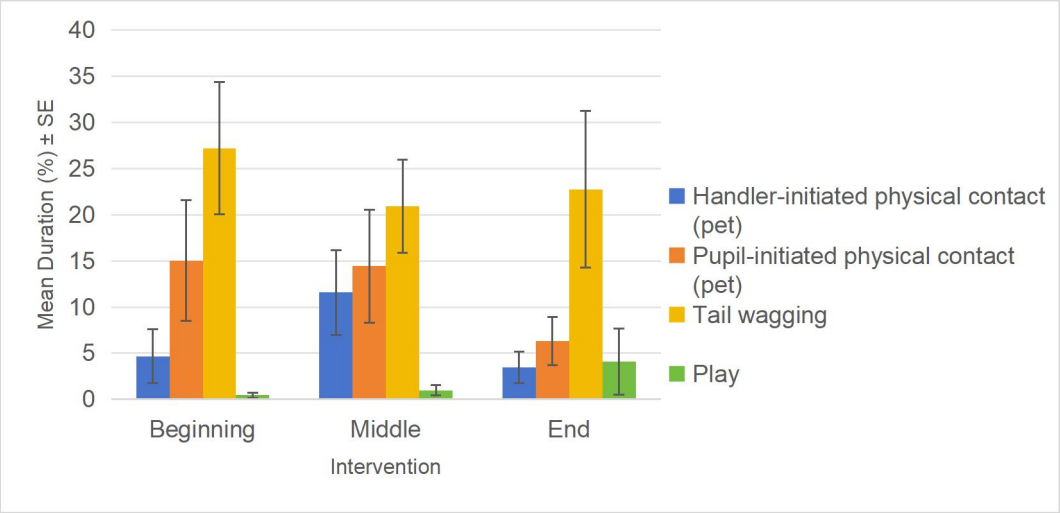

Figure 5. Duration (%) during 30 min. meetings of handler - and pupil – (p = 0.968) initiated physical contact (pet), tail wagging (p = 0.687), play behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils over one semester.

Following (handler) differed significantly across meetings in both duration and frequency analyses (duration: p = 0.006; frequency: p = 0.015; Figure 6). Post-hoc comparisons revealed a significant difference between the Beginning and the the Middle (p = 0.016), with lower frequencies observed during the the Middle. Descriptively, following (pupil) also appeared lower during the Middle and the End than during the Beginning, although no statistical testing was performed.

No statistically significant differences were found for contact seeking behaviour. Descriptively, contact seeking (handler and pupil) behaviour was numerically lower during the Middle than during the Beginning and increased again during the End. During the Beginning, contact seeking (handler and pupil) frequencies were similar, whereas in later meetings contact seeking behaviour appeared more frequent towards handlers than towards pupils.

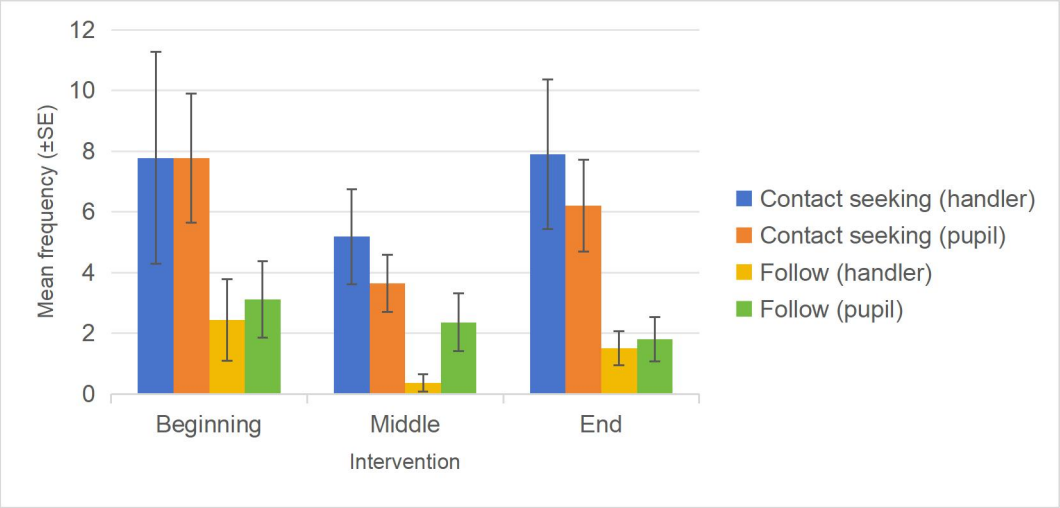

Figure 6. Frequency during 30 min. meetings of contact seeking and follow behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils over one semester.

No significant differences were detected across meetings for the frequencies of physical contact and make eye contact with handler or pupil (Figure 7). However, the frequency of physical contact (pupil) was lower at the end of the intervention than at the beginning, whereas physical contact (handler) increased in the middle of the intervention before declining again at the end. Make eye contact (handler) tended to increase across interventions, whereas make eye contact (pupil) increased from the Beginning to the Middle and decreased slightly during the End, although it remained higher than in the Beginning.

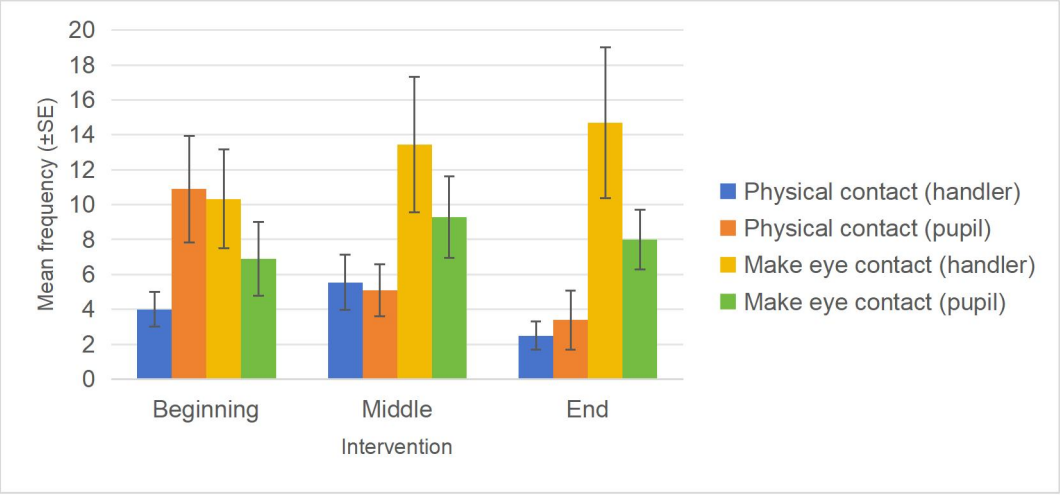

Figure 7. Frequency during 30 min. meetings of physical contact and eye contact behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils) over one semester.

4.1.4 Negative indicators

Negative indicators generally occurred at low frequencies and accounted for only a small proportion of the total observed duration. The behaviours low body position, tail between the legs, and trembling were not observed during any intervention and were therefore excluded from further analyses. Head away, showing teeth, overactive behaviour, growling, retching, and handler- or pupil-initiated physical contact (hug, kiss, pat, or touch the nose) were recorded only rarely and were not included in the statistical analyses.

No significant differences in percentage of duration of negative indicator were found. Panting showed the highest duration percentage among the negative indicators across all three interventions and was also associated with relatively large standard errors (Beginning: 5.18 ± 4.37, Middle: 6.00 ± 4.07, End: 2.67 ± 2.52), indicating considerable variation between dogs. Most other negative indicators accounted for less than 1% of the total meeting duration. Descriptively, avoidance (handler) was numerically lower during the Middle and the End than during the Beginning, whereas avoidance (pupil) remained infrequent throughout the intervention period.

Because the percentages of duration of most negative indicators were very low, duration-based inferential analyses were considered unlikely to provide meaningful results. Therefore, frequency data were used for statistical analyses of selected negative indicators. Although some variation between interventions was observed, none of the frequencies of the negative indicators differed significantly across meetings (Figure 8). Lip-licking occurred more frequently than the other negative indicators and showed a gradual decline across interventions ($p = 0.966$). Panting occurred at a relatively high frequency during the Beginning and the Middle and decreased during the End ($p = 0.801$). Yawning ($p = 0.135$), walking away, and avoidance (handler: $p = 0.368$) behaviours occurred at comparatively low frequencies throughout the meetings. Large standard errors for lip-licking and panting indicated substantial variation among individual dogs.

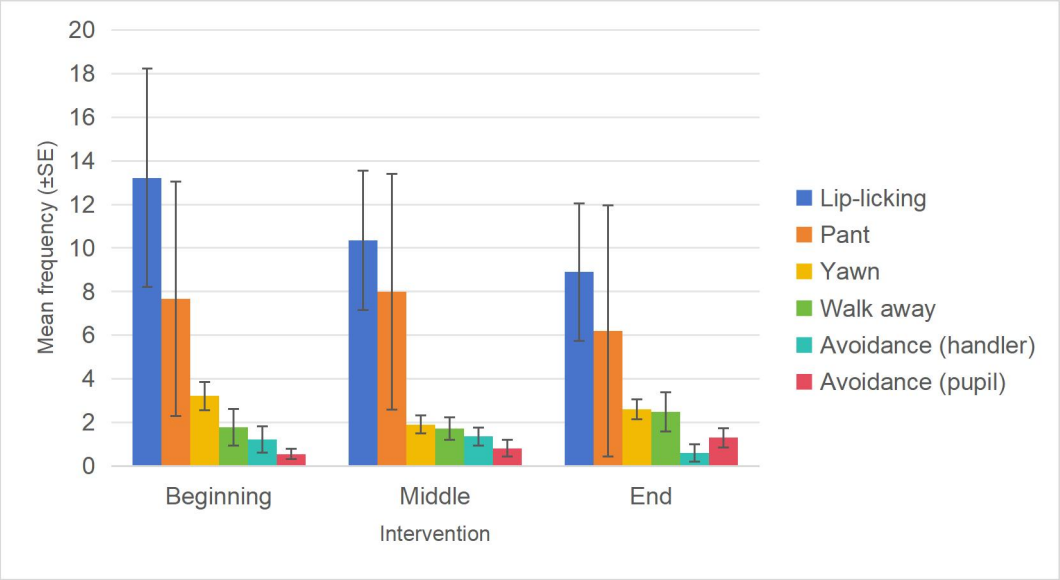

Figure 8. Frequency during 30 min. meetings of walk away, yawn, lip-licking, pant, avoidance behaviours across the Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n = 8) meeting pupils over one semester.

4.1.5 Other behaviours

Several other behaviours, including barking, whimpering, drinking, snorting, and coughing, occurred only rarely and were therefore excluded from further statistical analyses.

No significant differences in percentage of duration behaviour were detected for behaviour explore, stationary attentive (handler and pupil) (Figure 9). However, a tendency towards a difference across interventions was observed for the frequency of stationary attentive (pupil) ($p = 0.078$). Descriptively, stationary attentive (pupil) was highest during the Beginning, decreased during the Middle, and partially recovered during the End. Explore behaviour showed moderate variation across interventions, while stationary attentive (handler)behaviour remained relatively constant.

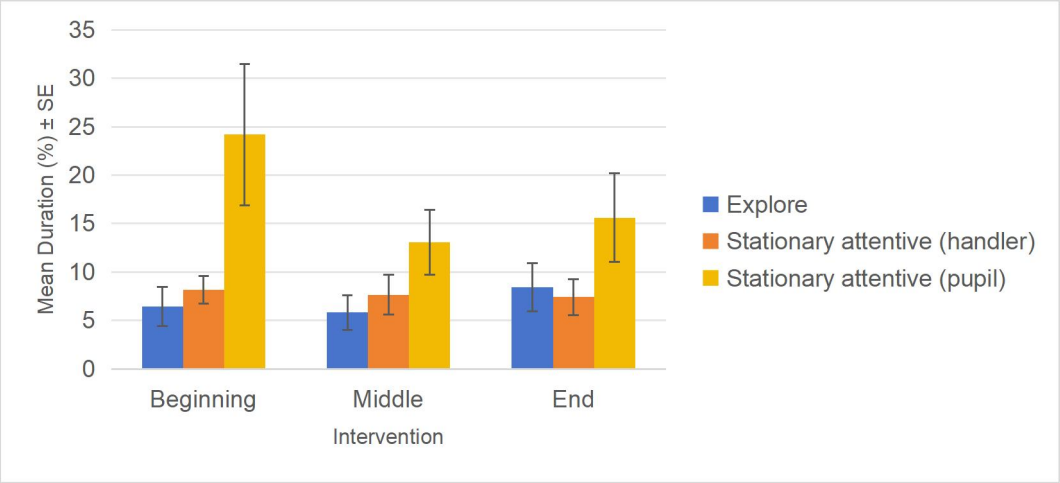

Figure 9. Duration (% ± SE) during 30 min. meetings of explore (p = 0.417), stationary attentive (pupil: p = 0.197) behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n=8) meeting pupils over one semester.

No significant differences were found for the frequencies of smack, scratch and shake the whole body(Figure 10). However, frequency of lift paw increased across meetings and differed significantly during the intervention (p = 0.024). The frequency of smack showed a decreasing trend throughout the meetings. The frequency of scratch increased during the Middle before decreasing again during the End of the intervention, whereas the frequency of shake the whole body showed a gradual increase during the intervention of 20 meetings.

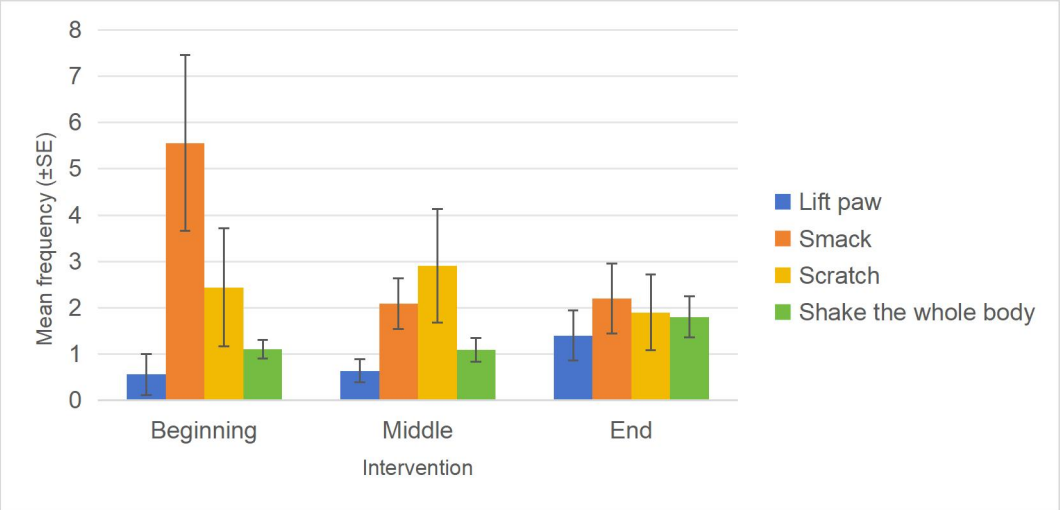

Figure 10. Frequency during 30 min. meetings of lift paw, smack, scratch, shake the whole body behaviours across Beginning (n = 9), Middle (n = 11), and End (n = 10) of 20 meetings in school dogs (n=8) meeting pupils over one semester.

4.2 The dogs' behaviour in the protocol

Handler protocols indicated that several positive and intervention-related behaviours were reported in a high proportion of meetings (Table 5). Contact seeking with pupils was the most consistently reported behaviour, occurring in almost all interventions (99.6 ± 0.4%). Reward engagement was also commonly reported (87.3 ± 5.5%), as was tail wagging (85.0 ± 8.4%).

Among the positive indicators, play behaviour was reported in approximately 61% of meetings, whereas lying on the back was less common (28.0 ± 7.4%). Contact seeking with handler showed substantial variation between pupils (45.9 ± 11.9%, range 0–100%).

Negative indicators were generally reported infrequently. Yawning (14.9 ± 5.3%), panting (12.1 ± 7.9%), avoidance (10.2 ± 4.4%), and overactive (10.6 ± 4.9%) were the most commonly reported negative indicators. Low body position, trembling, and growling were rarely reported (<4% of meetings on average).

Among the other behaviours, explore was relatively common (63.8 ± 9.1%), whereas scratching, shaking the whole body, and barking were reported less frequently (11–16% of meetings).

Table 5. Occurrence of behaviours recorded in handler protocols, expressed as the percentage of meetings in which each behaviour was reported for each pupil. Mean ± SE, minimum, and maximum values were calculated across pupils

Category	Behaviour	Mean(%)	SE	Min (%)	Max (%)
Intervention-related Behaviours	Reward engagement	87.3	5.5	37.5	100.0
Positive Indicators	Play	60.7	4.4	33.3	90.0
	Tail wagging	85.0	8.4	0.0	100.0
	Lie on back	28.0	7.4	0.0	75.0
	Contact seeking with pupil	99.6	0.4	95.0	100.0
	Contact seeking with handler	45.9	11.9	0.0	100.0
Negative Indicators	Avoidance	10.2	4.4	0.0	40.0
	Overactive	10.6	4.9	0.0	60.0
	Yawn	14.9	5.3	0.0	55.0
	Lip-licking	6.3	2.7	0.0	25.0
	Pant	12.1	7.9	0.0	80.0
	Low body position	1.0	1.0	0.0	12.5
	Tremble	0.5	0.5	0.0	5.6
	Whimper	4.2	2.0	0.0	20.0
	Growl	3.1	1.9	0.0	20.0
Other Behaviours	Explore	63.8	9.1	11.1	100.0
	Scratch	12.3	4.8	0.0	50.0
	Shake the whole body	16.0	4.0	0.0	50.0
	Bark	14.8	4.9	0.0	45.0

4.3 Comparison between video observations and handler protocols

Comparisons between video recordings and handler-completed protocols were based on the 27 meetings for which both data sources were available. Agreement (i.e. instances where the behaviour was noted (or not) in both video and protocol, regardless of duration or frequency) between the two methods varied across behaviours (Table 6). The behaviours tail between legs, low body position, and trembling were not recorded by either method in the matched meetings.

Several positive and intervention-related behaviours showed high agreement between methods. Tail wagging demonstrated complete agreement (100%), while contact seeking with pupil, reward engagement, lie on the back, and bark all exceeded 90% agreement. Contact seeking with handler, explore, lip-licking, and pant showed moderate to high agreement (74.1% to 77.8%). Whimpering and growling also showed high agreement (88.9% and 96.3%, respectively).

Lower agreements were observed for avoidance (37.0%), yawn (29.6%), shake the whole body (44.4%), scratch (51.9%), and play behaviour (66.7%). In most of these cases, behaviours were identified more frequently during video analysis than reported in the handler protocols. For example, yawning was recorded in 19 meetings exclusively during video observations, whereas no meetings were recorded exclusively in the handler protocols. Similarly, avoidance and shaking the whole body were considerably more often identified from video recordings than from handler reports.

Overactive activity showed a relatively high overall agreement (81.5%); however, this was primarily due to both methods classifying most meetings as dogs not showing the behaviour. No meeting was identified as dogs being overactive by both methods simultaneously.

Table 6. Agreement between video observations and protocols for behaviours recorded during matched intervention meetings. Agreement was calculated as the proportion of matched sessions in which both methods recorded the same outcome (both observed or both not observed) relative to the total number of matched video–protocol meetings (n = 27)

Behaviour	Both observed	Video only	Protocol only	Neither	Agreement (%)
Contact seeking (pupil)	25	0	2	0	92.6
Contact seeking (handler)	16	5	2	4	74.1
Avoidance	2	16	1	8	37.0
Reward	24	0	2	1	92.6
Explore	19	7	0	1	74.1
Scratch	5	12	1	9	51.9
Overactive activity	0	2	3	22	81.5
Play	11	3	6	7	66.7
Yawn	5	19	0	3	29.6
Lip-licking	0	3	4	20	74.1
Pant	4	6	0	17	77.8
Tail wagging	27	0	0	0	100.0
Lie on back	6	1	1	19	92.6
Shake the whole body	7	15	0	5	44.4
Bark	1	0	2	24	92.6
Whimper	2	2	1	22	88.9
Growl	0	1	0	26	96.3

5. Discussion

5.1 Overall welfare of the school dogs

Overall, the school dogs in the present study displayed considerably more positive than negative behavioural indicators during the intervention meetings, which is consistent with the findings for the other half of participants investigated in a previous master's project (Johansson 2024) conducted within the same school-dog project. Positive indicators accounted for the largest proportion of all recorded behaviours, whereas negative indicators represented a lower proportion than positive, other, and intervention-related behaviours. However, this does not necessarily mean that negative indicators were welfare-irrelevant. The welfare significance of these behaviours depends not only on their overall proportion, but also on their intensity, duration, context, and whether they occurred repeatedly in relation to specific interactions. Tail wagging, physical contact, contact seeking, make eye contact and explore were observed frequently throughout the intervention period, while behaviours commonly associated with stress or discomfort, such as avoidance, low body position, tremble, growl and tail between the legs, occurred rarely or were not observed at all. These findings are generally consistent with previous studies of therapy and school dogs, which reported low frequencies of stress-related behaviours and limited evidence of compromised welfare during animal-assisted interventions (Glenk et al. 2013; McCullough et al. 2018; Miller et al. 2022). Therefore, the present results do not show clear evidence that participation in school-dog meetings negatively affected the dogs' welfare.

5.2 Behavioural changes across repeated meetings

The intervention lasted 10 weeks with twice weekly meetings between a pupil and the same dog. Thus it was of interest to know if there were any changes of the dogs' behaviours between meetings in the beginning, middle and end of the intervention. Several behavioural changes were observed across the intervention period. The most pronounced changes were the significant decreases in following (handler) behaviour and execute command (handler). In contrast, make eye contact (handler) showed a non-significant tendency to increase across meetings.

Following (handler) behaviour decreased significantly in both duration and frequency across the intervention period. One possible explanation is that the dogs became increasingly familiar with the intervention context and therefore relied less on maintaining close physical proximity to their handlers. As the dogs gained experience with the pupils, routines, and meeting environments, they may have

become more confident and independent during the interventions. A reduction in proximity-seeking behaviours over time could therefore reflect habituation to the intervention setting rather than reduced engagement with the handler (Rehn et al. 2017; Wanser & Udell 2019).

A similar pattern was observed for executing command (handler), which also decreased significantly across interventions. One possible explanation is that the intervention meetingsbecame less dependent on direct handler guidance as the dogs became more familiar with the activities and expectations associated with the sessions. Alternatively, handlers may have needed to provide fewer instructions over time as dogs became increasingly accustomed to the intervention routines. Such a decrease may indicate that interactions became more natural and less structured during later stages of the intervention. It is also possible that handlers gradually allowed greater opportunities for pupil-led interactions as the intervention progressed, although this interpretation should be treated with caution because executing command from the pupil did not show a corresponding increase.

Despite reductions in following behaviour and executing command (handler), make eye contact (handler) tended to increase across meetings. Although this pattern was not statistically significant, it may still be relevant when interpreting the dogs' behaviour. Similar findings have been reported in studies of dogs involved in animal-assisted interventions, suggesting that dogs often use visual attention towards their handlers as a means of obtaining information, guidance, or emotional support (Merola et al. 2012; Horn et al. 2013; Mongillo et al. 2017). Dogs exposed to unfamiliar or potentially challenging situations frequently alternate their gaze between the environment and their owner or handler, a behaviour interpreted as social referencing or support-seeking (Merola et al. 2012).

The tendency for increased eye contact occurred simultaneously with a decrease in following behaviour. This combination may suggest that the dogs relied less on physical proximity to their handlers while maintaining visual contact as a source of information or reassurance. Such a pattern is consistent with attachment theory and the secure-base concept, whereby familiar humans facilitate exploration without requiring constant physical closeness (Ainsworth 1989; Rehn & Keeling 2016; Rehn et al. 2017; Wanser & Udell 2019). Visual attention towards the handler may therefore represent a form of support-seeking behaviour during intervention sessions, particularly in working dogs where continuous physical proximity is constrained by the nature of the task (Wanser & Udell 2019).

5.3 Interpretation of behavioural indicators

Some behaviours traditionally interpreted as indicators of stress did not always occur in isolation. This highlights the difficulty of assigning a fixed emotional

meaning to individual behaviours and supports previous suggestions that welfare assessments should consider the animal's overall behavioural expression rather than relying on single behavioural indicators alone (Wemelsfelder 2007; Pedersen & Malm 2025).

Although yawning and lip-licking are frequently described as indicators of stress or discomfort in dogs (Miller et al. 2022), both behaviours are considered context-dependent and may occur in a variety of situations unrelated to negative welfare states. For example, during video coding, lip-licking may occur during anticipation of food rewards, after feeding, during olfactory investigation, as part of normal maintenance behaviour or in social contexts such during reunion with the owner (Rehn & Keeling 2011; Rehn et al. 2014).Therefore, the presence of these behaviours should not automatically be interpreted as evidence of compromised welfare. Instead, they should be considered within the broader behavioural context and alongside other behavioural indicators.

Large standard errors were observed for lip-licking and panting behaviours, indicating substantial individual variation between dogs. Some dogs displayed these behaviours frequently, whereas others showed them rarely or not at all. Similar individual differences have been reported in previous AAI studies, indicating that dogs may differ considerably in how they respond behaviourally to intervention work (McCullough et al. 2018).

Furthermore, several behaviours frequently occurred simultaneously. For example, avoidance behaviour was occasionally observed together with tail wagging or other behaviours generally interpreted as positive. Such combinations illustrate the complexity of behavioural assessment and highlight the importance of considering behavioural context rather than interpreting individual behaviours in isolation. This observation is consistent with the principles of Qualitative Behaviour Assessment (QBA), which emphasise the animal's overall behavioural expression rather than single behavioural events (Wemelsfelder 2007; Pedersen & Malm 2025).

5.4 Comparison between video observations and handler protocols

While the overall behavioural patterns were broadly similar to those reported previously within this project, the present study extends earlier work by directly comparing video observations with handler-completed protocols. This comparison revealed substantial agreement for conspicuous behaviours such as tail wagging, reward engagement and contact-seeking behaviour, whereas subtle behaviours including yawning, avoidance and shaking were identified more frequently through systematic video analysis than through handler reports.

The lower agreement observed for several subtle behaviours may partly reflect methodological differences between systematic video analysis and handler-

completed protocols. Video recordings can be reviewed repeatedly and allow observers to detect brief or low-intensity behaviours that may be overlooked during real-time observations (Bateson & Martin 2021). This may explain why behaviours such as yawning, avoidance, and shaking the whole body were considerably more often identified during video analysis than in the protocols. In contrast, highly conspicuous behaviours such as tail wagging, reward, and contact-seeking behaviour showed high agreement between methods, suggesting that these behaviours were easier for handlers to notice and remember.

Another possible explanation is related to how the protocols were completed. Handlers filled in the protocols after each intervention meeting and may therefore have forgotten some behaviours, particularly behaviours that were brief, subtle, or occurred infrequently. Consequently, some low-frequency behaviours may have been underreported in the protocols compared with the video observations. The greatest discrepancy between methods was observed for overactive activity. Video analysis identified this behaviour in only two meetings, whereas handlers reported it considerably more often. One possible explanation is that the ethogram definition used in the video analysis was relatively strict and required observable running or walking around combined with reduced responsiveness to the handler or pupil. In some situations, behaviours classified by handlers as overactive activity may have been coded during video analysis as failure to execute commands rather than excessive activity itself. Consequently, the same behavioural event may have been interpreted differently depending on the observer's perspective and the operational definitions used.

5.5 Methodological limitations

5.5.1 Definitions and coding challenges

In the present study, eye contact was defined as lasting longer than one second. This threshold was chosen both to facilitate coding consistency and because very brief glances were considered insufficient to represent sustained visual interaction. However, brief glances (< 1s) may still carry behavioural relevance. Some eye contact may have been included within stationary attentive behaviour when the dog remained immobile and visually oriented towards the handler or pupil. However, brief visual check-ins occurring during movement, following, contact seeking, or command execution were not coded as eye contact. Thus, the one-second threshold may have underestimated short visual interactions that could be relevant for social referencing or reassurance (Merola et al. 2012; Wanser & Udell 2020). Therefore, the decision to include or exclude short glances may depend on the specific aims of the study.

A methodological consideration in the present study is that frequency and duration measures may provide different types of information depending on the

behaviour observed. Short event behaviours are usually more meaningfully represented by frequency, whereas longer-lasting behaviours may be better described by duration. Consequently, comparisons between behaviours or behavioural categories should be interpreted cautiously, as a high frequency does not necessarily indicate a large proportion of time spent performing that behaviour, and a long duration does not necessarily indicate frequent occurrence.

Another methodological consideration concerns the interpretation of behavioural frequencies. Frequency measures may not be equally informative for all behaviours included in the ethogram. Brief event behaviours, such as yawning or lip licking, are often more appropriately described by their occurrence rate, whereas longer-duration state behaviours, such as physical contact or stationary attentive behaviour, may be more meaningfully represented by duration measures. Consequently, comparisons based solely on behavioural frequencies may overemphasise short-lasting event behaviours relative to behaviours that occur less frequently but are maintained for longer periods. This should be considered when interpreting the relative distribution of behavioural categories and individual behaviours in the present study.

The lack of standardisation across intervention meetings is another limitation concern. Although all meetings followed the general framework of animal-assisted education, the specific activities, interactions and tasks varied between sessions and were adapted to the individual pupil and handler. Consequently, the number of commands given, opportunities for play, levels of physical contact and other interaction types were not standardised across meetings. This variation may have influenced the occurrence of several behaviours recorded in the present study. For example, changes in following behaviour, play behaviour or command execution may partly reflect differences in the activities performed during individual meetings rather than changes in the dogs' welfare or perception of the intervention over time. Future studies could benefit from recording such interaction variables in greater detail and incorporating them as explanatory factors when analysing behavioural responses.

For some interaction-based variables, frequency and duration measures yielded different temporal patterns. For example, reward engagement (pupil) showed decreasing frequencies across meetings but higher duration percentages during the middle period. This discrepancy likely reflects differences in what frequency and duration measures capture: frequency represents the number of reward events, whereas duration reflects the cumulative time spent engaging with reward engagement. Such findings further illustrate the challenges associated with interpreting frequency and duration measures interchangeably.

Another methodological limitation was related to the coding structure used in the present study. Although mutually exclusive settings can be modified when constructing an ethogram, several behaviours in the present coding scheme were

assigned to mutually exclusive behavioural groups. This meant that only one behaviour within the same group could be performed at a given time, and coding the onset of a new behaviour automatically terminated the previously performed behaviour within that group (Noldus Information Technology 2021). Mutually exclusive behavioural definitions can be useful when constructing ethograms because they support clear and consistent behavioural classification (Rose & Riley 2021). However, some behaviours may naturally co-occur during social interactions. For example, during ongoing physical contact, a dog could lean against a pupil while simultaneously engaging in licking or nosing behaviour. Coding these as separate physical contact events would artificially inflate behavioural frequencies, whereas prioritising one behaviour may result in underestimation of the other. Similar challenges were also reported by Johansson (2024), who suggested that contact-seeking behaviour towards pupils may have been underestimated because it frequently occurred simultaneously with physical contact, while only one behaviour could be registered at a time. Therefore, decisions regarding whether to prioritise broader behavioural categories or more specific behavioural subtypes should ideally be made prior to full video analysis in order to maintain consistency and avoid inflation of behavioural counts.

5.5.2 Video recording limitations

Several practical recording factors may substantially influence behavioural detectability and coding reliability. For example, low visual contrast between the dog and the surrounding environment (e.g., dark-coated dogs positioned against dark furniture or clothing) reduced visibility of subtle body movements and facial expressions. Lighting direction could also make it more difficult to judge postural changes, gaze direction, or behaviours involving contact with the dog's own body or another person. Although behaviours involving clear movements were generally identifiable, reduced visibility of specific body parts was not systematically coded as a separate "not visible" category. Therefore, it was not possible to quantify how much visibility issues may have affected the calculated frequencies or durations. This should be considered as a potential limitation when interpreting behaviours that were difficult to observe clearly. In addition, the use of a single camera occasionally limited behavioural observation when dogs moved out of frame or oriented away from the camera. Future studies may therefore benefit from standardized recording conditions and the use of multiple camera angles to improve behavioural visibility and coding accuracy.

5.5.3 Stress-related behaviours and welfare interpretation

Some dogs appeared highly behaviourally controlled during interactions with pupils and showed few overt stress-related behaviours. However, these dogs often returned quickly to resting areas once the interaction ended. In contrast, other

dogs displayed behaviours commonly associated with stress or arousal, such as yawning or lip licking, during the interaction itself.

This raises important questions regarding the interpretation of behavioural indicators in welfare assessment. The absence of overt stress-related behaviours does not necessarily indicate the absence of stress (Glenk et al. 2013; Rossi et al. 2018; Pedersen & Malm 2025), as some dogs may suppress behavioural responses, display different coping styles, or be highly trained to remain behaviourally controlled during interactions. Conversely, behaviours such as yawning or lip licking may not solely represent negative welfare states, but could also reflect coping attempts, or social communication (Miller et al. 2022).

Therefore, interpreting these behaviours as strictly positive or negative indicators may oversimplify the dogs' emotional experiences. Some interaction types initiated by pupils or handlers, such as hugging, kissing and patting, were categorised as negative interactions due to their potentially intrusive nature and the limited opportunity for the dog to control or avoid the interaction (Glenk 2017). However, these interaction types may differ substantially in how they are perceived by individual dogs, and their classification as negative should therefore be interpreted with caution. In addition, these variables primarily described actions initiated by pupils or handlers rather than behavioural responses expressed by the dogs themselves. Consequently, they may provide limited information about the dogs' affective state or welfare unless considered together with the dogs' immediate behavioural reactions (Glenk 2017; Meers et al. 2022).

The present analytical approach focused primarily on the frequency and duration of individual behaviours and interactions. As a result, it was not possible to systematically examine whether specific interactions were followed by particular behavioural responses from the dogs. For example, physical contact initiated by a pupil or handler may be associated with positive responses such as tail wagging or contact seeking behaviour in some situations, but with avoidance, lip-licking or turning the head away in others. Analysing the temporal relationship between interactions and subsequent behavioural responses could provide a more nuanced understanding of how dogs perceive and experience different forms of human interaction. Future studies could therefore benefit from treating handler- and pupil-initiated interactions as contextual variables and investigating the dogs' immediate or delayed behavioural responses to these interactions in greater detail.

Future studies would also benefit from combining behavioural observations with physiological measurements, such as salivary cortisol, heart rate variability, or oxytocin levels, in order to better understand the relationship between behavioural expression and underlying stress or emotional states (Glenk et al. 2013; Rossi et al. 2018; Pedersen & Malm 2025). In addition, qualitative data collection, such as handler interviews, field notes, or open-ended protocol questions, could provide further contextual information about the dogs' behaviour

duringinterventions. Handler perspectives may be particularly useful because handlers play a central role in monitoring and supporting therapy dogs' welfare during AAI (Mignot et al. 2022). Rather than focusing only on changes across meeting stages, future analyses could also include specific handler- and pupil-initiated interactions as explanatory factors. This would be consistent with recent recommendations to measure human–dog interactions more explicitly in dog-assisted interventions (De Santis et al. 2024). For example, behaviours shown by the dogs could be analysed in relation to pupil-initiated physical contact, reward engagement, execute command. This could help clarify whether specific types of interaction are associated with positive, other, or stress-related behavioural responses.

The findings of the present study highlight the complexity of interpreting canine behavioural signals during animal-assisted education (AAE), where single behaviours may serve multiple functions depending on the individual, context, and interaction dynamics (Wemelsfelder 2007; Pedersen & Malm 2025).

5.6 Practical and methodological considerations for future AAE studies

5.6.1 Potential influence of trained handlers

All handlers participating in the project had received specialised training in animal-assisted education, and both dogs and handlers had been assessed and certified for work with children. As part of their role, handlers were expected to monitor the dogs' welfare and intervene when necessary. Previous research suggests that dogs frequently use their handlers as a source of information and social support (Merola et al. 2012; Wanser & Udell 2019). Consequently, handler actions such as attention redirection, reassurance or rewarding behaviour may have influenced the behavioural patterns observed during sessions. However, such interactions are likely to reflect normal working conditions for educational dog teams rather than solely representing a methodological bias. Future research could investigate the extent to which handler involvement contributes to maintaining positive welfare during animal-assisted education sessions.

5.6.2 Welfare-related considerations during AAE sessions

The workload experienced by the dogs during the intervention should also be considered when interpreting the results. In the present study, five of the seven dogs participated in meetings with two pupils on the same day. Individual meetings lasted approximately 30 minutes, with rest periods typically ranging from 5 to 20 minutes between meetings, although some dogs attended one meeting in the morning and another later in the afternoon. Consequently, the total working time generally remained below two hours per day. No clear indications

of increasing negative indicators or behavioural disengagement across meetings were observed in the present study. Nevertheless, future research could examine how meeting frequency, recovery periods and cumulative workload influence welfare outcomes in educational dogs under different working schedules.

Structured interaction routines, such as hand hygiene procedures before and after meetings and simple caregiving interactions (e.g., offering water), may additionally contribute to both hygiene management and more predictable, positive human-animal interactions during AAE sessions.

5.7 Social, ethical and sustainability considerations

School dog interventions may have social value by supporting pupils' emotional well-being, motivation, and social interaction (Barker & Gee 2021; Bidoli et al. 2022; Miller et al. 2022). Long-term contact with dogs may also provide opportunities for pupils to develop responsibility and empathy towards animals, which is consistent with the social-emotional and developmental aims of AAE (Binder et al. 2024). However, these potential benefits should not be evaluated only from the human perspective. The welfare of the dog should be considered, particularly because school dogs are involved in repeated social interactions in a complex and sometimes unpredictable school environment (Glenk 2017; Barker & Gee 2021; Miller et al. 2022).

Although current literature does not provide clear evidence that dogs involved in AAI generally experience negative welfare, dog welfare in these settings has received less scientific attention than the effects on human participants (Glenk 2017; Miller et al. 2022). Therefore, it is important to recognize that school dogs, as sentient individuals, have their own needs and preferences. From an ethical perspective, dogs should have the possibility to choose whether to interact, to avoid or leave interactions, and to access a safe resting area where they are not disturbed (Lidfors et al. 2021; Meers et al. 2022). The handler has an important responsibility to monitor the dog's behaviour, recognize signs of stress or discomfort, and interrupt interactions when necessary (Lidfors et al. 2021; Mignot et al. 2022). Pupils should also be taught how to interact with dogs in a calm and respectful way (Bidoli et al. 2022).

A school dog programme can be considered socially and ethically sustainable when it protects the welfare of the dog, the workload and responsibility of the handler, the school's ability to manage the intervention safely, and the well-being and safety of the pupils (Lidfors et al. 2021; Bidoli et al. 2022). If the dog is repeatedly exposed to demanding interactions without sufficient rest, choice, or support from the handler, the intervention may become unsustainable even if it appears beneficial for pupils (Glenk 2017; Lidfors et al. 2021; Miller et al. 2022).

The present study also involved ethical considerations related to research and development. The use of video recordings and behavioural observations was non-

invasive and did not require experimental manipulation of the dogs or pupils. The participating pupils, guardians, and handlers received information about the project and were asked to provide informed consent. Because the study involved children, schools, handlers, and dogs, careful handling of personal data and confidentiality was important. Therefore, the names of pupils, handlers, schools, and dogs were not presented in the report.

6. Conclusion

The school dogs in this study displayed predominantly positive behavioural indicators, together with frequent interactions involving pupils and handlers. Other behaviours and occasional negative behavioural indicators were also observed. Based on the video recordings, behaviours such as tail wagging, physical contact and contact-seeking behaviour occurred frequently, whereas behaviours commonly associated with discomfort or stress were observed relatively infrequently. Overall, there were no clear indications of poor welfare in the participating school dogs during intervention meetings.

Handler-completed protocols similarly indicated that the dogs predominantly displayed intervention-related and positive indicators. The comparison between video observations and handler protocols showed substantial agreement for several conspicuous behaviours, such as tail wagging, reward and contact-seeking behaviour. However, subtle behaviours including yawning, avoidance and shaking the whole body were more frequently identified through systematic video analysis than reported in the protocols.

Several behavioural changes were observed across repeated meetings, including increased eye contact with the handler and decreased following behaviour. These findings suggest that the dogs' interactions with its handler and pupils may change over the course of the intervention.

The results suggest generally good welfare in the participating school dogs. However, due to the limited sample size and variation among individual dogs, these findings should be interpreted with caution and cannot be readily generalised to all school dogs participating in AAE programmes.

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Popular science summary

School dogs are increasingly used in Swedish schools to support pupils in different educational activities. Previous studies have shown that interacting with a dog may help children feel calmer, improve motivation and increase participation in school activities. However, while much attention has been given to the benefits for children, less is known about how the dogs themselves experience these activities.

The aim of this study was therefore to investigate the welfare of school dogs during school-based interventions. Eight school dogs from six schools in Sweden were included in the study. Video recordings from repeated meetings between the dogs and pupils were analysed, and behavioural reports completed by the dog handlers were also evaluated.

The dogs displayed many behaviours that are generally associated with positive experiences, such as tail wagging, seeking contact with pupils, physical interaction and exploratory behaviour. Behaviours often linked to discomfort or stress occurred less frequently. Overall, the results suggest that the participating dogs generally experienced good welfare during the intervention meetings.

Some behavioural changes were observed over time. For example, the dogs tended to look more often towards their handlers during later meetings, while following their handlers decreased. This may indicate that the dogs became more familiar with the school environment and the intervention routine while still using their handlers as a source of support and information.

The study also compared observations made from video recordings with reports completed by the handlers. Clear and easily observable behaviours were often recorded similarly by both methods. However, subtle behaviours such as yawning and avoidance were more frequently detected during detailed video analysis, showing that different observation methods may provide different information about dog behaviour.

Assessing animal welfare is complex because individual behaviours can have several meanings depending on the situation. For example, a dog may display a behaviour sometimes associated with stress while simultaneously showing behaviours usually interpreted as positive. Therefore, it is important to consider the overall behavioural context rather than relying on a single behaviour when evaluating welfare.

Although the study included only a limited number of dogs, the findings contribute valuable knowledge about school-dog welfare and suggest that participation in these educational activities was generally associated with positive welfare. Future studies combining behavioural observations with physiological

measures, such as hormone levels or heart-rate measurements, may provide an even more complete understanding of how school dogs experience their work.

Appendix 1

School I
The intervention meetings took place in a basement-level area consisting of two connected rooms. The first room contained a small kitchen area and a separate toilet. A partition separated the entrance area, which contained a round table and several chairs, from the intervention area. The intervention area included a large wooden table, a three-seat sofa positioned against the wall, a single armchair, and a square rug placed beneath the table. The pupil and dog most often sat together on the sofa, where a blanket was usually provided for the dog. The handler generally sat beside them on the sofa, although a small stool was occasionally used. Shelving units containing toys and materials for dog-related activities were located within the room. No windows were visible in the recorded videos from this room. A doorway connected the room to a second, substantially larger room resembling a storage or activity area. This room contained several windows, although no natural light was visible in the recordings and artificial lighting was used during sessions. The larger open space allowed the dog greater freedom of movement during activities.

School J
The intervention meetings took place in a relatively small room. A circular rug was positioned near the entrance, with a large round wooden table and three wooden chairs located behind it. Two additional chairs were placed in one corner together with the belongings of the pupil, handler and dog. Two large floor-to-ceiling windows were located along one wall and were generally covered by curtains, although a small opening was occasionally left uncovered. The pupil and handler most often interacted with the dog while sitting on the floor, typically on the rug. During some activities, particularly table-based tasks, the participants sat at the table.

School K
The intervention room contained a large square wooden table with four chairs. Two large floor-to-ceiling windows were situated along one wall and were partially covered by sheer curtains. Two beanbag chairs were positioned in the corner beside the windows. The pupil and handler most often sat on the floor leaning against the beanbags while interacting with the dog. During game-based activities, the participants occasionally sat together or separately on the chairs at the table. A whiteboard was mounted on the wall adjacent to the table, and a computer desk with a chair was positioned diagonally opposite the table. One wall of the room was fully covered by curtains.

School L

The intervention meetings took place in a narrow rectangular room. A long sofa covered with a grey blanket was positioned along one wall near the entrance, accompanied by a chair and a small table. Three windows were located along the same wall. A rectangular rug was placed in the centre of the room. Along the opposite wall stood another table with two chairs, a wooden bookshelf and a wall-mounted whiteboard. The pupil and dog most often sat together on the sofa, although the pupil occasionally used one of the chairs. The handler either sat beside them on the sofa or used a nearby chair. Some activities were conducted on the rug in the centre of the room.

School M

The intervention meetings took place in a small room with a glass door covered by a sheer curtain. A three-seat sofa was positioned along one wall and partially covered by a blanket used by the dog. A floor lamp was located in the corner beside the sofa. Additional furnishings included two bookcases of different sizes, an armchair, a small round coffee table and a square rug positioned in front of the seating area. The pupil and dog most frequently sat together on the sofa, while the handler usually sat in the armchair or occasionally joined the pupil on the sofa. Games were commonly conducted on the rug.

Appendix 2

Protokoll för hundens välfärd

Skola (bokstav):_____ Elev (nummer):_____ Hundförare:_____

Datum:_____ Veckodag:_____ Tid:_____

Träff nr.:_____ Plats: Inne_____ Ute_____

Beteenden	Definitioner	Ja/Nej
Kontaktsökande elev	Går målmedvetet mot eleven, söker kontakt, sätter eller ställer sig med kroppen tryckt mot eleven.	
Kontaktsökande förare	Går målmedvetet mot föraren, söker kontakt, sätter eller ställer sig med kroppen tryckt mot föraren.	
Avståndsökande beteende	Stretar emot, går från elev, vänder bort huvudet och/eller kroppen från elev.	
Få belöning	Hunden får godis av elev.	
Undersökande	Nosen mot marken eller andra objekt i rummet/miljön, inte på eleven.	
Klia sig	Snabbt tuggande med tänderna eller skrapande med tassarna mot kroppen, inkluderar slicka sig själv.	
Överdriven aktivitet	Kan inte vara stilla, cirkulerande, tappar fokus på aktiviteten eller föraren.	
Lek	Skakande av leksak, bärande på leksak, bjuder in till lek med elev genom knuffar med nos eller tass eller lägger leksak på elev.	
Gäspa	Gäspar, gapar med munnen.	
Slicka runt munnen	Slickar sig runt munnen eller på nosen, smackar med munnen (ej i relation till belöning)	
Hässja	Andas med öppen mun med en snabb andningsfrekvens på 200–400 andetag per minut.	
Viftande svans	Svansen går från sida till sida i ett neutralt läge.	
Svans mellan benen	Svansen tryckt mellan benen på sig själv.	
Ligga på rygg	Ligger på rygg med magen uppåt.	
Låg kroppshållning	Kroppen i låg ställning med böjda ben och rundad rygg.	
Skaka sig	Skakning av kroppen som börjar från huvudet och slutar vid svansen.	
Darra	Darrar så att hela kroppen skakar.	
Gnälla	Gällt utdraget ljud.	
Skälla	Skall av något slag.	
Morra	Dovt knarrande ljud.	

Etogram utvecklat av Jannice Kindsjö (2014) utgått från flera tidigare studier (Beerda *et al.*, 1997; 2000; Reid, 2007; Mizukoshi *et al.*, 2008; Handelman, 2011; Glenk *et al.*, 2013; Jakovcevic *et al.*, 2013; Rehn *et al.*, 2013).

Händelser under insatsen som påverkade hunden:_____

_____

_____

Appendix 3

Categories	Modifier	Definition
Individual behaviour		
Turn the head away		The dog turns its head away after looking at the pupil or handler. The behaviour starts when the head begins to turn away and ends when the dog stops turning or redirects its attention to another target.
Yawn		The dog slowly opens its mouth, draws in air, and then closes the mouth. The behaviour starts when the mouth begins to open and ends when the mouth is closed again.
Lip-licking		The dog licks around the mouth or over the nose. The behaviour starts when the tongue becomes visible and ends when the tongue is retracted.
Show teeth		The dog lifts the upper lip and shows the teeth, often with wrinkling of the nose and sometimes together with growling. The behaviour starts when the upper lip begins to lift and ends when the lip returns to a relaxed position.
Walk away		The dog moves away from the pupil or handler so that the distance between them increases. The behaviour starts when the dog begins moving away and ends when the dog stops, changes direction, or no longer increases the distance.
Tremble		Small, involuntary muscle contractions causing visible trembling in the dog's body or part of the body. The behaviour starts when trembling becomes visible and ends when the trembling stops.
Overactive activity		The dog moves rapidly or rushes around in an excited and restless manner, usually with difficulty settling or engaging calmly with the ongoing activity. This behaviour was distinguished from ordinary locomotion, exploration, or play by its higher speed, suddenness, and excited quality. The behaviour

		starts when the dog begins this rapid and restless movement and ends when the dog stops moving rapidly, settles, slows down, or re-engages calmly with the handler, pupil, or ongoing activity.
Pant		The dog shows rapid, shallow breathing with the mouth open, often with the tongue visible. The behaviour starts when open-mouth panting begins and ends when the mouth closes or breathing returns to normal.
Drink		The dog moves to the water bowl, ingests water by lapping, and returns to the handler, pupil, or previous activity area. The behaviour starts when the dog initiates movement towards the water bowl and ends when the dog stops drinking and returns to the handler, pupil, previous activity area or changes to another coded behaviour.
Shake whole body		The dog performs a rapid rotational movement of the whole body, typically starting at the head and moving towards the tail. The behaviour starts when the shaking movement begins and ends when the body stops shaking.
Eat treats		The dog attempts to pick up and consume or manipulate food rewards or reward objects that have fallen or been left on the ground, without permission from the handler or pupil. The behaviour starts when the dog lowers its head or reaches towards the food reward or reward object to pick it up, eat it, or manipulate it, and ends when the item is swallowed, dropped, released, or no longer manipulated.
Retch		The dog shows repeated or single abdominal contractions resembling vomiting, without expulsion of stomach contents. The behaviour starts when the abdominal contraction begins and ends when the contraction or gagging movement stops.
Explore		The dog walks around the room or approaches objects while sniffing or visually inspecting the environment, without engaging with the handler

		or pupil. The behaviour starts when the dog begins moving towards or investigating the environment and ends when the dog stops exploring, redirects attention to a person, or changes to another coded behaviour.
Smack		The dog smacks with the mouth (not in relation to reward), where a sound is produced when the tongue hits the palate. The behaviour starts when the smacking movement or sound begins and ends when the mouth movement stops.
Scratch		The dog scratches with a paw, gnaws with the teeth, or licks its own fur or body. The behaviour starts when the dog turns its body, lifts a paw, or otherwise initiates a clear movement towards scratching, gnawing, or licking itself. The behaviour ends when the dog stops the self-directed movement and returns to its previous body position or changes to another coded behaviour.
Lift paw		The dog lifts front paws while standing or sitting still, not in response to a command. The behaviour starts when the paw leaves the ground and ends when the paw is placed back on the ground or used for another behaviour.
Avoidance	with handler	The dog avoids interaction with the handler or pupil by stepping back, turning the body away, moving away, or withdrawing from attempted physical contact. The behaviour starts when the dog begins the avoidance movement and ends when the dog stops moving away, resumes interaction, or redirects attention to another target.
	with pupil	
Interaction behaviour		
Reward engagement	with handler	The dog chooses the game itself or receives a reward from the handler or pupil, including food treats or reward objects (e.g., chew sticks or toys). The behaviour starts when the dog takes the reward into the mouth or begins interacting with the reward object and ends when the reward is swallowed, dropped, released, or no longer manipulated.
	with pupil	

Execute command	with handler	The dog executes a command given by the handler or pupil. The behaviour starts when the dog begins the requested action and ends when the command has been completed, interrupted, or replaced by another behaviour.
	with pupil	
Does not execute command	with handler	The dog does not execute the command given by the handler or pupil, or performs an incorrect behaviour instead. The behaviour starts after the command is given when the dog fails to initiate the requested response and ends when the dog executes the command, a new command is given, the person redirects the situation, the person redirects their attention away from the dog, the command context is no longer maintained, or another coded behaviour occurs.
	with pupil	
Make eye contact	with handler	The dog directs its gaze towards the handler or pupil for at least one second, when not engaged in task-related behaviours such as command execution, following or contact seeking. The behaviour starts when sustained gaze towards the person begins and ends when the dog redirects its gaze away.
	with pupil	
Physical contact	with handler	The dog initiates or maintains physical contact with the handler or pupil, for example by leaning against the person, placing the head, nose or paw on the person, or licking the person. The behaviour starts when physical contact begins and ends when the contact is broken.
	with pupil	
Play	with pupil	The dog engages in play, such as inviting play by nudging with the nose or paw, placing a toy near a person, shaking or carrying a toy, or playing with the handler, pupil or itself. The behaviour starts when the play-related movement or interaction begins and ends when the dog stops playing, releases the toy, or changes to another coded behaviour.
	with handler	
	with itself	
Contact seeking	with handler	The dog moves in the direction of the pupil or handler, so that the distance between them and dog decreases. The behaviour starts when the dog begins moving towards the person and ends when the dog reaches the person, stops moving,
	with pupil	

		changes direction, or starts another coded behaviour.
Pupil-initiated physical contact	pet	Physical contact initiated by the pupil toward the dog without prior physical contact initiated by the dog. Includes petting, hugging, kissing, touching the nose, light tapping.
	hug	
	kiss	
	tap	
	touch the nose	
	blocking touch	Physical contact initiated by a pupil with the apparent purpose of controlling, restraining, redirecting, interrupting, or preventing the dog's ongoing behaviour or movement. This includes, for example, preventing access to food or objects, stopping exploration or play, pushing the dog away during approach attempts, physically blocking contact with another person, or removing inappropriate objects from the dog's mouth.
Handler-initiated physical contact	pet	Physical contact initiated by the handler towards the dog without prior physical contact initiated by the dog. This includes petting, hugging, kissing, touching the nose or light tapping. The behaviour starts when the pupil first touches the dog and ends when the physical contact is broken.
	hug	
	kiss	
	tap	
	touch the nose	
	blocking touch	Physical contact initiated by handler with the apparent purpose of controlling, restraining, redirecting, interrupting, or preventing the dog's ongoing behaviour or movement. This includes, for example, preventing access to food or objects, stopping exploration or play, pushing the dog away during approach attempts, physically blocking contact with another person, or removing inappropriate objects from the dog's mouth. The behaviour starts when the handler makes physical contact for this purpose and ends when the contact is released or the dog is no longer physically restricted or redirected.
Tail wagging		The dog’s tail swings from side to side. The behaviour starts when the tail begins to move from side to side and ends when the tail stops

		wagging.
Tail between the legs		The dog holds the tail tucked between the hind legs. The behaviour starts when the tail is moved into this position and ends when the tail is no longer held between the legs.
Bark	with handler	The dog produces a bark of any kind, fast and harsh sound where the mouth is opened, directed towards or occurring in relation to the handler or pupil. The behaviour starts when the bark begins and ends when the vocalisation stops.
	with pupil	
Growl	with handler	The dog produces low, muffled vocalisation, with the mouth closed or open and possibly together with showing teeth. The behaviour starts when the growling sound begins and ends when the sound stops.
	with pupil	
Whimper	with handler	The dog produces a whining vocalisation, which may be high- or low-pitched and may be brief or continuous. The behaviour starts when the vocalisation begins and ends when the sound stops.
	with pupil	
Snort	with handler	The dog produces a short, forceful nasal sound directed towards or occurring in relation to the handler or pupil. The behaviour starts when the snorting sound begins and ends when the sound stops.
	with pupil	
Cough		The dog shows a sudden, forceful expulsion of air from the respiratory tract producing an audible cough sound. Sneezing was included in this category. The behaviour starts when the cough or sneeze begins and ends when the sound or respiratory movement stops.
Stationary attentive	with handler	The dog remains stationary while visually attending to the handler or pupil. The dog may stand, sit or lie down, and the gaze may shift between individuals or follow their movements without maintaining sustained eye contact with one person. The behaviour starts when the dog becomes stationary and attentive towards the person and ends when the dog moves away,

	with pupil	redirects attention away from the person, or changes to another coded behaviour.
Lie on back	with handler	The dog lies on its back with the belly exposed and the front legs slightly bent, in relation to the handler or pupil. The behaviour starts when the dog rolls onto its back and ends when the dog changes position.
	with pupil	
Follow	with handler	The dog moves in the same direction as the handler or pupil while maintaining proximity, within approximately 0.5 m. The behaviour starts when the dog begins moving after or alongside the person and ends when the dog stops, changes direction, or no longer maintains proximity.
	with pupil	
Low body position		The dog lowers its body close to the ground with flexed limbs and a rounded back, reducing overall body height. The behaviour starts when the body is lowered into this position and ends when the dog returns to a normal posture or changes to another posture.
Out of view		The dog is fully outside the camera frame or more than 90% of the body is visually obstructed, preventing reliable observation of ongoing behaviour. The behaviour starts when the dog becomes unobservable and ends when the dog is visible again.

Note: 1. drinking behaviours coded as continuous behavioural sequences. The approach to and return from the target object were included in the same behavioural bout when they formed part of one continuous sequence. These approach and return movements were therefore not coded separately as walk away or contact seeking. 2. For continuous behaviours, frequency was recorded as the number of behavioural bouts. A continuous bout, such as tail wagging, scratching, whole-body shaking or whimpering, was coded as one occurrence regardless of the number of individual movements or sounds within the bout.

Coding rules

1. Eye contact and stationary attentive behaviour could not be coded simultaneously.
2. Eye contact directed toward the same individual was not coded simultaneously with execute command or does not execute command behaviours.
3. Lip licking occurring during ongoing exploratory behaviour was coded as part of the exploration.

4. Follow and contact seeking behaviours could include concurrent eye contact behaviours.

Observation period

1. **Start point**: the observation period began when the pupil entered the room. In cases where the entrance was not captured on video, the observation period began when the dog first initiated an approach toward the pupil.
2. **End point**: the observation period ended when the pupil exited the room.
3. **Maximum duration**: the maximum analysed video duration was 30 minutes.

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