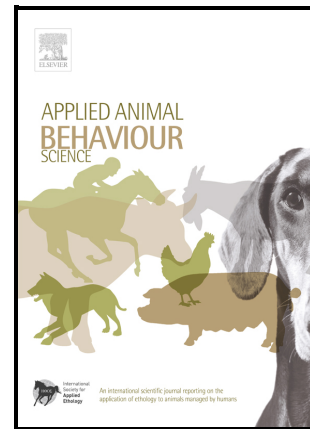


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**Human-dog communication: how body language and non-verbal cues are key to clarity in dog directed play, petting and hugging behaviour by humans**

Elizabeth Ann Walsh<sup>a</sup>, Lieve Lucia Meers<sup>b</sup>, William Ellery Samuels<sup>c</sup>, Dorian Boonen<sup>b</sup>, Anita Claus<sup>b</sup>, Carolina Duarte-Gan<sup>d</sup>, Vicky Stevens<sup>b</sup>, Laura Contalbrigo<sup>e</sup>, Simona Normando<sup>f\*</sup>

<sup>a</sup> Cork Pet Behaviour Centre, Cork, Ireland, walshelizabeth05@gmail.com

<sup>b</sup> BIAAT Foundation, Genk, Belgium, info@biaat.be

<sup>c</sup> Hunter College, School of Nursing, College of Staten Island, New York, USA,  
william.samuels@hunter.cuny.edu

<sup>d</sup> University of Jaén, Department of Psychology, Spain, duartecarolina@gmail.com

<sup>e</sup> National Reference Centre for Animal Assisted Interventions, Istituto Zooprofilattico Sperimentale delle Venezie, Padua, Italy, lcontalbrigo@izsvenezie.it

<sup>f</sup> University of Padua, Department of Comparative Biomedicine and Food Science, Padua, Italy, simona.normando@unipd.it

\*Corresponding author: Simona Normando > simona.normando@unipd.it simona@biaat.be

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**Abstract**

Clarity of communication between humans, intended to convey a message, may be misunderstood, or ambiguous, depending on many influencing variables, including impaired vision/hearing, neuro-divergence, culture, native language accent and gestures. Intraspecific communication in animals has been problematic to define in absolute terms, however, species such as dogs have a robustly researched and documented repertoire of behavioural body language, signalling and vocalizations. Humans tend to exhibit human communicative gestures of affection to their dogs, including hugging, touching, kissing and restraining them. Play is an essential element of the ontogenesis of any puppy/dog; however, it appears that intra and interspecies play in dogs differs in form, function and motivation. This study investigated, compared, and considered, the behaviours/communication which humans exhibit towards their dogs, and those exhibited by dogs towards their humans, during “play, petting and hugging behaviours”. Video-sharing platforms facilitate studying human-dog hugging, petting, and playing behaviour and comparing dogs' non-verbal communication with the comments “like/dislike clicks” of viewers. The current study was conducted on google, investigating media sharing platforms. Study (1) “play” reviewed the 30 most popular videos, and studies (2) “hugging” and (3) “petting”, reviewed the 80 most popular videos on media platforms. Our results showed that many human behaviours may be concerning as humans tend not to necessarily understand the body language or vocalizations shown by dogs, when interacting with them. A high number of stress behaviours were observed in the dogs involved which may have occurred due to misunderstanding of the information a dog is communicating during human-dog play, petting and hugging behaviour. This can cause feelings of discomfort, anxiety, fear, distress, and confusion in a dog, which may result in a fractured human/dog bond, welfare issues for the dog, and the possibility of a dog escalating to exhibit defensive/agonistic behaviour should communication fail. The high prevalence of videos in

which stress-related behaviours were identified was concerning, although the expression of a specific behaviour may sometimes depend on the kind of interaction and/or other characteristics of the dyad engaging in it. We advocate for increased education for both adults and children in canine communication, context and in co-operative ways of respecting agency in human-dog interactions.

## **1. Introduction**

### **1.1. Human-human communication**

Communication between humans can be both intentional and unintentional, and may use both, verbal and non-verbal signals. Many factors may influence how messages are understood and perceived (Jones, 1998) including impaired vision/hearing, learning difficulties (Badcock & Sakellariou, 2022), neuro-divergence (Howard & Sedgewick, 2021), culture (DeVito, 2016), native/sign language, accents/customs/gestures/context (Schapper, 1998). Thus, human-human communication may not be clear, causing misunderstandings, even insults/antipathy.

Humans tend to demonstrate affection through touching/hugging/rubbing/kissing/leaning-into/gestures and eye-contact. Hugging is considered to be a human greeting behaviour, described as indicating friendliness, with the form the hugging takes, embracing, body pressing, kissing, defining close or intimate relationships (Forsell & Åström, 2012). Hugging may include intense eye contact and caressing. This kind of communication comprises various sequences of body movements, which in addition to verbal communication, express intentions and convey, often subtle, information.

Even among humans, some forms of communication/touch between adults require consent; misunderstandings may cause offence/hurt/anger within a relationship (Anyadike-Danes et al. 2023).

A more perfunctory hug might be exchanged, between e.g., politicians as a symbolic gesture (Forsell & Åström, 2012). Gift giving between humans, can take various forms, and for varying motivations, however, relational gifting is indicative of a relationship, (Davies et al. 2010). Humans tend to make videos/photos/selfies (Sun, 2017) of family, friends, and pets, often uploading video and photos to social media platforms to share.

#### **1.1.1. Canine-canine communication**

Defining intraspecific communication in absolute terms has been problematic, Goodenough et al. (1993) suggest a broad definition may be “a transfer of information by a signal that evolved for the purpose, which modifies the recipient’s actions”.

Animals have evolved species-specific communication systems, with clear signalling, which convey information between conspecifics, with recognisable effects on the other’s behaviour. Interspecific communication also occurs, of course. Dogs have a relatively large repertoire of behaviour (Abrantes, 1997, Csányi, 2006, Krauss & Maue, 2022, Miklósi, 2007), inheriting their communication systems from wolves as they existed behaviourally and morphologically, when divergence occurred. Canine communication entails the use of ears, face, muzzle, teeth, body, coat, paws, and tail, all in addition to odours, all in combination with vocalisations (Lord et al. 2009). However, misunderstandings can occur between puppies/dogs of differing breeds due to morphological differences which have challenged some breeds’ ability to signal clearly.

Canine-communication has recognised structures and intentional behaviours (Horowitz, 2009). Dogs exhibit pawing, sniffing, licking, muzzle/scruff-mouthing, running, barking, play-

fighting, mounting, object-play, chasing, wrestling, and play-jumping. Importantly, these behaviours may be punctuated by “play-bows”, observed in various contexts, including prior to engaging in play and during play, acknowledging intent. Thus, communicative signalling, causes one dog’s behaviour to be influenced by another (Shettleworth, 1998), in a non-ambiguous manner.

Communication plays a role in nurturing bonds, and a key role in avoiding overt aggression. The “ladder-of-aggression” (Shepherd, 2002) describes least overt, “calming signals” to overt aggression, which may escalate in intensity and threat if initial signals are ignored. Calming signals or appeasement behaviours (Mariti et al. 2014,2017, Rugaas, 2006, Shepherd, 2002), recognised as indicators of stress include: turning head away, blinking, lip/nose licking, freezing, play-bow, yawning, licking human, ears back, panting, biting, staring, lying down, growling and barking. Mariti et al. (2017) found a higher incidence of calming signals between unfamiliar dogs, and de-escalation of aggressive behaviour in response to calming signals. Additionally, Mariti et al. (2012) found that an owner’s ability to recognise stress in their dogs varied dependent on multiple factors.

### **1.1.2. Human-canine communication**

Humans exhibit affectionate behaviours towards their dogs, and may hug/hold/carry them, restrain them on their lap, play/tease them with food/toys, kiss them on the nose/muzzle/face or stare/gaze at their eyes (Dwyer et al., 2006; Reisner, 2003). As with human families and friends, they tend to treat them relationally, including them in family photos/videos/selfies.

Some physical interactions that humans enjoy when communicating/interacting with dogs may not always be perceived as pleasant by dogs, such as behaviour associated with physical

closeness/proximity or intimacy. When dogs put their paws on another dog (analogous with human behaviours towards hugging/petting/playing), it may intimidate, causing deference, however, it should be interpreted congruent with other simultaneous physical interactions and body language, and with the preceding behaviours. It does not indicate affection/desire for social contact/hugging; nor is licking a human's mouth an indication of love/kissing (Cavali et al. 2020, Overall, 2013).

Kuhne et al. (2014) investigated emotional states in dogs who were being petted on different body parts, by both familiar and unfamiliar people. They found that petting a dog on its paw, back, using a hand to cover its muzzle and holding the dog on the ground or by the collar may risk the human-animal bond. Additionally, emotional state (measured by heart rate variability) differed depending on whether a familiar or unfamiliar person petted the dog.

Canine body language that is often perceived as amusing by humans includes: yawning and lip-smacking, which are recognized as calming signals and have been observed in research when assessing animal welfare (Palestrini et al., 2010). Non-verbal communication is a channel of interaction that humans and animals share, human body language occurring often on a subconscious level.

### **1.1.3. Play behaviour in animals, focusing on canines.**

Play inherited proclivity, is distinguished by a combination of traits. It is typically considered to be voluntary, pleasurable, distinct from other behaviour, and of a make-believe quality (Bekoff & Byers, 1981; Bekoff, 1984; Bekoff & Allen, 1998; Fagan and George, 1977; Norbeck, 1974). Many definitions of play suggest that the goals of play are non-utilitarian (Bekoff &

Byers, 1981). As benefits may be instantaneous or a future investment, there is a distinction between immediate, unconscious, or subconscious goals.

Play is believed to form a part of behavioural ontogeny (Beckoff & Byers, 1981) and appears to be essential to the development of many young animals. Function may differ dependent on species/age/sex and has been shown to provide necessary exercise in young animals (Fagan & George, 1977) and to confer physiological advantages; as bones/muscle strengthen, cardiopulmonary capacity and efficient movement increase (Beckoff & Allen, 1998). During play, animals engage motor patterns that may be used in other contexts, such as, predatory/defensive/agonistic/courting/mating behaviour (Landsberg & Denenberg, 2014), developing motor-skills, enhancing problem-solving skills, building social cohesion, co-operation, interactive use of motor and perceptual skills; hypothesised as learning or practising skills requisite for adult survival. Play may be modified by learning experience involving both inter/intra species (Beckoff & Byers, 1981). Normal motor patterns will develop within young animals without play; however, play enhances skill and proficiency.

Observed across species including humans, dogs, parrots, primates, equines and even bees (Samadi et al., 2022), across age categories from neonates to elderly, play features prominently in a puppy's ethogram and is observed in adult and elderly dogs, occurring socially, intra/interspecifically, and non-socially with objects/toys (Hall, 1998).

Adult play may appear superfluous but has been theorized as possibly enhancing skill proficiency. Role playing or fun interactions observed in "cared for dogs" may burn energy and satisfy an inherent breed specific motivation and is considered an indication of positive

welfare. Additionally, it may arise from behavioural neoteny which varies across breeds (Landsberg & Denenberg, 2014).

Some studies suggest that a single conceptual framework can be applied to both canine intraspecific and dog–human play interactions; others suggest that dog–human play may compensate for a deficiency in intraspecific play, as dog–human play exhibits the same behavioural patterns. Yet, others suggest that intraspecific social play may be structurally different from interspecific play (Aldis, 2013; Loizos, 2017).

Rooney et al. (2000) showed that having opportunities to engage in intraspecific play does not reduce or satisfy the motivation for dog-human play; the structure of dog–human object-oriented play differs to its intraspecific counterpart, specifically the motivation to possess an object and to interact with the partner differ, indicating that these play types are not homogeneous. Dogs' playfulness, in social contexts, may have been selected during domestication as an adaptive trait to facilitate the formation of emotionally based bonds between dog and owner (Rooney et al., 2000). Play frequency and form may indicate the quality of dog-owner relationships.

However, during human-dog play many interpretations of the implicit functions of specific elements of play behaviour, may be misinterpreted by humans and dogs. The aim of this study was to investigate, compare and consider, the behaviours/communication which humans exhibit towards their dogs, and those exhibited by dogs towards their humans, during “play, petting and hugging behaviours.”

## **2. Data treatment and Statistical analyses**

Study (1) “play” reviewed the thirty most popular videos during the research period, and studies (2) “hugging” and (3) “petting”, reviewed the 80 most popular videos during the research period. The origin of the data and videos are described in Table 1. The popularity of a video was indicated by the number of likes that the video received. The viewers indicated their appreciation of a video, which showed behaviour, at a point in time. It is unknown what transpired prior to or post the video recording. The videos were all close up, and it was the exception when the humans were not visible.

The data were coded by three individuals independently, according to a priori criteria, derived from a working ethogram of canine calming signals and behaviour (Table 2). Any outliers were discussed, and agreements reached.

The presence of each of the investigated behavioural patterns were dummy coded to indicate their presence ever or never within a given video. The presence of humans of various ages were also dummy coded; age categories were adult (19+yrs), teenager/child (4-18yrs and infant/toddler (0-3yrs). Human gender was as identified by the researcher. Age of the person interacting with the dog was either gained from the video or its description when available or estimated by the researcher on the basis of the appearance. It was not always possible to identify whether a child/infant was male or female. As the behaviours coded were from short fragments of behavioural sequences, this pilot study is investigating only that behaviour shown, in those fragments, which elicited positive reaction from viewers.

After descriptive statistics, we conducted Pearson's chi-squared test (with Yates' continuity correction when needed), and Fisher's exact test, with odds ratios.

We also conducted Fisher's exact test to investigate whether the number of videos in which the most shown behaviour was recorded differed among studies.

The possible link between the studied independent variables on the number of views the video had had, and its length were investigated by analyses of variance.

The inferential statistical analyses were run using R version 4.3.2. and significance was set as 0.05.

### **3. Results**

The behaviour recorded in most videos was “blinking” (present in 126/190 videos), which was shown in significantly fewer “play” videos (3/30) than in “hugging” (64/80) and “petting” (59/80) ones (both  $ps < .001$ ).

Table 3, describes the human-dog and dog-human behaviours observed in hugging, petting and play videos.

#### **3.1. Study 1. Descriptive results “play”**

The selected videos showed play behaviour between 20 adults, 8 teenagers/children, and 2 infants/toddlers, of which there were 16 males and 14 females. The dogs that were involved in the play interaction (25 adult dogs, 5 puppies) can be categorized into small dogs under 30 cm, of which there were 11, dogs between 30-45cm, of which there were 4, and finally 15 big dogs of more than 45cm.

Continuous observation showed that the most frequently shown human play behaviours targeting dogs, included: touching or stroking the dogs' back/body with their hand seen in 60% of the videos, leaning into or standing over the dog was seen in 53.33% of the videos, smiling or showing their teeth to dogs, as seen in 50% of the videos, and placing their face against the dog's face which was observed in 33.33%. Furthermore, we observed; grabbing or squeezing the dog's throat with a hand in 43.33% of the videos, luring the dog with a toy or

treat in 33.33%, directing hand gestures towards the dog in 26.67% of the videos, and in one video an infant/toddler was observed to bite and suckle the dog's head.

The most frequently shown dog behaviours during play were panting in 60% of the videos, ears back in 53.33%, turning their head or looking away in 50%, licking their nose or lip in 13.33%, biting their human playmate in 13.33% of the videos, and licking their humans face or mouth in 10% of the videos. In 46.67% of the video's the dog's tail was not visible which highlights whether owners are attending to the non-verbal communication that dogs exhibit with their tail movement and/or their entire body. In 20% of video's that showed dogs' tails, the tail was immobile during the video fragment, and in another 20% a wide high tail movement was observed. Only one dog exhibited a play bow.

The percentage of videos in which dogs were seen with ears back significantly differed depending on the age category of the person the dog was interacting with (adult, teenager/child, infant/toddler;  $P=.046$ ; Table 4), but, due to the Bonferroni correction, the pairwise comparisons did not manage to pinpoint any significant differences.

Table 4, describes the differences in dogs' behaviour linked to the age-category of the person interacting with them.

Men were found to hold a dog's legs in more videos than women ( $p = .045$ )

### **3.1.1. Study 2- Descriptive results "hugging"**

The selected videos showed hugging behaviour between 49 adults, 19 teenagers/children, and 12 infants/toddlers, of which there were 34 males, and 46 females (49 adults, 19 children/teens, 12 infants/toddlers). The dogs that were hugged (74 adult dogs, 6 puppies)

were again categorized into small dogs under 30 cm, of which there were 18, dogs between 30-45cm, of which there were 19, and finally 43 big dogs of more than 45cm.

Continuous observation showed that the most frequently shown dog directed, human hugging behaviours included: touching with hands (98.75%), embracing (91.25%), placing face next to animal's face (58.75%), catching dog's throat (26.25%), kissing (25%), staring 25.75 and carrying 17.5%.

Approximately 30% of videos that were linked to the search term "hugging" showed dogs clenching their paws around their human partner or jumping against them with their paws on the body and shoulders of the human partner, as the dog was being held in human arms. Furthermore, there were videos in which dogs showed calming behaviours as a response to being taken into human arms. For instance, 68.25% turned their head away from the hugger, 43.75% licked their lip or nose, 21.25% licked the human who was hugging them, 81.25% were observed blinking, 60% had ears flattened and 42.5% were panting. In 13% of the videos the dogs were heard barking, and in 67.5% of videos the dog showed biting behaviour to the human hugging them.

The percentage of videos in which dogs were seen licking the person with whom they were interacting significantly differed depending on the age category of the person (adult, teenager/child, infant/toddler; ( $p = .049$ , Table 4), but, due to the Bonferroni correction, the pairwise comparisons did not manage to pinpoint any significant differences.

### **3.1.2. Study 3 – Descriptive results "petting"**

The selected videos showed petting behaviour between 58 adults, 20 teenagers/children, and 4 infants/toddlers, of which there were 32 males, and 42 females, 6 unidentified. The dogs that were petted (66 adult dogs, 14 puppies) were again categorized into small dogs under 30

cm, of which there were 29, dogs between 30-45cm, of which there were 16, and finally 35 big dogs of more than 45cm.

Continuous observation showed that the most frequently shown human petting behaviours included: leaning into/over the animal (53.33%), touching (53.33%), and smiling/with teeth (50%). 33.33% of human behaviour included: staring, placing face to dog's face, and offering food/object. Additionally, hand gestures featured in 26.67% videos, embracing in 20%, holding animal's legs (16.67%), and lips on head/body. Least frequently observed were carrying, lifting by legs, and pulling skin (3.33%).

Videos that were linked to the search term petting showed that the most frequent dog behaviours included: blinking (73.95%), looking away (65%), flattening ears (48.75%), and panting (38.75%). 36.25% of animals licked their nose/lip, 11.25% licked the human, 11.25% stared, 5% were observed to bite, 3.75% barked, 3.75% growled, and 3.75% yawned. In 51.25% of videos, the dog's tail was not videoed.

The percentage of videos in which dogs were seen licking the person with whom they were interacting significantly differed depending on the age of the person (adult, teenager/child, infant; ( $p = .007$ ; Table 4), but due to the Bonferroni correction, the pairwise comparisons did not manage to pinpoint any significant differences. The same was true for dogs staring at the person ( $p = .002$ ; Table 4).

Puppies were found to pant in statistically less videos than adult dogs ( $p = .007$ ). People were found to have body contact in more videos with puppies than with adult dogs,  $p = .045$ . Dogs were found to lie down more in more videos recorded indoors than outdoors ( $p = .006$ ).

The number of total views of the videos was significantly different depending on the age-class of the person petting the dog ( $p = .014$ ). The mean number of views for adult handlers was 261,802, for child/teem handlers it was 1,066,685, and for infants 437,4333.

The length of the video footage significantly differed depending on the gender and age-class of the person petting the dog (both  $ps < .001$ ). Video portraying women lasted a mean of 21.05 seconds, men 16.00, and those in which the person was not seen/identifiable 56.83. Videos portraying adults lasted a mean of 19.6 seconds, teenagers/children 15.5 and infants 80.25.

#### **4. Discussion**

Our pilot studies show many causes for concern as humans tend not to necessarily understand the body language or vocalizations exhibited by dogs, when interacting with them. One of the main functions of human-dog play is creating and strengthening the bond between species, however our results revealed a high number of stress behaviours or calming signals (Mariti et al. 2014, 2017, Rugaas, 2006) observed in the dogs involved which may have occurred due to misunderstanding of the information a dog communicates during human-dog play, petting and hugging behaviour. Mariti et al. (2017), identified higher incidence of calming signals among unfamiliar dogs. In this pilot study, the relationship of the human to the dog was unknown, however, it may be more likely that dogs and humans were familiar to each other, and possible that lack of understanding of the dogs' behaviour may have caused an escalation of the exhibition of calming and stress signals, evidence of altered emotional state, to familiar people. Lack of comprehension of canine behaviour by humans can cause feelings of discomfort, anxiety, fear, distress, and confusion in a dog, which may result in a fractured human/dog bond, welfare and possible behavioural issues for the dog, causes a lack of ability in the owner to act appropriately (Horowitz, 2009a, Mariti et al, 2012), and the possibility of

a dog reacting defensively when communication fails. The high prevalence of videos in which stress-related behaviours were detected supports this view, although the expression of a specific behaviour may sometimes depend on the kind of interaction and/or other characteristics of the dyad engaging in it. The relationship between humans and dogs was unknown, as were the demographics of the human population.

One aspect of the human-dog relationship which has been argued is that it is adaptive for dogs to recognise human emotional faces, and to learn to discriminate between human facial expressions of emotion (Müller et al. 2015, Nagasawa et al. 2011), which may be dependent on experience and quality of the human-dog relationship (Barber, et al. 2015), eye and mouth areas show the shortest latency to fixate the gaze. Additionally, evidence has emerged from awake fMRI studies in dogs which indicate that an area sensitive to the processing of faces exists in the temporal cortex of dogs (Dilks et al. 2015). However, all of these studies agree that an angry/frowning emotional facial expression causes aversion in dogs. The emotional expression should be congruent with the actions or behaviour of the human, as learning will occur, associating a behaviour with a facial expression. Further evidence is shown by Lazzaroni et al. (2023), who investigated whether village dogs could understand human facial expression as pet dogs have been found to do. The finding was positive, it is suggested that village dogs need to develop awareness of human communication to survive, and that this is adaptive. However, of equal importance is that dog communication signaling needs to be recognized and correctly interpreted by humans. Dogs will avoid overt aggression, if possible (Shepherd, 2002), however, in the scenario when their expressions of behaviour have been ignored, they may be forced to escalate defensive behaviour.

Hugging is a typical human behaviour, and often difficult to read or understand by dogs. Therefore, they may respond to it with calming signals or fear and stress related behavior, as our study found; unfortunately these behaviors may often be perceived as positive or amusing behaviours by humans who may not, or who do not appear to understand the real meaning of these behaviours which is in fact the silent request of the dog to cease what they are doing because it frightens, confuses or causes them conflict. Our findings showed positive results for many behaviours, recognized to be indicative of stress (Palestrini et al. 2010). Additionally, the human handler did not appear to recognize or to relate to these signals.

Play behaviour in dogs has been shown to confer physiological advantage, developing skills, behaviours and exercising. However, our study found human-dog directed play behaviours including pulling skin/hind legs, lifting by the legs, holding the legs, and holding the head, which do not fit into an ethological framework of constructive dog play behaviour. Such human-dog behaviours may not only cause stress to dogs, cause negative emotional state, but also deprive them of constructive play which is beneficial to their species. Additionally, if play is indeed ontogenetic, such instances of human-dog play may hinder the development of healthy and appropriate-play behaviour. Specifically, Kuhne et al. (2014) have found some forms of petting to cause risk to the human-animal relationship, including holding/touching paws, and holding the muzzle. Approximately one third of videos showed luring with a toy or treat, which may be useful to position/lead an animal through a sequence of movement (Paredes-Ramos et al. 2020).

All three categories of video revealed some dogs/puppies barking and or growling and/or biting. This is very concerning, as these very clear signals do not appear to be recognized, risking the welfare of both human and dog. As fragments were short, and captured fragments

of a sequence of behaviour, it is not possible to ascertain what occurred prior to the fragment, or what the handlers did when behavioural interaction was inappropriate, such as biting. Context can influence aggression and bite (Westgarth & Watkins, 2015). Play biting can occur in puppies, however, it should be discouraged, and the behaviour transferred onto something suitable, such as a toy. Play biting can continue into adulthood, if not addressed, however more than one behaviour tended to be present when interactions occurred, so a brief sequence of behaviours.

Adult dogs were found to pant more than puppies, indicating stress, suggesting dogs may become sensitized to stress; these dogs have learned that the experience will be aversive and thus anticipate a poor experience. Alternately, as a short fragment of video provided a window into a moment of time, it was unclear whether other factors could influence the level of panting, such as climate, intensity of play, or underlying health conditions. Similarly, when blinking was observed, intensity of play could not be estimated as fragments were too short, thus the development, and duration were unknown. Observing blinking behaviour required intense analysis. However, co-occurrence of signals were considered for each signal observed, and blinking for example was never presented alone, but was associated with other body postures indicative of stress.

In petting videos teenager/child handlers were viewed the most, over twice as often as the next most-viewed category (infant/toddler), and about five times as often as those with adult handlers. The popularity of such videos demonstrates that education and communication awareness is requisite for this category of handler, and for the audience watching such videos.

Increased body contact with puppies may be indicative of being carried, or/and the extra attention which neotenised morphological characteristics (Coppinger & Coppinger, 2001, Fox, 1976) attract. Dog licking human behaviour may indicate stress/concern/anxiety. Our study found that it appears that adults may be less threatening than teenagers/children, and both adults and teenagers/children more threatening than infants/toddlers. This finding, although requiring further investigation, prompts cause for concern, as children present significantly in dog-bite statistics (Messam et al. 2018, Overall & Love, 2001, Oxley et al. 2018, Reisner et al. 2007). Both Reisner et al. and Overall & Love, suggest that the unpredictable nature of children, loud voices/screaming and lack of inhibition may be a risk factor. Additionally, an adult's presence may not be a guarantee of safety (Reisner et al. 2007). Reisner et al. found in their study, 81% of dogs had bitten previously and all dogs had either a behavioural or medical issue. Prior to dog-bite, behaviours in familiar children included: petting, hugging, kissing, stepping on, pulling on, hitting, cutting nails, interfering with resting dog, and approaching while dog was eating; petting, reaching, and restraining were included in behaviours of non-familiar children. Kuhne et al. (2014) suggested that these types of behaviour toward dogs altered emotional state and risked the human-animal bond.

In our study males were found to hold (restrain) a dog's legs more than women. Importantly, most dog-bites occur with family dogs, children are most likely to be bitten, and males of all age groups have the highest incidence of dog bite (Overall & Love. 2001). Westgarth & Watkins (2015) suggest that dog-owners might need to believe that dog bite can happen to them, with their dog, that it may be significant, as familiar dogs tended to be excused and may not be included in dog-bite statistics (Overall & Love, 2001). Although Mariti et al. (2012) and Kuhne, (2016) advocate education, it may in itself not prevent dog-bite (Westgarth & Watkins, 2015). However, in a study involving veterinary students' interpretation of a safe proximity to

simulated “aggressive” and “non-reactive” dogs, it was found that training increased recognition of dog behavioural signals (Oxley et al. 2024). Conversely, Messam et al. (2018), found that factors unrelated to the child such as husbandry practices may affect the bite risk in homes.

The importance of early and extensive socialization cannot be over emphasized, as puppies and dogs need to learn about every aspect of the environment in which they will be expected to live in and cope with, and about the range of communication which may be exhibited by human adults, teenagers/children, infants/toddlers. Conversely, humans, adults, teenagers, and children need to learn and be able to recognize dog communication, and to also have respect for the dog’s own space, need for fair and kind handling, and safe, effective training based on positive reinforcement. Infants/toddlers and children should always be supervised when with dogs, or the dog should be in a safe area (Walsh,2023).

## **5. Conclusion**

Miscommunication arises in human-dog relationships, creating risks to the welfare of both, and negatively affecting the human-dog bond. Our studies show a lack of awareness of the meaning or interpretation of canine signaling and communicative behaviours. Poor socialisation, inappropriate handling, and inappropriate exposure to people, may negatively affect a dog’s ability to learn human communication. Additionally, humans need to understand and recognise communication exhibited by their dogs, to respect it, respond appropriately and to respect agency in human-dog interactions. Children are most at risk from dog-bite in their home, and all factors need to be considered in context. We therefore advocate for increased owner education in canine communication, particularly in socialization of puppies to many people, and canine education programs in schools for children of all ages.

It is vital for dog owners to understand the circumstances which may elevate the risk of dog bite and to control for them. The videos analyzed were fragments of interaction, however, they received the highest amounts of “likes” during a period of the study, indicating that the behaviours portrayed were considered as popular, and the concerning aspects of them did not appear to be recognized. We consider it of high importance to research and hope to publish more studies in this area of human-dog interaction, to improve the welfare of dogs, to enhance their interactions with humans, and to foster and facilitate robust human/dog bonds.

## **6. Limitations**

This research had a number of limitations.

The numbers of videos coded differed between the three groups, future investigation should have equal data for each group.

The way in which the data were coded prevented us from gathering more fine-grained scores of the videos, such as the length of time humans tried to interact, and their response to stress signals. As the videos were short fragments, of a point in time, only that section was visible, therefore in some situations such as bite, videos usually stopped, and the human response was unclear. Additionally, it was not possible to ascertain the dog-human relationship in the videos, or any influence. However, as these videos were uploaded to media platforms, it is likely that they had been perceived as portraying ‘normal’ or ‘cute’ puppy and dog behaviour.

Non standardised videos were used as this provided a window of observation into popular rating of ‘liked’ video which may not have been ‘liked’ or popular if the observers were competent to understand dog behaviour. Information regarding the dogs participating in the videos such as breed, training, health, or the person interacting with it was not available, thus

these influences were unknown. Additionally, it was not possible to gather demographic information on the owners/people in the videos.

Many of the limitations arose from time constraints that constrained the granularity and number of factors that could be recorded. How the videos were selected, and thus their generalizability, is also an important limitation

We hope to address these limitations further in subsequent work, possibly through videoing people in more controlled circumstances, including adolescent and adult members of the same family.

Ethical approval was not required.

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## Tables

Table 1. Excel file of videos

Table 2. Working Ethogram

Table 3. Human-dog and dog-human behaviours observed in hugging, petting and play videos

Table 4. Differences in dogs' behaviour linked to the age-category of the person interacting with them

Table 1: Summary of the main characteristics of the videos (please, see supplementary table 1 for further details)

Search	Main channel (and n videos from it)	Videos' length (mean $\pm$ SD, sec.)	N° videos with a puppy	N° of videos with adult people interacting	Main gender of the person interacting (and n videos)	Main location (and n videos)	Total number of videos
Hugging	istockphoto (25)	21 $\pm$ 25	74	49	Female (46)	Indoor (45)	80
Petting	storyblocks (13)	22 $\pm$ 27	66	58	Female (42)	Indoor (48)	80
Playing	istockphoto (11)	20 $\pm$ 11	25	20	Male (16)	Outdoor (21)	30

**Table 2: Working Ethogram**

Behaviour	Definition and notes	Reference
Bark	Loud and/or repetitive barking (characteristic for dogs) directed towards a human. A “bark” is defined as a vocalization that is always abrupt in onset and short in duration. It may exhibit both tonality and noise in some degree, is relatively high-pitched, subject to frequency modulation, relatively loud, and subject to rapid repetition. (A bark may be directed at other stimuli within the environment also)	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015. Lord K., Feinstein M., Coppinger R., 2009. Barking and mobbing. <i>Behavioural Processes</i> 81, 358–368.
Bite	Taking any part of a human's body between the jaws and teeth with pressure sufficient to cause harm to the recipient	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Blinking	Eyelid opening/closing (slow, moderate, rapid)	Adapted from Pedretti et al., 2022
Dog toy/take object	Taking object or bone that is in possession of the recipient	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Dog kept on back/forced down	Human applying sufficient physical force to force a dog, partially or completely to the ground; force may be applied using a push/tackle, body slam or some other movement	Adapted from Bauer & Smuts, 2007

Ears back/flattened	Ears folded against sides and/or back of head and having a flattened appearance	Protopopova et al., 2014
Eat treat	Dog eats treat (given to him)	Horowitz, 2009
Freeze	General rigidity of the body, with exception of the tail, without staring towards the recipient	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Growl	Low-pitched rumbling, fairly monosyllabic vocalization from the dog's throat	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Immobile tail	The tail of the dog is stiff and does not move in relation to the rest of the body	Tami & Gallagher, 2009
Jump/Push/Tackle	Dog propels it's body upwards rapidly, causing it to stand on its hind legs, and places one or both front paws on the recipient with forceful contact; forelimbs may or may not be wrapped around the others body in a tackle grasp	Adapted from Bauer & Smuts, 2007
Licking human	Licking directed to the recipient's face/mouth corners, or other human body part. In licking the distal upper part of tongue is put in contact and passed, often repeatedly, over something	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Licking nose/lip/mouth	Dog licking over own mouth/lips and/or nose. In licking the distal upper part of tongue is put in contact and passed, often repeatedly, over something	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Looking away	Turning only the head away from the human, while remaining without moving	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Lying down	Posture in which the body of the dog is in contact with the ground due to flexion of both fore and hind legs, with forelimbs either tucked under or placed in front of body	Protopopova et al., 2014
No tail filmed	Tail undetermined, out of view	
Panting	Dog breathing with increased rapidity with open mouth	Adapted from Kuhne, 2016
Paw /paw lift	Dog lifts right, left, or both fore-paws in the air or touches a hand with a forepaw	Adapted from Kuhne, 2016
Paw on arm	Placing one or both forepaws on the human's arm	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Play bow	Dog crouches down touching (or almost touching) forelimbs to the ground with rear end high in the air,	Horowitz, 2009 and Bauer & Smuts, 2007

	orientation is directed towards play partner	
Rubbing/Grooming	Dog is cleaning its body surface by licking, nibbling, picking, rubbing, scratching, etc	Rehn and Keeling, 2011
Run away/Flee	Moving rapidly, at a fast gait away from a human to a distance of 3 meters or more, with head oriented in opposite direction to the human	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Run towards/Approach	Either an accelerated rapid gait or a moderate paced gait towards a human, to within a distance of 1 metre or less	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Body shake	Dog shakes any part of or whole body from side to side rapidly. Shaking involves a partial rotation along the longitudinal axis of the dog's body, in a standing position, or may be sitting if shaking the head	Adapted from Rehn and Keeling, 2011
Short wag (L/R)	Dog is wagging its tail, moving it within a restricted width in contrast to a usual tail wag	Rehn and Keeling, 2011
Sit	Dog's hind is in contact with the ground, forelegs are extended vertically beneath	Adapted from Roth and Jensen, 2015
Sneeze	Involuntary sudden explosive expulsion of air through the nose	Adapted from Flint et al., 2018 and Pfaller-Sadovsky et al., 2023
Stare	Intense fixating look towards human, tensed body, for a minimum duration of 2 seconds.	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Struggle	Attempt to escape restraint of a human hand	McGreevy et al. 2012
Tail wagging	Non accelerated, regular sideward movements of the tail, at a height natural to the dog's body	Adapted from Zimen and van Hooff and Wensing in van der Borg et al., 2015
Yawn	Involuntarily opening mouth wide, while inhaling and exhaling	Adapted from Protopopova et al., 2014

**Table 3. Human-dog and dog-human behaviours observed in hugging, petting and play videos**

Initiator/ recipient	Behaviour	Hugging	Playing	Petting

## Human to dog

Stare	+	+	+
Stroke			+
Embrace	+	+	+
Carry	+	+	+
Face against muzzle	+	+	+
Grab/touch throat	+	+	+
Pat			+
Push		+	+
Touch head		+	+
Kiss	+		+
Touch paw	+		
Pull skin		+	
Pull hind lag		+	
Lift by legs		+	
Lift body		+	
Hold legs		+	
Smile/show teeth		+	
Body contact		+	
Touch body		+	

Hold head		+	
Open arms		+	
Hand gestures		+	
Dancing		+	
Hold dog		+	
straight			
Food/object		+	
treat			
Press down		+	
Dog to human			
Look away	+	+	+
Lick nose/lips	+	+	+
Lick human	+	+	+
Ears back	+	+	+
Blink	+	+	+
Pant	+	+	+
Yawn		+	+
Bite	+	+	+
Stare			+
Lie down			+
Pawing			+
Shake paw			+
Bark			+

Growl		+
Touch paw	+	
Struggle	+	
Run toward human	+	
Run away from Human	+	
Wag tail broadly	+	
Wag tail tightly	+	
Tail wag to right	+	
Tail wag to left	+	
Tail immobile	+	
No tail visible	+	+
Toy in mouth	+	
Sit	+	
Eat treat	+	
Freezing	+	
Trembling	+	
Play bow	+	
Sneeze	+	

	Jumping	+
Other		
	Dressed up	+

**Table 4: Differences in dogs' behaviour linked to the age-category of the person interacting with them.**

People age class	N°	N°	N°	N°	N°	N°	N°	N°
	play	play	hug	hug	pet	pet	pet	pet
	videos	videos	videos	videos	videos	videos	video	videos
	dog	dog	dog	dog	dog	dog	dog	dog
	with	without	licked	did	licked	did	stared	did
	ears	ears		not		not		not
	back	back		lick		lick		stare
Adults	8	12	10	39	3	55	7	51
Teenagers/ children	7	1	7	12	4	14	0	18
Infants/ toddlers	1	1	0	12	2	2	2	2

#### CRediT authorship contribution statement

EW, LM, WES, DB, AC, CD, VS, LC and SN designed and conducted the study

EW, SN and LM wrote the paper

EW, SN, WES, LM, DB, AC contributed substantially to data analysis

EW, LM, WES, DB, AC, CD, VS, LC and SN contributed to critical review of the manuscript.

### 1. Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

### Highlights

- Human-dog communication may lack clarity and understanding for both species
- Human-dog hugging/petting/playing behaviour can effect canine ontogeny negatively
- Online video showed high incidence of stress and agonistic behaviour in dogs
- Targeted dog behavioural education for children/adults is vital to prevent dog bite
- Education can improve dog and human welfare creating stable enduring human-dog bonds