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The relationship between functional breed selection and attachment pattern in family dogs (*canis familiaris*)

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ABSTRACT

Adult dogs show similar behaviour pattern towards their owners as human infants towards their caregivers among experimental conditions, where the attachment behaviour is activated because of the moderately stressful situation. Meanwhile the capacity to form attachment towards the owner is considered as part of the domestication history of dogs, in more recent times dogs were selected for often very different work-related behavioural phenotypes. For instance, 'cooperative' dog breeds, like shepherd dogs, typically work in visual contact with the handler, while the 'independent' breeds, such as the hounds or sled dogs, work independently. We investigated whether cooperative and non-cooperative working dogs would also show different patterns in their attachment behaviour. We tested independent (N = 29) and cooperative (N = 28) dogs from various working breeds in the Strange Situation Test. To describe the subjects' behaviour, we used a scoring system with three main factors (Attachment, Acceptance, Anxiety). We did not find any significant between-group difference in the attachment pattern of the two main working dog types (Attachment: P = 0.499; Anxiety P = 0.200; Acceptance P = 0.339). Within-breed differences may be stronger than between-breed differences in this situation, while it is also possible that owners of different breeds handle their dogs differently. Our results support the theory that attachment to the owner is a fundamentally similar feature in socialized dogs, and subsequent functional breed selection may rather influence the more specific behavioural phenotypes of dogs.

1. Introduction

Although the exact mechanism is still debated (for various theories see Udell et al., 2010; Miklósi and Topál, 2013; Pörtl and Jung, 2019), it is widely accepted that because of their domestication dogs (*Canis familiaris*) became genetically predisposed for the successful integration to the anthropogenic niche by establishing stable social groups with humans (Miklósi, 2015). The specific dog-human bonding was not scientifically investigated until Topál et al. (1998) described it in the framework of the attachment theory. Using the modified version of the Strange Situation Test (SST) what was borrowed from human attachment literature (Ainsworth and Wittig, 1969), it was found that adult dogs show functionally analogous behaviour towards their owner as human infants do towards their caregivers. The core principle of the SST is that the subject is exposed to a moderate level of stress that activates the attachment system, which results in the observable behavioural features. The stress is caused by the unfamiliar place, the presence of a stranger and the separation from the caregiver. Based on a number of behavioural variables, after the combination of a factor and a cluster analysis the dogs' behaviour was described along three main continuums during the tests (Topál et al., 1998): (1) Attachment: contact seeking towards the owner and exploration/play while he/she is present, and sensitivity to his/her absence; (2) Anxiety: intensity of the evoked stress related to the strange place (not the separation) during the test; and (3) Acceptance: tendency to initiate/accept interaction with the stranger.

Several other studies followed the original one with the same or with slightly modified procedures (e.g.: Gácsi et al., 2001; Prato-Previde et al., 2003; Palmer and Custance, 2008; Rehn et al., 2013). It was proposed that attachment is the basis of the development of dogs' social competence and it also makes possible other synchronised behaviours with humans such as working together (Miklósi and Topál, 2013). On the other hand, even in case of humans, it is known that individuals show different attachment styles in the SST (Ainsworth et al., 1978; Main and Solomon, 1990). In line with this, Topál et al. (1998) identified five different clusters of dogs, based on their behaviours connected to

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the different main factors, revealing that individuals show different attachment patterns based on the combinations of the described continuums. Dogs from the first group were characterised by low stress, but they formed two subgroups because of the difference in the interrelationship between their acceptance and attachment scores. In the second group, dogs gained high scores in each of the three dimensions. Group three, besides the medium level of stress and acceptance, was also dividable into two main subgroups based on the attachment scores. Importantly, the authors did not match these to the human attachment styles (but see: Solomon et al., 2019). More recently, several factors were described that might have an effect on dogs' attachment pattern. For instance, it was found that older dogs (over 7 years of age) showed an increased salivary cortisol response after the SST procedure than the younger adult dogs (under 7 years of age), probably as a sign of an age-related stress response (Mongillo et al., 2013). Kovács et al. (2018) described that both genetic background (oxytocin gene receptor polymorphism) and environmental factors (country and attachment style of the owner) shape dogs' attachment pattern in the SST.

Once being domesticated, subsequently dogs were directionally selected further by humans for different looks (e.g. size, Sutter et al., 2007) and purposes (Wayne et al., 2006). Besides the vast differences in their physical appearance – what is also unique to this species – human efforts to select the most suitable working dogs caused remarkable differences also in particular canine behaviours (Svartberg, 2006), which in some cases is even detectable during the puppyhood (e.g.: Lenkei et al., 2019; Morrow et al., 2015). In spite of the growing interest towards breed-specific and breed-related behavioural patterns in dogs, there is a surprising lack of knowledge about the possible effect of breed selection on the attachment behaviour. Topál et al. (1998) did not find specific breed differences by comparing Belgian Shepherds as a reference group to a heterogeneous test group containing a wide assortment of different breeds. Besides the description of the behavioural characteristics of particular dog breeds, from the aspect of evolutionary and ecological validity it would be a better approach if we would assess the characteristics of several dog breeds along more general aspects of genetic selection such as clustering and investigating them based on their origin or specific work-purpose. In a questionnaire study, it was found that dogs from ancient and spitz-type breed groups obtained lower attachment and attention-seeking scores compared to other breed groups (Tonoike et al., 2015); and, in another study, toy breeds (e.g.: Chihuahua, Yorkshire terrier) received the higher scores of these factors. Interestingly, these toy breeds tended to gain also high scores on aggression and fear-related items, suggesting that their attention-seeking might be provoked by fear (Serpell and Duffy, 2014). However, as far as we know, currently there is no hypothesis-driven experiment about possible differences in the attachment pattern of different breed groups. The theoretical validity of such experimental approaches can be confirmed by large scale behavioral genetic surveys, as recently it was found that the differences among the dog breeds' human-directed play have considerable genetic background, which is suspected to be caused by artificial selection throughout the formation of dog breeds (Garamszegi et al., 2020; Kolm et al., 2020).

Working dogs can be grouped based on how closely they work together with humans. Herding breeds (e.g. Border collie) and gundogs (e.g. Labrador retriever) for example work in close visual contact with their handler, continuously taking attention to his/her cues, thus they are called as 'cooperative' breeds. Other working dogs, such as sled dogs (e.g.: Siberian husky), greyhounds, earth dogs (e.g.: dachshund) are labelled as 'independent' as they work with no or minimal visual contact with their handler, and they were presumably also selected for their individual problem-solving ability (Gácsi et al., 2009). The functional selection for different working purposes caused specific differences in the other (not strictly working task-related) behaviour of these breeds too. For instance, dogs from cooperative breeds more successfully interpret human pointing cues (Gácsi et al., 2009). While it is reasonable to assume that the tendency to keep visual contact with humans causes also differences in their gazing behaviour towards human faces, Bognár et al. (2018) did not find difference between the two breed groups in their duration of looking at human portraits. Recently, it was also found that independent breeds might show weaker negative cognitive bias in a food-reward related test (Pogány et al., 2018).

Based on our previous results, dogs from cooperative breeds react more intensively to the separation from their owner (Pongrácz et al., 2020). It was found that dogs from cooperative breeds bark more when they see their owner leaving than dogs from independent breeds, suggesting that they are indeed more motivated to stay close to their owner. Previous works demonstrated that specific acoustic features of the dog barks emitted in separation context are well-recognizable indicators of the inner state of the dog, for instance, due to frustration (Lenkei et al., 2018) and loneliness (Jégh-Czinege et al., 2020; Pongrácz et al., 2016). Separation stress is one of the main features of the attachment behaviour-complex (Bowlby, 1958). As dogs from cooperative breeds show more stress than independent working dogs during separation outdoors, there might be other differences in their attachment behaviour as well, for example regarding the owner's vicinity as a secure base in a moderately stressful situation. Thus, we tested cooperative and independently working dog breeds in the Strange Situation Test with an assumption that functional breed selection of working dogs is an appropriate approach to study differences between attachment patterns towards the owner.

The concept of standardized dog breeds originates from the Victorian Era, defining strict patterns to the morphology and behaviour of dog breeds (Worboys et al., 2018). This strong selective breeding has been going on for longer than the more recent formation of so-called breed lineages for show- and working lines with much more relaxed requirements (Kumpulainen et al., 2017). Although genetic differences within breeds have been identified between show lines and working lines, the gene flow goes mainly from the show lineages to the sport or working dogs, maintaining a relative stable gene pool within breeds irrespective of their lineages (Lampi et al., 2020). As here we assessed only companion dogs from both working dog types, where their upbringing and lifetime experiences might be quite similar, we expect that in case we find differences between their attachment behaviour, this will be more of a product of their original functional selection than some of the more recent within-breed segregation. We hypothesize that due to the effects of functional (work-related) selection, cooperative working dogs will differ from independent working dogs in their attachment pattern during the SST as they might have a different relationship with their owners. According to this, we predict that cooperative working dogs will receive higher attachment scores than the independent working dogs do. Besides, based on our previous results, we expect that cooperative breeds will also gain higher scores in the anxiety continuum as they showed more signs of stress in our outdoor separation study (Pongrácz et al., 2020). Regarding the acceptance of a stranger, we predict that independent working dogs would score higher, as they were less likely selected for an individualized work-relationship with one specific handler. Alternatively, considering that the attachment complex in dogs is functionally analogous to the human child-parent relationship, we may predict a uniformly strong, elemental bond between dog and owner that may overshadow the effects of subsequent functional selection – thus, in this case the cooperative and independent working dogs will show similar results in the main components of their attachment complex. In this case, it is still possible that the difference between the two breed groups emerges in more specific situations such as for instance when communication with the human is involved. We tested dogs from several cooperative and non-cooperative breeds in the SST to compare their behaviour based on the three main continuums (attachment, anxiety, and acceptance) of attachment behaviour.

2. Materials and methods

2.1. Subjects

We tested 28 dogs from cooperative breeds (mean age: 6.2 years, sex ratio: N = 12 males, N = 17 females) and 29 from independent breeds (mean age: 5.1 years, sex ratio: N = 16 males, N = 13 females; for details see Table 1). The tested dog population was balanced as much as possible between and within the groups for training status (not trained, basic obedience, specific supervised training) and keeping condition (i.e. outdoors, indoors, or both). We tested companion dogs, of which the owners were recruited through advertisements and the participation was voluntary. The owners were informed about the main aim of the study and that they are allowed to interrupt the test if it they think that their dog experiences an unpleasant amount of stress. The methods of the behaviour tests were accepted by the Animal Welfare Committee of the Eötvös Loránd University (Ref. no.: PE/EA/853-2/2016).

2.2. Experimental setup

The experimental protocol was based on the papers of Topál et al. (2005) and Kovács et al. (2018). We included some modifications of the original procedure based on the observation that more recently the subjects were less stressed in the SST procedure compared to the original studies. The average dog owners' attitude has changed and the number of dogs that are kept only in the backyards has decreased. On the other hand, more and more dogs have been frequently taken to other places besides their homes and habituated to strangers. Consequently, nowadays the unfamiliar environment of the SST is probably no longer as stressful for all dogs as it used to be (unpublished data: Świerkosz et al. in prep). To reach the moderate level of experienced stress, which is the main causative feature of the SST (Ainsworth and Wittig, 1969), an 8-second-long dog growl (from a so-called food-guarding context, see Faragó et al., 2010) was played to the subjects during the warm-up phase. Growling is a vocalisation evoked in agonistic situations in canines and it was found that even played back growling sounds cause increased cortisol level and also behavioural reactions, such as avoidance, in dogs (e.g.: Wood et al., 2014; Faragó et al., 2010). We opted to use these low-intensity agonistic dog vocalizations because, besides being moderately stressful for the subjects, they were otherwise not connected to the separation episodes of the SST or to the unfamiliar person acting as the 'stranger' in the SST.

The subjects were tested in an unfamiliar room (6.27m × 5.40m; Fig. 1). The room had two doors, during the test one was used only by the owner while the other by the stranger (in a randomised order between subjects). We placed two chairs to the middle of the room, one for the owner and the other for the stranger. There was a cage in the corner of the room covered with a blanket, hiding a wireless loudspeaker inside (Sony® SRS-XB2). The toys (two sticks and two balls) used during the test were placed within 1 m (marked on the floor) besides the cage. Two tables were placed along two adjacent walls of the room, with wooden toy blocks on one of them. Before the test, the owner was given a wireless headphone that was used to instruct the owner what to do (e.g. play with the dog, sit on the chair) via a standard pre-recorded list of commands.

2.3. Experimental procedure

2.3.1. Warm-up phase

Before the test, the Experimenter (E) explained the process in detail to the owner. Then, they entered the room together (always using the stranger's door). The owner was asked to take off the leash and the dog was free to explore the room. The E and the owner walked beside each other, meanwhile E showed the experimental setup to the owner. When the dog went close to the cage (within 1 m, marked on the floor), E played the growl once with the help of a mobile phone with wireless

Table 1
The basic demographic information of the subjects.

ID	Breed	Subgroup	Reproductive status	Sex	Age (years)
Independent Breeds					
1	Hovawart	Guard	intact	female	2
2	Miniature dachshund	Earth	intact	male	5
3	Pyrenean mountain dog	Guard	intact	male	7
4	Whippet	Hound	intact	male	10
5	Fox terrier	Earth	neutered	male	7
6	Fox terrier	Earth	neutered	male	6
7	Miniature dachshund	Earth	intact	male	5
8	Dachshund	Earth	neutered	female	12
9	Hungarian greyhound	Hound	intact	female	2
10	Pyrenean mountain dog	Guard	intact	male	2
11	Basset hound	Hound	neutered	female	5
12	Basset hound	Hound	neutered	female	5
13	Azawakh	Hound	neutered	male	5
14	Cairn terrier	Earth	neutered	male	8
15	Pyrenean mountain dog	Guard	intact	male	9
16	American pitbull terrier	Earth	neutered	female	7
17	Dachshund	Earth	neutered	female	7
18	West highland white terrier	Earth	neutered	female	11
19	Smooth fox terrier	Earth	neutered	female	10
20	Norwich terrier	Earth	intact	male	2
21	Dachshund	Earth	neutered	female	3
22	Komondor	Guard	intact	male	9
23	Pyrenean mountain dog	Guard	intact	male	7
24	Greyhound	Greyhound	neutered	female	5
25	Whippet	Hound	neutered	female	10
26	Spanish galgo	Hound	neutered	male	6
27	Whippet	Hound	neutered	male	4
28	Siberian husky	sled dog	neutered	male	2
29	West highland white terrier	Earth	neutered	female	8
Cooperative Breeds					
30	Golden retriever	Gundog	neutered	female	2
31	Golden retriever	Gundog	intact	male	6
32	Golden retriever	Gundog	neutered	female	9
33	Golden retriever	Gundog	neutered	female	2
34	Mudi	sheepdog	neutered	female	7
35	Mudi	sheepdog	intact	female	9
36	Mudi	sheepdog	intact	male	1
37	Hungarian vizsla	Gundog	intact	female	2
38	German shepherd dog	sheepdog	neutered	male	5
39	Border collie	sheepdog	intact	male	9
40	Mudi	sheepdog	intact	female	11
41	Labrador retriever	Gundog	neutered	female	11
42	German shepherd dog	sheepdog	intact	female	3
43	Hungarian vizsla	Gundog	neutered	female	1.5
44	Border collie	sheepdog	neutered	female	7
45	Border collie	sheepdog	neutered	male	9
46	Hungarian vizsla	Gundog	neutered	male	3
47	Border collie	sheepdog	intact	male	7
48	Golden retriever	Gundog	neutered	female	6
49	Mudi	sheepdog	intact	male	5
50	Border collie	sheepdog	intact	female	6
51	Puli	sheepdog	neutered	female	2
52	Labrador retriever	Gundog	neutered	male	4
53	Hungarian vizsla	Gundog	intact	female	3
54	Labrador retriever	Gundog	neutered	male	4
55	Border collie	sheepdog	intact	female	2
56	Golden retriever	Gundog	neutered	male	4
57	Puli	sheepdog	neutered	female	5
58	Malinois	sheepdog	intact	male	3

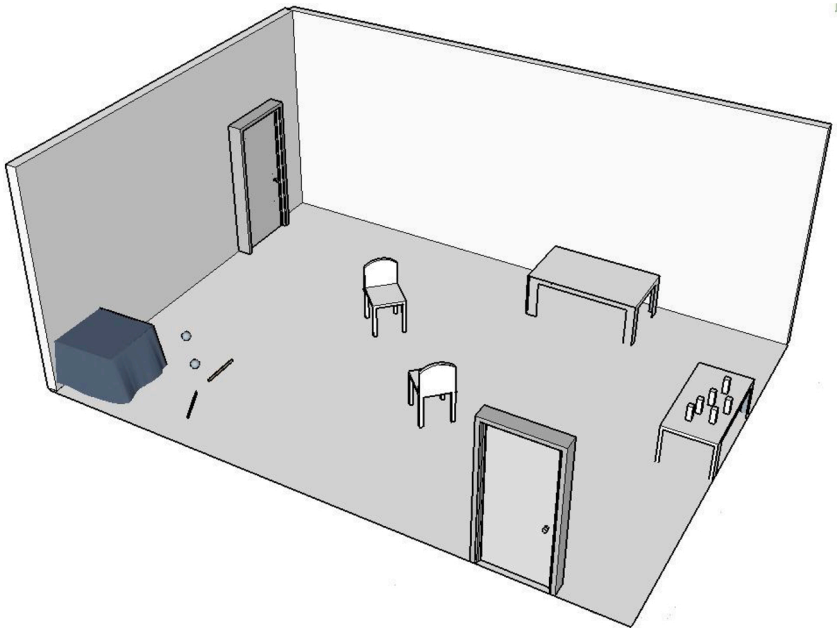

Fig. 1. Schematic drawing of the experimental setting.

connection to the loudspeaker. The owner was asked not to react or pay attention to the reaction of the dog. If the dog did not go close enough to the covered cage the owner and E stood near it to facilitate the dog's approach. After this phase, the dog was put on leash again and they left the room together through the same door where they came in earlier.

2.3.2. General overview

E and the owner entered again and E showed his/her chair to the owner. He/she was asked to place the leash on the chair and leave it there. E started to play the recording with the instructions and to measure the time with a stopwatch (later used also by the stranger to follow the phases) and left the room. The whole test was 12 min long, consisting of 6 different phases, each lasting for 30 s (for the details of the particular phases see Table 2) where the dog was with the owner, with the stranger or alone. During the test, the owner and the stranger performed the following tasks:

1 Sit on the chair: Meanwhile sitting on the chair, the owner/stranger did not initiate any interaction with the dog, but if the dog approached him/her then he/she could respond adequately. For example, if the dog gave a ball him/her then he/she was allowed to throw it for the dog.
2 Cube carrying: The owner/stranger carried the building blocks from one table to another meanwhile completely ignoring the dog.
3 Play with the dog: The owner/stranger played as naturally as possible with the dog by using the available toys. If the dog did not want to play, then the owner/stranger petted the dog instead.
4 Leave the room: The owner/stranger left the room without saying anything to the dog.
5 Enter the room: After entering the room, the owner/stranger paused beside the door (at the opposite side of the opening door) and waited 5 s. If the dog approached immediately, then he/she was allowed to respond accordingly (greet and pet the dog), if not, he/she greeted the dog and waited 5 more seconds. If the dog did not approach the person within these 10 s, he/she sat down on the chair.

Table 2
The order of the phases of the Strange Situation Test.

Phase	Owner	Stranger
1.	sits still carries cubes sits still plays with the dog sits still when the stranger enters	absent enters the room
2.	sits still	sits still carries cubes sits still on the chair plays with the dog
3.	leaves the room absent	sits still sits still carries cubes sits still plays with the dog
4.	enters the room sits still carries cubes sits still plays with the dog leaves the room	leaves the room absent
5.	absent (the dog is alone) absent	absent enters the room sits still leaves the room
6.	absent (the dog is alone) enters the room sits still	absent

2.4. Data analysis

2.4.1. Behaviour analysis

During the behaviour analysis, we used the scoring system (See Table 3) developed by Kovács et al. (2018). They created three separated composite scores based on the detailed analysis of Topál et al. (1998). Each subject received a score for Attachment (to the owner), Anxiety (caused by the strange place) and Acceptance (of interaction with the stranger), as these are the three main factors the subjects' behaviour. All scores were summed up based on relevant behavioural variables (see Table 3). To check the inter-rater reliability, an independent coder re-scored 19 videos (33 %). We calculated Cohen's Kappa values for each behaviour items and we averaged them for each composite score (Attachment: 0.726 Anxiety: 0.71 Acceptance: 0.66). The overall mean value was 0.7 indicating substantial agreement.

Table 3
The description of the behaviour variables. m: meter; s: second.

Episode	Variable		Score
Attachment			
1,2,4,6	**Proximity**	Dog is close to owner (O) (closest body part is within 1 m) - in more than 75 % of the time when the dog is not exploring or playing	1
1	**BlockO-1**	During the first block-carrying episode dog watches or follows O for more than half of the time	1
2	**LeaveO-1**	When O first leaves, dog follows O to door (at least within 1 m from door)	1
4	**EnterO-1**	When O first enters, it approaches O at once (in reaching distance) and wags tail	1
4	**BlockO-2**	During the second block-carrying episode dog watches or follows O for more than half of the time	1
4	**LeaveO-2**	When O leaves the second time, dog follows O to door (at least within 1 m from door)	0.5
6	**EnterO-2**	When O enters the second time, dog approaches O at once (in reaching distance) and wags tail/jumps/spins	0.5
3	**DoorS-1**	Dog stands by or orients at O's door (for at least 5 s - score 0.5; almost all the time - score 1) during first separation	1
3	**NoPlayS**	Dog does not play with stranger (S) although it played with her more than 10 s in Episode 2 (in O's presence)	1
3,5	**VocaliseS**	Dog vocalises (any occurrence, except asking for ball from stranger)	0.5
3,5	**Chair**	Dog is mostly (for more than half of the time) at the chair of O if it is not at the door	0.5
5	**DoorS-2**	Dog stands by *or* orients at O's door (for at least 5 s) during 2nd separation	1
5	**EscapeS**	When stranger enters, dog at first tries to approach the door opening (to sneak out through the door) instead of greeting S	0.5
6	**DoorS-3**	Dog stands by *or* orients at O's door (for at least 5 s) during 3rd separation	0.5
	sum		**11.0**
Anxiety			
1	**DoorO-1**	Stands at any door (for at least 5 s - score 1, almost all the time during sit/play - score 2)	2
1,2	**ContactO**	Contact seeking with O before the 1st separation from O	1
1,2,4,6	**VocalO**	Dogs vocalises (except asking for the ball and greeting the owner)	1
1,2,4	**Passive**	Does not play and does not explore for more than a few seconds	1
1,2,4,6	**Hide**	Dog stays (hides) under/behind O's chair for more than half of the time of the *sit* phases	1
1,2,4,4	**Lead**	As soon as O stands up, dog approaches door (going ahead of O) (score 4*0.5)	2
4	**DoorO-2**	Stands at any door for at least 5 s	1
6	**DoorO-3**	Stands at any door for at least 5 s	1
3	**SeparationS**	When separated from O, dog runs around for at least 10 s, or vocalises, or scratches door	1
3	**Calm1**	Dog does not play or lie down comfortably (head down) for more than 10 s.	1
4	**FollowS**	Follows S to the door when she leaves	1
5, 6	**Separation**	When alone dog runs around up and down for at least 10 s (in sum), or vocalises, or scratches door (score 2*0.5)	1
5,6	**Calm2**	Dog does not play or lie down comfortably (head down) for more than 10 s when alone (in sum)	1
	sum		**15.0**
Acceptance			
1	**EnterS**	Approaches stranger when she first enters (at once, within reaching distance)	1
1	**GreetS**	Gets in physical contact and wags its tail when the stranger first enters	1
2	**BlockS-1**	During the block-carrying part, dog watches or follows S for more than half of the time	1
2	**PlayS**	Plays with S at least for 10 s	1
2,3,5	**ToyS**	Offers the toy to stranger (not during play)	1
2,3,5	**ContactS**	Seeks physical contact (jumps on, snuggles up to, nudges) during the episodes	1
2,3	**AvoidS**	Does not avoid stranger during play (stands off, avoids her touch)	1
3,5	**PoximityS**	Dog stays close (closest body part is within 1 m) to S in sit phases (at least for 5 s - score 1, almost all the time – score 2)	2
3	**BlockS-2**	During the block-carrying part dog watches or follows S for more than half of the time	1
3	**PlayS-2**	Plays with her also during separation (a little – score 1, a lot – score 2)	2
5	**GreetS-2**	Approaches (score 0.5) and gets in physical contact and wags (score 1) when the stranger enters second time	1
	sum		**13.0**

2.4.2. *Statistical analysis*

The analysis was performed in R environment (R Core Team, 2016) using R studio with lme4 package. We tested the normality of the data distributions with Shapiro-Wilk test and we used Box-Cox transformation to normalise the data where it was necessary (only in case of the Anxiety score). We ran three separate generalized linear mixed models (GLMMs; lme) for the composite scores, with cooperativeness as explanatory variable in each model.

3. Results

3.1. *Results of the composite scores*

We did not find significant effect of the breed group (i.e., the cooperativeness) in any of the three composite scores (Fig. 2). Attachment: ($\beta \pm SD = -0.414 \pm 0.607$; $t(56) = -0.681$; $P = 0.499$); Anxiety: ($\beta \pm SD = -0.146 \pm 0.113$; $t(56) = -1.296$; $P = 0.2$); Acceptance: ($\beta \pm SD = 0.741 \pm 0.770$; $t(56) = 0.964$; $P = 0.339$).

4. Discussion

To our best knowledge, this is the first hypothesis-driven study to describe potential differences in the attachment patterns of different working dog breeds. We formed two test groups from the numerous dog breeds included to the Strange Situation Test: 'cooperative' breeds that traditionally work in close visual contact with their handlers; and 'independent' breeds that usually work without frequent human guidance. The behaviour of the dogs in the SST was described with three composite scores, respectively: Attachment (to the owner), Anxiety (caused by the strange place) and Acceptance (of interaction with the stranger). As a

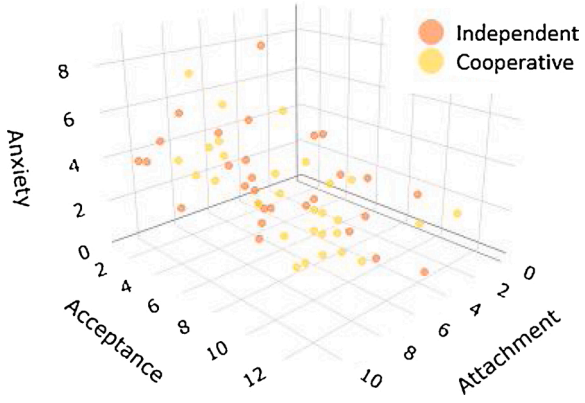

Fig. 2. Three-dimensional illustration of the distribution of cooperative and independent subjects according to their values along the three composite score axes.

main result, we did not find any association between these behavioral dimensions and the functional breed selection (whether a subject belonged to a breed originally being selected for a cooperative or an individual working role).

Our results are in line with Topál et al. (1998), who suggested that although there are noticeable individual differences in the attachment pattern of the individual dogs, these are not strongly associated with breed selection. Although dogs were selected and they are still used for numerous (and often very different) purposes, the capacity of forming attachment bonds with the owner might be such an elementary feature that is almost uniformly present in breeds, independently of their selective history (Topál et al., 2009). The attachment relationship between human and dog is unique because dogs are dependent on humans (showing a functional analogy with the offspring-parent bond), however, this relationship is formed between two not related adult individuals. This might imply that, in some cases, rather the apparent availability of the attachment figure and not the physical proximity with him/her is the main source of bonding (Sable, 2008). This latter feature can be regarded as a partial analogy with attachment bonds between adult humans (Holman et al., 2009). This special aspect of human-dog attachment may have a key role in different work-related situations maintaining a balance between the ability to work independently or from a distance and the motivation to re-establish the contact with the handler. Also, it is important to emphasize that each working dog breed has been originally selected for collaboration with humans (Kuhl, 2011), and the grouping of breeds used for this study refers rather to the way 'how' these breeds usually work. Based on this assumption, attachment with the owner might play an equally important role in the two breed groups and the difference is rather linked only to the different responsiveness in those situations where communication takes place.

While the SST is widely used to assess owner-dog attachment, it is important to emphasize that it has its limitations and it is not suitable to describe every feature of this behaviour-complex. In the framework of the infant-mother attachment theory, the security-providing roles of the attachment figure are described as the secure base and the safe haven effects (Rajecki et al., 1978; Gubernick, 1981). In case of a moderately stressful situation in the presence of the attachment figure, the subject explores its environment using him/her as a secure base, however in case of potential treat or danger, the offspring also seeks protection in the close vicinity of the figure of attachment, what is known as the safe haven effect. Meanwhile both effects have been found in case of dogs (Topál et al., 1998; Gácsi et al., 2013), the SST paradigm measures the secure base effect only, as the subject is exposed to a strange place and separation from the owner, but not to any direct threat. Though we did not find differences in their attachment scores nor in the other two factors measured in the SST, it is possible that the difference between the breed groups is rather associated with the availability or lack of the owner during a potential threat. Dogs from independent breeds might less intensively seek protection from the owner than cooperative ones as they are disposed to independent problem solving. For instance, they were selected for guarding purposes, or to hunt underground individually like in case of terriers. These specific aspects of their selection could cause that independent working dogs show generally bolder behaviour in particular stressful situations (Turcsán et al., 2011).

Results of breed-related behavioural studies should always be interpreted with caution because of two main reasons. First, in some cases within-breed behavioural differences can also be considerably high (Svartberg, 2006). To tackle this problem to a given extent, we included several different breeds to both test groups and we did not test more than six subjects from one breed. It is also possible that the attachment pattern of a dog is also a trait that in case of some breeds shows higher variability than in others. Second, – although our sample was balanced as much as possible for training status and keeping condition of dogs between the two test groups – it is still possible that the owners of cooperative and independent dogs handle their dogs differently. Earlier, it was reported that owner's attitude can be different towards particular breeds (e.g. Arhant et al., 2010) what could have affected their behaviour in a test situation like ours.

5. Conclusion

While the fact that there were no differences in the Anxiety and Acceptance scores of cooperative and independent working dogs suggests that the test situation equally affected them, we did not find difference in their Attachment scores. It seems that artificial breed selection did not affect significantly their attachment behaviour towards the owner in the Strange Situation Test. However, it is still possible that a difference would emerge if the attachment-related behaviours were compared between non-working and working breeds. Furthermore, dog-human attachment manifests itself in several situations, thus it is possible that in other contexts (such as in case of potential danger see Vas et al., 2005; Salamon et al., 2020) breeding for close cooperation between dogs and humans may affect the dog's behaviour.

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