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Perceptions of domestic dogs' (*Canis familiaris*) manifestations of joy, shame and stress based on photographs

Ewelina Kuźniewska, Janusz Strychalski*

Department of Fur-bearing Animal Breeding and Game Management, Faculty of Animal Bioengineering, University of Warmia and Mazury, 10-719 Olsztyn, Poland

Abstract: The aim of the study was to determine the extent to which the experience of owning a dog, the number of owned dogs, ownership of purebred or crossbreed dogs, the dog's breed, and membership in online social groups dedicated to obedience and agility training affect the ability to identify feelings of joy, shame and stress in dogs based on photographs. An online survey was shared on selected social networking sites dedicated to dogs. Respondents were given links to 11 online photographs. The questionnaire was completed by 513 people. The duration of ownership or the number of owned dogs were not correlated with the ability to identify canine behaviors indicative of joy, shame or stress. However, the obtained results revealed that ownership of purebred or crossbreed dogs affects the owners' capability to interpret dogs feelings. In one of the photos, the Border Collie owners were less likely to notice signs of joy in dogs than the owners of defensive breeds, dogs from FCI group V, and dogs from FCI group IX. Signs of stress were not identified by any terrier owner, while it was noticed by 9.30% of owners of FCI group VIII dogs. The majority of dog owners who were not members of obedience/agility online social groups recognized more signs of joy and shame, but fewer signs of stress than the respondents who belonged to these groups. The results of the study indicate that a dog's breed and genetic origin (purebred vs. crossbreed), and the owner's interest in cynological sports influence humans' ability to read canine behaviors and emotions.

Key Words: canine body language, dog emotions, stress, human-dog communication

* *Corresponding Author*: janusz.strychalski@uwm.edu.pl

Introduction

Dogs and humans communicate with each other through verbal and non-verbal messages. They exchange information about, among other things, their emotional state, attitudes towards each other, intentions and needs (Rugaas, 1997; Mariti et al., 2017; Mota-Rojas et al., 2021). Effective interspecies and intraspecies communication requires clear messages that are correctly interpreted, analyzed and understood by the recipient (Dash & Bhattacharyya, 2017). The ability to interpret the signs and cues displayed by dogs enables humans to engage in meaningful communication with animals. Signs and cues that are understood can also be used by humans to communicate their own feelings, intentions and needs to dog. Dog owners have to develop non-verbal communication skills to establish interspecies relationships that are based on partnership. These skills are essential for training dogs for a variety of working roles, including hunting, therapy, cynological sports (obedience, agility, dog frisbee, etc.), defense, military, as well as in daily obedience training (Rugaas, 1997; Dennison, 2007; Lipka et al., 2017).

Depending on circumstances, dogs can display non-verbal cues that are indicative of affiliative or agonistic behavior. Affiliative behaviors aiming to establish, develop and maintain good and friendly relations with other individuals include a bowing posture as an invitation play or physical contact between a puppy and its mother. In contrast, dogs engage in agonistic behaviors to maintain and/or increase distance between individuals, where at least one individual experiences aversion, hostility or fear (Mota-Rojas et al., 2021). Agonistic behaviors include warning messages such as baring and snapping of teeth (Rugaas, 1997). These messages can precede an attack,

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and they are communicated when calming signals (such as standing motionless and turning the head in a direction opposite to the source of stress) do not bring the expected results (changes in attitude, greater distance) and fail to minimize the risk of conflict. Rugaas (1997) described twenty-nine calming signals that are used by dogs to de-escalate aggressive behavior. Considerable research on appeasement signals in dogs has been done since that time (Firnkes et al., 2017; Mariti et al., 2017; Siniscalchi et al., 2018; Kujtkowska et al., 2020).

Dogs often display calming signals when they experience stress (Rugaas, 1997). Stress is often defined as a response of the organism to an internal or external threat (Mariti et al., 2012). Besides, dog emotions are equally intriguing. According to Ekman (1992), Demoulin et al. (2004) and Harmon-Jones et al. (2016), emotions can be divided into primary and secondary. Primary emotions include anger, joy, sadness, fear and surprise, and it is believed that dogs can experience these emotions. Secondary emotions include shame, pride, jealousy, disappointment and compassion. As presently understood, secondary emotions, such as shame, require self-awareness which dogs probably do not possess. It is generally believed that only mature humans and perhaps other primates can experience these emotions (Preston & De Waal, 2002; Viki & Abrams, 2003). However, some authors have argued that non-primate species can also experience secondary emotions, but that these feelings are less sophisticated, less expressed and less experienced than in humans (Morris et al., 2008). There is no scientific evidence to indicate that dogs are unable to experience secondary emotions.

Several studies have analyzed humans' ability to identify canine feelings and emotions from photographs (Bloom & Friedman, 2013; Amici et al., 2019; Bloom at al.; 2021), videos (Demirbas et al., 2016) and voice recordings (Pongrácz et al., 2005). The aim of this study was to determine the extent to which the experience of owning a dog, the number of owned dogs, ownership of purebred or crossbreed dogs, and the dog's breed affect the ability to identify feelings of joy, shame and stress in dogs based on photographs. We also aimed to determine whether the ability to read these signals is influenced by membership in online social groups dedicated to obedience and agility training. The purpose of the study was to identify differences between these groups, without rating the accuracy of their judgments.

Materials and Methods

An online survey was prepared and shared on selected social networking sites dedicated to dogs. The survey was anonymous, and it was conducted between August and September 2021. The survey consisted of the following questions:

1. What is your gender?
2. How many dogs do you own?
3. What breed of dog/dogs do you own, possibly non-purebred?
4. Select photos where dogs manifest joy (you can give more than one answer) or check the "none of the above" option.
5. Select photos where dogs manifest shame (you can give more than one answer) or check the "none of the above" option.
6. Select photos where dogs manifest stress (you can give more than one answer) or check the "none of the above" option.

For questions 4-6, the respondents were given links to 11 online photographs. The photographs are described in Table 1.

Table 1. Description of the photographs presented to the respondents.

Photo	Description
1	A smiling girl is crouching next to a German Shepherd that is sitting on the ground. She is holding the dog by the collar with both hands. The dog is panting and turning its head away from the girl's face. The dog's ears are pinned back.
2	In the lower right corner of the photo, there is a human hand with the pointing finger raised. This gesture is adressed to a medium-sized dog that is laying on the grass and trying not to look at the human or the hand. The dog's head is slightly turned and it's ears are pinned back.
3	A smiling girl is standing in front of the camera and holding a small dog in her hands. The dog keeps his head away from the girl's face and looks off into the distance. The dog's ears are slightly pinned back.
4	A Golden Retriever is lying on the bed. The dog is looking directly at the camera, its mouth is open with the tongue hanging down. The dog's body is relaxed and its ears are floppy.
5	A smiling little girl is standing in front of the camera, holding a small dog in her hands. The dog is looking in the opposite direction and is clearly twisting its head away from the girl's face. The dog's ears are pinned back.
6	An adult Beagle dog is lying on the carpet with its tail and head pinned to the ground. The dog is looking upwards and sideways, with its ears hidden under the neck. Mostly the whites of the dog's eyes are showing. There is torn paper around the dog.
7	A Golden Retriever puppy is running across a lawn directly towards the camera. It is looking at the camera with its mouth wide open and tongue slightly dropping. The dog's floppy ears are pricked forward.
8	The dog is lying upside down on the bed with its eyes and mouth closed. The dog's entire body (ears, paws, tail) is relaxed.
9	In the foreground, a dog and a young woman are lying on the bed with their eyes and mouths closed. Their heads are turned to the same (left) side. The woman is lying on her side, and the dog is lying on its back. The dog's body is relaxed, and its paws and ears are droopy. In the background, a middle-aged man is lying on the other side of the bed with a pillow under his neck and head. His eyes and mouth are closed.
10	A young child is sitting on the bed with a large dog on its right side. The baby is looking at the dog and lifting one of its lips. The dog glances away, its body is slightly tilted to the right. The dog's ears are tightly pinned back.
11	A young girl is standing next to a sitting dog. The girl is stooping over the dog and embracing it with both arms. The dog's head is turned strongly to the right, and the dog is looking off into the distance. The dog's mouth is closed, and its ears are pinned back.

The answers given by respondents who had more than one dog were multiplied by the number of owned dogs.

The obtained data were statistically analyzed. Descriptive statistics were calculated using the Excel spreadsheet program in the MS Office 365 package. Comparative analyses were conducted with the use of Fisher's exact test (2 x 2) in R (R Core Team, 2015).

Results

The questionnaire was completed by 513 people, including 450 women and 63 men.

The frequency with which the respondents identified signs of joy in photographs was not influenced by the experience of owning a dog or the number of owned dogs (Table 2). The owners of purebred dogs were somewhat less likely to identify signs of happiness than the owners of crossbreed dogs (PA ratio of 3.90 and 4.36, respectively). However, the observed differences were sig-

nificant only in relation to photos 1 and 11 (27.15% vs. 47.13% for photo 1, and 5.63% vs. 18.00% for photo 11, P<0.01 for both photos).

Table 2. Experience of owning a dog, owning one or more dogs, owning a purebred or a crossbreed dog, and the ability to interpret signs of joy in photographed dogs (% of answers).

Photo	≤3 years n=205	4-5 years n=47	≥6 years n=261	1 dog n=328	≥2 dogs n=185	Purebred n=302	Crossbreed n=261
1	37.07	40.43	36.02	40.55	30.81	**27.15^{A}**	**47.13^{A}**
2	1.95	8.51	1.92	3.66	1.08	1.66	3.83
3	0.98	2.26	1.95	1.52	1.62	1.32	2.30
4	90.73	85.11	88.51	91.46	85.95	86.75	92.72
5	1.46	2.13	1.15	1.52	0.00	0.99	1.53
6	1.95	2.13	3.83	1.22	3.78	2.32	3.83
7	96.59	95.74	95.02	95.43	94.05	95.70	96.93
8	86.83	78.72	86.97	89.33	82.16	86.75	85.06
9	79.02	74.47	78.16	82.62	75.14	80.13	80.08
10	3.90	2.13	3.07	3.96	2.16	1.99	4.60
11	14.63	2.26	11.49	14.63	8.65	**5.63^{A}**	**18.00^{A}**
PA ratio[1]	4.15	3.98	4.08	4.26	3.85	3.90	4.36
None	1.46	0.00	0.77	1.22	0.54	1.32	0.77

[1] Ratio of the number of positive answers to the number of people in the group
[A] mean values with the same uppercase letter within rows are different at p≤0.01

Similarly to joy, the frequency with which the respondents identified signs of shame in photographs was not affected by the experience of owning a dog or the number of owned dogs (Table 3).

Table 3. Experience of owning a dog, owning one or more dogs, owning a purebred or a crossbreed dog, and the ability to interpret signs of shame in photographed dogs (% of answers).

Photo	≤3 years n=205	4-5 years n=47	≥6 years n=261	1 dog n=328	≥2 dogs n=185	Purebred n=302	Crossbreed n=261
1	4.88	6.38	4.21	4.88	5.41	3.31	6.51
2	32.68	27.66	27.59	27.74	28.65	**23.51^{a}**	**34.87^{a}**
3	29.27	27.66	24.14	28.96	23.78	22.52	30.65
4	1.95	2.13	1.53	1.52	1.62	0.33	1.53
5	28.29	36.17	33.33	30.79	27.03	**24.17^{a}**	**36.78^{a}**
6	44.39	38.30	35.25	44.21	32.97	36.09	44.83
7	0.98	2.13	0.77	0.61	0.54	**0.00^{a}**	**1.92^{a}**
8	0.98	2.13	0.77	1.52	0.00	**0.33^{a}**	**2.68^{a}**
9	0.98	0.00	0.38	1.52	0.00	0.33	1.92
10	15.12	17.02	14.18	14.63	17.30	14.24	12.64
11	16.10	19.15	17.24	17.38	15.14	14.24	19.92
PA ratio[1]	1.76	1.79	1.59	1.74	1.52	**1.39^{A}**	**1.94^{A}**
None	31.71	19.15	36.40	28.66	40.54	**35.76^{a}**	**23.37^{a}**

[1] Ratio of the number of positive answers to the number of people in the group
[A] mean values with the same uppercase letter within rows are different at p≤0.01
[a] mean values with the same lowercase letter within rows are different at p≤0.05

However, the owners of purebred dogs were less likely to identify signs of shame than the owners of crossbreed dogs, and the PA ratio was determined at 1.39% vs. 1.94%, respectively (P<0.01). A detailed analysis revealed statistically significant differences between both groups of dog owners (P<0.05 in each case) for photographs 2 (23.51% vs. 34.87%), 5 (24.17% vs. 36.78%), 7 (0.00% vs. 1.92%) and 8 (0.33% vs. 2.68%). Additionally, 35.75% of the owners of purebred dogs did not identify signs of shame in any of the photographs, whereas only 23.37% of the owners of crossbreed dogs were able to identify such signs (P<0.05).

The frequency with which the respondents identified symptoms of stress in the photographs was not influenced by the experience of owning a dog or the number of owned dogs, and the calculated PA ratio was determined at 4.23-4.40 and 4.09-4.57, respectively (Table 4). Interestingly, the number of respondents who were unable to identify signs of stress was six times higher in the group of subjects who owned only one dog (3.35%) than in the group of respondents who owned at least two dogs (0.54%), but the difference was not statistically significant. Excluding photo 7, the owners of purebred dogs were somewhat more likely to notice symptoms of stress than the owners of crossbreed dogs, but the difference was significant only in photo 1 (49.00% vs. 31.80%, P <0.01). The calculated PA ratio was 4.69 and 4.10, respectively (the difference was not statistically significant).

Table 4. Experience of owning a dog, owning one or more dogs, owning a purebred or a crossbreed dog, and the ability to interpret signs of stress in photographed dogs (% of answers).

Photo	≤3 years n=205	4-5 years n=47	≥6 years n=261	1 dog n=328	≥2 dogs n=185	Purebred n=302	Crossbreed n=261
1	39.51	40.43	40.61	35.67	41.08	**49.00^{A}**	**31.80^{A}**
2	47.32	40.43	48.28	42.99	47.03	52.98	42.53
3	77.56	68.09	83.52	75.00	78.92	82.12	79.69
4	0.98	4.26	2.68	1.83	2.70	2.65	1.53
5	80.00	78.72	80.46	76.83	84.86	82.78	76.25
6	40.00	46.81	46.36	40.55	48.11	49.67	38.70
7	0.00	0.00	0.38	0.30	1.08	0.00	0.77
8	0.49	2.13	0.38	0.30	2.16	1.32	0.38
9	0.98	4.26	2.30	0.91	4.86	2.32	1.92
10	75.61	68.09	75.48	74.39	75.68	75.83	74.71
11	63.90	63.83	66.28	60.37	70.81	70.20	61.30
PA ratio[1]	4.23	4.26	4.40	4.09	4.57	4.69	4.10
None	1.95	4.26	2.30	3.35	0.54	2.98	1.15

[1]Ratio of the number of positive answers to the number of people in the group
[A] mean values with the same uppercase letter within rows are different at p≤0.01

As shown in Table 5, the owners of Border Collies were less likely to notice signs of joy in dogs in the first photograph than the owners of defensive breeds (five-fold difference, P<0.01), terriers (four-fold difference, not significant), dogs from FCI group V (more than six-fold difference, P<0.05), dogs from FCI group VIII (four-fold difference, not significant), as well as companion and toy dogs (more than eight-fold difference, P<0.01). No differences in the PA ratio were found between the studied groups, which ranged from 3.16 for Border Collie owners to 4.05 for owners of FCI group V dogs. All owners of defensive breeds, terriers, companion and toy dogs recognized signs of joy in at least one photo, whereas some respondents from the remaining groups did not identify signs of joy in any of the photos (2.63% to 4.76%). However, the differences between the groups were not statistically significant.

Table 5. Breed/type of owned dog and the owner's ability to interpret signs of joy in photographed dogs (% of answers).

Photo	Border Collie n=38	Defensive breeds[2] n=69	FCI group III n=65	FCI group V n=21	FCI group VIII n=43	FCI group IX n=34
1	**5.26^{ABa}**	**26.09^{A}**	23.08	**33.33^{a}**	23.26	**44.12^{B}**
2	0.00	2.90	0.00	0.00	0.00	2.94
3	0.00	0.00	1.54	0.00	0.00	0.00
4	81.58	89.86	86.15	90.48	88.37	82.35
5	0.00	0.00	1.54	4.76	0.00	0.00
6	0.00	1.45	4.62	0.00	0.00	0.00
7	92.11	95.65	100.00	85.71	93.02	91.18
8	71.05	85.51	86.15	90.48	86.05	88.24
9	63.16	75.36	76.92	85.71	76.74	85.29
10	0.00	0.00	3.08	4.76	0.00	0.00
11	2.63	5.80	4.62	9.52	2.33	0.00
PA ratio[1]	3.16	3.83	3.88	4.05	3.70	3.94
None	2.63	0.00	0.00	4.76	4.65	0.00

[1] Ratio of the number of positive answers to the number of people in the group
[2] German Shepherd, Belgian Shepherd Malinois, Rottweiler, Doberman, Giant Schnauzer
[A] mean values with the same uppercase letter within rows are different at $p \leq 0.01$
[a] mean values with the same lowercase letter within rows are different at $p \leq 0.05$.

No significant differences in the respondents' ability to identify manifestations of shame were found between owners of different dog breeds/types (Table 6).

Table 6. Breed/type of owned dog and the owner's ability to interpret signs of shame in photographed dogs (% of answers).

Photo	Border Collie n=38	Defensive breeds[2] n=69	FCI group III n=65	FCI group V n=21	FCI group VIII n=43	FCI group IX n=34
1	7.89	4.35	4.62	4.76	0.00	2.94
2	18.42	30.43	16.92	23.81	16.28	29.41
3	7.89	21.74	23.08	28.57	11.63	35.29
4	0.00	1.45	4.62	0.00	0.00	0.00
5	15.79	23.19	24.62	28.57	11.63	32.35
6	23.68	24.64	46.15	47.62	41.86	32.35
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00
10	5.26	15.94	10.77	23.81	16.28	14.71
11	15.79	15.94	13.85	19.05	4.65	29.41
PA ratio[1]	0.95	1.38	1.45	1.76	1.02	1.76
None	60.53	47.83	35.38	38.10	46.51	32.35

[1] Ratio of the number of positive answers to the number of people in the group
[2] German Shepherd, Belgian Shepherd Malinois, Rottweiler, Doberman, Giant Schnauzer.

The PA ratio ranged from 0.95 in the group of Border Collie owners to 1.76 in the group of owners of FCI group V and IX dogs. A total of 43.70% respondents marked the "none of the above" option, where the number of negative responses was highest in the group of Border Collie owners (60.53%) and lowest in the group of owners of FCI group IX (32.35%), III (35.38%) and V dogs (38.10%). The owners of selected dog breeds/types did not differ in their ability to interpret signs of stress, and the PA ratio ranged from 4.62% to 5.21% (table 7). However, differences were noted in the percentage of respondents who did not recognize any signs of stress in any of the photographs. Signs of stress were not identified by any terrier owner and by 9.30% of owners of FCI group VIII dogs ($P < 0.05$).

Table 7. Breed/type of owned dog and the owner's ability to interpret signs of stress in photographed dogs (% of answers).

Photo	Border Collie n=38	Defensive breeds[2] n=69	FCI group III n=65	FCI group V n=21	FCI group VIII n=43	FCI group IX n=34
1	63.16	53.62	56.92	42.86	48.84	38.24
2	63.16	50.72	61.54	42.86	44.19	47.06
3	92.11	86.96	89.23	76.19	81.40	61.76
4	2.63	1.45	4.62	4.76	0.00	5.88
5	84.21	84.06	84.62	85.71	86.05	82.35
6	50.00	49.28	49.23	66.67	41.86	44.12
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	2.90	3.08	0.00	0.00	0.00
9	5.26	4.35	4.62	0.00	0.00	2.94
10	84.21	59.42	84.62	76.19	69.77	64.71
11	76.32	69.57	72.31	66.67	79.07	58.82
PA ratio[1]	5.21	4.62	5.11	4.62	4.51	4.06
None	2.63	1.45	**0.00**[a]	0.00	**9.30**[a]	5.88

[1] Ratio of the number of positive answers to the number of people in the group

[2] German Shepherd, Belgian Shepherd Malinois, Rottweiler, Doberman, Giant Schnauzer

[a] mean values with the same lowercase letter within rows are different at $p \leq 0.05$.

Striking differences in the respondents' ability to identify signs of joy in photos 1 and 11 were noted between dog owners who belonged and did not belong to obedience/agility training groups (Table 8). Among respondents who did not belong to these groups, 43.06% and 14.35% recognized signs of joy in photos 1 and 11, respectively, vs. only 5.36% and 1.79% of the subjects belonging to the obedience training group, respectively ($P<0.01$ and $P<0.05$, respectively). The percentage of participants belonging to both training groups (obedience or agility) who recognized signs of joy in photos 1 and 11 was determined at 8.64% and 2.47%, and the difference was highly significant in both cases ($P < 0.01$) compared to the group of respondents who did not belong to either group. The percentage of agility group members who identified signs of happiness in photos 1 and 11 was more than twice lower and more than three times lower compared to the former group, but these differences were not statistically significant.

Table 8. Membership in obedience/agility training groups and the owner's ability to interpret signs of joy in photographed dogs (% of answers).

Photo	Non-members n=432	Obedience n=56	Agility n=25	Members combined[2] n=81
1	**43.06^{AB}**	**5.36^{A}**	16.00	**8.64^{B}**
2	3.24	0.00	0.00	0.00
3	1.85	1.79	0.00	1.23
4	91.67	71.43	88.00	76.54
5	1.62	0.00	0.00	0.00
6	3.24	1.79	4.00	2.47
7	96.53	92.86	96.00	93.83
8	86.57	89.29	80.00	86.42
9	81.48	69.64	56.00	65.43
10	3.94	0.00	0.00	0.00
11	**14.35^{Aa}**	**1.79^{a}**	4.00	**2.47^{A}**
PA ratio[1]	4.28	3.34	3.44	3.37
None	0.69	3.57	0.00	2.47

[1] Ratio of the number of positive answers to the number of people in the group
[2] Total responses in Obedience and Agility groups vs. the responses given by non-members
[A] mean values with the same uppercase letter within rows are different at p≤0.01
[a] mean values with the same lowercase letter within rows are different at p≤0.05.

Respondents who belonged and did not belong to obedience/agility training groups differed considerably in their ability to interpret manifestations of shame (Table 9). Individuals who did not belong to either group recognized this emotion relatively more often. The PA ratio was higher in the non-member group than in the obedience training group and both training groups (1.94 vs. 0.55 and 0.69, respectively, P<0.01 in both cases), as well as the agility training group (1.94 vs. 1.00, P<0.05). Similar trends were noted in the interpretation of photo 11, where signs of shame were identified by 19.91% of the respondents in the first group, 3.57% in the second group, 0.00% in the third group, and 2.47% in the combined group. Moreover, the obedience training group and both training groups were significantly less likely to interpret the emotions displayed in photographs 2, 3, 5, 6 and 10 than the first group. It should also be noted that 27.08% of the respondents who were not members of obedience/agility training groups did not recognize signs of shame in any of the photographs, whereas the same response was given by 73.21% of the subjects in the obedience training group and by 66.66% of the subjects in both training groups (P<0.01 in both cases).

Membership in obedience/agility training groups also influenced the interpretation of stress in photos 1, 2 and 4 (Table 10). Non-members recognized symptoms of stress in photo 1 far less frequently than members of the obedience group and both training groups (34.49% vs. 76.79% and 72.84%, P<0.01 in both cases). In photo 2, stress was identified by 43.75% of non-members and by 65.43% of the respondents belonging to both training groups (P<0.05). An analysis of photo 4 revealed interesting results, where symptoms of stress were recognized by only 2.08% of non-members and by 8.93% of the respondents from the obedience training group (P<0.05). The PA ratio was lowest in the group of respondents who did not belong to either training group, and highest in the obedience group and both training groups (4.17 vs. 5.70 and 5.62, P<0.05 in both cases).

Table 9. Membership in obedience/agility training groups and the owner's ability to interpret signs of shame in photographed dogs (% of answers).

Photo	Non-members n=432	Obedience n=56	Agility n=25	Members combined[2] n=81
1	5.33	3.57	0.00	2.47
2	**33.10^{ab}**	**12.50^{a}**	20.00	**14.81^{b}**
3	**31.94^{AB}**	**3.57^{A}**	12.00	**6.17^{B}**
4	2.08	0.00	0.00	0.00
5	**34.49^{AB}**	**7.14^{A}**	16.00	**9.87^{B}**
6	**44.68^{Aa}**	**17.86^{A}**	44.00	**25.93^{a}**
7	1.16	0.00	0.00	0.00
8	1.62	0.00	0.00	0.00
9	1.39	0.00	0.00	0.00
10	**17.83^{a}**	7.14	8.00	**7.41^{a}**
11	**19.91^{ABa}**	**3.57^{A}**	**0.00^{a}**	**2.47^{B}**
PA ratio[1]	**1.94^{ABa}**	**0.55^{A}**	**1.00^{a}**	**0.69^{B}**
None	**27.08^{AB}**	**73.21^{A}**	52.00	**66.66^{B}**

[1] Ratio of the number of positive answers to the number of people in the group
[2] Total responses in Obedience and Agility groups vs. the responses given by non-members
[A] mean values with the same uppercase letter within rows are different at p≤0.01
[a] mean values with the same lowercase letter within rows are different at p≤0.05.

Table 10. Membership in obedience/agility training groups and the owner's ability to interpret signs of stress in photographed dogs (% of answers).

Photo	Non-members n=432	Obedience n=56	Agility n=25	Members combined[2] n=81
1	**34.49^{AB}**	**76.79^{A}**	64.00	**72.84^{B}**
2	**43.75^{a}**	62.50	72.00	**65.43^{a}**
3	77.32	89.29	100.00	92.60
4	**2.08^{a}**	**8.93^{a}**	0.00	6.17
5	78.24	89.29	96.00	91.36
6	41.20	60.71	52.00	58.02
7	0.69	0.00	0.00	0.00
8	0.92	3.57	0.00	2.47
9	2.55	5.36	0.00	3.71
10	74.07	85.71	80.00	83.95
11	61.58	87.50	80.00	85.19
PA ratio[1]	**4.17^{ab}**	**5.70^{a}**	5.44	**5.62^{b}**
None	1.62	3.57	0.00	2.47

[1] Ratio of the number of positive answers to the number of people in the group
[2] Total responses in Obedience and Agility groups vs. the responses given by non-members
[A] mean values with the same uppercase letter within rows are different at p≤0.01
[a] mean values with the same lowercase letter within rows are different at p≤0.05.

Discussion

In the displayed photographs, dogs differed in terms of nonverbal signals such as gaze direction, ear and tail position, opened or closed mouth and body posture. According to the previous research (Bremhorst et al., 2019; Hasegawa et al., 2014; Bloom et al., 2021), these signs can be used by dog owners as a crucial source of information about their pets' emotional state. Many people find it difficult to identify the non-verbal cues displayed by dogs (Gallagher & Tami, 2009). The circumstances in which the experimental photos were taken are unknown, therefore we cannot unambiguously confirm whether the dogs were in fact feeling ashamed, joyful or stressed, or which interpretations were correct. However, the varied responses given by dog owners who were presented with the same photographs are not only intriguing, but also disturbing, because they indicate that not a single emotion was correctly interpreted by all respondents. These observations suggest that people should be educated about the prerequisites for effective human-animal communication, and they should learn how to accurately interpret canine emotions and, perhaps most importantly, stress signals which, when disregarded or underestimated, can prompt the dog to attack a human (Bradley, 2014). Proper stress recognition is needed to adequately estimate an animal's anxiety level and minimize the risk of anxiety-induced aggression (Mannion & Shepherd, 2014; Lakestani et al., 2014; Gallagher & Tami, 2009; Salgirli et al. 2016). Public awareness of stress signals in dogs should be raised to reduce the number of injuries from dog bites. According to Loder (2019), the overall annual incidence of dog bite injures noted by United States emergency department was 1.1 per 1,000 population. Bearing in mind the annual costs associated with medical treatment of dog bite victims, these preventive measures can also generate measurable financial and economic benefits (Mannion & Shepherd, 2014). The ability to read stress signals in dogs may improve social and emotional skills and enhance the quality of canine-human relations, which may consequently lead decrease the number of homeless dogs.

Meyer & Forkman (2014) and Lakestani et al. (2014) found that the experience of owning a dog has an impact on human interpretation of canine emotions. However, in the present study, the duration of ownership was not correlated with the ability to identify canine behaviors indicative of joy, shame or stress. In this context, important observations were made by Salgirli et al. (2016) who found that people with similar experience in caring for a dog interpreted canine behaviors differently due to varied levels of scientific knowledge about dogs. Therefore, it could be assumed that the experience of owning a dog is not as important as the quality of human-canine interactions, the specificity of non-verbal communication between a dog and its owner, and the quality of the relationship.

As demonstrated in Tables 2-4, no significant differences were found between the answers given by respondents who owned only one dog and those who owned at least two dogs, which suggests that the number of owned dogs may not play a significant role in the owner's ability to interpret canine behavior. The dog's genetic origin appears to be a more important factor because crossbreed dog owners recognized signs of shame and happiness more often than purebred dog owners, whereas a reverse trend was noted in the respondents' ability to identify signs of stress. Perhaps, the owners of purebred dogs are somewhat more familiar with symptoms of canine stress; however, further research is needed to confirm this assumption.

A comparison of the responses given by owners of different dog breeds/types produced highly interesting results. Unlike more than 40% of companion and toy dog owners and other participants, the majority of Border Collie owners (94.74%) did not recognize signs of joy in photograph 1. The Border Collie differs from other breed in many respects. Border Collies herd sheep and win herding competitions. The breed also scores high in obedience and agility training (Pastore et al., 2011). Border Collies are highly active, and they are usually chosen by owners who have had previous experience with dogs and who enjoy dog sports. In fact, some Border Collie owners in this survey belonged to online obedience or agility training groups. It should also be noted that Border

Collie owners recognized signs of joy relatively rarely (PA ratio of 3.16), and they most often identified signs of stress (PA ratio of 5.21). Owners of defensive dog breeds and FCI group III, V, VIII and IX dogs were also surveyed. This division resulted mainly from the structure of dog breeds owned by the respondents. Numerous studies have demonstrated that behavioral differences exist between breeds or between groups of dogs (Coren, 1994; Helton, 2009; Helton, 2010; Turcsán et al., 2011; Mehrkam & Wynne, 2014). Defensive breeds, including German Shepherd, Belgian Shepherd Malinois, Rottweiler, Doberman and Giant Schnauzer, are renowned for their courage, working intelligence and trainability. Terriers are renowned for their bravery and cleverness. In turn, companion and toy dogs (group IX) are expected to spend a lot of time with people without bothering them (Palika, 2007; Strychalski et al., 2015; Lipka et al., 2017). In this study, the owners of these dog breeds did not recognize signs of joy in the photographs (Table 5), but this observation is difficult to explain. No significant correlations were found between dog type/breed and the owners' ability to identify signs of shame. However, signs of stress were less frequently recognized by the owners of FCI group VIII dogs than terrier owners. FCI group VIII breeds are more similar in terms of personality, and terriers are even more similar to each other; therefore, the observed differences in appear to be justified.

According to Bloom et al. (2021), human perceptions of dogs are influenced by type/breed-specific appearance, including head shape, coat color, history of domestication, as well as the type of relationships that a given breed establishes with humans. Another aspect was investigated in this study, namely the respondents' ability to read emotions in dogs with different genetic origin (purebred vs. crossbreed) and in dogs of different breed/type. Both factors were important. Further research is needed to determine the way in which the owners of different dog types/breeds interpret specific features and which features are regarded as most important for understanding canine behavior. It would also be interesting to determine whether tail visibility affects the respondents' interpretations of canine behavior. In the present study, tails were not visible in all pictures. We agree with Gallagher & Tami (2009) who noted that this fact could have influenced the answers by throwing people into confusion.

As expected, the interpretation of canine emotions was influenced by the respondents' affiliation with obedience/agility training groups. The majority of dog owners who were not members of obedience/agility training groups recognized more signs of joy and shame, but fewer signs of stress than the respondents who belonged to these groups (Tables 8-10). Similar results were reported by Hasegawa et al. (2014) who found that a dog's learning outcomes are determined mainly by the trainer's ability to apply the knowledge of canine behavior to minimize stress levels in the teaching process. Therefore, the ability to understand a dog's body language is crucial for achieving spectacular results in dog training. These observations also imply that in order to achieve success in canine sport disciplines, such as obedience and agility, trainers should be able to perceive and correctly interpret a dog's emotions as well as willingness to learn. Only then, the trainer can apply new training methods and modify training time to achieve better results within a much shorter time (Hasegawa et al., 2014; Gazzano et al., 2015; Bremhorst et al., 2019).

Conclusions

The results of this study indicate that a dog's breed and genetic origin (purebred vs. crossbreed), and the owner's interest in cynological sports influence humans' ability to read canine behaviors and emotions.

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Percezioni delle manifestazioni di gioia, vergogna e stress dei cani domestici (*Canis familiaris*) basate su fotografie

Ewelina Kuźniewska, Janusz Strychalski

Department of Fur-bearing Animal Breeding and Game Management, Faculty of Animal Bioengineering, University of Warmia and Mazury, 10-719 Olsztyn, Poland

Sintesi

Lo scopo dello studio era determinare la misura in cui l'esperienza di possedere un cane, il numero di cani posseduti, la proprietà di cani di razza o incrocio, la razza del cane e l'appartenenza a gruppi sociali online dedicati all'obbedienza e all'agilità influenzi la capacità di identificare sentimenti di gioia, vergogna e stress nei cani sulla base di fotografie.

Un sondaggio online è stato condiviso su selezionati siti di social network dedicati ai cani. Agli intervistati sono stati forniti collegamenti a 11 fotografie online. Il questionario è stato compilato da 513 persone. La durata della proprietà o il numero di cani posseduti non erano correlati con la capacità di identificare comportamenti canini indicativi di gioia, vergogna o stress. Tuttavia, i risultati ottenuti hanno rivelato che la proprietà di cani di razza o incrocio influisce sulla capacità dei proprietari di interpretare i sentimenti dei cani. In una delle foto, i proprietari di Border Collie avevano meno probabilità di notare segni di gioia nei cani rispetto ai proprietari di razze difensive, cani del gruppo V FCI e cani del gruppo FCI IX. Segni di stress non sono stati identificati da nessun proprietario di terrier, mentre è stato notato dal 9,3% dei proprietari di cani del gruppo VIII FCI. La maggior parte dei proprietari di cani che non erano membri di gruppi sociali online di obbedienza/agilità ha riconosciuto più segni di gioia e vergogna, ma meno segni di stress rispetto agli intervistati che appartenevano a questi gruppi. I risultati dello studio indicano che la razza e l'origine genetica di un cane (razza contro incrocio) e l'interesse del proprietario per gli sport cinologici influenzano la capacità degli esseri umani di leggere i comportamenti e le emozioni canine.