

## Video Article

# The Other End of the Leash: An Experimental Test to Analyze How Owners Interact with Their Pet Dogs

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## Abstract

It has been suggested that the way in which owners interact with their dogs can largely vary and influence the dog-owner bond, but very few objective studies, so far, have addressed how the owner interacts with the dog. The goal of the present study was to record dog owners' interaction styles by means of objective observation and coding. The experiment included eight standardized situations in which owners of pet dogs were asked to perform specific tasks including both positive (i.e. playing, teaching a new task, showing a preference towards an object in a food searching task, greeting after separation) and potentially distressing tasks (i.e. physical restriction during DNA sampling, putting a T-shirt onto the dog, giving basic obedience commands while the dog was distracted). The video recordings were coded off-line using a specifically designed coding scheme including scores for communication, social support, warmth, enthusiasm, and play style, as well as frequency of behaviors like petting, praising, commands, and attention sounds. Exploratory Factor Analysis of the 20 variables measured revealed 3 factors, labeled as Owner Warmth, Owner Social Support, and Owner Control, which can be viewed as analogues to parenting style dimensions. The experimental procedure introduced here represents the first standardized measure of interaction styles of dog owners. The methodology presented here is a useful tool to investigate individual variation in the interaction style of pet dog owners that can be used to explain differences in the dog-human relationship, dogs' behavioral outcomes, and dogs stress coping strategies, all crucial elements both from a theoretical and applied point of view.

## Video Link

The video component of this article can be found at <https://www.jove.com/video/56233/>

## Introduction

Humans are the principal social partners of pet dogs living in western households and the study of the relationships dogs and humans build with each other is of primary importance from both the theoretical and applied points of view<sup>1</sup>. In fact, dogs, having closely evolved with humans, can be studied as models for the evolution of human social skills<sup>2</sup>. Additionally, the widespread presence of dogs in human environments presents societies with practical issues that have implications for human safety, dog welfare, and the health of both parties<sup>3</sup>. In fact, it has been shown that the way in which handlers treat their dogs during training (e.g. using punishment-based techniques) is associated with dog aggression towards people and conspecifics, highlighting the importance of considering how the owner behaves with its dog in dog bites prevention<sup>4,5,6</sup>. However, most of the studies which aimed at investigating the dog-owner relationship focused only on one partner: the dog. While hundreds of measurements have been developed to describe one or more aspects of the dog behavior<sup>7</sup>, no studies so far have systematically coded how the owners behave towards their dogs in a variety of contexts. While many studies acquired information about the owners' behavioral characteristics using questionnaires (e.g.<sup>8,9,10,11</sup>), only few studies used behavioral observations to analyze the way dog owners interact with their pet dogs<sup>12,13,14,15,16,17,18</sup>. However, these latter studies investigated the behavior of dog owners in only a few contexts (ranging between one<sup>12,13,15,17</sup> and three<sup>16</sup>, and mainly contexts with positive valence (e.g. play<sup>12,14,15</sup>)), and only three of these studies were conducted in a standardized environment<sup>14,15,17</sup>. Moreover, most studies focused on training methods<sup>4,11,16,19</sup>, applied by owners in specific contexts, like teaching a dog a specific behavior or modifying undesired ones. However, formal training is just one way that owners interact with their dogs and it may depend not only on the owners' own characteristics but also on the dog school they attend. Therefore, the way owners train their dogs may not even reflect reliably how they spontaneously interact and communicate with them in everyday life situations, with the latter probably being more important in affecting the dogs' everyday behavior. Considering the lack of standardized measurements of dog owners' behavioral characteristics, we developed the first behavioral test aimed at analyzing how owners interact with their pet dogs in tasks reflecting everyday situations.

It has been shown that human infants' behavior is influenced by daily interactions with their parents: for example, by how parents support their children's autonomy<sup>20</sup>, how sensitive and responsive parents are in distressful situations<sup>21</sup>, and how parents control the behavior of their

children<sup>22</sup>. All these elements have been proven to greatly vary among parents and the combinations of these behaviors are known as parenting styles<sup>20,21,22,23,24</sup>. Since the dog-owner relationship has been described as similar to the child-mother bond<sup>1,25,26</sup>, it is feasible to assume that the way the owners interact with their dogs can also be categorized into specific behavioral patterns (i.e. owner interaction styles), but no attempt has been made so far to create such categories.

Human parenting style studies have shown that combining detailed observational coding and factor analytic methods are less susceptible to coder biases and more reliable than global ratings and self-reports<sup>27</sup>. Therefore, we decided to apply this method to study the interaction styles of dog owners. The present study was conducted in a laboratory setting and the behavior of the owners was videotaped and analyzed off-line by two independent coders (allowing us to test for inter-rater reliability). The tasks were designed to reflect everyday situations that dog-owner dyads are confronted with in a western, urbanized environment. Importantly, we included tasks with both positive and negative valence for the dog. The coding scheme we used included a combination of variables reflecting verbal, facial, physical, and gestural communication, measured as counts and scales. For the characterization of the owner interaction styles we used Exploratory Factor Analysis.

The present method is not only the first specifically developed to describe pet dog owners' behavioral characteristics in numerous different contexts, but it also allowed for identification of owner interaction dimensions, which might show high similarity to the dimensions used to describe parenting styles<sup>18,28</sup>.

The present paper describes in detail the entire procedure and presents some of the results which are published in full in Cimarelli et al. (2016)<sup>18</sup>.

## Protocol

All methods described here were approved in accordance with GPS guidelines and national legislation by the Ethical Committee for the use of animals in experiments at the University of Veterinary Medicine of Vienna (Ref: 09/10/97/2012 and 10/10/97/2012).

### 1. Participant recruitment

1. Recruit 220 owners (here, 187 females, 33 males; mean age  $\pm$  SD = 38.64  $\pm$  13.57 years, range 13-72 years) of pet Border Collies and invite them to take part in a behavioral study with their dogs (here, 125 females (45 neutered) and 95 males (32 neutered); mean age  $\pm$  SD = 48.07  $\pm$  42.43 months).

### 2. Behavioral testing procedure

#### 1. Pre-test

1. Welcome the owner and the dog to the lab and invite them to familiarize with the experimental room (6 m X 5 m, see **Figure 1**).
2. Explain to the owner the overall procedure for 5 min while the dog is free to explore the room.
3. Videotape the tests using four digital video cameras placed at the four corners of the room (black dots named "Camera" in **Figure 1**) connected to a video-recording station outside the test room.

#### 2. Food Choice Test

1. Have the owner sit on a chair on one side of the room (orange square; "Chair (Food choice)" in **Figure 1**).
2. Provide the owner with a questionnaire to record demographic information of both dog and owner (i.e. owner age, owner gender, dog age, dog sex, dog neuter status) so that the owner does not influence the dog during the set-up and choice.
3. Put the dog on a leash and tie it to the wall directly opposite to the owner (orange curved line; "Leash (Food choice + Teaching)" in **Figure 1**).
4. Take two plates (one with a piece of sausage and one empty) from a table positioned beside the owner (orange square; "Table" in **Figure 1**).
5. Walk towards the dog and place the two plates on the floor in front of the dog, 1 m from each other and 1.5 m from the dog (orange squares; "Plate 1 (Food choice)" and "Plate 2 (Food choice)" in **Figure 1**).
6. Walk behind the dog. Stand behind the dog looking at the floor.
7. Have the owner stand up, walk to the empty plate and crouch next to it.
8. Have the owner pick the plate up and show to the dog that this plate is interesting and delicious.  
NOTE: Instruct the owner to show preference for the empty plate for ~ 5 s, but otherwise let the owner behave as desired.
9. Have the owner go back to the chair and continue filling in the questionnaire.
10. Once the owner sits back on the chair, release the dog from the leash and allow it to approach one plate.
11. Once the dog is within 15 cm from one plate, walk to pick up the other plate.
12. Hold the leash and bring the dog back to the starting position (orange curved line in **Figure 1**). Collect the other plate from the floor and bring both plates back to the table.
13. Repeat the procedure (steps 2.2.2 - 2.2.12) six times.

#### 3. DNA sample collection

1. Have the owner hold the dog by the collar/harness in the "DNA sample area" (**Figure 1**). Explain that DNA samples will be collected from the inner side of the dog's mouth. Instruct that the owner can talk to and pet the dog during this test. Allow the owner to behave as desired.
2. Take the samples by crouching close to the dog and gently rotating a cotton swab in the inner side of the mouth. Repeat with a second swab.
3. Repeat the procedure twice, one for each side of the dog's mouth.

#### 4. Reunion after separation

1. Have the owner leave the experimental room by "Door 1" (**Figure 1**) for 3 min, while the dog stays inside the room unleashed and free to move.
  2. Have the owner go back inside the room by "Door 1" and pause next to the door (blue square; "Owner position 2 (Reunion + Commands)") for 5 s without interacting with the dog. Have the owner greet the dog for 30 s. Instruct the owner to greet the dog as done at home.
5. **Tug-of-war play**
1. Have the owner use a rope toy to play tug-of-war with the dog for 30 s. Instruct the owner to play with the dog as they normally would in everyday play situations.
6. **T-shirt**
1. Have the owner put a T-shirt on the dog by placing it over the head, putting each front paw into the sleeves one after the other, and tying a knot at the bottom of the T-shirt on the dogs' back.
  2. Have the owner walk around the room ignoring the dog. After 30 s, have the owner remove the T-shirt off the dog. Instruct the owner not to talk during the procedure, but behave as desired.
7. **Basic commands**
1. Have the experimenter crouch on one side of the room (grey square; "Experimenter position (Commands)" in **Figure 1**) behind a box full of crumpled newspapers.
  2. Have the owner stand on the opposite side (grey square; "Owner position 1 (Commands) + Owner position (Ball play)" in **Figure 1**).
  3. Have the owner call the dog so that both the owner and the dog are in the grey square ("Owner position 1 (Commands) + Owner position (Ball play)"), the dog facing the doors, the owner facing the dog.
  4. Search for something in a box full of crumpled newspaper to distract the dog from the owner's commands.
  5. Have the owner issue three simple commands to the dog.
    1. First, have the owner command the dog to sit. Once the dog sits, have the owner command the dog to lay down. Once the dog lays down, have the owner command the dog to stay.
  6. After the stay command, have the owner walk towards the experimenter and wait for 15 s besides the experimenter, 5 m from the dog (blue square; "Owner position 2 (Reunion + Commands)" in **Figure 1**), facing the dog. Have the owner call the dog. The owner can praise and talk to the dog during the task.
8. **Teaching**
1. Have the owner tie the dog on a 1 m leash to the wall (curved line; "Leash (Food choice+ Teaching)" in **Figure 1**) and walk 2 m away from the dog (red dotted area; "Teaching area" in **Figure 1**).
  2. Have the owner show the dog how to remove the lid from a bin containing a piece of sausage following this sequence:
    1. Hold a piece of sausage in one hand while removing the lid of the bin with the other hand. Put the food in the bin and cover it back. Remove the lid of the bin and show the food inside the bin.
    2. Have the owner repeat the procedure four times.
 NOTE: The owner can talk and look at the dog during the whole procedure.
9. **Ball play**
1. Have the owner stand in a specific location of the room (grey square; Ball play; **Figure 1**) and throw a tennis ball towards the opposite side of the room. Have the owner to ask the dog to retrieve the ball.
  2. Have the owner repeat the procedure three times.
- NOTE: Instruct the owner to play with the dog as they normally would in everyday play situations.

### 3. Behavioral coding

1. Analyze the videos taken during testing and record the following behaviors on a spreadsheet:
  1. Score the behavioral variables; communication style, active social support, warmth and play style on a 4-point scale, and score the enthusiasm and authoritarian behaviors on a 3-points scale. See Table 1 for definitions of each value.
  2. Count the number of commands, praises, petting and attention sounds in the situations indicated in Table 1.
2. Provide a second coder the list and definitions of the coded variables. Have the second coder code 20% of the videos to calculate inter-rater reliability.

### 4. Data processing

1. Transform all count variables in 2- or 4-point scales as described in Table 2.
2. Run an Exploratory Factor Analysis (EFA) with Oblimin rotation on all behavioral variables. Define the number of factors to be extracted based on the Scree plot. Extract the factors using a regression method and excluding missing values list wise.
3. Calculate the internal consistency of the extracted factors using Cronbach's alpha. Compare the data provided by the main coder and a second coder using Cohen's kappa to have a measure of the inter-rater reliability.

## Representative Results

### Exploratory Factor Analysis

The EFA conducted on the behavioral variables analyzed during the Owner Interaction Style test revealed three factors accounting for 29.47% of the total variance. The Kaiser-Meyer-Olkin (KMO) test resulted in a value of 0.69. The first factor was labeled "Owner Warmth" (variance explained: 17.41%, internal consistency: Cronbach's  $\alpha = 0.77$ ) and it included the following behavioral variables: enthusiasm, frequency of praising, and play style during Ball play; enthusiasm, frequency of praising, and play style during Tug-of-war play; warmth during the Reunion after separation; communication style during Teaching; communication style during Food choice. The second factor, labeled as "Owner Social Support" (variance explained: 6.64%; internal consistency: Cronbach's  $\alpha = 0.68$ ) included the following behaviors: social support, frequency of petting, and frequency of praising during the DNA sample; social support during the T-shirt; frequency of petting, and frequency of praising during Basic commands. The third factor was labeled "Owner Control" (variance explained: 5.41 %; internal consistency: Cronbach's  $\alpha = 0.49$ ) and it included: frequency of commands during Ball play; frequency of attention sounds and commands during Tug-of-war play; frequency of commands during Basic commands.

### Relationship between the extracted factors

The factors "Owner Warmth" and "Owner Social Support" correlated positively with each other (Pearson's  $r = 0.53$ ,  $p < 0.01$ , **Figure 2**), while "Owner Control" seemed to be independent from the other two factors ("Owner Control" vs. "Owner Warmth"; Pearson's  $r = -0.03$ ,  $p > 0.05$ ; "Owner Control" vs. "Owner Social Support"; Pearson's  $r = -0.05$ ,  $p > 0.05$ ).

### Inter-rater reliability

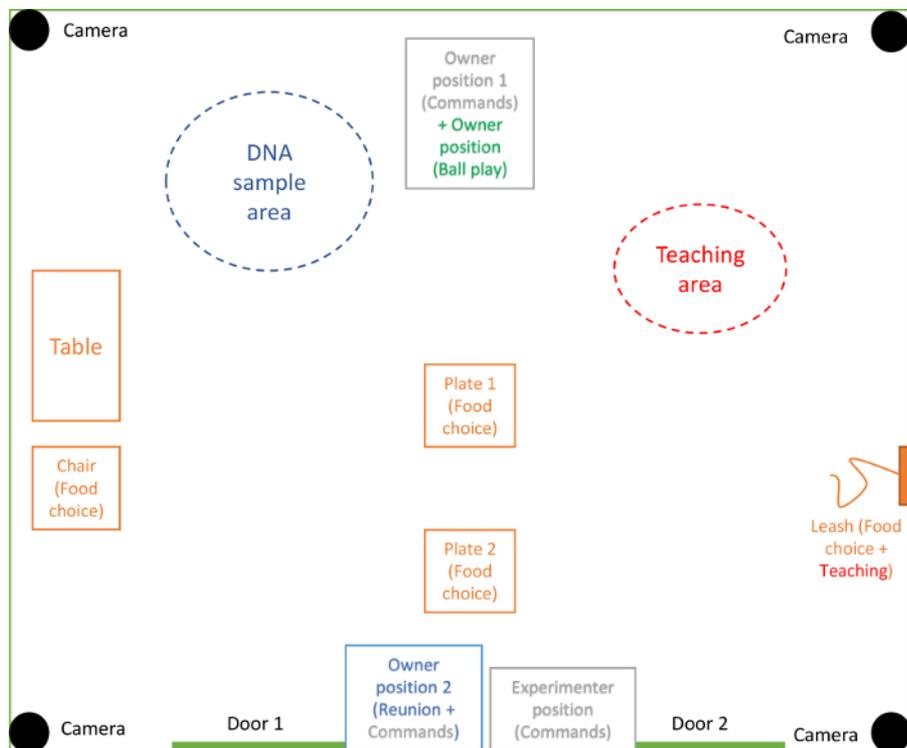
The agreement between the two independent coders ranged between good to excellent depending on the variable (Cohen's kappa = 0.72 - 0.94).

### Associations between the owners' demographic characteristics and the extracted factors

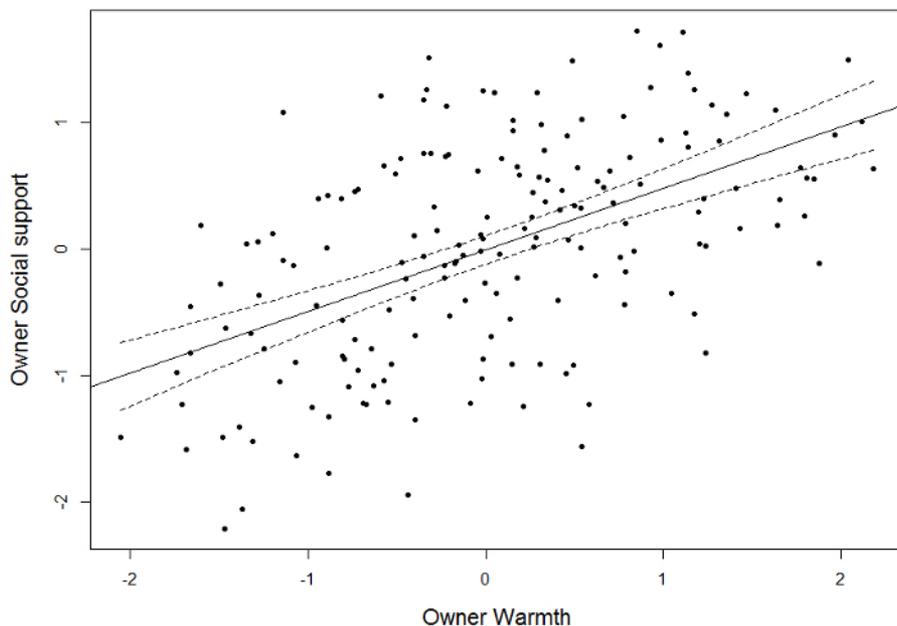
In a previous study<sup>18</sup>, we found that the age of the owner was negatively associated with "Owner Warmth" (Pearson's  $r = -0.25$ ,  $p < 0.01$ , **Figure 3**) and with "Owner Social Support" (Pearson's  $r = -0.24$ ,  $p < 0.01$ , **Figure 4**), but no significant correlation was found with "Owner Control" (Pearson's  $r = 0.12$ ,  $p > 0.05$ ). Furthermore, we found that female owners scored higher in "Owner Warmth" than male owners (Pearson's  $r = 0.15$ ,  $p < 0.05$ ), but not in "Owner Social Support" (Pearson's  $r = 0.13$ ,  $p > 0.05$ ) and "Owner Control" (Pearson's  $r = 0.04$ ,  $p > 0.05$ ). Additionally, we showed that "Owner Control" was negatively associated with the personality factor called "Openness" (Pearson's  $r = -0.22$ ,  $p < 0.01$ ) and that "Owner social Support" was negatively associated with the personality factor called "Conscientiousness" (Pearson's  $r = -0.16$ ,  $p < 0.05$ ).

### Associations between the extracted factors and dog behavior

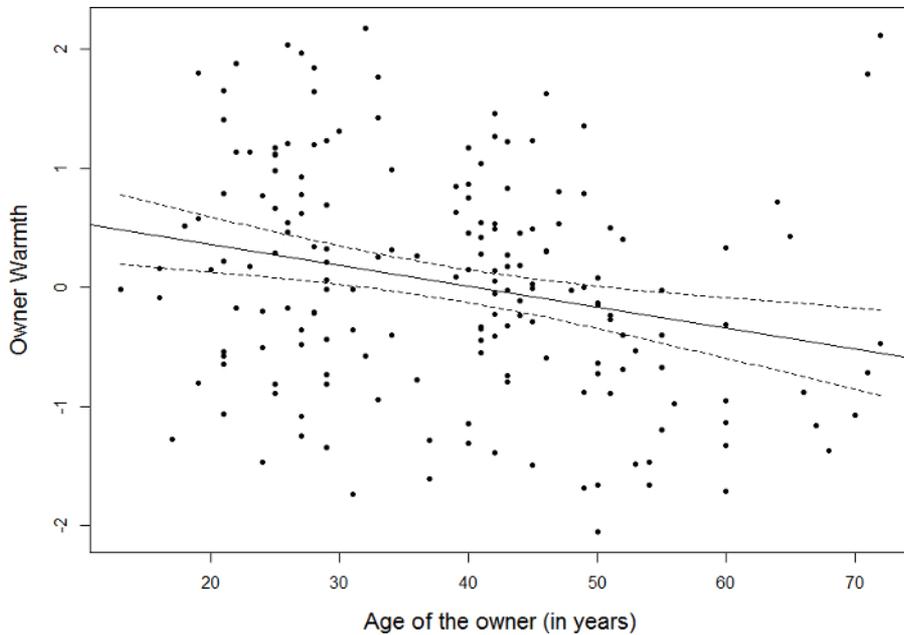
The present methodology, analyzing various aspects of a dog owner interaction style, allows for investigating the effects of the owner's behavior on the behavior of his/her dog. In a previous study<sup>18</sup>, we analyzed whether the reaction of a dog to a stressful situation (that is, a stranger approaching the dog in a threatening manner) is dependent on the behavior of the owner. There, we found that the likelihood that a dog would hide behind the owner when approached by a threatening stranger was higher for dogs whose owners scored higher in "Owner Warmth" than in dogs whose owners scored lower (Pearson's  $r = 0.16$ ,  $p < 0.05$ ). Similarly, when the stranger was closer than 2 m to the dog-owner dyad, we found that dogs that stepped back towards the owner or remained passive throughout the threatening approach had owners which scored higher in "Owner Warmth" than dogs that approached the stranger (either in a friendly, appeasing or aggressive manner) (Multinomial regression model:  $\chi^2 = 8.94$ ,  $p < 0.05$ ). In addition, we found that the likelihood that a dog would show aggression towards the threatening stranger was higher in dogs, whose owners scored higher in "Owner Control" than in dogs whose owners scored lower in this factor (Pearson's  $r = -0.15$ ,  $p < 0.05$ ).



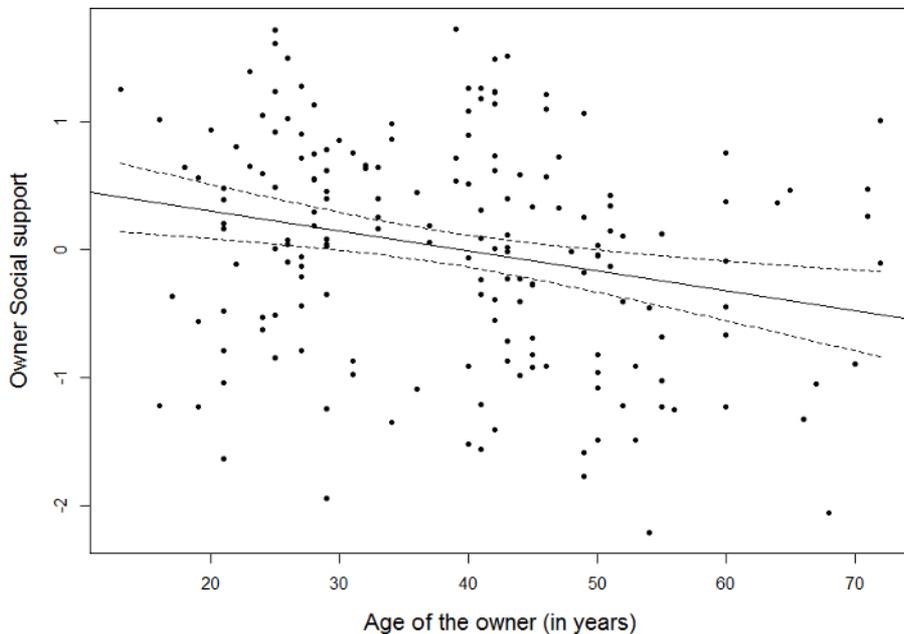
**Figure 1: Experimental set-up.** The figure represents the experimental room in which the tests are performed. The room has two doors (Door 1 and Door 2) on one side of the room and four cameras placed at the four corners of the room ("Camera"). The figure shows the position of the owner, the dog, and the experimenter throughout the tests as well as the position of the chair, the table, and the plates used during the Food choice test. Finally, it shows the position of the areas in which the DNA sample collection and the Teaching test are performed. [Please click here to view a larger version of this figure.](#)



**Figure 2: Positive association between "Owner Warmth" and "Owner Social Support" factors (Pearson's  $r = 0.53$ ,  $p < 0.01$ ).** [Please click here to view a larger version of this figure.](#)



**Figure 3: Negative association between "Owner Warmth" and the age of the owner (in years) (Pearson's  $r = -0.25$ ,  $p < 0.01$ ).** Older owners scored lower in "Owner Warmth" than young owners. This figure has been adapted from <sup>18</sup>. [Please click here to view a larger version of this figure.](#)



**Figure 4: Negative association between "Owner Social Support" and the age of the owner (in years) (Pearson's  $r = -0.24$ ,  $p < 0.01$ ).** Older owners scored lower in "Owner Social Support" than young owners. [Please click here to view a larger version of this figure.](#)

Behavior	Type	Definition	Test in which it was coded
Communication style	Score	1: The owner expresses their preference in a cold way and never looks at the dog; 2: The owner expresses their preference in a cold way but looks at the dog at least once but no longer than for 2 sec; 3: The owner communicates with the dog using a friendly, high-pitched tone of voice and looks at the dog more than once. The owner does not smile; 4: The owner communicates with the dog in a friendly, high-pitched tone of voice, smiles and looks at the dog for almost the entire trial	Food choice, Teaching
Enthusiasm	Score	1: The owner plays with the dog showing low energy and no involvement; 2: The owner plays with the dog showing medium energy and scarce involvement, 3: The owner plays with the dog showing high energy and high involvement	Ball play, Tug-of-war play
Praising	Frequency	Verbal utterances pronounced in a positive and friendly tone of voice (e.g., German equivalents of "Well done!", "Super!")	Ball play, Tug-of-war play, DNA sample, Basic commands
Petting	Frequency	Pats, strokes, and scratches	DNA sample, Basic commands
Play style	Score	1: The owner does not laugh or smile during the play session, continuously gives commands and uses a strong/harsh tone of voice. The owner never allows the dog to win the game; 2: The owner does not laugh or smile during the play session and might give commands to the dog using a strong/harsh tone of voice. The owner never allows the dog to win the game; 3: The owner is cheerful and enthusiastic during the play session but does not allow the dog to win the game; 4: The owner is cheerful and enthusiastic during the play session and lets the dog win the game.	Ball play, Tug-of-war play
Warmth	Score	1: The owner is avoidant and pushes down the dog if she tries to jump on her/him. The owner does not greet actively the dog and could give some commands to control the behavior of the dog; 2: The owner is avoidant but can accept passively the greetings of the dog. The owner does not greet actively the dog and could give some commands like "sit" or "down" to control the behavior of the dog; 3: The owner actively greets the dog and speaks to the dog in a friendly and high pitched tone of voice; 4: The owner clearly smiles and greets the dog in an excited way speaking to the dog in a friendly and high pitched tone of voice	Reunion after separation
Social Support	Score	1: The owner restricts the movements of the dog using strength, never reassures the dog nor verbally, nor physically and speaks with the dog using a harsh tone of voice; 2: The owner restricts the movements of the dog using strength, never reassures the dog nor verbally, nor physically but does not use a harsh tone of voice. 3: The owner might reassure the dog verbally and/or physically but not continuously. The owner speaks to the dog in gentle way and could praise the dog at the end of the test; 4: The owner reassures the dog verbally and/or physically continuously. The owner speaks to the dog in gentle way and praises the dog during and at the end of the test	DNA sample, T-shirt
Commands		Verbal utterances pronounced using an imperative tone of voice (e.g., German equivalents of "sit!" or "stay!")	Ball play, Tug-of-war play, Basic commands
Attention sounds	Frequency	Claps, whistles, tongue, or palatal clicks	Ball play, Tug-of-war play
Authoritarian behaviors	Score	1: The owner does not raise the tone of voice neither forces the dog in a determined position; 2: The owner raises the tone of the voice; 3: The owner goes physically forces the dog in a determined position	Basic commands

**Table 1: List and definitions of the behaviors analyzed during the Owner Interaction Style test.** This table has been adapted from <sup>18</sup>.

Test	Behavior	Transformation	Distribution	
DNA sample collection	Commands	N = 0 -> score 1	34.60%	
		N = 1 - 2 -> score 2	37.10%	
		N = 3 - 5 -> score 3	17.10%	
		N = 6 - 19 -> score 4	11.20%	
	Attention sounds	N = 0 -> score 1	77.80%	
		N = 1 - 5 -> score 2	22.20%	
	Petting	N = 0 -> score 1	25.40%	
		N = 1 - 2 -> score 2	26.30%	
		N = 3 - 5 -> score 3	26.80%	
		N = 6 - 20 -> score 4	21.50%	
	Praising	N = 0 - 4 -> score 1	25.40%	
		N = 5 - 9 -> score 2	26.30%	
		N = 10 - 14 -> score 3	26.80%	
		N = 15 - 20 -> score 4	21.50%	
	Tug-of-war play	Commands	N = 0 -> score 1	38.00%
			N = 1 - 2 -> score 2	24.50%
N = 3 - 5 -> score 3			27.40%	
N = 6 - 13 -> score 4			10.10%	
Attention sounds		N = 0 -> score 1	68.60%	
		N = 1 - 13 -> score 2	31.40%	
Praising		N = 0 - 4 -> score 1	24.80%	
		N = 5 - 9 -> score 2	27.60%	
		N = 10 - 14 -> score 3	20.00%	
		N = 15 - 20 -> score 4	27.60%	
Basic commands		Commands	N = 3 - 6 -> score 1	29.20%
			N = 7 - 9 -> score 2	26.10%
	N = 10 - 14 -> score 3		22.80%	
	N = 15 - 50 -> score 4		21.90%	
	Petting	N = 0 -> score 1	13.20%	
		N = 1 - 2 -> score 2	47.90%	
		N = 3 - 4 -> score 3	19.60%	
		N = 5 - 10 -> score 4	19.30%	
	Praising	N = 0 -> score 1	23.20%	
		N = 1 -> score 2	33.30%	
		N = 2 -> score 3	19.80%	
		N = 3 - 10 -> score 4	23.70%	
	Ball play	Commands	N = 0 -> score 1	23.70%
			N = 1 - 2 -> score 2	19.80%
			N = 3 - 5 -> score 3	30.00%
			N = 6 - 77 -> score 4	26.50%
Attention sounds		N = 0 -> score 1	42.50%	
		N = 1 - 16 -> score 2	57.50%	
Praising		N = 0 -> score 1	35.30%	
		N = 1 - 2 -> score 2	29.00%	

		N = 3 - 4 -> score 3	19.80%
		N = 5 - 10 -> score 4	15.90%

**Table 2. Data processing of the behavioral variables initially coded as counts.** The number of commands, praising, and petting are transformed into 4-point scales while the number of attention sounds are transformed into 2-point scales. This table has been adapted from <sup>18</sup>.

## Discussion

The Owner Interaction Style test is a newly developed protocol aiming at analyzing the behavior dog owners show towards their dogs in many different situations. We defined three factors characterizing the interaction style of pet dog owners, which related to warmth, social support, and control. The three factors show similarities with the dimensions identified in human parenting<sup>21,22,29</sup>. Moreover, two of the factors identified here significantly correlated with owner age, suggesting a modulatory effect of age on owner interaction styles.

In a previous study, conducted using the methods presented here, we also found associations between the owner interaction factors and personality traits (i.e. a negative association between Owner Control and Openness, between Owner Social Support and Conscientiousness, and a positive association between Owner Warmth and Openness)<sup>18</sup>. Building on this, in the current study we additionally found associations between owner interaction factors and dog behavior (e.g. positive associations between dog proximity-seeking behaviors towards the owner and Owner Warmth)<sup>18</sup>. Taken together, the results suggest that the present methodology provides reliable and useful measurements of human social behaviors that can advance the fields of animal-human interactions, human personality, and social psychology.

The objective behavioral analyses combined with a factor analytical approach allowed a more objective assessment of the behavior than the use of owner reports or questionnaires. The inter-coder reliability analysis confirmed that the results are also reliable and free from coder bias/subjectivity. The present protocol is the first to comprehensively analyze the behavior of dog owners in a variety of situations mirroring the everyday life of dog-owner dyads. This includes components of owner behavior that the owners do not necessarily intentionally use to influence their dogs or that they are even consciously aware about. As such, the Owner Interaction Style Test covers a much broader range of behaviors than most other studies investigating human-animal interactions, many of which focus on training or verbal commands<sup>4,11,16,19</sup>.

One of the three components of owner interaction styles, namely the Owner Social Support factor, was associated with neither owner personality or dog behavior<sup>18</sup>. As a possible explanation, this factor in its current form may include not only appropriately supportive but also overprotective behaviors. In children, adequately supportive and overprotective parenting lead to different behavioral outcomes<sup>31</sup>, which may also be the case in dogs. For this reason, overprotectiveness and adequate support need to be better disentangled, for example by adding a global rating scale about the owners' intrusiveness and prevention of independent behavior of the dog<sup>32</sup>.

The most critical aspect of the described method is the possibility that the owner could make a mistake in following the protocol. For this reason, we suggest providing a detailed written protocol to the owners prior to testing to allow them to form an overall idea of how the tests will be performed. In addition, before each sub-test, the experimenter shall again explain the details and the owner's specific duties. Moreover, the owners should be instructed only about the actual task they need to perform, but not about how they should perform it, allowing them to behave as they normally would (which is what we want to measure) rather than how they 'think' the test requires them to behave. Furthermore, in the basic commands test (see the protocol), there is the possibility that the dog would not perform the behaviors asked by the owner. If this happens, the owner will repeat the commands for a maximum of 3 min. In the Ball play test, the dog might not retrieve the ball when asked. In this case, the owner can take the ball from the floor, move to the starting position, and continue with the procedure. In case the dog takes the ball but does not give it to the owner, the owner can take the ball away from the dog in a manner they would normally take objects from the dog.

The context, knowing that they are being observed and recorded, likely affects the behavior of dog owners. Even being passively observed (i.e. the experimenter being present during the tests) may prevent owners from using negative behaviors (i.e. severe scolding, leash pulling, etc.), which they may think is not publicly acceptable, even though they may normally use it. This phenomenon (known in psychology as social desirability bias<sup>30</sup>) is quite common when human behavior is tested. Our suggestion is to make the owner as comfortable as possible before the testing begins and informing the owners that the test is about dog behavior or the dog-owner interaction rather than only about the owner behavior. In addition, the present protocol was designed for adult dogs (older than one year), therefore further modifications might be needed if testing dog puppies.

Nevertheless, the method developed here provides a useful tool for various research purposes. For example, future studies could further elaborate on how owner interaction styles affect the behavioral characteristics of pet dogs, how they develop and change over time, how they relate to the owners' individual characteristics (e.g. personality, interpersonal behavior), and how they affect the owners' satisfaction with the dog-owner bond. Moreover, our method could also have direct practical applications (e.g. for dog trainers, veterinarians, and other dog practitioners) and ultimately help improve the welfare of pet dogs. In particular, the test could be used to investigate whether and how owner interaction styles influence dog behavioral problems, like aggressiveness, advancing the fields of dog-bite prevention and behavioral medicine. Furthermore, the strong similarity between owner interaction styles and parenting styles offers the possibility to directly compare interaction styles towards animals and parenting styles towards children. Moreover, the protocol allows to investigate whether there are similar psychological, demographical, environmental and cultural factors influencing/driving parenting and dog caregiving behavior and it would allow to use dog-human interactions for modeling the development and progression of parent-child relationships.

## Disclosures

The authors have nothing to disclose.

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