Research

Dog and owner characteristics affecting the dog–owner relationship☆

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ABSTRACT

The nature of the relationship between companion dogs and their owners has important impact on the effect of life for both dog and owner. Identifying factors that affect the dog–owner relationship will assist the understanding of how the successful relationship is achieved and how the less successful relationship is mended, with potential benefits for the welfare of both species. In the present study, we investigated the effect of several dog and owner characteristics, including the personality of the dog, on the dog–owner relationship as measured by the Monash Dog Owner Relationship Scale (MDORS). Data were collected by inviting owners of dogs that had been tested on the Danish Dog Mentality Assessment (DMA) to answer an online questionnaire. We were able to match 421 owner answers with their dogs' DMA test results. The questionnaire consisted of the 28 items of the MDORS, as well as questions about the owners and their dogs. Using factor analysis, 5 dog personality traits could be derived from the dogs' test results on the DMA. The predictive value of questionnaire-based owner and dog variables and the 5 dog personality traits on the dog–owner relationship was tested using multiple linear regressions: 1 for each of the 3 subscales of the MDORS. Overall, the variables investigated only predicted a small proportion of the variance in MDORS scores, and owner characteristics appeared to influence the dog–owner relationship more than dog personality traits did. We found that children in the family and using the dog only for company were negatively associated with the owners' perception of the relationship with their dogs. The only dog characteristics to predict the dog–owner relationship were fearfulness and fear-related behavior problems.

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Introduction

The most common reason for owning a dog in the Western world is companionship (Bennett et al., 2007; Staats et al., 2008). The nature of the relationship between companion dogs and their owners can have an important impact on quality of life for both dog and owner (Crawford et al., 2006; Marinelli et al., 2007; Julius et al., 2013), responsible ownership practices (Rohlf et al., 2010, 2012), and the risk of relinquishment of the dog (Patronek et al., 1996). It could therefore be potentially beneficial for the welfare of both owners and dogs to discover ways of improving the dog–owner relationship, and a first step in this is identifying factors that have an impact on this entity.

Dog–owner relationships can be described in many ways (Crawford et al., 2006; Beck, 2007; Dotson and Hyatt, 2008; Blouin, 2013). The Monash Dog Owner Relationship Scale (MDORS) is a questionnaire-based measure of the relationship between owner and dog as perceived by the owner. The MDORS is rooted in social exchange theory, specifying that benefits and perceived costs (PCs) of a relationship need to be balanced for the relationship to be successful. The scale has 3 subscales measuring the emotional closeness (EC) of the owner to the dog, the amount of interactions the owner has with the dog, and how much the owner perceives the relationship to have a cost (Dwyer et al., 2006). The MDORS has been used to measure dog–owner relationships in samples of Australian and Swedish dog owners. MDORS scores have been shown to be correlated to the level of hormones related to well-being and stress in both dog and owner (Handlin et al., 2012), and especially the subscale measuring amount of interaction between owner and dog has been shown to affect the owner's responsibility for the dog's health and behavior (Rohlf et al., 2010, 2012). The same dog–owner interaction (DOI) subscale has been shown to be positively affected by the owners training engagement

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and negatively by the dog's aggressive/unfriendly behavior and excessive barking (both as perceived by the owner), owner age, number of people in the household, and dog age and size (Bennett and Rohlf, 2007). To our knowledge, factors affecting the other subscales of the MDORS have not been investigated so far.

For dog–owner relationship measures, other than the MDORS, different owner characteristics have been shown to affect the relationship between dog and owner. Dotson and Hyatt (2008) found that females, young people, unmarried people, and people without children score higher on 1 or more of the 7 dimensions underlying dog–human companionship in their study (symbiotic relationship, dog-oriented self-concept, anthropomorphism, activity/youth, [lack of] boundaries, specialty purchases, and willingness to adapt). Similarly, the presence of children has been shown to negatively affect the owner's attachment to his or her dog, whereas living alone increases the care of the dog. Sharing the dog with others or having more than 1 dog decreases the level of care for the dog (Marinelli et al., 2007).

Dog and owner routines have also been shown to affect the dog–owner relationship. As mentioned previously, training engagement has positive effects on the DOI subscale of the MDORS (Bennett and Rohlf, 2007). In the study by Dotson and Hyatt (2008), quality time spent with the dog increased the score on all 7 dimensions of the dog companionship experience. Because spending time with the dog is associated with experiencing the relationship with the dog as close (Lago et al., 1983), the EC subscale of the MDORS is likely to be affected by dog–owner routines as well. Spending a lot of active time with the dog could increase the PC of owning a dog, but it could also result in fewer behavioral problems (Kobelt et al., 2003; Bennett and Rohlf, 2007) and thereby lower the PC of owning a dog.

Some studies have also looked at the effect of dog characteristics on the dog–owner relationship. Purebred dogs have owners with stronger dog companionship experience (Dotson and Hyatt, 2008) and receive more care from their owners (Marinelli et al., 2007) than mixed breed dogs. It seems that the age of the dog can have both negative and positive effects on the dog–owner relationship, depending on how this is measured (Bennett and Rohlf, 2007; Marinelli et al., 2007; Dotson and Hyatt, 2008). Problematic or unwanted behavior in the dog has negative effects on the dog–owner relationship (Serpell, 1996; Bennett and Rohlf, 2007); problematic behavior in the dog increases the risk of relinquishment (Patronek et al., 1996; Kwan and Bain, 2013); and obedient behavior can have a positive effect on owner attachment to the dog (Clark and Boyer, 1993). In relation to this finding, it has been shown that people generally prefer a dog that is calm, compliant, faithful, and nonaggressive (King et al., 2009). Because personality predicts individual differences in behavior (Svartberg, 2007), it is possible that dog personality can influence the dog–owner relationship. Personality has been shown to affect social relationships between humans (Asendorpf and Wilpers, 1998), and human personality has been shown to affect human–dog interaction in different ways (Kotrschal et al., 2009; Kis et al., 2012). Dog personality has been investigated and measured with several different methods; 1 method being the use of behavioral test batteries (Jones and Gosling, 2005). The rationale behind the use of test batteries is that dog personality traits can be derived from the dogs' behavioral scorings on such tests. Evidence from studies applying the standardized test battery, the Dog Mentality Assessment (DMA), indicate that dog personality can be described by 5 traits: playfulness, curiosity/fearlessness, chase proneness, sociability, and aggressiveness (Svartberg and Forkman, 2002). These 5 dog personality traits show consistency across breed groups (Svartberg and Forkman, 2002), and individual personality differences show consistency over time in repeated tests (Svartberg et al., 2005). Three of the 5 traits have shown good correlation to everyday dog behavior reported by the dogs' owners (Svartberg, 2005).

With the intention of improving our understanding of the relation between dogs and their owners, the aim of this project was to investigate factors with possible effects on the dog–owner relationship, as measured by the MDORS questionnaire, and especially to find out whether the personality of the dog, as measured by the DMA test, has an effect on the dog–owner relationship. The question was investigated in a population of Danish dog owners. Based on previous studies, we expected young age, female gender, single living, the absence of children and other dogs, experience with dogs, primary responsibility, and a high level of training engagement to predict a higher score on the MDORS, that is, more EC, more DOI, and less PC. We also expected owners of young dogs without perceived behavioral problems and owners of playful, calm, social, and nonaggressive dogs to score higher on the MDORS.

Methods

Participants

Owners of dogs that completed the Danish DMA in 2010 and 2011 (a period of up to 2.5 years before this study) were invited by letter to participate in an online questionnaire. For owners who had more than 1 dog assessed in the chosen period, the most recently tested dog was chosen, and if more than 1 dog was tested in the same day, the oldest dog was chosen. Letters of invitation were sent to 842 Danish dog owners. The registration number of the dog was written in the letter to ensure that the owners answered the questionnaires in relation to the dogs whose DMA results we had. In the letter, there was a link to the online questionnaire. Participating owners were anonymous because the letters were sent out from the Danish Kennel Club, and questionnaire answers were matched with dog DMA results by using the registration number of the dog. In the period May 2012-September 2012, 426 dog owners completed the online questionnaire, giving a response rate of 50%. Of these, 421 questionnaires answers could be matched with the dogs' DMA results.

Questionnaire

The online questionnaire consisted of 2 parts: (1) a set of general questions about the owner and his or her dog, which formed the base of 23 dog and owner variables and (2) the MDORS. The MDORS consists of 28 questions that can each be attributed to 1 of 3 subscales: EC, DOI, and PC (Dwyer et al., 2006). The EC subscale consists of 10 questions on how the owner perceives the degree of support from and bonding with the dog (e.g., my dog is there whenever I need to be comforted). The DOI subscale consists of 9 questions about the frequency of various activities with the dog (e.g., How often do you play games with your dog?). The PC subscale consists of 9 questions on how inconvenient the owner perceives the relation to the dog to be (e.g., It is annoying that I sometimes have to change my plans because of my dog). The original English MDORS questions were translated to Danish (and back translated to ensure accuracy of the translation) with the help of a bilingual (English/Danish) person. For each question in the MDORS, the owner could answer from 1 to 5. For questions related to the EC and DOI subscales, a score of 1 was indicating a low level of EC or DOI, and a score of 5 was indicating a high level of EC or DOI. For questions related to the PC subscale, a score of 1 was indicating a high level and a score of 5 was indicating a low level of PC, that is, higher scores on EC, DOI, and PC indicated a more positive dog–owner relationship.

Dog Mentality Assessment

The results from the Danish DMA were provided by the Danish Kennel Club that arranges and administers the mentality assessments in Denmark. The Kennel Club states in a flyer about the mentality assessment that its purpose is to function as a tool for breed clubs, when they develop breed-specific behavioral profiles, to function as a tool for breeders, and to provide dog owners information about their own dog's behavior. Only purebred dogs from breeds that have an optimal scoring profile may be tested, and the dogs have to be older than 10 months. The mentality assessment includes 8 subtests and is very similar to the Swedish DMA described by Svartberg and Forkman (2002). The dog owner accompanies the dog during the test, and the dog's behavioral reactions on the 8 subtests are scored by a certified DMA test leader. During the 8 subtests, 23 behavioral variables are scored on predefined scales ranging from 1 to 5. The subtests of the Danish DMA, variables scored, and description of the dog's behavior for the lowest and highest scores are given in Table 1.

Analysis

All data were analyzed using SAS 9.3 (SAS Institute, Cary, NC, USA). For the MDORS data, EC, DOI, and PC scores were calculated for each participant as the mean score on the MDORS items related to the 3 subscales, respectively (Dwyer et al., 2006; Rohlf et al., 2010; Handlin et al., 2012). Means, standard deviations (SDs), and Cronbach's alphas were calculated for EC, DOI, and PC.

To describe the dogs' DMA results in terms of personality traits, factor analysis was performed on the dogs' scoring on the DMA. Prior communality estimates were specified as squared multiple correlations, and primary factors were rotated using oblique rotation. To decide on the number of factors to be extracted, we used the eigenvalue criterion, scree plot, and interpretability of the factors. Variables with loadings above 0.4

or below −0.4 were considered as important for a given factor. For each extracted factor, factor scores were estimated for all dogs, and these factor scores were subsequently used as personality trait measures for the dogs.

Descriptive statistics, including frequency counts, range, means, and SDs, were used to describe the questionnaire-based owner and dog variables, EC, DOI, and PC scores, and DMA-derived dog personality factor scores.

In the present study, we had information about dog and owner demographics and about how the dog owners' perceived the relationship to their dog at the time of the study. We also had information about the behavioral assessment of the dogs 0.5-2.5 years before the study. To investigate possible predictors of the quality of the dog–owner relationship, we analyzed the relationship between the dog owners' MDORS scores and the 5 dog personality traits as well as between the MDORS scores and the owner and dog demographics measured in the questionnaire. We first tested the individual relationships between the independent variables (the 5 dog personality traits and the owner and dog questionnaire variables) and EC, DOI, and PC by using Pearson correlation (predicting value of continuous variables), t test (predicting value of dichotomous variables), and analysis of variance (predicting value of ordinal variables). We then performed 4 multiple linear regression analyses with stepwise inclusion/exclusion of variables to determine which dog personality factors and dog and owner variables best predict the EC, DOI, and PC scores. Variables were included in the model if they significantly predicted the given dog–owner relationship score and excluded if they failed to significantly predict the dog–owner relationship score. This method of stepwise inclusion/exclusion has been described by other authors as a way of achieving a final model of predicting variables in linear regression analysis (Houe et al., 2004). If inclusion/exclusion of one variable altered the significance of another variable or affected the regression coefficient estimate of another variable considerably (about 25% or more), it was evaluated which of the 2 interacting variables

Table 1
Subtests, scored behavior variables, and description of endpoints on the scoring scale for the Danish DMA

Subtest	Variable	Lowest score 1	Highest score 5
Social contact	Greeting reaction	Refuses to greet, growls, and/or tries to bite	Intense greeting possibly with jumping and barking
	Cooperation	Refuses to walk with the TL	Follows the TL willingly
	Handling	Tries to escape/threatening behavior	Is willingly handled
Play	Interest in play	Does not play	Engages fast and actively in play. Difficult to stop
	Grabbing	Does not grab rope	Grabs rope firmly—determined
	Tug-of-war	Does not grab rope	Grabs tug rope and tugs until TL lets go. Shakes after TL lets go
Chase	Following 1	Does not start	Starts with high speed and runs more than 2 meters past the target
	Grabbing 1	Ignores the target or does not reach the target	Picks up the target without hesitation
	Following 2	As for following 1	
	Grabbing 2	As for grabbing 1	
Passive situation	Activity	Inactive—not interested	Changes fast between activities, whines, barks, pulls on lead
Sudden appearance	Startle	Stops shortly. No avoidance reaction	Flees more than 5 meters
	Aggression	No threatening behavior	Strong threatening behavior with direct attacks
	Exploration	Approaches the dummy when it is lowered or does not approach at all	Approaches the dummy without support, possible with lowered body posture
	Remaining avoidance	No remaining avoidance behavior	Pulls away from the dummy on at least 2 passes
Metallic noise	Startle	Stops shortly. No avoidance reaction	Flees more than 5 meters
	Exploration	Approaches the metal plate when the handler touches it or does not approach at all	Approaches the metal plate without support, possibly lowered body posture
	Remaining avoidance	No remaining avoidance behavior	Pulls away from the metal plate on at least 2 passes
Ghosts	Avoidance	No tendency to flee	Pulls away from the ghosts during their approach
	Aggression	No threat behavior	Strong threatening behavior with attacks throughout the subtest
	Exploration 1	Approaches functionary 1 when he or she is unmasked or does not approach at all	Approaches functionary 1 without support, possibly with lowered body posture
	Exploration 2	As for exploration 1, but with functionary 2	
Gunshot	Avoidance	Unaffected/small reaction, then unaffected	Flees during activity, possibly leaving test site

DMA, Dog Mentality Assessment; TL, test leader.
For a description of the test setup of the 8 subtests, see Svartberg and Forkman (2002).

Table 2
Descriptive statistics for the 3 subscales of the MDORS

Subscale	R	M	SD	Cronbach's alpha
EC	1.9–5.0	3.7	0.7	0.85
DOI	1.4–5.0	3.8	0.5	0.60
PC	2.0–5.0	4.1	0.5	0.75

MDORS, Monash Dog Owner Relationship Scale; R, range; M, mean; SD, standard deviation; EC, emotional closeness; DOI, dog−owner interaction; PC, perceived cost. For each subscale is given R, M, SD, and internal consistency (Cronbach's alpha). Note that PC is scored such that a high PC indicates a low level of PC.

had the largest effect on the dog−owner relationship score, and then this variable was kept in the model.

Results

The dog owner relationship scale

The descriptive statistics for the 3 subscales of the MDORS are shown in Table 2.

Factor analysis of DMA results

Factor analysis of the DMA results from the 421 dogs revealed 4 factors with an eigenvalue above 1. The scree plot indicated that 5 or 6 factors should be retained. The interpretability of a factor solution with 4, 5, and 6 factors was evaluated, and we found that a 5-factor solution was the most meaningful. The 5 factors, their labels, and their loading variables are shown in Table 3. Three variables, sudden appearance—aggression, activity, and gunshot—avoidance, did not load on any of the 5 factors, although gunshot—avoidance had a fairly high loading of 0.33 on factor 2 (nonsocial fear). All other variables had loadings of 0.4 or more on only 1 of the factors.

Owner and dog questionnaire variables

The 421 dog owners participating in this study had a mean age of 47 years (SD = 11.36), ranging from 18 to 75 years. Descriptive statistics of the other owner variables generated from the general questions of the online questionnaire can be seen in Table 4. Similarly, descriptive statistics of the dog variables generated from the online questionnaire and the DMA-derived personality factor scores can be seen in Table 5.

Regression analyses

The results of the 4 multiple linear regression analyses with stepwise inclusion/exclusion of owner and dog variables that were by themselves significantly associated with the MDORS scores can be seen in Tables 6-8.

For the EC score, the following variables were tried for inclusion in the multiple linear regression analysis: owner age, owner gender, marital status, children in the family, other dogs in the family, prioritizing dog shows highly, dog used only for company, frequency of walking the dog, breed, and DMA social fear. Table 6 shows the final model of factors that predict the EC, as measured by the MDORS. This model explained 8% of the total variance. Dog owners living without a partner score a little higher than dog owners living with a partner, the estimate of the EC score being 0.14 higher, if the owner is single than if he or she is living with a partner. This effect is not statistically significant though ($P = 0.11$). If the owner answering the MDORS was still living with his or her parents, the EC score was significantly higher than if the owner was living with a partner. Only 2 owners were living with their parents, and so this relationship should be interpreted with caution. The EC score is lower if the dog is only used for company and if the owner has children, that is, owners who use their dog for more than just company and owners who do not have children perceive the relation to their dog as more emotionally close. The EC score is

Table 3
Results from the factor analysis of 421 dogs' DMA results

DMA subtest	Variable	Extracted factors				
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
		Chase proneness	Nonsocial fear	Playfulness	Social fear	Sociability
Social contact	Greeting reaction	0.03	0.03	0.03	−0.10	**0.40**
	Cooperation	0.01	−0.01	−0.01	0.01	**0.56**
	Handling	−0.04	0.01	0.02	0.03	**0.68**
Play	Interest in play	0.04	−0.03	**0.75**	0.02	0.11
	Grabbing	−0.02	0.02	**0.89**	0	−0.01
	Tug-of-war	−0.04	0.01	**0.81**	−0.09	−0.02
Chase	Following 1	**0.81**	−0.04	−0.05	0.03	0.02
	Grabbing 1	**0.83**	−0.03	0	−0.01	0.01
	Following 2	**0.88**	0.01	−0.02	−0.03	0.01
	Grabbing 2	**0.84**	0.04	0.06	−0.04	−0.05
Passive situation	Activity	−0.01	−0.01	0.14	0.10	0
Sudden appearance	Startle	0.03	**0.55**	0.13	0.21	0.05
	Aggression	0.06	0.19	0.28	0.17	−0.07
	Exploration	−0.01	**−0.46**	0.09	−0.24	0.02
	Remaining avoidance	0.07	**0.66**	0.11	0.01	0.02
Metallic noise	Startle	−0.04	**0.59**	−0.01	−0.05	−0.06
	Exploration	0.13	**−0.54**	0.18	0.13	0.03
	Remaining avoidance	−0.04	**0.62**	0.02	−0.08	0.04
Ghosts	Avoidance	−0.03	−0.05	0.05	**0.64**	0.06
	Aggression	−0.05	−0.08	0.23	**0.46**	−0.15
	Exploration 1	−0.01	−0.05	0.08	**−0.54**	−0.03
	Exploration 2	−0.01	−0.09	0.14	**−0.45**	0.03
Gunshot	Avoidance	−0.04	0.33	−0.26	−0.03	0.05

DMA, Dog Mentality Assessment.
The rows show the 23 variables from the Danish DMA, and the columns show the 5 retained factors and the loadings from the 23 DMA variables.
Bold numerals are factor loadings that are above 0.4. Variables with loadings above 0.4 are considered important for the extracted factors.

Table 4
Descriptive statistics of owner variables

Variable	Frequency (%)
Gender	
Female	328 (77.9)
Male	93 (22.1)
Marital status	
With partner	353 (83.8)
Single	66 (15.7)
Living with parents	2 (0.5)
Children in the family	
Yes	175 (41.6)
No	246 (58.4)
Young children in the family	
Yes	70 (16.7)
No	350 (83.3)
Other dogs in the family	
Yes	251 (59.6)
No	170 (40.4)
Other pets	
Yes	66 (15.7)
No	354 (84.3)
Other animals	
Yes	103 (24.5)
No	318 (75.5)
First time dog owner	
Yes	57 (13.5)
No	364 (86.5)
Responsibility for the dog	
Primary	291 (69.1)
Shared	122 (29)
No	8 (1.9)
Frequency of walking the dog	
At least 2 times a day	276 (65.5)
Once a day	95 (22.6)
A couple of times a week	32 (7.6)
Once a week	3 (0.7)
A couple of times a month	8 (1.9)
Rarely	7 (1.7)
Never	0
Prioritizing dog shows highly[a]	
Yes	111 (26.4)
No	310 (73.6)
Prioritizing working dog training highly[a]	242 (57.5)
Yes	
No	179 (42.5)
Dog only used for company[a]	
Yes	44 (10.5)
No	377 (89.5)

[a] Prioritization of different activities with dogs was measured by asking owners to prioritize company, hunting, working dog training, agility, herding, and show from 1 to 6. Those who put show as first or second priority were scored as prioritizing dog shows highly. Those who put working dog training as first or second priority were scored as prioritizing working dog training highly. Some owners only filled in the first priority with company, and these were scored as using their dog only for company.

Table 5
Descriptive statistics of dog variables

Variable	M	SD	[R]/F (%)
DMA personality factor scores			
Chase proneness	0	0.95	−1.30 to 1.95
Nonsocial fear	0	0.89	−1.72 to 2.60
Playfulness	0	0.93	−2.09 to 1.69
Social fear	0	0.82	−2.18 to 1.65
Sociability	0	0.78	−3.51 to 2.0
Age (months)	37.89	13.78	16–123
Age at acquisition (weeks)	11.51	21.13	0–216
Breed[a]			
Danish Broholmer			52 (12.4)
Boxer			27 (6.4)
Golden retriever			29 (6.9)
Icelandic sheepdog			37 (8.8)
Rottweiler			52 (12.4)
Other breed			224 (53.2)
Gender			
Female			224 (53.2)
Neutralized female			23 (5.5)
Male			159 (37.8)
Neutralized male			15 (3.6)
Way of acquisition			
From breeder			377 (89.8)
From shelter			10 (2.4)
From friends/family			2 (0.5)
Other			31 (7.4)
Owner perceived home alone problems			
Yes			18 (4.3)
No			391 (93.1)
Owner perceived problems with aggression toward dogs			
Yes			61 (14.5)
No			353 (84.1)
Owner perceived problems with aggression toward humans			
Yes			6 (1.4)
No			407 (97.8)
Owner perceived problems with fear			
Yes			63 (15)
No			334 (79.5)

M, mean; SD, standard deviation; R, range; F, frequency count; %, percentage; DMA, Dog Mentality Assessment.
Missing values or don't know—answers are not included, and therefore F (%) does not always count up to 421 (100).

[a] The DMA results covered 69 breeds, many of which were represented by less than 10 individuals. As 5 breeds were represented by much higher numbers than other breeds, the effects of these breeds were investigated to rule out that an overall effect was caused by just a few breeds.

estimated to be 0.15 points higher if the owner has other dogs than if the owner has only the 1 dog, that is, owners perceive the relation to their dog as more emotionally close if they have other dogs besides the one being evaluated. The EC score and dog's score on the DMA personality factor social fear are positively related, that is, the more the dog reacts fearfully to social-like stimuli in the DMA test, the more emotionally close does the owner perceive the relationship with the dog. With a regression coefficient of 0.10, DMA social fear does not have a strong impact on the EC score however.

For the DOI score, the following variables were tried for inclusion in the multiple linear regression analysis: owner age, marital status, children in the family, young children in the family, prioritizing dog shows highly, dog used only for company, dog gender, and breed. Table 7 shows the final model of factors that predict the DOI, as measured by the MDORS. This model explained 10% of the

total variance. Owners of Danish Broholmer dogs scored lower on the DOI scale of the MDORS, the estimate of the DOI score being 0.33 lower for Danish Broholmer owners than for owners of other breeds, that is, owners of Danish Broholmer dogs have less interaction, as measured by the DMA, with their dog than owners of other breeds. As for EC, owners with children scored lower on DOI than owners without children, that is, dog owners with children have less interaction, as measured in the MDORS, with their dog than owners without children. The owner's age had a significant effect on the DOI score, but looking at the regression coefficient of owner age, owner age does not have a large impact on the DOI score.

For the PC score, the following variables were tried for inclusion in the multiple linear regression analysis: first time dog owner, other dogs in the family, dog gender, breed, age at acquisition, owner perceived problems with fear, DMA chase, and DMA play. Table 8 shows the final model of factors that predict the PC, as measured by the MDORS. This model explained 6% of the total variance. Acquiring an older puppy or an adolescent dog decreases

Table 6
Results from regression analysis investigating the effect of dog personality factors and owner and dog characteristics on the owner's EC with the dog (EC) as measured by the MDORS

Variables	Regression coefficient	Standard error	t Value	P value
Intercept	3.7117	0.0635	58.43	<0.0001
Marital status				
With partner	0			
Single	0.1409	0.0892	1.58	0.1148
Living with parents	1.2560	0.4636	2.71	0.0070
Dog used only for company				
No	0			
Yes	−0.2603	0.1058	−2.46	0.0143
Children in the family				
No	0			
Yes	−0.1873	0.0659	−2.48	0.0047
Other dogs in the family				
No	0			
Yes	0.1491	0.0663	2.25	0.0251
DMA social fear	0.1025	0.0392	2.61	0.0093

EC, emotional closeness; MDORS, Monash Dog Owner Relationship Scale; DMA, Dog Mentality Assessment.
EC is a score ranging from 1 (lowest level of EC) to 5 (highest level of EC). Degrees of freedom = 414.

the estimate of the PC score by 0.29-0.31 compared with if the owner has had the puppy from newborn (own breeding), that is, acquiring an older/adolescent puppy is associated with lower PC scores and thereby with higher PC. PC scores are affected negatively if the owner reports that the dog has problems with fear, or if the owner is a first time dog owner, and thus the PC of owning a dog is higher among first time dog owners and owners who perceive their dog as having fear-related behavior problems.

Discussion

In the present study, we found significant associations between several owner characteristics plus a few dog characteristics and the owners' scores on the MDORS. However, the dog and owner characteristics investigated in this study predicted only a small proportion of the variance in the dog–owner relationship score.

Previous studies have shown that human personality can affect human–human relationships and interactions between human and dog (Asendorpf and Wilpers, 1998; Kotrschal et al., 2009; Wedl et al., 2010; Kis et al., 2012), and other studies have shown that dog behavior can affect the DOI subscale of the MDORS and owner attachment to the dog (Clark and Boyer, 1993; Serpell, 1996;

Table 7
Results from regression analysis investigating the effect of dog personality factors and owner and dog characteristics on the amount of DOI as measured by the MDORS

Variables	Regression coefficient	Standard error	t Value	P value
Intercept	3.8530	0.0488	79.02	<0.0001
Breed				
Other breed	0			
Danish Broholmer	−0.3089	0.0795	−3.89	0.0001
Boxer	0.1448	0.1038	1.40	0.1637
Golden retriever	−0.0862	0.1011	−0.85	0.3946
Icelandic sheepdog	−0.0124	0.0916	−0.14	0.8926
Rottweiler	−0.0348	0.0786	−0.44	0.6586
Children in the family				
No	0			
Yes	−0.2196	0.0525	−4.18	<0.0001
Owner age	−0.0085	0.0023	−3.73	0.0002

DOI, dog–owner interaction; MDORS, Monash Dog Owner Relationship Scale.
DOI is a score ranging from 1 (lowest level of DOI) to 5 (highest level of DOI). Degrees of freedom = 412.

Table 8
Results from regression analysis investigating the effect of dog personality factors and owner and dog characteristics on the PC as measured by the MDORS

Variables	Regression coefficient	Standard error	t Value	P value
Intercept	3.9431	0.1041	37.88	<0.0001
Acquisition age of dog				
From newborn	0			
Young puppy (8-11 weeks)	−0.0676	0.0757	−0.89	0.3725
Older puppy (12-23 weeks)	−0.3073	0.1300	−2.36	0.0186
Adolescent/adult dog (24+ weeks)	−0.2934	0.1239	−2.37	0.0184
Owner perceived problems with fear				
No	0			
Yes	−0.2028	0.0729	−2.78	0.0057
First time dog owner				
No	0			
Yes	−0.1819	0.0814	−2.24	0.0259

PC, perceived cost; MDORS, Monash Dog Owner Relationship Scale.
PC is a score ranging from 1 (highest level of PC) to 5 (lowest level of PC). Degrees of freedom = 390.

Bennett and Rohlf, 2007). We therefore expected the personality traits derived from the behavioral test of the dogs to affect the dog–owner relationship measured by the MDORS. However, 4 of the 5 DMA-derived dog personality traits did not have any predictive value for the dog–owner relationship score. One explanation for this could be that the DMA is not very good at predicting the future behavior of dogs, and that the missing association between dog personality and dog–owner relationship scores is caused by the temporal separation between the behavioral assessments of the dogs and the owners' answers on the MDORS, in the present study between 0.5 and 2.5 years. In support of this, Fratkin et al. (2013) have showed that the reliability of dog personality measures is reduced, when the period between 2 measurements is more than 24 weeks compared with when it is less than 10 weeks. However, Svartberg (2005) found that 3 of the 5 DMA-derived personality traits correlate well with owners' report on their dog's behavior on the Canine Behavioral Assessment & Research Questionnaire, even with temporal separation of up to a year between the behavioral assessment and the owners' report.

Another possible explanation for the missing association between dog personality and the dog–owner relationship score is that the behavior of the dog is less important for the owner's perception of the relation to his or her dog than the match between the dog's behavior and the lifestyle of the owner. In support of this, Serpell (1996) has shown that the owner's attachment to his or her dog is probably affected more by unsatisfied expectations of the dog's behavior than by the actual dog behavior. Moreover, Curb et al. (2013) have shown that owners' satisfaction with their dog does not seem to rely on a perfect match between owner and dog personality, instead owner satisfaction appears to be associated with a good match between dog and owner with regard to, for example, motivation to exercise.

The 1 DMA-derived personality trait that did have predictive value for the dog–owner relationship was social fear: owners of dogs with more fearful/aggressive reactions to social-like stimuli on the DMA test perceived the relationship with their dog as more emotionally close than owners of dogs with less fearful/aggressive reactions on the DMA test. One explanation for this finding could be that dogs that are more fearful initiate contact with their owner more often (Wedl et al., 2010), which could stimulate a feeling of EC in the owner. We cannot however infer causal directionality from our results, and an alternative explanation could be that owners who perceive the relationship to their dogs as very emotionally close influence their dogs in ways that make them react more fearfully/aggressive on the DMA test. In support of the latter

interpretation, owner attitudes and behaviors have been shown to influence problematic behaviors in dogs (O'Farrell, 1997), dog and owner scores on the personality dimension neuroticism have been shown to correlate (Turcsán et al., 2012), and owner neuroticism has been linked to the level of attachment to the dog and to the dog staying close to the owner and being more reserved toward others (Kotrschal et al., 2009; Wedl et al., 2010). The owner's perception of the dog having fear-related behavior problems was not however associated with the perceived EC to the dog but rather was associated with increased PC of the dog–owner relationship. This is in line with studies showing that behavioral problems are often reported as a reason for relinquishment of dogs (Patronek et al., 1996; Mondelli et al., 2004; Kwan and Bain, 2013). It is worth noting that in this study, the owner's perception of fear-related, but not aggression or home alone problems, affected the PC of the dog–owner relationship, in contrast to studies on reasons for relinquishments, that often report aggression and destructiveness as the most problematic behavior (Patronek et al., 1996; Mondelli et al., 2004; Kwan and Bain, 2013) but in accordance with an earlier investigation of Danish dog owners (Lund, 2001).

Several owner characteristics had predictive value for the dog–owner relationship score. The presence of children in the dog owner's family was negatively associated with the owner's perceived closeness and level of DOI. This supports previous findings showing that people with children have lower levels of affection for and shared activities with their dog, see their dog less as a friend, and spend less time and money on their dog's care and accessories (Paul, 2000; Bennett and Rohlf, 2007; Marinelli et al., 2007; Dotson and Hyatt, 2008). Possibly people with children have less time for their dog, which would be an obvious explanation for the negative association between the presence of children and the amount of DOI but could also be a reason for why owners with children feel less emotionally close to their dog (Lago et al., 1983; Dotson and Hyatt, 2008). Time, or rather lack of time, is also mentioned as a primary reason for the relinquishment of dogs (Patronek et al., 1996). Another owner factor that was associated with the quality of the dog–owner relationship was whether the owner reported to use the dog for more than just company. Owners not reporting to engage in activities like agility, dog shows, hunting, herding, or working dog training scored lower on EC. The EC subscale covers items that are related to psychological attachment (Dwyer et al., 2006), and dog relinquishment has been associated with lower levels of attachment to the dog (Kwan and Bain, 2013). The negative association between having children and only using the dog for company and the perceived EC in the dog–owner relationship could therefore increase the dog's risk of being relinquished and decrease the welfare of both dog and owner.

Contrary to our expectations, we found a positive association between owning more than 1 dog and the owners' perceived EC to their dogs. Marinelli et al. (2007) have shown that the level of care a dog receives is negatively affected by the owner having more than 1 dog. They argue that exclusivity in the relationship is an important criterion in the bond between people and dogs. But they also find that the owner's number of emotional bonds (to other humans) is positively correlated to the attachment to their dog, indicating that being emotionally close with other humans is not necessarily restraining for being emotionally close with one's dog. These findings by Marinelli et al. (2007) are contradictory to our findings of ownership of more than 1 dog being positively associated and the presence of children being negatively associated with perceived closeness to the dog. It could be speculated that acquiring several dogs is a well-considered decision, with owners making such a decision also feeling more emotionally close to their dogs. As opposed to this, the parent acquiring a dog for the family might plan the purchase less, resulting in less EC with the dog.

In our study, dog personality was derived from standardized behavior assessments rather than being owner reported. Although the behavior of dogs in a standardized test battery, like the DMA, is not necessarily the same as in the everyday life with the owner, using owner report would have increased the risk of owner bias because the owner would be reporting on both dog behavior and on the quality of the relationship. Furthermore, several of the DMA-derived personality traits have shown good correlation with everyday behavior of the dog (Svartberg, 2005). Because not all dogs in Denmark are mentality assessed, and only the breeds, for which an optimal scoring profile exists, can be tested, the sample of dogs and owners in the present study might not be representative of all dog–owner relationships. However, our sample of Danish dog owners were comparable in their MDORS scorings to a Swedish and an Australian sample of dog owners (Handlin et al., 2012; Rohlf et al., 2012). Thus, sampling owners of DMA-tested dogs did not seem to affect the level of MDORS scorings markedly. As only 50% of the invited dog owners responded within the data collection period, and because this sample was self-selected, there is a risk that the less positive dog–owner relationships were not reported and consequently that factors predicting such relationships were not detected. Our study should however be less sensitive to this source of error because it focuses on the association between factors rather than the absolute levels of them. It also has to be mentioned that because the MDORS is thought to capture primarily the owner's perception of the relationship (Rehn et al., 2013), we cannot conclude which dog and owner variables are predictive for the dog–owner relationship seen from the dog's point of view.

In summary, it has to be emphasized that other factors, than the ones studied here, will influence how dog owners perceive the relationship to their dogs. It could be recommended that families with children should be targeted more specifically in relation to campaigns on optimal dog ownership practices. In general, information about the positive consequences of engaging in different activities with the dog could benefit many dog–owner relationships, and more information to dog owners on how to handle fear-related behavior problems could benefit not only the fearful dogs but also the owners' perception of the relationship with their dog. Interestingly, dog personality does not seem to have a large impact on the owner's perception of the dog–owner relationship. If this finding can be replicated, it has important implications for our understanding of the dog–owner relationship, and we propose that other factors, such as owner's unfulfilled expectations and owner and dog's ability to adjust to each other, should be investigated.

Conflict of interest

The authors declare no conflict of interest.

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