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Links Between Play and Dominance and Attachment Dimensions of Dog–Human Relationships

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It is often claimed that certain behavioral problems in domestic dogs can be triggered by the games played by dog and caregiver (owner). In this study, we examine possible links between the types of games played and dimensions of the dog–owner relationship that are generally considered to affect such problems. Fifty dog–owner partnerships were filmed during 3-min play sessions in which the owner was allowed to choose the games played. All partnerships then undertook a 1-hr test designed to measure elements of behavior commonly ascribed to "dominance" and "attachment." Principal components analysis of the data produced 2 dominance-related factors (Amenability and Confident Interactivity) and 4 factors describing aspects of attachment (Nonspecific Attention Seeking, Preference for Owner, Preference for Unfamiliar Person, and Separation-Related Behavior). Amenability, in particular, varied significantly between breeds. In the study, we then compared types of games played to each of these factors. Dogs playing rough-and-tumble scored higher for Amenability and lower on Separation-Related Behavior than did dogs playing other types of games. Dogs playing tug-of-war and fetch scored high on Confident Interactivity. Winning or losing these games had no consistent effect on their test scores. If the dog started the majority of the games, the dog was significantly less amenable and more likely to exhibit aggression. The results suggest that how dogs play reflects general attributes of their temperament and relationship with their owner. This study provides no evidence that games play a major deterministic role on dominance dimensions of dog–human relationships, but the results suggest that playing games involving considerable body contact may affect attachment dimensions.

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The potential benefits of dog caretaking depend on the formation of a successful relationship between dog and caregiver (owner). Frequently, people acquire a dog whose behavior does not meet their expectations or fit in with their lifestyle. Although some owners tolerate suboptimal relationships, many do not, and their dogs are surrendered or even euthanized. In the United Kingdom, behavioral problems are among the most common reasons for owners abandoning their dogs (Podberscek, 1997). In the United States, an estimated 7.5 to 9 million dogs per year are euthanized because of unacceptable behavior (Anderson & Foster, 1988). To prevent such welfare problems and reduce the number of partnerships ending tragically, we need to build a thorough understanding of the dynamics of the dog–human relationship.

In the popular dog literature, there are numerous claims of factors that can affect dog–human relationships (Appleby, 1997; O'Farrell, 1992; Rogerson, 1992). However, there are few data to substantiate these claims. Recent studies have started to investigate influences on dog–human relationships but have relied mainly on owners' reports (Goodloe & Borchelt, 1998). Useful for obtaining large samples, this methodology is less objective than assessment by a third party. Although case studies of problematic dog–human relationships are numerous (Anderson & Foster, 1988; Overall, 1997), there have been very few attempts to measure apparently healthy relationships objectively.

The terms *attachment* and *dominance* often are used to describe elements of dog–human relationships, but there are no universal definitions of these terms (Drews, 1993; Cairns, 1972; Overall, 1997), particularly as applied to interspecific relationships. For this article, we define *dominance* as the tendency of the dog to assert priority of access to resources and *attachment* as the tendency of the dog to seek and maintain contact with the owner. In our experimental studies, we have found that both dominance (Rooney & Bradshaw, 2002) and attachment (Rooney, 1999) in dog–human relationships are multidimensional. In this article, we describe a test procedure, modified from these two prior studies, which we use to measure dog–owner relationships within the home environment. In devising these tests, we have made as few a priori assumptions about what constitutes dominance and attachment as possible but have taken a post hoc approach, measuring the dogs' behavioral responses in a variety of situations and then applying exploratory statistical analysis to discover the underlying dimensions. Having obtained measures of these dimensions, we then investigated their connections with the types of games played by dog and owner.

It is commonly asserted that play between dog and owner has significant effects on dominance dimensions of their relationship. Dog trainers and companion animal behavior counselors warn that allowing a dog to win uncontrolled games such as tug-of-war can increase the likelihood that the dog will attempt to become dominant over the owner (O'Farrell, 1992; Rogerson, 1992); on this basis, controlled tug-of-war is used as therapy to correct behavioral problems (Appleby, 1997). We

refer to this as the dominance enhancement theory. However, questionnaires (Goodloe & Borchelt, 1998) and experimental studies of Labrador (Rooney 1999) and Golden Retrievers (Rooney & Bradshaw, 2002) have found no evidence for these postulated effects.

In this article, we further investigated the effects of dog–owner play. We used videotaped play sessions and questionnaire surveys to measure the play that occurs between 50 dogs and their owners. We then explored whether features of that play bear any significant relationship to the measured dimensions of the dog–owner relationship. In particular, we test whether

1. Dogs who play specific game types (tug-of-war) differ significantly in their relationship with their owners from dogs who do not play those games.
2. Dogs who play uncontrolled games (which they are allowed to win) with their owners differ in dominance aspects of their relationship compared to dogs who play controlled games.
3. The amount of play occurring between dog and owner correlates to dimensions of their relationship.

In addition to play, numerous other factors are commonly believed to affect dog–human relationships. These include characteristics of the dog and features of the owner's behavior toward the dog. We used a verbal questionnaire to investigate three of the most common assertions:

1. Dogs who have continual access to toys often become dominant (Rogerson, 1992).
2. Allowing dogs to sleep in the owner's bedroom can lead to overattachment (Appleby, 1997).
3. Dogs who are frequently allowed to initiate social interactions (including play) behave with increased dominance toward their owner (O'Farrell, 1992).

METHODS

Subjects

Fifty dog owners (35 women and 15 men) were recruited through personal contacts and posters in veterinary surgeries in Southampton (Hampshire, Southern England) and the Wirral (Cheshire, Northwest England). All had owned a single dog for at least 1 year and were willing to be filmed. The dogs were 29 males and 21 females; 52% of the males and 76% of the females were neutered. They ranged in age from 20 months to 14 years, with a median of 7 years (25th percentile = 4.5; 75th percentile = 9). There were 19 crossbred dogs and 31 pure-

bred/pedigree dogs representing 17 different breeds. When classified according to Kennel Club categories (Sylvester, 1984)—crossbreeds were categorized according to the breed that they most closely resembled as agreed by experimenter and owner—there were 17 gundogs, 16 working dogs, 10 terriers, 3 hounds, 2 toy dogs, and 2 utility dogs.

Procedure

The Visit

The experimenter (Nicola Rooney) visited each dog owner in his or her own home once. The visit lasted approximately 1 to 1.5 hr. When possible, it took place at the dog's usual feeding time and when the owner and dog were alone. When other family members were present (12 cases), they were requested to remain in a different part of the house and to avoid interrupting the procedure or attracting the dog's attention. The visit followed the protocol outlined in Figure 1.

FIGURE 1 Outline of the protocol for the visit to the volunteer dog owner's home including approximate durations of each stage. *Filmed via camera held by experimenter; all other parts filmed by camera on tripod.

Acclimatization

None of the dogs had met the experimenter previously, so there was a 10-min familiarization period. This allowed the owner to relax and the dog to acclimatize to the experimenter and the equipment. During this time, the experimenters chatted to the owner, petted their dogs if they approached, and set up the equipment. They also outlined the protocol to the owners. The most commonly used room was selected as the filming location (usually the living room but in two cases the kitchen). A video camera (Sony Video 8 CCD–TR370E; Sony Corporation, Japan) with a wide angle lens was mounted on a tripod and positioned to allow the maximum floor area to be viewed while minimizing the risk of damage by the dog. This setup was used to film the questionnaire and testing sections of the protocol. The same camera was handheld by the experimenter to film the play session.

Play Session

Owners were instructed to play with their dogs for approximately 3 min. They were urged to play as they would normally, to ignore the experimenter, and to start and end the session in their usual way. The owner determined the games played and the precise session length. The experimenter remained seated and filmed the session by hand.

Questionnaire

The questionnaire was composed of 23 questions designed to obtain information about normal play routines and ownership style. The experimenter sat opposite to and at least 2 m away from the owner. She asked the questions, standardizing presentation and making a written record of the owner's responses. The Petting test (described following) was carried out concurrently.

Testing

The testing procedure was designed to assess attachment and dominance dimensions of the dogs' relationships with their owners. It was based on tests developed during experimental studies (Rooney, 1999; Rooney & Bradshaw, 2002) but modified to measure the dog's behavior toward the owner (instead of an experimenter), to ensure that the test was easily replicable by different dog owners, was unaffected by the size and shape of the room, and accommodated the presence of an additional person (the experimenter). The test had 16 compo-

nents, 5 designed specifically to assess attachment dimensions, 10 to assess dominance dimensions, and 1 for the assessment of both. They subsequently are referred to separately as the *Attachment Test* and *Dominance Test.* We describe the procedure during each component next.

Attachment Test Components

A1. Petting: This test took place while the questionnaire was being answered. The owner and experimenter were seated at least 2 m apart. Owners were instructed to let their dogs roam freely and to pet them only if they approached. Dogs who approached the experimenter were petted moderately. The first 10 min were analyzed.

A2. Ignoring: This test lasted for 3 min. The owner was instructed to read silently and not to interact with the dog in any way. The experimenter did the same. If the dogs approached the owner or experimenter they were ignored.

A3. Novel object: The experimenter encouraged the dog to approach her to be petted. She then took a motorized child's toy (Motorized Crazy Shaker, Ertl Preschool, Bolingbrook, IL) from a bag, turned it on, and placed it on the ground halfway between the owner and herself. The toy vibrated and moved along the floor. After 20 sec, it was turned off and placed out of the dog's reach.

A4. Call response: The experimenter crouched on the floor and petted the dog. The owner was seated opposite and called the dog by name. The call was repeated until the dog responded or for a maximum of 30 sec. This component was repeated once and also formed part of the Dominance Test.

A5. Separation: Owners were asked to behave toward their dogs as they usually did when leaving them alone: to give commands, put on coats, and collect keys. The owners then left the room and if possible the house, closing the door and leaving the experimenter and dog alone. The experimenter remained seated for 1 min, petting any dog who approached. She then exited via the same door as the owners and remained outside with the owners, out of sight and earshot of the dogs, for a further 3 min.

A6. Return: The experimenter reentered the room and greeted the dogs moderately. She sat down and petted any dogs who approached. Thirty seconds later, the owners reentered and greeted their dogs in their usual manner.

Dominance Test Components

D1. Food removal: This component was carried out after the play session and before the questionnaire. This ensured all dogs were similarly satiated and prevented begging from interfering with their behavior during the remaining test components. The owners followed their normal feeding routine; but once the dog had been given food and had commenced eating, the owner removed the bowl. The owner used the necessary force to stop the dog feeding and to pick up

the food bowl, holding it above the dog's head for 10 sec before returning it to the floor. The owner then instructed the dog to "Leave" using verbal commands and/or physically blocking to prevent the dog from touching the food for 20 sec. The dog was then allowed to resume eating. This component was repeated, but the second time, when the food was replaced on the floor only a single verbal command was given.

D2. Sit: The owner instructed the dog to sit. If there was no response, the command was repeated until there was a response or for a maximum period of 30 sec. This component was repeated once.

D3. Forced down: While their dogs were sitting, the owners placed a hand on the dogs' shoulders and attempted to push them gently into a lying position. This continued for a maximum of 20 sec or until the dog lay down. This component was repeated once.

D4. Rise: After the dogs had been forced down, the owners instructed them to "Stay" and took five steps backward, remaining facing their dogs until they rose or for a maximum of 1 min.

D5. Approach: The experimenter crouched on the floor and petted the dog. The owner then approached the dog at walking pace and halted when 10 cm away. This was repeated once.

D6. Lying: The owners lay on their back on the floor and remained motionless for 30 sec.

D7. Grooming: The owners groomed their dogs lightly for 1 min. They were encouraged to groom the entire surface, including the head.

D8. Toy removal: The owners were given a small plastic squeaky toy, which they gave to their dog. After 20 sec, the owner attempted to retrieve the toy. They initially commanded the dog, but if this failed, they applied the necessary force to retrieve the toy. This was carried out twice.

D9. Toy regain: After retrieving the toy, the owners held it out of the dog's reach for 10 sec. They then placed it on the floor in front of the dog and instructed the dog to "Leave." If the dog was still obeying after 20 sec, they were praised and allowed to regain the toy. This component was repeated after each toy removal.

D10. Shout: The owner crouched down and petted the dog for 10 sec before rising suddenly and shouting "No."

All Attachment and Dominance Test components were carried out within a single session. They were presented in a standard order: D1, A1 (during questionnaire), A2, A3, A4, D2, D3, D4, A5, A6, D5, D6, D7, D8, D9, and D10.

The owners were instructed before each component and also prompted when necessary. At the outset, it was stressed that they could refuse to perform any of the components and were free to pet and interact with their dogs between components. The dog's behavior was filmed using the video camera and written records were made of any subtle behaviors observed during testing.

Behavioral Measures

The behavior of the dog during each phase of the visit was transcribed from the videotapes.

Play Session

We recorded all the game types that were played during the play session. Ten owners used more than five games, so only these games were used in subsequent analysis (Table 1). The total play duration was recorded, and subjective ratings were made for the dog's involvement and the interactivity of the play session (Rooney, 1999). There also were five variables that described the extent to which the owner and dog controlled the play session (Table 2).

Testing

Preliminary observations of the videoed behavioral tests were used to select variables. The selection criteria were that the variable must describe a behavior pattern exhibited by and showing variation in at least 10% of subjects. When appropriate, rarer behaviors were combined into categories to reach the 10% threshold. During the six Attachment Test components, 38 variables were measured that described the dog's behavior toward the owner and the experimenter.

During the Dominance Test, 50 variables were measured. Of these, 29 were specific to individual test components. A further 21 behavior patterns could occur at various stages throughout the test; therefore, we measured the number of test components out of a maximum of 11 in which the dog performed the pattern.

TABLE 1
Definitions of Dog–Human Game Types

Game Type	*Definition*
Fetch	Object is repeatedly thrown by person and retrieved by dog
Rough-and-tumble	Partners wrestle, involving no focal object, and there is a high level of contact between the players
Tug-of-war	Two partners simultaneously pull on a single object, each apparently aiming to gain sole possession
Chase	Partners reciprocally chase and run away from one another
Keep-away	One player possesses an object and tries to retain it, often while enticing their partner to pursue

TABLE 2
Behavioral Variables Measured During the Play Session

Variable	*Description*	*Units*
General play		
Involvement	Subjective rating of the dog's involvement or commitment to playing during the play session (Rooney, 1999)	Scale: 1 to 5
Interactivity	Subjective rating for the degree of interactivity or reciprocity between the players during the play session (Rooney, 1999)	Scale: 1 to 5
Play duration	Time for which the dog plays with the owner over 3 min session: 0 < 160 sec; 1 ≥ 160 sec	0/1
Play control		
Proportion of dog wins	Proportion of object competitions following which the dog maintains possession of the object	Prop
Dog winner	Session winner as derived from proportion of dog wins: 0 = proportion of dog wins < 0.66; 1 = proportion dog wins ≥ 0.66 ("dog win")	0/1
Dog possession duration	Duration for which the dog has sole possession of the object	Sec
Toys removed	Focal toy is retained by the owner at the end of the play session	0/1
Command frequency	Total number of commands given by the owner to the dog	Freq

Note. Prop = proportion; sec = seconds; freq = frequency.

Data Analysis

Data Reduction

Five partnerships failed to complete one of the test components because of the owner's choice or physical disabilities. Three owners could not conduct the Toy Removal test (D8) because their dogs were not interested in toys; none of these dogs were reported as aggressive toward their owners. One owner could not complete the Food Removal test because that dog would not eat; this dog had been aggressive in the past but not over food and not currently. The missing data were replaced with the mean value calculated using the remainder of the sample. The variables measured during Attachment and Dominance Tests were treated as discrete data sets. Principal components analysis (PCA) without rotation was applied twice to each data set to maximize parsimony (Cooley & Lohnes, 1971). The initial application served to reduce the number of variables, and the second identified the relevant factors.

Attachment Test. Preliminary PCA identified six potentially interpretable factors (as identified from a scree plot of eigenvalues). The key variables (those with a loading factor of greater than half the maximum loading factor, irrespective of sign) comprising these factors were examined. Any of the 38 measured variables that (a) were not highly loaded in any of the factors or (b) always occurred in the same factors as another variable, the accompanying variable having a higher loading factor in the first factor, were eliminated from further analysis. Two variables were eliminated for reason (a) and 6 for reason (b). A final PCA was run on the remaining 30 variables (Table 3). This produced seven factors with eigenvalues over

TABLE 3
Behavioral Variables Measured During the Attachment Test Components Excluding Measures Eliminated During Data Reduction

Test Component/Variable	*Description*	*Unit*
A1. Petting		
Owner interaction duration	Time dog spends in contact with, or < 50 cm from and attending to, owner	Sec
Owner approach frequency	Number of times dog approaches to within 50 cm of owner	Freq
Owner resting distance	Distance from owner that dog sits/lies for the longest time	Meter
Owner furthest distance	Furthest distance from owner that dog reaches	Meter
Owner toy presentations	Number of times dog contacts owner with toy	Freq
Owner—lick, paw, nuzzle, jump	Number of times dog contacts owner via lick, paw, nuzzle, or jump	Freq
Experimenter interaction duration	Time dog spends in contact with, or < 50 cm from and attending to experimenter	Sec
Experimenter approach frequency	Number of times dog approaches to within 50 cm of experimenter	Freq
Experimenter resting distance	Distance from experimenter that dog sits/lies for the longest time	Meter
Experimenter furthest distance	Furthest distance from experimenter that dog reaches	Meter
Experimenter toy presentations	Number of times dog contacts experimenter with toy	Freq
Experimenter—lick, paw, nuzzle, jump	Number of times dog contacts experimenter via lick, paw, nuzzle, or jump	Freq
Duration object interest	Time for which dog attends to object	Sec
A2. Ignoring		
Owner attention duration	Time dog spends in contact with or < 50 cm from and attending to owner	Sec
Owner vocalizations	Number of vocalizations dog makes while facing towards owner	Freq
Experimenter attention duration	Time dog spends in contact with or < 50 cm from and attending to experimenter	Sec

(continued)

TABLE 3 (Continued)

Test Component/Variable	*Description*	*Unit*
A3. Novel object		
Avoid	Dog withdraws from object	0/1
Investigate	Dog approaches or contacts object	0/1
Vocalization	Dog vocalizes while facing toward object	0/1
Owner response level	Degree of dog's response toward owner: 0 (*none*); 1 (*look*); 2 (*approach*); 3 (*contact*)	Scale: 0 to 3
Experimenter response level	Degree of dog's response towards experimenter: 0 (*none*); 1 (*look*); 2 (*approach*); 3 (*contact*)	Scale: 0 to 3
First approach owner	Person dog approaches first: 0 (*none*); 1 (*experimenter*); 2 (*owner*)	Categoric
A4. Call		
Response lag	Latency of dog's approach to owner following first call	Sec
A5. Separation		
Accomp. near door duration	Time dog spends < 50 cm from exit door while experimenter is present	Sec
Time with experimenter	Time dog spends < 50 cm from and oriented towards experimenter while owner is absent	Sec
Alone attend door duration	Time dog spends oriented toward and attending to exit door while experimenter and owner are absent	Sec
Alone near door duration	Time dog spends < 50 cm from exit door while experimenter and owner are absent	Sec
Alone vocalization frequency	Number of vocalizations dog makes while experimenter and owner are absent	Freq
Alone contact door frequency	Number of times dog contacts exit door while experimenter and owner are absent	Freq
A6. Return		
Experimenter greeting intensity	Subjective rating of dog's greeting of experimenter: 0 (*none*); 1 (*moderator*); 2 (*intense*)	Scale: 1 to 3

Note. Sec = seconds; freq = frequency; accomp. = accompanied by experimenter.

1.0, which jointly explained 65% of the initial variance in the data. Factors 5 and above were composed primarily (over 80%) of variables that also were key variables in earlier factors. The latter three factors were not interpreted, and only Factors 1 to 4 (Nonspecific Attention Seeking; Preference for Owner; Separation-Related Behavior; Preference for Unfamiliar Person) were retained (Tables 4 to 7).

Dominance Test. The Dominance Test data were analyzed in the same way. Preliminary PCA identified five factors. Three of the measured variables were not key variables in any of these factors, and 5 variables occurred only in the same factors as another variable, the accompanying variable having a higher

TABLE 4
Key Variables and Their Loadings on Attachment Factor 1: Nonspecific Attention Seeking

Positively Loaded Variables			*Negatively Loaded Variables*		
Test Component	*Variable*	*Loading Factor*	*Test Component*	*Variable*	*Loading Factor*
Petting	Experimenter approach frequency	0.87		None	
	Experimenter toy presentations	0.86			
	Owner approach frequency	0.83			
	Owner toy presentations	0.74			
	Duration object interest	0.57			

TABLE 5
Key Variables and Their Loadings on Attachment Factor 2: Preference for Owner

Positively Loaded Variables			*Negatively Loaded Variables*		
Test Component	*Variable*	*Loading Factor*	*Test Component*	*Variable*	*Loading Factor*
Petting	Experiemnter resting distance	0.73	Petting	Experiementer interaction duration	–0.67
Novel object	First approach owner	0.67	Call	Response lag	–0.45
Novel object	Owner response level	0.65	Ignoring	Experimenter attention duration	–0.42
Petting	Duration object interest	0.44			
Petting	Owner interaction duration	0.43			
Petting	Owner toy presentations	0.43			
Petting	Experimenter furthest distance	0.39			
Petting	Owner approach frequency	0.37			

TABLE 6
Key Variables and Their Loadings on Attachment Factor 3: Separation-Related Behavior

Positively Loaded Variables			*Negatively Loaded Variables*		
Test Component	*Variable*	*Loading Factor*	*Test Component*	*Variable*	*Loading Factor*
Separation	Accomp. near door duration	0.76	Separation	Time with experimenter	–0.67
Ignoring	Owner vocalizations	0.56			
Ignoring	Owner attention duration	0.50			
Petting	Owner resting distance	0.41			

Note. Accomp. = accompanied by experimenter.

TABLE 7
Key Variables and Their Loadings on Attachment Factor 4: Preference for Unfamiliar Person (Experimenter)

Positively Loaded Variables			*Negatively Loaded Variables*		
Test Component	*Variable*	*Loading Factor*	*Test Component*	*Variable*	*Loading Factor*
Petting	Experimenter—lick, paw, nuzzle, jump	0.49	Call	Response lag	–0.48
Petting	Experimenter interaction duration	0.47	Separation	Alone contact door frequency	–0.44
Petting	Owner resting distance	0.46	Separation	Alone near door duration	–0.41
Novel object	Experimenter response level	0.35	Petting	Owner interaction duration	–0.35
Petting	Owner furthest distance	0.35	Return	Experimenter greeting intensity	–0.31
			Separation	Alone attend door duration	–0.31
			Novel object	Investigate	–0.26

loading factor in the first factor. These 8 variables were eliminated before subsequent analysis. Final PCA on the remaining 42 dominance variables (Tables 8 and 9) produced 7 factors with eigenvalues greater than 1.0, jointly explaining 51% of the original data variance. Factors 3 and above were composed primarily (over 70%) of variables featuring as key variables in earlier factors and were therefore rejected. Factors 1 (Amenability) and 2 (Confident Interactivity) were retained for further analysis (Tables 10 and 11).

TABLE 8
Behavioral Variables Measured During Specific Components of the Dominance Test Excluding Measures Eliminated During Data Reduction

Test Component/Variable	*Description*	*Unit*
D1. Food removal		
Response intensity	Strategy dog uses to regain food: 0 (*none*); 1 (*skirt*); 2 (*push*)	Scale: 0 to 2
Restrain force	Force used by owner to remove food from dog: 0 (*one command*); 1 (*multiple command*); 2 (*gesture*); 3 (*contact*); 4 (*restraint*); 5 (*not removed*)	Scale: 0 to 5
One command eat	Time for dog to resume feeding following second food replacement with one command	Sec
A4. Call		
Response lag	Latency for dog to approach owner following first call (mean of 2 trials)	Sec
Approach gait	Gait of dog's approach to owner: 0 (*none*); 1 (*walk*); 2 (*trot*); 3 (*run*); 4 (*bound*)	Scale: 0 to 4
Indirect approach	Dog takes nondirect route to owner	0/1
D2. Sit		
Sit latency	Latency for dog to sit following first command (mean of two trials)	Sec
Orientate away	Dog sits facing away from owner	0/1
D3. Forced down		
Number comply	Number of times owner successfully forces dog into lying position (out of two trials)	Freq
Comply latency	Time owner takes to force dog into lying position (mean of two trials)	Sec
D4. Rise		
Rise latency	Latency for dog to rise from lie after forced down	Sec
Reapproach gait	Gait of dog's approach to owner after forced down: 0 (*none*); 1 (*walk*); 2 (*trot*); 3 (*run*); 4 (*bound*)	Scale: 0 to 4
D5. Approach		
Response positivity	Degree of dog's response to owner's approach: 0 (*retreat*); 1 (*unreactive*); 2 (*approach*); 3 (*jump up*)	Scale: 0 to 3

(continued)

TABLE 8 Continued

Test Component/Variable	*Description*	*Unit*
D6. Lying		
Ignore	Dog shows no response to owner lying down	0/1
Step over legs	Dog steps over owner's legs	0/1
Stand on/over	Dog stands on or over owner's torso: 0 (*never*); 1 (*head over*); 2 (*body over*)	Scale: 0 to 2
D7. Grooming		
Stance height	Posture assumed by dog for most of 60 sec: 0 (*lie*); 1 (*sit*); 2 (*stand*); 3 (*move*)	Scale: 0 to 3
Time tolerated	Duration dog tolerates grooming without escape attempt	Sec
D8. Toy removal		
Force required	Force required for owner to retrieve toy from dog: 0 (*command*); 1 (*contact*); 2 (*contact and command*); 3 (*pull*); 4 (*strong tug*); 5 (*will not surrender*)	Scale: 0 to 5
Brings toy	Dog brings toy to owner when instructed to leave	0/1
D9. Toy Regain		
Regain latency	Time for dog to pick up toy following removal (mean of two trials)	Sec
D10. Shout		
Stance height	Posture dog assumes after shout: 0 (*lie*); 1 (*sit*); 2 (*stand*); 3 (*move*)	Scale: 0 to 3
Change posture	Dog changes posture immediately after shout	0/1

Note. Sec = seconds; freq = frequency.

Hypothesis Testing

The six factors (four attachment and two dominance) were used as dependent variables. Because they were derived from observation, they are referred to as "measured" dependent variables. Additionally, two "reported" dependent variables were derived from the owners' questionnaire responses. Owners were asked if their dogs had ever exhibited aggression defined as "any exhibition of growling (not playful), baring teeth, snapping or biting" toward them and when it had last occurred. If they described aggression as ongoing, they scored 1 for the categoric (0/1) variable "current aggression." They also were asked to describe the form the aggression took. Their responses were ranked 0 (*none*), 1 (*growling*), 2 (*baring teeth*), 3 (*snapping*), or 4 (*biting*). This ordinal variable was named "aggression intensity."

Examination of the dependent variables revealed that they were not normally distributed; therefore, all subsequent statistics are nonparametric, and all descriptions of data are in the form of medians and quartiles. A range of independent variables was selected, each of which was hypothesized to affect relationship dimensions. These described demographics, features of dog–owner play, and

TABLE 9
Behavioral Variables Measured Over All 11 Dominance Test Components

Variable	*Description*	*Units*
Bark	Dog barks at owner	Number
Climb up	Dog jumps up placing forepaws on owner	Number
Display	Dog displays inguinal region	Number
Ears pricked	Dog's ears are pricked up	Number
Ears low	Dog's ears are low or back	Number
Growl	Dog growls at owner	Number
Head in lap	Dog places head in owner's lap	Number
Lick lips	Dog licks lips	Number
Lick owner	Dog contacts owner with tongue	Number
Low body position	Dog exhibits low posture	Number
Mouth owner	Dog places mouth around owner's hand	Number
Nuzzle	Dog contacts owner with its head	Number
Paw	Dog raises paw or places paw on owner	Number
Playful	Dog reacts playfully	Number
Roll	Dog rolls over on floor	Number
Sit	Dog sits uncommanded	Number
Tail height	Average of tail positions during each component: 1 (*tucked*) to 5 (*vertical*)	Scale: 1 to 5
Tail movement	Dog wags tail	Number
Tail tucked	Dog's tail is tucked between its legs	Number

Note. Number = the number of test components during which the behavior occurred.

ownership style that had been measured during the play session (Table 2) and derived from the questionnaire responses (Table 12). To explore the effect of each independent variable on the dependent variables, four nonparametric statistical tests were used (Spearman Rank Correlation, Kruskal–Wallis, Mann–Whitney U, Contingency, and Fisher's Exact tests; SPSS Version 10).

RESULTS

Play Behavior

The most common observed game type was keep-away, which was played by 36 of the 50 partnerships (Figure 2). Involvement and interactivity scores both ranged from 1 to 5, with medians (*Mdn*) of 3.9 (25th percentile = 2.5, 75th percentile = 4.6) and 3.6 (25th percentile = 2.5, 75th percentile = 4.5), respectively. The median play duration was 158 sec (25th percentile = 97, 75th percentile =

TABLE 10
Key Variables and Their Loadings on Dominance Factor 1: Amenability

Positively Loaded Variables			*Negatively Loaded Variables*		
Test Component	*Variable*	*Loading Factor*	*Test Component*	*Variable*	*Loading Factor*
All	Roll	0.68	All	Ears pricked	–0.52
All	Low body position	0.65	Food removal	Response intensity	–0.52
All	Ears low	0.64	Call	Response lag	–0.52
All	Display	0.62	Toy removal	Force required	–0.51
Food removal	One command eat	0.61	Forced down	Comply latency	–0.43
All	Tail tucked	0.60	Call	Indirect approach	–0.43
All	Head in lap	0.51	All	Mouth owner	–0.41
Toy regain	Regain latency	0.43	All	Climb up	–0.39
Rise	Rise latency	0.44	All	Tail height	–0.35
Grooming	Time tolerated	0.44			
Toy removal	Brings toy	0.41			
All	Lick owner	0.41			

TABLE 11
Key Variables and Their Loadings on Dominance Factor 2: Confident Interactivity

Positively Loaded Variables			*Negatively Loaded Variables*		
Test Component	*Variable*	*Loading Factor*	*Test Component*	*Variable*	*Loading Factor*
All	Tail movement	0.65	Call	Response lag	–0.46
Call	Approach gait	0.61	Lying	Ignore	–0.33
All	Playful	0.55	All	Tail tucked	–0.33
All	Lick owner	0.53			
Lying	Stand on/over torso	0.53			
Grooming	Stance height	0.53			
Rise	Reapproach gait	0.51			
All	Sit	0.49			
All	Tail height	0.48			
All	Bark	0.46			
All	Paw	0.46			
Approach	Response positivity	0.44			

TABLE 12
Variables Extracted From the Questionnaire and Used As Independent Variables for Testing Relationships With Attachment and Dominance Dependent Variables

Variable	*Description*	*Units*
Demographics		
Dog age	Age of dog at time of visit	Years
Dog breed type	Kennel Club category of dog breed or breed most closely resembled	6 categories
Pure breed	Reported purebred or pedigree dog	0/1
Dog sex	Sex of dog: 0 (*male*); 1 (*female*)	0/1
Owner gender	Gender of owner: 0 (*male*); 1 (*female*)	0/1
Play behavior		
Play frequency	No. of dog owner play sessions per week	Frequency
Dog initiates	When asked how they start play, owner volunteers that dog usually starts play sessions	0/1
Owner's behavior		
Daily time together	Time owner spends with dog in an average day	Minutes
Daily interaction time	Time owner spends interacting with dog in an average day	Minutes
Current training time	Time spent training dog per week: 0 (*none*); 1 (< *10 min*); 2 (*10 to 30 min*); 3 (>*30 min*)	Scale
Sleeping location	Dog's usual night sleeping place: other room; locked in other room; owner's bedroom; owner's bed	4 categories

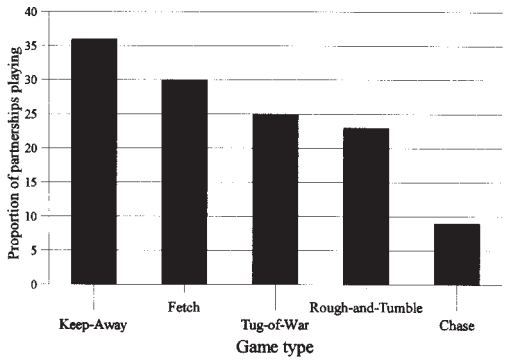

FIGURE 2 Number of dog–owner partnerships (out of 50) observed to play each game type during the play session.

180), and 25 dogs played for 160 sec or more and were classified as "long players." The dogs observed to play fetch were significantly younger (*Mdn* age = 5.3 years; 25th percentile = 3.0, 75th percentile = 8.6) than nonplayers (*Mdn* age = 8 years; 25th percentile = 7, 75th percentile = 11; Mann–Whitney $U = 164$, $p < .01$). No further variables were affected by age.

Although the games played appear to be influenced by breed type, insufficient numbers of some breed categories made the relationship statistically untestable. Female dogs scored higher for involvement in the play session (*Mdn* = 4.5; 25th percentile = 2.9, 75th percentile = 5.0)) than did male dogs (*Mdn* = 3.5; 25th percentile = 2.5, 75th percentile = 4.5; $U = 194$, $p < .05$). Male owners were more likely to engage in rough-and-tumble play (67%) than were female owners (37%), but this trend did not reach statistical significance (Fisher's Exact test; $p = .07$).

Thirty-nine owners incorporated commands within their play, giving an average of 6 (25th percentile = 1, 75th percentile = 14.5) per session. Seven partnerships did not include a toy in their game; therefore, the remaining play control variables were measured on a reduced sample of 43. The proportion of dog wins varied from 0 to 1 with a median of 0.17 (25th percentile = 0, 75th percentile = 0.5). Seven partnerships were classified as dog winners(> 0.66 dog wins). The dog possession duration ranged from 1 to 173 sec, with a median of 78 (25th percentile = 27, 75th percentile = 105). Eighteen owners removed the toy at the end of the play session, whereas 25 dogs had continual access to the focal toy.

Questionnaire Responses

The reported frequency of play sessions varied between 0 and 42 per week, with a median of 7 (25th percentile = 7, 75th percentile = 21). When asked how they usually started play, 29 of the 50 owners said that the dog was often the initiator.

Owner's Behavior

Owners spent between 4 and 24 hr per day (*Mdn* = 13 hr; 25th percentile = 7, 75th percentile = 17.5)) with their dog. An average of 1.75 hr (25th percentile = 1.5, 75th percentile = 2.5) of this time was spent interacting. However, the majority (72%) of owners currently devoted no time to training their dog, and only 14% spent more than 30 min per week training. When asked about the dog's usual sleeping position, 45% of the dogs were reported to be locked out of the owner's room at night, 14% voluntarily slept in another room, 10% usually slept in the owner's room, and 31% slept on the owner's bed.

Dog's Behavior

Reported aggression levels ranged from 0 to 4 with a median of 1 (25th percentile = 0, 75th percentile = 1.3). Twelve owners reported their dog as showing current aggression.

What Affected Attachment Dimensions of the Dog–Owner Relationship?

Demographics

Preference for Owner was negatively correlated to the dog's age ($\rho = 0.29$, $df = 49$, $p < .05$). Preference for Unfamiliar Person was the only attachment dimension to vary significantly according to breed type (Kruskal–Wallis test; $\chi^2 = 13.1$, $df = 5$, $p < .05$). Crossbred dogs scored significantly higher for Preference for Owner (*Mdn* = 0.3; 25th percentile = –0.5, 75th percentile = 0.9) than did purebred dogs (*Mdn* = –0.3; 25th percentile = –0.8, 75th percentile = 0.6; $U = 196$, $p < .05$). The attachment dimensions were not significantly affected by the dog's sex or the owner's gender.

Play Behavior

Dogs observed to play rough-and-tumble scored lower for Separation-Related Behavior (*Mdn* = –0.6; 25th percentile = –0.9, 75th percentile = 0.2) than did nonplayers (*Mdn* = 0.4; 25th percentile = –0.6, 75th percentile = 1.1; $U = 210$, $p = .05$). Interactivity scores were significantly correlated to scores for Preference for Unfamiliar Person ($\rho = 0.36$, $df = 49$, $p = .01$). Dogs classified as long players scored higher for Preference for Owner (*Mdn* = 0.3; 25th percentile = –0.4, 75th percentile = 1.0) than did short players (*Mdn* = –0.5; 25th percentile = –1.1, 75th percentile = 0.5; $U = 196$, $p < .05$). Involvement scores and other game types played showed no significant relationships to any of the attachment dimensions.

Owner's Behavior

Neither daily time together nor the daily interaction time showed significant correlation to the attachment dependent variables ($\rho < 0.2$, $df = 49$, $p > .18$). No attachment dependent variables were affected by the dog's sleeping location (Kruskal–Wallis; $\chi^2 < 5.0$, $df = 3$, $p > 0.2$).

What Affected Dominance Dimensions of the Dog–Owner Relationship?

Reports of current aggression showed no significant relationship to the measured ($U > 150$, $p > .05$) dominance variables.

Demographics

Confident Interactivity scores decreased with the age of the dog ($\rho = -0.39$, $df = 49$, $p = .005$). The remaining dependent variables were unaffected by age. Amenability scores varied significantly between the breed types (Kruskall–Wallis; $\chi^2 = 14.7$, $df = 5$, $p = .01$). Crossbred dogs obtained higher scores for Amenability ($Mdn = 0.4$; 25th percentile = –0.2, 75th percentile = 0.9) than did purebred dogs ($Mdn = -0.1$; 25th percentile = –1.2, 75th percentile = 0.2; $U = 189$, $p < .05$). Extracted dominance variables did not vary with the sex of the dog ($U > 210$, $p > .05$) or the owner ($U > 181$, $p > .1$).

Play Behavior

Observed play session. Dogs observed to play specific game types differed from nonplayers in dominance dimensions. Players of tug-of-war scored significantly higher for Confident Interactivity ($Mdn = 0.4$; 25th percentile = –0.5, 75th percentile = 1.2) than did nonplayers ($Mdn = -0.4$; 25th percentile = –0.7, 75th percentile = 0; $U = 197$, $p < .05$). Similarly, players of fetch obtained higher scores for Confident Interactivity ($Mdn = 0.2$; 25th percentile = –0.5, 75th percentile = 1.1) than did nonplayers ($Mdn = -0.4$; 25th percentile = –0.7, 75th percentile = –0.1; $U = 192$, $p < .05$) and players of rough-and-tumble scored higher for Amenability ($Mdn = 0.2$; 25th percentile = –0.1, 75th percentile = 0.9) than dogs who did not play this game type ($Mdn = -0.2$; 25th percentile = –1.2, 75th percentile = 0.3; $U = 207$, $p < .05$). Involvement in the play session was highly correlated to Confident Interactivity ($\rho = 0.43$, $df = 49$, $p < .005$), and Interactivity in the play session correlated to Amenability ($\rho = 0.30$, $df = 49$, $p < .05$). Also, dogs described as long players scored higher for Confident Interactivity ($Mdn = 0.3$; 25th percentile = –-0.5, 75th percentile = 1.3) than did short players ($Mdn = -0.3$; 25th percentile = –0.9, 75th percentile = 0; $U = 197$, $p < .05$).

None of the control variables measured during the play session showed significant relationships to the measured dominance variables or the reported aggression level. However, current aggression was more common in dogs who took part in a dog winner play session (Fisher's Exact test; $p < .01$). Five of the seven dog-win sessions involved currently aggressive dogs (of the nine aggressive dogs playing with toys). Command frequency had no effect on any of the dependent variables.

Questionnaire variables. The reported play frequency did not significantly affect the dominance variables. The variable "dog initiates" showed very

significant associations to two dependent variables. Dogs who were reported to initiate play scored lower for Amenability (*Mdn* = –0.2; 25th percentile = –1.2, 75th percentile = 0.3; *N* = 29) than dogs who did not initiate play (*Mdn* = 0.2; 25th percentile = 0, 75th percentile = 1; *N* = 21; *U* = 162, *p* = .005). Dogs who initiated play also were more likely to exhibit current aggression (Fisher's Exact test; $p < .01$). Of the 12 currently aggressive dogs, 11 were reported to initiate play (Figure 3).

Owner's Behavior

The time currently devoted to training did not affect any of the measured dominance variables.

DISCUSSION

Attachment Test

We are aware of no previous attempts to quantify attachment dimensions of a dog–owner relationship within the home setting. Our test yielded four meaningful attachment factors, confirming that attachment is a multidimensional construct (Cairns, 1972), although given our sample size (50), we cannot be confident that the factors we have identified would be adequate to describe all dog–owner relationships. However, they are in broad agreement with those we have found in similar studies (Rooney, 1999). The attachment factors were affected by demographics. Preference for Owner decreased with age and was higher in crossbred dogs, which is consistent with the higher prevalence of sepa-

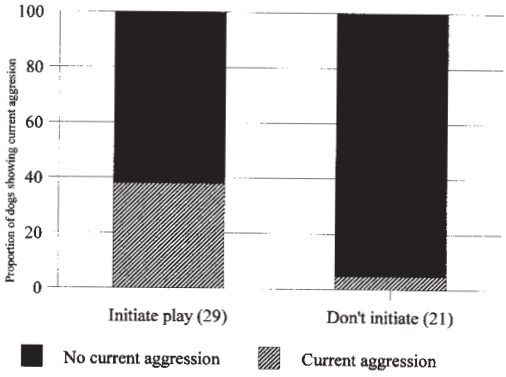

FIGURE 3 Relationship between dogs who initiate play sessions and those who exhibit current aggression.

ration disorders in crossbreeds found in some studies (Takeuchi, Ogata, Houpt, & Scarlett, 2001), although not all (Bradshaw, McPherson, Casey, & Larter, 2002). Preference for Unfamiliar Person was significantly associated with breed type, suggesting that characteristics of the dog have an important role in determining this attachment dimension.

The Link Between Rough-and-Tumble Play and Attachment Dimensions

This study did not detect any relationship between attachment dimensions and the quantity of play, but the types of games played were important. The dogs observed to play rough-and-tumble games scored significantly lower for Separation-Related Behavior than did nonplayers. Because this is a correlational study, in isolation it provides no evidence that rough-and-tumble is the cause of, and not a result or correlate of, reduced Separation-Related Behavior. However, based on this and a previous study (Rooney, 1999), we suggest that there may be a causal relationship between the playing of rough-and-tumble and attachment-related behavior. We suggest that this game may inhibit the exhibition of separation-related behavior and therefore may be beneficial for the dog. The means by which this occurs is unknown, but one possibility is that the physical contact between dog and owner during rough-and-tumble play fulfils the dog's need for contact that they no longer need to seek; hence, the exhibition of Contact Seeking (Rooney, 1999) and Separation-Related Behavior (this study) are decreased. A similar relationship between play and contact is seen in rats (*Rattus norvegicus*), as deprivation of social contact leads to an increased drive for rough-and-tumble play (Ikemoto & Panksepp, 1992).

Dominance Test

This home-based Dominance Test was adapted from a test developed in an experimental setting (Rooney & Bradshaw, 2002). Our test yielded two meaningful factors—Amenability and Confident Interactivity—that equated well to the factors produced in experimental studies. Our test, therefore, may be useful, with modifications, in the home as well as the laboratory context. As for attachment, however, given our sample size (50) we cannot be confident that the factors we have identified would be adequate to describe all dog–owner relationships. However, they are in broad agreement with those we have found in similar studies (Rooney, 1999; Rooney & Bradshaw, 2002).

Amenability is a desirable quality in a dog–human relationship. Low scores for Amenability can be problematic because they describe dogs who refuse to leave

their food or their toys or who do not respond to a call. Confident Interactivity, although including many behaviors that may be described as dominant, also is a desirable trait in moderation. A dog scoring high for Confident Interactivity is likely to be playful, lick the owner frequently, and approach quickly when called. Therefore, we suggest that factors that decrease Amenability are potentially more harmful than those that increase Confident Interactivity.

Dissociation Between Dominance and Aggression

We found no significant relationship between reported aggression incidence and the measured dominance dimensions. This is likely to be because aggression is multicausal; it can be a result of fear or pain (Overall, 1997) as well as being dominance related. Presumably, many of the dogs reported to show aggression did so for reasons other than dominance.

Effects of Demography

Characteristics of the dogs strongly affected the dominance dimensions. Confident Interactivity decreased with age ($p = .005$), and Amenability varied with breed type ($p = .01$). These results suggest that biological factors play a major role in the determination of dominance dimensions of dog–human relationships, and the effects of external factors are comparatively weak. Thus, games and owners' behavior may only modify dominance tendencies that are already predetermined.

Does Playing Tug-of-War Enhance Dominance?

Tug-of-war players scored higher for Confident Interactivity than did nonplayers. Although this could be interpreted as supporting the dominance enhancement theory, further evidence suggests it does not. Dogs who played fetch in the play session also scored higher for Confident Interactivity than did nonplayers. A link between fetch and confidence was found in previous experimental studies when a group of Labrador Retrievers who received regular games of fetch increased significantly in confidence (Rooney, 1999). Fetch is human controlled, therefore the dominance enhancement theory would predict players of fetch to have lower scores for Confident Interactivity or higher scores for Amenability. Our results do not support these predictions.

Previous experimental studies have failed to identify any significant dominance-related effects (Rooney & Bradshaw, 2002), and links between dominance and tug-of-war in this study are indiscernible from those between dominance and fetch. We therefore conclude that playing tug-of-war does not substantially alter dominance dimensions of the dog–human relationship.

Effects of Other Game Types on Dominance Dimensions

Dogs who were observed to play rough-and-tumble games scored higher for Amenability than nonplayers. Amenability is a desirable trait; therefore, this link does not support O'Farrell's (1992) warnings that rough-and-tumble should be avoided. Other experimental studies have shown no significant effects of rough-and-tumble on dominance dimensions (e.g., Rooney, 1999), which implies this link is correlative and not causal.

Control the Game, Control the Dog?

Although it is often advised that tug-of-war games should be avoided, a crucial factor in the effects of games is claimed to be which partner (human or dog) wins or controls the game (McBride, 1995). A previous experimental study (Rooney & Bradshaw, 2002) failed to find any differences in dominance-related behavior of dogs after winning and losing tug-of-war games.

In this study, we examined the effect of control variables (including the proportion of competitions won, the command frequency, and the possession duration) during play. None of these variables affected the measured dominance dimensions. However, there was a significant trend for dogs reported to be currently aggressive to win over two thirds of competitions during the play session. This appears to support the link between winning games and aggression, but there is no evidence that this aggression was dominance related. Although five of the seven dogs who were allowed to win at play were aggressive, they did not differ significantly in dominance dimensions to the control sample. Also, we cannot be sure which factor is the cause and which the effect. It is equally plausible that owners who are aware of the dog's aggressive tendencies allow them to win possession of toys rather than winning causing the aggression. Longitudinal studies may prove useful in resolving this issue.

Popular Theories or Common Myths?

This study allowed preliminary examination of a number of popular theories, and we now review the extent to which each is supported by these results.

Do Dogs Who Have Continual Access to Toys Become Dominant?

Rogerson (1992) claimed that dogs who have continual access to toys learn to dictate interactions and often become dominant over their owners. We found no

difference in dominance dimensions of those dogs who retained toys at the end of the observed games and those dogs whose owners retained the toys.

Does Allowing Dogs to Sleep in the Bedroom Lead to Overattachment?

The importance of the dog's sleeping location is stressed by many behavioral counselors (Appleby, 1997). In her longitudinal study, McPherson (1998) was unable to detect any effects of sleeping location on the development of separation-related problems in Labrador Retrievers, Border Collies, or a sample of re-homed dogs of many breeds. Within this mixed-breed sample, we too found no association between sleeping location and any of the attachment dimensions of the dog–owner relationship.

Does Interaction Initiation Affect Dominance?

It is claimed that dogs who are frequently allowed to initiate social interactions (including play) behave with increased dominance toward their owner (O'Farrell, 1992). This study provides strong evidence for this claim. Dogs who were reported to initiate play frequently were found to score lower for Amenability and were more likely to exhibit aggression.

The nature of the link between initiation of play and dominance dimensions (including aggression) is not clear. O'Farrell (1992) maintains that interaction initiation by the dog is the cause of increased dominance, but there are alternative explanations:

1. Play initiation may reflect a dominance relationship that already exists. Dominant hamsters, *Mesocricetus auratus* (Pellis & Pellis, 1993) and squirrel monkeys, *Saimiri sciureus* (Biben, 1998) more frequently initiate play with subordinate conspecifics. Dogs may similarly instigate play with their owners only when they are sufficiently dominant to do so.
2. Allowing dogs to initiate play may reflect a general ownership trait. Dogs who determine the timing of play sessions may also dictate other aspects of their routine; for example, they may be allowed access to all areas of the house, demand attention, and beg for food. The owner may reinforce the dog's status in a great number of ways, and responding to play initiation is just one symptom of this.
3. When owners initiate play, they usually perform human–dog play signals (Rooney, Bradshaw, & Robinson, 2001). Play sessions that are initiated by the dog are likely to involve reduced human–dog signaling. The link between dog initiation and decreased Amenability (and increased aggression) may result from this

reduced metacommunication, allowing games to assume competitive consequences.

Play As a Window on Dog–Human Relationships

This study points to some factors that may play a deterministic role in dog–human relationships, for example, rough-and-tumble games. However, it also identifies a number of features of a dog's play behavior with the owner, which correlates to quantifiable aspects of the relationship. These include the following:

1. Interactivity during the play session was positively correlated to Preference for Unfamiliar Person and to Amenability.
2. Dogs who were long players showed higher Preference for Owner scores.
3. Involvement during the play session was highly correlated with Confident Interactivity.

It is unlikely that these characteristics of play are the cause of their associated relationship dimensions. It is more likely that features of an established dog–owner relationship determine the way they play or that play behavior, and relationship dimensions are controlled by the same overriding traits. Play behavior reflects relationship patterns in children (Clark, Wyon, & Richards, 1969), squirrel monkeys (Biben, 1998), and rats (Smith, Field, Forgie, & Pellis, 1996) and, we suggest, also in dog–human relationships. Because quantifiable aspects of play correlate to both attachment and dominance dimensions of dog–human relationships, examination of play sessions may give an insight into a dog–owner relationship. This suggests that play has the potential, with further research, to be used as a probe in the assessment of dog–human relationships.

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