



Investigating the function of play bows in adult pet dogs (*Canis lupus familiaris*)



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ABSTRACT

Play bows are a common, highly stereotyped canine behavior widely considered to be a 'play signal,' but only one study has researched their function. Bekoff (1995) found that play bows function as behavioral modifiers to help clarify playful intent before or after easily misinterpretable behaviors, such as bite-shakes. To further examine the function of play bows, the current study analyzed five types of behaviors displayed by the bower and the partner immediately before and after a play bow during dyadic play. We found that play bows most often occurred after a brief pause in play. Synchronous behaviors by the bower and the partner, or vulnerable/escape behaviors by the bower (such as running away) and complementary offensive behaviors by the partner (such as chasing) occurred most often after the play bow. These results indicate that during adult dog dyadic play, play bows function to reinstate play after a pause rather than to mediate offensive or ambiguous actions.

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1. Introduction

Despite over 50 years of research on nonhuman animal play (hereafter animal play), researchers have yet to reach consensus on how to define this eclectic behavior. While easily determinable to observers (i.e., they know play when they see it) (Darling, 1937; Bekoff, 1995; Burghardt, 2005), defining play is problematic due to extensive variation in its behavioral components and seeming lack of adaptive function (Lorenz, 1956; Rosenberg, 1990; Bekoff and Allen, 1998). As animal play research has become more systematic and comparative, it has become increasingly clear that play behavior is not easily generalizable and varies dramatically across species (Pellis, 1993; Pellis and Pellis 1998; Bekoff, 1995; Palagi, 2006). During play, different species emphasize different motor patterns (Watson and Croft, 1996; Thompson, 1998), arrange these patterns into different sequences (Palagi, 2006) and employ unique behaviors or "play signals" to invite and/or maintain play (Loizos, 1967; Bekoff, 1976; Bekoff and Byers, 1981; Fagen, 1981; Ch.2; Palagi et al., 2015a,b).

Researchers have therefore proposed a wide variety of potentially adaptive benefits for social play (Baldwin and Baldwin, 1977; Poirier et al., 1978; Fagen, 1981; Lewis, 1982; Byers and Walker,

1995; Brown, 1998; Dolhinow, 1999; Spinka et al., 2001). Since across species play is typically more common in young adults and juveniles, it may function to develop motor abilities or hunting behaviors for future use (Fagen, 1981; Martin and Caro, 1985; Enomoto, 1990; Pellis and Iwaniuk, 2000; Burghardt, 2005). On the other hand, social play often utilizes play fighting, thereby borrowing behaviors shown during real fights, such as chasing, running and wrestling, potentially providing participants with a cost effective way to establish dominance or reinforce/test social bonds without engaging in an actual dispute (Bekoff, 1974; Aldis, 1975; Owens, 1975; Zahavi, 1977; Fagen, 1981; Paquette, 1994; Bekoff, 1995; Pellis and Pellis, 1996; Bekoff and Allen, 1998; Pellis and Iwaniuk, 2000; Bekoff et al., 2002; Burghardt, 2005).

Irrespective of the lack of consensus on its definition or function, play clearly involves communication between participants. Participants have to communicate their motivation in initiating play and negotiating the nature of their play interactions (Fagen, 1981; Pellis and Pellis 1996; Bekoff, 2001). Researchers have suggested that participants do this frequently through the use of *play signals*, which are generally used to commence, continue and recommence social play (Bekoff, 1972; Fagen, 1981; Smith, 1982; Palagi et al., 2015a,b). Such communicative skills typically develop during early social interactions and allow playmates to discern playful from non-playful scenarios (Bekoff, 1974; Horowitz, 2009). This communication employs bodily movements, vocalizations and facial expressions (Darwin, 1872; Rheingold, 1963; Fox, 1970; Bekoff, 1972).

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Table 1

Demographic data of domestic dogs sampled.

Name	Age during study (months)	Breed	Sex	Avg. weight (kg)	Housemates ^b
Abby (AB)	12 ^a	Labrador Retriever	F	24.5	Mitch
Bahati (BA)	7–33, 144–156	Unknown mix	F	20.4	Safi, Tex, Lela*, Bentley
Bentley (BE)	12–40	Golden retriever mix	M	21	Tex, Lela*, Bahati
Bodhi (BO)	72 ^a	German Shepherd	M	38	
Kobe (KO)	16–27	Unknown mix	F	28.1	
Lela (LE)	4–10	German Shepherd	F	13	Tex, Bahati*, Bentley*
Lucy (LU)	8–39	Keeshond/Shepherd mix	F	14.5	
Mitch (MI)	26–57	Labrador Retriever	M	34.5	Abby
Raven (RA)	23–42	Siberian Husky	M	23.1	
Rascal (RAS)	24 ^a	Unknown mix	M	22	
Safi (SA)	108–146	German Shepherd	F	34.5	Bahati
Sullivan (SU)	12 ^a	Pit bull mix	M	20	
Tasha (TA)	60 ^a	Husky mix	F	22	
Tex (TX)	12–100	Belgian Tervuren mix	M	24	Lela*, Bahati, Bentley
Tuna (TU)	48 ^a	German Shepherd	F	32	
Zoe (ZO)	15 ^a	Standard Poodle	F	20	

^aSubjects without an age span include data from a period of one year or less.^bHousemates reflect the other individuals a dog lived with over their lifetime. An * reflects a living arrangement of less than 1.5 years at the time the data were collected.**Table 2**

Ethogram of behavior codes organized by behavior categories.

Vulnerable/escape	Offensive	Synchronous	Miscellaneous	Pause
Receives bite	Bites move	Mutual rear up	Close approach	Relatively stationary
	Bite still	Moves together	Chin-over move	Sitting
Receives muzzle bite	Bite muzzle		Chin-over stationary	Lying down
Runaway	Charge		Close non directional movement	
	Chase		Far non directional movement	
Being forced down	Force down		Move away	
Receives genital sniff	Gives genital sniff		Partial approach	
Receives mount	Mount		Play bow*	
Receives nip	Nip move		Play face	
	Nip still		Out of view	
Receives push/tackle	Push/tackle			
	Failed tackle			
Voluntary down				
Gives muzzle lick	Receives muzzle Lick			
Receives overs during downs	Overs during downs			

* See S7.

Domestic dogs (*Canis lupus familiaris*, hereafter referred to as dog) are unusual in that they exhibit high frequencies of play behaviors even as adults (Rooney et al., 2000; for a review of dog play see Bradshaw et al., 2015). Unlike play in other domestic carnivores such as cats (Hall, 1998; Hall et al., 2002) play in domestic dogs often involves a conspecific or human partner, suggesting that the underlying motivations are likely social (Rooney et al., 2000; Ward et al., 2008). Therefore, dog play signals are of considerable significance.

One of the most stereotyped play behaviors, the play bow (Darwin, 1872), is consistently found within dog play, in addition to other closely related species like coyotes, wolves, foxes and even lions (Bekoff, 1974; Schaller, 1972). Play bows can be identified by the high-rump crouch position, which occurs when the forequarters of an individual are bent, often in a lying down position, while the hindquarters remain elevated. Though this behavior is widespread and easily recognizable, its function within play has rarely been addressed scientifically.

Bekoff (1995) conducted the first detailed study on the function of play bows in canines. He observed that play bows were more likely to occur in association with behaviors that could potentially be misinterpreted as aggressive. Specifically, in a cross-species sample of domestic dogs (both infants and adults), infant gray wolves, and infant coyotes, bite-shakes were the most common behavior shown immediately before or after play bows (Bekoff, 1995). Bite-shakes are typically defined as one animal biting down on a play partner's head or neck and rapidly shaking his or her own head side to side. Therefore, Bekoff hypothesized that canines

use play bows to reinforce ongoing social play and to clarify the bower's intentions so as to maintain a playful atmosphere (Bekoff, 1972, 1995).

Bekoff's (1995) domestic dog subjects included 4 infants (with observations taken over the period from 3 to 7 weeks of age) as well as 10 adults. The data from both age groups were combined, but it was not indicated how many observations from each contributed to the analysis. This is an unfortunate omission, since bite-shakes are rarely observed in adult domestic dogs (Ward et al., 2008). When analyzing play data during three stages, 3–8, 10–23 and 27–40 weeks of age, Ward et al. (2008) found that, as puppies from different litters developed, bite-shakes decreased drastically in frequency. Observed at their highest frequency of 13% (of all offensive plus self-handicapping behaviors shown during play) during weeks 3–8, bite-shakes dropped to 4% during weeks 10–23, and weren't seen at all during weeks 27–40 (Ward et al., 2008). Thus, Bekoff's (1995) conclusion about the clarifying function of play bows seems to apply only to infant (and maybe occasionally juvenile) dog play.

Furthermore, play bows have consistently been found to occur in association with non-aggressive behaviors rather than aggressive ones. During adult dog social play, within pair play bows were most frequently exhibited by individuals who self-handicapped (i.e., restrained full force or put themselves in vulnerable positions) more often, not by those who showed more offensive (i.e., mock-attack) behaviors (Bauer and Smuts, 2007). Ward et al. (2008) replicated these findings in young littermates.

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