

# Examining dog–human play: the characteristics, affect, and vocalizations of a unique interspecific interaction

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**Abstract** Despite the growing interest in research on the interaction between humans and dogs, only a very few research projects focus on the routines between dogs and their owners. In this study, we investigated one such routine: dog–human play. Dyadic interspecific play is known to be a common interaction between owner and charge, but the details of what counts as play have not been thoroughly researched. Similarly, though people represent that “play” is pleasurable, no study has yet undertaken to determine whether different forms of play are associated with different affective states. Thus, we aimed to generate an inventory of the forms of dyadic play, the vocalizations within play, and to investigate the relationship of affect to elements of play. Via a global citizen science project, we solicited videotapes of dog–human play sessions from dog owners. We coded 187 play bouts via frame-by-frame video playback. We then assessed the relationship between various intra-bout variables and owner affect (positive or neutral) during play (dog affect was overwhelmingly positive). Amount of physical contact (“touch”), level of activity of owner (“movement”), and physical closeness of dog–owner dyad (“proximity”) were highly correlated

with positive affect. Owner vocalizations were found to contain different elements in positive- and neutral-affect play. One novel category of play, “tease”, was found. We conclude that not all play is created equal: the experience of play to the owner participant is strongly related to a few identifiable characteristics of the interaction.

**Keywords** Dog–human play · Categories of play · Citizen science · Affect · Vocalizations

## Introduction

Recently, a number of biological and behavioural fields, from comparative psychology to epidemiology to evolutionary biology, have become interested in a subject right in front of their noses: the domestic dog. Dogs are not only a common companion—an estimated 75 million live in US homes—but are an increasingly common subject for scholarly research (Horowitz 2014). At the same time, a field of study of the interaction of dogs with their most frequent companion, humans, has emerged. Research looking at the dog–human dyad is especially fertile in the investigation of disease and seizure detection, the effect on human well-being, and the training and use of therapy dogs (Gadbois and Reeve 2014; Rooney and Bradshaw 2014).

Less thoroughly investigated but potentially just as useful is the study of the behaviours of dogs and humans in a daily activity: when they play together. Dog–owner play is a regular feature of many owners’ interactions. Dog–human play is not homologous with dog–dog play (Rooney et al. 2000), but all social play thus far studied share some features and results. Play behaviour in general is seen as an indication of good health, robust development, and positive affect (Held and Spinka 2011; Rooney and Bradshaw

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2014). Among humans, childhood play is implicated as integral for normal cognitive and social development (Bergen 2002; Piaget 1962; Smith and Pellegrini 2008; Vygotsky 1933/1976)—though the relationship might not be causal (Lillard et al. 2012)—as well as being rewarding (Rooney and Bradshaw 2014). Social play is considered to be a rich context in which subjects learn about one another, how to behave, and forge affiliations and bonds.

For dogs, play is an indication of positive welfare and is essential for normal development (Rooney and Bradshaw 2014). A high level of play between a dog and owner is thought to strengthen their relationship (Bradshaw et al. 2015); dog–owner play bouts that owners describe as “successful” or “satisfying” share many routines with successful dog–human interactions (Horowitz and Bekoff 2007). The mutual attention and social coordination of both dog and owner in interspecific play not only allows the play to occur, it is emblematic of the dog–human bond (Hecht and Horowitz 2015). Research has looked at—and dismissed—the notion that rough (tug) play may lead to displays of “dominance” in dogs (Rooney and Bradshaw 2002). Yet, little research has examined the common claim that all forms of dog–human play lead to positive affect in humans (Rooney and Bradshaw 2014). In one study, owners who pet, talked to, and lightly played with their dogs showed an increase in oxytocin (Odendaal and Meintjes 2003); in another, looking at a marker of dog affect, cortisol, changes of dogs’ hormonal levels after play were variable depending on the play style of their handlers (Horváth et al. 2008).

To begin, further basic descriptions of what counts as “play” between dogs and owners are needed. A few inventories of play types have been begun (e.g. Rooney 1999; Rooney et al. 2001; Bradshaw et al. 2015), but these did not attempt a full characterization; other research has focused on the components of (Horowitz and Bekoff 2007) or subroutines within play (Mitchell and Thompson 1991). In most dog–human play, the owner spends at least some time talking while playing with the dog. Research looking at human vocalizations during play (Mitchell and Edmonson 1999) found them to be highly repetitive. Surprisingly, given the hypotheses about the affiliative consequence of play, these authors also found the words used to be demonstrative of owners’ attempt to “control the dog[s]” (Mitchell and Edmonson 1999).

Thus, the aims of the present study were, first, to characterize this form of interspecific dyadic play more completely than has previously been done. Through ethological coding of video submissions, we compiled an inventory of different forms of play engaged in by dogs and owners. This catalogue represents, essentially, a demarcation between bouts that have varying levels of a prescribed set of behaviours (listed on the ethogram, Appendix A of

supplementary material). Second, we aimed to assess owner affect during play and relate it with levels of various behaviours during play.

In this way, we begin to test the hypothesis that play contributes to well-being and the dog–human bond. In particular, we examined whether there was a relationship between owner affect and five behavioural variables within the play bouts. These variables were chosen for their prior identification as markers of dog responsiveness and the dog–human bond. First, given research showing a correlation between owner “involvement” in play and their dogs’ responsiveness to owners in obedience training (Rooney and Cowan 2011), we looked at (1) the level of physical activity of owners in the play bouts. Second, given that a bout of affiliative behaviour (petting, gentle playing, and talking) has been shown to decrease blood pressure of humans and dogs, as well as increasing both species’ dopamine, beta-endorphin, and oxytocin levels (Odendaal and Meintjes 2003), we examined (2) each dyad’s proximity to each other, and (3) the amount of physical contact (“touch”) between owner and dog in the play bouts. It has also been suggested that dogs’ ability to look at human faces or eyes for information gathering may have enabled domestication (Prato-Previde and Marshall-Pescini 2014) and encourages the dog–human bond (Horowitz 2009), so we examined (4) the amount of face-to-face contact between owner and dog during the bouts. Finally, given the frequency of dog-directed speech by owners, we also (5) transcribed and analysed owners’ vocalizations in each play bout. We were then able to form a corpus of words for “positive affect” and “neutral-affect” bouts (only one bout showed negative affect, see Results below).

Across taxa, play behaviour has been slow to be studied, and consensus about its function is still elusive (Bekoff and Byers 1998). This work adds to our understanding of what exactly dog–human play consists, and speaks to play’s ostensive benefit for the participants.

## Methods

### Subjects and data collection

We gathered instances of dog–human playful interaction through what is described as “citizen” or “participatory” science (Bonney et al. 2014; Hecht and Spicer Rice 2015): we requested distant participation from dog owners. There was no fee to participate nor remuneration offered. An original website was developed (doghumanplay.com: screenshots in Appendix B of supplementary material) onto which owners were asked to upload video clips of themselves “playing with their dog”. Specifically, instructions directed owners to submit videos from 30 to 60 s long, in

which the owner–dog dyad is visible for most of the bout; that is, a third party or tripod would hold the video camera. The manner of play was not specified to the owner/submitters on the website, in order to gather owner-defined rather than experimenter-defined examples of “what counts as play”. Owners also filled out a short survey about themselves, their dogs, and features of their relationship. Participants could elect to add a picture of themselves and their dog to an online “Wall of Contributors;” the majority of participants did. Between December 2012 and April 2013, 239 submissions were received.

The participant dog owners lived in a variety of locations (representing 19 countries, a combination of suburban (105), urban (96), and rural (38) habitats) and ages (range 8–75 years; mean 38.8 years, median 37 years). One hundred and fifty-two videos were submitted by women, 87 by men. Fifty-two participants described themselves as working with dogs professionally, the majority as trainers (34) and in the veterinary field (8); others worked in animal shelters, research, grooming, day care, breeding, non-profit, dog walking, photography, and therapy. Owners who had lived with their dog for over a year averaged a 4.5-year relationship (range 1–16 years). (Statistics for 33 other owners who had lived with their dogs for less than one year is not included here since the specific age of dog acquisition was unknown.) When asked about the frequency with which owners engaged in the kind of play seen on their videotaped entries, two-thirds of the answers were *daily* ( $n = 161$  bouts) and one-third, *weekly or rarely* ( $n = 78$  bouts). Both single-dog ( $n = 100$ ) and multi-dog ( $n = 139$ ) households were represented. For the majority of owners, this was their first time participating in a citizen science project.

Of the dogs in the submitted play bouts, 121 were male and 118 were female, and most ( $n = 196$ ) were neutered (43 unneutered or owner “not sure”). The average dog age was 4.7 years (range 0.5–15; median 3.5). Subject dog breeds, from owner report, included 117 mixed-breed dogs and 122 purebred dogs—the latter from 54 distinct named breeds [excluding thirteen ostensible purebreds who were actually mixes of purebreds (such as “chiweenie”) or who were not specified club breeds (such as “pit bull”)].

### Behavioural coding

An ethogram was developed based on prior ethological analyses of play (Bekoff 1995; Horowitz 2009; Rooney et al. 2001). Appendix A (supplementary material) lists definitions of behaviours and coding details. For each bout, a descriptive characterization of the “kind of play” engaged in (with the possibility of many kinds within one bout) was made, and the play signals used by person and dog were recorded. Play signals (“play bow”, “chase-me”, “open mouth”, “bow head”, “play slap”, “leap on”) are

described as communicating play intent (Bekoff 1974; Rooney and Bradshaw 2002) and can be identified functionally by the change they effect (Horowitz 2009). Vocalizations by humans in each bout were transcribed. Based on a preliminary coding of all of the sequential behaviours of a subset of dog–human play bouts, the entire corpus of bouts was coded along a restricted number of parameters. Given abovementioned hypotheses of correlated features, these included such salient components as, first, apparent affect of owner and dog (positive, neutral, negative): where “positive” included presence of positive-affect indicators such as smiling (human) or strongly wagging tail (dog); “negative” has presence of negative-affect indicators such as an angry tone (human) or bodily signs of fear (dog); and “neutral” has neither positive or negative signs.

Second, bouts were coded for the level of four hypothesized significant variables (level of owner activity; amount of face-to-face contact between owner and dog; proximity between owner and dog; amount of physical contact (touch) between owner and dog). Two variables were scored on a 0–2 scale (level of owner activity and amount of owner–dog contact); the other two were scored as percentage of time spent (either in close proximity or in face-to-face contact) (Details of scoring are in Appendix A of supplementary material).

Reliability of the coding was gauged by having two individuals independently code a randomly selected 20 % of the videos, or 38 scores per variable, on four variables. Using Cohen’s kappa to assess interobserver agreement, the scores were 0.94 for dog affect, 0.75 for owner affect, 0.86 for touch and 0.92 for movement.

## Results

After video and other submission errors (including participants failing to attach a video, the video failing to download from the website, or the video containing an unreadable file type) were accounted for, there were 187 usable videos of dog–human play. For details of human affect, 178 bouts were used, as affect could not be determined in 9 bouts in which the owner was out of view. Two owners submitted more than one video, with different dogs: one owner submitted four videos; a second owner submitted two videos. Given the different nature of the play bouts within, these videos were included in analysis.

### Characteristics of dog–human play

Coding each play bout by frame-by-frame, video playback allowed the beginning of characterization of spontaneous dog–human play. As the manner of play was not specified,

data exposed various behaviours and routines that are not part of the traditional canon of dog–human play actions.

Over 30 identifiable types of play—distinctive interactive routines—were seen, from the familiar play types “roughhouse”, “tug”, and “chase”, to the less common “keep-away”, “laser play” (with a laser pointer), and “parallel running”. By a *form, type, or routine* of play is meant “a delineable set of playful actions involving both parties acting responsively to each other”. A minority of bouts ( $n = 61$ ; 32 %) had just one form of play; most ( $n = 127$ ; 68 %) involved from 2 to 4 distinctive play routines, often with dissimilar characteristics. For instance, “fetch” involved a tossing of a toy or ball, causing the dyad to increase and decrease distance from each other, often with very little movement by the owner or physical contact between owner and dog. But the same bout might also include “tug”, which was performed in continual close proximity, with a much greater chance of dog–owner contact, more equal levels of movement, and certain kinds of dog-imitative behaviours by the owner, like growling.

One novel type of play was identified, which we call “tease”; it appeared in 54 bouts. This form was identified as a genuinely distinct form of *play* insofar as it involves a set of actions involving both parties acting in response to each other in a playful manner. It has been used in primate ethograms (Nishida et al. 1999; Petrù et al. 2009), but never as a type of play in canid or dog–human research.

“Tease” could be descriptively defined as “play which provokes or bothers lightheartedly”. Teasing actions are not typical between owner and dog outside of play contexts. Some examples of behaviours within teasing play are “spider fingers” (walking fingers towards dog); “feigning toss” (pretending to toss a ball or toy); a quick grab of the dog’s paw or leg; pushing, gently hitting, or tapping the dog; hide-and-seek; pulling the dog’s tail; and “stalk” (a slow creeping approach to dog) (Rooney et al. 2001). The specific play subroutines were not ritualized, nor did any stand by itself as the entire play episode. One distinguishing characteristic of “tease” play is that the human players reliably began the routines. The dogs’ responses were not themselves teasing but overlapped with actions seen in other types of play, such as biting-at, running, chasing, and so forth.

Another novel form of play was “tricks” ( $n = 8$  instances): a person asking dogs to do learnt tricks (leaping obstacles, spinning, finding hidden objects) or display obedience skills. This form often included giving commands to the dog, identified by Rooney (1999) as “instruct”. Interestingly, these routines involved responsive human–dog actions, but were not characteristically “playful” nor did they begin with a play signal. However, as they were designated as play by the owner-submitters, we must consider that at least to one party in those dyads, “tricks” is indeed a form of play.

Within these play routines, a number of other human play actions were seen that have been infrequently documented. Some meet the definition of play behaviours in that they are behaviours used outside of play but exaggerated or otherwise revised for use in play (Horowitz 2009). For instance, “ruffle”, a vigorous petting, was common ( $n = 12$ ): here, the typical petting of a dog by a person is increased in pace and force. The petting appears to be arousing, not calming. Other actions appeared to be unique to play, and may have functioned to prompt play, as a play signal (Bekoff 1974). “Blow”—blowing in the face of a dog—was so used ( $n = 2$ ). Others were dog-imitative, such as growling or vocalising like a dog ( $n = 11$ ).

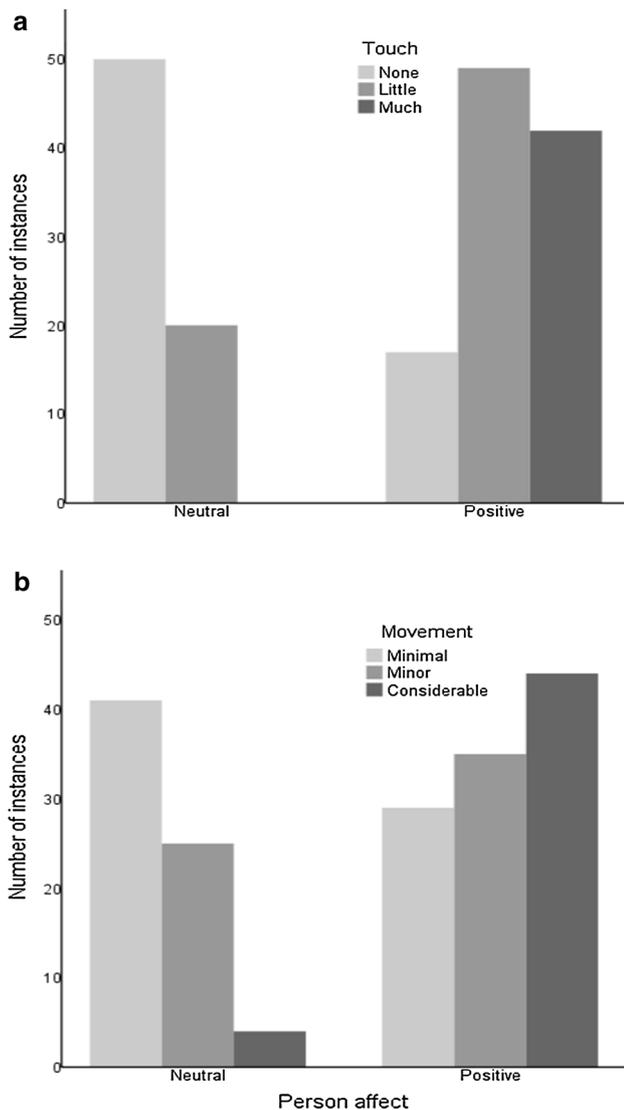
### Relation of play variables to human affect

Dog affect was predominantly positive (89 %;  $n = 165$ ; 165/187), so analyses were done only with human affect. There were 108 bouts scored as having positive owner affect, 69 neutral-affect bouts, and 1 negative-affect bout. Given this distribution, further analysis contrasted only “positive” and “neutral” bouts, with the singleton thus included as “non-positive”.

Considering the relationship between four variables—face-to-face contact, level of activity, proximity, and physical contact—and owner affect (positive or neutral) during play, four significant relationships were found. There was a significant relationship between level of physical contact (“touch”) and person affect [ $\chi^2(2, n = 178) = 65.31, p < 0.001$ ] (Fig. 1a): positive-affect bouts were also high-touch bouts. Relatedly, bouts marked by positive affect ( $M = 0.75, SD = 0.24$ ) were significantly more likely to contain close proximity between owner and dog than neutral-affect bouts ( $M = 0.65, SD = 0.28$ ) [ $t(164) = -2.37, p = 0.019$ ]. There was also a significant relationship between owner movement and positive affect [ $\chi^2(2, n = 178) = 30.33, p < 0.001$ ] (Fig. 1b): higher-movement bouts were more often positive-affect bouts. By contrast, there was no difference in face-to-face contact in bouts with positive ( $M = 0.63, SD = 0.24$ ) or neutral ( $M = 0.57, SD = 0.24$ ) affect [ $t(151) = -1.64, p = 0.104$ ]: while those owners noted to have positive affect spent a larger portion of the time in face-to-face contact with the dog than those with neutral affect, the finding was not significant.

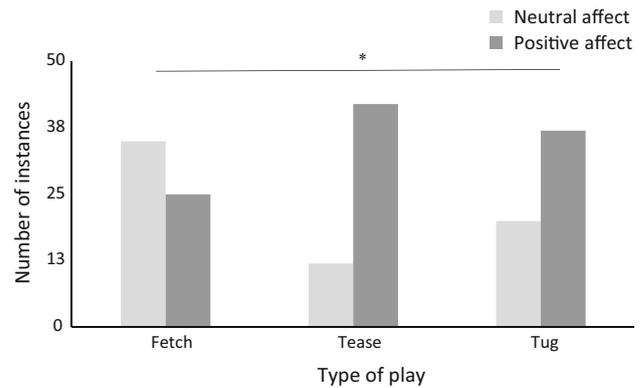
### Human affect in different forms of play

There was a difference in the affect score between the top three play types: fetch, tease, and tug [ $\chi^2(2, n = 171) = 16.15, p < 0.001$ ] (Fig. 2). These three types of play accounted for over 40 % of the instances recorded. There was a significant difference between fetch and tease



**Fig. 1** Relation between variables and positive-affect bouts. **a** High levels of physical contact (“Touch”) were highly correlated with positive-affect bouts ( $p < 0.001$ ). **b** High levels of physical activity (“Movement”) were highly correlated with positive-affect bouts ( $p < 0.001$ )

$[\chi^2(1, n = 114) = 15.30, p < 0.001]$  and fetch and tug  $[\chi^2(1, n = 117) = 6.34, p < 0.01]$ , but no difference between tease and tug  $[\chi^2(1, n = 111) = 2.24, p = 0.13]$ . This last statistic marks that tease and tug bouts were principally positive affect (tease: 78 % positive affect,  $n = 42/54$ ; tug: 65 % positive affect,  $n = 37/57$ ), as distinct from the more neutral affect of fetch (fetch: 42 % positive affect,  $n = 25/60$ ). Notably, these affect scores were achieved with different levels of the “positive affect” variables of movement, contact, and proximity, as seen above. Two other, less common forms of play were exclusively or near-exclusively positive affect: roughhouse (100 % positive affect,  $n = 10$ ) and chase (94 % positive



**Fig. 2** Comparison of rates of positive- and neutral-affect bouts among the top three play types: fetch, tease, and tug ( $*p < 0.001$ )

affect,  $n = 17/18$ ). There was no form of play in which the humans were exclusively neutral affect.

### Vocalizations

We transcribed the human vocalizations, making a corpus of words (total word count: 4267) in all bouts of dog–human play. Table 1 displays the frequency of word use in the positive- and neutral-affect bouts, expressed as a percentage of the total words used. Among the forty most-used words, it is of note that some are more often used in positive-affect bouts (e.g. “get/got”, “play”, “yes”). Other words are more frequent in neutral-affect bout (e.g. “come”, “on”, “drop”, “kill”). Considering personal pronoun use, “I”, “me”, and “you” are more frequent in positive-affect bouts; “it” is more frequent in neutral-affect bouts.

Table 2 shows the frequency of word use in the entire vocalization corpus, as contrasted with the only previous dog–human play vocalization corpus, Mitchell and Edmonson (1999). The 35 most frequent words in the current corpus are listed, with frequency displayed as a percentage of the total words used. Frequency rates are noticeably different between corpora, especially with respect to “come”, “here”, “on”, “the”, “ball” [more common in Mitchell and Edmonson (1999)], and “you”, “good”, “Yay”, “yes”, “girl”, “boy” (more common in the present corpus). There is a greater diversity of words accounting for the top 50 % of words used: 15 words, in the present corpus (or, when considered separately, 14 words in positive-affect bouts, 17 words in neutral-affect bouts); 8 words, in Mitchell and Edmonson (1999).

### Relation of owner and dog demographics to elements of play

From the questionnaire data, we examined the potential relationship of the abovementioned play variables with two

**Table 1** Frequency of word use in the positive- and neutral-affect bouts, expressed as a percentage of the total words used, and showing proportion trend

word	% of total words used		trend
	positive bouts	neutral bouts	
you/you're	8.87	4.48	■ ■
get/getting/got/gotta	6.56	3.02	■ ■
good	5.37	5.95	■ ■
it/its	5.11	7.5	■ ■
go/goin/gonna	3.95	5.79	■ ■
dog's-name	2.98	3.42	■ ■
girl	2.76	2.04	■ ■
I/I'm	2.65	1.3	■ ■
that/s	2.24	2.28	■ ■
oh	2.20	1.14	■ ■
come	2.16	4.4	■ ■
play/playing	1.79	0	■ ■
me	1.72	0.65	■ ■
here	1.68	2.61	■ ■
boy	1.49	1.79	■ ■
ready	1.38	2.04	■ ■
the	1.38	1.3	■ ■
where/d/'s	1.34	0.9	■ ■
okay	1.23	1.87	■ ■
what/whats/whatcha	1.19	1.3	■ ■
your	1.16	0.57	■ ■
on	1.12	3.75	■ ■
is	1.08	0.33	■ ■
yeah	1.04	0.9	■ ■
give	0.97	0.73	■ ■
want/wanna	0.97	0.65	■ ■
no	0.89	0.9	■ ■
a	0.86	1.14	■ ■
this	0.78	0.24	■ ■
do/doing/don't	0.75	1.3	■ ■
there/s	0.75	0.41	■ ■
yes	0.75	0.24	■ ■
let/let's	0.67	0.41	■ ■
so	0.67	0	■ ■
to	0.67	0.81	■ ■
ball	0.63	0.9	■ ■
hey/hi	0.60	0.81	■ ■
we/'re	0.60	0.08	■ ■
dog/doggie	0.34	0.81	■ ■
drop	0.34	2.36	■ ■
kill	0	0.73	■ ■

Top forty words in positive-affect bouts listed, with one high-frequency negative-affect bout word appended

owner features—owner gender, and whether the owner worked with dogs professionally—and two dog features: dog gender and, of the purebred dogs, dog breed.

Fifty-two participants described themselves as working with dogs professionally; their bouts ( $n = 48$ ) were compared with the remainder. The dog professional owners spent significantly more time in close proximity with their dogs than those who did not work with dogs professionally

**Table 2** Frequency rate of top 35 words used in the present corpus of dog–human play bouts (H + H), versus usage in Mitchell and Edmonson (1999) (M + E)

word	% of total words		H+H vs M+E corpora
	H-H corpus	M+E corpus	
you	7.69	3.19	■ ■
good	5.60	1.50	■ ■
it	5.46	3.45	■ ■
get / got	5.41	3.99	■ ■
go/ gonna	4.34	3.98	■ ■
come/c'mon	2.93	13.46	■ ■
(dog's name)	2.88	8.96	■ ■
girl	2.48	0.80	■ ■
yay/yeah!	2.23	0.00	■ ■
that	2.18	1.36	■ ■
here	2.04	6.55	■ ■
I	1.95	1.22	■ ■
on	1.85	8.10	■ ■
oh	1.78	0.57	■ ■
are/aren't/'re	1.78	0.95	■ ■
ready	1.66	0.00	■ ■
boy	1.59	0.00	■ ■
the	1.50	3.80	■ ■
give / gimme	1.43	1.37	■ ■
play	1.38	0.92	■ ■
okay	1.36	0.63	■ ■
what/whatcha/what's	1.31	0.85	■ ■
me	1.27	1.50	■ ■
to	1.12	2.01	■ ■
yes/yea	1.05	0.00	■ ■
do/does	1.01	0.00	■ ■
wanna / want	0.98	1.27	■ ■
where/where'd/where's	0.96	0.00	■ ■
your	0.96	0.00	■ ■
drop	0.94	0.55	■ ■
is	0.94	0.00	■ ■
no	0.87	0.74	■ ■
ball/bally	0.82	3.98	■ ■
am/'m	0.77	0.00	■ ■
this	0.68	0.00	■ ■

Rate is displayed as a percentage of the total words used in the respective corpora, and as proportion trend

$[t(173) = -2.13, p = 0.025]$  (Table 3). Those who worked with dogs spent more time in face-to-face contact with their dogs than those who did not  $[t(155) = -2.01, p = 0.046]$ . There was no difference in the amount of physical contact or owner movement between the two groups.

Considering the relationship between owner gender and the owners' behaviour in the play bouts, there was one significant difference: female owners had more physical contact ("touch") with their dogs  $[\chi^2(2, n = 187) = 7.12, p = 0.028]$  (Table 3). Fifty per cent of male owners had no contact with their dogs during play; 32 % of female owners had no contact. No differences were found between male

**Table 3** Relationship between owner demographics and elements of play

Play feature	<i>M</i> (SD)	<i>df</i>	<i>t</i>	<i>p</i>
Proximity		173	−2.13	0.025
Dog professional	0.77 (0.24)			
Not professional	0.68 (0.27)			
Face-to-face contact		155	−2.01	0.046
Dog professional	0.67 (0.23)			
Not professional	0.58 (0.24)			
Proximity		173	0.41	0.684
Female	0.69 (0.27)			
Male	0.71 (0.27)			
Face-to-face contact		155	−0.68	0.500
Female	0.62 (0.24)			
Male	0.59 (0.24)			

Play feature	<i>n</i>	<i>df</i>	$\chi^2$	<i>p</i>
Physical contact				
Dog professional	187	2	4.52	0.104
Not professional				
Movement				
Dog professional	187	2	0.13	0.939
Not professional				
Physical contact				
Female/male	187	2	7.12	0.028
Movement				
Female/male	187	2	0.72	0.699

and female owners in their levels of movement, proximity, or face-to-face contact with their dogs.

The eighty-five purebred dogs in the analysed videos represented dozens of breeds, across all American Kennel Club groups ( $n = 27$  Herding,  $n = 8$  Hound,  $n = 13$  Non-sporting,  $n = 14$  Sporting,  $n = 9$  Terrier,  $n = 5$  Toy, and  $n = 9$  Working). Since there is evidence of different behavioural profiles of dog breeds, when clustered according to historical function (Turcsán et al. 2011), we first compared the dogs from sporting and working ancestry (AKC groups Working, Herding, Hound, Terrier, and Sporting) to those from non-working ancestry (AKC groups Non-sporting and Toy), who might have been bred more for companionship than work. There was no difference in the levels of contact [ $\chi^2(2, n = 85) = 1.26, p = 0.533$ ], movement [ $\chi^2(2, n = 85) = 1.58, p = 0.454$ ], proximity ( $t(77) = 0.20, p = 0.846$ ), or amount of face-to-face contact ( $t(65) = 0.11, p = 0.916$ ) between the groups.

Prior research has also identified two groups—Hound and Herding—as distinguished along some of the measures of the elements play used in this study (Lit et al. 2010; Mehrkam and Wynne 2014). Though previous work found that dogs in the Hound grouping showed high levels

of activity and high levels of face-to-face contact with owners, in the current study Hound group dogs had similar levels of activity (“movement”) as other breeds [ $\chi^2(2, n = 85) = 3.88, p = 0.144$ ] and had a similar amount of face-to-face contact with their owners as other breeds ( $t(65) = -0.02, p = 0.988$ ). Nor did members of the Herding group show any more or less movement than members of the toy or non-sporting group [ $\chi^2(2, n = 45) = 0.58, p = 0.750$ ], a difference that had been seen in past research (Mehrkam and Wynne 2014).

There were no differences in elements of the kinds of play seen based on dog sex.

## Discussion

The current research extends our knowledge of the behaviours within dog–human play. With this study, a fuller catalogue of forms of this common owner–dog interaction has been developed. Previous descriptive inventories generated from observation as well as from owners’ report primarily list “fetch”, “tug-of-war”, “chase”, and “rough-and-tumble”/“roughhousing” play; more extensive studies of dog–human dyads have added “keep-away”, “search”, “object competition”, “hide-and-peek” (Rooney 1999; Bradshaw et al. 2015), and “runaway”, as well as various subroutines within chase, fetch, and object competition play (Mitchell and Thompson 1991). In the present study, a new category of play, “tease”, was seen as often as the very common “fetch” and “tug”.

Possibly, behaviours within “tease” may serve as play signals, insofar as they are used to stimulate an unplayful partner or to increase the intensity of play (Horowitz 2009; Rooney et al. 2001). Indeed, in the coded bouts, it most often was initiated by the person, occurred at the beginning of play, and instigated responsive play on the dog’s part.

## Play and affect

In addition, given the common claim that play leads to positive affect in humans, this research undertook to determine whether different forms of play are associated with different affective states. Affect was identified through reliable behavioural indicators. Affect types (positive, neutral, or negative) were discriminable, and each form of play could then be defined in part by its overall (human) affect. Not all forms of play were characterized by positive affect: the owners showed a non-positive, or neutral, affect in nearly 40 % of the bouts. Of the most common forms of play, some can be characterized as involving primarily positive affect (tug, tease), and some as involving primarily neutral affect (fetch).

Another approach to the question of play affect is to consider physiological markers. In concurrent pilot research, we asked if levels of the hormones oxytocin and cortisol are changed with play (Hecht and Horowitz, in prep). Both are broadly associated with affective state: oxytocin is known to be involved in parent–child bonding, and cortisol is a gauge of stress or arousal (Odendaal and Meintjes 2003; Uvnäs-Moberg 1989). Salivary (human and dog) and urine (dog) samples were collected before and after interspecific play. In our study, owners who engaged in play with their dogs experienced a significant decrease in salivary cortisol from before to after play, while no difference was observed when owners simply watched a video of dog–human play. Human salivary oxytocin was not affected by the play intervention nor were dog cortisol or oxytocin profiles (Hecht and Horowitz, in prep).

The current study also revealed that identifiable elements within play are differentially correlated with positive affect in the human players. Higher rates of physical contact (“touch”), more owner activity (“movement”), and closeness of dog–owner dyad (“proximity”) were highly correlated with positive affect; having face-to-face contact was not correlated with either positive or neutral affect. In other words, people smiled more in play when they were active and moving around, and when there was a lot of physical contact between them and their dogs (Fig. 3) and less when there was little movement or contact in the bout (Fig. 4). Given the study design, we must remain agnostic about any causation: the data do not speak to whether these elements caused the human affect seen, or whether the affect itself led to the appearance of these elements.

By contrast, more face-to-face contact did not in itself induce smiling, laughing, or other positive emotional expression. Given how relevant eye-contact is for communication between people—and between people and dogs (Schwab and Huber 2006), as well as research showing an



**Fig. 3** Screenshot of positive-affect, active, high-contact play



**Fig. 4** Screenshot of a neutral-affect, low-movement, low-contact play

increase in owner oxytocin levels after bouts of mutual gazing with dogs (Nagasawa et al. 2015)—it was surprising that this variable did not correlate with positive affect. While visible play signals, displayed to a fellow playmate’s face, are an important part of play (Horowitz 2009), our data suggest that face-to-face contact is not *necessary* for play to feel like fun.

### Demographic data

Participants who worked with dogs professionally maintained closer proximity and had higher levels of face-to-face contact with their dogs than those who did not work with dogs. While dogs attend preferentially to owners over strangers (Cook et al. 2014), the present result suggests that variations might also exist between different owner types. Numerous studies find that dogs attend to human attentional states and emotional expressions (Call et al. 2003; Müller et al. 2015). In the case of dog professionals, either the dog or the owner may engage in increased time in a posture and proximity amenable to the exchange of meaningful and useful information with the other.

Male dog owners in this study engaged in less physical contact with their dogs than the female dog owners. In previous studies, other qualitative differences between male and female interactants with dogs have been found: for instance, women use more baby talk with a familiar dog than men do (Mitchell 2004). More research on the aspects of the gender difference, as well as its origin, remains to be done.

### Vocalizations corpus

In most dog–human play, the owner spends at least some time talking to, about, or at the dog. Human vocalizations during play tend to be highly repetitive (Mitchell and

Edmonson 1999). Still, just as with human–human speech, analysis of the specific vocalizations may be informative both about the nature of the interaction and about the general tone established between the parties. Previous research found a high rate of use of the phrases “come on” and “come here”, and concluded that the owners’ talk demonstrated that they were attempting to “control the dog” (Mitchell and Edmonson 1999). In this study, vocalizations were found to differ in positive- and neutral-affect play. It could be that the characterization of play as unitary is premature. In these bouts, the highest use of *come* and *on*, for instance, were in the neutral-affect bouts, and less frequent in the positive-affect bouts. Notably, in Mitchell and Edmonson subjects were provided with a tennis ball and asked to begin play by “throwing the ball” (1999). Although the form(s) of play that resulted were not specified, this may have led to more bouts of “fetch”, which in the present study was associated with neutral-affect play—and use of *come* and *on*. Also in the present study, bouts differed in their rate of usage of personal pronouns, with *you*, *me*, and *I* more common in positive-affect bouts, and *it* more common in neutral-affect bouts. While speculative, we suggest that use of subjective personal pronouns may be more affiliative and the objective personal pronoun more distancing, which would accord with the affect results.

Word frequency was also affected by having owner-defined play bouts, which perhaps included a broader range of play forms than in previous research. Fifteen words accounted for 50 % of the coded vocalizations, versus 8 words in Mitchell and Edmonson (1999). For future research, the kind of dog–human play being analysed should be considered relevant to the generalizability of any data therefrom.

### What is play: outstanding issues

New types of dog–human play emerge when one considers the owners’ definitions of play, and code naturally occurring play. Citizen science data gathering allowed for accumulation of a large sample of play behaviour. While it may be suggested that the method suffers from a selection bias (Hecht and Spicer Rice 2015), including only participants willing to include themselves among the playing dyads, the fact that not all bouts looked equally “playful” suggests that any bias does not undercut the method or results. A benefit of our approach is the collection of raw, un-analysed behavioural data from a wide-ranging and international subject pool, a scope that is atypical of laboratory-based studies. Using this method, we were able to determine salient characteristics of the dog–human play interaction that differentiate forms of play: levels of owner and dog physical contact, owner movement, proximity, and

face-to-face contact. This research supports the notion that some forms of play—but not all—function, for owners, as affiliative interactions.

An alternate interpretation of these data is that the forms of ostensible play in which the owner affect was not positive are not, in fact, “play” at all, insofar as play is frequently defined as behaviour which observers believe looks “fun” or pleasurable (Burghardt 2010; Fagen 1981). However, the neutral-affect play bouts did contain other criterial elements of play: non-stereotyped, coordinated behaviours; actions from other contexts either moderated in force or exaggerated in form; turn-taking and play-signalling (Bekoff and Byers 1998; Horowitz 2009). Moreover, they were considered to be “play” by the submitters of the videos, a testament to the owners’ conviction of the playfulness of the bouts, even if their affect did not reflect it.

Play may indeed enhance the dog–human bond (Bradshaw et al. 2015), but based on the present research, not all play appears to be equal in its form, its characteristics, and in affect.

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