

ARTICLE

Relationship between Dog Walking Behaviour and Owner-Dog Attachment Using the Lexington Attachment to Pets Scale

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ABSTRACT

Human-dog attachment is a special relationship and has been studied from various perspectives. Attachment or social bonding has a positive effect on the psychological and physiological wellbeing of a dog owner, increasing physical health and quality of life. Attachment is idiosyncratic, induced by neuroendocrinological functions like an oxytocin increase after an interaction, but also based on subjective perceptions of the quality of bonding and relationship. Dog-owner attachment was measured in this study using the Lexington Attachment to Pets Scale in its validated German version as a tool to compare owner perception with factual movement data of their dog. The question posed was whether the perceived dog behaviour impacted on the attachment score as assessed through the LAPS. The authors could show that perceived problematical or unwanted conduct, like hunting behaviour, had a negative effect on LAPS scores whereas perceived obedient behaviour had a positive effect upon attachment. The authors found that actual walking data of the dogs were not in congruence with owner assessments. Thus, owner reports alone possibly will not be a sufficient measure of dog-human relationships and animal behaviour.

1. Introduction

Establishing companionship and attachment parameters or merely interacting with dogs has been linked to several health benefits for humans such as enriched affective, physiological and psychological wellbeing^[1,2]. Attachment to dogs has been shown to affect dog owners' social facilitation and quality of life^[3]. Attachment bonds of the dog-human dyad are understood to be analogous to

those that describe human caregiver-infant interactions^[4,5] and these relationships are bidirectional^[6].

Analysed was the exploration and orientation behaviour of off-leash pet dogs (n=30) while on a walk with their owner and without being signaled or called to. The dogs were off the leash at all times and their roaming behaviour was measured by means of GPS in the course of four consecutive walks. Additionally, the dog owners completed two

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questionnaires. First, an owner questionnaire from which data were used to bear comparison to individual owner estimations (e.g. how far/long does your dog explore) with factual dog exploration data and secondly the Lexington Attachment to Pets Scale (LAPS) by Johnson et al. (1992)^[7], in its validated German version^[8].

Dog companionship has undoubtedly the potential to sustain health and personal development by way of the dog satisfying its owner's psychological needs for self-sufficiency as well as affiliation as represented by several attachment levels^[9]. Ownership contentment with their dog implicates numerous characteristics of their relationship for instance dog-owner attachment strength^[10]. Owner satisfaction is established through a number of behavioural traits exhibited by their dogs. Perceived problematical or undesirable activities, like hunting behaviour, have an adverse effect on the owner-dog affiliation and attachment^[11] perceived obedient behaviour, however, leads to a positive consequence on owner affection^[12].

The observed values of the owner-dog dyads herein showed high attachment and bonding scores and positive correlations could be observed between the time period of the walks and LAPS scores. Owners of male dogs exhibited greater attachment values compared to owners of female dogs. Moreover owners of intact dogs displayed greater scores in general attachment and lesser values in the Subscales "People Substitution" and "Animal rights/welfare" compared to owners of neutered dogs. Between owners of purebred dogs and owners of mixed breed dogs significant differences could be shown at the animal rights subgroup and LAPS total.

Aim of this study was to gather data in order to measure duration and distance pet dogs spent away from their owner during a walk and on the other hand to evaluate whether dog owners accurately judged their dog's movement patterns as well as time and distance parameters. Furthermore, to show the value of reflecting subjective emotional responses and to display the influence our judgment and concurrent behavioural reaction has on dog-owner attachment. Pet attachment plays a significant part in how owners care for their dogs. Subjective perception impacts on owner (re-)actions in interspecific situations and a direct link between perception and behaviour exists. Thus the subjective evaluation of their dogs' behaviour even though not borne out in facts may alter dog owners' conduct. The classification of "problem behaviours" is plainly influenced by individual owner perception and as such might well cause compromised dog welfare and an increased risk of relinquishment.

2. Methods

GPS data were collected of freely exploring, off lead pet dogs (n = 30) on (n = 3145) trials while walking with their owners on four consecutive walks, two in known and two in unknown regions in North Rhine Westphalia, Germany (n = 120). Dogs were of different size, sex, breed, reproductive status and age. The average length (median) was 1:17:17h per walk; 5:24:53h over all walks. For each dog-owner dyad 51 parameters were recorded for every walk. The GPS used were a Garmin Astro® 320 and the dog collars DC™ 50, and T5 Mini, Garmin International Inc., Kansas, USA. Video camera used was a Garmin VIRB® Elite. Size: (H × B × T): 32 mm × 53 mm × 111 mm; weight 170 g. Datatype: MP4; 1080p-HDVideo: 1920 × 1080; 30 fps. Video data were also displayed on Garmin BaseCamp™ 4.5.2.1. The video camera could merely be attached onto the larger dogs' harnesses because it was too weighty and problematic to fasten to the small dogs harnesses. Main interest here was to establish whether dogs were hunting prey. Eighteen owners participated, fifteen female (83%) and three male (17%). Dog-owner teams were recruited via social media.

Owners had to answer a questionnaire with 57 dog-related items prior to the walks regarding the breed (in case of mixed breeds the owner description was used), date of birth, reproductive status, training and obedience status, duration of being with the family, attachment level, whether it was used for hunting purposes (in which case the dog was excluded), see Supplement Table S1 for details. The sociodemographic details are displayed in Supplement Table S2.

In addition, the owner was asked to appraise the dogs hunting tendencies on a scale from 1-6 (very weak to very strong) and an attachment scale (1-6). The owner moreover had to estimate the distance their dog would travel on any given exploration (maximal distance away from owner) as well as the duration their dog would be beyond his or her vision (minutes). Owners also had to estimate how often their dog would move beyond the range of 20 m (in%) Supplement Table S3. Measured were the time and distance from a starting point of a dogs exploration >20 m away from owner to a point of return (outbound) and the route back from the point of return to the owner (inbound).

Length of runs >20 m were at variance significantly, hence three different dog groups were determined to define roaming patterns more detailed and specify idiosyncratic movement patterns variance between the dogs: The majority of dogs moved within a maximum radius of 150 m encircling the owner (13 of 30 dogs =43%

Group 1) at all times on all walks; eight (27%) of the dogs exhibited a range between >150 m and 350 m (Group 2) away from the owner; nine of the 30 dogs (30%) had at least one run >350 m away from their owner (Group 3).

Correlation measures like distance and duration as well as speed and exploration patterns utilized by the dogs were applied to the LAPS scores.

LAPS - Lexington Attachment to Pets Scale

The LAPS questionnaire was employed to measure the owner-dog attachment. LAPS and socio-demographic data were recorded and online and paper-pencil questionnaires were used. The Lexington Attachment to Pets Scale (LAPS) by Johnson et al. (1992) [7] is a commonly employed instrument to measure attachment of owners to their pets [13,14]. Herein the validated German translation from Hielscher et al. (2019) [8] was applied for all dog owners. The LAPS questionnaire comprises 23 items in total on a scale of 0 to 69 and measures the overall value of owner attachment. The LAPS questionnaire contains three subscales: “General Attachment” (11 items, manifestation from 0 to 33), “People Substituting” (7 items, manifestation from 0 to 21) and “Animal Rights/Animal Welfare” (5 items, manifestation from 0 to 15) and a total LAPS Score. The coding of the items lies between 0 (strongly disagree) and 3 (strongly agree). Each owner (n = 18) in this study completed a LAPS questionnaire for each individual dog. Therefore in total n = 30 questionnaires were obtained. 11 different dog breeds participated in this study.

3. Statistical Analysis

Discrete variables were summarized as absolute and relative frequencies. For graphical visualization Boxplots were used. To measure the relationship of two continuous or ordered variables Spearman correlation coefficients were applied. Mann-Whitney-U Test was used to compare LAPS between independent groups. For comparison between three or more groups Kruskal-Wallis Test was applied. For correction of multiple testing Standard Bonferroni correction was obtained. Level of significance was set to $\alpha = 0.05$. All tests are performed two-tailed using SPSS version 25, IBM Inc.

Statistical tools to determine the reliability and validity of the components assessed by multivariate analysis of questionnaire data are in a similar way to their application in canine behavioural testing. Reliability, in the context of a questionnaire, refers to the internal consistency and the degree to which individual questions associated with a specific construct are correlated. Cronbach alpha

coefficient is used as an estimate of internal consistency, where measures greater than 0.7 are generally considered acceptable [15].

4. Results

For all dog-owner dyads LAPS total revealed a mean of 57.1 (6.6 SD) with a median of 57 and lower and upper quartile of 55 and 61. The observed values showed high to very high attachment and bonding of all owner-dog dyads considering the range from 0 to 69. All subscales revealed high values: for LAPS “General Attachment” a median of 29 (quartiles: 27 and 31) - with the theoretically achievable maximum of this subscale of 33- was observed. For LAPS “People Substitution” the median was 15 (quartiles: 13 and 18) compared to the theoretical maximum of 21. The observed median of the subscale “Animal right/welfare” was 13 (quartiles: 13 and 15) compared with a theoretically achievable maximum of 15, see Table 1. In comparison, in his study Hielscher et al., (2019) [8] postulated a somewhat lower but similar dog-owner attachment (M = 55.5, SD = 8.2) with men (M = 52.3, SD = 8.9) scoring lower than women (M = 55.3, SD = 8.5). In this study it was not differentiated between men and women as only two owners were men.

Table 1. LAPS scores for Subscales General attachment; people substitution; Animal right/welfare and LAPS total for all questionnaires (n = 30) mean and median and range.

n = 30	mean	SD	Q25	median	Q75	range
LAPS: general attachment	29.00	2.84	27	29	31	23-33
LAPS: People substitution	14.70	3.57	13	15	18	8-20
LAPS Animal right/welfare	13.40	1.65	13	13	15	9-16
LAPS total	57.10	6.55	55	57	61	42-67

Distance Measures and Correlations

Looking at all values a positive correlation could be demonstrated between the total walking distance of the owner walk and the subscale “Animal Welfare”. Between the total distance of the dog walk and “People substitution” “Animal rights” and LAPS total significant correlations were found. Between the total distance of the dog walk and “People Substitution” “Animal rights/Welfare” and LAPS total, significant correlations could be shown, see Table 2. Thus, higher owner attachment scores and lengthier walks were correlated with a higher score of LAPS.

Table 2. LAPS and Subscales correlated with total walking distance; owner walking distance and dog walking parameters.

		LAPS: General Attachment	LAPS: People Substitution	LAPS Animal right/welfare	LAPS total
total distance walk owner total in m	r	-0.053	0.110	0.266	0.134
	p	0.568	0.230	0.003	0.143
	p*			0.072	
total distance dog walk in m	r	0.036	0.414	0.304	0.380
	p	0.696	<0.001	0.001	<0.001
	p*		<0.024	0.024	<0.024
total runs>20 m in m	r	-0.081	0.097	-0.117	0.022
	p	0.381	0.294	0.202	0.812
	p*				
Max distance of run in m	r	-0.012	0.182	-0.088	0.118
	p	0.893	0.047	0.337	0.201
	p*		>0.999		

Spearman correlation coefficient (r) and corresponding p-value. P*: Bonferroni correction of p-value. Correction factor for Bonferroni: 4×6= 24; only significant uncorrected p-values are affected.

Owner Assessment of Hunting Behaviour

Table 3 displays the correlative values between the LAPS subscales, LAPS total and perceived hunting behaviour estimates and reliance on owner scores. The hunting value was negatively correlated with the Subscales “General attachment” “People Substitution” as well as LAPS total. The hunting score had a high

Table 3. LAPS and Subscales correlated with Attachment, Hunting behaviour estimates and reliance on owner.

		LAPS: General Attachment	LAPS: people substitution	LAPS Animal right/welfare	LAPS total
Attachment (1-6)	r	-0.246**	-0.438**	-0.228*	-0.403**
	p	0.007	<0.001	0.012	<0.001
	p*	0.084	<0.012	0.144	<0.012
Hunting behaviour	r	-0.538**	-0.197*	-0.055	-0.325**
	p	<0.001	0.031	0.551	<0.001
	p*	<0.012	0.372		<0.012
Reliance on owner	r	-0.204*	-0.166	-0.022	-0.125
	p	0.026	0.070	0.814	0.172
	p*	0.312			

Spearman correlation coefficient (r) and corresponding p-value. P*: Bonferroni correction of p-value. Correction factor for Bonferroni: 4×3= 12; only significant uncorrected p-values are affected.

negative correlation with a value of $r = -0.538$ ($p < 0.001$; $p^* = < 0.012$) for the Subscales “General Attachment” and “People Substitution” as well as LAPS total. Owner reliance which also assessed through a six rating scale was negatively correlated with the Subscale “General Attachment”.

LAPS subscales values and sex of the dog(s)

With respect to dog behaviour sex differences have been proposed [16]. The correlative values between the LAPS Subscales, LAPS total and assessment of owners of male versus owners of female dogs displayed significant variations for the Subscales “General Attachment”, “Animal Rights/Welfare” as well as LAPS total. Owners of male dogs’ displayed higher values in these subscales compared to owners of female dogs. The differences were about 1 unit/point for “General Attachment” as well as “Animal Right/Welfare” and 3 units/points for LAPS total signifying different attachment levels.

LAPS subscales values and reproductive status of the dog(s)

Behavioural differences based on the reproductive status of dogs have been proposed and animal welfare matters are also often associated with neutering issues in dogs. The attachment of owners and the correlation with the reproductive status of their dog was therefore measured. Significant differences of attachment scores between owners of intact and owners of neutered dogs were found at the Subscales “General Attachment”, “People Substitution” ($p = 0.045$) and at the “Animal Rights/Welfare” level. Owners of neutered dogs had lower values in “General Attachment” (about 1.5 units/points)

but higher values in “People Substitution” (about 1 unit/point) as well as “Animal Rights/Welfare” (about 1.3 units/points).

LAPS subscales values comparing owners of pure breed versus owners of mixed breed dogs

Significant differences were established at the Subscale “Animal Rights/Welfare” with a difference of about 1 unit/point as well as LAPS total with a difference about 1.5 units/points between the owners of purebred and the owners of mixed breed dogs. Owners of purebred dogs displayed lower values in the Subscales and in LAPS total compared to owners of mixed breed dogs.

LAPS and radius of exploration (3 Groups)

The three different radius groups showed very varied travelling behaviour and therefore it was examined whether owner attachment was influenced based on the distance their dog traversed. Between owners of dogs of the three radius groups significant differences (Mann Whitney U test) were found at the Subscale “People Substitution” and LAPS total (Figure 1).

Post hoc-tests revealed that LAPS Subscale “People

Substitution” as well as the total LAPS score contrasted between owners of dogs belonging to different radius groups. Divergence was found in particular for the radius ≥ 350 m, Group 3 dogs, compared to Group 1 and Group 2 dogs. Group 3 dog owners, thus owner of dogs having a large radius ≥ 350 m, displayed higher scores at the Subscale “People Substitution” as well as LAPS total in comparison to Group 1 and Group 2 owners. Between Group 1 and Group 2 dog owner no difference became apparent. Hence owners of far ranging Group 3 indicated higher attachment values with their dogs.

Comparison of owner assessment and GPS measurements

In the owner questionnaire every owner had to estimate the duration their dog(s) would explore on each run >20 m. Figure 2 demonstrates the difference in time measures. As may be perceived owners greatly overestimated the duration of runs >20 m. Displayed are the outbound route (from start of exploration >20 m away from owner to point of return) and the inbound route (from point of return back to owner).

Clearly, great discrepancies exist between owner estimate of duration and factual exploration data recorded with respect to time explored.

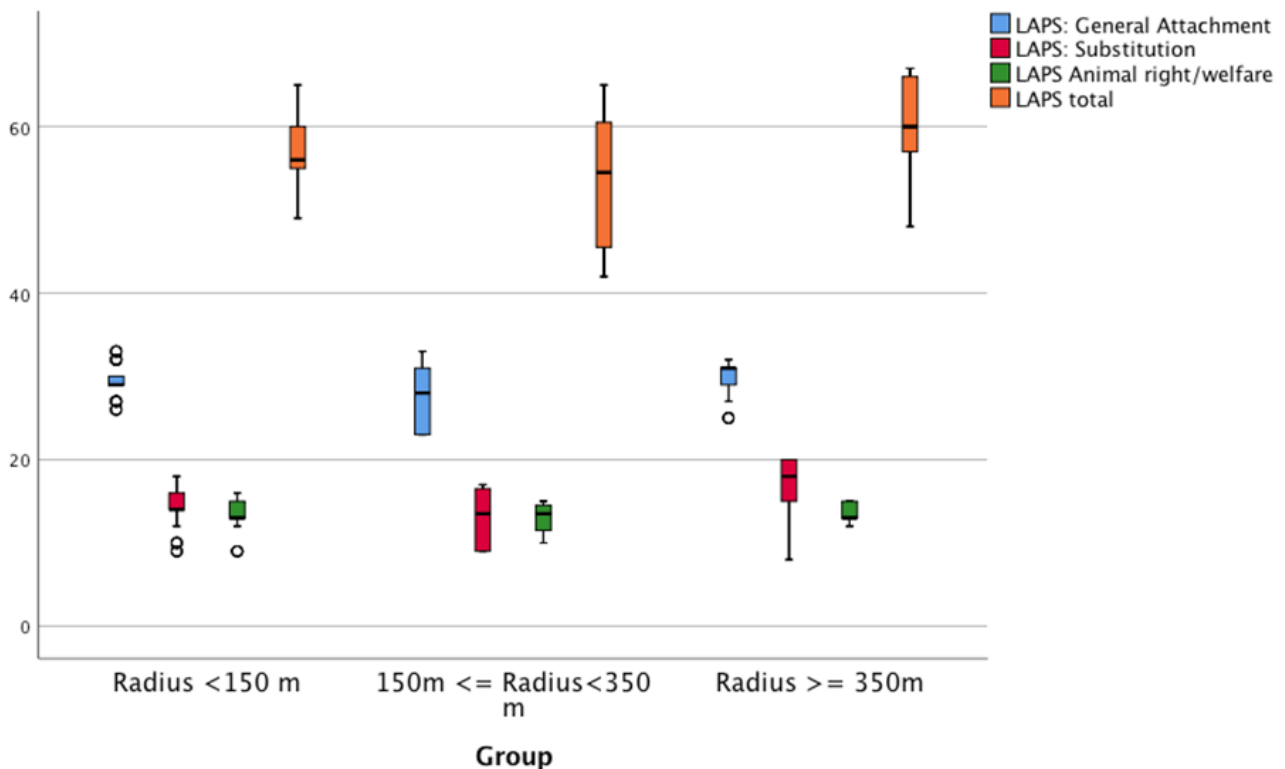


Figure 1. Comparison of dog owners with dogs belonging to Group 1, Group 2 and Group 3, correlated to Subscales General Attachment, People Substitution, Animal rights/Welfare and LAPS total.

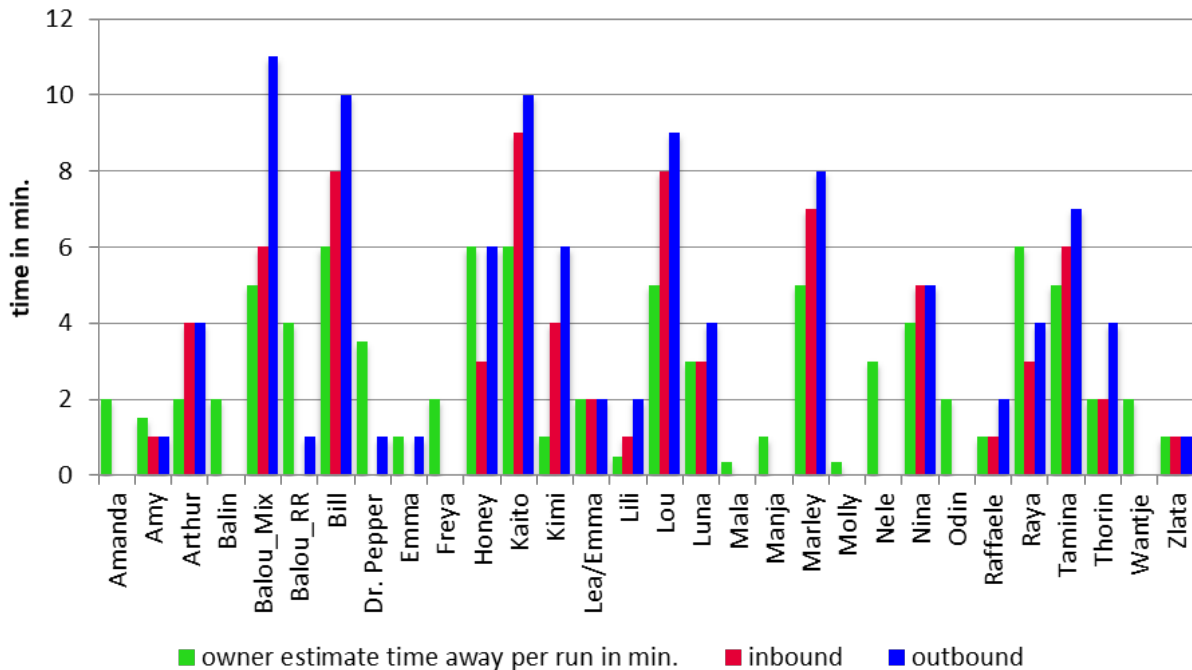


Figure 2. Variance between factual exploration time in minutes of all dogs (n=30) of all runs >20 m, back to the owner=inbound (red) and away from the owner to a point of return=outbound (blue) compared with owner assessment (green: estimate of duration per run in minutes).

5. Discussion

Attachment to and bonding with dogs are a widespread phenomenon. The quality of the attachment between owner and dog clearly affects the dog owners' (and the dogs) quality of life in a number of aspects. Frequently dog ownership is connected with mental, physical and psychosocial health benefits, for instance greater levels of physical activity like dog walking compared to non-owners^[3,17]. Dogs may serve as a safe haven with attachment function^[5] or act as a secure base^[18,19] thereby providing comfort to their owner in distressing situations. Green et al., (2018)^[20] proposed that attachment-related behaviours were associated with attachment dimensions. Owners may turn to their dog as a replacement for human companionship or feel less emotionally secure without their dog. Therefore, attachment theory may illuminate individual differences in relationship dynamics within the dyad^[20].

Herein for all dog owners the perceived LAPS scores presented high attachment and bonding values of the owner to their dog(s). All Subscales indicated high to very high values. In their study Hielscher et al., (2019)^[8] found a slightly lower German owner-dog attachment with men scoring lower than women. In this study no differentiation between men and women was made. This may of course have skewed results as female dog owners generally score

higher than men dog owners^[8,13]. Moreover, male owners have reduced odds of reporting problem behaviour(s) in their dog(s) compared to female owners^[21]. Reevy & Delgado (2015)^[13] using LAPS proposed that numerous variables were related to the degree of affection for one's dog. Greater scores of neuroticism and conscientiousness correlated significantly with greater LAPS values, as did gender (being female).

In addition attachment to dogs and other animals appears to be culturally predisposed. Average LAPS total and Subscale values in this study were higher compared to the results of the studies of Hayama et al., (2016)^[22] in which exclusively male owners were studied, and Hielscher et al., (2019)^[8], German male and female owners, as well as Johnson et al., (1992)^[7], and Weiss & Gramann (2009)^[23]. The studies of Reevy & Delgado (2015)^[13] and Stephens et al., (2012)^[24] published comparable values, whereas Kruger et al., (2014)^[25] established higher scores in their study. Singer et al., (1995)^[26] found varied effects with an overall score higher than the values in this study. All the above-mentioned studies that used the LAPS were executed in the USA. Hielscher et al., (2019)^[8] conducted their LAPS study (cats and dogs) likewise in Germany, with results comparable to the ones presented herein. Comparable to this study Hielscher et al., (2019)^[8] only had a small sample size (30 LAPS total). As one shortcoming the

LAPS values were less reliable due to a lack of statistical power. Owner subjectivity is also an important study limitation. While owner reports are arguably effective, interobserver reliability has been shown to vary depending on the particular trait being rated [27].

Studies have shown that attachment values correlate with the motivation to go on walks with their dog thereby increasing physical activity levels in dog owners [3,28]. We correspondingly found significant correlations between the total distance of the dog walk and the Subscales “People Substitution”, “Animal rights/Welfare” as well as LAPS total. Cause and effect are difficult to distinguish since this was a correlation study. However, it seems plausible that owner attachment correlates with longer walking distances with their dogs and higher outcome of LAPS are correlated accordingly. To spend and enjoy increased quality time with their dog resulting in a closer bonding and higher attachment values is in accordance with findings of Kotrschal et al., (2009) [29] and Miklósi et al., (2014) [30]. Quality time spent with the dog is associated with experiencing the relationship with the dog as close [31] and may result in fewer behavioural problems [11] which in turn would also affect attachment positively.

An additional factor influencing attachment may be oxytocin as it plays a significant part in the dog-owner relationships. Oxytocin plays an important role in bond formation [32], and increased oxytocin levels are interconnected with an improved and augmented relationship from the owner perception [32]. Frequent affiliative interactions between owner and dog reinforce and fortify the attachment bond. The quantity of time that owner and dog spend together is reported to have a critical influence on both functional dog-human relationships [29] as well as dogmanship [33] and this may be one physiological explanation that may be reflected in the correlation between the walking duration and the LAPS measures.

Attachment strength is furthermore associated with owner satisfaction [10] which is based on different behavioural traits displayed by their dog. A number of dog-associated characteristics influence this owner satisfaction and consequently the dog-owner attachment strength such as preferred traits for example obedience, physical closeness and affection [34] with an owner preference of having a dog that is approachable, obedient, calm and friendly [35]. In the past dog-owner attachment has been associated with canine behaviour [36] and owner perception may influence how they view their dog’s conduct and the severity of a “problem behaviour” which may objectively not be substantiated. Owners are more likely to judge behaviours as undesirable which negatively impact

on their daily lives, such as poor recall, or behaviours which may be embarrassing or socially unacceptable to them [21]. We therefore expected a high hunting value to correlate negatively with owner attachment. In the main the opinion on high hunting activities or poor recall of pet dogs is acknowledged as undesirable and associated with owner stress and anxiety. The majority of owners in this study expected their dog to be interested in or to actually exhibit hunting behaviour. Significant negative correlations between a high hunting score assessment by the owner and attachment values could be perceived for all subscales and the total LAPS scores. Hence perceived problematic, negative, or unwanted dog behaviour clearly results in adverse effects on the dog-owner attachment values and relationship. Interestingly, data analysis of the dogs travelling movements as assessed through their GPS collars and video cameras (all medium to large dogs carried a camera) provided no evidence of any hunting or chasing activity by the dogs.

LAPS subscales values and sex of the dog(s)

Significant differences were also found between the predominately (83%) female owners of male and female dogs regarding the LAPS Subscales “Animal rights/Welfare” and “General Attachment” and LAPS total. Owners of female dogs’ showed lower values in these Subscales compared to owners of male dogs signifying distinctive levels of attachment depending on the sex of their dog. This result is thought-provoking as it has been claimed that male dogs tend to be more independent, showing more less-appreciated behaviour such as straying tendencies [37] compared to female dogs. Male dogs have been found to exhibit higher levels of separation-related behaviours and aggression compared to their female counterparts [38] and it has been postulated that male dogs interact less with their owners [39,40], which would have led to the expectation that female dogs would receive higher attachment scores. Inconsistencies in the literature regarding personality and canine sex, however, indicate that further research is needed.

LAPS subscales values and reproductive status of the dog(s)

Behavioural differences based on the reproductive status of the dog have also been proposed, including exploration behaviour [41]. Moreover animal welfare questions are frequently connected with neutering issues. Results reflected significant variances of attachment values at the Subscale “Animal rights/Welfare” between owners of intact and owners of neutered dogs. Owners

of intact dogs had lower values in the Subscale “Animal rights/Welfare”.

Owners of intact dogs showed higher values in the Subscale “General attachment” and lower values in the Subscale “People substitution” compared to owners of neutered dogs. Arguably general attachment values were higher for owners of intact dogs because many intact dogs are purebred dogs and have been with their owner from an early age. On the other hand neutered dogs are in many cases adopted and come to their owner later in life. Studies show that one characteristic related to owner satisfaction is the dog’s age with an owner preference to acquire a puppy ^[42].

The same holds true with respect to welfare issues: Purebred dogs are often not neutered whereas adopted dogs are frequently neutered for greater welfare purposes like decreasing the dog population. Awareness in owners of adopted dogs may thus be disparate in that they place a higher value on the non-reproductive status of their dog.

LAPS subscales values between owner of mixed versus owner of pure breed dogs

Data were analysed regarding attachment values of owners of purebred versus mixed bred dogs. Hielscher et al., (2019) ^[8] in their study established no significant differences between owners of purebred versus owners of mixed breed dogs. Herein significant differences between the two groups could be demonstrated at the Subscale “Animal rights/Welfare” and LAPS total. Owners of mixed breed dogs presented higher scores in these subscales compared to owners of purebred dogs.

It has been proposed that more extrinsically motivated dog owners display behaviour focused on earning external rewards and social acknowledgment (i.e., status) and that these owners tend to acquire a dog as part of a personal identity, thus frequently owning “designer” or purebred dogs ^[42]. Conversely, owners with an intrinsic motivation towards dog ownership are more likely to own a mixed breed dog. They may be more concerned with their dog’s innate qualities rather than the breed or appearance ^[42]. Furthermore, to acquire a puppy increases owner satisfaction ^[34]. Mixed-breed dogs are likely to spend more time in shelters prior to adoption and the stressors of shelter life may lead to additional behavioural problems. Bir et al., (2017) ^[43] stated that women were more inclined to rescue a dog and favour adoption compared to men. Another factor pertaining to owner demographics is their educational level. Respondents with at least a college degree are more likely to adopt a dog from a shelter than those without a college degree ^[43]. Pogány et al.,

(2018) ^[44] similarly described a connection between how dog owners’ define themselves and their dog breed choice. People who professed their race and personal behaviour as central in defining their sense of self rated the dog’s breed as an important feature in their acquisition choice.

LAPS and radius of exploration

Owners of Group 3 dogs with a substantial walking radius (at least one run > 350 m away from owner) had the highest values at people substitution and total LAPS in comparison to Group 1 and Group 2. The far ranging Group 3 dogs had a type of owner with a higher score on the Subscales “People Substitution”, demonstrating an increased value of their dog(s) company compared to people. Connections between dog behaviour and owner attachment style suggest that dogs established different strategies in their exploration and walking behaviour. This may be based on the type of support they got from their owner in the past during challenging or novel situations and by experience from their previous interaction history ^[45,46]. It has been publicized that owner-dog dyads with a secure attachment style similar to that of securely attached children and their caretakers have dogs that display a comparable behavioural response. They view their owner as safe haven and secure base and thus are able to engage in exploration behaviour ^[47]. Dogs, in contrast, which got less social support from their (insecure) owners, tend to become overly dependent on them, showing reduced exploration behaviour and staying closer to their owner most of the time. High attachment scores in Group 3 dogs therefore may reflect a secure attachment style within that dyad. These owners arguably support their dog’s endeavors to independently solve problems, encouraging learning processes and thus resulting in more confident, experienced and self-reliant dogs that explored longer distances.

Comparison owner assessment and GPS measurements

The time the dogs explored was greatly over-estimated by their owners. Dogs explored significantly shorter periods and returned faster than predicted by their owner. A number of possible reasons for the overestimation are plausible. Moods for example affect perceptions ^[48] in that a downcast mood leads to systematically overestimating times and distances ^[49] and perception differs with the perceiver’s biases and capability. It has been shown that emotional responses such as fear influence perception of distance ^[50]. Emotional reactions engage motivational systems produced by stimuli which are highly significant

to the individual and that developed throughout evolution. Consequently, if the stimuli elicited the owners' expectation of potential danger and uncontrollability it resulted in the owner's estimation being increased and perceiving the dog as travelling longer and moving further away. Thus, emotions influence how and what we see and possibly expect to see and suggest an acute rousing influence on how the environment is perceived^[51]. Supposing the adaptive function of fear is to protect an individual or organism from danger it could be expected that stimuli relevant to that risk may be enhanced and thus imprecise. Emotions may stimulate owners to focus on particular sources of information or cues or to perceive these information in a distinctive manner in the environment. That in turn could then produce changes in their time and/or distance estimates. Stefanucci & Storbeck (2009)^[52] stated that an emotional state of arousal (whether positive or negative) influences perception, signifying that arousal may be a sufficient cue for changing duration and distance cognizance, which is in agreement with the findings herein. Time perception is also prone to distortions and illusions based on emotional dynamics and features^[53]. Studies have shown that ostensible periods of emotionally arousing events are usually inaccurate based on the valence of the occurrence when compared to neutral stimuli^[54]. In general, time estimations increase as arousal intensifies with the presentation of affective stimuli. Unlike positive valence, negative valence like discomfort or fear is generally correlated with time overestimations^[53].

6. General Conclusions

Physiological, psychological and affective benefits result from an enriching and positive dog-human relationship and these encompass both parties of the dyad. The dyads have comparable qualities as interpersonal affiliations in that both members may be significant attachment figures for one another^[55]. Owners' perception of their dog as affectionate, caring and accepting, are qualities which can satisfy a person's basic need for self-worth^[56]. Green et al., (2018)^[20] proposed that attachment dimensions and affection-related behaviours were associated such as turning to one's dog as an auxiliary for human companionship or feeling less emotionally secure without one's dog. Attachment theory therefore does illuminate individual differences in relationship dynamics within a dog - owner dyad^[20].

It is likely that dogs, analogous to children, have varying attachment styles towards their owners and vice versa. Improved awareness and understanding of these attachment manners could shed light on the aspects and elements having an effect on the establishment of a

particularly positive and fulfilling dog-human relationship. Of course, such approaches may be overly simplistic, as attachment dimensions alone may fail to capture the influence of specific human behaviours, such as affiliation and perceptions. Nevertheless, the dog-human bond may be described as a symbiotic relationship, potentially benefitting owner and dog.

Implications for Practice

The dog-human bond is multifaceted and numerous components influence the attachment level. Practical implications may be that these factors should be taken into consideration prior to owning a dog. Dog professionals such as trainers or veterinarians may be of help to find effective strategies to improve the dog-owner connection to ensure a lasting and rewarding relationship, thereby increasing dog welfare.

Conclusions

In summary, positive, affirmative emotions, assenting dispositions and constructive behaviour towards their dog clearly enhance a strong owner-dog relationship improving and stabilizing their attachment level. This attachment and bonding is bidirectional, exemplifying the benefits that may arise from a positive and sustaining owner-dog relationship for both parties. The beneficial welfare implications should encourage the cultivation of such an affiliation. In contrast, adverse attitudes, misinterpretation of dog behaviour, insecure attachment, and feelings of arousal which influence perception and may lead to erroneous interpretations have the potential to disrupt the relationship. The impact on the dyadic functionality may be negative results for both partners. More information on the determinants of dog ownership satisfaction facilitates the identification of factors in relatively fulfilled dog owners' relationships and the lack thereof may on the other hand also be used as early warning signals for a compromised owner-dog association.

Compliance with Ethical Standards

Non-invasive observational studies on dogs are allowed to be done without any special permission in Germany according to the "German Animal Welfare Act 2013".

Conflict of Interest

The authors declare there are no conflicting interests.

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