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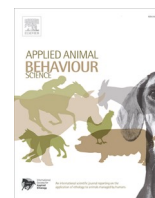
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Owner perception of problem behaviours in dogs aged 6 and 9-months

Michelle S. Lord^{a,b,*}, Rachel A. Casey^a, Rachel H. Kinsman^a, Séverine Tasker^{c,d},
Toby G. Knowles^c, Rosa E.P. Da Costa^a, Joshua L. Woodward^a, Jane K. Murray^a

^a Dogs Trust, London, United Kingdom

^b Co-Evolve, Bristol, United Kingdom¹

^c Bristol Veterinary School, University of Bristol, Bristol, United Kingdom

^d Linnaeus Group, Shirley, United Kingdom

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ABSTRACT

Problem behaviours may lead to compromised welfare, risk of relinquishment and euthanasia for dogs, as well as distress and safety issues for owners. This study used data provided by 1111 UK and Republic of Ireland participants in the 'Generation Pup' longitudinal study of canine health and behaviour. The aims were to; i) identify the proportion and type of problem behaviours reported by owners when their dogs were 6 and 9-months; ii) identify risk factors for behaviours owners reported as a 'problem' when their dog was 9-months old; iii) identify risk factors for behaviours reported to occur but not recorded as a 'problem' by owners when dogs were 9-months old; and iv) identify whether and how owners sought help for undesired behaviours. In the 6 and 9-months questionnaires, 31 % and 35 % (respectively) of owners reported their dog to be showing behaviour(s) that they found a problem. Owners most often sought help for these behaviours from dog trainers (72 % at 6-months and 68 % at 9-months), and online sources excluding those associated with welfare organisations (which were listed separately) (34 % at 6-months and 27 % at 9-months). The most commonly reported problem behaviours at both ages were pulling on the lead, jumping up at people and poor recall. Multivariable logistic regression analysis showed that female owners, owners who were unemployed/homemakers/pensioners/retired, owners who did not attend (nor planned to attend) puppy classes, and owners who reported they used a mixture of positive reinforcement and positive punishment or positive punishment only training methods at 9-months had increased odds of reporting a problem behaviour in their dogs at that age. Further investigation determined risk factors for owners reporting one or more of the three most commonly reported problem behaviours (pulling on the lead, jumping up at people and poor recall) in their dog's 9-months questionnaire compared with those owners who separately recorded the occurrence of these behaviours, but did not report any to be problematic. Owners who were employed/self-employed/students, owners who reported that they used positive reinforcement only, owners that had not attended puppy class, and owners of small dogs had increased odds of not reporting a behaviour to be problematic despite evidence of the behaviour having been observed by the owner. These results indicate that not all potentially concerning canine behaviours were perceived by the owners to be problematic, and has identified groups of owners more likely to require support with behaviour issues in their dogs.

1. Introduction

An abundance of benefits from dog ownership have been published with respect to human health (Raina et al., 1999; Allen, 2003; Knight and Edwards, 2008), social facilitation and companionship (Filiatre et al., 1986; Paul and Serpell, 1996; Raina et al., 1999; McCardle et al.,

2011a, b), and child development (Hergovich et al., 2002; Kotrschal and Ortbauer, 2003). Despite these benefits, a large proportion of the pet dog population are perceived by their owners to display problematic behaviours (40–87 %, Voith, 1985; Campbell, 1986; O'Farrell, 1992; Lund et al., 1996; Martínez et al., 2011). Such behaviour problems may lead to welfare issues for the dog (Beerda et al., 1997; Horwitz et al., 2009),

* Corresponding author at: Co-Evolve, Bristol, United Kingdom.

E-mail address: michelle@co-evolve.co.uk (M.S. Lord).

¹ Current affiliation.

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distress for the owner (De Keuster and Jung, 2009), increased risk of relinquishment (Salman et al., 2000; Marston and Bennett, 2003; Segurson et al., 2005; Diesel et al., 2009; Kwan and Bain, 2013) and even to euthanasia of dogs (Reinser et al. 1994; Proschowsky et al., 2003; Lund et al., 2010; Lambert et al., 2015; Siracusa et al., 2017). A recent study in the UK reported that 33.7 % of mortalities in dogs under three years of age were due to ‘undesirable behaviours’ (Boyd et al., 2018).

The development of undesired behaviours is often complex, and involves a combination of factors, including genetic, developmental (including epigenetic) influences and learning throughout life (Rooney et al., 2016). For example, chasing behaviour is more likely in some breeds (Udell et al., 2014) but will be influenced by individual differences and the extent to which the response is reinforced. Jumping up at people is a common behaviour that is reinforced by owner response (Koru et al., 2018) but will also be influenced by individual differences and early learning about familiar and unfamiliar people. Many problematic behaviours may be essentially “normal” for dogs and develop through learning adaptive responses to specific situations (including behaviours such as fear-based aggression to repel a perceived threat) but considered unacceptable in modern society (Houpt et al., 1996). However, physiological or pathological changes, such as pain, can be a factor in the initiation or development of behavioural signs (Lopes Fagundes et al., 2018). In some cases, pathological changes are the primary cause of changes, for example age-related cognitive dysfunction (Pirrone et al., 2015).

The definition of ‘problem behaviours’ is further complicated by owner perception. Whether an owner perceives a behaviour as a ‘problem’ to them involves more factors than the characteristics, nature and severity of the behaviour shown by their dog. Some owners may tolerate behaviours in their pets that would result in relinquishment or euthanasia in other contexts, perhaps because of their home and family circumstances, time availability, dog ownership experience, attachment to their pet and even personality. Understanding the factors underlying owner perception of what constitutes a ‘problem’ is therefore an important factor in reducing the risk of euthanasia and relinquishment, as well as identifying risk factors for the behaviours themselves. Data related to owner perception of problem behaviours has previously been collated via owner questionnaires (see for example Adams and Clark, 1989; Guy et al., 2001; Kobelt et al., 2003; Marder et al., 2004; Bennett and Rohlf, 2007; Blackwell et al., 2008; Arhant et al., 2010) and studies based on clinical behaviour cases (see for example Denenberg et al., 2005; Bamberger and Houpt, 2006; Fatjó et al., 2007; Yalcin and Batmaz, 2007; Lord et al. 2017). Studies based on owner opinions reveal the most frequently reported problem behaviours include barking and jumping up (Adams and Clark, 1989; Marder et al., 2004), overexcitement and jumping up (Kobelt et al., 2003; Blackwell et al., 2008), fearfulness (Wells and Hepper, 2000 (although this study population consisted entirely of dogs that had been rehomed from an animal shelter)), pulling on the lead and attention seeking behaviours (Blackwell et al., 2008), and inappropriate toileting (Woodbury, 1998, 1999). In contrast, data from clinical behaviour case records suggest that aggression is the primary behaviour problem reported by dog owners (APBC Annual Review of Cases, 2005; Denenberg et al. 2005; Bamberger and Houpt, 2006; Fatjo et al. 2007; Yalcin and Batmaz, 2007; Lord et al., 2017). There is an increasing level of public concern associated with canine aggression (Michaelazzi et al., 2004), and human-directed aggression is a serious public health issue (Weiss et al., 1998; Chen et al., 2000; Calkins et al., 2001). It may be that owners are more likely to invest time and finances engaging a professional behaviourist to treat aggression in their dogs due to the impact of this behaviour on their lives and concern for the safety of others (Casey et al., 2014; Pirrone et al., 2015). Although issues such as separation-related anxiety or abnormal repetitive behaviours may reflect a significant welfare issue for dogs, the data suggest these are less likely to be problems that owners seek help for. Rather, it appears that owners are more likely to report behaviours which negatively impact on their day to

day lives (such as poor recall) or which may be embarrassing or socially unacceptable (such as aggression to other dogs or people) as ‘problems’ (Blackwell et al., 2008; Casey et al., 2014; Pirrone et al., 2015).

It is therefore important to a) better identify the specific behaviour(s) that owners do and do not perceive of as problematic in their dog, b) investigate if, when and how owners address this behaviour, c) determine whether there is a higher likelihood of comorbidity between certain problem behaviours, and d) identify whether any owner characteristics predict how behavioural signs are perceived. With these data, veterinary and behaviour practitioners will be better placed to offer the appropriate education and support to dog owners such that a healthy and successful dog-owner relationship is promoted and maintained.

In this longitudinal study, the authors investigated owner reports of problem behaviours. The aims were;

- To identify the proportion of owners reporting problem behaviours in their dog at age 6 and 9-months, what the most commonly reported problem behaviours were, and if/where owners sought help for these behaviours.
- To investigate risk factors for owners reporting behaviours as a ‘problem’ in their dog at age 9-months.
- To identify risk factors for behaviours reported to occur but not recorded as a ‘problem’ by owners when dogs were 9-months old.

Data from the 9-month survey were selected for further analysis at this stage in the ongoing longitudinal study due to availability of an adequate sample size at the time of analysis. As ‘Generation Pup’ is a longitudinal study, data from the same dogs can be collected over time and in the future, later timepoints in the dogs’ lives may be investigated.

2. Materials and methods

2.1. Subjects

This study’s subjects were obtained from a large prospective birth cohort study called ‘Generation Pup’. Owners (aged 16 years or more) of puppies aged up to 16-weeks old, of any breed or crossbreed, living in the UK or the Republic of Ireland were recruited to the study (recruitment will continue until 10,000 puppies have been recruited). Recruitment strategies included advertising via veterinary practices, Kennel Club breeders, social media, rehoming centres, dog trainers/behaviourists, and publications/events aimed at dog owners.

2.2. Data collection

Recruited owners were asked to complete questionnaires at set time points throughout their dog’s life (normally in online format, although paper copies were also available).

Questionnaires were administered at the following time points up to age 9-months, and subsequently for data collection relating to other studies. The questionnaires were only available for completion for a limited time, as specified by the age of the dog in brackets:

- Registration questionnaires: three profile questionnaires related to the owner, the owner’s household and the puppy’s background
- Settling in questionnaire: (1–3 weeks after acquisition) or until 12-weeks of age, whichever was sooner
- 12-weeks questionnaire: 12-weeks (84 days) to 15.5-weeks (108 days)
- 16-weeks questionnaire: 16-weeks (112 days) to 19.5-weeks (136 days)
- 5-months questionnaire: 5-months (150 days) to 5-month + 3-weeks (171 days)
- 6-months questionnaire: 6-months (180 days) to 6-months + 3.5-weeks (204 days)

- 7-months questionnaire: 7-months (210 days) to 7-months + 4-weeks (238 days)
- 9-months questionnaire: 9-months (274 days) to 9-months + 6-weeks (316 days)

As owners had up to six weeks to complete questionnaires once they were issued to them, questions were commonly phrased using specific time frames (for example “in the last seven days” or “in the last month”) to provide clarity on how owners should respond (Supplementary Information Table A).

Each questionnaire is broken down into smaller steps pertaining to different aspects of the dog’s activities, health, training and behaviour (with the number of ‘steps’ in each questionnaire ranging from 2 to 19). One of these steps gathers data on whether the owner found any behaviours in their dogs to be problematic, and this step was included in the ‘6-months’ and ‘9-months’ questionnaires. If owners reported their dog to be showing behaviour(s) they found to be a problem they were asked to describe the behaviour(s) in a free text box. These owner responses were coded by the lead author of this paper (ML), whose qualifications include certification as a Certified Clinical Animal Behaviourist (CCAB) with the Association for the Study of Animal Behaviour (ASAB) and full membership of the Association of Pet Behaviour Counsellors (APBC). The owners were also asked if they had sought help for this behaviour, and if so from which source(s).

Elsewhere in the 9-months questionnaire, owners were asked to report the occurrence of a range of behavioural signs, such as response to unfamiliar people in different contexts, response to noises, whether the dog returned when called, etc (Supplementary Information Table A). Questions in this section were as objective as possible, asking owners to record behavioural responses (e.g. ‘growled’) rather than more subjective interpretations (e.g. ‘aggression’) or motivations (‘anxiety’). For some questions specific timeframes for owners to consider their responses were provided. The most commonly used time frame was “in the last seven days”, for example, for jumping up at people, barking at people and destruction behaviour, however the timeframe “within the last month” was used for resource guarding. For other questions, a timeframe for owners to consider their responses was not provided, but the questions were phrased in the present tense. For some behaviours, multiple questions were asked so as to gather evidence of the behaviour across several contexts. For this reason, some of the evidence is reported as having been reported at least 2 or 3 times by the owner. If there were at least three questions related to a specific behaviour, occurrence of the behaviour was deemed most strongly evident if reported in response to all three questions. In one case (for behaviour related to barking at dogs) there were two questions that related to the specific behaviour so strongest evidence of the behaviour having occurred was based on the behaviour being reported in response to both questions. Responses to these specific questions were examined for comparison with those behaviours spontaneously reported to be a problem by owners separately in a different section of the questionnaire. Supplementary Information Table A includes full details of the questions assessed to determine if behaviours were present despite not being reported as a problem behaviour by the owner.

Table 1 gives a summary of how evidence of a behaviour was determined from the questions shown in Supplementary Information Table A.

Table 1. Evidence that was assessed to determine if a behaviour was recorded in the ‘Generation Pup’ cohort 9-months questionnaire despite not having been reported as a problem behaviour by the owner. For more detailed information on the questions and options informing these categories please see Supplementary Information Table A.

Data for the current study were extracted on 25/02/19. Where an owner had two or more dogs registered with the ‘Generation Pup’ project, one puppy per owner was selected at random for inclusion in the analysis to avoid clustering at the household level.

The registration surveys and the 6-month survey were completed by

Table 1

Evidence that was assessed to determine if a behaviour was recorded in the ‘Generation Pup’ cohort 9-months questionnaire despite not having been reported as a problem behaviour by the owner. For more detailed information on the questions and options informing these categories please see Supplementary Information Table A.

Behaviour	Evidence that was assessed for
Pulling on the lead	If the owner selected anything other than that their dog always walked on a loose lead
Jumping up at people (including owner)	If the dog had at least three reports of having jumped up at people (including the owner)
Poor recall	If the owner selected anything other than that their dog always came when called
Excessive inappropriate barking (unrelated to people or dogs or other animals)	If the dog had at least three reports of having barked (unrelated to people, dogs or other animals)
Chewing/mouthing/nipping/play-biting at hands/clothes	No information available at age 9-months*
Barking at people (including owner)	If the dog had at least three reports of having barked at people (including the owner)
Destructive behaviour in house (not reported as separation-related behaviour)	If the dog had at least three reports of having carried out destructive behaviour in the previous seven days
Separation-related behaviour	If the dog had at least three reports of having shown separation-related behaviour in the previous seven days
Barking at dogs	If the dog had at least two reports of having barked at dogs (there were two questions related to response to meeting other dogs in the 9-months questionnaire)
Resource guarding	If the dog had at least three reports of resource guarding

* In the 9-month survey, there were no questions that collected data on the presence/absence of these behaviours. This behaviour was included in this table as it was a commonly reported problem behaviour (see Table 5). However, further analysis of reported problem behaviours and owner reports was not available.

965 owners. Where as, 784 owners completed the registration surveys and the 9-month survey. Some (but not all) owners completed both the 6-month and the 9-month survey, and the data from these owners were included in both sub-samples.

Online questionnaire data were stored in a Structured Query Language (SQL) database on a secure server and personally identifiable data were encrypted. Paper questionnaires were stored in locked filing cabinets at a secure location before being entered onto encrypted databases on secure servers and the hard copies destroyed. Selected variables were drawn down as an excel file and loaded onto Statistical Package for the Social Sciences (IBM SPSS, v.24 for MacBook) for analysis.

2.3. Statistical analysis

Descriptive statistics were collated to present the proportion of owners reporting problem behaviours in their dogs at 6 and 9-months of age, and to identify the most commonly reported problem behaviours. Whether or not the owners sought help for these behaviours, and from which source(s), was also described.

As the types of problem behaviours reported by owners was consistent across the 6 and 9-months questionnaires, further analyses were just completed for the 9-months questionnaire. Despite a smaller dataset, this timepoint was selected because a greater range of comparative behaviour data were available at this timepoint.

Data were analysed using univariable and multivariable logistic regression analyses. The dependent variables for analyses were:

- 1 Owners reporting one or more problem behaviours in their dogs at age 9-months. (Yes/No).

2 Owners reporting that their dogs displayed one or more of three commonly occurring behaviours at age 9-months (pulling on the lead, jumping up at people, or recall issues, based upon data presented in Table 1), but who did not report any of these behaviours to be a problem, were compared with owners who reported either pulling on the lead, jumping up at people, or recall issues as a behaviour they consider to be a problem.

Supplementary Information Table B details categorisation of the aforementioned variables. The variables were initially screened, one at a time, using univariable logistic regression models. Categories within an independent variable were combined where they both occurred at low frequency and combination was plausible. Variables with a Wald test P value of ≤ 0.2 in this screening were included in further, multivariable model selection.

The independent variables included in the statistical analyses were; owner gender, owner age, education, employment status (with those owners who selected that they were employed, self-employed or students categorised in one group as they were considered more likely to be away from the home for longer durations than those owners who selected that they were not working, homemakers, retired, or pensioners), annual household income, location of home, previous dog ownership, house type, presence of other dogs in the household, presence of another adult/adults in the household, presence of a child/children in the household, puppy class attendance (before 16-weeks), dog training class attendance in the two months prior to the dog reaching 9-months of age, original owner intentions for the dog (for example pet dog/breeding/showing/working - further detail in Supplementary Information Table B), dog size (based on UK Kennel Club 'size' categories; small, medium and large) and training methods used at age 9-months. To determine the latter, responses to the following two questions were investigated; "when training my puppy, I use the following rewards..." and "when correcting my puppy for doing something wrong, I would...". These responses were restricted to a list of training approaches (shown in Supplementary Information Tables B and C). Owners were also provided with a free text option, the responses to which were manually coded and assigned to existing categories.

3. Results

3.1. Study population characteristics

Of the 965 owners who completed the question about behaviour problems in the 6-months questionnaire, 302 (31.3 %) of these owners reported that their dog was showing one or more behaviours that they found a problem (mean = 1.7 problems per dog, range = 0–8, median = 1). Of the 784 owners who completed this question in the 9-months questionnaire, 276 (35.2 %) of these owners reported their dog to be showing one or more behaviours that they found a problem (mean = 1.7 problems per dog, range = 0–6, median = 1).

A total of 638 owners had completed the question about problem behaviours in both the 6 and 9-months questionnaires. Table 2

Table 2
Numbers of dogs with and without owner reported problem behaviour at age 6 and 9-months within the 'Generation Pup' cohort.

	No problem behaviours at 6-months	%	One or more problem behaviours at 6-months	%
No problem behaviours at 9-months	343	53.8	81	12.7
One or more problem behaviours at 9-months	89	13.9	125	19.6

summarises the number of dogs with behaviours reported by owners to be a problem at each time point.

Table 2. Numbers of dogs with and without owner reported problem behaviour at age 6 and 9-months within the 'Generation Pup' cohort.

Of the 302 owners who reported problem behaviours in their dogs at age 6-months, 118 (39.1 %) had sought help for these behaviours (with no time frame specified, so possible that owner could have reported any help since acquisition), with 68 of these (57.6 %) seeking help from more than one source. Of the 276 owners who reported problem behaviours in their dogs at age 9-months, 126 (45.7 %) had reportedly sought help for the problem behaviour within the last three months, with 70 of these (55.6 %) seeking help from more than one source.

Help for behaviours the owners found to be a problem was most often sought from dog trainers (85/118 at 6-months (72.0 %) and 86/126 at 9-months (68.3 %)), and online sources excluding those associated with welfare organisations (40/118 at 6-months (33.9 %) and 34/126 at 9-months (27.0 %)). Considering those owners who sought help from either a dog trainer and/or behaviourist at 6-months, 4/99 (4%) were able to report that the individual was accredited with the Animal Behaviour and Training Council (ABTC; council responsible for sector standards), and at 9-months this figure was 12/100 (12 %).

Table 3. Sources of help sought by owners who reported their dog to be showing behaviour(s) that they found a problem at age 6-months ($n = 118$) and at age 9-months ($n = 126$) within the 'Generation Pup' cohort (owners could indicate that more than one source of help was sought).

The most commonly reported behaviours that owners found problematic at age 6-months were jumping up at people, chewing/mouth-ing/nipping/play biting at hands/clothes, pulling on the lead and recall issues (Table 4). In the 9-months questionnaire, the most commonly reported behaviours that owners found problematic were pulling on the lead, jumping up at people, recall issues, and excessive/inappropriate barking (unrelated to people or dogs or other animals), (Table 4).

Table 4. The most commonly reported behaviours by owners who considered their dogs to show behaviour(s) they found to be a problem at age 6-months ($n = 302$) and at age 9-months ($n = 276$) within the 'Generation Pup' cohort.

Data from other questionnaire sections, which asked owners to select descriptions of their dogs' response to a range of circumstances, were investigated to identify where behaviours were reported to occur. The occurrence of these behaviours was categorised according to whether

Table 3

Sources of help sought by owners who reported their dog to be showing behaviour(s) that they found a problem at age 6-months ($n = 118$) and at age 9-months ($n = 126$) within the 'Generation Pup' cohort (owners could indicate that more than one source of help was sought).

Source where help was sought	Number of owners seeking help from this source at 6-months	%	Number of owners seeking help from this source at 9-months	%
A vet	16	13.6	14	11.1
A vet who is also a behaviourist	6	5.1	2	1.6
A behaviourist	31	26.3	36	28.6
A vet nurse	14	11.9	11	8.7
Other members of veterinary practice staff	3	2.5	3	2.4
A dog trainer	85	72.0	86	68.3
A friend	18	15.3	18	14.3
Books	34	28.8	36	28.6
Animal welfare organisation (staff or online resources)	10	8.5	9	7.1
Online sources not mentioned above - including forums	40	33.9	34	27.0
Other	3	2.5	7	5.6

Table 4

The most commonly reported behaviours by owners who considered their dogs to show behaviour(s) they found to be a problem at age 6-months ($n = 302$) and at age 9-months ($n = 276$) within the 'Generation Pup' cohort.

Problem behaviour reported	Number of owner-reports at 6-months	%	Number of owner-reports at 9-months	%
Jumping up at people (including owner)	34	11.3	39	14.1
Chewing/mouthing/nipping/play biting at hands/clothes	33	10.9	23	8.3
Pulling on lead	31	10.3	41	14.9
Recall issues	30	9.9	36	13.0
Destructive behaviour in house (not reported as separation-related behaviour)	26	8.6	15	5.4
Barking at people (owner and/or others)	24	7.9	21	7.6
Barking at people (other than owner)	24	7.9	14	5.1
Separation-related behaviour	24	7.9	14	5.1
Excessive/inappropriate barking (unrelated to people, dogs or other animals)	21	7.0	35	12.7
Barking at dogs	20	6.6	12	4.3
Resource guarding	15	5.0	12	4.3
Barking at noises	7	2.3	2	0.7

owners had separately reported this behaviour as a 'problem' (Table 5).

Table 5. Comparison of owner reports in the 9-months questionnaires ($n = 784$) of behavioural signs in response to a range of contexts (despite the owner not having separately reported this to be something they

Table 5

Comparison of owner reports in the 9-months questionnaires ($n = 784$) of behavioural signs in response to a range of contexts (despite the owner not having separately reported this to be something they found to be a problem), with their separate report of whether the same behaviours were considered to be a problem, (see Supplementary Information Table A for additional detail).

Problem behaviours	Number of owners reporting behaviour occurrence in their dog, but not separately reporting it as a problem	%	Number of owners reporting behaviour occurrence in their dog, and also reporting it as a problem	%
Pulling on the lead	625	79.7	41	5.2
Jumping up at people (including owner)	345	44.0	39	5.0
Poor recall	451	57.5	36	4.6
Excessive inappropriate barking (unrelated to people/other animals)	16	2.0	35	4.5
Chewing/mouthing/nipping/play biting at hands/clothes	No information available at age 9-months	n/a	23	2.9
Barking at people (including owner)	93	11.9	21	2.7
Destructive behaviour in house (not reported as separation-related behaviour)	54	6.9	15	1.9
Separation-related behaviour	141	18.0	14	1.8
Barking at dogs	27	3.4	12	1.5
Resource guarding	14	1.8	12	1.5

found to be a problem), with their separate report of whether the same behaviours were considered to be a problem, (see Supplementary Information Table A for additional detail).

3.2. Logistic regression

Risk factor analysis was conducted for;

- 1 Owners reporting one or more problem behaviours in their dog in the 9-months questionnaire compared with those owners who did not report any problem behaviours in their dog in the same questionnaire.
- 2 Owners reporting one or more of the three most commonly reported problem behaviours (pulling on the lead, jumping up at people and poor recall) in the 9-months questionnaire compared with those owners who separately recorded the occurrence of these behaviours, but did not report any of these to be problematic in the same questionnaire.

Univariable screening revealed no evidence for a significant association ($P > 0.2$) between owner age, education, annual household income, location of home, previous dog ownership, house type, presence of other dogs in the household, presence of another adult/adults in the household, presence of a child/children in the household, dog training class attendance in the two months prior to the dog reaching 9-months of age, original owner intentions for the dog (for example pet dog/breeding/showing/working - further information in Supplementary Information Table B) and dog size with the likelihood of an owner reporting a problem behaviour in their dog in the 9-months questionnaire and these variables were excluded from further analysis.

The following variables were included in further multivariable model selection: owner gender, employment status, puppy class attendance (before 16-weeks) and training methods used at age 9-months. All four variables were retained in the final multivariable model, as each had a P -value < 0.05 (Table 6). The excluded variables were then added back into the model individually but remained insignificant ($P > 0.05$) and were thus excluded from the final model (Table 6).

The final multivariable logistic regression model is shown in Table 6. Female owners had two times increased odds of reporting a problem behaviour in their dog in the 9-months questionnaire as compared with male owners ($P = 0.019$). Owners who were unemployed/homemakers/pensioners/retired had 1.6 times increased odds of reporting a problem behaviour in their dog's 9-months questionnaire compared with owners who were employed/self-employed/students ($P = 0.011$). Owners who did not attend (nor planned to attend) puppy classes had 1.5 times increased odds of reporting a problem behaviour in their dog at 9-months compared with owners who had attended (or planned to attend) puppy class ($P = 0.04$) and owners who reported they used a mixture of positive reinforcement and positive punishment or positive punishment only, had 1.8 times increased odds of reporting a problem behaviour in their dog at age 9-months compared with owners who reported that they used positive reinforcement only ($P = 0.001$). The Hosmer-Lemeshow test was non-significant suggesting a good model fit. The overall model explained approximately 4–5 per cent of the variance (Cox and Snell $R^2 = 0.038$, Nagelkerke $R^2 = 0.052$).

Table 6. Variables remaining in the final multivariable logistic regression model for owner reporting of problem behaviours in their dog's 9-months questionnaire within the 'Generation Pup' cohort.

Univariable screening suggested that owner gender, owner age, education, annual household income, location of home, previous dog ownership, presence of another adult/adults in the household, presence of a child/children in the household, dog training class attendance in the 2 months prior to the dog reaching 9-months of age, training methods used in their dog's 9-months questionnaire and original owner intentions for the dog had limited influence on the likelihood of an owner recording the occurrence of jumping up at people, pulling on the lead

Table 6

Variables remaining in the final multivariable logistic regression model for owner reporting of problem behaviours in their dog's 9-months questionnaire within the 'Generation Pup' cohort.

Variable	Categories	Wald statistic	P value	OR (ExpB)	95 % CI for ExpB	
					Lower	Upper
Owner employment	Reference category: Employed/self-employed/student. Not working, homemaker, retired, pensioner.	6.479	0.011	1.563	1.108	2.204
Owner gender	Reference category: Male. Female.	5.498	0.019	2.024	1.123	3.648
Training method used	Reference category: Positive reinforcement only. Positive reinforcement/positive punishment, or positive punishment only.	10.268	0.001	1.777	1.250	2.525
Puppy class attendance	Reference category: At least one class or plan to. No classes attended or planned.	4.232	0.040	1.510	1.020	2.237

and/or poor recall within the 9-months questionnaire but not having reported any of these behaviours as problematic ($P > 0.2$) and were excluded from further analysis.

The following variables were included in the model-building process: employment status, house type, presence of other dogs in the household, puppy class attendance (before age 16-weeks), training methods used at age 9-months and dog size.

Multivariable logistic regression results (Table 7) indicated that owners who were employed/self-employed/students had 1.6 times increased odds of not reporting a problem behaviour despite having recorded occurrence of it elsewhere in the questionnaire compared with owners who were homemakers/retired/not employed/pensioners ($P = 0.049$). Owners who reported that they used positive reinforcement only had 1.8 times increased odds of not reporting the behaviour as a problem despite having recorded evidence of it elsewhere in the questionnaire compared with those who reported that they used a combination of positive reinforcement and positive punishment, or positive punishment only ($P = 0.042$). Owners of small dogs had 1.9 times increased odds of not reporting a behaviour to be problematic despite evidence of the behaviour having been observed by the owner compared with owners with medium/large dogs ($P = 0.019$). Owners that had not attended puppy class at age 16-weeks had three times increased odds of not reporting behaviours up to be a problem at age 9-months, despite recording occurrence of the behaviour elsewhere in the questionnaire compared with owners that had attended (or planned to attend) puppy class ($P = 0.005$). The model overall explained between 4–7 per cent of the variance (Cox and Snell $R^2 = 0.036$, Nagelkerke $R^2 = 0.067$).

Table 7. Variables remaining in the final multivariable regression model for 'Generation Pup' cohort owners reporting either pulling on the lead, or jumping up at people, or recall issues as a problem behaviour in their dog's 9-months questionnaire.

4. Discussion

4.1. Study population

Approximately a third of dogs in this population had behaviours which owners found to be a problem in the 6-months (31.3 %) and 9-months (35.2 %) questionnaires. These figures are lower than those

Table 7

Variables remaining in the final multivariable regression model for 'Generation Pup' cohort owners reporting either pulling on the lead, or jumping up at people, or recall issues as a problem behaviour in their dog's 9-months questionnaire.

Variable	Categories	Wald statistic	P value	OR (ExpB)	95 % CI for ExpB	
					Lower	Upper
Owner employment	Reference category: Employed/self-employed/student. Not working/homemaker/retired/pensioner.	3.872	0.049	0.610	0.373	0.998
Training method used	Reference category: Positive reinforcement only. Positive reinforcement and positive punishment, or positive punishment only.	4.137	0.042	0.569	0.330	0.980
Dog size	Reference category: Small. Medium or large.	5.548	0.019	0.537	0.320	0.901
Puppy class attendance	Reference category: At least one class or plan to. No classes attended.	7.970	0.005	2.992	1.398	6.402

reported in other pet dog populations (40–87 %, Voith, 1985; Campbell, 1986; O'Farrell, 1992; Lund et al., 1996; Martínez et al., 2011), but this may in part reflect the age difference between these populations. Moreover, research has suggested that owners who are sufficiently engaged with their dogs to complete questionnaires about their behaviour, are less likely to report potentially problematic behaviours (Bennett and Rohlf, 2007), thus the problem is most likely underreported here. Nevertheless, the proportion of owners finding one or more behaviours of their 6 and 9-month old dogs problematic is concerning.

The most commonly reported problem behaviours at age 6-months and 9-months were jumping up at people, chewing/mouthing/nipping/play biting at hands/clothes, pulling on the lead, recall issues, and excessive/inappropriate barking (unrelated to people, dogs, or other animals). These reported problem behaviours are in line with other studies where data were collected through owner questionnaires (see for examples; Adams and Clark, 1989; Kobelt et al., 2003; Marder et al., 2004; Blackwell et al., 2008; Pirrone et al., 2015). The mean number of behaviour problems, where there was a problem reported, within this study was 1.7 per dog in both the 6-months and 9-months questionnaires (range 0–8, median = 1 in the 6-months questionnaires and range = 0–6, median = 1 in the 9-months questionnaires). Other studies have reported similar mean numbers of problem behaviours ranging from 1.6 to 2.1 per dog (Wright and Nesselrode, 1987; Bamberger and Haupt 2006; Lord et al., 2017).

Studies reporting prevalence within clinical populations suggest the most commonly reported problem behaviours for which owners seek help are aggression (Denenberg et al., 2005; Bamberger and Haupt 2006; Fatjó et al., 2007; Yalcin and Batmaz, 2007), fearfulness (Bamberger and Haupt 2006) and separation anxiety (Bamberger and Haupt 2006; Takeuchi et al., 2001). Given the age of the population in this study, it is likely that these behaviour problems may not have developed or become established enough to be 'problematic' for owners as compared to clinical population data. This is supported by studies suggesting the average dog age at which owners report problem behaviours is >18 months (Wright and Nesselrode, 1987; Landsberg, 1991; Lund et al., 1996; Bamberger and Haupt 2006). This suggests that problems such as aggression or separation related behaviour develop at >9-months of age, or, perhaps more likely, develop at a young age but only become serious enough to impact on owners lives and be reported

after this age. It is possible that owners tolerate such behaviours for a certain time, attempting their own methods to alleviate the issue(s), but then may seek help when the behaviour(s) reach a certain extent or when owners consider their methods to have been ineffective. Earlier development is supported by the findings of this study, where behavioural responses to specific situations suggest early stages of these issues. For example, responses suggested evidence of 'resource guarding', separation-related behaviour, barking at people and jumping up at people where the owner had not reported finding behaviour(s) their dogs were showing to be problematic (Table 5). This would indicate that indeed owners may not be considering early signs of potentially serious behaviour issues as problematic.

Considering the owners in this study who indicated that they had sought help for the reported problem behaviour, help was most often obtained from dog trainers and online sources excluding those associated with animal welfare organisations. Although there are several organisations seeking to improve regulation in the dog training and behaviour industry in the UK and Republic of Ireland, there is currently no legal regulation of practitioners in the sector. This can result in dog owners seeking advice from individuals who practice beyond their expertise across all aspects of dog training and behaviour (McBride, 2010). Very few of those owners who had reported seeking help from a trainer or behaviourist were able to confirm that the person they saw was appropriately qualified/accredited in that field (only 4% at 6-months and 12% at 9-months). This may be due to a lack of qualifications in those individuals from whom help was sought, or that the owner was unable to recall or recognize the individual's qualifications. Equally, there is a lot of information online regarding how to address behaviour issues in dogs of varying quality and accuracy, and it is difficult for dog owners to differentiate appropriate sources of advice. It is therefore worrying that so many owners sought help for their dog's problem behaviour from online sources excluding those associated with animal welfare organisations. Future analysis of this population will facilitate investigation of the efficacy of help sought, by determining whether behaviour issues resolve/escalate/remain the same depending on the type of help sought and potentially provide an insight into how owners could be directed to the most effective sources in the future.

4.2. Risk factors for owners reporting problem behaviour(s) in their dog in the 9-months questionnaire

Dogs that had attended puppy classes have been reported as scoring higher for trainability (Seksel et al., 1999; Kutsumi et al., 2013; González-Martínez et al., 2019), as having diminished touch sensitivity (González-Martínez et al., 2019) and as less likely to be relinquished by their owners (Duxbury et al., 2003). In the study reported here, owners who had attended (or planned to attend) puppy class(es) at age 16-weeks had decreased odds of reporting problem behaviour(s) in their dog in the 9-months questionnaire compared with owners who had not attend (nor planned to attend) puppy classes at age 16-weeks. Future analyses of data from the 'Generation Pup' population will assess further the relationship between class attendance and undesired behaviours such as tolerance of handling.

In this study, owners who reported using a combination of positive reinforcement and positive punishment or positive punishment only, had increased odds of reporting a problem behaviour in their dog in the 9-months questionnaire compared with owners who reported that they used positive reinforcement only. This is supported by findings from other studies that reported fewer behaviour problems and better obedience as reported by dog owners who used positive reinforcement (Hiby et al., 2004; Blackwell et al., 2008), and increased fear, stress, aggressive reactions, problem behaviours and distraction during training by owners who used punishment based techniques with their dogs (Roll and Unshelm, 1997; Beerda et al., 1998; Hiby et al., 2004; Schilder and van der Borg, 2004; Schalke et al., 2007; Haverbeke et al., 2008; Herron et al., 2009; Casey et al., 2014; Cooper et al., 2014). Of

course, it could be that owners of dogs with problem behaviours are more likely to use punishment-based methods (Arhant et al., 2010). Further investigation of longitudinal data provided by the 'Generation Pup' cohort will help to identify causality in the use of punishment-based training methods by owners who report problem behaviours in their dogs.

Household dynamics have been reported as affecting resident dogs' behaviour. Dogs from larger (human) families have been rated by owners as more "disobedient", more "unfriendly/aggressive" (Bennett and Rohlf, 2007), and less social towards their conspecifics (Kubinyi et al., 2009) than dogs from smaller households. Kubinyi et al. (2009) proposed that people in larger families might show less care and devotion towards their dogs. According to Marinelli et al. (2007) people living without children are more attached to their dogs. It could be that families may have less time to spend working with a dog with behavioural problems or that behavioural problems could be more concerning in households with children (Diesel et al. 2008). The current study did not find location of household, owner education, number of adults or children, or number of other dogs to be significantly associated with whether or not the owner reported behaviour(s) they found to be a problem in their dog's 9-months questionnaire. Female owners had increased odds of reporting problem behaviour(s) in their dog's 9-months questionnaire compared with male owners. Owners who were unemployed/homemakers/pensioners/retired had increased odds of reporting problem behaviour(s) in their dog compared with owners who were employed/self-employed/students. This may be due to the former being present in the household during the day and therefore more likely to observe/focus on their dogs' behaviour due to being close by. Further investigation of the relative relationship between time spent with dogs and perception of behaviour from owners in the cohort may highlight further insight into this finding.

Previous research has suggested that first time dog owners may be more likely to consider their dogs' behaviour to be problematic than more experienced owners (Wells and Hepper, 2000). This may be due to first time owners having less experience of what constitutes 'normal' dog behaviour (Jagoe and Serpell, 1996). Although owners' lack of knowledge has historically been considered a contributory factor in the development of behaviour issues in their dogs (Peachy, 1993), the first-time owners in the current study were no more likely to have reported problem behaviours in their dogs than experienced owners. It could be that inexperienced owners might not recognize problem behaviours and therefore underreport them, or that they take extra care to seek up-to-date advice and research current trends in training having had less prior knowledge.

4.3. Risk factors for owners recording evidence of certain behaviour(s) in their dog's 9-months questionnaire but not reporting this(/these) as something they found to be a problem

This study highlighted evidence of owners reporting the occurrence of behaviours in their dog's 9-months questionnaire but not identifying them as a problem (see Table 5). Further multivariable analysis was conducted to identify which factors may contribute to owners finding aspects of their dogs' behaviour problematic or not in the 9-months questionnaire. Considering the three most commonly reported problem behaviours occurring at this timepoint, there were four variables which contributed to owners not regarding these as a problem. These were: size of dog, owner employment status, reported training method used, and puppy class attendance at age 16-weeks.

Previous studies have reported lower rates of training and play activities for owners of small dogs compared to those who own larger dogs (Kobelt et al., 2003; Masters and McGreevy, 2008; Westgarth et al., 2008) as well as increased 'disobedience' and 'excitability' in smaller dogs (Bennett and Rohlf, 2007). It may be that more training effort is devoted by owners of larger dogs due to the safety risk if a dog of that size were to behave in an inappropriate manner (Arhant et al., 2010).

This would be supported by findings from this study (Table 7) that owners of small dogs had increased odds of not reporting a behaviour as a problem, despite providing evidence of this behaviour elsewhere in the questionnaire, as compared with owners with medium or large dogs. A higher owner tolerance of undesirable behaviours by small dogs does have several potential concerning consequences. For example, it may lead to retention in the population of predisposing characteristics which would increase in prevalence over time (Guy et al., 2001). It has also been reported that small dogs cause more bite injuries in children under 5 year than larger dogs and that there is an increased frequency and severity of bite injuries correlated to smaller sizes of dogs (Reisner et al., 1994; Schalomon et al., 2006; Messam et al., 2018), though it should be noted that the current study assessed a wide range of owner perceived behaviour problems in young dogs as opposed to specifically studying serious aggression resulting in bite injuries.

Many owners may not be aware of what could be deemed as 'normal' dog behaviour or of how to deal with emerging problematic behaviours (Gazzano et al., 2008; Landsberg et al., 2013). Attendance at puppy class has been associated with reduced risk of relinquishment (Duxbury et al., 2003), increased trainability and reduced risk of behaviour problems (González-Martínez et al., 2019). In this study, owners that had not attended puppy classes at age 16-weeks had increased odds of not reporting behaviours to be a problem in their dog's 9-months questionnaire, despite recording evidence of the behaviour elsewhere in the questionnaire, compared with owners who had attended (or planned to attend) puppy class. It may be that these owners who had attended puppy class were aware of what constitutes 'problem' canine behaviour having been educated at puppy classes, or it may be that the demographic of owners that take their puppies to class are likely to be concerned about problem behaviours in their dogs.

Owners who reported that they used positive reinforcement only had increased odds of not considering observed behaviours a problem as compared with those owners who reported that they used a combination of positive reinforcement and positive punishment, or positive punishment only. Those owners who used positive reinforcement only may be more tolerant of potentially problematic behaviour or consider behaviour normal for the dog, perhaps because of underlying owner personality characteristics which have been shown to affect human-dog interactions (Kotrschal et al. 2009; Kis et al., 2012).

In this study, owners who were employed/self-employed/students had increased odds of not reporting a problem behaviour despite its occurrence as compared with owners who were homemakers/retired/not employed/pensioners. This could be attributed to owners that were homemakers/retired/not employed/pensioners having a higher exposure to the problem behaviour than the other group of owners. It is speculated that owners who were employed/self-employed/students may have been more likely to be absent during the day or occupied by work/studies, resulting in them being less aware of the behaviour and therefore less likely to report it.

Due to the nature of longitudinal studies, sampling bias should be considered. For example, participants from lower socio-economic backgrounds may be less likely to be retained (Nohr and Liew, 2018). Also, most dog owners participating in Generation Pup are female, however, it is relatively common for there to be a female response bias to surveys (Sax et al., 2003). Although there was the potential for selection bias, previous work has shown the effects of selection bias within longitudinal studies to be limited (Nohr and Liew, 2018). Whilst caution should be taken in extrapolating prevalence data to the UK dog-owning population, results from the risk factor analyses are likely to be less impacted by selection bias.

5. Conclusion

This study highlights the complexity of understanding 'problem behaviours' in dogs, and the influence of owner perception on reporting. Although recall bias may impact on owner reports, they provide good

ecological validity.

The most commonly reported behaviours that owners consider a problem in dogs aged approximately 6 and 9-months are not necessarily those that may be early indicators of more serious behavioural diagnoses later in life (such as aggression and separation related behaviour). This highlights the importance of education in ensuring owners recognize early indicators and seek help from appropriately qualified individuals. By considering the risk factors for owners reporting one or more problem behaviours, industry professionals such as rehoming centres and qualified trainers/behaviourists could offer additional support to those owners presenting as potentially requiring more detailed/specific guidance in understanding and resolving their dogs' behaviour issues.

Similarly by considering the risk factors for those who did not report one of three commonly reported behaviours (pulling on the lead, jumping up at people and poor recall) as problematic, despite recording evidence of one or more of these behaviours, industry professionals could highlight these issues to the owner as requiring further consideration of and subsequent training. This study has highlighted those owners who may most benefit from interventions to prevent the development of behaviours which can impact on dog welfare and the dog-owner bond.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.applanim.2020.105147>.

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