

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/312972177>

Adoption and relinquishment interventions at the animal shelter: A review

Article in *Animal welfare* (South Mimms, England) · February 2017

DOI: 10.7120/09627286.26.1.035

CITATIONS

23

READS

2,725

2 authors:



Alexandra Protopopova

University of British Columbia - Vancouver

30 PUBLICATIONS 356 CITATIONS

[SEE PROFILE](#)



Lisa M Gunter

Arizona State University

12 PUBLICATIONS 90 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Assessing Human Behavior as a Predictor of Dog Relinquishment [View project](#)



Impacts of Encouraging Dog Walking on Returns of New Adopted Dogs to a Shelter [View project](#)

Adoption and relinquishment interventions at the animal shelter: a review

A Protopopova^{*†} and LM Gunter[‡]

[†] Department of Animal and Food Sciences, Texas Tech University, Lubbock, TX 79409, USA

[‡] Department of Psychology, Arizona State University, Tempe, AZ 85287, USA

* Contact for correspondence and requests for reprints: a.protopopova@ttu.edu

Abstract

Each year, nearly 4 million dogs will enter one of over 13,000 animal shelters operating in the United States. We review programmes implemented at shelters aimed at increasing the likelihood of adoption. The morphology of shelter dogs plays a large role in in-kennel adopter selection, but their behaviour is also influential in out-of-kennel adopter interactions. Previous studies suggest that dogs have the ability to readily learn new behaviours at the shelter, and programmes designed to improve behaviour of the dogs can increase adoption rates. Whilst human interaction has been well-established to improve behavioural and physiological outcomes of dogs living in shelters, analysis of the effects of sensory, environmental, and social-conspecific enrichment has not resulted in clear conclusions. We also review the literature on the relinquishment of owned dogs and return rates of previously adopted dogs. Whilst owner- and dog-related risks to relinquishment are discussed, we show that there is a notable lack of research into programmes that address issues that may prevent the initial surrender of dogs to shelters, or that could prevent re-relinquishment. It is likely that factors, unrelated to the dog, play a larger role than previously believed. Suggestions for further research include multi-site studies, investigations into the efficacy of in-shelter enrichment programmes, predictive validity of behavioural assessments, understanding of adopter behaviour at the shelter, and programmes within the community focused on keeping dogs in their homes.

Keywords: adoption, animal shelter, animal welfare, dog, relinquishment, review

Introduction

The American Society for the Prevention of Cruelty to Animals (ASPCA) estimates that over 13,000 animal shelters operate in the United States. Each year, nearly 4 million dogs will enter one of these shelters (ASPCA 2016). Recent survey data from the American Pet Products Association (APPA) indicate that 54 million homes in the United States have a dog, with 78 million dogs living in human households (APPA 2016), approximately 20% of which were adopted from shelters (Campbell 2012). The number of dogs living in the US is comparable to that of Europe, where more than 80 million dogs live in over 20% of the region's households (The European Pet food Industry Federation [FEDIAF] 2014). The percentage of the US population that is dog-owning has remained relatively stable for the last twenty-five years (Scarlett 2013).

Dogs may arrive at the animal shelter in one of four ways: i) surrendered by their owners; ii) as strays; iii) returned to the shelter after adoption; or iv) confiscated as part of cruelty and criminal cases. Results from the National Council on Pet Population Study and Policy's survey of 4,700 United States shelters from 1994–1995 indicate that close to 30% of dogs that entered shelters did so as owner-surrenders (Zawistowski *et al* 1998). This complements more recent statistics from the ASPCA that finds twice as many dogs enter shelters as strays rather than as relinquishments by their owner (ASPCA 2016).

However, findings from a 2010 census from the United Kingdom suggest that the number of owner-surrendered dogs may be nearer to 50% of that country's shelter dogs (Stavisky *et al* 2012) while in Australia that number is only 15% (Marston *et al* 2004). A majority of owner-surrendered dogs are young, intact and not purebred (New *et al* 2000). In Patronek *et al* (1997), dogs relinquished to the shelter accounted for nearly 4% of the canine population in the community with authors noting that owners likely under-reported surrendering their pets when questioned.

Dogs entering as strays compose 53–83% of shelter canine populations (Wenstrup & Dowidchuk 1999; Lepper *et al* 2002; Marston *et al* 2004; Protopopova *et al* 2012). In a 2009 study investigating microchip prevalence in United States animal shelters, 58% of microchipped dogs arrived as strays. Of those dogs, 52% were returned to their owners compared to 22% of the shelters' total stray dog population (Lord *et al* 2009). Overall, dogs that come into shelters but then are reunited with their owners make up 13–23% the shelter dog population, with older dogs having higher rates of being reclaimed than those under six months of age (Zawistowski *et al* 1998; Wenstrup & Dowidchuk 1999; Bartlett *et al* 2005). Calculations about the number of dogs returned to owners, however, are often based on total dogs received at the shelter and not solely on stray intakes.

A small portion of dogs in animal shelters are owner confiscations due to abuse or neglect (McMillan *et al* 2015). Such cases are uncommon and, as such, it is difficult to determine prevalence on a national scale as they are often included in multi-use ('other') categories that do not provide for a detailed breakdown. From regional studies, Protopopova *et al* (2012) found that confiscated dogs comprised approximately 10% of the shelter dog population at a Florida municipal shelter. A collective confiscate percentage at four shelters in Massachusetts over a two-and-a-half year period was 3% (Dowling-Guyer *et al* 2011) while dogs held under legal order in Australia made up only 1% of admissions (Marston *et al* 2004).

The majority of dogs living in animal shelters are under two-years old (Patronek *et al* 1995; Bollen & Horowitz 2008; Protopopova *et al* 2014; Barnard *et al* 2015), although their exact ages are often difficult to determine. In an attempt to describe shelter dogs, researchers have often identified the prevalence of certain breeds in these facilities to understand demographics of the shelter dog population and often various aspects of their adoption success. However, breed assignment performed at animal shelters is often based on visual appearance; and this method has been found to be an inconsistent and unreliable means of identification (Voith *et al* 2009; Olson *et al* 2015).

Instead, genetic canine heritage testing may more accurately describe the breeds present in today's shelter dogs and allow us to better infer the influence of breed on outcomes, however the majority of shelter dogs may be mixed breed with only a small percentage of purebreds (Barnard *et al* 2015). In a study of over nine hundred shelter dogs at two US shelters, using the MARS Wisdom Panel, only 3–8% of dogs were purebreds and the majority of dogs had more than two breeds identified. While dogs having a pit-bull-type or Chihuahua comprised roughly 50% of the population at both shelters, the remaining dogs consisted solely of other breeds. In total, 125 single-breed populations were identified with Labrador Retrievers comprising a very small proportion. With the MARS Wisdom Panel product used in this study, DNA is extracted from the buccal cells and typed at 321 single nucleotide polymorphisms (SNPs) across the canine genome (Gunter *et al* in prep).

Whilst almost one-and-a-half million dogs entering US shelters will find homes, over 30% will ultimately be euthanased (ASPCA 2016). Without a national database that collects this information, these numbers will continue to be approximations and not take into account reasons for euthanasia (ie medical, behavioural, kennel space). Thus far, however, researchers have identified dogs surrendered to the shelter by their owners to be at higher risk for euthanasia (Houpt *et al* 1996; Zawistowski *et al* 1998).

Bartlett *et al* (2005) calculated that a 40% euthanasia rate at shelters in Michigan equated to roughly 3% of the dog population, and Patronek and Glickman (1994) arrived at similar percentages for Washington and Iowa. Whilst the national dog population model developed by Patronek and Glickman predicts a higher euthanasia rate than is cited by

more recent statistics from the ASPCA (2016), shelter euthanasia continues to be the leading cause of canine death in the United States (Olson *et al* 1991). In an effort to reduce the number of healthy dogs dying in animal shelters, understanding the efficacy of interventions that reduce the number of dogs arriving at animal shelters and increase those leaving alive are the foci of this paper.

Increasing adoption rates

Extensive research suggests that adopters select shelter dogs based on their morphology, background, and behaviour. The following section discusses these variables as predictors of adoption. In the behavioural literature, we focus on a growing and promising area of research in the training of shelter dogs to behave attractively in the shelter in order to increase their likelihood of adoption.

Predictors of adoption

Several studies have attempted to answer the question of what makes a dog attractive to adopters. Wells and Hepper (1992) found that participants in Northern Ireland reported that the temperament of shelter dogs was the most important variable they would consider when asked to imagine adopting a dog. However, extensive research has now shown, through retrospective and correlational studies, that the morphology of the dog is highly important to actual adopters. In fact, appearance was the single most important reason adopters provided as to why they choose a specific dog (Weiss *et al* 2012), and photographs of adopted dogs were rated as more attractive than euthanased dogs by potential adopters (Protopopova *et al* 2012).

Specifically, more adopted dogs have been shown to be light than dark-coloured (eg Posage *et al* 1998; Lepper *et al* 2002), long-haired than short-haired (eg Wells & Hepper 1992; Sietou *et al* 2014), young than old (eg Lepper *et al* 2002; Clevenger & Kass 2003; Normando *et al* 2006; Brown *et al* 2013; Sietou *et al* 2014; Žak *et al* 2015), small than medium-sized (eg Lepper *et al* 2002; Protopopova *et al* 2012; Brown *et al* 2013; Sietou *et al* 2014; Žak *et al* 2015), and were of toy breed-type (eg Clevenger & Kass 2003; Protopopova *et al* 2012; Brown *et al* 2013). Neuter status has also been found to influence adoption likelihood (eg Lepper *et al* 2002; Clevenger & Kass 2003) but, as most shelters mandate spay and neuter prior to adoption, this variable is, perhaps, less pertinent than previously. A review of literature by Brown *et al* (2013) showed that the most widely reported morphological variables to consistently influence length of stay at the shelter were age, size, and breed of the dog. Interestingly, more pedomorphic features in the face of dogs in a shelter in the UK increased the likelihood of adoption (Waller *et al* 2013). Kennels of dogs with preferred morphologies (ie puppies, long-coated dogs, small dogs, and certain breeds) in Florida were visited 30% times more frequently than other dogs and had a nine times higher frequency of being taken out of their kennel for further inspection by shelter visitors (Protopopova & Wynne 2016).

Aside from the morphological features of the dog, certain aspects of information on the kennel may influence adopter decisions. For example, correlational and questionnaire studies have found that adopters prefer a dog labelled as an owner-surrender rather than a stray (Wells & Hepper 1992; Protopopova *et al* 2012). However, as noted above, euthanasia rates are actually higher for owner-surrendered dogs compared to strays in the US (Haupt *et al* 1996; Zawistowski *et al* 1998). Furthermore, the breed label on the kennel card has a large impact on adopters. Gunter *et al* (2016) found that dogs that were labelled as pit-bull-type breeds had three times the lengths of stay of dogs that looked similar but were labelled another breed. When breed labels were removed from kennel cards at a Florida shelter, adoptions significantly increased for dogs that would have been previously labelled as pit-bull-type breeds, without any decline in adoptions of other breeds (Gunter *et al* 2016).

The contents of the kennel have been hypothesised to affect adoption rates. Wells and Hepper (1992) found that people preferred photographs of shelter dogs that had a clean cage; and Lampe and Witte (2014) found that high quality photographs, taken outdoors, with the dog standing up and making eye contact, were negatively correlated with time to adoption. However, a study using survival analyses found that when all morphological and behavioural variables were accounted for, cleanliness of the kennel did not predict time to adoption (Protopopova *et al* 2014). Similarly, the presence of toys in the kennel has not been shown unequivocally to improve adoption. Whilst Wells and Hepper (1992) showed that people preferred photographs of dogs with a toy, and more dogs were adopted during a time-period in which toys were placed in the kennel compared to the previous year (Wells & Hepper 2000b), Luescher and Medlock (2009) did not find an effect of the presence of toys on adoption rates. Furthermore, placing other potentially attractive items around the kennel, namely plastic plants and colourful kennel cards, also did not influence adoption rates (Luescher & Medlock 2009).

Few studies have attempted to understand whether the behaviour of shelter dogs while kennelled predicts adoption (Wells & Hepper 1992; Weiss *et al* 2012; Protopopova *et al* 2014; Protopopova & Wynne 2014). Wells and Hepper (1992) found that photographs of dogs that were depicted as not barking and being in the front of the kennel were rated as more adoptable. In an observational study, Protopopova *et al* (2014) assessed whether any behaviours exhibited by the dogs inside the kennel predicted time to adoption. These findings showed that increased locomotion in the kennel, rubbing or leaning on the walls, and facing backward extended the dogs' length of stay at the shelter. Surprisingly, barking, jumping, and sitting (behaviours that are typically assumed to be important to adopters) did not influence length of stay. Adopters have been found to spend very little time observing the dogs available for adoption, stopping to look at approximately one-third of the kennels (Wells & Hepper 2001; Protopopova & Wynne 2016). Once stopped, adopters only spend approximately 15–70 s observing and

interacting with the dogs (Wells & Hepper 2001; Protopopova & Wynne 2016).

Once the potential adopter indicates his or her interest in a certain kennelled dog, many shelters allow the adopters to interact further with the dogs outside the kennel. Weiss *et al* (2012) found that adopters reported that dogs approached and greeted, licked, jumped on, and wagged their tails during their first meeting. The authors suggested that these behaviours might have influenced adopters' choices. In an observational study, Protopopova and Wynne (2014) found that dogs that spent more time lying down next to and not ignoring play initiations from a potential adopter significantly increased their likelihood of adoption. A large proportion of adopters justified their selection of the dog by explaining that the dog displayed 'calmness', 'friendliness' and 'playfulness' during the interaction. Also, a majority of adopters justified not adopting a dog by explaining that the dog was too active and insufficiently attentive (Protopopova & Wynne 2014). The desire to be around and interact with people may be seen as the most valued aspect of pet dogs, but dogs do not have long to impress potential adopters. On average, a potential adopter only interacted with the dog for 8 min prior to making a decision (Protopopova & Wynne 2014). While morphology plays a significant role in the choice of dog during the initial in-kennel selection, behaviour becomes especially important during the secondary out-of-kennel selection process.

Behavioural interventions

A large number of studies have evaluated the effect of various environmental and social enrichment programmes on the behaviour of shelter dogs (see reviews by Wells 2004 and Taylor & Mills 2007). While the goal of enrichment programmes is to improve the well-being of shelter dogs while kennelled, an additional benefit may be an increase in behaviours which are correlated with higher adoptions. Thus, enrichment programmes may indirectly alter adoption rates through changing the dogs' behaviour.

Object enrichment, such as beds and toys, have been evaluated as tools to improve kennelled dog behaviour. Placing a dog bed in the front of the kennel resulted in more time spent in that location (Wells & Hepper 2000b), suggesting that this alteration could influence adoption rates (Wells & Hepper 1992, 2000b). Food toys in the kennel can increase activity levels (Hubrecht 1993; Schipper *et al* 2008), but reduce locomotion (Hubrecht 1993) and barking (Schipper *et al* 2008). Other non-edible and non-destructible toys do not seem to alter behaviour as dogs, by and large, ignore these objects (Wells 2004; Pullen *et al* 2010, 2012). It is not yet entirely clear how such objects could affect dog behaviour and adopter choice. Whilst an increase in the time in the front of the kennel is likely to increase adoptions, a bed may encourage facing backward and low overall alertness, which may impede adoption. Toys, while reducing undesirable locomotion, may also discourage the dogs from paying attention to potential adopters (ie facing forward).

Sensory enrichment in the form of music or odours was found to have some effects on shelter dog behaviour. Graham *et al* (2005) found that dogs exposed to chamomile and lavender odours spent more time resting with less time moving and vocalising. However, when exposed to rosemary and peppermint, dogs spent more time standing, sitting, and moving. Shelter dogs exposed to a dog-appeasing pheromone diffuser exhibited a short-term reduction in barking and an overall increase in resting and sniffing (Tod *et al* 2005). However, a pheromone solution sprayed into smaller cages increased alertness and visual exploration (Siracusa *et al* 2010) and a pheromone collar did not affect behaviour of dogs housed long-term and exhibiting repetitive behaviours (Grigg & Piehler 2015). Wells *et al* (2002) and Kogan *et al* (2012) found that classical music, but not heavy metal, increased time spent sleeping and reduced barking. Recently Brayley and Montrose (2016) found that an audiobook intervention (a recording of a book read by a person) played for 2 h in shelter kennels reduced dogs' vocalisations and increased resting time over and above classical music. Much more research on the effect (and the magnitude of effect) of sensory enrichment for shelter dogs is needed prior to an establishment of guidelines for shelters, and especially how these interventions alter behaviour, which is ultimately important to adopters (Wells 2009).

As dogs are a social species displaying complex social behaviour, enrichment programmes involving conspecific contact have been widely investigated. Wells and Hepper (1998) found that shelter dogs with visual access to conspecifics preferred the front of their cages versus dogs that had no visual access. However, the authors did not find a significant difference in activity or vocalisations in the two groups. A consistent finding is that group housing reduces repetitive or problem behaviour in kennelled dogs (Hetts *et al* 1992; Hubrecht *et al* 1992; Hubrecht 1993; Mertens & Unshelm 1996; Beerda *et al* 1999, 2000; but see Clark *et al* 1997 for no effect of group exercise on abnormal behaviour). It is unclear how social isolation affects locomotor activity: Hetts *et al* (1992) found that beagles that lived in social isolation spent more time moving, vocalising, and engaging in stereotypy. Similarly, higher locomotor activity in beagles was found in the most austere housing condition (Beerda *et al* 2000) and when housed alone in small cages (Hughes & Campbell 1990). When a conspecific was removed from pair-housing, the remaining dog showed an increase in activity (Walker *et al* 2014). However, Beerda *et al* (1999) found that locomotor activity was higher in group-housed beagles (also see Hubrecht *et al* 1992). It is also not clear how the size of the pen affects adoptable behaviour of the dogs. Consistent with the findings of Hubrecht *et al* (1992), Hetts *et al* (1992) found that the size of the pen did not significantly affect the dogs' behaviour; however, a more recent study by Normando *et al* (2014) reported increased activity, social interaction, exploration, and vocalisation when dogs were moved from smaller to larger enclosures. It is possible that large differences in enclosure sizes might have an effect on behaviour, but small-scale changes do not

(as discussed in Taylor & Mills 2007). It is also possible that activity levels may be bimodally distributed — increasing in the most austere conditions (correlating with increased incidence of stereotypy) and also in the most enriched environments (during social play with conspecifics; as also discussed in Taylor & Mills 2007).

Human interaction has been shown to improve the quality of life in shelter dogs by reducing behavioural and physiological measures of stress (Hennessy *et al* 1997, 1998, 2006; Coppola *et al* 2006; Valsecchi *et al* 2007; Bergamasco *et al* 2010; Menor-Campos *et al* 2011; Shiverdecker *et al* 2013; Cafazzo *et al* 2014). However, the effects of human interaction on adoptable behaviour of shelter dogs have not been widely investigated. Seeing visitors approach the kennel resulted in higher activity and approach behaviour (Wells & Hepper 2000b; Arhant & Troxler 2014; Protopopova *et al* 2014), which may have both positive and negative effects on adoption as coming to the front of the kennel and facing forward was correlated with fewer days to adoption, but increased activity (back and forth motion) had the opposite effect (Protopopova *et al* 2014). Direct human interaction has been found to affect various behaviours that may be indicative of improved well-being (Shiverdecker *et al* 2013) and affected some behaviours that have been implicated in affecting time to adoption (Normando *et al* 2009; Protopopova *et al* submitted). Shelter dogs that had 15 min of human interaction per week for approximately five weeks spent more time in the front of the cage (Normando *et al* 2009) and daily 15-min calm interactions, achieved by passively reading and not interacting in a quiet room, resulted in overall decreases in in-kennel behaviours predictive of lower adoption rates (Protopopova *et al* submitted).

Previous research has shown that dogs housed in animal shelters are capable of learning new behaviours and inhibiting problem behaviour. Thorn *et al* (2006) evaluated the ability of shelter dogs to learn to respond to a 'sit' command. The authors found that shelter dogs were able to learn the command and retain it for at least two days. Steiss *et al* (2007) determined that in only three days of administering positive punishment to shelter dogs (via a citronella spray bark collar and a shock bark collar) for 30 min each day, barking was virtually eliminated, with no effects on plasma cortisol and activity levels. Recently, Protopopova and Wynne (2015) showed that a simple pairing of a person with food elicited behaviour, previously implicated in a decreased length of stay, from kennelled dogs. When an experimenter rang a bell and tossed treats into kennels as she walked by, the dogs spent more time in the front of the kennel, facing forward, and not barking. In fact, this simple procedure resulted in a 68% decrease in the number of dogs behaving undesirably (staying in the back of the kennel, facing backwards, engaging in locomotion, rubbing their body on the kennel wall, and barking) in the kennel (Protopopova & Wynne 2015). However, a follow-up evaluation of the use of this pairing procedure, while improving in-kennel adoptive behaviour of dogs, did not result in altered shelter visitor behaviour (such as asking to take the

dog out of the kennel for further inspection during their decision to adopt) towards the trained dogs compared to the dogs in the control condition (Protopopova & Wynne 2016).

Several authors have attempted to directly alter adoption rates through human interaction with the dogs. Braun (2011) reported anecdotal evidence that an unsystematic volunteer training programme in an animal shelter in Austria decreased length of stay of dogs at a shelter. Luescher and Medlock (2009) reported that obedience training at a shelter in Indiana, USA had positive effects on adoption rates. Trained dogs were 1.4 times more likely to be adopted than dogs in the control group when taking into account certain individual qualities of the dogs (ie age, adult size, behaviour with dogs). However, the intervention consisted of a professional trainer training a multitude of different behaviours, which makes this intervention difficult to replicate. Protopopova *et al* (2012) conducted a study as an extension of Luescher and Medlock (2009) in which shelter dogs in Florida were trained to perform a social behaviour, gazing into the eyes of adopters, to evaluate the effect of this social training on adoption rates. Although the experimental manipulation did increase gazing towards experimenters in the dogs in the training group, this did not significantly increase adoption rates. Herron *et al* (2014a) trained dogs at a municipal shelter in Ohio, USA to approach the front of the kennel, to sit or lie down, and to remain quiet. While the training was effective at increasing some of the target behaviours, no effect on adoption was found.

More recently, Protopopova *et al* (2016) utilised prior research that showed that dogs that lay down next to and played with potential adopters were more likely to be adopted (Protopopova *et al* 2014) to develop a behavioural programme aiming to increase adoption in a Florida county shelter. Potential adopters, who indicated that they wanted to interact with a dog, were subjected to a structured intervention. To encourage play, the dog's preferred toy was made available, and the experimenter modelled appropriate play with the dog. After play, the experimenter restricted the dog's movement through the use of a short leash and reinforced lying down next to the adopter. Furthermore, all experimental sessions were conducted in a smaller area to further encourage these behaviours. This multi-component programme resulted in dogs engaging in higher rates of social play and lying down in proximity, and lower rates of independent play away from the potential adopter compared to a control group of dogs (in which no structure was given to the interactions between the dogs and the potential adopters). Dogs in the experimental group were 2.5 times more likely to be adopted than dogs in the control group.

Decreasing relinquishment and return rates

The previous section discussed strategies that impact the number of dogs leaving shelters, but improved understanding of relinquished dogs, their owners, and motivations for relinquishment is needed to effectively address the causes of dog abandonment. This type of information will aid in the creation and assessment of programmes that successfully reduce the flow of dogs entering shelters and keep shelter dogs in their adoptive homes.

Reasons for relinquishment

Our understanding about relinquished dogs and their owners has been heavily influenced by research conducted on behalf of the National Council on Pet Population Study and Policy in the mid-nineties (Salman *et al* 1998, 2000; New *et al* 1999, 2000; Scarlett *et al* 1999; Kass *et al* 2001). Studies by Patronek *et al* (1996, 1997) conducted in the St Joseph County area of Indiana also identified relinquishment risk factors by focusing on differences in behaviour of surrendering and non-surrendering owners.

Comparing the characteristics of dogs relinquished to shelters with those of owned dogs in homes, these shelter dogs were often under the age of two; in fact, as dogs increased in age, their chances of relinquishment were reduced. The same relationship was seen with length of ownership (New *et al* 2000). Diesel *et al* (2010) found that 65% of dogs surrendered to Dogs Trust animal shelters in the UK were three years old and younger with nearly a similar percentage owned for less than a year. According to New *et al* (2000), purebreds in the US were more often in owned homes, and relinquished dogs, in general, were most commonly obtained from friends and animal shelters. House soiling, destruction, hyperactivity, and fear issues were more prevalent in relinquished dogs than dogs not relinquished. This suggests that follow-up support for owners when the human-animal bond is newly formed and likely at its most vulnerable, particularly with adolescent dogs, may reduce the probability of relinquishment.

New *et al* (2000) found that owners of relinquished pets in regions across the US tended to be under 50 years of age with a trend of decreasing incidence of surrender with increasing age. Not seeking out veterinary services, unmet expectations, and lack of participation in obedience classes were the owner behaviours most strongly associated with surrender (Patronek *et al* 1996). In Salman *et al* (1998), relinquished dogs more often had been trained by the owner only, had not attended obedience classes or received other forms of professional training advice. Owners of these surrendered dogs were often white with no observed income-to-relinquishment relationship. However, without a comparison groups of owned dogs in this study, it's difficult to determine if these are indeed statistically significant risk factors or simply characteristics of the dog-owning population. In a study that surveyed owners relinquishing their pets to animal shelters, Salman *et al* (1998) found that housing challenges, non-aggressive problem behaviour, and lifestyle complications represented the largest proportion of reasons given. Similarly, Weiss *et al* (2014) found that personal, moving, and landlord issues were much more frequently cited by owners in two cities in the eastern United States as reasons for surrender than behaviour and health concerns. Moving was most often provided as the reason for relinquishment, with housing restrictions commonly indicated as additional grounds (New *et al* 1999).

Shore *et al* (2003) reported that 85% of pet owners designated moving as their primary motivation for surrender, with 70% indicating that there was no secondary reason (such as

behaviour) behind the decision. When Marston *et al* (2004) asked Australian owners for their relinquishment reasons, factors pertaining to the owner and not the dog comprised the majority of reasons, with housing issues again topping the list. In Vučinić *et al* (2009), owners in Belgrade, Serbia that surrendered their dogs for adoption most often gave reasons related to finances. Diesel *et al* (2010) found that while problematic behaviour and other behaviour-related reasons were indicated in at least 35% of owner surrenders in the UK, the majority of reported reasons were housing, personal issues, and situations unrelated to the dog. Kim *et al* (2010) failed to find a relationship between presence of behavioural problems and owner relinquishment in Korea. While a quarter of US canine relinquishments reported in Kass *et al* (2001) were requests for euthanasia, these owners did so overwhelmingly for reasons of old age and illness, as did owners in Vučinić *et al* (2009).

In cases where problematic behaviours were indicated by dog owners in the UK as grounds for relinquishment, problem behaviours unrelated to aggression, particularly destruction, were more frequently reported in aggregate than aggressive behaviour toward people and other pets (Diesel *et al* 2010). Salman *et al* (1998) found that aggression towards people and other animals as a reason for relinquishment by US owners, even when combined, did not equal the total of all other behavioural problems combined — which most often included escaping, house soiling, destruction, and disobedience. When examining behavioural reasons given for relinquishment individually, however, biting and human aggression easily topped owner-provided reasons for relinquishment (Salman *et al* 2000). Nonetheless, this suggests that while aggressive behaviour is certainly a cause for relinquishment in the US and UK, other behavioural concerns — that could be potentially easier to address — were reported more often.

Reasons for returning an adopted dog to the shelter

Once adopted, dogs face the risk of being returned to the animal shelter. An average return rate of adopted dogs across the US, UK, and Italy is approximately 15% (Posage *et al* 1998; Marston *et al* 2004; Mondelli *et al* 2004; Diesel *et al* 2008) while Australia's adopters return their dogs about half as often (Marston *et al* 2004). Approximately 35 to 50% of these dogs are returned within 2 weeks to 1 month after adoption (Shore 2005; Diesel *et al* 2008; Gunter *et al* in press). In fact, half of the owners reported observing the problematic behaviour which, ultimately, led to the return, within 24 h of adoption (Shore 2005).

Wells and Hepper (2000a) found that 90% of surrendering owners at a Northern Ireland shelter reported a behavioural problem within the first month of adoption (compared to 67% of owners who kept their dogs). Similar to New *et al* (2000), the most common behavioural issues were fearfulness and hyperactivity. Interestingly, Mondelli *et al* (2004) found that only 20% of new owners in Italy whose dogs were previously adopted and then returned to the shelter reported the same behavioural problem as the

original owner. In Duffy *et al* (2014), only three behavioural problems reported by relinquishing owners were positively correlated with observations of the same behaviour in the new home. In a study carried out in the UK by Stephen and Ledger (2007), fewer than half of the problem behaviours indicated by relinquishing owners were observed by the new adopter (with one-third of those being related to the veterinarian), indicating that these differences could be related to the inaccuracy of owner reports (Segurson *et al* 2005), that perceptions of behavioural problems may differ amongst owners, or some behaviours may simply be related to the environment in which the animal is living.

Dogs are returned to the shelter for similar reasons that cause initial surrender. In both the US and Italy, the vast majority of returned dogs are under two years of age (Mondelli *et al* 2004; Shore 2005). Housing and personal issues combined are most often given by owners as reasons for re-relinquishment, followed by behavioural problems unrelated to aggression and then failure to co-habitate successfully with other pets and people, which can include aggression (Mondelli *et al* 2004). In Shore (2005), problem behaviours that did not include aggression were provided most frequently by surrendering owners in the US, but issues with other pets, children and human aggression (albeit in only three cases) were, in total, given nearly as often, followed closely by housing and lifestyle reasons. Over half of surrendering adopters were uncertain or did not plan to adopt another dog in the future (Shore 2005), suggesting how influential adoption failure may be in future obtainment decisions.

Interventions to prevent dogs from entering or returning to shelters

As identified by a recent review by Coe *et al* (2014), nearly three-quarters of the research on relinquishment, primarily conducted in the US and Europe, has examined the reasons why owners surrender their pets. Conversely, only 15% has directly investigated interventions designed to abate owner relinquishment. Despite the paucity of attention prevention has received, we believe that designing programmes based on factors influencing pet relinquishment and evaluating their efficacy is a logical next step in reducing pet abandonment.

Given that the largest proportion of dogs in shelters are strays, encouraging owners to use a personalised tag or microchip for identification may increase the likelihood that the owner will be reunited with their dog and reduce the possibility that the dog will enter the shelter. Weiss *et al* (2011) found that placing collars and identification tags on pets during veterinary visits resulted in higher usage by owners with a nearly 70% change in collar and tag wearing pre- and post-intervention. Fifty percent of animals that were lost during the study (ten dogs and cats) were found because of tag identification. Studies from the US, Australia, and Serbia have found that animals that had updated and correct information on their microchips also had higher reclaim rates (Lord *et al* 2009; Lancaster *et al*

2015; Vučinić *et al* 2015). As suggested by Lord *et al* (2009), having shelters and clinics register owner information at the time of implantation (rather than the owner registering after adoption or veterinary visit) would reduce the number of animals with unregistered microchips. Sending reminders to owners to maintain up-to-date contact information along with the development of a centralised microchip database would likely further improve recovery.

Interventions that target other perceived components of responsible ownership may also prove to be effective in addressing abandonment. Scarlett and Johnston (2012) investigated the impact of a subsidised spay/neuter clinic on a North Carolina shelter's animal intake and euthanasia. While the number of dogs euthanased at the shelter declined, the researchers found that the percentage of dogs taken in by the shelter that were ultimately euthanased did not. Similar results were seen by White *et al* (2010) where a sterilisation programme did not decrease the intake of dogs into the shelter or euthanasia rates. Yet the authors did find that a spay/neuter programme in Austin, Texas that targeted specific areas of the city for such services did slow the rates of intake and euthanasia from those areas compared to control areas. Considering the relationship between frequency of veterinary care and likelihood of relinquishment (Patronek *et al* 1996), providing free or subsidised health services may address cost-related factors of this owner-related risk. Additionally, it may create a known point-of-contact with owners where they could also receive qualified behavioural advice about issues the owner and dog are currently experiencing, which both have been identified as opportunities to improve owner retention (Weiss *et al* 2014; Dolan *et al* 2015).

Providing one-size-fits-all educational interventions in an effort to reduce relinquishment has been met with mixed success. In Weng *et al* (2006), Taiwanese owners were given written materials about pet care, methods to reduce unwanted behaviour, and the benefits of sterilisation. In follow-up phone interviews, researchers found that while most owners used the materials provided, they returned their dogs more often in the first four months of ownership than those in the control group (a trend that reversed after four months). Similarly, in Herron *et al* (2014b), adopters at an Ohio shelter were provided with 5 min of counselling, written materials, and a food-dispensing toy at the time of adoption to prevent the development of separation anxiety in the home. While the dogs were not selected because of separation-related problem behaviours that were identified, it has been suggested that shelter dogs may be predisposed to the behaviour (Flannigan & Dodman 2001). The authors found that while owners in the intervention likely complied with recommendations (particularly in regards to providing a food-dispensing toy upon departure), group assignment did not affect the presence of separation-related problem behaviour in adopted dogs. Additionally, in a study investigating the impact of a behavioural intervention on owner attachment and relinquishment, owners that were emailed advice about the benefits of walking and recommendations on how to improve leash walking along with in-person training walks were just as

likely to keep their dogs as owners that received general adoption information (Gunter *et al* in press). Similarly, adopters in Kogan *et al* (2000) did not utilise training resources despite their cost-free accessibility.

Conversely, when new owners were provided with 5 min of house-training counselling during adoption, significantly more owners perceived house-training success one-month post-adoption than owners who did not receive such information. Differences in the use of verbal punishment and enzymatic cleaners were also reported. However, only four dogs were relinquished at the time of the follow-up surveys, and only one was relinquished because of elimination problems (Herron *et al* 2007). Given the high rate of success in the study's intervention and control groups (98 and 86%, respectively) coupled with the low incidence of return for this behaviour, it seems likely that relatively straightforward problem behaviours like house-soiling may benefit from inclusion in the adoption conversation whereas more complex behavioural issues, like separation anxiety, may not respond to such general behaviour advice.

Training classes have been shown to have some effect on owner retention, dependent on the age of the dog. In Duxbury *et al* (2003), adopters of puppies that attended socialisation classes from the shelter in which they adopted relinquished less frequently than owners that had attended socialisation classes elsewhere or did not attend any classes. However, no difference was observed in retention when dogs attended training classes after four months of age. It has been suggested that punitive methods of dog training may be involved in higher incidents of problem behaviour and subsequent relinquishment (Hiby *et al* 2004; Herron *et al* 2009; Arhant *et al* 2010), but the direct effect of these methods on rates of retention and surrender remains largely unexplored. Gazzano *et al* (2008) found that behaviour and training information provided by a veterinary behaviourist to Italian owners of puppies (at an average age of five months) resulted in their owners reporting undesirable behaviours such as house-soiling, mouthing, as well as aggression to people and dogs less often at the puppy's one-year vaccination visit. While the researchers did not include information about owner retention, it does suggest, when taken together with the findings from Duxbury *et al* (2003), that receiving expert, relevant advice during an influential period of a young dog's life may be beneficial to owners and could impact future relinquishment.

Focusing on in-shelter interventions, Bollen and Horowitz (2008) implemented a behavioural assessment (Assess-a-Pet; Sternberg 2002) to identify dogs that displayed aggression and recorded the outcomes of these dogs at a New England animal shelter. The premise of standardised behavioural screening in shelters is that dogs that do not aggress during these assessments are safer to adopt to the public, resulting in more successful adoptions and fewer returns. During the study's two-year span, nearly 40% of dogs failed the behavioural assessment (796 dogs), and 95% of those dogs were euthanased. Dogs that displayed stiffening or minor growling during one component of the shelter assessment were more likely to be returned for

behavioural problems in the home than dogs that did not show any such behaviour during the assessment. Ninety percent of dogs that aggressed in the relinquisher's home prior to relinquishment showed aggression when assessed at the shelter; however, the evaluator was aware of the dog's history prior to conducting the assessment. The authors note that because dogs that failed the evaluation were most often not placed in new homes (95%), the ability of the assessment to effectively predict future aggressive behaviour was not possible. Overall, the researchers found that during the period behavioural assessments were conducted, the return rate decreased by 25% with returns specifically for aggression falling from 5 to 3.5%.

More recent studies (Mohan-Gibbons *et al* 2012; Marder *et al* 2013) have attempted to answer the question of predictive validity of shelter assessments (with the Safety Assessment to Evaluate Rehoming [SAFER] and Match-Up II Shelter Dog Rehoming Program, respectively), specifically concerning the behaviour of the dog guarding its food. Of sixty dogs which guarded their food while at the shelter and whose new owners were contacted post-adoption, only 13% displayed aggression or concerning behaviour around food or toys at least once during the three-month follow-up period (Mohan-Gibbons *et al* 2012). Six dogs from the study were returned, but none of the owners indicated aggression with food or toys as the reason for relinquishment. In Marder *et al* (2013), 55% of dogs that displayed food aggression in the shelter continued to do so after adoption, whereas 22% that were not food aggressive did go on to aggress over food or food items in the home. This resulted in a 4.31 times greater likelihood of dogs displaying aggression in the home after having done so in the shelter compared to dogs that did not aggress during the shelter's behaviour evaluation. Interestingly, there was no difference between the attitudes of owners of dogs that displayed food aggression and those that did not when asked about the likelihood of adopting the same dog again given this behaviour.

Inclusion criteria and small sample sizes of these studies indicate the need for further research to draw robust conclusions; but the studies, nevertheless, highlight why the validation of shelter behavioural assessments is necessary if they are to be used efficaciously in reducing relinquishment of shelter dogs.

Learning about the temperament and behaviour of a dog outside of the shelter may be influential in determining how well the dog will fit into an owner's lifestyle. Normando *et al* (2006) assessed the influence of a Temporary Adoption Program (TAP), trial adoptions, and traditional adoption on return rates at an Italian shelter. The TAP consisted of matching members of the public with shelter dogs that they could take on walks and bring home for the day. Trial adoptions consisted of allowing interested people to take their prospective dog home prior to finalising the adoption process. While dogs were not randomly assigned to treatment groups because of behavioural, health, and age concerns, the results do suggest that the TAP dogs that were adopted by their volunteers and dogs that were trial adopted were returned less

frequently than traditionally adopted dogs. Similarly, Braun (2011) reported anecdotal data that 20% of sponsors adopted the shelter dogs for which they cared.

More recently, Mohan-Gibbons *et al* (2014) examined an adoption programme implemented at two US shelters, in which foster homes provided daily care for the dogs and were responsible for placing them in their adoptive homes. The authors found that return rates were lower for these dogs compared to dogs adopted at the shelter. Over 20% of owners that acquired their dogs through the adoption programme reported that information received from the foster home was helpful in their decision-making, compared to only 3% of adopters who interacted with shelter staff. Prospective owners of programme dogs deliberated longer than adopters of regular shelter dogs when making their adoption decisions. This extra time, coupled with information from the foster home and opportunities to interact with the dog outside of the shelter environment, may have contributed to the higher adoption success.

Animal welfare implications

For those in animal welfare, one pressing issue essential in the development of successful adoption interventions is improving our understanding of adopter behaviour beyond self-reported data. At this time, the question of which behaviours of potential adopters at the shelter are associated with successful adoption remain largely unanswered. If an individual is interested in adopting when they arrive at the shelter, they are more likely to adopt a dog during that visit (Protopopova *et al* 2014). Wells and Hepper (2001) showed that people who came in groups spent less time observing the dogs. Research also suggests that dogs respond differently to the gender of shelter visitors (Lore & Eisenberg 1986; Wells & Hepper 1999). It may therefore be valuable to explore such variables as socioeconomic status, age, and prior experiences with dogs during potential adopter interactions.

Furthermore, the impact of kennel cards upon adoption remains largely unknown. While Luescher and Medlock (2009) found that using coloured cards had no effect on adoption rates, growing evidence suggests that some aspects of the kennel card, such as the breed label, may be influential. For example, the label 'pit bull' has been associated with increased length of stay and reduced attractiveness (Gunter *et al* 2016). A recent marketing campaign in Costa Rica to improve the desirability of mixed-breed dogs by creating unique 'breed' names, ie Shaggy Shepherd Dachspaniel, purports to have successfully increased the flow of people into shelters, but this approach remains unstudied (Bekoff 2013). Therefore, it may be interesting to see how information provided about the dogs, such as details regarding their behaviour, may affect adopter perceptions and acquisition behaviour.

The effect of the shelter environment on adopter behaviour remains to be evaluated. While the presence of toys and other items in the kennel has been demonstrated to influence adopters (Wells & Hepper 1992, 2000b), object, sensory, and social enrichment may indirectly alter adoption rates by changing the dogs' behaviours. However, previous data are

not entirely clear, and more research needs to be conducted. Behavioural training both inside and outside the kennel continues to be a promising area of research in improving adoption rates more directly. While the behaviour of the dogs is important to adopters when viewing dogs in-kennel, it is especially important once the dog is taken out of the kennel for further inspection (Weiss *et al* 2012; Protopopova *et al* 2014; Protopopova & Wynne 2014).

Although previous research has identified owner risk factors associated with the surrender of owned dogs and failed adoption of shelter dogs, there are no validated interventions that have systematically altered the number of dogs arriving at shelters. While some responsible owner initiatives, puppy training, and novel adoption programmes have found success, their impacts need further evaluation and replication. An added complication in this domain is that it is logistically difficult to accurately study returns at individual study sites as not all owners return dogs to the shelter from which they were acquired. Furthermore, return rates may not be the best measure of adoption success as adopters may not maintain ownership of their dog but utilise options, other than shelter relinquishment, for re-homing. New technologies, such as smartphone applications and GPS tracking devices, may soon provide ways to track the location of dogs without having to rely exclusively on owner reporting. The movement of feral cats, for example, has already been investigated with these technologies (Recio *et al* 2010).

While it is generally accepted that there is a temporal component related to the likelihood of adopter return (Shore 2005; Diesel *et al* 2008), what is less understood is the interaction between length of ownership and the type of return. Such evidence may be helpful in informing what kind of information is provided to adopters throughout their owner-dog relationship. Considering that a majority of new owners in Shore (2005) observed the behaviour problem that led to return soon after adoption and the top reasons for adopter return included pet and child incompatibility, we may find that certain temperament issues of the dog drive immediate returns and relinquishments that occur later in the owner-dog relationship are driven by issues unrelated to the dog. If this is indeed the case, interventions designed to increase ownership success may begin before the adoption takes place by encouraging introductions for families that have children and/or other pets to avoid preventable conflicts with resident household members. Once the dog is successfully living in the home, services that support the owner may play a bigger role in continued adoption success.

To this end, it may be possible to reduce the overall numbers of dogs in shelters through more engagement with dog owners and the community outside the animal shelter. Carlisle-Frank *et al* (2005) found that fewer than half of the rental properties in the ten surveyed cities in the US allowed owners to have pets (with some restrictions) and fewer than 10% allowed pets without any limitations on type, size, or breed. Owners of large dogs and those with multiple dogs faced significant housing challenges. The authors found that over 40% of landlords surveyed prohibited pets because of insurance issues. With the reduced number of rental units

available to dog owners, it may be advantageous for animal welfare agencies to engage with property owners within their cities to advocate for more pet-friendly accommodations to reduce housing-related relinquishment. Safety net programmes, such as subsidised spay/neuter and medical services, as explored by Dolan *et al* (2015) shows promise in positively affecting owner retention. Lastly, shelter programmes that offer temporary housing for owned animals, as suggested by participants in Weiss *et al* (2014), is a relatively unexplored area of intervention research that may provide transitional relief to dog owners, preventing the need to relinquish the animal, which ultimately may be less costly to the animal shelter than taking it into its care and re-homing it.

Conclusion

Throughout this review, we included the locations of various studies in order to draw attention to potential regional differences in the human-companion animal relationship and allow implications to be drawn in the adoption and relinquishment of dogs living in shelters. Undoubtedly, cultural differences likely result in some variance in how people acquire and surrender their dogs. Interestingly, some phenomena described in previous sections seem to be cross-regional. For example, people consistently pay attention to the breed, age, and size of dogs when adopting from a shelter. These variables seem to be important for adopters from the US, UK, Italy, Czech Republic, and Australia (see Brown *et al* 2013). Another example of cultural similarity may be seen in the findings that adopters both in the US (Protopopova & Wynne 2016) and in Northern Ireland (Wells & Hepper 2001) only stopped in front of approximately one-third of the kennels when looking to adopt a dog and spent about 1 min or less observing or interacting with those dogs. These similarities in findings across countries allow for more confident generalisations about human behaviour when adopting a dog.

However, many other findings described in this review were not consistent across different world regions, thereby making generalisations difficult. For example, Protopopova *et al* (2014) found that barking in the kennel did not increase the dogs' length of stay at a Florida shelter. However, Wells and Hepper (1992) found that study participants in Northern Ireland preferred dogs that did not bark in their kennels (when pictured in photographs). It is possible that this difference in perception of behaviour as problematic or not is due to cultural differences of the human populations rather than different study methodologies. Another example of a potential cultural effect is evident in the percentage of adopted dogs returned to the shelters; Australian adopters return dogs half as often as adopters in the US, UK, and Italy (Posage *et al* 1998; Marston *et al* 2004; Mondelli *et al* 2004; Diesel *et al* 2008). Furthermore, most studies are conducted in only one region and never replicated, making generalisations impossible. By replicating research across several countries and regions, we can begin to better understand the cultural effects on companion animal adoption and relinquishment, which may lead to more targeted interventions that are met with greater success.

Acknowledgements

We thank Clive DL Wynne, the section editor, and two anonymous reviewers for their very useful comments and suggestions.

References

- Arhant C, Bubna-Littitz H, Bartels A, Futschik A and Troxler J** 2010 Behaviour of smaller and larger dogs: Effects of training methods, inconsistency of owner behaviour and level of engagement in activities with the dog. *Applied Animal Behaviour Science* 123: 131-142. <https://doi.org/10.1016/j.applanim.2010.01.003>
- Arhant C and Troxler J** 2014 Approach behaviour of shelter dogs and its relationships with the attitudes of shelter staff to dogs. *Applied Animal Behaviour Science* 160: 116-126. <https://doi.org/10.1016/j.applanim.2014.08.013>
- Barnard S, Chincarini M, Di Tommaso L, Di Giulio F, Messori S and Ferri N** 2015 Free-roaming dogs control activities in one Italian province (2000-2013): Is the implemented approach effective? *Macedonia Veterinary Review* 38: 149-158. <https://doi.org/10.14432/j.macvetrev.2015.04.041>
- Bartlett PC, Bartlett A, Walshaw S and Halstead S** 2005 Rates of euthanasia and adoption for dogs and cats in Michigan animal shelters. *Journal of Applied Animal Welfare Science* 8: 97-104. https://doi.org/10.1207/s15327604jaws0802_2
- Beerda B, Schilder MBH, Van Hooff JARAM, De Vries HW and Mol JA** 1999 Chronic stress in dogs subjected to social and spatial restriction. I. Behavioral responses. *Physiology and Behavior* 66: 233-242. [https://doi.org/10.1016/S0031-9384\(98\)00289-3](https://doi.org/10.1016/S0031-9384(98)00289-3)
- Beerda B, Schilder MBH, Van Hooff JARAM, De Vries HW and Mol JA** 2000 Behavioural and hormonal indicators of enduring environmental stress in dogs. *Animal Welfare* 9: 49-62.
- Bekoff M** 2013 Designer dogs Costa Rica style: Unwanted but unique breeds. *Animal emotions, psychology today*. <https://www.psychology-today.com/blog/animal-emotions/201309/designer-dogs-costa-rica-style-unwanted-unique-breeds>
- Bergamasco L, Osella MC, Savarino P, Larosa G, Ozella L, Manassero M, Badino P, Odore R, Barbero R and Re G** 2010 Heart rate variability and saliva cortisol assessment in shelter dog: Human-animal interaction effects. *Applied Animal Behaviour Science* 125: 56-68. <https://doi.org/10.1016/j.applanim.2010.03.002>
- Bollen KS and Horowitz J** 2008 Behavioral evaluation and demographic information in the assessment of aggressiveness in shelter dogs. *Applied Animal Behaviour Science* 112: 120-135. <https://doi.org/10.1016/j.applanim.2007.07.007>
- Braun G** 2011 Taking a shelter dog for walks as an important step in the resocialization process. *Journal of Veterinary Behavior: Clinical Applications and Research* 6: 100. <https://doi.org/10.1016/j.jveb.2010.08.004>
- Brayley C and Montrose VT** 2016 The effects of audiobooks on the behaviour of dogs at a rehoming kennels. *Applied Animal Behaviour Science* 174: 111-115. <https://doi.org/10.1016/j.applanim.2015.11.008>
- Brown WP, Davidson JP and Zuefle ME** 2013 Effects of phenotypic characteristics on the length of stay of dogs at two no kill animal shelters. *Journal of Applied Animal Welfare Science* 16: 2-18. <https://doi.org/10.1080/10888705.2013.740967>
- Cafazzo S, Maragliano L, Bonanni R, Scholl F, Guarducci M, Scarcella R, Di Paolo M, Pontier D, Lai O, Carlevaro F, Bucci E, Cerini N, Carlevaro L, Alfieri L, Fantini C and Natoli E** 2014 Behavioural and physiological indicators of shelter dogs' welfare: Reflections on the no-kill policy on free-ranging dogs in Italy revisited on the basis of 15 years of implementation. *Physiology and Behavior* 133: 223-229. <https://doi.org/10.1016/j.physbeh.2014.05.046>
- Campbell K** 2012 Pet adoption & spay/neuter: Understanding public perceptions by the numbers. <https://www.petsmartcharities.org/blog/pet-adoption-spay-neuter-understanding-public-perceptions-by-the-numbers>
- Carlisle-Frank P, Frank JM and Nielsen L** 2005 Companion animal renters and pet-friendly housing in the US. *Anthrozoös* 18: 59-77. <https://doi.org/10.2752/089279305785594270>
- Clark JD, Rager DR, Crowell-Davis S and Evans DL** 1997 Housing and exercise of dogs: effects on behavior, immune function, and cortisol concentration. *Comparative Medicine* 47: 500-510
- Clevenger J and Kass PH** 2003 Determinants of adoption and euthanasia of shelter dogs spayed or neutered in the University of California veterinary student surgery program compared to other shelter dogs. *Journal of Veterinary Medical Education* 30: 372-378. <https://doi.org/10.3138/jvme.30.4.372>
- Coe JB, Young I, Lambert K, Dysart L, Nogueira Borden L and Rajić A** 2014 A scoping review of published research on the relinquishment of companion animals. *Journal of Applied Animal Welfare Science* 17: 1-21. <https://doi.org/10.1080/10888705.2014.899910>
- Conley MJ, Fisher AD and Hemsworth PH** 2014 Effects of human contact and toys on the fear responses to humans of shelter-housed dogs. *Applied Animal Behaviour Science* 156: 62-69. <https://doi.org/10.1016/j.applanim.2014.03.008>
- Coppola CL, Grandin T and Enns RM** 2006 Human interaction and cortisol: Can human contact reduce stress for shelter dogs? *Physiology and Behavior* 87: 537-541. <https://doi.org/10.1016/j.physbeh.2005.12.001>
- Diesel G, Brodbelt D and Pfeiffer DU** 2010 Characteristics of relinquished dogs and their owners at 14 rehoming centers in the United Kingdom. *Journal of Applied Animal Welfare Science* 13: 15-30. <https://doi.org/10.1080/10888700903369255>
- Diesel G, Pfeiffer DU and Brodbelt D** 2008 Factors affecting the success of rehoming dogs in the UK during 2005. *Preventive Veterinary Medicine* 84: 228-241. <https://doi.org/10.1016/j.prevetmed.2007.12.004>
- Dolan E, Slater M, Scotto J and Weiss E** 2015 Preventing pet relinquishment at animal shelters in Los Angeles: Human risk factors and social safety net services. *The 143rd APHA Annual Meeting and Exposition*. 2 November 2015, Chicago, IL, USA
- Dowling-Guyer S, Marder A and D'Arpino S** 2011 Behavioral traits detected in shelter dogs by a behavior evaluation. *Applied Animal Behaviour Science* 130: 107-114. <https://doi.org/10.1016/j.applanim.2010.12.004>
- Duffy DL, Kruger KA and Serpell JA** 2014 Evaluation of a behavioral assessment tool for dogs relinquished to shelters. *Preventive Veterinary Medicine* 117: 601-609. <https://doi.org/10.1016/j.prevetmed.2014.10.003>
- Duxbury MM, Jackson JA, Line SW and Anderson RK** 2003 Evaluation of association between retention in the home and attendance at puppy socialization classes. *Journal of the American Veterinary Medical Association* 223: 61-66. <https://doi.org/10.2460/javma.2003.223.61>

- Flannigan G and Dodman NH** 2001 Risk factors and behaviors associated with separation anxiety in dogs. *Journal of the American Veterinary Medical Association* 219: 460-466. <https://doi.org/10.2460/javma.2001.219.460>
- Gazzano A, Mariti C, Alvares S, Cozzi A, Tognetti R and Sighieri C** 2008 The prevention of undesirable behaviors in dogs: effectiveness of veterinary behaviorists' advice given to puppy owners. *Journal of Veterinary Behavior: Clinical Applications and Research* 3: 125-133. <https://doi.org/10.1016/j.jveb.2008.04.004>
- Gazzano A, Bianchi L, Campa S and Mariti C** 2015 The prevention of undesirable behaviors in cats: Effectiveness of veterinary behaviorists' advice given to kitten owners. *Journal of Veterinary Behavior: Clinical Applications and Research* 10: 535-542. <https://doi.org/10.1016/j.jveb.2015.07.042>
- Graham L, Wells DL and Hepper P** 2005 The influence of olfactory stimulation on the behaviour of dogs housed in a rescue shelter. *Applied Animal Behaviour Science* 91: 143-153. <https://doi.org/10.1016/j.applanim.2004.08.024>
- Grigg EK and Piehler M** 2015 Influence of dog appeasing pheromone (DAP) on dogs housed in a long-term kennelling facility. *Veterinary Record Open* 2: e000098. <https://doi.org/10.1136/vetreco-2014-000098>
- Gunter L, Barber R and Wynne CDL** 2016 What's in a name: Effect of breed perceptions & labeling on attractiveness, adoptions & length of stay for pit-bull-type dogs. *PLOS One* 11: e0146857. <https://doi.org/10.1371/journal.pone.0146857>
- Gunter L, Protopopova A, Hooker S, Der Ananian S and Wynne CDL** Effects of an owner activity & behavioral intervention on walking activity and return rates of shelter dogs. *Journal of Applied Animal Welfare Science*, in press
- Hennessy MB, Davis HN, Williams MT, Mellott C and Douglas CW** 1997 Plasma cortisol levels of dogs at a county animal shelter. *Physiology and Behavior* 62: 485-490. [https://doi.org/10.1016/S0031-9384\(97\)80328-9](https://doi.org/10.1016/S0031-9384(97)80328-9)
- Hennessy MB, Morris A and Linden F** 2006 Evaluation of the effects of a socialization program in a prison on behavior and pituitary-adrenal hormone levels of shelter dogs. *Applied Animal Behaviour Science* 99: 157-171. <https://doi.org/10.1016/j.applanim.2005.09.011>
- Hennessy MB, Williams M, Miller DD, Douglas CW and Voith VL** 1998 Influence of male and female petters on plasma cortisol and behaviour: Can human interaction reduce the stress of dogs in a public animal shelter? *Applied Animal Behaviour Science* 61: 63-77. [https://doi.org/10.1016/S0168-1591\(98\)00179-8](https://doi.org/10.1016/S0168-1591(98)00179-8)
- Herron ME, Kirby-Madden TM and Lord LK** 2014a Effects of environmental enrichment on the behavior of shelter dogs. *Journal of the American Veterinary Medical Association* 244: 687-692. <https://doi.org/10.2460/javma.244.6.687>
- Herron ME, Lord LK, Hill LN and Reisner IR** 2007 Effects of preadoption counseling for owners on house-training success among dogs acquired from shelters. *Journal of the American Veterinary Medical Association* 231: 558-562. <https://doi.org/10.2460/javma.231.4.558>
- Herron ME, Lord LK and Hussein SE** 2014b Effects of preadoption counseling on the prevention of separation anxiety in newly adopted shelter dogs. *Journal of Veterinary Behavior: Clinical Applications and Research* 9: 13-21. <https://doi.org/10.1016/j.jveb.2013.09.003>
- Herron ME, Shofer FS and Reisner IR** 2009 Survey of the use and outcome of confrontational and non-confrontational training methods in client-owned dogs showing undesired behaviors. *Applied Animal Behaviour Science* 117: 47-54. <https://doi.org/10.1016/j.applanim.2008.12.011>
- Hetts S, Derrell Clark J, Calpin JP, Arnold CE and Mateo JM** 1992 Influence of housing conditions on beagle behaviour. *Applied Animal Behaviour Science* 34: 137-155. [https://doi.org/10.1016/S0168-1591\(05\)80063-2](https://doi.org/10.1016/S0168-1591(05)80063-2)
- Hiby EF, Rooney NJ and Bradshaw JWS** 2004 Dog training methods: Their use, effectiveness and interaction with behaviour and welfare. *Animal Welfare* 13: 63-69
- Haupt KA, Honig SU and Reisner IR** 1996 Breaking the human-companion animal bond. *Journal of the American Veterinary Medical Association* 208: 1653-1659
- Hubrecht RC** 1993 A comparison of social and environmental enrichment methods for laboratory housed dogs. *Applied Animal Behaviour Science* 37: 345-361. [https://doi.org/10.1016/0168-1591\(93\)90123-7](https://doi.org/10.1016/0168-1591(93)90123-7)
- Hubrecht RC, Serpell JA and Poole TB** 1992 Correlates of pen size and housing conditions on the behaviour of kennelled dogs. *Applied Animal Behaviour Science* 34: 365-383. [https://doi.org/10.1016/S0168-1591\(05\)80096-6](https://doi.org/10.1016/S0168-1591(05)80096-6)
- Hughes HC and Campbell SA** 1990 Effect of primary enclosure size and human contact. In: Mench JA and Krulisch (ed) *Canine Research Environment* pp 66-73. Scientists Center for Animal Welfare: Bethesda MD, USA
- Kass PH, New JC, Scarlett JM and Salman MD** 2001 Understanding animal companion surplus in the United States: Relinquishment of non-adoptables to animal shelters for euthanasia. *Journal of Applied Animal Welfare Science* 4: 237-248. https://doi.org/10.1207/S15327604JAWS0404_01
- Kim YM, Kim SA, Lee SM, Choi YJ, Kim BJ and Shin NS** 2010 Canine behavioral problems and their effect on relinquishment of the Jindo dog. *Journal of Veterinary Science* 11: 345-350. <https://doi.org/10.4142/jvs.2010.11.4.345>
- Kogan LR, Ruch-Gallie R and Salman MD** 2000 Keeping spot at home: An epidemiological approach to maintaining the human-animal bond through behavior education and obedience training. *Presentation at 9th International Symposium on Veterinary Epidemiology and Economics*. August 2000, Breckenridge, CO, USA
- Kogan LR, Schoenfeld-Tacher R and Simon AA** 2012 Behavioral effects of auditory stimulation on kennelled dogs. *Journal of Veterinary Behavior: Clinical Applications and Research* 7: 268-275. <https://doi.org/10.1016/j.jveb.2011.11.002>
- Lampe R and Witte TH** 2014 Speed of dog adoption: Impact of online photo traits. *Journal of Applied Animal Welfare Science* 8705: 1-12
- Lancaster E, Rand J, Collecott S and Paterson M** 2015 Problems associated with the microchip data of stray dogs and cats entering RSPCA Queensland shelters. *Animals* 5: 332-348. <https://doi.org/10.3390/ani5020332>
- Lepper M, Kass PH and Hart L** 2002 Prediction of adoption versus euthanasia among dogs and cats in a California animal shelter. *Journal of Applied Animal Welfare Science* 5: 29-42. https://doi.org/10.1207/S15327604JAWS0501_3

- Lord LK, Ingwersen W, Gray JL and Wintz DJ** 2009 Characterization of animals with microchips entering animal shelters. *Journal of the American Veterinary Medical Association* 235: 160-167. <https://doi.org/10.2460/javma.235.2.160>
- Lore RK and Eisenberg FB** 1986 Avoidance reactions of domestic dogs to unfamiliar male and female humans in a kennel setting. *Applied Animal Behaviour Science* 15: 261-266. [https://doi.org/10.1016/0168-1591\(86\)90096-1](https://doi.org/10.1016/0168-1591(86)90096-1)
- Luescher AU and Medlock RT** 2009 The effects of training and environmental alterations on adoption success of shelter dogs. *Applied Animal Behaviour Science* 117: 63-68. <https://doi.org/10.1016/j.applanim.2008.11.001>
- Marder AR, Shabelansky A, Patronek GJ, Dowling-Guyer S and D'Arpino SS** 2013 Food-related aggression in shelter dogs: A comparison of behavior identified by a behavior evaluation in the shelter and owner reports after adoption. *Applied Animal Behaviour Science* 148: 150-156. <https://doi.org/10.1016/j.applanim.2013.07.007>
- Marston LC, Bennett PC and Coleman GJ** 2004 What happens to shelter dogs? An analysis of data for 1 year from three Australian shelters. *Journal of Applied Animal Welfare Science* 7: 27-47. https://doi.org/10.1207/s15327604jaws0701_2
- McMillan FD, Duffy DL, Zawistowski SL and Serpell JA** 2015 Behavioral and psychological characteristics of canine victims of abuse. *Journal of Applied Animal Welfare Science* 18: 92-111. <https://doi.org/10.1080/10888705.2014.962230>
- Menor-Campos DJ, Molleda-Carbonell JM and Lopez-Rodriguez R** 2011 Effects of exercise and human contact on animal welfare in a dog shelter. *Veterinary Record* 169: 388-388. <https://doi.org/10.1136/vr.d4757>
- Mertens PA and Unshelm J** 1996 Effects of group and individual housing on the behavior of kennelled dogs in animal shelters. *Anthrozoös* 9: 40-51. <https://doi.org/10.2752/089279396787001662>
- Mohan-Gibbons H, Weiss E, Garrison L and Allison M** 2014 Evaluation of a novel dog adoption program in two US communities. *PLoS ONE* 9: e91959. <https://doi.org/10.1371/journal.pone.0091959>
- Mohan-Gibbons H, Weiss E and Slater M** 2012 Preliminary investigation of food guarding behavior in shelter dogs in the United States. *Animals* 2: 331-346. <https://doi.org/10.3390/ani2030331>
- Mondelli F, Prato Previde E, Verga M, Levi D, Magistrelli S and Valsecchi P** 2004 The bond that never developed: Adoption and relinquishment of dogs in a rescue shelter. *Journal of Applied Animal Welfare Science* 7: 253-266. https://doi.org/10.1207/s15327604jaws0704_3
- New JC, Salman MD, King M, Scarlett JM, Kass PH and Hutchison JM** 2000 Characteristics of shelter-relinquished animals and their owners compared with animals and their owners in U.S. pet-owning households. *Journal of Applied Animal Welfare Science* 3: 179-201. https://doi.org/10.1207/S15327604JAWS0303_1
- New JC, Salman MD, Scarlett JM, Kass PH, Vaughn JA, Scherr S and Kelch WJ** 1999 Moving: Characteristics of dogs and cats and those relinquishing them to 12 U.S. animal shelters. *Journal of Applied Animal Welfare Science* 2: 83-95. https://doi.org/10.1207/s15327604jaws0202_1
- Normando S, Contiero B, Marchesini G and Ricci R** 2014 Effects of space allowance on the behaviour of long-term housed shelter dogs. *Behavioural Processes* 103: 306-314. <https://doi.org/10.1016/j.beproc.2014.01.015>
- Normando S, Corain L, Salvadoretti M, Meers L and Valsecchi P** 2009 Effects of an Enhanced Human Interaction Program on shelter dogs' behaviour analysed using a novel non-parametric test. *Applied Animal Behaviour Science* 116: 211-219. <https://doi.org/10.1016/j.applanim.2008.10.005>
- Normando S, Stefanini C, Meerst L, Adamelli S, Coultis D and Bono G** 2006 Some factors influencing adoption of sheltered dogs. *Anthrozoös* 19: 211-224. <https://doi.org/10.2752/089279306785415556>
- Olson KR, Levy JK, Norby B, Crandall MM, Broadhurst JE, Jacks S, Barton RC and Zimmerman MS** 2015 Inconsistent identification of pit bull-type dogs by shelter staff. *Veterinary Journal* 206: 197-202. <https://doi.org/10.1016/j.tvjl.2015.07.019>
- Olson PN, Moulton C, Nett TM and Salman MD** 1991 Pet overpopulation: A challenge for companion animal veterinarians in the 1990s. *Journal of the American Veterinary Medical Association* 198: 1151-1152
- Patronek GJ, Beck AM and Glickman LT** 1997 Dynamics of dog and cat populations in a community. *Journal of the American Veterinary Medical Association* 210: 637-642.
- Patronek GJ and Glickman LT** 1994 Development of a model for estimating the size and dynamics of the pet dog population. *Anthrozoös* 7: 25-42. <https://doi.org/10.2752/089279394787002050>
- Patronek GJ, Glickman LT and Moyer MR** 1995 Population dynamics and the risk of euthanasia for dogs in an animal shelter. *Anthrozoös: A Multidisciplinary Journal of The Interactions of People & Animals* 8: 31-43
- Patronek GJ, Glickman LT, Beck AM, McCabe GP and Ecker C** 1996 Risk factors for relinquishment of dogs to an animal shelter. *Journal of the American Veterinary Medical Association*, 209: 572-581
- Posage JM, Bartlett PC and Thomas DK** 1998 Determining factors for successful adoption of dogs from an animal shelter. *Journal of the American Veterinary Medical Association* 213: 478-482
- Protopopova A, Brandifino M and Wynne CDL** 2016 Preference assessments and structured potential adopter-dog interactions increase adoptions. *Applied Animal Behaviour Science* 176: 87-95. <https://doi.org/10.1016/j.applanim.2015.12.003>
- Protopopova A, Gilmour AJ, Weiss RH, Shen JY and Wynne CDL** 2012 The effects of social training and other factors on adoption success of shelter dogs. *Applied Animal Behaviour Science* 142: 61-68. <https://doi.org/10.1016/j.applanim.2012.09.009>
- Protopopova A, Hauser H, Goldman K and Wynne CDL** 2014 Should you take Fido on a walk or read him a book? The effects of exercise and calm interactions on in-kennel behavior of shelter dogs. *Journal of Applied Animal Welfare Science*, submitted
- Protopopova A, Mehrkam LR, Boggess MM and Wynne CDL** 2014 In-kennel behavior predicts length of stay in shelter dogs. *PLoS One* 9: e114319. <https://doi.org/10.1371/journal.pone.0114319>
- Protopopova A and Wynne CDL** 2016 Judging a shelter dog by its cover: Morphology but not training influences visitor behavior towards kennelled dogs. *Anthrozoös* 29: 469-487. <https://doi.org/10.1080/08927936.2016.1181381>
- Protopopova A and Wynne CDL** 2014 Adopter-dog interactions at the shelter: Behavioral and contextual predictors of adoption. *Applied Animal Behaviour Science* 157: 109-116. <https://doi.org/10.1016/j.applanim.2014.04.007>

- Protopopova A and Wynne CDL** 2015 Improving in-kennel presentation of shelter dogs through response-dependent and response-independent treat delivery. *Journal of Applied Behavior Analysis* 48: 590-601. <https://doi.org/10.1002/jaba.217>
- Pullen AJ, Merrill RJN and Bradshaw JWS** 2010 Preferences for toy types and presentations in kennel housed dogs. *Applied Animal Behaviour Science* 125: 151-156. <https://doi.org/10.1016/j.applanim.2010.04.004>
- Pullen AJ, Merrill RJN and Bradshaw JWS** 2012 Habituation and dishabituation during object play in kennel-housed dogs. *Animal Cognition* 15: 1143-1150. <https://doi.org/10.1007/s10071-012-0538-2>
- Recio MR, Mathieu R, Maloney R and Seddon PJ** 2010 First results of feral cats (*Felis catus*) monitored with GPS collars in New Zealand. *New Zealand Journal of Ecology* 34: 288-296
- Salman MD, Hutchison J, Ruch-Gallie R, Kogan L, New JC, Kass PH and Scarlett JM** 2000 Behavioral reasons for relinquishment of dogs and cats to 12 shelters. *Journal of Applied Animal Welfare Science* 3: 93-106. https://doi.org/10.1207/S15327604JAWS0302_2
- Salman MD, New JG, Scarlett JM, Kass PH, Ruch-Gallie R and Hetts S** 1998 Human and animal factors related to relinquishment of dogs and cats in 12 selected animal shelters in the United States. *Journal of Applied Animal Welfare Science* 3: 207-226. https://doi.org/10.1207/s15327604jaws0103_2
- Scarlett J** 2013 Population statistics. In: Miller L and Zawistowski S (eds) *Shelter Medicine for Veterinarians and Staff* pp 13-20. Blackwell Publishers: Iowa, USA
- Scarlett J and Johnston N** 2012 Impact of a subsidized spay neuter clinic on impoundments and euthanasia in a community shelter and on service and complaint calls to animal control. *Journal of Applied Animal Welfare Science* 15: 53-69. <https://doi.org/10.1080/10888705.2012.624902>
- Scarlett JM, Salman MD, New JG and Kass PH** 1999 Reasons for relinquishment of companion animals in US animal shelters: Selected health and personal issues. *Journal of Applied Animal Welfare Science* 2: 41-57. https://doi.org/10.1207/s15327604jaws0201_4
- Schipper LL, Vinke CM, Schilder MBH and Spruijt BM** 2008 The effect of feeding enrichment toys on the behaviour of kennelled dogs (*Canis familiaris*). *Applied Animal Behaviour Science* 114: 182-195. <https://doi.org/10.1016/j.applanim.2008.01.001>
- Segurson SA, Serpell JA and Hart BL** 2005 Evaluation of a behavioral assessment questionnaire for use in the characterization of behavioral problems of dogs relinquished to animal shelters. *Journal of the American Veterinary Medical Association* 227: 1755-1761. <https://doi.org/10.2460/javma.2005.227.1755>
- Shiverdecker MD, Schiml PA and Hennessy MB** 2013 Human interaction moderates plasma cortisol and behavioral responses of dogs to shelter housing. *Physiology and Behavior* 109: 75-79. <https://doi.org/10.1016/j.physbeh.2012.12.002>
- Shore ER** 2005 Returning a recently adopted companion animal: Adopters' reasons for and reactions to the failed adoption experience. *Journal of Applied Animal Welfare Science* 8: 187-198. https://doi.org/10.1207/s15327604jaws0803_3
- Shore ER, Petersen CL and Douglas DK** 2003 Moving as a reason for pet relinquishment: A closer look. *Journal of Applied Animal Welfare Science* 6: 39-52. https://doi.org/10.1207/S15327604JAWS0601_04
- Sietou C, Fraser IM and Fraser RW** 2014 Investigating some of the factors that influence "consumer" choice when adopting a shelter dog in the United Kingdom. *Journal of Applied Animal Welfare Science* 17: 136-147. <https://doi.org/10.1080/10888705.2014.883924>
- Siracusa C, Manteca X, Cuenca R, del Mar Alcalá M, Alba A, Lavín S and Pastor J** 2010 Effect of a synthetic appeasing pheromone on behavioral, neuroendocrine, immune, and acute-phase perioperative stress responses in dogs. *Journal of the American Veterinary Medical Association* 237: 673-681. <https://doi.org/10.2460/javma.237.6.673>
- Stavisky J, Brennan ML, Downes M and Dean R** 2012 Demographics and economic burden of un-owned cats and dogs in the UK: Results of a 2010 census. *BMC Veterinary Research* 8: 1. <https://doi.org/10.1186/1746-6148-8-163>
- Steiss JE, Schaffer C, Ahmad HA and Voith VL** 2007 Evaluation of plasma cortisol levels and behavior in dogs wearing bark control collars. *Applied Animal Behaviour Science* 106: 96-106. <https://doi.org/10.1016/j.applanim.2006.06.018>
- Stephen J and Ledger R** 2007 Relinquishing dog owners' ability to predict behavioural problems in shelter dogs post adoption. *Applied Animal Behaviour Science* 107: 88-99. <https://doi.org/10.1016/j.applanim.2006.09.012>
- Sternberg S** 2002 *Great dog adoptions: A guide for shelters*. Latham Foundation: Alameda, CA, USA
- Taylor KD and Mills DS** 2007 The effect of the kennel environment on canine welfare: A critical review of experimental studies. *Animal Welfare* 16: 435-447
- The American Society for the Prevention of Cruelty to Animals (ASPCA)** 2016 *Pet statistics*. <https://www.aspc.org/about-us/faq/pet-statistics>
- The American Pet Products Association (APPA)** 2016 *Pet industry market size & ownership statistics*. http://www.americanpet-products.org/press_industrytrends.asp
- The European Pet Food Industry Federation** 2014 *Facts and Figures 2014*. <http://www.fedaf.org/facts-figures>
- Thorn JM, Templeton JJ, Van Winkle KMM and Castillo RR** 2006 Conditioning shelter dogs to sit. *Journal of Applied Animal Welfare Science* 9: 25-39. https://doi.org/10.1207/s15327604jaws0901_3
- Tod E, Brander D and Waran N** 2005 Efficacy of dog appeasing pheromone in reducing stress and fear related behaviour in shelter dogs. *Applied Animal Behaviour Science* 93: 295-308. <https://doi.org/10.1016/j.applanim.2005.01.007>
- Valsecchi P, Pattacini O, Beretta V, Bertozzi J, Zannoni S, Viggiani R and Accorsi PA** 2007 Effects of a human social enrichment program on behavior and welfare of sheltered dogs. *Journal of Veterinary Behavior: Clinical Applications and Research* 2: 88-89. <https://doi.org/10.1016/j.jveb.2007.04.017>
- Voith VL, Ingram E, Mitsouras K and Irizarry K** 2009 Comparison of adoption agency breed identification and DNA breed identification of dogs. *Journal of Applied Animal Welfare Science* 12: 253-262. <https://doi.org/10.1080/10888700902956151>
- Vučinić M, Djordjevic M, Teodorović R, Janković L, Radenković-Damnjanović B and Radisavuević K** 2009 Reasons for relinquishment of owned dogs in a municipal shelter in Belgrade. *Acta Veterinaria* 59: 309-317. <https://doi.org/10.2298/AVB0903309V>

- Vučinić M, Radisavljević K, Hammond-Seaman A and Ilić V** 2015 Visibly marked and microchipped lost dogs have a higher chance to find their owners in Belgrade. *Macedonian Veterinary Review* 38: 79-83. <https://doi.org/10.14432/j.macvetrev.2014.12.035>
- Walker JK, Waran NK and Phillips CJC** 2014 The effect of conspecific removal on the behaviour and physiology of pair-housed shelter dogs. *Applied Animal Behaviour Science* 158: 46-56. <https://doi.org/10.1016/j.applanim.2014.06.010>
- Waller BM, Peirce K, Caeiro CC, Scheider L, Burrows AM, McCune S and Kaminski J** 2013 Paedomorphic facial expressions give dogs a selective advantage. *PLoS ONE* 8: e82686. <https://doi.org/10.1371/journal.pone.0082686>
- Weiss E, Miller K, Mohan-Gibbons H and Vela C** 2012 Why did you choose this pet?: Adopters and pet selection preferences in five animal shelters in the United States. *Animals* 2: 144-159. <https://doi.org/10.3390/ani2020144>
- Weiss E, Slater M, Garrison L, Drain N, Dolan E, Scarlett JM and Zawistowski SL** 2014 Large dog relinquishment to two municipal facilities in New York City and Washington, DC: Identifying targets for intervention. *Animals* 4: 409-433. <https://doi.org/10.3390/ani4030409>
- Weiss E, Slater MR and Lord LK** 2011 Retention of provided identification for dogs and cats seen in veterinary clinics and adopted from shelters in Oklahoma City, OK, USA. *Preventive Veterinary Medicine* 101: 265-269. <https://doi.org/10.1016/j.prevetmed.2011.05.008>
- Weiss E, Slater MR and Lord LK** 2012 Frequency of lost dogs and cats in the United States and the methods used to locate them. *Animals* 2: 301-315. <https://doi.org/10.3390/ani2020301>
- Wells DL** 2004 The influence of toys on the behaviour and welfare of kennelled dogs. *Animal Welfare* 13: 367-373
- Wells DL** 2009 Sensory stimulation as environmental enrichment for captive animals: A review. *Applied Animal Behaviour Science* 118: 1-11. <https://doi.org/10.1016/j.applanim.2009.01.002>
- Wells DL, Graham L and Hepper PG** 2002 The influence of auditory stimulation on the behaviour of dogs housed in a rescue shelter. *Animal Welfare* 11: 385-393
- Wells DL and Hepper PG** 1992 The behaviour of dogs in a rescue shelter. *Animal Welfare* 1: 171-186
- Wells DL and Hepper PG** 1998 A note on the influence of visual conspecific contact on the behaviour of sheltered dogs. *Applied Animal Behaviour Science* 60: 83-88. [https://doi.org/10.1016/S0168-1591\(98\)00146-4](https://doi.org/10.1016/S0168-1591(98)00146-4)
- Wells DL and Hepper PG** 1999 Male and female dogs respond differently to men and women. *Applied Animal Behaviour Science* 61: 341-349. [https://doi.org/10.1016/S0168-1591\(98\)00202-0](https://doi.org/10.1016/S0168-1591(98)00202-0)
- Wells DL and Hepper PG** 2000a Prevalence of behaviour problems reported by owners of dogs purchased from an animal rescue shelter. *Applied Animal Behaviour Science* 69: 55-65. [https://doi.org/10.1016/S0168-1591\(00\)00118-0](https://doi.org/10.1016/S0168-1591(00)00118-0)
- Wells DL and Hepper PG** 2000b The influence of environmental change on the behaviour of sheltered dogs. *Applied Animal Behaviour Science* 68: 151-162. [https://doi.org/10.1016/S0168-1591\(00\)00100-3](https://doi.org/10.1016/S0168-1591(00)00100-3)
- Wells DL and Hepper PG** 2001 The behavior of visitors towards dogs housed in an animal rescue shelter. *Anthrozoös* 14: 12-18. <https://doi.org/10.2752/089279301786999661>
- Weng HY, Kass PH, Chomel BB and Hart LA** 2006 Educational intervention on dog sterilization and retention in Taiwan. *Preventive Veterinary Medicine* 76: 196-210. <https://doi.org/10.1016/j.prevetmed.2006.05.002>
- Wenstrup J and Dowidchuk A** 1999 Pet overpopulation: Data and measurement issues in shelters. *Journal of Applied Animal Welfare Science* 2: 303-319. https://doi.org/10.1207/s15327604jaws0204_5
- White SC, Jefferson E and Levy JK** 2010 Impact of publicly sponsored neutering programs on animal population dynamics at animal shelters: the New Hampshire and Austin experiences. *Journal of Applied Animal Welfare Science* 13: 191-212. <https://doi.org/10.1080/10888700903579903>
- Žák J, Voslášková E, Večerek V and Bedáňová I** 2015 Sex, age and size as factors affecting the length of stay of dogs in Czech shelters. *Acta Veterinaria Brno* 84: 407-413. <https://doi.org/10.2754/avb201584040407>
- Zawistowski S, Morris J, Salman MD and Ruch-Gallie R** 1998 Population dynamics, overpopulation, and the welfare of companion animals: New insights on old and new data. *Journal of Applied Animal Welfare Science* 1: 193-206. https://doi.org/10.1207/s15327604jaws0103_1