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Preferences for toy types and presentations in kennel housed dogs

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ABSTRACT

Toys are often provided for adult dogs housed in kennels, but their effectiveness as environmental enrichment is not well documented. At a minimum, toys need to elicit interest in the animal for which they are intended, before any "enrichment" can be claimed. In this study we have examined short-term preferences for toys with a range of characteristics, using two methods of presentation, in both long-stay dogs in complex kennels, and short-stay dogs in rehoming kennels. The dogs, one sample in residential kennels (LSE, $N = 30$) and the other in rehoming kennels (RH, $N = 66$), were tested individually with four robust toys, presented both hanging and on the floor, over two 15 min trials. The trial was also repeated with a second RH sample ($N = 34$) comparing the four robust toys with less robust toys, all presented on the floor. Latency to and duration of interaction with each toy were recorded remotely. In the first trial, 34% of RH dogs and 43% of LSE dogs interacted with the toys; of the dogs that interacted, the average duration of interaction was higher among RH dogs (120 s) than among LSE dogs (28 s). Toys on the floor were interacted with for significantly longer than hanging toys by both LSE and RH dogs. RH dogs were faster to interact with the floor toys than the hanging toys, but the LSE dogs did not appear to discriminate between hanging and floor toys in latencies to interact. In the second trial, 76% of the RH dogs interacted with one or more of the toys, interacting for significantly longer with the four less robust toys, but their latencies to interact were similar between the robust and less robust toys. Average duration of interaction (227 s) was higher than in the first trial. Our findings support previous proposals that robust toys are little used by kennel housed dogs. However, with less robust toys, interaction was relatively prolonged, indicating that interest to the dog may be enhanced if the toy can be chewed easily and/or makes a noise. Hanging toys were not favoured, although these have been reported to stimulate high levels of interaction in juvenile laboratory beagles.

1. Introduction

Large numbers of adult domestic dogs (*Canis lupus familiaris*) are housed in kennels, for a variety of reasons. Despite its long history of domestication (Miklósi, 2007), it is doubtful whether the domestic dog is fully adapted to kennelling, since long-term kennelled dogs show signs of chronic stress (Beerda et al., 2000). The kennel environment is both spatially and socially restrictive for the dog, and dogs show signs of acute stress when introduced into kennels for the first time (Hiby et al., 2006; Rooney et al., 2007). Furthermore, barren kennels appear to provide little mental or physical stimulation (Wells, 2004a; Taylor and Mills, 2007), and environmental enrichment is sometimes promoted as a means of reducing problems caused by confinement in the kennel environment, by increasing normal and/or decreasing abnormal behaviour (Hubrecht, 1993; Young, 2006).

Environmental enrichment with objects that can be manipulated (hereafter "toys") has been widely investi-

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gated, particularly for zoo animals (Shepherdson, 1998), and can be a valuable method for improving welfare if it engages the animal and does not simply enhance human perception of the quality of the environment. Hubrecht (1993) has concluded that if appropriate enrichment is given it can reduce undesirable behaviours and increase the performance of "natural" behaviour, and the provision of enrichment for kennelled domestic dogs may improve both human and canine perception of the quality of the environment (Wells and Hepper, 1992; but see also Luescher and Tyson Medlock, 2009). However, there continue to be gaps in knowledge of how to optimise environments for kennelled dogs, particularly in the long-term (Wells, 2004a).

If the most appropriate environmental enrichment is to be provided for all kennelled dogs, their needs within that environment need to be understood more fully. Research has tended to focus upon juvenile beagles in laboratory housing (Hubrecht et al., 1992; Hubrecht, 1993) and dogs in rescue and rehoming centres (Wells and Hepper, 1992; Wells et al., 2002; Wells, 2004b). Although the effects of breed and welfare status have been recognised as important (Overall and Dyer, 2005), these factors have not been examined for their impact on the success of enrichment.

Because of their origins as unwanted or stray animals, and the high turnover of dogs in rehoming centres, the welfare of rescued dogs is often assumed to be of a lower standard than dogs in domestic environments. Rehoming kennels are also novel, highly stimulating and generally stressful for many dogs (Wells and Hepper, 1992; Hennessy et al., 1997; Hiby et al., 2006; Stephen and Ledger, 2006), especially those coming from domestic environments (Hiby et al., 2006). It is therefore likely that such dogs will react differently to environmental enrichments compared to dogs which have spent most or all of their lives in kennels. However, no direct comparison has been made of the enrichment requirements of dogs with different backgrounds or welfare status.

Toys are generally thought of as a practical means of enrichment for kennel housed dogs, as the dog can interact with them either when on its own, or socially, with other dogs and/or people. However, their effectiveness in any of these contexts is not well documented. Studies by Wells and co-workers (Wells and Hepper, 1992, 2000; Wells, 2004a) in rehoming centres found that toys were more beneficial in increasing rehoming success than for actual interaction and enrichment for the dog, indicating that they were primarily valuable to welfare in affecting human perception of the kennel environment. Hubrecht's (1993) study indicated that hanging chewable toys were useful as enrichment for laboratory beagles, but these stimulated mainly oral behaviour rather than play as such. Laboratory dogs have been found to prefer toys that make noise or can be chewed (DeLuca and Kranda, 1992; Hubrecht, 1993, 1995), although such properties may render the toys easy to destroy, presenting the risk that fragments will be ingested.

At a minimum, toys need to excite interest in the animal for which they are intended, before any "enrichment" can occur. In this study we have examined short-term preferences for toys with a range of characteristics, in both long-stay dogs in complex kennels, and short-stay dogs in rehoming kennels. The two populations were chosen as being substantially different in prior experience of kennelling and enrichment.

2. Materials and methods

2.1. Study sites

Two study sites were used, rehoming kennels at Dogs Trust, Salisbury (DT) (RH), and residential kennels at the WALTHAM® Centre for Pet Nutrition, Leicestershire (LSE).

The RH (rehoming) dogs were housed individually or in pairs, in line block kennels. The dogs had access to an indoor kennel area (facing a corridor and the opposite kennels) and an outdoor covered kennel area, allowing visual access to people walking past. The two areas could be separated using a hatch. The trial was carried out in the outdoor area of each dog's home kennel. The pens were cleaned thoroughly daily and as necessary throughout the day, and the dogs were walked daily.

The LSE (long-stay enriched) dogs were housed in pairs, in pens arranged around an octagonal central court (Loveridge, 1998). The dogs had constant access to an indoor pen (3.05 m^2) with a raised, heated bed area (facing a central area and other dog pens), and an outdoor covered area; additional access to an outdoor paddock was available during the day with access to large dog toys in the paddocks such as Aussie hanging balls (Aussie dog products, AU), as well as platforms and staging to climb on. The indoor pen area could be sectioned off using a lockable dog flap. Overnight, pens were provided with fleece bedding and nylon chews, considered safe for unsupervised interaction. The trial was carried out in the indoor area of an identical pen that was dedicated to the trial. The dogs were habituated to this pen prior to the trial and the pen was cleaned between each trial. The pens were cleaned thoroughly daily and as necessary throughout the day, and the dogs also had a daily schedule of training and exercise. In addition to exercise in paddocks with other dogs throughout the day, each dog received at least one half hour exercise session per day. This varied between a walk with off lead interaction in an enclosed field, interactive play sessions in paddocks with carers and obedience training session. Pet carers also spent time interacting individually with the dogs in their pens or paddocks on an ad hoc basis when time allowed. Soft toys such as teddies were only provided during supervised interaction with the staff due to the risk of destruction and ingestion during unsupervised interaction. The dogs could maintain visual contact with kennel staff throughout the day. All dogs were clicker trained using positive reinforcement, a regime maintained on a daily basis. This schedule continued throughout the study period.

2.2. Subjects

Adult (1–8 years) dogs were randomly chosen from those housed at the RH at the time of each trial, $N = 66$ for the first trial and $N = 34$ (11 also used in the first trial and 23 newly recruited) for the second. As the majority of the dogs were of mixed or unknown breeding, they were

divided into three size groups by shoulder height: medium (28–44 cm), e.g. terrier (N = 16, 11); large (45–59 cm), e.g. collie (N = 30, 16); and extra large (>60 cm), e.g. husky (N = 20, 7). All dogs had been housed on site for at least one week prior to the trial but were otherwise from a wide variety of often-unknown backgrounds.

At the LSE kennels, 30 adult (1–8 years) dogs were randomly chosen from the four breeds available; Labrador retriever (N = 8), miniature schnauzer (N = 8), cocker spaniel (N = 8) and papillon (N = 6). All dogs had been born on site or brought in at ~9 weeks of age. The dogs had all received the same regime of socialisation and enrichment.

2.3. Toys

Toys were chosen from those available commercially to dog owners and kennels, avoiding any that might have become associated with food enrichment (e.g. Kongs® (Kong Company, US), flavoured chews). Food related enrichments, including those with a food odour or flavour, were excluded because they are difficult to standardise, and because we chose to focus on visual, tactile and auditory characteristics of enrichment. They were also selected to permit several different types of interaction such as roll, tug and chew. Two types of toy, each differing in their degree of robustness, were tested.

In the first trial, the toys were selected to be robust and relatively indestructible, to minimise the risk of damage to the toy and subsequent injury or ingestion by the dog, and thereby permit unsupervised interaction. They also needed to be suitable for different sizes of dogs.

1. Boomer Ball (The Company of Animals, UK). A virtually indestructible, rollable pursuit toy.
2. Ragger (Petlove, UK). Cotton blend rope tug knotted at both ends.
3. Tug (Kong Company, UK). Durable nylon and rubber flexible tug toy.
4. Tetra Grip (Good Boy, UK). Durable rubber frame toy for retrieving, rolling, tugging and chasing.

For the second trial, four additional toys were chosen, again from commercially available toys commonly provided by owners and kennels, but without the restriction that the toys must be indestructible and robust. The individual toys were chosen to stimulate higher levels of interaction by the dogs, from a larger selection of toys piloted at DT.

1. Squeaky bone (Myword, UK). Vinyl bone containing an internal high pitched squeaker.
2. Soft teddy (Chubleez, UK). Soft fabric dog-shaped toy with an internal squeaker at either end.
3. Plush teddy (Pets at Home, UK). Plush fabric dog-shaped toy with an internal squeaker.
4. Tennis ball (Petbase, UK). Soft chenille safari print, non-squeaking small ball.

2.4. Procedure

Trial 1 was divided into two phases of 15 min each carried out on consecutive days. In the first phase each dog was presented with all four toys simultaneously, after the dog had entered the kennel, each one either on the floor of the kennel, or hanging from a metal chain across the middle of the kennel at collar height for the dog, according to a randomised incomplete block design (Cochran and Cox, 1957), including the restriction that at least one toy was hanging, and one on the floor, in each phase. In the second phase, the dog was exposed to the same toys but using the opposite mode of presentation, i.e. hanging toys in the first phase were placed on the floor in the second, and vice versa, such that each dog received all four toys in each phase, and all eight combinations of toy and presentation in the two phases combined.

Trial 2 was performed only with the RH population, using the same incomplete block design, but replacing the four hanging toys with the four less robust toys, presented on the floor alongside the robust toys.

All presentations were recorded remotely by video camera, and latency to and duration of interaction with each toy was extracted. An interaction was defined as anything other than sniffing or accidental contact, so included any contact with the mouth or paw, such as mouthing, chewing and pawing at the toy.

2.5. Statistical analysis

Statistics were calculated using the statistical package SPSS 14.0 (SPSS Inc.). Since none of the data were found to be normally distributed, within group differences were examined using non-parametric tests. Wilcoxon tests were used to compare latency to interact and duration of interaction with the toys within the RH and LSE environments. Friedman Chi squared tests were used to compare latency of interaction and duration of interaction between individual toys. Breeds and size classes were compared for the proportion of individuals interacting with toys using Fisher's exact test.

3. Results

3.1. Trial 1: site and breed differences

When presented with the robust toys, 35% of the RH dogs and 43% of LSE dogs interacted with one or more of the toys over the two presentations. Of the dogs that interacted with toys, the RH dogs interacted for longer than did the LSE dogs (average durations of interaction 120, 28 s).

Among the RH dogs, the proportion of dogs that interacted with the toys did not differ between the three size classes (Fisher's exact = 0.236). Some of the four breeds comprising the LSE dogs showed a tendency towards interacting with the toys more than others (Fisher's exact P = 0.120). However, since so few of the LSE dogs interacted with the toys (6 Labradors, 2 cocker spaniels, 4 miniature schnauzers and 1 papillon) it was not possible to interpret breed comparisons further.

3.1.1. Comparisons between presentation methods

Excluding dogs that did not interact with the toys at all, the floor toys were interacted with for longer than the hanging toys at RH (Wilcoxon Z = 2.71, P = 0.007) and also at LSE (Z = 3.18, P = 0.001).

Table 1
The median and third quartile for latency to interact (s) with the robust toys, by the 13 LSE dogs that interacted with any of the toys. Treatments followed by the same letter were not significantly different at $P < 0.05$ by multiple Wilcoxon tests.

Toy presentation and type		Median	3rd quartile[a]	Dogs interacting (*N*)
Floor tetra	*a*	2.5	23.0	9
Floor ragger	*a*	0.4	6.9	6
Floor tug	*a*	0	9.6	4
Hanging ragger	*ab*	0	0	1
Hanging tug	*ab*	0	0	1
Hanging tetra	*ab*	0	0	1
Hanging ball	*b*	0	0	0
Floor ball	*b*	0	0	0

[a] Third quartiles are included for discrimination between treatments with which less than half of the dogs interacted.

The LSE dogs did not interact with the toys on the floor any quicker than the hanging toys (Wilcoxon $Z = 0.941$, $P > 0.05$). However, when comparing toys, the tetra, ragger and tug were all interacted with more quickly than the ball (Table 1).

3.1.2. Comparisons between robust toys

All the floor toys were interacted with for equal durations by the RH dogs (Friedman Chi squared = 4.25, df = 3, $P = 0.235$). However, for the hanging toys, there was a significant difference in the duration of interaction (Friedman Chi squared = 15.0, df = 3, $P = 0.002$), with the hanging ragger being interacted with for longer than the other 3 hanging toys, albeit by a minority of the dogs (Table 2).

The LSE dogs showed a difference in the length of interaction with the four floor toys (Friedman Chi squared = 10.06, df = 3, $P = 0.02$), interacting with the floor ball for a shorter period than the three other floor toys (Table 3). They spent similar amounts of time interacting with the four hanging toys (Friedman Chi squared = 1.000, df = 3, $P = 0.801$).

The RH dogs interacted more rapidly with the floor toys than with the hanging toys ($Z = 2.938$, $P = 0.003$) but LSE dogs took similar times to begin interaction with the hanging and floor toys ($Z = 0.941$, $P = 0.347$).

Table 2
The median and third quartile duration for duration (s) of interaction with the robust toys, by the 22 RH dogs that interacted with any of the toys in either presentation. Hanging treatments followed by the same letter were not significantly different at $P < 0.05$ by multiple Wilcoxon tests.

Toy presentation and type		Median	3rd quartile[a]	Dogs interacting (*N*)
Hanging ragger	*a*	0	2.4	6
Hanging ball	*b*	0	0	2
Hanging tetra	*b*	0	0	2
Hanging tug	*b*	0	0	1
Floor ragger		0	13.2	10
Floor ball		0	8.7	14
Floor tetra		0	11.8	5
Floor tug		0	0.7	13

[a] Third quartiles are included for discrimination between treatments with which less than half of the dogs interacted.

Table 3
The median duration and third quartile for duration (s) of interaction with the robust toys, by the 13 LSE dogs that interacted with any of the toys. Floor treatments followed by the same letter were not significantly different at $P < 0.05$ by multiple Wilcoxon tests.

Toy presentation and type		Median	3rd quartile[a]	Dogs interacting (*N*)
Floor tetra	*a*	4.3	13.6	9
Floor ragger	*a*	3.3	8.2	7
Floor tug	*a*	0	5.9	4
Floor ball	*b*	0	0	0
Hanging tetra		0	0	1
Hanging ragger		0	0	1
Hanging tug		0	5.9	1
Hanging ball		0	0	0

[a] Third quartiles are included for discrimination between treatments with which less than half of the dogs interacted.

Within each presentation method, there was no difference among the RH dogs between the latencies to interact with the four hanging toys (Friedman Chi squared = 3.545, df = 3, $P > 0.05$) and only a tendency towards a difference between the four toys when presented on the floor (Friedman Chi squared = 7.286, df = 3, $P = 0.063$), interaction with the ball being the quickest, followed by the tetra, ragger and slowest with the tug.

3.2. Trial 2: size-group differences

There was no significant difference between the three size groups in the proportion of dogs that interacted with any of the toys (Fisher's exact $P = 0.129$), nor was there any difference between the size groups for overall duration of interaction with the toys (Friedman Chi squared = 4.41, df = 2, $P = 0.110$) and the rankings (using duration of interaction) of the toys were similar for the three size groups (Spearman rho = 0.571–0.667).

3.2.1. Comparisons between robust and less robust toys

In the second trial, undertaken only with RH dogs, 76% of the dogs interacted with one or more of the toys, interacting for longer with the four less robust toys ($Z = 3.80$, $P < 0.001$). The dogs also showed a difference in duration of interaction within the 4 less robust toys (Friedman Chi squared = 14.31, df = 3, $P = 0.003$). Of the four, the tennis ball was interacted with the least, with no significant difference between length of interaction with the squeaky bone, soft teddy and plush teddy (Table 4). Of the four robust toys, there was a tendency towards a difference in duration of interaction (Friedman Chi squared = 6.75, df = 3, $P = 0.08$), which was slightly longer for the tetra grip and ball than for the ragger and tug.

No difference was detected in the latency of the dogs to interact, comparing the robust and less robust toys ($Z = 0.825$, $P = 0.409$).

4. Discussion

4.1. Overall levels of interaction with toys

The relatively low proportion of dogs that interacted with the robust toys in both the rehoming (RH) (35%) and

Table 4
The median duration (s) of interaction with the less robust toys (upper part of the table) and robust toys (lower part), all presented on the floor, by the 26 RH dogs that interacted with any of these toys. Treatments within the less robust toys followed by the same letter were not significantly different at $P < 0.05$ by multiple Wilcoxon tests.

Toy type		Median	Dogs interacting (*N*)
Soft teddy	*a*	13.3	21
Squeaky bone	*a*	5.7	16
Plush teddy	*a*	3.4	18
Tennis ball	*b*	0.7	14
Ball		0	12
Tetra		0	10
Ragger		0	6
Tug		0	4

LSE (43%) environments confirms previous studies (Wells and Hepper, 1992; Wells et al., 2002; Wells, 2004b) indicating that toy use in kennels is generally low. This is also supported by the low overall durations of interaction for those dogs that did interact with the toys, both in RH (28 s) and LSE (120 s), given that the toys were accessible for 1800 s. For the RH dogs, the rehoming kennel environment is highly unpredictable, busy and unfamiliar. Such a stimulating environment may lead to the toys being of little relative interest to the dogs (Wells, 2004b). For the LSE dogs, the environment is much more controlled and familiar, but the high levels of daily enrichment may lead to the toys being less interesting than the other enrichments and interactive 'play' with people and dogs that these dogs receive throughout the day. In outdoor-housed pet dogs with high levels of environmental diversity, use of toys was also found to be low (Kobelt et al., 2007). The particularly low level of interaction with the floor ball by the RH dogs supports DeLuca and Kranda's (1992) conclusion that large polypropylene balls are generally ignored by kennel housed dogs, and suggests a greater interest in toys that can be picked up.

When less robust toys were included among those presented (Trial 2) the proportion of the RH dogs interacting with the toys increased from 35% to 76%, and the duration of interaction almost doubled; most of this interaction was with the less robust toys, and the robust toys were largely ignored. When laboratory rats were given 'toys' as enrichment objects, they were found to utilise them as objects to gnaw (Belz et al., 2003) suggesting that it is necessary to understand the underlying motivation for interaction with any 'toy' in order to provide those that will be interacted with the most, rather than simply choosing toys that are convenient for caretakers, e.g. are difficult to destroy and easy to keep clean in a kennel environment (Bayne, 2003). The higher levels of interaction with the less robust toys (particularly the squeaky bone, soft teddy and plush teddy) than the robust toys confirms DeLuca and Kranda (1992) and Hubrecht's (1993, 1995) proposal that dogs have a preference for chewable toys that make a noise. However, Wells (2004b) has suggested that it is more probable that dogs like toys that can be chewed rather than those that make noises.

The low levels of interaction with the robust toys, seen in both trials, raise questions about the use of such toys in kennel environments. Any requirement that toys should be robust, easy to clean and relatively indestructible, may concomitantly reduce the very features that stimulate interactive 'play'. Some of what we as humans label 'toys' may be perceived simply as uninteresting objects to the dogs.

The low levels of interaction with hanging toys, seen in both sets of dogs, contrast with Hubrecht (1993), who recorded high levels of interaction with hanging "toys" by group housed juvenile laboratory beagles; however the "toys" tested there were food flavoured Nylabone chews that were likely to encourage interaction due to food motivation. However, it is worth noting that Hubrecht (1993) presented chews a short distance above the floor on springs rather than at collar height on chains, as was used in this study. Although Hubrecht's (1993) method of presentation may have increased interest in the toys, allowing the dogs to chew them lying down with a paw over the item, this was not considered suitable for unsupervised interaction and in our study toys were hung higher to provide resistance, allowing the dogs to tug against them. The dogs were also able to chew the toys and hold them in their paw when they were presented on the floor, allowing comparisons between types of interaction with the toys.

4.2. Latency to interact as a measure of preference

The third measure of preference used, latency to interact, did not provide identical rankings to the duration of interaction, suggesting that distinct sets of factors influence the initial decision of whether or not to interact with a toy, and the subsequent duration of interaction.

The RH dogs showed a preference for floor toys in both duration of interaction, and in their latency to interact. The RH dogs were often noted to withdraw away from the hanging toys when they began to swing, suggesting that this method of presentation was novel, or possibly aversive, to many of them. In the second trial, in which all the toys were presented on the floor, the average latency to interact was similar for all eight toys, despite strong preferences for the less robust toys as measured by duration of interaction.

The LSE dogs, like the RH dogs, interacted for longer with toys presented on the floor, but showed no difference in latency between the hanging and floor presentations. This may reflect a general lack of fear of novelty among LSE dogs, as all these dogs had been extensively socialised to novel objects and situations from an early age, and also had occasional experience of toys hanging from ropes in their exercise paddocks. Carlstead and Shepherdson (1994) and Shepherdson (1994) suggest that past experiences of novelty and exploration of objects can aid in the development of coping strategies, adaptability and learning in new situations, such as those encountered by the dogs when experiencing novel toys.

Overall, the initial preference for a toy was not necessarily indicative of the subsequent length of interaction with that toy. In an individual dog, initial preferences may reflect neophilia or neophobia, but many dogs appeared to first investigate several of the toys at random and then choose one for extended interaction.

4.2.1. Breed differences

Breed (LSE dogs) or size class (RH dogs) appeared to have little influence on whether a dog chose to interact with any of the toys, suggesting that preferences for toys are fairly consistent across breeds. Previous studies of enrichment for kennelled dogs have not examined breed effects, but the breeding of dogs for differing roles, such as retrieving or guarding, would suggest that different types should prefer different toys (Hart and Hart, 1985; Bradshaw et al., 1996). General observations at the RH kennels suggested that the 'Staffordshire bull terrier' types showed a preference for the hanging ragger as it allowed for interactive 'tugging'.

5. Conclusion

The two populations of dogs studied both showed strong preferences for toys placed on the floor of the kennel, as opposed to hanging. In addition to this, the RH dogs, trialled with robust and less robust toys, showed a preference for softer, more manipulable toys. It appears that some compromise may be needed between enrichment and safety, since the toys preferred by the dogs appear to be those that are most difficult to keep clean and pose highest risk of destruction and ingestion. Although preference for particular toys appears to be little affected by breed and size of dog, prior experience may affect individual preferences; the most confident dogs may be initially attracted to novel toys, while those that are more generally fearful or anxious may react neophobically to unfamiliar toys and/or modes of presentation. Further studies will be required to determine whether the initial preferences demonstrated here are sustained over more prolonged presentation of the toys, and which toys, if any, provide sustained "enrichment" beyond their value in temporarily increasing environmental complexity. Interaction with toys may be further altered by availability of more attractive toys presented outside of the artificial kennel environment. However, it may be that for dogs housed in an enriched and complex environment, such as the LSE dogs, there may be little need or value in providing extra enrichment.

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References

Bayne, K.A., 2003. Environmental enrichment of nonhuman primates, dogs and rabbits used in toxicology studies. Toxicol. Pathol. (31 Suppl.), 132–137.

Beerda, B., Schilder, M.B.H., van Hooff, J.A.R.A.M., de Vries, H.W., Mol, J.A., 2000. Behavioural and hormonal indicators of enduring environmental stress in dogs. Anim. Welf. 9, 49–62.

Belz, E.E., Kennell, J.S., Czambel, R.K., Rubin, R.T., Rhodes, M.E., 2003. Environmental enrichment lowers stress-responsive hormones in singly housed male and female rats. Pharmacol. Biochem. Behav. 76, 481–486.

Bradshaw, J.W.S., Goodwin, D., Lea, A.M., Whitehead, S.L., 1996. A survey of the behavioural characteristics of pure-bred dogs in the United Kingdom. Vet. Rec. 138, 465–468.

Carlstead, K., Shepherdson, D., 1994. Effects of environmental enrichment on reproduction. Zoo Biol. 13, 447–458.

Cochran, W.G., Cox, G.M., 1957. Experimental Design. John Wiley and Sons Inc., New York.

DeLuca, A.M., Kranda, K.C., 1992. Environmental enrichment in a large animal facility. Lab. Anim. 21, 38–44.

Hart, B.L., Hart, L.A., 1985. Selecting pet dogs on the basis of cluster analysis of breed behaviour profiles and gender. J. Am. Vet. Med. Assoc. 186, 1181–1185.

Hennessy, M.B., Davis, H.N., Williams, M.T., Mellott, C., Douglas, C.W., 1997. Plasma cortisol levels of dogs at a county animal shelter. Physiol. Behav. 62, 485–490.

Hiby, E.F., Rooney, N.J., Bradshaw, J.W.S., 2006. Behavioural and physiological responses of dogs entering re-homing kennels. Physiol. Behav. 89, 385–391.

Hubrecht, R.C., Serpell, J.A., Poole, T.B., 1992. Correlates of pen size and housing conditions on the behaviour of kennelled dogs. Appl. Anim. Behav. Sci. 34, 365–383.

Hubrecht, R.C., 1993. A comparison of social and environmental enrichment methods for laboratory housed dogs. Appl. Anim. Behav. Sci. 37, 345–361.

Hubrecht, R.C., 1995. Enrichment in puppyhood and its effects on later behaviour of dogs. Lab. Anim. Sci. 45, 70–75.

Kobelt, A.J., Hemsworth, P.H., Barnett, J.L., Coleman, G.J., Butler, K.L., 2007. The behaviour of Labrador retrievers in suburban backyards: the relationships between the backyard environment and dog behaviour. Appl. Anim. Behav. Sci. 106, 70–84.

Loveridge, G.G., 1998. Environmentally enriched dog housing. Appl. Anim. Behav. Sci. 59, 101–113.

Luescher, A.U., Tyson Medlock, R., 2009. The effects of training and environmental alterations on adoption success of shelter dogs. Appl. Anim. Behav. Sci. 117, 63–68.

Miklósi, A., 2007. Dogs: Behaviour, Evolution and Cognition. Oxford University Press, Oxford.

Overall, K.L., Dyer, D., 2005. Enrichment strategies for laboratory animals from the viewpoint of clinical veterinary behavioral medicine: emphasis on cats and dogs. ILAR J. 46, 202–216.

Rooney, N.J., Gaines, S.A., Bradshaw, J.W.S., 2007. Behavioural and glucocorticoid responses of dogs (*Canis familiaris*) to kennelling: investigating mitigation of stress by prior habituation. Physiol. Behav. 92, 847–854.

Shepherdson, D.J., 1994. The role of environmental enrichment in the captive breeding and reintroduction of endangered species. In: Mace, G., Olney, P., Feistner, A.T.C. (Eds.), Creative Conservation: Interactive Management of Wild and Captive Animals. Chapman and Hall, London, pp. 167–177.

Shepherdson, D.J., 1998. Tracing the path of environmental enrichment in zoos. In: Shepherdson, D.J., Mellen, J.D., Hutchins, M. (Eds.), Second Nature: Environmental Enrichment for Captive Animals. Smithsonian Institution, Washington, DC, pp. 1–12.

Stephen, J.M., Ledger, R.A., 2006. A longitudinal evaluation of urinary cortisol in kennelled dogs, *Canis familiaris*. Physiol. Behav. 87, 911–916.

Taylor, K.D., Mills, D.S., 2007. The effect of the kennel environment on canine welfare: a critical review of canine studies. Anim. Welf. 16, 435–447.

Wells, D., Hepper, P.G., 1992. The behaviour of dogs in a rescue shelter. Anim. Welf. 1, 171–186.

Wells, D.L., Hepper, P.G., 2000. The influence of environmental change on the behaviour of sheltered dogs. Appl. Anim. Behav. Sci. 68, 151–162.

Wells, D.L., Graham, L., Hepper, P.G., 2002. The influence of length of time in a rescue shelter on the behaviour of kennelled dogs. Anim. Welf. 11, 317–325.

Wells, D.L., 2004a. A review of environmental enrichment for kennelled dogs, *Canis familiaris*. Appl. Anim. Behav. Sci. 85, 307–317.

Wells, D.L., 2004b. The influence of toys on the behaviour and welfare of kennelled dogs. Anim. Welf. 13, 367–373.

Young, R.J., 2006. Environmental Enrichment for Captive Animals. UFAW/Blackwell Publishing, Oxford.