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A comparison of social and environmental enrichment methods for laboratory housed dogs

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Abstract

This study compares the effects of social and physical enrichment on the behaviour and physiological responses of group and pair-housed beagles. Some 432 h of observation were collected from 48 beagles assigned equally to four groups: (1) a control group, (2) a group given increased opportunities for social contact with conspecifics, (3) a group given 30 s day^{-1} of intensive handling, and (4) a group provided with three different toys/chews permanently suspended in the pen: Rawhide, Gumabone chew and a piece of plastic tubing. After 2 months both the controls and the enriched groups spent less time resting and more time on hind legs looking out of the pen. Both human-socialised and dog-socialised groups maintained pre-treatment scores of 'sniffing kennel mate', and 'time spent in contact with kennel mate', while the control and environment-enriched groups scores for these behaviours fell, but overall intraspecific socialisation in these groups showed no change. During human-socialisation, dogs' time spent chewing items of cage furniture was reduced by 90%. Following 2 months of environmental enrichment, dogs spent a substantial proportion of their time (24%) using the toys, showing that frequent changes of items are not necessary to avoid habituation, if the appropriate toys/chews are used. Time spent inactive by environment-enriched dogs fell by 20% of pre-treatment values to 51% of total time. However, socialising with kennel mates also fell by 70% of pre-treatment values to 4% of the total time. Environment-enriched dogs solicited less play, played less and spent less time in contact with their kennel mate. These changes may show a 'preference' by the dogs for toys over social activity or they may be due to competition for toys. Environment-enriched dogs also spent less time chewing items of pen furniture (a fall on pre-treatment scores of 85%) and walked less (a fall of 35%). Following the addition of a platform to the pens these dogs spent over 50% of their time on it observing surroundings as well as guarding toy items. The study shows that appropriate enrichment can: increase the complexity of dog behaviour, substantially change the expression of behaviour and help to prevent undesirable behaviours. Small increases in the opportunities for social interactions with handlers may produce changes in behaviour with conspecifics. In large facilities physical enrichment is likely to be the most cost-effective option, but staff should be encouraged to have regular positive socialisation sessions with their dogs.

Keywords: Dog; Housing; Activity pattern; Toys; Laboratory; Psychological well being

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Introduction

Dogs are kept in specialised animal housing for a variety of reasons: pet dogs and strays are housed by kennels and animal shelters; dogs may need to be kept in quarantine; they are also used as models in biomedical research. Despite the dog's status as a pet, the development of ethologically sound housing has received little attention, even though it has been known for some time that dogs housed in restricted environments can develop behavioural abnormalities generally considered to be typical of poor welfare (Thompson et al., 1956; Fox, 1965, 1986; Solarz, 1970; Luescher et al., 1991). Unfortunately, the lack of research does not indicate that a consensus has been reached as to what constitutes good housing. For example, a recent study of four housing types (Hubrecht et al., 1992) showed that: there were widely varying housing designs and husbandry; the dogs' behaviour was very different in the different types and sizes of pen; at three of the four sites the dogs were spending substantial proportions of their time in repetitive, possibly stereotyped behaviour. Although stereotypies do not necessarily reflect the welfare status of current housing (Mason, 1991), it is clear that some dog housing is relatively barren and that the behavioural repertoire of single-housed dogs, which tend to be housed in smaller pens, can be reduced.

Environments can be improved by increasing the opportunities for social contact, or the physical or temporal complexity of the pen, in a manner appropriate for the species. Many authors have stressed the benefits of both canine and human social contacts, particularly in puppyhood (e.g. Fox and Stelzner, 1967; Fox, 1986; Campbell et al., 1988; Wolfle, 1987, 1990), but there has been little specific research on the welfare aspects of the presence or absence of conspecifics. Nor has there been any general agreement on methods of physically enriching the pen environment. In some establishments toys or chews are occasionally thrown into pens, but there is a perception that they can lead to possessive aggression and make cleaning more difficult. DeLuca and Kranda (1992) have demonstrated preferences of dogs for certain toys, but there have been no systematic observations on the effects of environmental enrichment on dog behaviour, or comparisons of the costs and benefits of different forms of enrichment.

Using behavioural and physiological measures, this paper compares three enrichment techniques applied to dogs in laboratory housing: (1) increased opportunities for intra-specific social contact; (2) increased time socialising with the handler; (3) the provision of toys and furniture to enrich the physical environment — these consisted of chewable objects suspended from the ceiling to reduce cleaning problems and monopolisation by individuals, a kennel to allow the dogs increased opportunities to control their social and physical environment, and a raised viewing platform to allow the dogs to see freely out of their pens while resting.

Animals, materials and methods

The subjects were 48 beagles, aged between 5 and 9 months at the start of the experiment, obtained from a breeding colony. The pups had been handled twice daily prior to weaning at 5 weeks for about 10 s/pup/day. At 5 weeks they were vaccinated and weighed (handling time: approximately 1 min/pup). They remained in litters until they were 16 weeks old (contact time with humans: approximately 3 min/litter/day during feeding). After 16 weeks they were housed in pairs in indoor/outdoor pens where each dog received a few seconds contact per day during feeding. They were also weighed once a week and inspected (handling time: approximately 2 min/pup).

The beagles were divided into four treatment groups ($N=12$ per group) and housed in same-gender pairs: females in one room and males in another. Genders were balanced between the treatments except for the control group which contained eight females and four males. Each pair had the use of two standard pens (Fig. 1) connected by a pop-hole which could be closed with a metal slide. After a 2-week acclimatisation period, the technician, who had daily contact with the dogs, recorded his rating of the dog's dominance, confidence, friendliness, aggressiveness and playfulness by placing a cross on a line each end of which represented an extreme of the particular character to be measured (a semantic differential type scale (Osgood et al., 1957)). At the same time he coded the response of the dogs to his entering the pen on an arbitrary five-point scale: (1) cower in back of cage growling; (2) in back of cage not growling; (3) comes forward but not all the way; (4) greets technician at door but not with enthusiasm; (5) eagerly greets with enthusiasm, i.e. jumping up, wagging tail etc.

At the end of the 2 weeks each dog's behaviour was videotaped, as a focal animal over 2 days, for a total of 4 h between 08:30 and 16:30 h (the pre-treatment observation). The whole working day was sampled to ensure even coverage of the dogs' range of behaviour and to obtain a daily time budget. During taping the beagle pairs were confined to one of the pens so that they

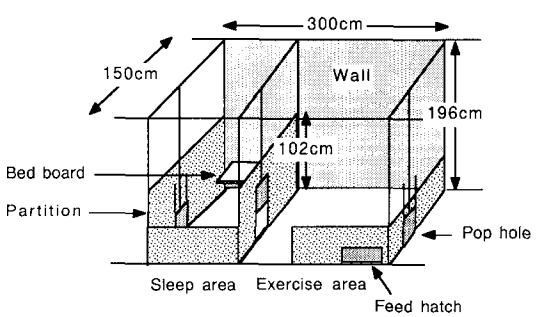

Fig. 1. Standard dog pen (mesh and front door have been omitted for clarity).

remained in the field of view of the camera. The behaviour and location of the dogs were transcribed from the tapes, by an observer, using a computerised event recorder (PSION Organiser II, Psion House, London, UK). The behaviour categories recorded are described in Table 1. Saliva samples were taken at the same time each morning over 3 successive days. The sample from each dog was collected within 2 min after entry into the pen and stored at −20°C for subsequent radioimmunoassay for cortisol by Serono Laboratories, UK.

Each treatment group was then exposed to 2 months of differing husbandry. The choice of this period was arbitrary as Hubrecht et al. (1992) found no correlation between duration of stay in housing type and repetitive behaviour, and the development of the behaviour is likely to be idiosyncratic. It was hoped that 2 months would be sufficient to provide a reasonable term of enrichment and to avoid novelty effects following initial exposure. The husbandry for each group was as follows:

(1) The control group received normal laboratory husbandry, i.e. pens washed out in the morning, fed between 12:00 and 13:00 h, pens scraped out in the afternoon. Each dog was weighed once a week and given veterinary attention as appropriate. The technician did not socialise with the dogs during cleaning or feeding and so the only close interaction with humans was once a week during weighing, a procedure that took approximately 2–3 min.

(2) Dog-socialisation group: husbandry as for the control group, but the dogs were allowed out of pens to interact with others of the same gender in the room (12 dogs per room) for a period of 1 h each weekday during the treatment period. This group inevitably received extra handling, but it would have been of a comparatively low grade compared with the grooming received by the human-socialisation group described below.

(3) Human-socialisation group: husbandry as for the control group, but each of the dogs received 30 s of grooming and handling each weekday during the treatment period.

(4) Environment-enriched group: husbandry as for the control group, but the dogs were provided with a Gumabone chew[1], a length of rolled Rawhide[2] and a length of reinforced plastic piping. These items were suspended by a chain into the pen, 10–15 cm from the ground, with a spring to allow the dogs to pull the toys to the ground for chewing (Fig. 2(a)). The centre toy was connected to the opposite pen by a pulley system, with the aim of promoting use, but the system was not found to be of any practical advantage. In addition, a vertical board was added to the front of the dogs' bed-boards allowing the area underneath to be used as a kennel.

At the end of 2 months, post-treatment behavioural data, saliva data and

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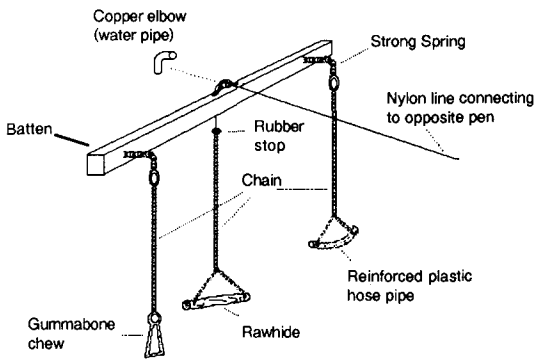
Table 1
Behaviour categories used in the study

Summed category	Category	Definition
Active	Walk	Ambulatory gait.
	Trot	Trotting gait.
	Run	Running gait.
	Hind legs	Standing on hind legs using forelegs against a wall to support the body.
Active repetitive or sterotyped	Circle	Repetitive circling around pen.
	Tail chase	Repetitive chasing of tail.
	Pace	Repetitive pacing usually along a fence.
	Jump	Repetitive jumping so that hind legs leave the ground.
	Wall bounce	Repetitive jumping at wall, rebounding off it.
	Flank suck	Repetitve and prolonged autogrooming of flank.
Inactive	Rest	Lying down with eyes open or closed.
	Sit	Sit on hind legs.
	Stand	Stand on 4 legs.
	Contact[a]	Lying in contact with dog.
Socialise with kennel mate	Amicable	Lick, paw or allogroom dog often with tail wag.
	Threat	Snarl raise hackles to dog.
	Attack	Bite snap paw or chase dog.
	Defensive	Evade dog, cower, roll over, lick face.
	Competitive	Defend object or food from dog.
	Sniff	Nose to any area of another dog.
	Solicit play	Bow, often barking.
	Play	Bouncing gait, play face, wrestle, play chase.
	T-Dog	Muzzle placed across neck of another dog.
	Mount	Hetero/homosexual mounting.
	Mounted	Focal animal mounted by other dog.
Alimentary	Eat	Eating food, or nose at food hopper.
	Drink	Drinking/mouth at drinking nipple.
	Coprophagy	Eat own or other dog's faeces.
	Urinate squat	Urinate in squatting position.
	Urinate raised leg	Urinate with one leg cocked.
	Defecate	Squat and defecate.
Others	Sniff ground	Nose to ground.
	Dig	Dig at ground with fore paws.
	Chew	Chew non nutritive material.
	Autogroom	Lick, pull at body/pelage.
	Kick ground	Scratching ground with hind legs, usually following urination or defecation.
Vocalisations	Bark[a]	Staccato vocalisations.
	Howl[a]	Long drawn out vocalisations.
	Use toy	Sniff or chew gumabone, rawhide or tube.

[a]Indicates non-exclusive category.

a Method of suspending toys/chews in pens



b Dog Platform

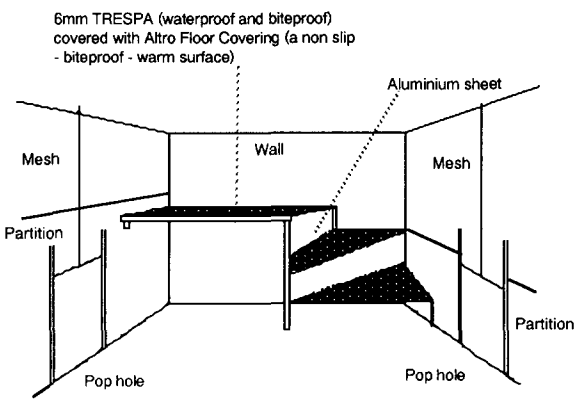


Fig. 2. Physical enrichment devices.

technician's rating were collected as for the pre-treatment observation. The various husbandry regimens were continued during the data collection. As an extension to the study of the environmental-enrichment group a platform, large enough to allow a resting dog to see over the pen partitions, was added to these dogs' pens at the end of the post-treatment period (Fig. 2(b)). After a further 2 months the behaviour, technician's rating and saliva data were collected for this group for a third and final time. This was a late addition to the experiment and it was not possible to provide a control group for this period.

The dogs were out of view (i.e. behind partitions) for only a small proportion of the observation time (mean 1.46%), but to account for this and to

maintain consistency with Hubrecht et al. (1992), the data were calculated as a percentage of the time observable and were subjected to a square root transformation for analysis. To take into account pre-treatment differences that existed between the dogs, the various behaviour categories were compared with a two-way analysis of covariance using the pre-treatment watch as the covariate and treatment group and gender as the factors (Table 2). Only behaviour categories accounting for more than 1% of the observable time were analysed in this fashion, with the exception of summed repetitive or stereotyped behaviour and circling, which were included because of their interest as a measure of welfare (e.g. Broom, 1988). Other analyses are described in the text and all significance levels are based on two-tailed tests.

Table 2
F-values for significant effects obtained in analyses of covariance (using pre-treatment as covariate) on post-treatment variables accounting for more than 1% of observed time (except active repetitive and circle). An interaction signifies a differential effect of treatment by gender

Variable	Effect		
	Treatment (d.f. 3,39)	Gender (d.f. 1,39)	Interaction (treatment×gender) (d.f. 3,39)
Active			
Active repetitive			4.35**
Inactive	3.64*		
Socialise with kennel mate	18.09***		
Others	3.25*		
Walk	3.03*		4.24*
Trot			
Hind legs			
Circle			3.02*
Rest			
Sit			
Stand		6.14*	
Amicable			
Sniff	8.56***		
Solicit play	5.97**		
Play	12.64***		
Contact	4.73**		
Eat			
Drink			3.22*
Sniff ground			
Chew	7.17***		
Autogroom			
Pen			
Sleep area	3.43*		
Under bed	5.70**	8.18**	
On bed			

*$P<0.05$, **$P<0.01$, ***$P<0.001$.

Results

An appraisal of the ease of use, success, cost and problems of the three treatments

(1) Dog-socialisation group: the release and return of the dogs to their pens took approximately $\frac{3}{4}$ h of the technician's time per day, most of which was used to sort the dogs back into their pens. The dogs were also monitored for fights, but this could be done while the technician was carrying out other duties. Videotapes of the dogs' behaviour showed that they spent their time in vigorous play and investigation of the room. The males were particularly prone to mount each other, in the process biting fur from the nape and scratching the mounted dog's flanks. The scratches occasionally became infected with faeces during play, but responded well to medical treatment.

(2) Human-socialisation group: these dogs were perceived by the technician to be more friendly on arrival and scored higher on the response scale when the handler entered the pen. The technician found that socialising with the dogs was rewarding and allowed him to assess their characters better. Socialising took approximately $\frac{1}{2}$ h day^{-1}. At the end of the treatment, these dogs became markedly more approachable both by the handler and by strangers to the dogs. No problems arose as a result of this treatment.

(3) Environment-enriched group: the dogs took time to adjust to the toys which did not need replacing until they had been in for 4 weeks. The toys needed to be regularly replaced after 10 weeks (Fig 3(a)). Economies were made by re-hanging toys, where possible, after they had been chewed from the chains. Average cost of the toys for each dog per week over 21 weeks was: Rawhide £0.52, Gumabone chew £1.21 and pipe £0.13. The Rawhide and chew were used substantially more than the pipe during the post-treatment watch (One-Way repeated measures ANOVA $F_{2,22}=4.05$; $P<0.05$). Two months later the time spent chewing Rawhide had fallen dramatically (Fig. 3(b)). The differences in toy use were still obvious ($F_{2,22}=6.47$; $P<0.01$) and the chew was used more than the pipe (Scheffé $F=6.4$; $P<0.01$). The Gumabone chew needed to be replaced less frequently than the other items tested and, in view of the consistency of its use, proved to be the most effective of the toys. There was a non-significant reduction in the use of toys 2 months after the platform was added, however, the rate of replacement of toys during this period remained the same. Most of the dogs made substantial use of the toys, however, two females, housed together spent less than 1% of their time using the toys and none of their toys needed replacing. The dogs spent little time playing jointly with the same item (0.8%, falling to 0.4% after the platform was added). Despite being suspended off the floor, the Rawhide, in particular, became fouled either by direct contact with faeces or from the dogs coats when they played chase games through the suspension chains. The

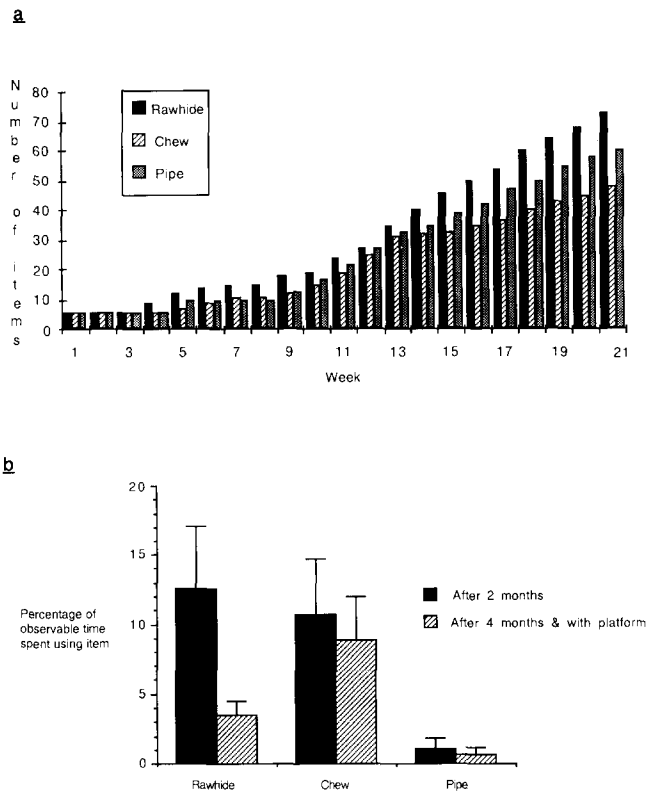


Fig. 3(a). Cumulative number of toys needing replacement in the six pens of the environment-enriched dogs. (b) Percentage of observed time spent using toys (mean ± SE).

technician spent approximately 1 h day^{-1} servicing the toys, but most of this time was spent setting-up cleaning apparatus. Substantial savings in time might be made by hanging the Rawhide higher.

The dogs often hid in the kennels during daily inspection, which was a problem for the technician (6 of the 12 during response testing), but spent on average only 3.0% (pre-treatment watch) of the observed time in the kennel, falling to 0.2% (after the addition of the front flap) and 0.1% (after the addition of the platform).

The platforms were fitted at a cost of £327 each. No problems were encountered in cleaning out the pens, or from dogs falling from the platforms or attempting to jump over partitions.

At the end of the treatment period, the technician's ratings of the control, dog-socialisation and human-socialisation groups were that they were all more dominant, confident, friendly and playful with the handler (Wilcoxon matched-pairs tests, $P<0.05$). The dog-socialisation and human-socialisa-

tion groups were also more approachable as shown by the response test ($P<0.05$). The environment-enriched group had low pre-treatment scores compared with the other groups and showed no significant changes post-treatment. However, when the same group was tested after the further 2 months with the platform, they were more approachable and were perceived as being more confident, friendly and playful ($P<0.05$).

Behavioural time budgets

The summed behaviour categories (Table 1, also used in Hubrecht et al., 1992) are shown as time budgets in Fig. 4. The overall budgets of the groups prior to treatment were similar, although there was some pre-treatment variation which was probably due to the small sample size of 12 dogs per group. Dogs spent the majority of their time inactive, 9–12% of their time active and a similar proportion of their socialising with the kennel mate. Following addition of the toys the environment-enriched group spent nearly a quarter of their time interacting with them. There was a corresponding decrease in time spent in other behaviour categories, particularly time spent socialising with kennel mate (Treatment effect, $P<0.001$). There was no correlation between time spent using toys and amount of time spent in repetitive behaviour. The time budgets of the control, dog socialisation and human socialisation groups did not differ markedly between the pre- and post-treatment watches. Over the course of the study, all groups tended to spend less time inactive and more time active, particularly on hind legs looking out of the pen. They also spent more time in active-repetitive categories although the rise was most marked in the human-socialisation and environment-enriched groups. Females in the environment-enriched group showed the largest increase in activity (Treatment X gender interaction, $P<0.01$; Table 2). The human-socialisation group increased social behaviour by an average of 3.4%, but the change was not significant.

Locomotion and posture categories (Fig. 5)

There was a marked decrease in walking in the environment-enriched group (Treatment effect, $P<0.05$), particularly in the males (Interaction, $P<0.05$). Despite this, all groups spent less time resting in the second watch (Paired t-test, $P<0.01$), partly because of an increase in time on hind legs $P<0.01$) and circling (non-significant trend). Circling accounted for less than 0.5% of the time, but was the largest component of the repetitive behaviour category, although pacing and jumping were also seen. There were no differences between treatment groups in circling, but environment-enriched females spent the most time in this activity, while the males of this group had the lowest

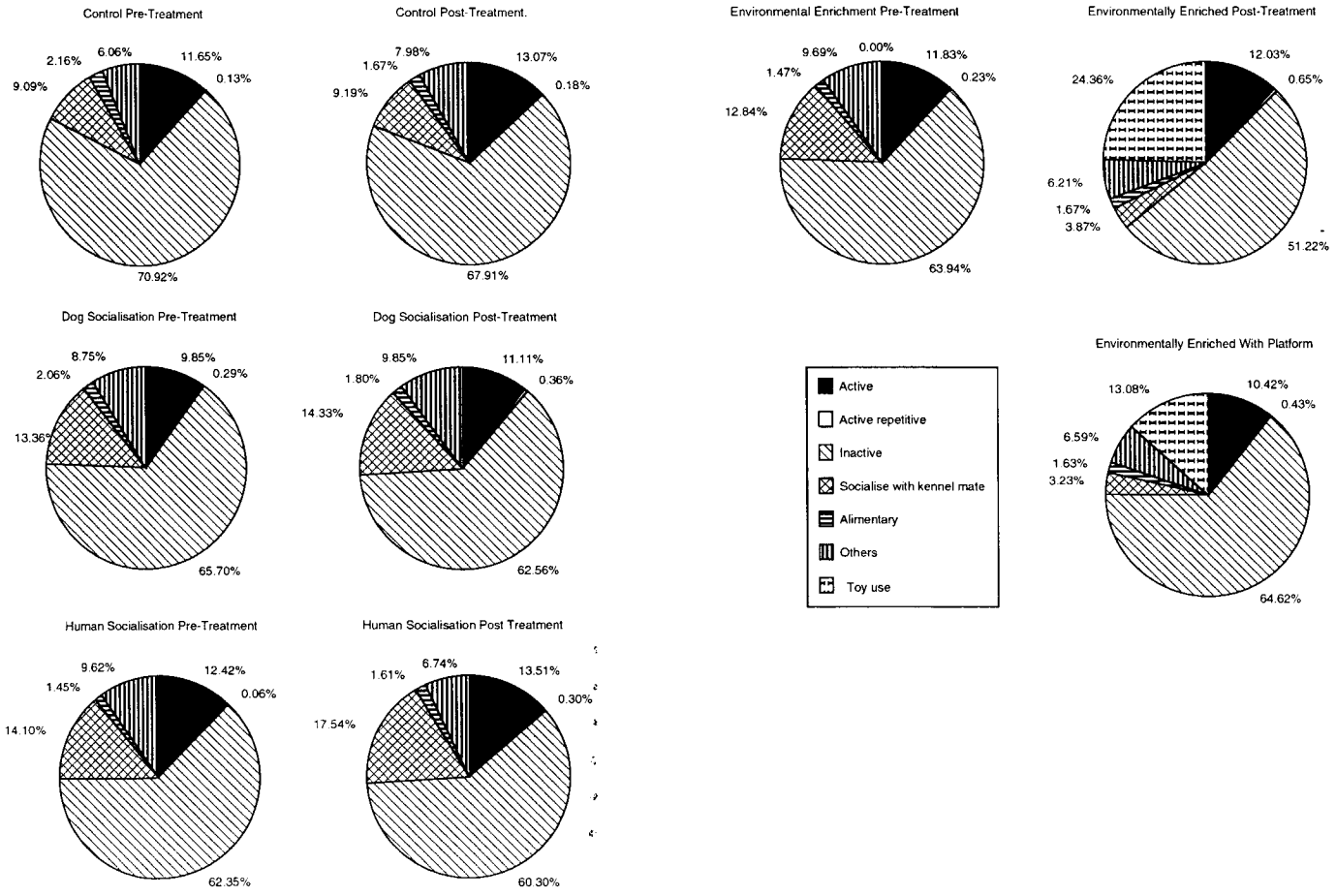


Fig. 4. Mean time budgets pre- and post-treatment using summed behaviour categories. See text for details.

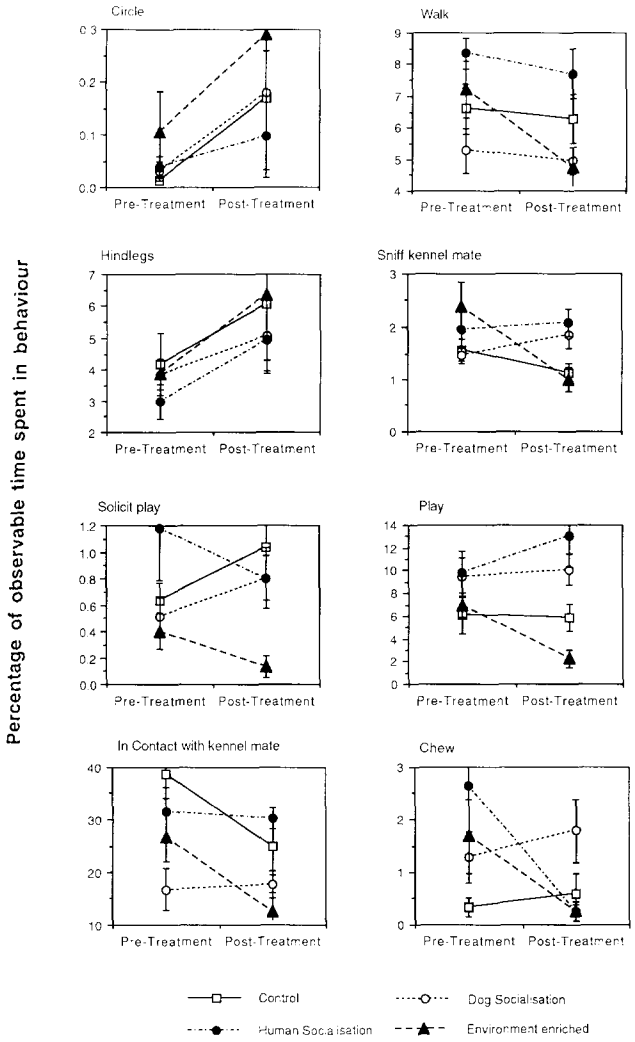


Fig. 5. Percentage of observed time spent in selected behaviour categories pre- and post-treatment (mean ± SE).

score (Interaction, $P<0.05$). Generally females spent more time standing than males (Gender effect, $P<0.05$).

Social behaviour categories (Fig. 5)

Time spent sniffing and time in contact with kennel mate dropped in the control and environment-enriched groups in the post-treatment watch, but were maintained at pre-treatment levels in the groups which received extra

social contacts (dog-socialisation and human-socialisation) (Treatment effects, $P<0.01$ and $P<0.001$). Allowing for pre-treatment effects the human-socialisation group's contact score was high relative to those of the other groups, while that of the environment-enriched group was lowest. The environment-enriched group also solicited less play (Treatment effect, $P<0.01$) and played less than the socially enriched groups (Treatment effect, $P<0.001$).

Alimentary behaviour categories

The only category that showed an effect was drinking. Control females spent less time drinking than the other groups (Interaction, $P<0.05$). It is hard to explain this finding and in view of the number of analyses it is possible that it was a chance result.

Other behaviour categories (Fig. 5)

During the study, the dogs were observed to chew at a variety of items in their pens, namely, the water feed-pipe, the 4-mm stainless steel wire used to raise pop-hole partition, plaster from the walls and the plywood underside of the bed-board. The dog-socialisation group chewed the most post-treatment (treatment effect, $P<0.001$), but the human-socialisation and environment-enriched dogs both showed a marked decrease in this behaviour.

Vocalisations

Noise from barking can be a problem in dog housing (Van der Heiden, 1992) and could have effects on dogs as well as humans. Barking in the dog-socialisation and environment-enriched groups increased over the course of the study (0.6–1.9% and 0.7–2.5% respectively, paired t-tests, $P<0.05$), possibly because of an increased intra-specific responsiveness, while the human-socialisation group's barking remained constant, but, overall, rather higher than the other groups (2.5–2.7% of the observation time). It was not possible to record vocalisations in the control group during the pre-treatment period, but post-treatment the time spent barking was comparatively small (0.3% of observation time).

Effects of adding the platform to the environment-enriched group

The platform was much used by the dogs, as they spent an average of 54.6% of their time on top of it and 11.1% of their time on the stairs. The area under the stairs was often used as a retreat if a stranger entered the room. In two pens, the platform was monopolised by one of the two dogs. Time spent ac-

tively playing with toys was reduced (Fig. 4) but, in fact, the dogs were dragging the items to the top of the platform and appeared to be guarding them. The net result was that the time inactive, particularly standing, increased. The platform was also used for resting and as a look-out platform. The dogs no longer had to stand on their hind legs to see out of the pen and time spent in this behaviour declined to that in the pre-treatment watch, thus accounting for the overall drop in the active category. Barking continued to increase from 2.5 to 5.3% of the observation period (Paired t-test, $P<0.01$). The dogs spent, on average, less time circling and chewing at non-toy items than in the post-treatment watch, but the changes were not significant.

Salivary cortisol

Using only the first day's samples, the only significant change was in the control group whose cortisol had fallen to the sensitivity level of the assay, by the end of the study (Wilcoxon matched-pairs test, $P<0.05$). However, as the measured values were generally low, and the control post-treatment value did not differ from pre-treatment values for the dog-socialisation and environment-enriched groups, the remaining samples were not analysed.

Discussion

This study clearly shows that social and physical enrichment have effects on the behaviour expressed by dogs in the pens, but it is rather more difficult to assess the welfare implications of the changes. The general trend to increase time spent on the hind legs may be an indication of the dog's interest in events outside of the pen and could be indicative of boredom. Although the overall amount of repetitive or stereotyped behaviour at the end of 2 months was low, compared with that seen at previous sites by Hubrecht et al. (1992), there was a non-significant increase in circling in all the groups. These two results suggest that increased opportunities for social contact and the provision of toys did little to prevent the development of stereotyped behaviour or maintain the dog's interest while within the pen.

The dog-socialisation group seemed to enjoy opportunities to run free with other dogs, but the development of coat and skin problems in the male dogs, the increased chewing of cage furniture and the cost of the technicians time, suggests that this method of enrichment for pair-housed dogs may be of marginal value. Moreover, these pair-housed dogs were spending similar amounts of time in social activities compared with 6 to 7-month-old beagles housed in groups of five at another breeding colony (Hubrecht et al., 1992). Therefore, under this housing system, opportunities for extra social contacts with other dogs may not represent a substantial improvement in welfare. Of the two social enrichment methods, human social enrichment was more effective since

there was no possibility of damage to the dogs, inappropriate chewing of articles of cage furniture was reduced and time spent barking remained constant. The activity was also rewarding for the technician and was actively solicited by the dogs.

The possibility of new activities provided by the addition of toys to the pen was likely to have had the most profound effect on behaviour. This study demonstrates that, at least over 2 months, habituation is not a problem. Moreover, toys hung in the pens did not increase aggression between the dogs, although some aggression was noted during a pilot study. As in DeLuca and Kranda's (1992) study, Rawhide was initially popular, but in contrast to their findings with beagles, the Gumabone chew was also favoured. The popularity of these toys is, presumably, because of the taste and association with food. The dog's interest in the Gumabone seemed to be maintained by their ability to bite small pieces from it to chew elsewhere in the pen. The provision of chews worked, in the sense that inactive time was reduced and the dogs were chewing appropriate items rather than articles of cage furniture, but the large decrease in social interactions was not expected. It is possible that the presence of the toys resulted in non-overt competition between the dogs or simply that the dogs preferred to spend their time using the toys rather than socialising.

In contrast with Hubrecht et al.'s previous study, where dogs housed in groups of five on a slatted floor system spent 35% of their time in a kennel, the kennel in the present study was clearly not favoured (0.2%, falling from 3% of time spent under the bed before the toys and the front of the bed-board were fitted). The discrepancy may have been due to the previous study's less complex pen, which provided fewer hiding places for play, slatted floor, or a more complex social environment. However, the kennel was used by some dogs when the technician or a stranger entered or stood in front of the pen. The staff at the site felt that the kennel, while it might allow some of the dogs to cope with a possibly threatening situation, was a hindrance to daily inspection. Moreover, as this was the only group of dogs which did not become easier to approach over the 2-month course of the experiment, it possibly inhibited the development of a trusting relationship with their handler.

The platform was intended to mimic the look-out mounds used by wolves (Murie, 1985) and to help reduce frustrated attempts to see out of pens which might lead to stereotypies. Although there was no control group the dogs made extensive use of the platform, it produced behaviour patterns not previously seen and there were indications that stereotypies might be reduced. Further, the platform both increased the complexity of the pen and increased the space available to the dogs by making use of the neglected third dimension.

To conclude, this paper shows that both social and physical enrichment of the life of penned dogs can have measurable and beneficial effects on the behaviour changes observed in caged dogs. Even a comparatively small amount

of time invested per dog in increased human social contact is valuable, rewarding for the dog and handler, and affects intra-specific socialisation. Physical enrichment has been shown to be particularly valuable as it allows the dogs to exercise greater choice in behaviour throughout the day. The toys were a continuing financial outlay, but this was because, even after a substantial habituation period, they were successful enrichment devices. Possibly other chew items could be found that might be as successful, or cheaper, and there may be better methods of presenting them to the dogs. There is an initial outlay for the platforms, but they should last as long as the pens. It is important to realise that, in practice and dependant on facilities and experimental protocol, an array of social and physical enrichment techniques could be adopted. Dogs are sometimes kept in more restricted social or physical environments than in the present study and for these animals enrichment is likely to be even more important.

This study has shown that dogs make extensive use of toys/chews and appear to enjoy social enrichment, but studies are needed to determine the demand of the dogs for these resources (sensu Dawkins, 1983). Further experiments are also required to compare different methods of presentation of toys/chews and to determine how effective the various types of enrichment are in single housing or in larger groups.

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