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Applied Animal Behaviour Science 113 (2008) 166–174
APPLIED ANIMAL BEHAVIOUR SCIENCE
www.elsevier.com/locate/applanim

The influence of visual stimulation on the behaviour of cats housed in a rescue shelter

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Accepted 12 November 2007
Available online 21 February 2008

Abstract

This study explored the influence of 5 types of visual stimulation (1 control condition [no visual stimulation] and 4 experimental conditions [blank television screen; and, televised images depicting humans, inanimate movement, animate movement]) on the behaviour of 125 cats housed in a rescue shelter. Twenty-five cats were randomly assigned to one of the five conditions of visual stimulation for 3 h a day for 3 days. Each cat's behaviour was recorded every 5 min throughout each day of exposure to the visual stimuli. Cats spent relatively little of the total observation time (6.10%) looking at the television monitors. Animals exposed to the programmes depicting animate and inanimate forms of movement spent significantly more of their time looking at the monitors than those exposed to the moving images of humans or the blank screen. The amount of attention that the cats directed towards the television monitors decreased significantly across their 3 h of daily presentation, suggesting habituation. Certain components of the cats' behaviour were influenced by visual stimulation. Animals in the animate movement condition spent significantly less time sleeping, and displayed a non-significant trend to spend more time resting, and in the exercise area of their pens, than those in the other conditions of visual stimulation. Overall, the results from this study suggest that visual stimulation in the form of two-dimensional video-tape sequences, notably that combining elements of prey items and linear movement, may hold some enrichment potential for domestic cats housed in rescue shelters. Such animals, however, may not benefit from this type of enrichment to the same degree as species with more well-developed visual systems, such as primates.

Keywords: Behaviour; Cats; Enrichment; Rescue shelters; Television; Visual stimulation; Welfare

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0168-1591/$ – see front matter
doi:10.1016/j.applanim.2007.11.002

1. Introduction

Visual images have long been used in animal behaviour research. A wide selection of stationary photographs and dynamic video films have been utilised over the years to test animals' abilities on abstract tasks, as a replacement for mirrors in the study of 'self-recognition' and as alternatives for real stimuli, especially other animals (for review see D'Eath, 1998).

Recently, some attention has been directed towards the potential value of visual imagery as a method of environmental enrichment for captive animals. Studies have explored the influence of two-dimensional video-tape sequences, television programmes, computer-generated images and slide stimuli on the behaviour and welfare of several species, including, for example, birds (e.g. Jones et al., 1996, 1998; Clarke and Jones, 2000a,b), primates (e.g. Bloomsmith et al., 1990; Lincoln et al., 1994; Brent and Stone, 1996; Platt and Novak, 1997; Harris et al., 1999; Newsome and Portnoy, 1999; Bloomsmith and Lambeth, 2000) and more recently, domestic dogs (Graham et al., 2005).

To date, the value of visual stimulation as a method of enrichment for the domestic cat has been overlooked. This species, however, has a well-developed sense of vision (Bradshaw, 1992), and is believed to benefit from exposure to visual stimuli. Rochlitz (1999), for example, suggests that designing enclosures for captive cats that overlook areas of human and animal activity can improve feline welfare, whilst Shyan-Norwalt (2005) indicates that pet cats typically spend 5 or more hours a day looking out of windows, suggesting an inherent motivation for visual stimulation.

Recently, some authors have advocated the use of television as a method of enrichment for captive cats (Poe and Hope, 2000; Shyan-Norwalt, 2005), and indeed many rescue shelters, particularly in the United States, present televisions to their cats in the belief they provide a source of enrichment. Videotapes have also been made with the explicit goal of entertaining cats (e.g. Cool for Cats, M.I.A. Video 1992); whether or not cats actually gain any welfare benefits from such types of stimulation, however, is unknown.

The following study aimed to determine whether visual stimulation in the form of televised moving images holds any potential as a method of environmental enrichment for captive-housed cats, specifically those housed in rescue shelters. Thousands of cats are housed in rescue shelters worldwide, many for lengthy periods of time. Attempts at improving the welfare of such animals have traditionally focused on increasing the complexity of the environment through the provision of, for example, climbing structures, vantage points and retreats (for reviews see Rochlitz, 2000, 2002, 2005). Sensory stimulation for such animals, whilst advocated (Rochlitz, 1999, 2000), has thus far been largely overlooked. The present study sought to explore whether cats housed in a rescue shelter show any interest in the presence of televised moving images, and whether this type of stimulation can serve as a sustainable method of enrichment within the shelter environment.

2. Method

2.1. Study site

Cats Protection Adoption Centre in Co. Antrim, Northern Ireland, was employed as the study site.

The cats at this study were housed in 2 rows of line-block style enclosures. Each cat's enclosure was divided into 2 sections, referred to hereafter as 'sleeping quarters' and 'exercise area'. The sleeping quarters (90 cm long × 75 cm wide × 108 cm high) contained a plastic bed, blanket and heating apparatus. From the sleeping quarters, the cats could view conspecifics housed in opposite enclosures, and humans (both staff

and visitors) as they walked past the front of the animals' pens. Cats were able to move freely through a flap from their sleeping quarters to the exercise area (187 cm long × 75 cm wide × 216 cm high), which contained a litter tray and water dish. From this location, the cats could view animals in the adjacent exercise areas, but not those in opposite enclosures. Visitors were only permitted to view the cats from a central corridor on the sleeping quarters' side of the enclosures, rendering it difficult for them to see animals in the exercise areas.

Compatible cats were kept in pairs or groups, although some were single-housed in a bid to reduce outbursts of aggression. The cats' enclosures were cleaned thoroughly every morning and as needed throughout the course of the day. The animals were fed twice daily, once in the morning and once in the late afternoon. Visitors were able to view the animals between 11 a.m. and 3 p.m. every day of the week.

2.2. Subjects

One hundred and twenty-five cats (67 males, 58 females) of mixed breed were randomly chosen as subjects. Most of the cats ($n = 111$, 88.8%) were housed in pairs or groups; the remainder were held singly. All of the cats were physically healthy, and between approximately 4 months to 7 years of age (exact ages were difficult to determine since most of the animals were either relinquished by their previous owners or found as strays). Most of the animals ($n = 110$, 88.0%) had been housed in the shelter for over 1 month. The sample employed was representative of cats admitted to Cats Protection in terms of breed, age, and sex.

2.3. Visual stimulation

Five conditions of visual stimulation were developed for the study. These included: (1) a *control*, during which cats were exposed to no visual stimulation other than that arising naturally from their environment (e.g. the sight of visitors, staff and cats), and 4 experimental conditions, namely: (2) a *blank screen* (a television monitor that was switched off); (3) *human stimulation* (moving televised images of people interacting, sitting in, and walking around, internal and external environments); (4) *inanimate movement* (moving images of snooker balls on a green snooker table. Snooker was chosen because of the cat's visual sensitivity to quick linear movements (Bradshaw, 1992)); (5) *animate movement* (moving televised images of prey animals and conspecifics taken from the video *Cool for Cats*, M.I.A. Video, 1992). This video was specifically developed by a behaviour therapist as a form of visual stimulation for cats that are kept inside, or are alone, for lengthy periods of time. A wide variety of stimuli are presented in the video, including, for example, moving images of birds, rodents, fish and cats, all performing naturalistic behaviours, e.g. moving, feeding. Individual species are presented separately on the video, in scenes lasting anywhere between 5 and 20 s. The visual images are accompanied by either calming music or animal vocalisations, e.g. purring, squeaking. The acoustic component of the video was not presented to the subject animals in this investigation (see later).

Each of the experimental conditions was presented to the cats using a Philips 14″ TV/video unit (14PV200/07). Each unit was positioned 1.5 m outside the exercise area of the cats' enclosures, at the eye level of the animals. The relatively large spaces (2″ × 2″) in the wire grid barrier at the end of the exercise areas enabled the animals to have a clear view of the television monitors. The volume of each unit was turned off to eliminate the confounding effect that differences in sound may have exerted on the animals' behaviour. Each video-tape ran on a continuous loop for 3 h.

2.4. Procedure

The cats were randomly assigned to one of the five conditions of visual stimulation (25 animals per condition). It was ensured that there was a roughly equal distribution of animals across conditions according to age, sex and length of time in shelter.

Each cat was exposed to its randomly allocated condition of visual stimulation for 3 days, between 12 noon and 3 p.m., totalling 15 h of exposure per animal. Each animal stayed in its normal cage, and with

Table 1
The ethogram of cat behaviours recorded in this study (adapted from the UK Cat Behaviour Working Group, 1995)

Behaviour	Description
Eye contact	Cat looks directly at television monitor
Sitting	Cat is positioned with its front legs extended straight, front paws and rump on the ground
Standing	Cat is positioned with four paws in contact with the ground
Resting	Cat is positioned with its legs in a crouched position and body held ventrally close to the ground. Cat is generally inactive, with its eyes open or partially closed
Sleeping	Cat is in resting position, with eyes constantly closed. Paws may or may not be in contact with the ground
Moving	Cat walks, runs, trots or climbs through the environment
Grooming	Cat licks, chews or scratches its own body
Socialising	Cat interacts (i.e. grooms, plays) with conspecific/s
Exercise area	Cat is located in exercise area of enclosure

its usual pen-mate (if housed with a conspecific), throughout testing. The days on which the cats were studied were not always the same between conditions due to uncontrollable events in the shelter environment (e.g. veterinary visits, husbandry disruptions). Cats were only studied on the days on which there were no disruptions in the environment. The cats were always presented with the visual stimuli at the same time of day to prevent any inconsistent exposure to extraneous events in the shelter environment, e.g. feeding, enclosure cleaning.

The behaviour of each cat was recorded on all 3 days of presentation to the visual stimulation. Observations of the animals' behaviour commenced as soon as the TV/video units were switched on. The experimenter (SE) approached the front of each subject's enclosure and recorded the cat's behaviour as soon as she saw the animal. Each cat's behaviour was recorded every 5 min over the recording period using a scan-sampling technique (e.g. Martin and Bateson, 1993), providing 36 observations of each animal's behaviour per day. For each condition, at every sample point, the behavioural state of each individual was recorded according to an ethogram devised from pilot studies and existing work in this area (UK Cat Working Group, 1995, see Table 1). In addition, for the experimental conditions only, the number of times that cats were observed making eye contact with the television monitor (i.e. looking directly at the screen) was also recorded.

2.5. Data analysis

The total number of times each cat in each condition was observed performing each behaviour on the ethogram was summed, providing an overall frequency count per animal per behaviour (the 14 single-housed cats were excluded from an analysis of the behaviour *socialising*). Kruskal–Wallis tests were subsequently carried out to determine whether there was any significant difference in the behaviour of the cats between conditions of visual stimulation.

For the experimental conditions only, a Friedman ANOVA was conducted to determine whether the amount of time that the cats made eye contact with the television monitors differed significantly across the 3 h of presentation, i.e. 1–3 h.

All post hoc tests (Mann–Whitney *U*-tests, Wilcoxon tests) were carried out using a Bonferroni adjusted alpha level of 0.01 to avoid spurious positive results.

3. Results

3.1. Eye contact with television

Overall, the cats spent 6.10% of the total available viewing time making eye contact with the television monitors (i.e. 6.58 times out of 108 sample points).

Table 2
The mean (±S.E.) number of times cats in each condition of visual stimulation were observed performing each of the behaviours on the ethogram

Behaviour	Control mean (S.E.)	Blank screen mean (S.E.)	Human stimulation mean (S.E.)	Inanimate movement mean (S.E.)	Animate movement mean (S.E.)	*P*
Eye contact	n/a	2.16 (0.57)	3.52 (0.63)	6.20 (0.79)	14.44 (3.50)	<0.001
Sleeping	69.00 (4.03)	80.68 (3.17)	81.24 (2.67)	80.56 (2.60)	66.20 (4.45)	0.009
Moving	18.76 (2.89)	10.00 (1.60)	7.36 (1.22)	7.44 (1.15)	9.36 (1.40)	<0.001
Resting	17.84 (1.74)	15.88 (1.58)	15.72 (1.45)	15.76 (1.18)	23.24 (2.06)	0.04
Sitting	16.36 (3.32)	8.24 (1.52)	10.08 (1.62)	9.44 (1.11)	12.92 (2.09)	0.07
Grooming	4.76 (0.70)	3.84 (0.53)	6.76 (0.87)	5.28 (0.76)	3.96 (0.64)	0.05
Standing	2.00 (0.34)	1.24 (0.38)	1.16 (0.29)	1.96 (0.51)	3.00 (0.75)	0.06
Socialising	2.70 (0.69)	2.62 (0.79)	0.67 (0.27)	1.39 (0.34)	1.00 (0.37)	0.10
Exercise area	13.00 (1.96)	8.12 (2.41)	7.08 (1.55)	8.48 (1.95)	20.60 (3.91)	0.02

P values arising from the Kruskal–Wallis tests are presented.

The amount of time that the cats were recorded looking at the television monitors was significantly ($\chi^2 = 25.23$, d.f. = 3, $P < 0.001$) related to the condition of visual stimulation (see Table 2). Post hoc Mann–Whitney *U*-tests showed that the cats in the animate ($U = 114.00$, $P < 0.001$), and inanimate ($U = 107.00$, $P < 0.001$), movement conditions spent significantly more time looking at the television monitors than animals exposed to the blank screen. The amount of time that the cats were observed looking at the television monitors did not differ significantly, however, between the human stimulation and blank screen conditions ($U = 219.5$, $P = 0.07$).

There was a significant difference in the amount of time that the cats in the experimental conditions spent looking at the television monitors across their 3 h of daily presentation ($\chi^2 = 29.93$, d.f. = 2, $P < 0.001$). Thus, the animals spent significantly more time looking at the monitors during their first hours of presentation (mean number of observations = 3.36, ±0.51), compared to their second ($Z = 5.03$, $P < 0.001$; mean number of observations = 1.49, ±0.37) or third ($Z = 3.62$, $P < 0.001$; mean number of observations = 1.74, ±0.30) hours of presentation. There was no significant difference in the amount of time cats spent looking at the monitors between hours 2 and 3 of presentation ($Z = 1.75$, $P = 0.08$).

3.2. The effect of visual stimulation on cat behaviour

Visual stimulation had a significant effect on the amount of time that the cats spent sleeping ($\chi^2 = 13.44$, d.f. = 4, $P = 0.009$). The cats exposed to inanimate movement spent significantly ($U = 177.00$, $P = 0.009$) more time sleeping than those in the control environment.

The amount of time that the cats were observed moving was also significantly related to visual stimulation ($\chi^2 = 20.26$, d.f. = 4, $P < 0.001$). Cats in the control environment spent significantly more time moving than animals exposed to the blank screen ($U = 166.00$, $P = 0.004$), human stimulation ($U = 122.50$, $P < 0.001$), inanimate ($U = 111.50$, $P < 0.001$) or animate ($U = 153.00$, $P = 0.002$), movement conditions.

Kruskal–Wallis tests showed a significant relationship between visual stimulation and the behaviours of resting ($\chi^2 = 10.25$, d.f. = 4, $P = 0.04$), grooming ($\chi^2 = 9.64$, d.f. = 4, $P = 0.05$), and the amount of time spent in the exercise area ($\chi^2 = 11.12$, d.f. = 4, $P = 0.02$), however,

Bonferroni corrections on the pairwise comparisons for these behaviours, using an adjusted alpha level of 0.01, revealed no significant effects ($P > 0.01$ for all pairwise comparisons).

There was no significant relationship between condition of visual stimulation and the amount of time that the cats spent engaged in any of the other behaviours recorded on the ethogram, i.e. sitting, standing, socialising ($P > 0.05$ for all behaviours, Table 2).

4. Discussion

Overall, the findings from this study suggest that sheltered cats may gain some enrichment benefits from certain types of televised moving images.

The cats in this investigation spent, on average, across the four conditions in which the television monitors were present, 6.10% of their time looking at the screens. Similar studies with other animals have revealed a considerably higher degree of television-directed eye orientation. Old world monkeys, for instance, have been reported to spend between 14 and 75% of the available viewing time looking at images of conspecifics, interspecifics and humans (Swartz and Rosenblum, 1980; Capitanio et al., 1985; Levin et al., 1986; Brent et al., 1989; Bloomsmith and Lambeth, 2000). More recently, however, a similar study carried out on another domestic species, namely the dog, showed that such animals spent just under 11% of the total observation time looking at televised moving images of conspecifics, interspecifics and humans (Graham et al., 2005); this result is much more similar to that found in the present experiment for the domestic cat. The lower frequencies of television-directed behaviour recorded for dogs and (in this study) cats, suggests less of an inherent interest in this type of visual material. The stimulating nature of the rescue shelter environment may also explain the relatively low amount of interest that these animals directed towards the television monitors. The external environment of a captive animal can greatly affect the efficacy of any enrichment method (Schapiro and Bloomsmith, 1995). The sight of visitors, staff and other animals, may have served as more interesting stimuli than the mere sight of a silent video broadcast.

The cats' interest in the television monitors differed significantly across the conditions of visual stimulation. Animals exposed to the televised images involving animate movement were recorded looking at the monitors significantly more than cats exposed to the blank television screens. It seems likely that the greater amount of interest in the former type of visual stimulation is related to the high level of prey material (rodents, fish, birds) in the footage. These types of animals appear to be inherently interesting to a predatory species such as the domestic cat. Shyan-Norwalt (2005), for example, reported that the most common items watched from windows by pet cats were birds and small forms of wildlife. The moving images of the cats on the video may also have appealed to the subject animals. A preference for visual images of conspecifics has been noted in other species (e.g. primates [Wilcoxon et al., 1969; Bloomsmith et al., 1990]; dogs [Graham et al., 2005]), and it appears that cats may have a similar preference for moving images of these more 'meaningful' stimuli to those that have less biological relevance.

The televised images of the snooker balls (inanimate movement condition) also attracted the cats' attention better than the presence of a blank television screen. In some respects, a moving ball of small size possesses many of the properties of prey that cats are highly attuned to and utilise for detection, for example, quick linear movement. Whilst it is most likely to be the movement of the balls that attracted the cats' attention in this condition, the colour of the table (green) may also have held some appeal, as this is one of the main colours thought to be perceived by this species (e.g. Hammond, 1978).

The amount of attention that the cats directed towards the television monitors decreased significantly across the 3 h of daily presentation. The loss of interest shown by the animals over time raises some questions over the value of visual stimulation as a sustainable, and even practical, method of enrichment within the shelter environment. Many authors have suggested that the rotation of enrichment items, or a less frequent schedule of presentation, may help to prevent decay of interest (e.g. Wells, 2004; Tarou and Bashaw, 2007). However, it is unknown from this present study whether the animals' habituation to the television monitors was due to a reduction in novelty, or an increase in understanding that the visual stimuli could not be physically manipulated.

Visual stimulation had an effect on certain components of the cats' behaviour. Notably, cats studied in the animate movement condition spent significantly less time sleeping and displayed a non-significant trend to spend more time resting, and to stay longer in the exercise area of their pens, than animals in any of the other conditions of visual stimulation. These behavioural changes most likely reflect the heightened amount of interest shown in the *Cool for Cats* video. Rather than sleeping, the animals exposed to this form of animate movement preferred to spend their time in the vicinity of the television screens (i.e. in the exercise area), looking at the monitors.

Whilst this study suggests that certain types of visual stimulation might be enriching for captive cats, it must remembered that this type of presentation does not allow for any physical contact with the stimulating items, e.g. moving images of prey. This may have the potential to lead to frustration. For example, whilst laser pointers were initially considered to be a suitable method of enrichment for cats (e.g. Holmes, 1993; Landsberg, 1996), recent concerns over their use have been raised, believing that the cats' inability to capture the light may give rise to frustration and obsessive compulsive behaviour (Association for Pet Behaviour Counsellors forum, 2007, Pers. Comm.). Further research is needed to ensure similar effects are not evident with the long-term use of televisions.

Individual variation in response to visual information also needs to be considered. Differences in feline personality (e.g. McCune, 1992; Lee et al., 2007) may give rise to differences in response to visual stimulation, with some animals perhaps gaining more benefits from this type of sensory input than others. Previous work has aimed to facilitate visual stimulation for captive cats through the introduction of windows, overlook areas and the construction of perches (for reviews see Rochlitz, 2002, 2005). It seems likely that individual cats will differ in the extent to which they utilise, and gain enrichment benefits from, such strategies. Work is currently underway to explore the effect of individual differences on cats' responses to enrichment schemes in a bid to shed light on what types of device might be the most suitable for what types of cats.

This research was carried out using an opportunistic sample of sheltered animals, the majority of which (88%) were pair-housed. Social interactions between pen-mates were seldom witnessed during the testing periods. Nonetheless, it cannot be ignored that the presence of another animal in the same living quarters can exert an influence on felid behaviour and may affect the amount of attention directed towards an enrichment item. The low number of single-housed cats in this study ($n = 14$) prevented any statistical comparison of television-directed behaviour between solitary and pair-housed animals. Such a comparison, however, would be interesting in any future investigations of this nature.

5. Conclusions

Overall, the results from this study suggest that visual stimulation in the form of televised moving images, notably that combining elements of prey items and linear movement, may be

enriching for domestic cats housed in rescue shelters. Several authors have highlighted the potential use of visual stimulation, and more specifically, the use of television and video-material, for captive-housed cats (e.g. Poe and Hope, 2000). The present study suggests that video-material may indeed hold some merit as a method of environmental enrichment for the domestic cat. Further long-term studies in this area are highly advocated, however, become generalised conclusions can be drawn.

Acknowledgements

The authors would like to thank the staff at Cats Protection for facilitating this research and to an anonymous referee for their useful comments. Sarah Ellis was funded by a DEL studentship.

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