



# The effects of additional socialisation for kittens in a rescue centre on their behaviour and suitability as a pet

Rachel Alison Casey<sup>\*</sup>, John William Stephen Bradshaw

*Anthrozoology Institute, Department of Clinical Veterinary Science, University of Bristol, Langford, Bristol BS40 5DU, UK*

Accepted 14 January 2008

Available online 28 March 2008

---

## Abstract

The effects of handling during the socialisation period on the subsequent development of behaviour problems and the cat–owner bond have been investigated in kittens homed from rescue centres. Thirty-seven kittens in three centres were given either standard socialisation or enhanced socialisation between 2 and 9 weeks of age. All kittens were then homed, and their owners were interviewed when they were approximately 1-year-old. Owners of additionally socialised kittens reported significantly higher emotional support from their cats, and fewer of these cats exhibited behaviour indicative of fear of humans, compared to cats that had received standard socialisation.

© 2008 Elsevier B.V. All rights reserved.

*Keywords:* Domestic cat; Kitten; Socialisation; Behaviour problems; Fearfulness

---

## 1. Introduction

In recent years the number of cats (*Felis silvestris catus*) kept as pets in the UK has surpassed the number of dogs: approximately 8 million cats were owned by 5 million households in the UK in 2000 (PFMA, 2000). The popularity of cats as pets is generally held to be because they offer affection and companionship, but are easier to care for than dogs (Zasloff and Kidd, 1994). However, friendliness varies substantially between individual cats (Karsh and Turner, 1998). The friendliness shown by individual cats towards their owners is obviously an important factor in the

---

<sup>\*</sup> Corresponding author. Tel.: +44 117 9289368.

E-mail address: [Rachel.Casey@bristol.ac.uk](mailto:Rachel.Casey@bristol.ac.uk) (R.A. Casey).

success of their relationship: in most circumstances people seeking a pet prefer an affectionate cat (Archer, 1997).

It is well established that variability in friendliness towards humans in cats is influenced by complex interactions between genetic factors and specific learning experiences (Mendl and Harcourt, 2000). Studies in a range of different species have suggested that plasticity to learning about environmental stimuli is more pronounced in particular 'sensitive periods' of development than others (Bateson, 1979). In companion animals a sensitive period that occurs in the weeks after birth, during which social contact with humans is necessary to prevent the development of fearful responses towards people later in life, is generally referred to as the 'socialisation period' (McCune et al., 1995). The effects of specific social experiences during this period can be profound: for example, Kuo (1930) found that kittens reared with rats become "socialised" to them, despite the fact that rats are naturally a prey species for cats.

In a series of experiments, Karsh (reported in Karsh and Turner, 1998) identified the socialisation period in cats as beginning at 2 weeks of age, and coming to an end, apparently spontaneously, at about 7 weeks of age. In addition, she determined that increasing the period of handling from 15 to 40 min per day significantly increased the period of time kittens spent in close contact with testers at 14 weeks of age (Karsh and Turner, 1998). Handling of kittens during this period appears to have long-term effects on behaviour, as beneficial effects of 5 h of handling per week between 2 and 12 weeks of age were detectable in approaches to both familiar and unfamiliar people at 1 year of age (McCune, 1995). Collard (1967) reported that kittens handled by 5 people made fewer attempts to escape from a stranger than those handled by one person or not handled at all. In addition, it has been suggested that experience of specific stimuli, such as contact with handlers of a particular sex, will differentially affect perception of men and women when kittens reach adulthood (McCune et al., 1995).

The sensitive period for socialisation to people comes to an end in the seventh or eighth week of life, irrespective of whether humans have been encountered or not, and may be terminated by the onset of a fear reaction towards all unfamiliar animate stimuli. For cats whose socialisation to people has begun before the end of the sensitive period, reactions to humans continue to change over the next 2 months or so. Differential effects of the amount of handling received during the socialisation period on reaction to handling have been detected at 4 months of age, but not thereafter in pet cats (Lowe and Bradshaw, 2002). Reactions to handling were found to be broadly consistent between 4 and 33 months, suggesting that this aspect of behavioural "style" is mainly formed in the first 4 months of life (Lowe and Bradshaw, 2002).

It is likely, therefore, that a variety of experience during the 'socialisation period' in kittenhood will add to the quality of the human–cat relationship later in the cat's life (McCune et al., 1995). There have not, however, been any studies investigating the effect of varying the quality and quantity of socialisation on the longer-term behavioural "styles" (Mendl and Harcourt, 2000) of cats, or on quality of the owner–cat relationship.

It is commonly the situation that rescue shelters hold a large number of kittens, either brought in at a young age, or born within the shelter. Although their physical care in such centres is generally very good, the social and physical stimuli that they experience are inevitably different, and generally less varied, than those experienced by kittens born into domestic environments. In shelters, close handling of individual kittens by a range of different people is also limited by constraints on staff time.

The aim of this study is to investigate the effect of an additional programme of 'socialisation' given to kittens whilst in a rescue shelter, on the occurrence of owner reported behaviour problems, and the reported level of emotional support, 1 year after homing.

## 2. Materials and methods

### 2.1. Recruitment of sample

Eleven Cats Protection rescue and re-homing centres in the UK were recruited to participate in this study. The researcher (female, 35 years of age) visited each centre prior to the start of the study period, in order to introduce the project to the managers and key staff, and deliver the necessary protocol sheets and forms. During this visit details of the normal routines of cleaning, feeding and veterinary care within the ‘maternity’ areas of each centre were recorded. In addition, the location of kitten accommodation in relation to the rest of the centre (i.e. its degree of isolation) was noted, as well as the age at which kittens were routinely made available for homing in each centre.

All litters of kittens either born in the centres, or brought into them prior to 2 weeks of age, during the period 13 May–31 August 2002, were included in the study. This study period was divided in half, such that for half the period in each centre all kittens entered the ‘control group’, and all kittens arriving in the other half joined the ‘socialised group’. Centres were randomly divided into two groups, with those in Group 1 starting with the additional socialisation programme in the first half of the period, and reverting to their normal routine in the second half, and those in Group 2 presenting the treatments in reverse, in order to control for any possible effects of season.

### 2.2. Socialisation of kittens

Kittens in the ‘control group’ experienced the normal care routine in each centre. The exact amount of contact varied to some extent between centres, but typically involved between one and four members of staff (all of whom were female) feeding the queen (and kittens in older litters) two or three times daily, and cleaning the cages twice daily (in the morning and late afternoon). The cleaning regime involved removing and replacing the litter tray, feed and water bowls, and soiled bedding, sweeping out any solid materials such as litter material, and wiping the surfaces of the pen with a disinfectant solution. The general public was not allowed to routinely enter the maternity area in any of the centres. The kittens allocated to the ‘socialised’ group were given a programme of handling and exposure to stimuli in addition to their normal routine (summarised in Table 1). The additional handling was conducted either by centre staff or by volunteers. Handlers were given instruction sheets as to the type and duration of handling for each age category of kitten, which is summarised in Table 2. Handlers were also given specific instructions regarding hygiene, such as only handling a single litter of kittens on each visit, and hand washing before and after each session, in order to minimise the risk of disease transmission. Litters of kittens with medical problems, or which required either additional or reduced handling from the normal routine for some other reason, were excluded from the study.

### 2.3. Data collection

The pen of each litter involved in the study was identified with a coloured clip, which held a ‘Kitten Record’ sheet, with the dates for each half of the study period. For kittens in both ‘socialised’ and ‘control’ groups, staff and volunteers were asked to mark off on the record sheets every time kittens in the litter were

Table 1  
Elements of the additional programme of socialisation and habituation

---

Additional experiences in the “socialisation group”

Gradually increasing programme of handling (for details see Table 2)

Contact with a minimum of four different people, including at least one man and one child under 10 years of age

Contact with a friendly, well trained dog

Exposure to normal household sounds (via a pre-recorded audio tape or CD)

---

Table 2  
Summary of amount of handling of kittens related to their age

Age of kitten	Advice to handlers
2 weeks	Open the pen door, talk to kittens, and gently stroke them. Briefly pick up each kitten and cradle in hand, returning to queen straight away
3 weeks	As at 2 weeks, except the period of holding each kitten is extended to a minute, during which time kittens are touched all over the body
4 weeks	As at 3 weeks except each kitten is held for 2 min, returned to the litter, and then picked up again and 'examined' all over, including in the ears, under the tail, and between the toes, and each kitten turned briefly onto its back
5 weeks	As at 4 weeks, but also two short periods of play with a toy introduced
6 weeks	As at 5 weeks, but each kitten is held for a longer period of time—up to 5 min, during which time it is carried away from the queen, and the period of play is increased
7–9 weeks	Continue as for 6-week-old kittens, except that the play session can become progressively more active, and involve the kittens leaving their pen and running on the floor, where this is feasible and does not increase the risk of disease

handled on the appropriate date. This, therefore, provided a check as to the amount of handling received both as part of the normal routine, and during the additional socialisation.

The majority of kittens in the study were homed at between 8 and 9.5 weeks of age. All the litters that remained in the centres for longer than this period did so because of illness, and were excluded from the study for this reason. In order to reduce within litter effects only two, randomly selected, kittens from each litter were followed up. At the time of homing, the new owners of these kittens were given a letter explaining the study, were asked to give permission to be contacted by the researcher, and completed a form with their contact details. The group from which each kitten came from was coded on these forms, so that the researcher was blinded to this information at the time of follow up. The researcher contacted owners by telephone approximately 1 year after the kittens were homed. During the interview, the owners were asked whether they had retained the cat, and were also asked if their cat showed any behaviour that they perceived

Table 3  
Summary of individual described patterns of behaviour present in respondents' cats that were combined to create the 'people' category

Behavioural responses to contact with people
Withdraw when familiar people approach
Withdraw when familiar people enter the same room
Avoid being in same area of house with familiar people
Avoid close physical contact with familiar people, such as stroking
Struggle when picked up by familiar people
Draw back when handled by familiar people
Hiss spit or lash out at familiar people when approached or handled (differentiated from other causes of aggression with further questions)
Keep away from people during busy times in the household
Withdraw when unfamiliar people approach
Withdraw when unfamiliar people enter the same room
Avoid being in the same area of the house as unfamiliar people
Avoid close contact with unfamiliar people, such as stroking
Struggle when picked up by unfamiliar people
Draw back when handled by unfamiliar people
Hiss spit or lash out at unfamiliar people when approached or handled

to be a problem. They were then asked about the frequency (using a five point scale) with which their cat displayed a range of behavioural signs, in the context of interaction with people, contact with dogs, and exposure to loud or unexpected noises. The questions that were asked with respect to the cats' response to familiar and unfamiliar people are summarised in Table 3. These behaviours were described to the owner (for example "Does your cat withdraw when you approach him or her?"), to avoid as much as possible the effect of subjective interpretations of concepts such as "fearfulness". Similar questions were asked about the cats' response to loud noises and the presence of dogs, as these were also stimuli present in the programme of additional socialisation. If necessary further questions were asked to clarify the type of behaviour shown by each cat. In addition, owners were also asked to complete a scale of emotional support (ES). This is a previously validated nine-item scale, which records the extent to which an owner would turn to their cat for support in nine different stressful situations (Bradshaw and Limond, 1997). For example, owners were asked, on a scale of one to five, the extent to which they would turn to their cat for emotional support when they were feeling lonely.

### 3. Results

Eight shelters withdrew from the study, mainly due to problems relating to the time taken to conduct the study, arising from staffing related issues, such as illness and holidays, but in two cases due to the outbreak of infectious disease within the centre (ringworm and calici virus respectively) leading to shelters taking measures to limit access for volunteers. From the data from the three remaining centres, kittens were removed from the 'socialised group' that had received less than a total of 4 weeks of additional socialisation, on the 'Kitten Record' sheets. In addition, kittens were removed from the control group where special circumstances, such as illness, or, in one case, a 'favourite' litter of a staff member, had led to additional handling. Four kittens were also lost from the study as owners were not contactable. 37 kittens remained, 20 in the control group, and 17 in the socialised group.

Overall, 22 of the kittens in the study were born in the shelter: 24 of the queens and/or kittens originated from a farm or stray background and 3 from a domestic environment. There was no significant difference in the proportion born in the shelter, nor the origin of the kittens, between the socialised and control groups. Kittens in the socialisation group were given a mean of 39 days of handling (range 28–47 days), by a mean of 4.3 handlers (range 3–6). Of kittens in the socialised group, 59% ( $n = 10$ ) had been exposed to a dog, but only 24% ( $n = 4$ ) had been presented with the tape or CD of household sounds.

At the time of the follow up questionnaire when the kittens were 1 year of age, only three kittens had not been retained by their owner at 1 year of age: 2 of these were from the control group. For the remainder, when the total number of cats' behaviours perceived by owners as problematic were compared between groups using a Mann–Whitney test, there were a greater number of owner reported "problem behaviours" in the control group than the socialised group (means of 1.6 and 1 problem behaviour respectively), although the difference was not statistically significant ( $Z = -1.942$ ;  $p = 0.52$ ). Due to low numbers of individual behaviour patterns, it was not possible to compare differences in prevalence between the two groups. However, when cats were classified according to whether they displayed one or more of 15 behaviours associated with a fear response towards people (see Table 3), 77% were in the control group, significantly more than the 35% in the socialised group (Pearson Chi-Square 4.142, d.f. = 1,  $p < 0.05$ ).

When the mean score for emotional support (ES) reported by owners was compared between the 'socialised' and 'control' groups using a Mann–Whitney test, it was found that ES was significantly lower in the owners of the control group (mean = 2.82) as compared to the socialised group (mean = 4.13) ( $Z = -2.868$ ,  $p < 0.05$ ).

To ensure that within litter effects were not responsible for overestimating the statistical significance of differences in fear of people and owner reported emotional support, these analyses were repeated using only one kitten selected randomly from each litter. As with the full data set, more kittens in the control group showed some form of fear behaviour to people (71%), than in the socialised group (38%), and the mean ES reported by owners was higher in the socialised group (4.09), than in the control group (3.18), although these differences were no longer statistically significant.

Individual behavioural responses to unfamiliar or loud noises, and, separately, dogs, were also combined. There was, however, no significant difference between socialised and control group cats with respect to their behaviour to noises or dogs. Because only a proportion of cats in the socialised group were exposed to noises ( $n = 4$ ) or dogs ( $n = 10$ ), the behaviour of these cats were compared with a combined group of unexposed cats from the socialised and control groups. However, there was still no significant difference between the groups.

Individual behavioural responses to unfamiliar or loud noises, and, separately, dogs, were also combined. There was, however, no significant difference between socialised and control group cats with respect to their behaviour to noises or dogs. Because only a proportion of cats in the socialised group were exposed to noises ( $n = 4$ ) or dogs ( $n = 10$ ), the behaviour of these cats were compared with a combined group of unexposed cats from the socialised and control groups. However, there was still no significant difference between the groups.

#### 4. Discussion

The term ‘socialisation’ has been used in the literature to refer to the process of interaction between animals and humans in adulthood, as well as during the early sensitive period for learning known as the ‘socialisation period’. Hennessey *et al.* (2006), for example, found a positive outcome from using a ‘socialisation’ programme in a prison setting for shelter dogs. In this paper, the term ‘socialisation’ is used specifically to refer to interaction with people that occurs specifically within the ‘socialisation period’. It is important to make this differentiation, as acceptance of human interaction in individuals with no previous experience of people, is likely to be very different during and after the ‘socialisation period’.

We did not attempt to measure at what age our additional socialisation was most effective. The conclusions of Karsh and Turner (1998) were used as a guide as to the age at which additional handling by people would have an optimal effect on adult behaviour in the design of this project. Some authors have criticised the use of chronological measures of behavioural development in other species (e.g. Webster, 1997), for example because of differences in rate of development between different breeds, or as a result of different complexities of environment. These effects were considered to be minimal in this study as all the cats used in the study were domestic short hairs, and were all exposed to a similar environment from 2 weeks of age. The existing data on sensitive periods for learning about handling by people in cats was therefore considered to be applicable in this study. Moreover, it would have been difficult to extend the additional socialisation programme beyond 8 weeks of age, because many of the kittens were homed soon after this. Had the socialisation continued for a further 2 months, further, or more pronounced differences between the two groups might have emerged, as suggested by the results reported by Lowe and Bradshaw (2002). No significant relationship was found between exposure to other stimuli, such as household noises, or a dog, to later patterns of behaviour. This is likely to be due to the low numbers of kittens in each group exposed to these stimuli, although it is possible that

the sensitive period at which kittens become habituated to these non-social stimuli may be chronologically distinct from the ‘socialisation period’.

In order to reduce genetic effects in this study, only two kittens were followed on from each litter enrolled onto the study. However, because of the study design, each sibling pair entered the same experimental group, and this may have confounded the results of the study. The importance of genetic effects on the behaviour of kittens was highlighted by Turner et al. (1986), and McCune (1992) reported that 1-year-old socialised cats born from a friendly father approached people more readily than those from a more fearful father. These effects are consistent with those found in a range of other species in both domesticated and wild populations, and appear to represent a ‘boldness–fearfulness continuum’ (Sloan-Wilson et al., 1994). Underlying personality traits or ‘behavioural styles’ have also been identified in adult cats. Lowe and Bradshaw (2001) investigated personality traits amongst adult cats, and found four elements of behavioural style that were consistent over time (from 4 months to 2 years). These underlying personality types appear to have an effect on the different strategies that cats show in response to environmental stressors (Casey and Bradshaw, 2005).

Ideally, a single kitten from each litter should have been followed up at 1 year of age: owners of two kittens were contacted in this case because of the large number of kittens lost to the project for various unavoidable reasons, in order to increase the overall sample size. The effect of relatedness between sibling pairs would also have been minimised had the study design allowed for the treatment group for individual kittens to be randomised. However, such a study design would have been practically difficult in the rescue shelter environment, particularly as the extra handling and monitoring for the project was conducted by staff in addition to their routine duties. It is acknowledged by the authors that the ‘half and half’ study periods, where all kittens were given additional handling for half of the study period and not in the other, is not an ideal experimental design, but was designed to make study as practicable as possible for centre staff. However, when the data were re-analysed using only one randomly selected kitten from each litter, the differences between groups were of a similar magnitude, suggesting that the inclusion of two kittens from each litter is not significantly confounding the differences between the socialised and control groups.

The results of this study tend to support the findings from other species of the importance of early social experiences on the subsequent display of fearful or aggressive responses in social situations. Markowitz et al. (1998), for example, found that lambs socialised to people showed a much greater affinity for people in tests carried out until 25 days of age than controls. Similar results were found when handled piglets were compared with an unhandled control group at 18 weeks of age (Hemsworth and Barnett, 1992). However, in contrast to a previous study (Hemsworth et al., 1986), Hemsworth and Barnett (1992) found that differences in response between handled and unhandled groups were no longer significant at 20-, 22- and 24-week tests. Differences in findings between these studies probably reflect differences in experiences of humans subsequent to the initial handling sessions (Hemsworth and Barnett, 1992), suggesting that positive experience of people can subsequently be reversed due to, for example, an aversive experience during routine management routines.

Care should be taken when extrapolating findings between species, however, as differences in timing of sensitive periods for learning are likely to have a profound impact on the influence of handling at a particular age. D’Eath (2005) found little evidence for a comparable ‘socialisation period’ in pigs to that seen in dogs and cats: rather, in his study investigating the effect of pre-weaning mixing of piglets on later intraspecific social behaviour, he found that previous experience of individuals from other litters improved the ‘social skills’ of pigs, such that their

ability to resolve situations of conflict and form stable relationships was enhanced. From an evolutionary perspective, the occurrence of a sensitive period for learning in the post-natal period, appears to be a ‘strategy’ adopted by altricial species, such as the cat, to increase their adaptability to a range of different environmental situations. In these species, the developmental period during which there is a massive expansion of neuronal development within the cortices of the brain occurs after birth. During this period, new cells which are not ‘used’ within a period of 1–2 weeks after mitosis are lost: only those that are activated are retained and integrated into the existing network of cells (Greenough et al., 1999). Hence, the developing animals’ interaction with their environment during this period has a profound effect on the synaptic pathways present as the individual enters its juvenile period.

In contrast, this period of neuronal development occurs largely in utero in precocial species, where the young are born at a later stage of development in terms of motor, sensory and cognitive capabilities. This ‘strategy’ is more important in prey species, where it is important for the young to be active enough to avoid predators as soon as possible after birth. The ‘cost’ of this strategy, however, is the reduced adaptability to the environment into which the individual is born. In the sheep and horse, therefore, the equivalent period of neurological development, described as the ‘socialisation period’ in the dog and cat, is likely to occur pre-natally, or may be just closing in the very immediate post-partum period. Markowitz et al. (1998) found that the contact with people in the 1–3-day treatment group was most effective at reducing timidity to people. Similarly, mares will actively keep their newborn foals away from other members of the social group for the first 24 h of life, a behaviour that is assumed to enhance the bonding process between mother and foal (Crowell-Davis and Weeks, 2005). Williams et al. (2002, 2003) evaluated the effectiveness of ‘imprint training’, where foals undergo a wide range of intensive handling procedures shortly after birth, and concluded that there was no positive effect on subsequent handling tests. However, there is also good evidence (e.g. Visser et al., 2002) that continued gentle handling over their first months of development, and after weaning (e.g. Landsade et al., 2004), is important in improving horses’ response to handling and exposure to novel stimuli later in development. These findings suggest that, in contrast to the dog and cat, these precocial species may have a very brief period of sensitivity to learning in the first days of life, but are unlikely to have a prolonged period in which they are particularly plastic to accepting new social contacts. In these species, as after the ‘socialisation period’ in the dog and cat, individual animals will learn positive or negative associations with the approach of people, depending on their perception of the encounter.

The kittens receiving additional socialisation were evidently less fearful than the controls at 1-year-old, and their owners may have been more strongly attached to them, if this reflects the greater degree of emotional support they experienced. This finding tends to support that of Serpell (1996), who found a relationship between owner reported levels of attachment and pet behaviour. However, the attachment owners feel for their cats is inevitably complex and influenced by a number of factors. Bradshaw et al. (2001), for example, found that owner reported levels of emotional support from their pet were highest in cats with more than 5 ‘problem’ behaviours, although the owners in this category may have been a ‘residual’ population who kept their cats due to a high level of attachment, despite their behaviour problems. The friendliness of adult cats towards humans does appear to be an important factor in the establishment of a strong owner–pet bond, and the retention of the pet by the owner. Further studies would be required to elucidate whether these two effects are connected, though it seems likely that owners would find it less easy to form strong attachments to fearful kittens compared to confident kittens.



## 5. Conclusions

This study highlights the benefits of expanding socialisation beyond that provided as a by-product of routine care within rescue and re-homing centres on the behaviour of cats towards people 1 year after re-homing. In addition, it provides some evidence that the relationship between owner and adult cat is influenced by the socialisation experiences of the latter. Since mismatches between owners' expectations and the actual behaviours shown by cats appear to be an important risk factor in relinquishment to rescue facilities (Miller et al., 1996; Patronek et al., 1996), adequate socialisation is likely to be an important factor in the retention of cats within homes. Matching early experiences as closely as possible with those likely to occur in adulthood is therefore a fundamental responsibility for rescue shelters as well as commercial cat breeders.

## Acknowledgements

The authors would like to sincerely thank Cats Protection for their support of this project. Cats Protection fund Rachel Casey's position, and the charity also supported this project through the provision of facilities and staff time. We would also like to thank the individual members of staff and volunteers in all the shelters involved in this study: it was their dedication and enthusiasm that made this project possible.

## References

- Archer, J., 1997. Why do people love their pets? *J. Evol. Hum. Behav.* 18, 237–259.
- Bateson, P., 1979. How do sensitive periods arise and what are they for? *Anim. Behav.* 27, 470–486.
- Bradshaw, J.W.S., Limond, J., 1997. Attachment to cats and its relationship with emotional support: a cross cultural study. In: Tufts Center for Animals & Public Policy (Ed.), Proceedings of the 1997 ISAZ Conference, Boston, MA, July 24–25, pp. 12–13.
- Bradshaw, J.W.S., McDonald, J., Casey, R.A., 2001. Undesirable behaviour by pet cats is related to emotional support as reported by their owners. In: Bradshaw, J.W.S., Frederickson, M., Turner, D.C. (Eds.), Proceedings of the 9th International IAHAIO Conference. Rio de Janeiro, Brazil p. 40.
- Casey, R.A., Bradshaw, J.W.S., 2005. The assessment of welfare in cats. In: Rochlitz, I. (Ed.), *The Welfare of Cats*. Springer, Dordrecht, pp. 23–46.
- Collard, R.R., 1967. Fear of strangers and play behaviour in kittens with varied social experience. *Child Dev.* 38, 877–891.
- Crowell-Davis, S.L., Weeks, J.W., 2005. Maternal behaviour and mare–foal interaction. In: Mills, D.S., McDonnell, S.M. (Eds.), *The Domestic Horse: The Origins, Development and Management of its Behaviour*. Cambridge University Press, Cambridge, pp. 126–138.
- D'Eath, R.B., 2005. Socialising piglets before weaning improves social hierarchy formation when pigs are mixed post-weaning. *Appl. Anim. Behav. Sci.* 93, 199–211.
- Greenough, W., Cohen, N., Juraska, J., 1999. New neurons in old brains: learning to survive? *Nat. Neurosci.* 2, 203–205.
- Hemsworth, P.H., Barnett, J.L., 1992. The effects of early contact with humans on the subsequent level of fear of humans in pigs. *Appl. Anim. Behav. Sci.* 35, 83–90.
- Hemsworth, P.H., Barnett, J.L., Hansen, C., Gonyou, H.W., 1986. The influence of early contact with humans on subsequent behavioural responses of pigs to humans. *Appl. Anim. Behav. Sci.* 5, 55–63.
- Hennessey, M.B., Morris, A., Linden, F., 2006. Evaluation of the effects of a socialization programme in a prison on behaviour and pituitary–adrenal hormone levels of shelter dogs. *Appl. Anim. Behav. Sci.* 99, 157–171.
- Karsh, E.B., Turner, D.C., 1998. The human–cat relationship. In: Turner, D.C., Bateson, P. (Eds.), *The Domestic Cat: The Biology of its Behaviour*. Cambridge University Press, Cambridge, pp. 67–81.
- Kuo, Z.Y., 1930. The genesis of the cat's response to the rat. *J. Comp. Psych.* 11, 1–35.
- Landsade, L., Bertrand, M., Boivin, X., Bouissou, M.-F., 2004. Effect of handling at weaning on manageability and reactivity of foals. *Appl. Anim. Behav. Sci.* 87, 131–149.

- Lowe, S.E., Bradshaw, J.W.S., 2001. Ontogeny of individuality in the domestic cat in the home environment. *Anim. Behav.* 61, 231–237.
- Lowe, S.E., Bradshaw, J.W.S., 2002. Responses of pet cats to being held by an unfamiliar person. *Anthrozoös* 15, 69–79.
- Markowitz, T.M., Martin, R.D., Gursky, K., Price, E.O., 1998. Early handling increases lamb affinity for humans. *Anim. Behav.* 55, 573–587.
- McCune, S. 1992. Temperament and the welfare of caged cats. Ph.D. Thesis, University of Cambridge, UK.
- McCune, S., 1995. The impact of paternity and early socialisation on the development of cat's behaviour to people and novel objects. *Appl. Anim. Behav. Sci.* 45, 109–124.
- McCune, S., McPherson, J.A., Bradshaw, J.W.S., 1995. Avoiding problems: the importance of socialisation. In: Robinson, I. (Ed.), *The Waltham Book of Human–Animal Interaction: Benefits and Responsibilities of Pet Ownership*. Pergamon Press, Oxford, pp. 87–97.
- Mendl, M., Harcourt, R., 2000. Individuality in the domestic cat: origins, development and stability. In: Turner, D.C., Bateson, P. (Eds.), *The Domestic Cat: the biology of its behaviour*. 2nd ed. Cambridge University Press, Cambridge, UK, pp. 179–190.
- Miller, D.D., Staats, S.R., Partlo, C., Rada, K., 1996. Factors associated with the decision to surrender a pet to an animal shelter. *JAVMA* 209, 738–742.
- Patronek, G.J., Glickman, L.T., Beck, A.M., McCabe, G.P., Ecker, C., 1996. Risk factors for relinquishment of cats to an animal shelter. *JAVMA* 209, 582–588.
- PFMA, 2000. Pet Food Manufacturers' Association report, London.
- Serpell, J.A., 1996. Evidence for an association between pet behaviour and owner attachment levels. *Appl. Anim. Behav. Sci.* 47, 49–60.
- Sloan-Wilson, D., Clark, A.B., Coleman, K., Dearstyne, T., 1994. Shyness and boldness in humans and other animals. *TREE* 9, 442–446.
- Turner, D.C., Feaver, J., Mendl, M., Bateson, P., 1986. Variation in domestic cat behaviour towards humans: a paternal effect. *Anim. Behav.* 34, 1890–1901.
- Visser, E.K., van Reenan, C.G., van der Werf, J.T.N., Schilder, M.B.H., Knaap, J.H., Barneweld, A., Blokhuis, H.J., 2002. Heart rate and heart rate variability during a novel object test and a handling test in young horses. *Physiol. Behav.* 76, 289–296.
- Webster, S.D., 1997. Being sensitive to the sensitive period. In: Mills, D.S., Heath, S.E., Harrington, L.J. (Eds.), *Proceedings of the First International Conference on Veterinary Behavioural Medicine*, Birmingham, UK, April 1–2, pp. 20–27.
- Williams, J.L., Friend, T.H., Toscano, M.J., Collins, M.N., Sisto-Burt, A., Nevill, C.H., 2002. The effects of early training sessions on the reactions of foals at 1, 2 and 3 months of age. *Appl. Anim. Behav. Sci.* 77, 105–114.
- Williams, J.L., Friend, T.H., Collins, M.N., Toscano, M.J., Sisto-Burt, A., Nevill, C.H., 2003. The effects of an imprint training procedure conducted at birth on the reactions of foals at six months of age. *Eq. Vet. J.* 35, 127–132.
- Zasloff, R.L., Kidd, A.H., 1994. Attachment to feline companions. *Psych. Rep.* 74, 747–752.