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The Science Behind Feline Socialisation

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Introduction

Friendliness towards people in cats is an important factor in their success as companion animals (Archer 1997). However, their response to people varies considerably from cat to cat (Karsh and Turner 1988), being influenced by complex interactions between genetic characteristics and experiential factors (Mendl and Harcourt 2000). It is well established that sensitive periods, where plasticity to learning about environmental stimuli is more pronounced, occur in many species (Bateson, 1979). In cats, 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.

The aim of this lecture is to examine the neurobiological processes that underlie the behavioural plasticity at this time and consider why such a period might be adaptive in the cat. In addition, we address when the 'socialisation period' occurs in cats, and how we can use this period to optimise cats' ability to live within a domestic environment.

What is 'socialisation'?

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 interactions with people that occurs specifically within the early sensitive period for learning. 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'.

'Socialisation period' tends to be used in both general and scientific literature because the majority of research conducted in this area has investigated the effect of manipulations in social behaviour towards humans. However, it is unlikely that the plasticity for learning during this period is specific to interactions with people: exposure to other events during this period is also likely to influence behaviour in adulthood, as evidenced by exposure to fireworks being protective against the development of noise phobias in dogs (Blackwell et al. in press). The term 'sensitive period' as used by Bateson (1979) could therefore be argued to be a more appropriate term than the commonly used 'socialisation period'.

Neurobiological changes in the sensitive period

The enhanced capacity for learning during the sensitive period results in the development of neural circuitry which can last through life (Bottjer 2004). The rapid production of neural cells that starts in gestation, and reaches a maximal rate during the early post-natal period (Altman and Bayer 1990) is thought to be the neurobiological process underlying the enhanced learning that occurs during this period. This rapid neurogenesis leads to high numbers of immature nerve cells which have unique characteristics. They grow rapidly and send out masses of axons to connect with other neurons (Gaarskjaer 1986). In this massive increase in neurons, there is a competition for survival: it is only those that send out axons which synapse with other neurons that survive (Oppenheim 1991), the rest dying within two weeks of mitosis (Greenough et al. 1999). The resulting network of neurons, therefore, is made up of cells that are 'used' during the developmental stages. In this way the pathways in the brain as the individual heads into adulthood are those best suited to the kinds of stimuli present in the environment encountered in the early weeks of life.

Other aspects of these immature cells also appear to enhance their ability to form synapses. Long term potentiation (LTP) at granule cell synapses occurs relatively early in post-natal development, enabling changes in synaptic strength to last approximately five times longer than in adulthood (Durand et al. 1996). Giant depolarising action potentials occurring in response to activation of perforant pathways have also been identified, which lead to greater influences on post-synaptic cells than would occur in mature cells (Leinekugel et al. 1998). In addition, there is a different response to activation of GABA_A receptors in immature and mature cells: in immature cells GABA acts as an excitatory transmitter, working in a similar way to glutamate as AMPA receptors would in mature cells (Ben-Ari et al. 1997). The experiences of an animal during this period, therefore, not only influence the pattern of cellular networks, but the pathways formed as a result are stronger than those formed at any other time of life. The profound effects of experiences at this time are illustrated by the large number of studies that have investigated the impact of aversive early experiences on adult behaviour in both humans and animals (e.g. Sanchez 2006).
What is the advantage of sensitive periods?

There are, therefore, good neurobiological reasons for the remarkably enhanced learning about environmental cues that is observed in the post partum period in both dogs and cats, and its subsequent impact on adult behaviour (Appleby et al. 2002). Clearly, such a potent biological process would not be conserved across a wide range of species if it did not have adaptive value (Bateson et al. 2004). In addition, it is adaptive for the degree of plasticity to be related to the predictability of the future environment (Sih et al. 2004). From an evolutionary perspective, therefore, 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. For those species where early environment does not predict later environment, selection will tend to favour a low level of plasticity (Sih et al. 2004). Hence, 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.

Therefore, in situations where the features of the environment at the time of birth reliably predict those experienced in adulthood, a high degree of plasticity in early life should be advantageous (Bateson et al. 2004). Since the environment in which the ancestors of both the cat evolved was likely to have been stable enough to support this strategy phenotypic plasticity would have been highly adaptive in this species, enabling the 'fine tuning' of the behavioural phenotype of the individual to the environment it would inhabit in the future (Zhang et al. 2004). This means that kittens could be born in a range of different environmental circumstances, with the behavioural plasticity to adapt to the environment in which they are born.

The socialisation period in cats

Cats have been recognised for some time as having a sensitive period, during which experiences appear to have a long term effect on behaviour (Casey and Bradshaw 2008). McCune (1995) demonstrated beneficial effects on the latency to approach both familiar and unfamiliar people at one year of age, by handling kittens for five hours per week between 2 and 12 weeks of age. A programme of additional handling for kittens in rescue centres had a significant effect on owner reported occurrence of both fearful behaviours in the cats, and emotional support received by owners from their cats (Casey and Bradshaw 2008).

Research by Collard (1967) suggests that handling by multiple people enhanced the likelihood that kittens would be friendly towards a stranger, suggesting that multiple different experiences enhance individual's ability to generalise responses to stimuli with similar characteristics. 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), suggesting that discrimination also occurs during this period.

In a series of experiments, Karsh (reported in Karsh and Turner, 1988) identified the socialisation period in cats as beginning at 2 weeks of age, and coming to an end at about 7 weeks of age. In addition, she determined that increasing the period of handling from 15 to 40 minutes per day significantly increased the period of time kittens spent in close contact with testers at 14 weeks of age (Karsh and Turner, 1988).

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 two months or so. Differential effects of the amount of handling received during the socialisation period on reaction to handling have been detected at four 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 four months of life (Lowe and Bradshaw, 2002).

Matching early and adult environments

The obvious drawback of enhanced phenotypic plasticity is where the early environment is not similar to that experienced later in life, a situation Bateson and colleagues (2004) term 'phenotypic mismatch'. In wild populations this type of situation can occur when 'one off' events, such as flooding or fires, cause unpredictable environmental changes (Macrì and Würbel 2006). However, in the domestic situation, mismatches occur much more frequently because of human interventions. In fact the whole process of breeding and rearing cats in one environment, and then moving them to a different one towards the end of the sensitive period tends to predispose to such mismatches. Kittens developing an expectation of what should be 'normal' in their environment during their first eight weeks of life may then be moved to an environment which is entirely novel to them – clearly a situation of welfare concern.

It is therefore essential that kittens are exposed to many of the contexts and experiences that they are likely to encounter as adults in a domestic environment as possible. This should involve positive interactions with a wide range of people (i.e. both sexes, different ethnic origins, different ages of children), as well as
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It is important to remember when considering the impact of this period of adult behaviour that the experiences of the kitten in this period need to 'match' those likely to be experienced later in life. As well as exposure to specific events or social contacts, it is important to consider cats' expectations of their daily routine. In practice, the routine of many cats after homing will often involve long periods of time when their owners are out of the house, or times when owners are present but occupied with other things. Making the early life of a kitten very interactive and exciting, therefore, will not necessarily be a good match for its experiences after homing.

Conclusions

Since the socialisation period is mainly when kittens are in their maternal environment, the effect of breeder environment is likely to be even greater for cats than dogs. A kitten homed at eight weeks is coming towards the end of its sensitive period for learning, whereas in a similar aged puppy the sensitive period will continue for several weeks, and the new owner has more opportunity to give it a range of appropriate experiences. The education of cat breeders, and those who manage rescue shelters, about the importance of matching early experiences with those likely to occur in adulthood (i.e. aspects of the domestic environment) is therefore particularly important (Casey and Bradshaw 2008).

References


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