

EDITORIAL

Caring for the brains of young pups

Karen L. Overall

VETERINARY surgeons, dog trainers, dog breeders and rescue services frequently, often automatically, recommend that puppies are 'socialised'. What this means, why it's important and how 'socialisation' should be executed are often left undiscussed. In a paper summarised in this week's issue of *Veterinary Record*, Pierantoni and others (2011) strongly suggest that if we are interested in the welfare and behavioural health of puppies, and in keeping patients in our practices rather than in shelters or our freezers, few discussions are more important.

Classic research by Scott, Fuller and colleagues (summarised in Scott and Fuller 1965) generated the following broad conclusions, which are implicit in our recommendations today.

- From birth to 13 days old puppies are dependent on rudimentary locomotor skills, and use tactile signals to locate and orientate towards dams and littermates. If separated from dams, puppies vocalise. Olfactory ability is present, but is poorly characterised in dogs at this age.
- Mild stress of daily/early handling is beneficial for puppies and allows them to better cope with later stresses. Excessive stress should be avoided because chronic, excess secretion of adrenocorticotrophic hormone has been correlated with a decreased ability to learn.
- From days 13 to 20 dogs become more coordinated, open their eyes, and begin to startle to sound. The change in motor abilities coincides with eruption of teeth at

approximately day 20 and with improved vision.

- Tail-wagging behaviour appears at the end of this 20-day period, varying greatly by breed.
- If pups are exposed to passive observers, beginning at three weeks, they will approach and explore the observer.
- If pups are not exposed to passive observers until seven weeks of age, they must habituate to the observers before they approach and explore, a process reported to take two days in the laboratory.
- Dogs isolated from people through to 20 weeks become fearful of them and have impaired learning ability. Even if kept with their dams, by 12 weeks of age puppies chose to wander extensively.
- Pups kept only in kennels beyond 14 weeks become timid in any circumstances other than that kennel, often exhibiting true neophobia.

Using these data, the inclusive period from three to 12 weeks has been deemed the 'socialisation period', within which are often cited context-specific developmental periods for exposure to other dogs, humans and novel environments (belying the definition of 'socialisation'). Unfortunately, these periods have been treated prescriptively with respect to the types and extent of exposure thought to be required to produce 'normal' dogs, with little critical thought or data collection. While it is a small study with preliminary results, the study by Pierantoni and others (2011) has made an important contribution to these data.

We may wish to view such findings and recommendations within the context of a 'sensitive period' (Bateson 1979), which implies risk assessment. A 'sensitive period' is the period when animals may best benefit

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from exposure to certain stimuli, and where, if deprived of such exposure, there is an increased risk of developing problems attendant with the stimulus. In other words, when animals are neurodevelopmentally able to respond to stimuli, they will benefit from exposure of which they will avail themselves, if possible. Lacking exposure, behavioural problems associated with the omission could develop (Bateson 1979, Cairns and others 1985). It is this concept of risk assessment that Pierantoni and others (2011) have elucidated. We now know enough about the molecular biology of neurodevelopment to suggest why such patterns are important.

Pierantoni and others (2011) showed that when 70 adult dogs which, as puppies, had been separated from their dam and litter from 30 to 40 days were compared with 70 adult dogs which, as puppies, were not separated until after eight weeks, early age of separation was a significant predictor for excessive barking, fearfulness on walks, reactivity to noises, toy possessiveness, food passiveness and attention-seeking behaviour. Early adopted dogs were also more at risk for destructive behaviour than were those that had been permitted to stay with their litter through to eight weeks (Pierantoni and others 2011).

There are few data on the effects of anxiety on learning in dogs, but we know from studies on rodents and human children that chronic glucocorticoid excess – at any time, including pre- and perinatally – interferes with learning at the cellular level (Yau and others 2002). Such chronic glucocorticoid exposure also appears to affect the structural development of the hippocampus (the brain region responsible for associational learning and its further integration into cortical function) and the amygdala (the region responsible for developing and modulating fear) (LeDoux and others 1990, Davis 1997, Schafe and others 2001, Carter and others 2002, Wittenberg and Tsien 2002, Gogolla and others 2009).

Chronic cortisol elevation appears to act as a translational gene regulator, a hormonal response element, that interferes with acquisition and consolidation of task learning in regions of the hippocampus (Lubin and others 2008). Prenatal stress and chronic ongoing stress in rats leads to lower levels of extinction of cue-conditioned fear (Green and others 2011), causes shrinkage of the hippocampus, leading to memory impairment, and facilitates fear conditioning in the amygdala, especially for consolidation of auditory fear conditioning (Bisaz and Sandi 2010). These effects may be more pronounced in some genetic backgrounds (Carola and Gross 2010).



Exposure of nine-week-old Labrador retriever puppies to new environments and toys, other dogs and people, as part of a workshop for veterinarians about puppy behavioural development. The dogs shown were being raised to be explosive detection dogs

These studies suggest potential mechanisms for Pierantoni and others finding that puppies separated early experienced more fearfulness on walks, reactivity to noises and overall enhanced reactivity as adults than did those allowed to stay with their dams and littermates. One has to wonder whether those people willing to rush pups out the door act on any concept of providing the best environment for the bitch, and hence the pups, during pregnancy. If early adoption co-occurs with less-than-optimal breeding and pregnancy practices, pups can have real problems.

Prenatal exposure to maternal stress causes epigenetic methylation of glucocorticoid receptor promoter regions, which leads to hyper-reactivity in rodents and human beings (Radtke and others 2011). In rodents, hippocampal expression of the glucocorticoid receptor gene and behavioural responses to stress are modulated by the amount of care mothers give their young in the first few days of life (Weaver and others 2004), a process that I would postulate probably also occurs in dogs. These studies show that task learning can be enhanced when stress and distress are mitigated. Raising puppies with their siblings and dam through 70 days, a time when most brain myelination is complete, but when neuronal remodelling should be rapidly ongoing, provides such mitigation.

These emergent, complex neurobiological findings can be distilled to a few simple guidelines for breeding and raising pups. Considering the enhanced risk of relinquishment, abandonment and euthanasia for dogs with any behavioural concerns, welfare and behavioural standards – including those currently being developed by the UK Advisory Council on the Welfare Issues of Dog Breeding – should mandate that puppies remain with their litters in the home of the dam and with access to the dam through to at least eight weeks of age, and that puppies,

bitches and dams be exposed to humane conditions that minimise the risks of excess stress and fear.

Simply by caring for their developing brains, we spare pups the risk of debilitating, tragic and often lethal behavioural problems and avoid lives marked by profound fear and reactivity. Is this really so complex?

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