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The effect of conspecific removal on the behaviour and physiology of pair-housed shelter dogs

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ABSTRACT

Dogs (*Canis familiaris*) are a highly social species and within a shelter environment pair-housing is recommended to prevent the stress associated with social isolation. Separation of individuals which may have formed bonds in this environment is a usual occurrence, as a result of rehoming or euthanasia. To investigate the impact of separation, the behaviour, cognitive bias, faecal S-IgA and cortisol levels were examined in 12 adult pair-housed dogs, maintained in a private animal shelter. Prior to separation, dogs engaged in more affiliative than agonistic behaviour with conspecifics (means of 3 and 0.1% of time respectively). Following separation, increased activity was observed in the form of more running and grooming ($P = 0.02$), circling ($P = 0.006$), figure of 8 movement ($P = 0.01$), posture changes ($P = 0.003$) and stretching ($P = 0.005$), and less play behaviour was observed ($P = 0.01$). Secretory IgA increased ($P = 0.02$) after separation (mean = 443.7 ± 182.5 ng/mL; before separation mean = 370.1 ± 108.2 ng/mL). Cortisol concentrations were not affected by separation ($P = 0.26$, mean before separation = 792 ng/g; mean after separation = 874 ng/g). There was no indication from cognitive bias testing that the dogs' emotional valency was affected, as latencies to reach ambiguous cues before and after separation did not differ significantly ($P = 0.33$). These results demonstrate that separation of a dog from a conspecific negatively affected behaviour and stimulated the immune system, changes which could be indicative of stress.

1. Introduction

For social animals, separation from conspecifics has negative physiological (Boissy and Le Neindre, 1997; Guesdon et al., 2012; Hennessy, 1997) and behavioural (Donaldson et al., 2002) effects on the animals' ensuing welfare states (Newberry and Swanson, 2008). Dogs (*Canis familiaris*) form strong social bonds with conspecifics, the function of which, from an evolutionary perspective, is to maintain relationships essential for survival (Archer, 1999; Topál et al., 2005). Attachment between mother and offspring is the most commonly documented social bond in animals (Newberry and Swanson, 2008; Mogi et al., 2011), however, separation of conspecifics is also documented to result in pronounced behavioural changes, suggestive of distress, in a range of species. For example primate species, including chimpanzees (Bard and Nadler, 1983) and bonnet macaques (Boccia et al., 1997), many farm animal species (Rault, 2012), including goats (Lyons et al., 1993), cattle (Boissy and Le Neindre, 1997; Flower and Weary,

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2003) and sheep (Guesdon et al., 2012), and some companion animal species, including horses, donkeys (Murray et al., 2013) and dogs (Hepper, 1994; Ward et al., 2008) all show behaviour indicative of distress when separated. For dogs, these behavioural responses can include withdrawal, inactivity, stereotypic behaviours, increased vocalisations and increased cortisol measures (Beerda et al., 1999b; Hennessy et al., 2001; Wells, 2004).

Traditionally, the physiological impact of conspecific separation has been assessed by evaluating activation of the HPA axis, through the measurement of cortisol. Fluctuations of cortisol resulting from separation have been documented in numerous species, as well as across a range of social relationships (for a review see Hennessy, 1997). More recently, the response of an animal's immune system to acute and chronic stressors has also been considered. IgA is present in the mucosal membranes of the intestinal, respiratory, biliary and genital tracts and is the dominant immunoglobulin in mucosal secretions of dogs (Stokes and Waly, 2006). In dogs, IgA concentrations have been documented to increase as a result of experiencing acute stress (Kikkawa et al., 2003) and decrease as a result of chronic stress (Skandakumar et al., 1995).

The effect of emotional states on cognition is well documented in humans (Mathews and MacLeod, 1994; Mellers et al., 1999). Recently, in animals, the term 'cognitive bias' has been coined to describe the possible role played by emotions in an animal's cognitive processing. It is based on the idea that when an animal evaluates a situation with ambiguous stimuli, its emotional valence affects its interpretation of the situation and possible outcomes (Broom, 2010; Mendl et al., 2009). Using this methodology, emotional valence has been investigated in a range of mammal species (Burman et al., 2008; Douglas et al., 2012; Doyle et al., 2010a; Svendsen et al., 2012), including the domestic dog (Mendl et al., 2010; Müller et al., 2012; Titulaer et al., 2013), as well as in birds (Brilot et al., 2009; Wichman et al., 2012) and insects (Bateson et al., 2011). This body of research has demonstrated that animals in a negative emotional state, comparative to animals in a positive emotional state, are more likely to display pessimistic behaviour and vice versa. For example, cognitive bias methodology has successfully been used to identify dogs suffering from separation anxiety (Mendl et al., 2010).

Pair-housing of dogs is recommended within a shelter environment (Wells, 2004) due to the stress of social isolation (Beerda et al., 1997; Bergamasco et al., 2010; Hennessy et al., 1997). However, eventual separation is inevitable for most dogs (due to rehoming or euthanasia), and due to the social nature of this species we hypothesised that this would result in a negative experience, evidenced by increases in behaviours indicative of stress, increased cortisol, reduced IgA levels and more pessimistic responses during cognitive bias testing.

2. Materials and methods

2.1. Subjects

Twenty-four shelter-housed dogs (four entire males, five desexed males, 11 entire females and four desexed females), ranging in estimated age from 0.75 to 7 years (mean 2.18 ± SD 1.38) were included in this study. Eight of the dogs were purebred (Greyhound $n = 5$; Labrador $n = 1$; Griffon Terrier $n = 1$, German Sheppard $n = 1$) and the remainder crossbred. The subjects had been maintained in the same companion animal facility for a mean of 126 ± 29.4 days prior to the present study.

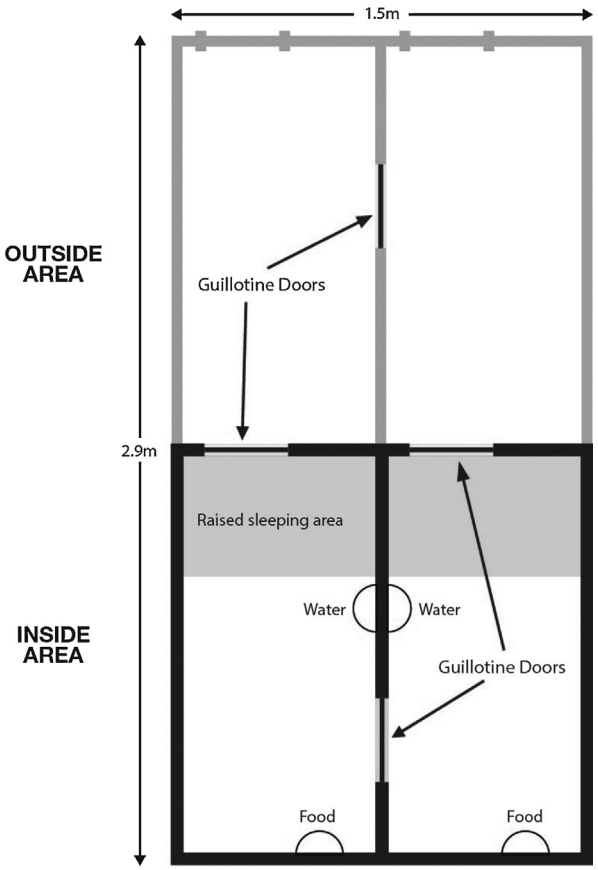

Fig. 1. A pair of kennel enclosures, showing guillotine doors to allow shared housing by the pair of dogs.

2.2. Housing

Only dogs involved in the study were housed across three allocated kennel blocks. Other dogs within the facility that were available for adoption were maintained in a different part of the facility with separate access. Each kennel had an indoor and outdoor section, both 2.9 m × 1.5 m (Fig. 1). There were three guillotine doors, one between the two sections and one in the side, both indoors and out, to allow access to the adjoining kennel for paired housing at all times except during cleaning (08:00–10:00 h and 15:00–16:00 h) and feeding (08:00 h and 14:00 h) when the dogs were separated into their individual kennels. Kennels had painted concrete flooring, and walls were a combination of solid plastic and wire mesh both indoors and out. The solid plastic component comprised two-thirds of the wall from the ground and acted to prevent contact (both visual