

Predator odour *per se* does not frighten domestic horses

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Abstract

Horses frequently react nervously when passing animal production farms and other places with distinctive smells, leading riders to believe that horses are innately frightened by certain odours. In three experiments, we investigated how horses respond to (1) urine from wolves and lions, (2) blood from slaughtered conspecifics and fur-derived wolf odour, and (3) a sudden auditory stimulus in either presence or absence of fur-derived wolf odour. The experiments were carried out under standardised conditions using a total of 45 naïve, 2-year-old horses. In the first two experiments we found that horses showed significant changes in behaviour (Experiments 1 and 2: increased sniffing; Experiment 2 only: increased vigilance, decreased eating, and more behavioural shifts), but no increase in heart rate compared to controls when exposed to predator odours and conspecific blood in a known test environment. However, the third experiment showed that exposure to a combination of wolf odour and a sudden stimulus (sound of a moving plastic bag) caused significantly increased heart rate responses and a tendency to a longer latency to resume feeding, compared to control horses exposed to the sudden stimulus without the wolf odour. The results indicate that predator odour *per se* does not frighten horses but it may cause an increased level of vigilance. The presence of predator odour may, however, cause an increased heart rate response if horses are presented to an additional fear-eliciting stimulus. This strategy may be adaptive in the wild where equids share habitats with their predators, and have to trade-off time and energy spent on anti-predation responses against time allocated to essential non-defensive activities.

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1. Introduction

Predation is a strong selective force leading to various adaptations in prey species. Many species have developed specific behaviours to facilitate recognition, avoidance and defence against predators. Such anti-predator behavioural systems are fundamental to survival, and natural selection has favoured mechanisms in prey to detect predators prior to their attack, increasing the probability of escaping or avoiding encounter (Kats and Dill, 1998; Apfelbach et al., 2005; Monclús et al., 2005). Anti-predator defence can involve responses to specific chemical cues that predators produce, and avoidance of predator odours, such as fur, urine, faeces, or anal gland secretions, has been observed in several mammalian species, particularly in rodents (for review see Apfelbach et al., 2005). It has also been shown that odour-induced unconditioned fear in rodents is associated with Hypothalamic-pituitary-adrenal (HPA) and amygdala activation (Dielenberg and McGregor, 2001; Li et al., 2004; Roseboom et al., 2007; Takahashi et al., 2007). Recent studies have suggested that skin and fur-derived predator odours may have a more profound and lasting effect on prey species than those derived from urine or faeces (Apfelbach et al., 2005). Studies on domestic herbivores, such as sheep and cattle, have demonstrated behavioural changes (Terlouw et al., 1998) and reduced feeding (Pfister et al., 1990; Arnould and Signoret, 1993; Arnould et al., 1993) in the presence of dog faeces. Highly distinctive smells, such as that of carnivore faeces, may however interfere with the experience of taste which may in turn cause reduced feeding, without the animal actually being frightened by the odour. Thus, both behavioural and physiological measures should be considered, because the body's immediate physiological reaction to perceived danger is characterised by activation of the sympathetic system (fight or flight response; Guyton and Hall, 1997; Korte, 2001). However, physiological measures have rarely been used in studies of predator recognition in herbivores because the majority of studies have been carried out in the field where such measures are difficult (Apfelbach et al., 2005; Monclús et al., 2005, 2006). In this study we have recorded behavioural reactions in combination with recordings of heart rate, which have been validated as a reliable and non-invasive physiological measure in horses during exposure to a stressor (Visser et al., 2002; Christensen et al., 2005, 2006; McCall et al., 2006).

Ungulates have co-evolved with their predators for millions of years in the wild, and like many other prey species they have evolved anti-predator responses both to actual encounters with predators and to generalised threatening stimuli, such as loud noises and sudden events (Frid and Dill, 2002). Equids typically live in open grasslands with a good view of the surrounding environment and they use vision as a major sensory avenue for detection of predators. Equids are also sensitive to auditory signals of danger, such as sounds of predators, and they have a good sense of hearing (Heffner and Heffner, 1983; MacDonald, 1995). In addition, equids may use olfaction as another modality through which predators can be detected and possibly identified. Chemical signals have been suggested to be involved in several equine processes such as individual identification, co-ordination and spacing of individuals both within and between social groups, mare-foal communication, navigation and orientation, sexual arousal and performance, as well as alarm signalling (Mills and Nankervis, 1999; Waring, 2003). Accordingly, there is a general belief among riders that horses are innately frightened by certain odours. However, we have currently no knowledge of whether horses do find certain odours aversive. A study by Christensen et al. (2005) showed that domestic horses reacted more to unknown visual and auditory stimuli compared to an unknown olfactory stimulus (eucalyptus oil). It is unknown, however, whether this lack in response applies to natural odours as well.

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