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The relationship between coat colour phenotype and equine behaviour: A pilot study

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ABSTRACT

Mutations in the genes influencing melanocytes not only affect the colour of an animal, but are also believed to impact physiological and behavioural functions. When this is taken into consideration, the common perception among horse owners that the chestnut coat colour is associated with adverse behaviours seems plausible. The aim of this study was to explore this perception by providing insight into any potential genetic associations between coat colour and adverse behaviours in horses. Data were acquired through an internationally accessible online questionnaire. Respondents provided information on their horse's behaviour during general handling, whilst being exercised, towards different stimuli in their environment and when isolated from other horses. Analyses considered behavioural data on 477 horses that represented a range of breeds, ages, and event disciplines. The breed, sex, and age of the horse significantly ($P < 0.05$) influenced many of the equine behaviours assessed in the questionnaire. Significant differences in behavioural responses between bay and chestnut horses were only present for four questions. No evidence was found to support that chestnut horses are more likely than bay horses to display behaviours often associated with training difficulties. However, chestnut horses were more likely to approach objects and animals in their environment, regardless of their familiarity. This suggests that selection for the chestnut phenotype in horses may have inadvertently involved selection for boldness and altered the way horses interact with their surroundings.

1. Introduction

Coat colour, one of the most noticeable features of an animal, has fascinated and intrigued mankind for centuries (Pruvost et al., 2011). Resulting from genetic mutations that affect pigment producing cells (melanocytes), unique variations in coat colour can often be seen as more desirable and routinely impact the value of an animal (Bellone, 2010; Gremmel, 1939; Haase et al., 2007; Marklund et al., 1996; Rieder et al., 2001; Thiruvenkadan et al., 2008). This is particularly apparent in the horse industry where some breeds are predominantly defined by the colour and colour patterns of their coats (American Paint Horse Association, 2015; Appaloosa Horse Club, 2015). Widespread innuendo and rumour also surround horses of certain colours with perhaps the most notable example being that chestnut horses, particularly those that are female, are "crazy".

While it is true that mutations in the genes involved in the development of melanocytes (e.g. melanocortin receptor or *MCR* genes) can lead to pleiotropic effects involving both physiological and behavioural functions (Bellone, 2010; Ducrest et al., 2008; Lin and Fisher, 2007), studies testing the hypothesis that chestnut horses are "crazy" are limited at best (Brunberg et al., 2013). However, in horses and many other vertebrates, melanocortin agonists bind to the same *MCR* gene that is responsible for red pigmentation – melanocortin 1 receptor (*MC1R*) (Ducrest et al., 2008; Marklund et al., 1996; Schioth et al., 2005). Because melanocortins also bind to melanocortin 2–5 receptors which are responsible for several physiological and behavioural functions, it is possible that the perceived link between the chestnut phenotype in horses and adverse behaviours may be warranted (Ducrest et al., 2008).

Differences in acute pain perception in mice and humans with mutations or variants in *MC1R* also suggest a link between the colour of a horse and its behaviour (Delaney et al., 2010; Mogil et al., 2005). If chestnut horses are more or less sensitive to pain, then their responses to stimuli such as a bit may differ from horses of other colours. In this paper we delve into this belief and

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Fig. 1. Coat colour classifications; A = Bay, B = Chestnut.

Table 1
Distribution of breeds, stratified by colour group.

	Bay	Chestnut
Arabian	17	15
Australian stock horse	20	11
Crossbred	47	24
Irish Sport Horse	7	4
Pony	6	7
Quarter horse	16	18
Thoroughbred	121	62
Warmblood	56	46
Total	**290**	**187**

Table 2
Distribution of sex, stratified by colour group.

	Bay	Chestnut
Females	78	60
Geldings	212	127
Total	**290**	**187**

explore possible associations between the chestnut coat colour and behavioural responses in the horse. This will provide insight into any potential genetic associations between coat colour and adverse behaviours in horses. As a result, equine industry professionals will be able to better understand why horses may have completely polar reactions to similar stimuli.

2. Materials and methods

2.1. Data collection

An owner questionnaire was designed to investigate a range of horse behaviours and was used for the behavioural assessment of each horse (Suppl. 1). Owner completed questionnaires have been shown to be an effective method of obtaining companion animal behavioural data, as owners have the opportunity to observe the animal daily in a variety of circumstances over a long period of time (Duffy et al., 2008). Epidemiological details regarding the experience and handling skills of the owner were obtained in the questionnaire as the impact of handler ability on animal behaviour is established (Chamove et al., 2002; Rooney and Cowan, 2011). To avoid biased responses, respondents were not privy to the aims of the study and the questions were designed to be neutral in their wording to avoid influencing the respondent's answers. The survey was built as a horse variant of the Canine Behavioural Assessment and Research Questionnaire (C-BARQ), a validated dog behaviour survey developed in 2003 as a standardized method of evaluating dog behaviour (Hsu and Serpell, 2003).

An online version of the questionnaire was provided from November 2013 to May 2014 (Suppl. 1). Approval for the study

Table 3
Minimum, mean, maximum and standard deviations of scores for behavioural responses where coat colour phenotype was significantly ($P < 0.05$) associated with the horses reported response.

	Minimum	Mean	S.D.	Maximum	Minimum	Mean	S.D.	Maximum
Question		Chestnuts				Bays		
Does the horse allow its feet to be picked up by a stranger	0	0.45	0.68	4	0	0.35	0.69	4
How does the horse approach familiar stationary objects	1	2.25	0.89	4	1	2.50	0.79	3
How does the horse approach unfamiliar animals	1	2.39	0.87	5	1	2.58	0.95	5
How does the horse approach familiar motorized objects	1	2.50	0.94	5	1	2.63	0.82	5

Table 4
P-values, variable values, and 95% confidence intervals for the chestnut phenotype variable for models where coat colour phenotype was significantly associated with the horse's reported response.

	P-value	Value*	95% C.I.
Question			
Does the horse allow its feet to be picked up by a stranger	0.018	0.637	0.27–0.99
How does the horse approach familiar stationary objects	0.001	−0.621	−0.99 to −0.25
How does the horse approach unfamiliar animals	0.025	−0.401	−0.75 to −0.05
How does the horse approach familiar motorized objects	0.039	−0.386	−0.75 to −0.02

* Value of the chestnut phenotype using the bay phenotype as the point of reference (Bay phenotype value = 0).