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Domesticated horses differ in their behavioural and physiological responses to isolated and group housing

Kelly Yarnell [a,*], Carol Hall [a], Chris Royle [a], Susan L. Walker [b]

[a] Nottingham Trent University, Brackenhurst Campus, Southwell, Nottingham NG25 0QF, United Kingdom
[b] North of England Zoological Society, Chester Zoo, Caughall Road, Upton-by-Chester CH2 1LH, United Kingdom

HIGHLIGHTS

- The impact of housing design on physiological and behavioural parameters was assessed.
- Group housing resulted in lower levels of faecal glucocorticoids.
- Horses were easier to handle whilst housed in designs that allowed social interaction.
- Social housing designs provided an improved standard of equine welfare.

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ABSTRACT

The predominant housing system used for domestic horses is individual stabling; however, housing that limits social interaction and requires the horse to live in semi-isolation has been reported to be a concern for equine welfare. The aim of the current study was to compare behavioural and physiological responses of domestic horses in different types of housing design that provided varying levels of social contact. Horses ($n = 16$) were divided equally into four groups and exposed to each of four housing treatments for a period of five days per treatment in a randomized block design. The four housing treatments used were single housed no physical contact (SHNC), single housed semi-contact (SHSC), paired housed full contact (PHFC) and group housed full contact (GHFC). During each housing treatment, adrenal activity was recorded using non-invasive faecal corticosterone metabolite analysis (fGC). Thermal images of the eye were captured and eye temperature was assessed as a non-invasive measure of the stress response. Behavioural analysis of time budget was carried out and an ease of handling score was assigned to each horse in each treatment using video footage. SHNC horses had significantly higher ($p = 0.01$) concentrations of fGC and were significantly ($p = 0.003$) more difficult to handle compared to the other housing types. GHFC horses, although not significantly different, had numerically lower concentrations of fGC and were more compliant to handling when compared to all other housing treatments. Eye temperature was significantly ($p = 0.0001$) lower in the group housed treatment when compared to all other treatments. These results indicate that based on physiological and behavioural measures incorporating social contact into the housing design of domestic horses could improve the standard of domestic equine welfare.

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1. Introduction

The predominant housing system used in domestic horses is individual stabling in box stalls that measure around 9–13 m^2 [26] and horses are often confined in these stalls for large proportions of the day. This type of management style is used for several reasons, including injury prevention and convenience for the owner [12]. To the human eye the stable appears safe and inviting and is based on an anthropomorphic belief of what the horse finds comfortable [17]. However, for a social animal that spends most of its time in close contact with con-specifics [4], the isolation due to single housing could potentially activate the stress response. Whilst this immediate physiological response can be considered adaptive, enabling horses to escape from danger, evidence suggests that stress related disease may be the result of repetitive or continuous activation of a system that has evolved to respond to acute emergencies [27].

In their natural habitat horses form harem bands that are typically comprised of mares and their foals, yearlings and one stallion [26] and these cohesive bands can roam areas of land up to 78 km^2 [13]. In contrast, domestic horses are kept in a variety of housing systems which offer differing levels of physical freedom, social opportunities and ability to forage which some horses find stressful. Changes in time budget [1] and manageability of horses [26] have been found to be associated

* Corresponding author.
E-mail address: Kelly.yarnell@ntu.ac.uk (K. Yarnell).

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with housing design which has implications on both equine wellbeing and the safety of the horse and handler.

The behaviour of horses in their natural state is often used to assess the welfare of domestic horses [32]. The assumption is that a healthy free ranging horse is likely to have adequate welfare as it has the opportunity to socialise, forage and display natural behaviour and a captive horse that is restricted in its expression of certain behavioural patterns may be a welfare concern. It is worth noting that a wild environment does not always offer optimum welfare and domestication has removed many dangers faced by wild horses including predation, hunger, thirst and some diseases. A more practical approach may be to use studies of wild or feral horses to identify those behaviours that are most important. This knowledge could then be used to modify management practices and housing design in order to allow natural behaviour to be performed [36].

A characteristic for the healthy unimpaired animal is repetition of daily routine [2] and studies report more or less identical time patterns of behaviour from day to day in stress free horses [20]. Allowing domestic horses the opportunity to display natural behaviour and managing horses in a way that reflects their natural habitat have resulted in horses displaying time budgets similar to those of wild horses. Paddock housed weanlings have been reported to display time budgets similar to feral horses and show strong motivation to be near con-specifics when compared to stalled weanlings, who spend significantly more time engaged in stereotypical behaviour [15]. Horses managed in ways that allow natural behaviour to be expressed have also shown improvements in response to training. Group housed horses took less time to complete a training procedure than horses singly housed in stalls. In addition, group housed horses showed less agonistic behaviour toward the trainer (biting and kicking) than singly housed horses [26].

Stereotypic behaviour in the horse may be associated with stress caused by an inadequate environment including housing type [21]. Stable design allowing visual contact between horses has been associated with a reduced risk of stereotypic behaviour [23] and increasing visual and tactile contact between horses significantly reduces weaving and nodding when compared to conventional stables where horses have no contact with one another [7]. In stabled horses the provision of an enrichment device that requires work to extract food with the aim of extending foraging time (Equiball) has also been shown to reduce stereotypic behaviour [16].

It seems that housing horses in a way that reflects their natural habitat and allows social interaction has benefits for equine wellbeing. Existing studies in this area have focussed only on first time stabling in young or recently weaned horses [15,28,33]. It is therefore important that current housing types are assessed objectively to evaluate their impact on adult equine physiology and behaviour. It is also important to assess new housing designs that allow natural behaviour to be displayed. This will allow adaptations to housing design to be made in order to reduce the impact of captivity.

Measuring glucocorticoids as an indicator of adrenal activity can increase understanding of the causes of poor welfare [5] and provides a more objective measure than behaviour alone. Monitoring adrenal activity through blood sampling can induce a stress response and potentially confound results, so non-invasive sampling methods are often preferred [6]. Faecal corticosterone assessment avoids sampling stress [18] and this form of analyses is better suited to long-term welfare profiling [30].

Infrared thermography (IRT) has recently been shown to provide an objective, non-invasive measure of the physiological response to an aversive situation in horses [37] through assessment of eye temperature change that correlated with increased salivary cortisol (an accepted measure of the stress response). Therefore, IRT was utilised during this study as an additional physiological measure.

The aim of this study was to assess the impact of housing design that provided differing levels of social contact upon 1) time budget, 2) adrenal activity using non-invasive faecal corticosterone metabolite analysis (fGC), 3) eye temperature and 4) ease of handling in domestic horses.

2. Materials and methods

2.1. Animals and husbandry

Horses of mixed breed ($n = 16$) aged 6 to 21 years (mean age: 15 years $\pm$ 3) consisting of eight geldings and eight mares, housed at Nottingham Trent University Equestrian Centre, Brackenhurst campus, Nottingham, United Kingdom were used in this study. The horses were ridden in the university riding school for a maximum of 2 h per day during term time. However, this study was conducted over the summer outside of academic term time; therefore, horses were not being ridden. One horse had been known to display stereotypical behaviour (cribbing) in the year before the study began. No other horse that took part in the study was known to display stereotypical behaviour. The study was given ethical approval by the School of Animal, Rural and Environmental Sciences at Nottingham Trent University.

2.2. Experiment design

The study was conducted over one month in August and each week, horses were exposed to one of four housing treatments ($n = 4$ horses/treatment according to gender) in a randomized block design for a period of five days. Following this the horses were turned out into grass paddocks in their experimental groups for two days before exposure to the next housing treatment. The four housing treatments were single housed no physical contact (SHNC), single housed semi-contact (SHSC), paired housed full contact (PHFC) and group housed full contact (GHFC) (see Table 1 for details of each housing type).

For each treatment horses were brought from their paddocks to the relevant housing at 1600 h and remained there until 1600 h the following day. This was to ensure that the first faecal samples collected were reflective of the change in environment from the paddock to the specific housing type. The horses were then walked back to their paddock by the

Table 1
The four housing treatments used in the study with differing levels of social and physical contact.

Housing treatment	Description
Group housed full contact (GHFC)	Horses were turned out in their experimental group of four into a paddock which had been grazed bare prior to commencement of the study. The horses had full physical contact with all other members of the group and had visual and auditory contact with horses in nearby paddocks.
Paired housing full contact (PHFC)	Horses were housed in pairs in a barn measuring 10 × 9 m. The barn lies adjacent to indoor single box stables which allowed the study horses visual and auditory contact with the horses stabled in them. In addition there were two horses housed in the neighbouring barn (from the same experimental group of four) which allowed visual and auditory contact through a wire partition separating the two enclosures. Each pair of horses had full physical contact with one another.
Single housed semi-contact (SHSC)	Horses were individually housed in box stables measuring 3 × 3.6 m with a solid wall to ceiling height at the rear. The front, sides and integrated sliding door of the stable measured a total height of 2.5 m with solid walls of 1.2 m high and vertical metal bars spaced at 5 cm apart for the remainder of the height. Visual, auditory and tactile communication with the neighbouring horse at either side was possible through the bars and the horses were also able to see their companions stabled opposite in the same housing treatment.
Single housed no contact (SHNC)	Horses were housed in box stables measuring 3 by 3.6 with 2.5 metre high solid brick walls to the rear and side. No contact with other horses was possible.

This table provides details of each of the four housing treatments used in this study which were group housed full contact (GHFC) in a paddock, paired housed full contact (PHFC) in a barn, single housed semi-contact (SHSC) in stables with bars and single housed no contact (SHNC) in traditional box stables. Horses were rotated in groups of four through each of the treatments for a period of five days per treatment.

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