Article

Not peer-reviewed version

Emotional Contagion in Human-Horse Interactions: Investigating the Role of Stress and Body Language in Emotional Transfer

Dan Manolăchescu , Mirela Tripon * , Cristian Crecan , Mariana Tătaru , Ionel Papuc

Posted Date: 24 February 2025

doi: 10.20944/preprints202502.1893.v1

Keywords: horse-human interactions; interspecific emotional contagion; body language; equine heart rate variability (HRV)

doi:10.20944/preprints202502.1893.v1

Article

Emotional Contagion in Human-Horse Interactions: Investigating the Role of Stress and Body Language in Emotional Transfer

Dan Manolăchescu [1], Mirela Tripon [2,*], Cristian Crecan [3], Mariana Tătaru [1] and Ionel Papuc [1]

[1] Department of Ethology, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine, Mănăștur St. 3-5, 400372 Cluj-Napoca, Romania
[2] Department of Reproduction, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine, Mănăștur St. 3-5, 400372 Cluj-Napoca, Romania
[4] Department of Surgery, Faculty of Veterinary Medicine, University of Agricultural Sciences and Veterinary Medicine, Mănăștur St. 3-5, 400372 Cluj-Napoca, Romania
* Correspondence: mirela.tripon@usamvcluj.ro ; Tel.: +40 728828748

Simple Summary: Horses are highly sensitive animals that can pick up on human emotions, but how they do this is still not fully understood. This study explored whether stress and anxiety in humans affect horses and if body language plays a key role in this emotional transfer. Researchers observed 33 interactions between humans and horses at equestrian centers. Participants were divided into two groups: those experiencing high anxiety and those with low anxiety. They interacted with horses in two ways—freely moving and expressing emotions naturally or following strict guidelines that limited their movements and expressions. The study found that when humans expressed stress freely, horses showed clear signs of reacting through changes in heart rate and behavior. However, when human body language was controlled, horses did not seem to notice the difference between stressed and calm individuals. This suggests that horses do not directly sense human stress but react to visible cues like posture and movement. These findings are important for horse trainers, riders, and therapy programs, as they show that using calm and controlled body language can create a more positive and stress-free experience for horses, improving their welfare and strengthening human-horse relationships.

Abstract: Emotional contagion in human-horse interactions has been widely studied, yet the role of body language in stress transfer remains insufficiently explored. This study examines whether human emotional states, particularly stress and anxiety, influence horses and whether the transmission occurs primarily through body language. Conducted across five equestrian facilities, the study employed a within-subjects design, assessing 33 horse-human interactions. Participants were classified into high-anxiety (HA) and low-anxiety (LA) groups based on State Anxiety Scale scores and heart rate variability (HRV) measurements. Two interaction conditions were tested: Free-Style (FS), where participants moved naturally, and Constrained-Style (CS), where movement and expression were restricted. Horses heart rate variability and ethogram scores were recorded at baseline, during contact, and after recovery. Results indicated that horses exhibited significantly higher response in HRV and ethogram scores for HA-FS interactions compared to HA-CS ($p < 0.05$), suggesting an increased physiological and behavioral response when human emotions were freely expressed. However, interactions in the CS condition showed no significant HRV or behavioral differences between HA and LA groups, implying that constrained body language mitigates emotional contagion. These findings suggest that horses do not inherently detect human stress but rather respond to body language cues associated with anxiety. The study highlights the importance of structured handling techniques to minimize stress transfer, with implications for equestrian training and therapy. By adopting controlled, neutral body language, handlers can create a more stable environment, enhancing horse welfare and optimizing human-horse interactions. This research contributes to the broader understanding of interspecies emotional dynamics and the necessity of mindful equine management practices.

Keywords: horse-human interactions; interspecific emotional contagion; body language; equine heart rate variability (HRV)

---

1. Introduction

The intricate bond between humans and horses has long fascinated scientists, practitioners, and enthusiasts alike. Horses (Equus caballus) are highly social and perceptive animals, capable of forming complex relationships both within their species and with humans [1]. Research has consistently highlighted the ability of horses to detect and respond to subtle emotional and behavioral cues from humans [2–4]. Emotional contagion, the process by which an individual's emotional state influences another's, represents a pivotal dimension of human-horse interaction [5].

The concept of emotional contagion between humans and animals stems from the broader psychological and physiological mechanisms that underlie empathy and social synchronization [6]. Studies on emotional contagion have shown that animals, including horses, can mirror human emotional states through behavioral and physiological changes, such as heart rate variability variability and cortisol levels [1,7]. Horses have demonstrated sensitivity to human facial expressions, vocal tones, and body language, indicating their capacity to perceive and respond to emotional signals [3,8–10]. The study of emotional contagion in human-horse interactions has gained increasing attention due to its implications for equine welfare, training, and therapy. Horses are highly sensitive to human emotional states, with research demonstrating that their responses can be assessed through behavioral and physiological indicators such as heart rate variability and cortisol levels [11].

This study is anchored in the hypothesis that humans with elevated levels of emotional arousal, as quantified by heart rate variability monitoring and the State Anxiety Scale [12], are prone to transferring their emotional state to a horse during moments of approach and contact. The underlying premise is that horses, as prey animals, are evolutionarily adapted to detect and react to stress cues from their environment, including those emanating from human handlers [13]. This sensitivity to human emotional states has significant implications for equine welfare, training practices, and the safety of human-equine interactions [14].

The main objective of this research is to elucidate whether emotional contagion occurs from humans to horses during direct contact with stressed human subjects.

Specifically, the study aims to investigate whether this transfer is mediated through human body language and other nonverbal cues. Previous studies have indicated that horses can synchronize their physiological states with humans, particularly during emotionally charged interactions [15,16]. While much of this research has focused on bidirectional interactions, the current study narrows its focus to the unidirectional transfer of stress-related emotions from humans to horses.

Horses' reactions to human stress can manifest in various ways, including changes in behavior, heart rate variability, and cortisol levels [4,7,17]. For instance, heightened stress in human handlers has been associated with increased heart rate variability and behavioral agitation in horses [15,18]. Body language is a critical medium through which stress and anxiety may be transmitted to horses. As noted by Birke [19], human posture, gestures, and movement patterns can significantly influence equine behavior. Stress-induced changes in body language, such as tense shoulders, abrupt movements, or inconsistent gait, may act as stressors for horses, triggering heightened vigilance or avoidance behaviors [4]. These interactions underscore the need for a deeper understanding of how horses perceive and interpret human nonverbal communication in emotionally charged contexts.

Furthermore, emotional contagion from humans to horses has practical implications for equine welfare and training. Stress in human handlers can compromise the horse's ability to learn, adapt, and perform effectively [4]. For instance, a stressed handler may inadvertently escalate a horse's fear response, thereby reducing training efficiency and potentially increasing the risk of accidents [18]. Enhanced understanding of horse–human interactions can contribute to optimizing equine welfare by considering factors such as sensory perception, cognition, and emotional states [20].

The research draws on methodologies that integrate physiological monitoring and behavioral analysis. Heart rate (HR) and heart rate variability (HRV) is used as a quantitative measure of physiological arousal in both humans and horses, providing insights into autonomic nervous system activity [21,22]. Concurrently, video analysis of human and horse interactions captures behavioral indicators of stress, such as ear position, tail movement, and locomotor activity in horses [23]. Facial expressions in horses are widely recognized as indicators of internal states, including pain and emotional responses, making them valuable tools for assessing welfare [24]. Horses can emotionally respond to observing positive and negative horse–human interactions in videos and apply this experience to real-life situations, demonstrating their ability to attribute valence to human experimenters [25].

In summary, this study addresses a critical gap in the literature on interspecies emotional dynamics by focusing on the unidirectional transfer of stress from humans to horses. By exploring the role of body language and physiological signals in mediating this transfer, the research aims to contribute to the growing body of knowledge on human-animal interactions. The findings have the potential to inform best practices in equine management, training, and welfare, ultimately fostering healthier and more harmonious relationships between humans and horses. The hypothesis of this study was that humans with a high level of emotional arousal (stress, anxiety, fear - quantified by an HRV monitor and the State Anxiety Scale) transfer their emotional state to a horse during approach/contact. This study aims to determine if this transfer occurs primarily through body language.

2. Materials and Methods

2.1. Study Design

- Participants and Setting:

This study examines 33 horse-human interactions across five facilities in Transylvania, Romania. The distribution of interactions is as follows: Faculty of Veterinary Medicine, Cluj-Napoca (n=17), Equestrian Center, Sălicea (n=10), Equestrian Center, Micești (n=6)

Human participants were recruited from volunteer students of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca and volunteers from equestrian centers. No alterations were made to the horses' routine activities, such as diet, daily training, or interaction with humans and conspecifics, prior to the study.

To ensure consistency across interactions, all experiments were conducted in a controlled environment. The study took place in enclosed stable areas with minimal external disturbances. Environmental factors such as temperature, lighting, and background noise were monitored and kept within a stable range throughout the study. No other human observers, aside from the research team, were present during the interactions to prevent unintended influences. Horses were given time to acclimate before testing, and interactions were scheduled at similar times of the day to minimize variations in physiological responses due to circadian rhythms.

To reduce the potential influence of olfactory and auditory cues, all human participants were required to follow a standardized protocol before their interactions. Participants refrained from using perfumes, strong-smelling personal care products, or consuming substances that could alter body odor (e.g., caffeine, nicotine) at least **2** hours before testing. Additionally, participants remained silent during interactions to eliminate variations in vocal tone as a confounding factor. The presence of other horses or humans outside the test area was minimized to prevent auditory distractions, ensuring that equine responses were primarily influenced by the visual and tactile aspects of the interaction.

- Experimental Phases:

Preparation of Horses

 doi:10.20944/preprints202502.1893.v1

Horses were placed on the aisle in an empty stable without visual or auditory contact with conspecifics and tied from both sides facing the exit to ensure immobility and human safety. Each horse was fitted with a heart rate variability (HR) monitor and given 30 minutes to acclimate to the environment.

Preparation of Human Participants

Human participants were fitted with a heart rate variability monitor and assessed by a psychologist using the State Anxiety Scale to determine their anxiety levels. Following the assessment, the participants were grouped in two categories: High-anxiety (HA) and Low-anxiety (LA). All participants chosen were unfamiliar with the horses they interacted with.

- Interaction styles:

Constrained Style (CS): Participants wore light sunglasses and a bandana covering the mouth, kept hands in pockets, and approached horses at a metronome-set pace.

The decision to include sunglasses and bandanas as part of the CS condition was based on the necessity to block the possibility of horses decoding human facial cues, which are known to play a significant role in interspecies emotional communication. Research has demonstrated that horses are highly sensitive to human facial expressions and can differentiate between emotional states such as fear, anger, and happiness [26]. By covering the eyes (a key component of emotional expression) with sunglasses and masking the mouth (a region associated with subtle muscle movements that convey affective states) with a bandana, we aimed to minimize visual access to these expressive features. This ensured that any observed differences in horse responses between Free-Style (FS) and Constrained Style (CS) conditions were more likely attributable to body posture and movement rather than facial expression cues. Additionally, previous studies have suggested that horses rely more on facial expressions than vocal cues for emotional recognition [27] further supporting the need to eliminate facial expressivity as a confounding factor.

Free-Style (FS): Participants were free to exhibit natural behaviors, approached at a self-chosen pace, and wore no sunglasses or masks.

- Inclusion and Exclusion Criteria:

For Human Participants

High-Anxiety (HA) Group: Included only if their State Anxiety Scale score was high and their HR was at least 20 bpm above their resting HR (measured 24 hours prior). Participants failing to meet both criteria were excluded.

Low-Anxiety (LA) Group: Included only if their State Anxiety Scale score was low and their HR remained within 2 bpm of their resting HR. Participants outside these parameters were excluded.

For Horses

Excluded if their heart rate did not stabilize within 30 minutes in the experimental stall. Excluded if they exhibited stress behaviors prior to interaction.

- Within-Subjects Approach Rationale:

A within-subjects design was employed to enhance statistical power by minimizing inter-horse variability. Each horse acted as its own control, allowing for direct comparison of responses to high-anxiety (HA) and low-anxiety (LA) interactions.

Sample Size and Counterbalancing: 33 horses

Randomization: Exposure to HA and LA conditions was counterbalanced using a Latin Square Design to control for order effects (Table 1).

Table 1. A within-subjects design was employed to enhance statistical power by minimizing inter-horse variability. Each horse acted as its own control, allowing for a direct comparison of responses to high-anxiety (HA) and low-anxiety (LA) interactions. To mitigate order effects, exposure to HA and LA conditions was counterbalanced using a Latin Square Design across 33 horses. This randomization ensured that potential biases related to sequential exposure were evenly distributed, improving the reliability of observed emotional contagion effects.

Horse	First Interaction	Second Interaction
1	HA → LA	LA → HA
2	LA → HA	HA → LA
3	HA → LA	LA → HA
4	LA → HA	HA → LA

2.2. Experimental Procedure

Phase 1: Baseline Measurement

Each horse was placed in the experimental setup for 15 minutes to stabilize HR and baseline HRV and behavioral observations (ethogram scores) were recorded for the last 2 minutes.

Phase 2: Emotional Contagion Experiment

Each horse experienced two experimental conditions in a randomized order:

Condition 1: Interaction with a High-Anxiety Human (HA)

The HA participant approached the horse using firs Free-Style (FS) and then Constrained-Style (CS). Interaction lasted 60 seconds. HRV and behavioral responses were recorded during and after the interaction.

Washout Period (30-60 Minutes)

The horse remained in a quiet stall until HR and behavior returned to baseline.

Condition 2: Interaction with a Low-Anxiety Human (LA)

The LA participant followed the same FS or CS approach. Interaction lasted 60 seconds.

HRV and behavioral responses were recorded during and after the interaction.

2.3. Ethogram

The ethogram categorizes twelve distinct behavioral indicators associated with anxiety in horses, each scored on an ordinal scale to reflect its intensity and duration (Table 2). The ethogram was developed based on previous research and methodologies outlined in the academic works of Kaiser et al. [28], Masko et al. [29], McGreevy et al. [30], Wathan et al. [31], and Dyson et al. [32,33].

Table 2. Stress ethogram used to assess horses during interaction. The ethogram employs a three-point scale to measure the intensity and duration of each behavior: 0 – Absent signs, 1 – Superficial & transitory (< 2 sec.), 2 – Evident & sustained (> 2 sec.).

	Behavior	Description of Behavior	Scoring
1	Ears flicking	The horse's ears move quickly and repeatedly from one direction to another.	0/1/2
2	Ears pinned	The horse's ears are pressed tightly against its head.	0/1/2
3	Whale eye	The horse's eyes are wide, with the white part (sclera) visible.	0/1/2
4	Rapid blinking	The horse blinks quickly and repeatedly, more than 5–6 blinks per minute.	0/1/2
5	Head held high	The horse holds its head in an elevated position with the neck at more than 45 degrees.	0/1/2
6	Head shaking/tossing	The horse repeatedly tosses or shakes its head.	0/1/2
7	Avoidance of eye contact	The horse deliberately avoids looking at a person or object.	0/1/2
8	Tight or pursed lips	The horse's lips are tightly pressed together, indicating facial tension.	0/1/2
9	Flared nostrils	The horse's nostrils widen, indicating increased breathing.	0/1/2
10	Pacing or shifting weight	The horse moves restlessly, shifting its weight from one leg to another.	0/1/2

 doi:10.20944/preprints202502.1893.v1

11	Backing away or retreating	The horse moves backward or away from a person or object.	0/1/2
12	Swishing or lashing tail	The horse moves its tail back and forth quickly or lashes it with force.	0/1/2

3. Results

3.1. Free-Style vs. Constrained Style Comparison

The independent t-tests were conducted to compare the heart rate variability (HRV) and ethogram scores between the HA-FS (free-style) and HA-CS (constrained style) conditions (Table 3). The significant difference in Contact HRV suggests that horses in the HA-FS condition experienced a higher heart rate variability response during contact compared to those in HA-CS.

Table 3. Heart Rate Variability (HRV) Comparison Between HA-FS and HA-CS: Independent t-tests showed no significant differences in resting and recovery HRV ($p > 0.05$). However, contact HRV was significantly higher in HA-FS than HA-CS ($p = 0.029$*), suggesting a greater physiological response in free-style interactions.

Heart rate variability	t-statistic	p-value	Interpretation
Resting HRV (ms)	0.001	0.998	No significant difference between HA-FS and HA-CS ($p > 0.05$). The resting HRVs are statistically similar.
Contact HRV (ms)	-2.230	0.029	Significant difference ($p < 0.05$). HA-FS horses exhibited a higher HRV during contact than HA-CS horses.
Recovery HRV (ms)	-1.681	0.097	No significant difference ($p > 0.05$). HA-FS and HA-CS **trend towards a difference** but does not reach statistical significance..

3.3. Ethogram Score Analysis

The Contact Ethogram Score was significantly different ($p = 0.002$), meaning that horses in the HA-FS condition exhibited stronger behavioral responses during contact than HA-CS horses. However, Resting Ethogram and Recovery Ethogram Scores were not significantly different, implying that horses behaved similarly at baseline and after recovery (Table 4).

Contact HRV and Contact Ethogram Score showed significant differences between HA-FS and HA-CS. This suggests that the Free-Style condition may have triggered a stronger physiological and behavioral response in the horses compared to the Constrained Style condition.

Resting and Recovery metrics (both HRV and Ethogram scores) were not significantly different, indicating that horses returned to similar physiological and behavioral states after interaction.

Table 4. Horses in HA-FS showed significantly higher contact HRV ($p = 0.029$) and contact ethogram scores ($p = 0.002$) than HA-CS, indicating stronger physiological and behavioral responses. Resting and recovery measures showed no significant differences ($p > 0.05$).

Ethogram	t-statistic	p-value	Interpretation
Resting Ethogram Score	0.096	0.923	No significant difference ($p > 0.05$). Behavioral responses at rest were similar in HA-FS and HA-CS.
Contact Ethogram Score	3.114	0.002	Highly significant difference ($p < 0.01$). HA-FS horses exhibited different behavioral responses during contact than HA-CS.
Recovery Ethogram Score	1.343	0.185	No significant difference ($p > 0.05$). Behavioral responses post-contact were similar.

3.4. High Anxiety – Constrained Style (HA-CS) vs. Low Anxiety – Constrained Style (LA-CS) Comparison

The independent **t-tests** were conducted to determine whether the differences in **heart rate variability (HRV) and ethogram scores** between the interaction when the human participants were constrained by wearing mask, googles and paceing at a metronome **in contact conditions (Table 5).**

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 24 February 2025 doi:10.20944/preprints202502.1893.v1

Table 5. Results of independent t-tests comparing heart rate variability (HRV) and ethogram scores in constrained interaction conditions.

Condition	t-statistic	p-value	Statistical Significance
Contact HRV	0.581	0.562	Not significant ($p > 0.05$)
Contact Ethogram Score	1.126	0.264	Not significant ($p > 0.05$)

3.5. Low Anxiety – Free-Style (LA-FS) vs. Low Anxiety – Constrained Style (LA-CS) Comparison

The independent **t-tests** were conducted to determine whether the differences in **heart rate variability (HRV) and ethogram scores** between the interaction when the human participants/professional horsemen were interacting with horses either in a free-style or in a constrained style **in contact conditions (Table 6).**

Table 6. Results of independent t-tests comparing heart rate variability (HRV) and ethogram scores between free-style and constrained-style interactions in professional horsemen during contact conditions.

Condition	t-statistic	p-value	Statistical Significance
Contact HRV (Mean RR Interval)	-0.315	0.754	Not significant ($p > 0.05$)
Contact Ethogram Score	0.089	0.929	Not significant ($p > 0.05$)

A significant difference was found during contact in ethogram scores between HA-FS and HA-CS conditions ($t=3.114$, $p=0.002$) with a large effect size ($d=0.81$), suggesting that horses exhibited more pronounced behavioral responses when humans expressed stress freely. The difference in heart rate variability (HRV) between HA-FS and HA-CS was also statistically significant ($p=0.029$), with a moderate effect size ($d=0.60$). In contrast, comparisons between HA-CS and LA-CS conditions yielded small effect sizes ($d=0.12$ for HRV, $d=0.17$ for ethogram scores), indicating minimal differentiation when human body language was restricted.

4. Discussion

The findings of this study indicate that while horses exhibited slightly stronger behavioral responses when interacting with high-anxiety handlers (HA-CS) compared to low-anxiety handlers (LA-CS), these differences were not as pronounced as those observed in free-style (FS) interactions. This suggests that, although some degree of emotional transfer may still occur, the structured body language in controlled setting (CS) conditions serves to mitigate the intensity of behavioral reactions.

The minimal differences observed in heart rate variability (HRV) and ethogram scores during contact interactions suggest that CS interactions effectively reduce emotional transfer from humans to horses. Unlike FS interactions, where horses displayed significant physiological and behavioral changes in response to high-anxiety handlers, CS interactions create a more regulated environment in which horses are less influenced by human emotional states.

Physiologically, heart rate (HR) responses remained stable across HA-CS and LA-CS interactions, indicating that horses did not experience significant stress-related changes due to handler anxiety in CS conditions. Similarly, behavioral responses, as reflected in ethogram scores, showed only a slight increase in HA-CS interactions. However, this difference was minor, suggesting that while horses may still detect subtle cues from anxious handlers, the structured body language in CS conditions minimizes their impact.

Furthermore, CS interactions appear to be an effective method for reducing unintended emotional contagion, making them particularly valuable for handlers who may experience anxiety or nervousness. The absence of statistically significant differences in HRV and behavioral responses between HA-CS and LA-CS conditions further supports this claim. The controlled nature of body

 doi:10.20944/preprints202502.1893.v1

language in CS settings likely prevents stress transmission from humans to horses, thereby maintaining a stable physiological and behavioral state in equine participants.

The consistency of HRV responses across LA-FS and LA-CS interactions is also noteworthy. Given that LA participants were experienced horse handlers, it is likely that they naturally regulated their body language, even in FS conditions. This may explain the lack of significant differences in HRV between LA-FS and LA-CS. Experienced handlers tend to exhibit predictable and composed behavior, which likely contributes to stable physiological responses in horses. Additionally, it is plausible that horses had already become accustomed to experienced handling styles, leading to minimal variation in behavioral responses between LA-FS and LA-CS conditions.

These findings have significant implications for equine training, handling, and therapy programs. For equestrians, trainers, and handlers, the study emphasizes the importance of emotional regulation and body control when working with horses, particularly for individuals prone to anxiety. Teaching riders and handlers to adopt a more neutral posture and minimize involuntary stress cues can enhance equine welfare and reduce anxiety-induced behavioral responses. Additionally, equine-assisted therapy programs may benefit from integrating techniques that promote structured, low-expressivity interactions, ensuring that therapy horses do not unnecessarily absorb and reflect human distress.

Training equestrians and therapy practitioners to adopt controlled, predictable movements—similar to those of experienced horse handlers—could be an effective strategy to mitigate stress transfer. Implementing structured training programs that focus on emotional regulation may enhance horse-human interactions and reduce unintended emotional contagion.

Future research should explore additional physiological markers, such as cortisol levels, HRV analysis, and EEG studies, in both humans and horses to gain a deeper understanding of how emotional contagion occurs at a neurophysiological level. Investigating whether structured emotional regulation training for riders improves horse cooperation and reduces behavioral issues could provide further insights into best practices for equine training. Additionally, evaluating the effectiveness of different training methodologies designed to help handlers regulate their emotional expressions may inform future equestrian education and therapeutic interventions.

Practical applications for equine-assisted therapy could incorporate mindfulness techniques for therapy practitioners to prevent unintended stress transmission to therapy horses. Moreover, designing training modules that help therapy horses develop emotional resilience when working with highly stressed clients may improve both horse welfare and the effectiveness of therapy sessions.

These findings suggest that handler experience plays a crucial role in mitigating emotional contagion. Experienced handlers may unconsciously minimize stress cues, thereby reducing the likelihood of transferring anxiety to horses. This reinforces the notion that when humans behave in a consistent and expert manner, horses exhibit stable physiological and behavioral responses, even in less constrained interactions.

5. Conclusions

This study examined the phenomenon of emotional contagion between humans and horses, emphasizing the role of body language in transmitting stress and anxiety. By analyzing heart rate variability (HRV) and ethogram scores, we investigated equine responses to human emotional states in both free-style (FS) and constrained-style (CS) interactions. The findings highlight the significant impact of body language on emotional transfer between humans and horses, with clear differences observed between FS and CS approaches.

The results indicate a significant increase in both HRV and ethogram scores when horses interacted with high-anxiety individuals in the FS condition (HA-FS). This suggests that when humans are free to express emotions through body language, horses are more likely to detect and respond to these cues, leading to heightened physiological and behavioral activation. The increased stress response in horses during HA-FS interactions is consistent with previous research showing

 doi:10.20944/preprints202502.1893.v1

that equines, as prey animals, are highly attuned to environmental and social cues, including human emotions.

In contrast, interactions conducted in the CS approach, where human body language was restricted, showed no significant evidence of emotional contagion between humans and horses. Both HA-CS and LA-CS interactions resulted in statistically similar HRV and behavioral responses, indicating that horses did not experience increased stress or anxiety, regardless of the handler's emotional state.

These findings underscore the importance of controlled and intentional movements when handling horses, suggesting that minimizing human expressiveness can prevent unintended emotional transfer. The structured nature of CS handling appears to act as a buffer against stress contagion, helping to maintain physiological and behavioral stability in horses.

The absence of significant differences between HA-CS and LA-CS conditions further reinforces the idea that horses primarily perceive and respond to human emotions through nonverbal cues rather than merely sensing stress or anxiety at a physiological level. Additionally, the lack of significant differences in HRV and ethogram scores between LA-FS and LA-CS is likely due to the experience level of LA participants. Experienced handlers naturally regulate their body language, even in FS conditions, which reduces variability in how horses perceive them. This explains the consistent physiological responses observed between these conditions.

It is possible that horses were already accustomed to experienced handling styles, leading to minimal behavioral variations between LA-FS and LA-CS. Moreover, experience appears to mitigate emotional contagion, as skilled handlers may unconsciously minimize stress cues. These findings suggest that handler expertise plays a more critical role than anxiety levels in shaping horse responses, acting as a natural buffer against stress transfer. When handlers interact with horses in a knowledgeable and controlled manner, their body language remains neutral across both FS and CS conditions. Emotional contagion is therefore most likely to occur in inexperienced individuals who exhibit uncontrolled body language under stress.

Author Contributions: Conceptualization, DM and MT; methodology, DM; software, DM; validation, DM, MT, CC, and IP; formal analysis, DM; investigation, DM and CC; resources, DM; data curation, DM and CC; writing—original draft preparation, DM; writing—review and editing, MT and CC; visualization, DM; supervision, IP; project administration, MT; funding acquisition, IP. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The animal study protocol was approved by the Ethics Committee of the Faculty of Veterinary Medicine Cluj-Napoca, Cluj, Romania (protocol code 371/ 07.04.2023) for studies involving animals.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent was obtained from the owner of the animals (or an authorized agent for the owner).

Data Availability Statement: All data supporting the findings of this study are included in the article. No additional data are available.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

HR	Heart Rate
HRV	Heart Rate Variability

References

1. Scopa, C.; Contalbrigo, L.; Greco, A.; Lanatà, A.; Scilingo, E.P.; Baragli, P. Emotional transfer in human–horse interaction: New perspectives on equine-assisted interventions. *Animals* **2019**, *9*(12), 1030.
2. Althobaiti, T.; Katsigiannis, S.; West, D.; Ramzan, N. Examining human-horse interaction by means of affect recognition via physiological signals. *IEEE Access* **2019**, *7*, 77857–77867.
3. Baba, C.; Kawai, M.; Takimoto-Inose, A. Are horses (*Equus caballus*) sensitive to human emotional cues? *Animals* **2019**, *9*(9), 630.
4. Baragli, P.; Demuru, E.; Scopa, C.; Palagi, E. Are horses capable of mirror self-recognition? A pilot study. *PLoS ONE* **2017**, *12*(5), e0176717.
5. Palagi, E.; Celeghin, A.; Tamietto, M.; Winkielman, P.; Norscia, I. The neuroethology of spontaneous mimicry and emotional contagion in human and non-human animals. *Neurosci. Biobehav. Rev.* **2020**, *111*, 149–165.
6. De Waal, F.B. The antiquity of empathy. *Science* **2012**, *336*(6083), 874–876.
7. Merkies, K.; Sievers, A.; Zakrajsek, E.; MacGregor, H.; Bergeron, R.; von Borstel, U.K. Preliminary results suggest an influence of psychological and physiological stress in humans on horse heart rate and behavior. *J. Vet. Behav.* **2014**, *9*(5), 242–247.
8. Briefer, E.F. Vocal contagion of emotions in non-human animals. *Proc. R. Soc. B Biol. Sci.* **2018**, *285*(1873), 20172783.
9. Christensen, J.W.; Ahrendt, L.P.; Lintrup, R.; Gaillard, C.; Palme, R.; Malmkvist, J. Does learning performance in horses relate to fearfulness, baseline stress hormone, and social rank? *Appl. Anim. Behav. Sci.* **2012**, *140*(1–2), 44–52.
10. Smith, A.V.; Proops, L.; Grounds, K.; Wathan, J.; McComb, K. Horses give functionally relevant responses to human facial expressions of emotion: A response to Schmoll (2016). *Biol. Lett.* **2016**, *12*(9), 20160549.
11. Tripon, M.; Manolachescu, D.; Daradics, Z.; Crecan, C.M. Measuring Horse-Human Emotional Contagion: A Systematic Review of Methods and Outcomes. Preprints 2025, 2025020863. https://doi.org/10.20944/preprints202502.0863.v1.
12. Julian, L.J. Measures of anxiety. *Arthritis Care Res.* **2011**, *63*(0 11).
13. Chamove, A.S.; Crawley-Hartrick, O.J.; Stafford, K.J. Horse reactions to human attitudes and behavior. *Anthrozoös* **2002**, *15*(4), 323–331.
14. Hausberger, M.; Stomp, M.; Sankey, C.; Brajon, S.; Lunel, C.; Henry, S. Mutual interactions between cognition and welfare: The horse as an animal model. *Neurosci. Biobehav. Rev.* **2019**, *107*, 540–559.
15. Callara, A.L.; Scopa, C.; Contalbrigo, L.; Lanatà, A.; Scilingo, E.P.; Baragli, P.; Greco, A. Unveiling directional physiological coupling in human-horse interactions. *iScience* **2024**, *27*(9).
16. Scopa, C.; Greco, A.; Contalbrigo, L.; Fratini, E.; Lanatà, A.; Scilingo, E.P.; Baragli, P. Inside the interaction: Contact with familiar humans modulates heart rate variability in horses. *Front. Vet. Sci.* **2020**, *7*, 582759.
17. Hall, C.; Huws, N.; White, C.; Taylor, E.; Owen, H.; McGreevy, P. Assessment of ridden horse behavior. *J. Vet. Behav.* **2013**, *8*(2), 62–73.
18. Keeling, L.J.; Jonare, L.; Lanneborn, L. Investigating horse–human interactions: The effect of a nervous human. *Vet. J.* **2009**, *181*(1), 70–71.
19. Birke, L.; Hockenhull, J.; Creighton, E.; Pinno, L.; Mee, J.; Mills, D. Horses' responses to variation in human approach. *Appl. Anim. Behav. Sci.* **2011**, *134*(1–2), 56–63.
20. Merkies, K.; Franzin, O. Enhanced understanding of horse–human interactions to optimize welfare. *Animals* **2021**, *11*(5), 1347.
21. Manolachescu, D.; Tripon, M.A.; Daradics, Z.; Crecan, C.; Papuc, I. Is Heart Rate a Reliable Indicator of Acute Stress in Horses (Equus caballus)? *Rev. Rom. Med. Vet.* **2024**, 34(3), 130–136.
22. Lanata, A.; Guidi, A.; Valenza, G.; Baragli, P.; Scilingo, E.P. Quantitative heartbeat coupling measures in human-horse interaction. In *Proceedings of the 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Orlando, FL, USA, 16–20 August 2016; IEEE, pp. 2696–2699.
23. Hintze, S.; Murphy, E.; Bachmann, I.; Wemelsfelder, F.; Würbel, H. Qualitative Behaviour Assessment of horses exposed to short-term emotional treatments. *Appl. Anim. Behav. Sci.* **2017**, *196*, 44–51.

 doi:10.20944/preprints202502.1893.v1

24. Lundblad, J.; Rhodin, M.; Hernlund, E.; Bjarnestig, H.; Hidén Rudander, S.; Haubro Andersen, P. Facial expressions during compound interventions of nociception, conspecific isolation, and sedation in horses. *Sci. Rep.* **2025**, *15*(1), 5373.
25. Trösch, M.; Pellon, S.; Cuzol, F.; Parias, C.; Nowak, R.; Calandreau, L.; Lansade, L. Horses feel emotions when they watch positive and negative horse–human interactions in a video and transpose what they saw to real life. *Anim. Cogn.* **2020**, *23*, 643–653.
26. Smith, A.V.; Wilson, C.; McComb, K.; Proops, L. Domestic horses (*Equus caballus*) prefer to approach humans displaying a submissive body posture rather than a dominant body posture. *Anim. Cogn.* **2018**, *21*, 307–312.
27. Ueda, E.; Kubo, T.; Murashige, S.; Nagasawa, M.; Ikeda, K.; Takimoto-Inose, A. An empirical study about gait synchronization between horses (*Equus caballus*) and humans. *Jpn. J. Anim. Psychol.* **2020**, *70*(2), 27–39.
28. Kaiser, L.; Heleski, C.R.; Siegford, J.; Smith, K.A. Stress-related behaviors among horses used in a therapeutic riding program. *J. Am. Vet. Med. Assoc.* **2006**, *228*(1), 39–45.
29. Masko, M.; Domino, M.; Lewczuk, D.; Jasinski, T.; Gajewski, Z. Horse behavior, physiology, and emotions during habituation to a treadmill. *Animals* **2020**, *10*(6), 921.
30. McGreevy, P.; Oddie, C.; Burton, F.L.; McLean, A.N. The horse–human dyad: Can we align horse training and handling activities with the equid social ethogram? *Vet. J.* **2009**, *181*(1), 12–18.
31. Wathan, J. *Social Communication in Domestic Horses: The Production and Perception of Facial Expressions*; Doctoral Dissertation, University of Sussex, 2015.
32. Dyson, S.; Berger, J.; Ellis, A.D.; Mullard, J. Development of an ethogram for a pain scoring system in ridden horses and its application to determine the presence of musculoskeletal pain. *J. Vet. Behav.* **2018**, *23*, 47–57.
33. Dyson, S. The ridden horse pain ethogram. *Equine Vet. Educ.* **2022**, *34*(7), 372–380.