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Psychometric Validation of the Adapted Pet Attachment Questionnaire in Measuring Human–Horse Attachment

Aada Ståhl[a,b,c,d], Alisa Viitanen[e], Océane Liehrmann[e†], and Milla Salonen[e†]

[a]Department of Medicine, University of Helsinki, Helsinki, Finland; [b]Department of Veterinary Biosciences, University of Helsinki, Helsinki, Finland; [c]Department of Medical and Clinical Genetics, University of Helsinki, Helsinki, Finland; [d]Folkhälsan Research Center, Helsinki, Finland; [e]Department of Biology, University of Turku, Turku, Finland

ABSTRACT

Attachment between humans and conventional pets like dogs and cats has been previously characterized by two dimensions: attachment-related anxiety and avoidance. This study used attachment theory as a framework to examine human–horse relationships by evaluating the psychometric properties of an adapted version of the Pet Attachment Questionnaire (PAQ), the Horse Attachment Questionnaire (HAQ). Horses exhibit the essential features that define an attachment figure, suggesting that the same attachment dimensions and assessment tools might apply to human–horse relationships. The psychometric properties of the HAQ were evaluated with online survey data from 2,287 horse owners worldwide. In the exploratory factor analysis, 21 of the original 26 items loaded onto their theoretically predicted factors, anxiety and avoidance. We performed a two-fold cross-validation and cross-cultural validation, comparing the two largest nationality groups in our dataset – French (922 respondents) and Finnish (765 respondents) – and the two-factor structure persisted. Supporting the convergent validity of the HAQ, correlations similar to those of human and human–pet relationships were observed with respect to owner age, gender, and neuroticism score. Specifically, younger age and neuroticism were positively associated with an anxious attachment style, while male gender was positively associated with an avoidant attachment style toward a horse. Individual differences in human–horse attachment occur in the dimensions of attachment-related anxiety and avoidance, and the HAQ survey tool developed to measure these dimensions is a conceptually and statistically sound way of examining human–horse attachment. This study deepens our understanding of how attachment styles extend to nonhuman attachment figures and lays the groundwork for more comprehensive future research into the variables associated with attachment in human–horse interactions.

KEYWORDS

Attachment theory; human–animal interaction; human–horse relationship; questionnaire validation

CONTACT Aada Ståhl aada.stahl@helsinki.fi Department of Medicine, University of Helsinki, Helsingin yliopisto, Haartmaninkatu 8, Helsinki 00014, Finland
[†]Co-last authors.

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Attachment theory originally focused on infant-to-mother attachment (Ainsworth et al., 1978; Ainsworth & Bowlby, 1991; Bowlby, 1977) and was later extended to explain adult attachment to other humans and nonhuman animals (Bartholomew & Horowitz, 1991; Zilcha-Mano et al., 2011). The individual differences in attachment to others have been described through attachment styles, which are individual, mental representations of how adults view themselves and others, guiding how they form and maintain relationships (Bartholomew & Horowitz, 1991).

Adult attachment is described using the two-dimensional model, in which the avoidant attachment dimension reflects an individual's internal model of trustworthiness and emotional availability of others, while the anxious attachment dimension indicates the internal model of themselves as whether they feel they deserve love and support (Bartholomew & Horowitz, 1991). Anxiously attached people crave closeness and attention and have a fear of abandonment. Avoidantly attached people seek independence and avoid proximity for fear of losing their autonomy and becoming too dependent on the attachment figure. In securely attached people, on the other hand, neither of the above dimensions is pronounced – they are comfortable with closeness, but also sufficiently independent and trusting with others (Bartholomew & Horowitz, 1991).

Humans form strong emotional connections with nonhuman animals, with attachment theory often serving as the framework to explore the dynamics of these bonds (Coy et al., 2021; Coy & Green, 2018; Gobbo & Zupan, 2020; Green et al., 2018; Kurdek, 2008; Reevy & Delgado, 2015, 2020; Ståhl et al., 2023; Zilcha-Mano et al., 2012). Notably, the attachment relationships with conventional companion animals, dogs and cats, who live near their human caretakers, have been characterized by the orthogonal dimensions of attachment-related anxiety and avoidance manifesting in the same way as in adult interpersonal relationships (Zilcha-Mano et al., 2011).

According to attachment theory, an attachment bond can exist if the four fundamental attachment features are present – proximity maintenance, safe haven, secure base, and separation distress (Ainsworth, 1991; Hazan & Zeifman, 1999). These features have been found to be present in the relationship between humans and companion animals (Kurdek, 2008; Zilcha-Mano et al., 2012): animals provide their owners with a safe starting point for exploration and growth, provide security when needed, and being apart from them activates discomfort. In an insecure (i.e., avoidant and/or anxious) attachment, these attachment features are disturbed (Zilcha-Mano et al., 2012). People with an avoidant attachment style tend to have weaker emotional bonds with their pets (Reevy & Delgado, 2015, 2020; Zilcha-Mano et al., 2012), whereas those with an anxious attachment style generally perceive their emotional connections as stronger but also face more psychological distress (Reevy & Delgado, 2015, 2020; Ståhl et al., 2023; Zilcha-Mano et al., 2011).

Attachment dimensions are associated with owner personality and demography and pet behavior. The personality trait neuroticism is associated with higher attachment anxiety (Noftle & Shaver, 2006; Reevy & Delgado, 2015, 2020; Ståhl et al., 2023; Zilcha-Mano et al., 2011). Additionally, men tend to exhibit higher attachment avoidance, while younger individuals are more likely to show higher attachment anxiety (Luchesi et al., 2022; Reevy & Delgado, 2015, 2020). From the companion animal's point of view, an insecure attachment style has been found to be linked to the quality of care received

from the owner (Coy et al., 2021; Coy & Green, 2018), the pet's style of attachment toward the owner (Konok et al., 2019), and the pet's unwanted behavior, although the precise nature of the causality is unknown (Gobbo & Zupan, 2020; Powell et al., 2021; Ståhl et al., 2023; Van Herwijnen et al., 2018).

Human-to-Horse Attachment

Little is known about the relationship between humans and horses from the perspective of attachment theory. The human–horse bond developed around 2000 B.C. (Librado et al., 2021) and since then, horses have served a variety of roles in human life, such as in war, work, travel, sports, and leisure. With the modernization of developed societies, horses no longer serve people mainly at work, but instead in leisure (Skinner et al., 2019). In western countries, horses occupy a unique position in human life, falling somewhere between farm or utility animals and companion animals (Liehrmann, 2023). As in other relationships, emotional attachment is an integral part of the human–horse relationship. Even in the high-level competitive field, people perceive their relationship with the horse as emotional (Wipper, 2000). On the other hand, unlike conventional companion animals such as dogs, which usually live in close proximity to humans, horses interact with humans less, as they live outside the home, often in a boarding stable away from the horse carer. Furthermore, horses often play a different role in human life: unlike dogs, horses are often not considered a companion for life but may be relinquished if the horse is no longer considered suitable or usable (Endenburg, 1999; Scagnetto et al., 2021).

In the relationship between humans and dogs or cats, attachment can be seen as a reciprocal phenomenon; both the owner and the pet apparently find security and facilitate free exploration, and both experience discomfort when separated from each other (Edwards et al., 2007; Payne et al., 2016; Rehn & Keeling, 2016). In contrast, there is limited evidence on whether owners similarly serve as attachment figures for horses (Ijichi et al., 2018; Merkies et al., 2024; Payne et al., 2016). However, the four features of attachment have been described as present in people's attachment to horses (Törmälehto & Korkiamäki, 2020), suggesting that attachment theory can be applied to the study of individual differences in forming attachments to horses from the human perspective. Indeed, DeAraugo et al. (2014) measured human attachment to horses using the two dimensions of attachment styles, and the study illustrated that the training style of horse trainers may be related to the trainer's attachment to their horses. However, the attachment measure in this study was not validated, except for its internal consistency.

We thought that the dimensions of attachment-related anxiety and avoidance could extend to human–horse relationships and hypothesized that the instrument used to assess attachment styles between humans and dogs and cats, the Pet Attachment Questionnaire (PAQ; Zilcha-Mano et al., 2011), might be effective for evaluating the human–horse bond. The PAQ was chosen because of its comprehensive and versatile development process, including integration of scales measuring human–pet relationships and scales measuring attachment orientations in interpersonal relationship, as well as the development of new questions based on semi-structured interviews from pet owners. The objectives of this study were (a) to use attachment theory as a framework to examine

human–horse relationships by adapting the PAQ to assess human–horse attachment, and (b) to assess the validity and reliability of the adapted scale by examining its factor structure, internal consistency, cross-validity, cross-cultural validity, and convergent validity.

Methods

Ethics Statement

The informed consent and the research protocol were approved by The Ethics Committee for Human Sciences at the University of Turku, Humanities and Social Sciences Division (approval number 36/2023).

Instruments

To adapt the PAQ (Zilcha-Mano et al., 2011) for horse owners, the original 26 items were evaluated and modified by O.L. to reflect human–horse attachment. The word "pet" was replaced with "horse." The Finnish version of the 26-item questionnaire was translated into English by A.V. and into French by O.L.

Horse owners filled out the HAQ by rating the 26 items on a 7-point Likert scale whose scores ranged from 1 (Strongly disagree) to 7 (Strongly agree). Table 1 shows the 26 items in the HAQ; the corresponding items from the PAQ are in italics (Zilcha-Mano et al., 2011). Odd-numbered items correspond conceptually to avoidant attachment; even-numbered items correspond to anxious attachment. The survey also included questions that gathered sociodemographic information on the respondent (gender and age), horse keeping, and the personality traits of the owner, assessed with the 64-item Short Five Questionnaire (S5; Konstabel et al., 2012). The data were collected online using the Webropol survey platform.

Participants

A total of 2,287 horse owners participated in the research. They were recruited between June 2023 and January 2024 with a multi-modal recruitment and snowball sampling method through a variety of channels. This included targeted social media groups focused on equine topics, both online and print equine press, specialized forums, and direct outreach to horse stables (randomly picked from Google Maps) in countries where English, Finnish, or French is spoken. While recruitment was targeted in these regions, the survey was accessible to respondents from anywhere in the world.

The conditions to fill in the survey were to be 18 years old or over and to own at least one horse. The modal age group was 35–44 years. There were 2,164 women (94.6%), 97 men (4.2%), and 26 individuals who were intersex or preferred not to disclose (1.1%). The participants were from 21 different countries, with the majority from France (40.3%), Finland (33.4%), the UK (7.7%), and Canada (5.6%). The attachment questionnaire was filled out only for the horse that was alive at the time of the study and to which the owner felt the closest or knew best. See online supplemental Table 1 for more detailed demographics.

Table 1. Exploratory factor analysis with varimax rotation of the Horse Attachment Questionnaire (HAQ, adapted from the Pet Attachment Questionnaire (PAQ); Zilcha-Mano et al., 2011) items. The original wording of the items in the PAQ is shown in italics.

	Factor 1: HAQ Avoidance	Factor 2: HAQ Anxiety
1. I find it pleasant to be near my horse (reverse-scored) *Being close to my pet is pleasant for me*	**0.73**	−0.01
2. I often worry about what I would do if something bad happened to my horse *I'm often worried about what I'll do if something bad happens to my pet*	**−0.30**	**0.46**
3. I prefer not to be too close with my horse *I prefer not to be too close to my pet*	**0.78**	0.01
4. Sometimes I feel like I'm pressuring my horse to show more commitment and desire to be around me *Sometimes I feel that I force my pet to show more commitment and desire to be close to me*	0.21	**0.54**
5. I prefer to keep a little distance from my horse *I prefer to keep some distance from my pet*	**0.70**	0.00
8. My horse's displays of affection strengthen my sense of self-worth *Signs of affection from my pet bolster my self-worth*	−0.23	**0.47**
9. I feel distant from my horse *I feel distant from my pet*	**0.77**	0.16
11. I am not very attached to my horse *I'm not very attached to my pet*	**0.79**	−0.10
13. If necessary, I could give up my horse without difficulty *If necessary, I would be able to give away my pet without any difficulties*	**0.68**	−0.24
14. I get frustrated if my horse is not around as much as I would like it to be *I get frustrated when my pet is not around as much as I would like it to be*	0.18	**0.60**
15. Being separated from my horse for a long time does not cause me any problems *I have no problem parting with my pet for a long duration*	**0.60**	**−0.35**
16. I need affection from my horse to feel that someone accepts me for who I am *I need shows of affection from my pet to feel there is someone who accepts me as I am*	−0.09	**0.79**
17. I feel uncomfortable when my horse wants to be close to me *I get uncomfortable when my pet wants to be close to me*	**0.65**	0.11
18. I get frustrated if my horse is not available when I need it *I feel frustrated if my pet doesn't seem to be available for me when I need it*	0.27	**0.59**
19. I get nervous if my horse gets too close to me *I get nervous when my pet gets too close to me*	**0.71**	0.08
20. Without my horse's displays of affection, I feel worthless *Without acts of affection from my pet I feel worthless*	0.06	**0.81**
22. I am worried that I will be alone without my horse *I am worried about being left alone without my pet*	−0.07	**0.64**
23. I try to avoid getting too close to my horse *I try to avoid getting too close to my pet*	**0.73**	0.14
24. I need affection from my horse to make me feel valued *I need expressions of love from my pet to feel valuable*	−0.05	**0.86**
25. When I'm away from my horse for a long time, I hardly think about it *When I'm away from my pet for a long period of time, I hardly think about it*	**0.66**	−0.27
26. I need a lot of reassurance from my horse that it loves me *I need a lot of reassurance from my pet that it loves me*	−0.08	**0.81**
REMOVED ITEMS		
6. If I can't get my horse to show interest in me, I get nervous or angry *If I can't get my pet to show interest in me, I get upset or angry*	**0.40**	**0.53**
7. My horse often make me sad *Often my pet is a nuisance to me*	**0.50**	**0.31**
10. I often feel that my horse does not allow me to be as close to it as I would like	**0.46**	**0.37**

(*Continued*)

Table 1. Continued.

	Factor 1: HAQ Avoidance	Factor 2: HAQ Anxiety
I often feel that my pet doesn't allow me to get as close as I would like		
12. I get angry when my horse does not want to be near me as much as I would like	**0.49**	**0.49**
I get angry when my pet doesn't want to be close to me as much as I would like it to		
21. I would like to be close with my horse, but I find myself pulling away	**0.59**	**0.41**
I want to get close to my pet, but I keep pulling away		
Cronbach's alpha*	0.79	0.85
Percent of explained variance in the item scores (%)*	27	22

Note: Factor loadings ≥ 0.30 and ≤ -0.30 are in bold. *Calculated with all items included in the analysis. Please see the final values, calculated excluding the removed items, in Table 2.

Statistical Analysis

All analyses and data handling were conducted using R version 4.3.2 (R Core Team, 2022). The raw data were exported from Webropol in CSV format and subsequently imported into R for data cleaning and preparation. Data editing was done with the package *dplyr* (Wickham et al., 2023). Prior to analysis, HAQ Item 1 was reverse scored, as demonstrated by the instrument's creators (Zilcha-Mano et al., 2011).

To ensure the HAQ only included internally consistent items and to ensure that items within each factor were appropriately related to one another, an item reduction analysis was conducted. This involved conducting inter-item and item-total correlation analyses for odd-numbered items (expected to load on factor "Avoidance") and even-numbered items (expected to load on factor "Anxiety") separately. Inter-item correlations were estimated using Pearson correlation analysis, and they were visually represented with the *corrgram* package (Wright, 2021). Item-total correlations were calculated using the *multilevel* package (Bliese et al., 2022). To enhance the accuracy of item-total correlations, the *psych* package (Revelle, 2023) and its *alpha* function were used to compute corrected item-total correlations.

Exploratory factor analysis (EFA) was performed to explore the dimensionality of the questionnaire items. The dataset's suitability for factor analysis was tested with the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy from the package *psych* (Revelle, 2023). The factor analysis was conducted with the package *psych* (Revelle, 2023). Polychoric correlation matrices were used, and the factor analyses were conducted with varimax rotation from the *GPArotation* package (Bernaards & Jennrich, 2005) and mean imputation for missing responses. Varimax rotation was chosen because it was used in the development of the scale (Zilcha-Mano et al., 2011). The number of factors to be extracted was evaluated with the scree test and Velicer's minimum average partial (MAP) test. Both methods suggested extracting two factors. Furthermore, the quality of the factor structure was assessed by extracting all possible structures (Goldberg's hierarchical tree), starting from one factor up to two factors more than recommended by the scree test and then comparing the recommended two-factor structure with the other structures, as suggested previously (Jones, 2008). The reliability of the scale was assessed by calculating Cronbach's alpha and Guttman's Lambda 6 with the package *psych* (Revelle, 2023) for the factors.

Before validity analyses, the Avoidance and Anxiety sum scores as well as personality trait sum scores for all individual responses were extracted, as indicated by the instrument's creators (Konstabel et al., 2012; Zilcha-Mano et al., 2011). Cross-validity was assessed by randomly splitting the data into two equal-sized samples using the *caret* package (Kuhn et al., 2023). A two-fold cross-validation strategy was used to conduct EFA on the training sample with the package *psych* (Revelle, 2023) and subsequently test the two-factor solution on the test sample with confirmatory factor analysis (CFA) using robust maximum likelihood (MLR) estimator with the package *lavaan* (Rosseel, 2023). The cross-validity procedure was conducted with all HAQ items excluding the removed cross-loading items.

Cross-cultural validity was assessed by splitting the data into French ($n = 906$) and Finnish ($n = 759$) subsamples and by performing CFA with MLR estimator with the package *lavaan* (Rosseel, 2023). The two-factor model was fitted with all 26 items and with the exclusion of the cross-loading items. The root mean square error of approximation (RMSEA), comparative fit index (CFI), and the Tucker–Lewis index (TLI) were compared between these structures.

Convergent validity was evaluated by testing predefined hypotheses about expected relationships with relevant constructs. Based on the literature on pet attachment and human attachment, the personality trait neuroticism was expected to be correlated with attachment anxiety (Noftle & Shaver, 2006; Reevy & Delgado, 2015, 2020; Zilcha-Mano et al., 2011). In addition, based on the literature on pet attachment, male gender was expected to be associated with higher attachment avoidance, and younger age was expected to be associated with higher attachment anxiety (Luchesi et al., 2022; Reevy & Delgado, 2015, 2020). Before the analyses, histograms and Q-Q plots were used to visually inspect normality, and skewness and kurtosis were calculated to assess deviations from normality. Based on these assessments, attachment anxiety score and neuroticism score were normally distributed. Avoidance score, however, showed significant departure from normality due to moderate skewness and high kurtosis. Thus, a log transformation was applied to reduce skewness and kurtosis.

For each ANOVA model, normality of residuals was checked with Q-Q plots, and homogeneity of variances were checked with Levene's Tests. To calculate the correlation between anxious attachment and neuroticism, Pearson correlations were calculated using the package *psych* (Revelle, 2023). To calculate the associations between attachment styles and owner age and the associations between attachment styles and owner gender, a one-way analysis of variance (ANOVA) and post-hoc tests were employed. One-way ANOVA was conducted to assess the significance of differences among the groups. Post-hoc Tukey tests were performed to identify specific pairwise differences between the groups, taking into account multiple comparisons. The significance was set at $p < 0.05$.

Results

Preliminary Analysis: Item-Total and Inter-Item Correlations

Most items showed adequate correlations (> 0.30) with other items and the total score within their proposed factors (online supplemental Tables 2–5). However, one item

(item 17: I feel uncomfortable when my horse wants to be close to me) exhibited a weak (< 0.30) correlation with other items and the total score (online supplemental Tables 2 and 4), suggesting that it may not align well with the expected factor structure.

Factor Structure

The KMO measure of sampling adequacy was 0.90, indicating excellent adequacy of the data for performing the EFA. Items with factor loadings over 0.30 or under −0.30 were retained in the EFA. Several cross-loadings were observed in the two-factor model (Table 1). To improve the model fit, the cross-loading items were removed, except the ones with adequate positive loading to the expected factor and under −0.30 loading to the other. Items 6, 7, 10, 12, and 21 were removed (see Table 1 for item labels). All remaining odd-numbered items showed over 0.30 correlation with the first dimension that was named "HAQ Avoidance," while all remaining even-numbered items showed over 0.30 correlation with the second dimension, named "HAQ Anxiety" (Table 2).

With the exclusion of cross-loading items, the factors explained 51% of the total variance of the data. The HAQ Avoidance factor explained 28% of the variance, and the HAQ Anxiety factor explained 23%. Cronbach's alpha showed a fair level of internal consistency for HAQ Avoidance ($\alpha = 0.78$) and a good level for HAQ Anxiety ($\alpha = 0.84$) (Cicchetti, 1994). Guttman's Lambda 6 showed good levels of internal consistency ($\lambda_6 = 0.81$ for HAQ Avoidance and $\lambda_6 = 0.86$ for HAQ Anxiety).

Table 2. Exploratory factor analysis with varimax rotation when cross-loading items are excluded.

Item number	Item (abbreviated)	Factor 1: HAQ Avoidance	Factor 2: HAQ Anxiety
11	Not attached	**0.81**	−0.07
3	Avoid close	**0.79**	0.04
23	Avoid too close	**0.73**	0.17
1	Pleasant near	**0.72**	0.00
9	Feel distant	**0.72**	0.14
5	Prefer distance	**0.71**	0.02
13	Give up horse easy	**0.70**	−0.21
19	Nervous close	**0.70**	0.09
25	Away hardly think about horse	**0.68**	−0.24
17	Uncomfortable close	**0.65**	0.13
15	Separated no problems	**0.62**	**−0.33**
18	Frustrated unavailable	0.24	**0.57**
4	Pressure commitment	0.16	**0.49**
14	Frustrated not around	0.14	**0.56**
20	Worthless without affection	0.06	**0.84**
24	Need affection feel valued	−0.05	**0.89**
22	Worried alone without horse	−0.07	**0.65**
16	Need affection acceptance	−0.09	**0.81**
26	Need reassurance love	−0.10	**0.79**
8	Affection strengthens self-worth	−0.23	**0.48**
2	Worry bad event	**−0.32**	**0.44**
Cronbach's alpha		0.78	0.84
Guttman's Lambda 6		0.81	0.86
Percent of explained variance in the item scores (%)		28%	23%

Note: HAQ = Horse Attachment Questionnaire. Factor loadings ≥ 0.30 or ≤ −0.30 are in bold.

Cross-Validity and Cross-Cultural Validity

In the CFA, the two-factor model demonstrated reasonably good fit for the test data as well as for the French and Finnish subsamples (Table 3). The factor loadings for each variable in the EFA conducted for the training sample were also highly consistent with those in the original sample (online supplemental Tables 6 and 7). Removal of the cross-loading items improved fit slightly in all cases. However, the fit was slightly weaker for the Finnish dataset compared with the French dataset and the test dataset.

Convergent Validity

For assessing convergent validity, the sum scores for both attachment dimensions were calculated. The score for attachment avoidance varied between 4 and 50 with a mean of 11.89 ($SD = 6.94$), and the score for attachment anxiety varied between 4 and 66 with a mean of 27.96 ($SD = 11.24$). As hypothesized, the anxious attachment score was strongly correlated with neuroticism (rho = 0.44, $p < 0.001$). Based on post-hoc analyses, younger age groups had significantly higher anxious attachment scores compared with older age groups, as hypothesized (Table 4). There were also some differences in avoidant attachment scores between age groups; the 55–64-year group had significantly higher avoidance scores than the 25–34-year group (difference of log means = 0.11, $p < 0.05$). In line with our hypotheses, male owners had significantly higher avoidant attachment scores than female owners (difference of log means = 0.17, $p < 0.01$).

Discussion

The aim of this study was to examine the applicability of the two-dimensional model of attachment styles quantified with a modified Pet Attachment Questionnaire (Zilcha-Mano et al., 2011) for measuring human–horse attachment. Based on previous literature, horses show the principal attachment features providing a secure base and a safe haven for their caretaker, eliciting separation distress, and prompting proximity-seeking behavior (Merkies et al., 2024; Törmälehto & Korkiamäki, 2020), indicating that horses could serve as attachment figures. The results show that the orthogonal dimensions of attachment-related anxiety and avoidance, and the tool developed to measure these in the context of human–pet attachment are a conceptually and statistically sound way of examining the human–horse attachment relationship, despite some item-level exceptions.

Table 3. Confirmatory factor analysis fit indices.

Model	CFI	TLI	RMSEA	SRMR	Null model RMSEA
Split validation, two-factor ($n = 1,132$)	0.799	0.776	0.077	0.076	0.162
Split validation: two-factor ($n = 1,158$), cross-loading items removed	0.837	0.816	0.064	0.070	0.176
Two-factor, French dataset ($n = 922$)	0.750	0.721	0.071	0.075	0.152
Two-factor, French dataset ($n = 922$), cross-loading items removed	0.816	0.792	0.066	0.067	0.166
Two-factor, Finnish dataset ($n = 765$)	0.713	0.680	0.081	0.091	0.174
Two-factor, Finnish dataset ($n = 765$), cross-loading items removed	0.773	0.773	0.079	0.087	0.188

Note: CFI = Comparative Fit Index; TLI = Tucker–Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Table 4. Post-hoc Tukey test results for Horse Attachment Questionnaire (HAQ) Anxiety and HAQ Avoidance scores and categorical variables (owner age and gender).

	Mean difference	*p*-adjusted
HAQ Anxiety – owner age		
25–34 years vs.18–24 years	−4.18	**< 0.001**
35–44 years vs. 18–24 years	−6.41	**< 0.001**
45–54 years vs. 18–24 years	−9.02	**< 0.001**
55–64 years vs. 18–24 years	−9.46	**< 0.001**
65 or over years vs. 18–24 years	−8.23	**< 0.001**
35–44 years vs. 25–34 years	−2.23	**0.01**
45–54 years vs. 25–34 years	−4.84	**< 0.001**
55–64 years vs. 25–34 years	−5.29	**< 0.001**
65 or over years vs. 25–34 years	−4.06	**< 0.01**
45–54 years vs. 35–44 years	−2.61	**< 0.01**
55–64 years vs. 35–44 years	−3.05	**< 0.001**
65 or over years vs. 35–44 years	−1.82	0.48
55–64 years vs. 45–54 years	−0.44	0.99
65 or over–years vs. 45–54 years	0.79	0.97
65 or over years vs. 55–64 years	1.23	0.86
HAQ Avoidance – owner age		
25–34 years vs. 18–24 years	0.59	0.95
35–44 years vs. 18–24 years	1.91	**0.04**
45–54 years vs. 18–24 years	1.31	0.33
55–64 years vs. 18–24 years	1.93	**0.05**
65 or over years vs. 18–24 years	2.01	0.14
35–44 years vs. 25–34 years	1.32	**0.02**
45–54 years vs. 25–34 years	0.72	0.54
55–64 years vs. 25–34 years	1.34	0.05
65 or over years vs. 25–34 years	1.42	0.26
45–54 years vs. 35–44 years	−0.59	0.71
55–64 years vs. 35–44 years	0.02	1.00
65 or over years vs. 35–44 years	0.11	1.00
55–64 years vs. 45–54 years	0.62	0.77
65 or over years vs. 45–54 years	0.70	0.90
65 or over years vs. 55–64 years	0.08	1.00
HAQ Avoidance (log) – owner age		
25–34 years vs. 18–24 years	0.03	0.99
35–44 years vs. 18–24 years	0.12	0.14
45–54 years vs. 18–24 years	0.09	0.42
55–64 years vs. 18–24 years	0.14	0.07
65 or over years vs. 18–24 years	0.13	0.26
35–44 years vs. 25–34 years	0.09	**0.05**
45–54 years vs. 25–34 years	0.06	0.38
55–64 years vs. 25–34 years	0.11	**0.02**
65 or over years vs. 25–34 years	0.10	0.28
45–54 years vs. 35–44 years	−0.03	0.96
55–64 years vs. 35–44 years	0.02	0.99
65 or over years vs. 35–44 years	0.01	1.00
55–64 years vs. 45–54 years	0.05	0.77
65 or over years vs. 45–54 years	0.04	0.96
65 or over years vs. 55–64 years	0.00	1.00
HAQ Anxiety – owner gender		
Male vs. female	1.38	0.64
HAQ Avoidance – owner gender		
Male vs. female	2.69	**< 0.01**
HAQ Avoidance (log) – owner gender		
Male vs. female	0.17	**< 0.01**

Note: Significant results in bold.

The original items from the PAQ, modified for application to horses, mostly aligned with the two attachment dimensions, except for five specific items out of 26. The items in question are: "If I can't get my horse to show interest in me, I get nervous or angry,"

"My horse often makes me sad," "I often feel that my horse does not allow me to be as close to it as I would like," "I get angry when my horse does not want to be near me as much as I would like," and "I would like to be close with my horse, but I find myself pulling away." The irrelevance of "My horse often makes me sad" may be attributed to the altered meaning of the emotional reaction in translation: the original form "Often my pet is a nuisance to me" is related to irritation, while the new formulation relates to sorrow. The rest of the unsuitable items reflect a common theme of frustration arising from the horse's apparent lack of interest or unwillingness to be close and an individual's own hesitation to be near the horse. These differences in item applicability may stem from the distinct ways in which horses, as opposed to dogs and cats (the original attachment figures in the questionnaire development), interact with humans. It might be because, unlike dog or cat owners, horse owners might not necessarily expect their horses to seek closeness in the same way. Much of the interaction with a leisure or sport horse usually consists of imposed contact, where the owner takes the horse out of its own environment (riding, training, grooming, veterinary, and other health care) (Hockenhull & Creighton, 2013). Therefore, horses often do not have the opportunity to interact with people, unlike pets that usually inhabit their owner's home, which might make the concept of seeking closeness somewhat different for horse owners.

The associations between HAQ scores and owner gender, age, and the neuroticism personality trait are similar to previous results of attachment orientations in human relationships as well as in other human–pet relationships (Luchesi et al., 2022; Noftle & Shaver, 2006; Reevy & Delgado, 2015, 2020; Ståhl et al., 2023; Zilcha-Mano et al., 2011). The positive association between scores on neuroticism and anxious attachment style, repeatedly found in studies of both human relationships and human–pet relationships (Noftle & Shaver, 2006; Reevy & Delgado, 2015, 2020; Ståhl et al., 2023; Zilcha-Mano et al., 2011), may be explained by the fact that both neuroticism and anxious attachment styles are characterized by similar behavioral phenomena, such as insecurity, anxiety, and sensitivity to threats (Noftle & Shaver, 2006). In this study, neuroticism and anxious attachment showed a correlation of 0.44, which is similar but slightly higher than those reported in previous studies (from 0.15 to 0.42; Noftle & Shaver, 2006; Reevy & Delgado, 2015, 2020; Zilcha-Mano et al., 2011).

In addition, in line with previous studies on human–human and human–pet relationships (Noftle & Shaver, 2006; Reevy & Delgado, 2015, 2020), we found a negative link between age and anxious attachment style and a positive link between age and avoidant attachment style. Given that family composition has been linked to pet attachment styles in previous studies (Luchesi et al., 2022; Ståhl et al., 2023), future studies could take family composition into account by including it as a covariate.

Male owners had significantly higher avoidant attachment to horses in our study than female owners, in line with previous studies (Luchesi et al., 2022; Reevy & Delgado, 2015, 2020). Women generally perceive the quality of their adult relationships more positively (Noftle & Shaver, 2006) and report a stronger overall attachment to pets than men (Dotson & Hyatt, 2008; Volsche et al., 2023; Woodward & Bauer, 2007). This has been explained, among other reasons, by the fact that women more often act as the primary caregivers for pets (Dotson & Hyatt, 2008). Cultural or attitudinal differences between men and women (Plymoth, 2012) or gender differences related to anthropomorphism

and empathy toward horses (Hötzel et al., 2019) may play a role in the observed differences in attachment styles. Men have been found to empathize and anthropomorphize animals and horses less than women (Chin et al., 2004), and anthropomorphism has been negatively linked to pet attachment avoidance (Rusu et al., 2019). In addition, it is also possible that men have a more utilitarian attitude toward horses than women, which could be reflected in the avoidant attachment dimension. However, a more detailed examination of gender differences would require a more balanced sample, as men were a clear minority in this study (4.3%). Future studies could look at gender differences in caregiver roles, attitudes toward horses, and anthropomorphic projections and their role in attachment styles toward horses.

We found cultural differences in the model fit, with the theoretical two-factor model showing slightly better fit for the French subsample of horse owners compared with the Finnish one. While the difference in fit was small, it may be attributed to demographic variations between the subsamples. In this dataset, more Finns (16%) shared their horses with other riders compared with the French (8%), potentially due to the higher costs of horse keeping in Finland. The exclusivity of horse riding also varied, with 76% of French owners being the sole riders of their horses compared with 48% of Finnish owners in the current sample. We speculate that this exclusivity may result in French owners spending more time with their horses, leading to a better recognition of their bond, possibly explaining the better model fit for the French sample. The potential association between time spent with the animal and the quality of the relationship assessment should be investigated in further studies.

By validating the use of a tool initially designed for assessing attachment between humans and traditional pets, this research enables a deeper look into the factors influencing attachment styles in human–horse interactions in future studies. The findings suggest that similar psychological frameworks used to assess human–human and human–pet relationships can be applied to human–horse relationships, highlighting the potential for broader applications of attachment theory in diverse human–animal bonds. To further study the relationship between humans and horses as an attachment bond, future research could use a similar setup as in Zilcha-Mano et al.'s (2012) study. This approach involves analyzing the impact of a pet's presence during stressful situations (the safe haven effect) and during tasks that involve exploration (the secure base effect) considering attachment styles as moderating variables. Future studies implementing the adapted and validated measure for assessing human–horse attachment may contribute to the comprehension of how individual variations can influence the success of attachment-oriented therapeutic practices that incorporate horses (equine-assisted therapy).

Limitations

There are limitations with this study that should be considered. The survey was translated from Finnish into English and French, even though an English original version would have been available. This slightly altered the wording of the questions. However, only one question (question number 7) had its meaning significantly changed in the translation and was consequently discarded from the analysis. Another limitation in our data is the gender bias; 94.6% of the participants identified as female. This is consistent with level

of participation in similar companion animal-related surveys (e.g., Fenner et al., 2019; Ståhl et al., 2023) and might reflect a lower interest of men to respond to companion animal-related surveys. Also, a further limitation was that the comparative fit indices in the CFAs were smaller than the suggested cutoffs. However, it is important to note that fit indices are susceptible to various factors other than simply misspecification of the model, such as estimator used, distribution of the items, and factor correlations (Groskurth et al., 2023). Another limitation was that conducting a test-retest analysis was not feasible within our ethical approval; future research should assess it by having a subset of respondents complete the survey again after a time delay and comparing their responses for consistency. Despite these limitations, this study represents a significant step forward as the first to validate an attachment measure assessing the human–horse relationship based on attachment theory.

Conclusions

An attachment measure grounded in attachment theory and previously used for human–pet relationships was adapted for the context of human–horse relationships. The tool is a psychometrically sound instrument for measuring the attachment relationship of humans to horses. However, some items, especially those related to anxiety or frustration with the experience of insufficient closeness or feelings of difficulty being close to the horse were not applicable when the attachment figure was a horse. This result may reflect differences in interaction and dynamics of human–horse dyads compared with human–dog or human–cat relationships. Several factors were linked to attachment to a horse, consistent with the attachment literature: younger age and neuroticism were positively associated with an anxious attachment style, and male gender was positively associated with an avoidant attachment style toward the horse. This measure can be used to examine human–equine attachment and factors associated with it to better reveal how attachment forms in cross-species relationships. As research on pet ownership suggests that attachment styles are linked to both the wellbeing of pet owners (Ståhl et al., 2023; Teo & Thomas, 2019; Zilcha-Mano et al., 2011) and the quality of care their pets receive (Coy et al., 2021; Coy & Green, 2018), studying attachment styles in the context of the human–horse relationship could provide valuable insights, potentially benefiting the wellbeing of both parties. Understanding how different attachment styles influence the owner–horse relationship can help trainers adapt their techniques to suit individual owners, improving communication and training outcomes. The findings could also guide recommendations for housing choices that align with the preferences and needs of both the horse and owner. By recognizing the impact of personality traits, trainers and professionals could offer more personalized support for owners, enhancing their experience and success in equitation. Ultimately, these insights could lead to more effective and customized approaches in the equestrian field.

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Author Contributions

Conceptualization: A.S., O.L., M.S, A.V.; Data curation: O.L., A.V.; Formal Analysis: A.S.; Funding acquisition: O.L.; Investigation: A.S.; Methodology: A.S., O.L.; Project administration: O.L., M.S.; Supervision: M.S; Validation: A.S.; Writing – original draft: A.S.; Writing – review & editing: A.S., O.L., M.S.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, A.S., upon request.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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