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Mustangs and Domestic Horses: Examining What We Think We Know About Differences

1. Introduction. Mustangs are defined as "all unbranded and unclaimed horses and burros on public lands" (United States Code: Title 16, Section 1331). Many descended from domestic stock who were released into the wild when they were no longer needed for farm work or transportation. This liminal space, created by humans, provides them with protection while putting them at constant risk of eradication. They lie "betwixt and between" the wild and domestic continuum (Turner). To some, they are a national heritage symbol and a link to our American identity. To others, they are feral animals devoid of any special protection. Media has, in many ways, created the mustang.

Over the years, especially during national economic downturns, mustangs have been viewed as invasive species, reproducing in an effort to drive ranchers from public lands. The mythology of mustangs creates an "Other" type of horse (Dalke). Gentzler identified widely accepted myths, including the inability to tame mustangs, and the belief that they are dumb and inbred. She attempts to dispel these myths using her personal work experience. Until the release of the United States Geological Survey (USGS) publication entitled *Quantifying Equid Behavior — A Research Ethogram for Free-Roaming Feral Horses,* little quantifiable data existed regarding mustang behavior (Ransom & Cade).

The USGS study included 1,800 hours of behavioral observations of 317 adult, free-roaming wild horses from 2003-2006 on three ranges: Little Book Cliffs Wild Horse Range in Colorado, McCullough Peaks Herd Management Area in Wyoming, and Pryor Wild Horse Range in Montana. Behaviors were classified into 13 discrete behavioral categories, some of which included feeding, resting, locomotion, and grooming. Two additional categories of "human awareness" and "out-of-sight" were used to account for observational bias. The same criteria were used in this study.

The catalyst for the USGS study was to assess the impact of immunocontraceptive porcine zona pellucida (PZP), a method for controlling the mustang population. A primary goal of the USGS ethogram was to quantify behavior that could address both applied and theoretical questions. This ethogram contributes a way to study mustangs that moves beyond self-reports and anecdotal observations. Because there was no way

to predict the horses who would be observed, "Instantaneous scan sampling at one minute intervals was ideal for quantifying time budget data" (Ransom and Cade).

Upon one of this manuscript's authors adopting two mustangs from the Bookcliffs, who were part of the aforementioned study, she began wondering what differences really exist between mustangs and domestic horses: Do mustangs exhibit the same behaviors in a domestic setting as displayed in the wild? Is there more variation between domestic horses and mustangs, or the individuals who comprise those categories? Does adaptation to domestic settings limit behaviors observed in the wild? What role does human perception play?

In an attempt to answer some of these questions, the focus of this study is to compare how domestic horses and mustangs utilize their time. Since one of the authors lives with the six animals in the study, there was considerable information known about their history and identifying features, unlike in the USGS study. This knowledge allowed for easy identification of each animal by markings if they were not in full view when photographed.

2. Subjects and methods

2.1. Subjects and data collection. This research study was conducted from August 20 to September 22, 2013 at the farm of one of the authors in northeastern Wisconsin, United States, using GoPro cameras (GoPro, Inc.). This time of year was chosen since it allowed for the most daylight and the most similarity to the more semi-arid regions used in the USGS study. Filming did not occur on nine days during the research study, due to weather or camera malfunctions. On days when one of the animals, Mister, was used for a lesson, at least two hours passed before data gathering resumed. On September 7, 8, 14 and 15, Mister was at a horse show, so no data was recorded. The cameras retain a charge for about 2.5 hours, and due to battery limitations, cameras were introduced at different times to ensure that different parts of the day were represented from 8:30 am-7:00 pm Central Standard Time. In total, 70 hours of data for each horse was collected during this timeframe, with the horses being photographed at one-minute intervals.

The cameras were placed in three areas: an indoor area, a mud lot, and a pasture. The indoor area (2,916 square feet) is a building that provides shelter from weather, a water tank, and granulated minerals and salt. The indoor area opens to a mud lot measuring 10,125 square feet (0.2 acres), where the herd is sometimes confined due to weather conditions (e.g., flooding that may impact required electro-braid fencing). The mud lot offers entry into two pastures, which are alternated to ensure ample feed. The herd was

confined to the northwestern pasture, measuring 164,304 square feet, or about four acres.

The horses moved freely between the indoor area, mud lot, and pasture area during a 24-hour period. At 7 am each morning, two of the horses were placed in box stalls and fed EquiShine (as this is a selenium-deficient region) and pellets. This was done to ensure each horse received the required amount of supplement, as finding six separate feeding places in the indoor area could not be achieved. A small amount of hay (15 pounds) was available in the indoor area in 3-5 small piles, but no other food was necessary due to pasture.

Cameras were synced remotely once placed in the three designated areas to ensure coverage of all animals for each photograph. The overlapping focal areas of the cameras ensured photographs of every animal at one-minute intervals. The photographs, in contrast to video, provided *discrete* actions for each member of the herd that could be categorized using the behavioral classifications.

The photographs were downloaded each day, and a student with extensive experience with horses (hired through Grants in Aid of Research from the University of Wisconsin-Green Bay) categorized the animals in the photos according to behavior. Specifically, the data were initially entered into the Statistical Package for Social Sciences (SPSS), version 21.0 (IBM Corp., 2012) based on the categories used in the USGS ethogram (see Table 2). On several occasions, random photographs were viewed by the researchers to ensure accuracy in coding.

The herd consisted of three mustangs, two domestically-bred horses, and a burro. Since this herd had been together as a unit, it did not seem humane to eliminate the burro, Juanita, for the sake of the study. The most common social grouping of burros is one or two adult females and their offspring. Since burros attach to one animal (in this case it was the mustang Ellie), she ethically needed to be part of the group (Rudman). Additionally, there was concern about changes in behavior as a result of her removal, possibly influencing the outcome of the study.

Wild mustangs Bandita and Cortez were introduced individually to the herd in 2008. Bandita, introduced first, allowed haltering and touching prior to Cortez. In 2007, both younger mustangs were kept in an adjacent 40 × 40 foot building with access to an outdoor arena. The area bordered the northwestern paddock, allowing for acclimation

to the other equines. In addition to these animals, there was also a stallion and mare in an adjacent paddock.

Originally, the expectation was to observe all animals, but health issues prevented this from occurring as the aforementioned mare and stallion were recovering from leg injuries. The entire herd had been together for nearly five years at the point of this study. Table 1 provides identifying information for each participant. Although not intended, the herd of equines under study fell into three naturally occurring groups: mustangs who have been in captivity for less than five years (Bandita and Cortez), a mustang and burro who have been in captivity for at least 15 years (Ellie and Juanita), and horses born in a domestic setting (Cosette and Mister). These groupings ultimately led to the main research question of interest: Does length of domestication have an effect on behavior?

The horses and burro did leave the paddock and grazing areas for varying reasons (e.g., veterinary care, riding) during the study period, but never during the observational period. Every attempt was made to avoid direct interaction with humans during observational data gathering. However, some variables could not be controlled, such as wind, heat, rain, or humidity.

It should be noted weather changes abruptly in northeastern Wisconsin, and thus every 2.5-hour time period was associated with the primary weather condition: sunny, mixed sun and clouds, cloudy, fog, rain, snow, or hail. In addition, temperature (F), average wind speed (mph) and dew point (F, an alternative measure of humidity) were measured. The purpose for measuring these variables was to help explain why the animals chose indoor or outdoor locations. For example, there could be an increase in indoor resting during hot or sunny weather. Approval for this study was granted by the University of Wisconsin Institutional Animal Care and Use Committee on May 22, 2013.

2.2. Statistical analysis. Basic summary statistics (counts, percentages) were calculated to determine those behaviors that occurred most frequently, as well as animals who spent notably larger amounts of time doing certain behaviors than other animals.

Additional descriptive statistics from a 3 × 3 contingency table were used to explore how length of domestication (< five years, > 15 years, or always) affected the animals' location preferences (two outdoor fields and one indoor location). Additionally, multinomial regression was used to assess the effect of environmental (weather) conditions (temperature, wind, and dew point) on where the animals chose to locate themselves. The outcome of the model was animal location (north field, west field,

indoors), with all three weather variables as predictors. Length of domestication was included as a covariate to control for correlation within a given group of horses.

Finally, in order to assess whether length of domestication (as defined above) had a significant impact on behavior (the research question of interest), mixed effects logistic regression models were used, one for each of the four behaviors ($\alpha = 0.05$). Specifically, a given behavior was the outcome (feeding: yes/no, e.g.), length of domestication was the fixed effect of interest, and individual horse was used as a random effect to account for correlated observations within a given horse. Analyses were conducted either in SPSS or SAS/STAT® software version 9.4 of the SAS system for PC (copyright © 2016 SAS Institute Inc.). The mixed effects logistic regression models were estimated using the GLIMMIX procedure in SAS.

3. Results

3.1. Descriptive summary statistics. Feeding, the most frequently occurring behavior, occupied about 84% of the time budget across all animals (Table 2). If an animal was moving and eating in a given picture, it was recorded as feeding to comply with the USGS criteria. Drinking or licking mineral was also coded in this category. Juanita (the burro) spent only 78.3% of her time eating, while the others spent 82%-87%. Feral burros spend the majority of their time eating, although individual variation depending on their "life stage, level of physical activity, health status, environmental conditions and individual digestive and metabolic differences" does exist (Svendsen 102). The difference of five percentage points amongst the horses also reflects individual variation.

Resting, which included rest standing, sleep standing, or any form of recumbency, was the second most frequently occurring behavior (10% across all animals). Locomotion represented the third largest amount of the time budget (1.1%), followed by grooming (0.7%). Thus, feeding, resting, and locomotion accounted for 95% of all behavior exhibited in the study, and were also the four most observed categories in the USGS study. However, compared to the USGS study, the animals here spent a larger percentage of their time feeding and less time in locomotion. A simple explanation for this difference could be due to the ample forage available in Wisconsin compared to that in the Western ranges from the USGS study. Specifically, since there was more abundant foliage available, the animals did not need to travel long distances to acquire grazing opportunities.

Although this herd did not have a stallion, there was one on the property, so harem behavior was included, as a mare may have been present during estrus, thus evoking other behaviors in the herd (McDonnell). There were no observations recorded for the categories of herding, harem tending, or reproduction.

Note that some behavioral categories did not have enough observations to allow for meaningful statistical analysis, but still warrant some attention. Additionally, individual differences between animals may be explained by placement in the hierarchy, sex, or age of the animal, although these differences lie outside the focus of this study. Bands of horses are complex entities where individuals negotiate status and identity within changing contexts (Argent). The following are other observations from the data that were not tested statistically.

Mister and Cortez, the two geldings, had the highest frequencies for standing attentive, while Ellie, the lead mare, had only one recorded observation for this behavior. Bandita accounted for all five observations of comfort behavior, such as sun-basking or play. Finally, Bandita and Cortez (domesticated less than five years) displayed harem social behavior most frequently with 30 and 33 observations, respectively. This was in stark contrast to animals always in domestication or domesticated for at least 15 years: Mister (0), Cosette (8), Ellie (3), and Juanita (9). In general, these preliminary findings may also be impacted by sex, age, placement in the hierarchy, etc.

3.2. Effect of domestication and weather on location. A 3 × 3 contingency table of length of domestication and location indicated that across all animals, preference was for the west side of the field (58.63% of their time was spent here) over the north side (30.62%), or being indoors (10.75%). However, 92% of resting behavior across all animals was done indoors. Preference for the west field may be due to the fact that it is farthest from human contact (buildings) and closest to open agricultural land and woods. It is one area of the property where there tends to be a slight breeze and has the shade of a tree.

With regard to the indoor location specifically, always-domesticated horses were more likely to be present (40.6%), followed by those domesticated at least 15 years (30.7%), and finally those in domestication less than five years (28.7%). This could be due to animals with longer domestication having increased experience with buildings in general, and familiarity with seeking cover during hot weather.

The basis of the findings for the west and north fields was less clear. Specifically, in the west field, always-domesticated animals and those domesticated for less than five years were most commonly present and with about the same frequency (36.2% and 35.3%,

respectively). In contrast, animals domesticated > 15 years tended to be less present (28.6%). For the north field, animals domesticated > 15 years were present most often (41.7% of the time), while those domesticated < 5 years and who were always domesticated were present less often, and at similar rates (30.8% and 27.5%, respectively).

In the multinomial regression model relating weather conditions to location, all weather predictors were significant in the full main effects model (adjusted for length of domestication) at the $\alpha = 0.05$ level. Results indicated that, as temperature increased, animals were more likely to be indoors than in either field, controlling for wind and dew point. Additionally, 59% of the time spent inside was on sunny days. This is an expected result, as the indoor area provides shade, and water is also located here. The animals then preferred the north over west field, although the reason for this observation is not clear given the characteristics of the fields.

As dew point increased (controlling for temperature and wind), animals were more likely to be in the fields than indoors. This could be due to increased air movement outdoors, allowing them to remain cooler as humidity rises. Between the two fields, their preference was the west over north, which could again be due to the fact that the west field is more open, allowing for the most air movement.

Lastly, as wind speed increased, the animals first preferred the west field, followed by indoors, and, finally, the north field. There is again no clear reason for this pattern based on the authors' knowledge of the property, and it may be due to a more complex relationship between wind and the other weather variables than was modeled here.

3.3. Mixed effects logistic regression models for differences in behavior according to length of domestication. Table 3 provides the observed counts for the top four behavior categories (feeding, resting, locomotion, and grooming) by length of domestication (less than five years, at least 15 years, or always). Additionally included are the conditional probabilities of each behavior, given length of domestication. For example, the probability of resting given domestication for less than five years is 686/8341 = 0.082. These probabilities are related to the logistic regression models, the results of which are found in Table 4.

From Table 3, animals with the shortest length of domestication (< 5 years) were less likely to rest (conditional probability of 0.082) compared to those in domestication for longer periods of time (0.113 and 0.118 for > 15 years and always, respectively). The

pattern for grooming was opposite of this, with the least-domesticated animals (< 5 years) grooming more often (0.012) than the other two groups (0.004 and 0.005, again corresponding to > 15 years and always). For feeding and locomotion, the conditional probabilities were all very similar across the three domestication groups (see Table 3).

Table 4 gives the results of the mixed effects logistic regression models (with individual horses fit as random effects to account for correlation) for domestication time, separately for each of the four behaviors. The predicted conditional probabilities from these models differed from the observed probabilities (Table 3) by at most 0.001 (one one-thousandth), so that accounting for the correlation within animals did not greatly influence the results.

The models align with the observed probabilities from Table 3 in that they indicate the likelihood of resting and grooming were both influenced by length of domestication, while feeding and locomotion were not (all domestication groups were similar in these instances). For the former two behaviors, animals domesticated less than five years were significantly different from those domesticated at least 15 years or always. However, there was no significant difference between the latter two groups (> 15 years and always).

For resting, the estimated odds ratio (OR) between animals domesticated for less than five years and those domesticated for at least 15 was 0.706 (95% CI: (0.501, 0.996), p = 0.0475). Thus, the estimated odds of resting for the < 5 year group were about 29% lower than those for the > 15 year group. When comparing the < 5 year group to horses who have always been domesticated, the estimated OR (0.670, 95% CI: (0.475, 0.945), p = 0.022) indicated the estimated odds of resting in the < 5 year group were about 33% lower than those for horses who were always domesticated. A possible explanation for these findings is that horses domesticated for shorter amounts of time may be more "on alert" with regard to potential predators, which longer-domesticated animals would have become less concerned about. Additionally, wild mustangs move frequently to secure water and food, so that resting only becomes more frequent after longer domestication and the realization that there is less need to roam to find these resources.

With regard to grooming, animals domesticated less than five years had an estimated OR of 3.108 (95% CI: (1.676, 5.766), p = 0.0003) when compared to the > 15 year group. As such, the estimated odds of grooming for animals domesticated < 5 years were about 210% higher than those for animals in domestication for > 15 years. Lastly, the estimated OR (2.344, 95% CI: (1.297, 4.237), p = 0.005) between the < 5 year and always groups showed the estimated odds of grooming in the < 5 year group were about 134% greater

than those associated with animals who were born into domestication. No other results based on the logistic regression models were significant at the $\alpha = 0.05$ level (see Table 4 for complete results).

The difference in grooming based on length of domestication could be explained by the fact that self-grooming includes behaviors for managing insects, such as rolling on grass, nibbling, or tail-swishing. These behaviors may not be observed as frequently in the longer-domesticated horses who have learned to avoid insects by retreating indoors. Horses that have been in domestication longer also allow fly spray to be applied by human counterparts, and thus require less self-grooming to manage insects.

The above findings indicate that, even though horses may start out as feral and differ from long-duration domesticated horses on commonly occurring behaviors (such as resting and grooming), over time they become similar to the domesticated animals. In fact, as time progresses, they become indistinguishable statistically with regard to the frequency of these behaviors. Even though these findings require more research, the implications are important.

4. Discussion. The ancestors of our current-day American mustangs helped found this nation. The Wild and Free-Roaming Horses and Burros Act of 1971 recognizes this contribution. Mustangs came under federal control because they could not be protected on a state-by-state basis. They were often brutalized and slaughtered by dealers looking to make money. Much of the West prior to 1971 was united by the land ethic, "first come, first served — survival of the strongest, and get while the getting was good, there is always more beyond" (United States House of Representatives, 92 Congress 101). Mustangs belonged to no one and there was no way to protect them from abuse. They lived in a wild environment, which the title of the law denotes. However, over time, "wild" has been applied to the temperament of the horse.

Arluke and Sanders remind us that, "although animals have a physical being, once in contact with humans, they are given a cultural identity as people try to make sense of them, understand them, use them, or communicate with them." This could not be truer for the mustang. The notion of "wild and free" created protection for mustangs, while at the same time suggesting they cannot be tamed. In retrospect, humans underestimated the adaptability of these horses, resulting today in burgeoning populations in both short- and long-term holding centers.

The "BLM [Bureau of Land Management] has been removing an average of about 8,000 horses from rangelands each year for the last decade in an effort to control horse populations and meet its legal obligations. Removing such a large number of horses each year has substantially exceeded the capacity of BLM to place horses into private ownership; a result is that many tens of thousands of unwanted horses are maintained in long-term facilities until they die" (National Research Council of the National Academies 66).

Many mustang advocates argue for keeping these animals on the range, and the majority of research has been focused on this issue. However, what should be done about the 50,000 horses awaiting adoption? The Extreme Mustang Makeover, established by the Mustang Heritage Foundation, is a current attempt at bringing attention to the versatility of these horses. Their mission is "to increase adoption of wild horses held in the Bureau of Land Management's corrals and long term holding facilities" (Mustang Heritage Foundation). The Makeover is a competition that displays the talents of these horses, coupled with humane training approaches. Trainers are given around three months to ready the mustang for competition. One could claim that attempting to train a horse in this amount of time could be taxing, "but stress also occurs during gathers and in holding facilities" (National Research Council of the Academies 2). Additionally, one could argue that in the long-term, placing a mustang in a private residence could be less stressful than housing it in a holding facility for the majority, if not all, of its life.

With more horses in holding facilities than on public lands, one may conclude the BLM has mismanaged mustangs on public lands. From the standpoint of the mustangs' welfare, anything that can be done to promote moving them to permanent homes should be of paramount concern. This case study, albeit small, offers some interesting results: differences are apparent when transitioning to a new environment, but the horses acclimate over time.

Specifically, this study found equines start out dissimilar but become more alike over time with regard to two predominant equine behaviors — resting and grooming — even without specific, intensive training. These results suggest mustangs can and do adjust to domestic living, despite assumptions about their "wild" nature. Although the exact underpinnings of this change cannot be determined with certainty, this research suggests constructing environments that allow mustangs to move about and interact with other horses may aid acculturation to a new setting. Given the two least-domesticated mustangs in this study did not undergo formal intensive training, there is evidence mustangs become accustomed to new environments on their own over time.

Although the Extreme Mustang Makeover has helped place animals, the program focuses on behavioral change through intense 90-day training, culminating in national competitions. This process exhibits traits such as intelligence and willingness, but perpetuates the belief that mustangs are behaviorally quite different from domestic horses. In contrast, this study suggests there are some initial differences after mustangs are removed from their original environment, but that they change over time. Since these findings help dispel the myth that mustangs are wild by nature and can only become integrated with intense training and resocialization, they open the door for further study and alternative adoption routines. The traditional approach to placing mustangs has been to train them to adapt to domestic settings. This study calls that tradition into question. May we instead create domestic settings that help mustangs transition and acculturate in a gradual manner that eventually leads to the same outcomes, but with fewer resources and less stress to the animals? It appears to be a possibility.

Although under this alternative model it is unlikely mustangs would be able to perform the tasks in the aforementioned competitions as quickly, it seems *normalizing* the adaptation and adoption process might increase the adoption rate, which is the ultimate goal. As with any horse, additional training would be needed if adopters planned to use the animal for a specific discipline (e.g., as a trail horse, for pleasure riding, for dressage, as a pack animal, etc.). However, note that this training is only enhanced by a mustang who is familiar with people and typical routines. Research shows that both the arousal state of the animal and the level of attachment to his person impacts new learning. Andrew McLean (BSc, PhD, Dipl. Ed), owner and director of the Australian Equine Behavior Center says, "So a lot of what might seem like 'horse whispering' as well as all sorts of touch therapies might really be 'horse attachment.' If your horse is attached to you, he's going to be more likely to have a lower state of arousal – meaning, he'll be calmer and more focused on his learning session…tactile contact is an antidote for insecurity" (Lesté-Lasserre). In other words, transition may be less about training and more about creating a stable private environment.

It is known that mustangs travel great distances each day for water and food when on public lands, but once adopted, they are often placed in small confined areas, fed at scheduled times, and approached with the expectation they should understand human behavior. This initial human contact could potentially impact the assimilation process in a negative manner. The results of this study raise the question of whether or not

holding centers should instead allow for the expression of "wild" behaviors initially and transition mustangs to more typical "domestic" routines gradually over time.

Interestingly, since mustangs are herd animals and follow other horses, domestic horses are used to lure mustangs into traps during the mustang gathering process. However, once in holding centers, the idea that more acclimated — or even domestic — horses can assist new mustangs in their transition is abandoned. Prison programs, the Extreme Mustang Makeover, and professional trainers focus on humans teaching horses new behaviors. Although these approaches work, is using animals who have been in holding centers for some time to help recently captured animals in the transition not an intuitive (and less resource-intensive) alternative? In other words, could horses help other horses? This study seems to suggest that.

In terms of other ways to increase the chances of mustang adoption, the BLM might consider taking advantage of the knowledge held by community groups advocating for mustangs on several ranges throughout the West. Specifically, many individuals have followed certain mustangs for their entire lives, knowing when they were born, as well as specific personality traits and dispositions. Adoptions are managed by the BLM, but could pairing with these local groups enhance the process by providing additional information about the animals? Animal shelters have utilized this technique to attract individuals looking to adopt a dog, cat, or other small animal. Creating working partnerships between the BLM and advocacy groups can only benefit mustangs.

5. Conclusion. Much of mustang research is dominated by a discussion of how to manage these horses on public lands. However, additional work should target ways to ensure successful adoptions, given the current large number of animals in holding facilities. "In fiscal year 2012, more than 45,000 animals were in holding facilities, and their maintenance consumed almost 60 percent of the Wild Horse and Burro Program's budget" (National Research Council of the National Academies 16). This small study suggests there are some differences when transitioning mustangs to private environments, but that adaptation is possible over time, even without intensive training. Further examining what aids this initial transition should thus be a primary focus of the agency, both for the sake of animal welfare and for monetary considerations.

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Table 1: Demographic summary of equines used in this study (ordered by age).

Name	Breed	Age	Sex	Capture date	Location at birth	Year of entry into current herd
Ellie	Mustang	25	Mare	2/18/95	Lava Beds, Nevada	2000
Juanita	Burro	20	Mare	5/20/95	Black Mountain, Arizona	2000
Mister	Paint	15	Gelding	NA	Krakow, Wisconsin	2003
Cosette	Quarter Horse	14	Mare	NA	Black Creek, Wisconsin	1999
Bandita	Mustang	7	Mare	9/19/07	Little Book Cliffs, Colorado	2008
Cortez	Mustang	7	Gelding	9/19/07	Little Book Cliffs, Colorado	2008

Table 2: Summary of equine behaviors based on photographs taken across three areas: an indoor area, a mud lot, and a pasture. The length of domestication (less than five years, at least 15 years or always) is given below the animals' names. Feeding, resting, locomotion, and grooming occurred most frequently.

		Equine						*Total* (Percent within behavior)
		Mister (Always)	**Cosette (Always)**	**Ellie (≥ 15 years)**	**Juanita (≥ 15 years)**	**Bandita (< 5 years)**	**Cortez (< 5 years)**	
Behavior count (Percent within behavior, percent within equine)	**Feeding**	3778 (17.2, 86.6)	3606 (16.4, 82.6)	3771 (17.1, 86.4)	3419 (15.5, 78.3)	3710 (16.8, 85.0)	3736 (17.0, 85.6)	22020 (84.1)
	Resting	439 (16.7, 10.1)	573 (21.8, 13.1)	428 (16.3, 9.8)	500 (19.0, 11.5)	368 (14.0, 8.4)	318 (12.1, 7.3)	2626 (10.0)
	Locomotion	42 (14.0, 1.0)	58 (19.3, 1.3)	37 (12.3, 0.8)	59 (19.6, 1.4)	57 (18.9, 1.3)	48 (15.9, 1.1)	301 (1.1)
	Grooming	30 (16.4, 0.7)	16 (8.7, 0.4)	16 (8.7, 0.4)	17 (9.3, 0.4)	42 (23.0, 1.0)	62 (33.9, 1.4)	183 (0.7)
	Standing Attentive	40 (27.2, 0.9)	24 (16.3, 0.5)	1 (0.7, 0.0)	12 (8.2, 0.3)	22 (15.0, 0.5)	48 (32.7, 1.1)	147 (0.6)
	Harem Social	0 (0.0, 0.0)	8 (9.6, 0.2)	3 (3.6, 0.1)	9 (10.8, 0.2)	30 (36.1, 0.7)	33 (39.8, 0.8)	83 (0.3)
	Elimination	8 (34.8, 0.2)	0 (0.0, 0.0)	1 (4.3, 0.0)	0 (0.0, 0.0)	8 (34.8, 0.2)	6 (26.1, 0.1)	23 (0.1)
	Human Awareness	2 (10.0, 0.0)	3 (15.0, 0.1)	3 (15.0, 0.1)	5 (25.0, 0.1)	1 (5.0, 0.0)	6 (30.0, 0.1)	20 (0.1)
	Comfort	0 (0.0, 0.0)	0 (0.0, 0.0)	0 (0.0, 0.0)	0 (0.0, 0.0)	5 (100.0, 0.1)	0 (0.0, 0.0)	5 (0.02)
	Agonism	1 (25.0, 0.0)	0 (0.0, 0.0)	0 (0.0, 0.0)	2 (50.0, 0.0)	0 (0.0, 0.0)	1 (25.0, 0.0)	4 (0.02)
	Out-of-Sight	25 (3.2, 0.6)	77 (9.9, 1.8)	106 (13.6, 2.4)	342 (43.8, 7.8)	122 (15.6, 2.8)	108 (13.8, 2.5)	780 (3.0)
Total (Percent within equine)		4365	4365	4366	4365	4365	4366	26192

Table 3: Observed counts of behaviors across length of domestication (less than five years, at least 15 years, always) for the top four most frequently occurring behaviors. Conditional probabilities of behavior given the length of domestication are given in parentheses.

	Length of domestication			*Total*
	< 5 years	**≥ 15 years**	**Always**	
Resting				
Yes	686 (0.082)	928 (0.113)	1012 (0.118)	2626
No	7655 (0.918)	7319 (0.887)	7530 (0.882)	22504
Total	8341	8247	8542	25130
Grooming				
Yes	104 (0.012)	33 (0.004)	46 (0.005)	183
No	8237 (0.988)	8214 (0.996)	8496 (0.995)	24947
Total	8341	8247	8542	25130
Feeding				
Yes	7446 (0.893)	7190 (0.872)	7384 (0.864)	22020
No	895 (0.107)	1057 (0.128)	1158 (0.136)	3110
Total	8341	8247	8542	25130
Locomotion				
Yes	105 (0.013)	96 (0.012)	100 (0.012)	301
No	8236 (0.987)	8151 (0.988)	8442 (0.988)	24829
Total	8341	8247	8542	25130

Table 4: Results from the mixed effects logistic regression models (fit separately for each behavior; individual horse included as a random effect): Estimated conditional probabilities of each behavior given length of domestication (less than five years, at least 15 years, always), and estimated odds ratios for each behavior across domestication groups.

	Length of domestication		
Resting	**< 5 years**	**≥ 15 years**	**Always**
Conditional probabilities	0.082	0.112	0.118
		< 5 years	**≥ 15 years**
Odds ratios (*p*-value) (95% confidence interval)	**≥ 15 years**	0.706 (0.048)* (0.501, 0.996)	--
	Always	0.670 (0.022)* (0.475, 0.945)	0.949 (0.764) (0.675, 1.335)
Grooming	**< 5 years**	**≥ 15 years**	**Always**
Conditional probabilities	0.012	0.004	0.005
		< 5 years	**≥ 15 years**
Odds ratios (*p*-value) (95% confidence interval)	**≥ 15 years**	3.108 (0.0003)* (1.676, 5.766)	--
	Always	2.344 (0.005)* (1.297, 4.237)	0.754 (0.399) (0.392, 1.452)
Feeding	**< 5 years**	**≥ 15 years**	**Always**
Conditional probabilities	0.893	0.872	0.865
		< 5 years	**≥ 15 years**
Odds ratios (*p*-value) (95% confidence interval)	**≥ 15 years**	1.221 (0.232) (0.880, 1.696)	--
	Always	1.298 (0.118) (0.936, 1.802)	1.063 (0.714) (0.767, 1.474)
Locomotion	**< 5 years**	**≥ 15 years**	**Always**
Conditional probabilities	0.013	0.012	0.012
		< 5 years	**≥ 15 years**
Odds ratios (*p*-value) (95% confidence interval)	**≥ 15 years**	1.092 (0.738) (0.652, 1.831)	--
	Always	1.081 (0.767) (0.646, 1.808)	0.990 (0.969) (0.589, 1.662)

* Significant at $\alpha = 0.05$ level