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Aggression in working mules and subsequent aggressive treatment by their handlers in Egyptian brick kilns—Cause or effect?

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ABSTRACT

Mules found working in Egyptian brick kilns are often faced with poor welfare from being over worked, overloaded, having multiple lesions from ill-fitted harnesses, poor body scores, and receiving aversive treatment by handlers. Reports have frequently revealed aggressive responses by mules toward their handlers. The main goal of this study was to investigate whether mule aggression is an innate act toward people or is a reactive response to rough handling procedures by their handlers. A total of 374 mules from 50 different kilns were assessed and their handlers were interviewed. The handler's questionnaire recorded the following parameters: handler's age, experience, and common beliefs about the aggression of brick kiln mules, and also data regarding load weights, working hours, and husbandry procedures carried out by the handlers were collected. The data were analyzed and correlations between parameters were tested using SPSS 17.1. Handlers' data showed that 79% of participants believed that mules are inherently difficult to handle, 65% used nose ropes/metal chain for driving their mules, and 67% responded that mules must be beaten to work properly. Behavioral assessment revealed that 66% of mules were alert. Approach tests indicated that 30% of the mules exhibited signs of aggression (e.g., bite threat) when approached by an unfamiliar handler and only 16% showed signs toward their handlers (familiar). The assessment of body lesions showed that mistreatment-induced lesions (42%) were more predominant than other categories of body lesions. Significant correlations ($P \leq 0.05$) were found between mules' aggressive responses toward observers and the following parameters; body condition score ($r_s = 0.42$), along with the handler's age ($r_s = -0.53$), level of experience ($r_s = -0.34$), handler's common beliefs about mule aggression ($r_s = 0.64$), and the nature of the work they were involved with at the kilns (work hours, $r_s = -0.63$; load weight, $r_s = 0.38$). Based on the results of this study, we concluded aggressive interactions exhibited by mules were most likely initiated by harsh, violent handling.

Introduction

Resource poor owners and their working equids face multiple challenges working in the Helwan Brick Kilns, located near Cairo, Egypt. In general, many of the working equids in the brick kilns, such as mules and hinnies, are subjected to harsh conditions where their overall welfare is compromised. Mules working in the brick kilns often receive inadequate nutrition and poor veterinary care and are equipped with ill-fitted harnesses attached to poorly constructed carts. Moreover, these equids are subjected to additional stress from working in hot conditions both because of the ambient temperature of the environment and the additional heat radiating from the kilns. Another challenge faced by the mules is to pull loads over uneven terrain (Dennison et al., 2007).

Preliminary data (collected by authors) indicated that the typical workday at the kilns ranges from 8 to 12 hours, pulling approximately 12 loads/h, with each load weighing between 500 and 1,000 kg. The workers at the kilns are paid according to how many loads

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are hauled (production-based salary) rather than hourly. Therefore, both man (all preliminary data have shown only male handlers thus far) and mule are forced to work with few or no breaks for rest in tiring conditions (http://thebrookeegypt.org, 2016). An earlier study, Ali et al. (2015), compares welfare outcomes between donkeys and mules working in these kilns and reports that mules are the best suited for the job. However, although that study shows that the mules are coping better than the donkeys, physically, it also notes that many of the mules are quite aggressive. That finding initiated the present study.

Most mule handlers at the kilns were between 8 and 18 years of age with different levels of education (http://thebrookeegypt.org, 2016). Preliminary data indicated that the mules were typically taken to the kilns at the age of 3 to 5 years and started working right away. The factory, itself, owned some of the mules, and some were rented from outside providers. In a previous study, Ali et al. (2015) reported multiple indicators of poor welfare for both donkeys and mules in Helwan brick kilns. Most of these animals have the following conditions: low body condition score (BCS), heat stress, overloading and overworking, unsatisfactory harnesses, mistreatment by handlers, and prolonged depression/apathy. In the 2015 study, mules have more lesions caused by abuse when compared to donkeys. The lesions of these equines were frequently located on the bridge of the nose, hindquarters, and the point of the hocks. The number of these lesions and locations is believed to be related to the type of equipment used by the handler in an attempt to increase control and productivity of the mules during work (Ali et al., 2015). For example, observations revealed that when mules were overloaded, they began to show signs of aggression in response to the handler beating and slapping them to encourage them to move. The striking with various whips and objects occurred in the hindquarter region. Once contact was made, the mules responded by kicking back, leading to hock injuries by hitting the cart or wagon and the receiving even more lashes. These reactions of the mules were considered to be aggressive by the handlers. As a consequence, the users, in their need to feel safe driving their animals, adopted even more abusive training and motivation tactics and added extra controlling gears to the harnesses. Even more, as we observed, the handlers seemed to believe that inducing pain increased the amount of control, so they often created open lesions on the nose bridge of their mules. As Ali et al. (2015) observed in an approach test, these animals frequently show aggressive behaviors (kicking, biting, pawing, etc.) toward unfamiliar handlers.

However, when the animals demonstrated signs of fear-based aggression, they were usually exposed to adverse handling procedures such as frequent beating, slapping, and ear twisting. The mules were rarely, if ever, approached for grooming or petting, which in turn influenced them to demonstrate an improper reaction toward handling (Rousing et al., 2001). Unfortunately, when mules display signs of fear-based aggression toward their handlers, despite the cause of the aggressive response, the handlers tend to react to the behavior by applying more drastic and severe methods of handling (e.g., tight and abrasive material nose ropes/metal chain nose bands or vigorous slapping on the hindquarters, Figures 1 and 2).

Many reports from preliminary data gathered from handlers and veterinarians claim that mules display aggressive behavior, and in many cases, it has become nearly impossible to work with these animals to even perform the most basic husbandry or veterinary procedures.

The primary objective of the present study was to investigate whether mule aggression consists in innate acts toward human beings or is a reactive response to the rough handling procedures performed by handlers. In this study, we attempted to track the nature of aggression in mules and the risk factors that trigger such responses in mules found working in brick kilns. We do know from previous evidences around the world that mules can be trained to perform in competitions, in a similar way to horses (Smith, 2008),

Figure 1. Lesions at the nasal bridge due to tightly fitted cloth or metal nose bands. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Figure 2. Lesions at hindquarters of a mule due to continuous and aggressive beating. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

and they still are used by many communities throughout the world as beasts of burden.

Materials and methods

A total number of 374 mules from 50 different kilns were assessed and their handlers were interviewed between March 2016 and August 2016. The study began after two months of preliminary data collection work in the kilns. During this preliminary data collection work, both veterinarians working for nongovernmental organizations and mule handlers from 10 kilns (5% of Helwan brick kilns) were interviewed to collect data about claims of aggressive behavior of mules working in brick kilns. The interview included questions investigating whether the handler/veterinarian had been kicked or bitten and whether the veterinarian could easily perform basic procedures on the kiln mules. This preliminary work helped us to determine both the main objective of the present study and the suitability of measuring the preselected animal-based parameters. Moreover, during this period, practical field training for the measurement of the selected parameters (i.e., equid's age, BCS, body lesions, and behavioral testing) and verification of the observer reliability was done with an experienced Brooke Egypt veterinarian (second author) and an experienced horse veterinarian behaviorist (first author) with a working equine expert (fourth author), until a ratio of 95% and 98% for interobserver and intraobserver reliabilities, respectively, were achieved.

Handlers' questionnaire

Upon invitation, the handlers voluntarily participated in the study and were informed about the whole procedure, the purposes, and the potential importance of the present study. Interviews were completed during handlers' breaks between loads. All questions were asked directly following the sequence shown in Table 1.

The questionnaire comprised five sections. Section 1 included baseline data about the handlers: age, level of education, and years of experience working with mules in brick kilns. Section 2 included handlers' common beliefs about the aggression of brick kiln mules.

Table 1
Handlers' questionnaire

Possible answers	Questions
Number of years	1. Handler's age?
Number of years	2. How long have you been working in kilns and with mules?
None, elementary, middle, high school, or college degree	3. What is the highest grade or level of school have you received?
Yes/No	4. Do you think all mules are difficult to be handled?
Yes/No	5. Do you think all mules must be driven by nose ropes or even metal chains?
Yes/No	6. Do you think all mules must be beaten to work properly?
Yes/No	7. Do you think all mules are habitually kicking or biting?
Yes/No	8. Do you think all mules are kicking or biting only when being beaten, teased, or overloaded?
Yes/No	9. Have you ever been kicked or bitten by mules?
Yes/No	10. Do you always drive this mule every day?
Number of loads	11. How many loads are pulled by this mule per day?
Number of hours	12. How many hours do you drive this mule per day?
Yes/No	13. What is the approximate weight of each load?
Yes/No	14. Do you groom your mule at least once per week?
Yes/No	15. Do you or someone else trim the hooves of this mule at least once per season?
Yes/No	16. Can you give your mule an oral medication?

Section 3 asked questions about the handlers' previous experiences of aggressive interactions with mules. Section 4 collected data related to the workloads in kilns such as load weights, working hours, and the number of loads pulled per day and investigated whether the handler worked with the same mule every day. Section 5 collected data related to husbandry procedures carried out by the handlers, for example, grooming, hoof trimming, and the handler's ability to administer oral medication to their mules.

Measurement variables: equid behavior, BCS, and body lesions assessment

The descriptors used in the present study were the equid's age and gender. Equid's age was determined by history from the owner and confirmed by following the study by Crane (1997). Mules were grouped into three age categories young (Y) = up to 5 years of age, medium (MA) = between 5 and 15 years of age, and old (O) = over 15 years (Pritchard et al., 2006). Equids were also grouped according to their gender as shown in Table 2. Moreover, the location of the kiln, handler's name, and the mule's specific body marks were recorded to avoid reassessing the same animal.

The behavioral parameters were measured according to Burn et al. (2010a) with some modifications to ensure the primary objective of the present study and to sustain a thorough assessment of the animals' state of alertness and response to both observer and handler approach and contact (Popescu et al., 2014). The sequence for measuring these parameters was conducted according to Ali et al. (2015).

The observer started from a distance of 3 m from the equid at an angle of 45° from the sagittal plane of the animal's body and maintained this position for 10 seconds without any disturbance, and the equid's attitude was observed. At the same distance but at an angle of 20° from the sagittal plane of the animal's head, the

Table 2
Equid's assessment (equid's behavior, body condition score, and body lesions)

Possible answers	Questions
Young (Y), medium (MA), and old (O)	1. Equid's age
Male (M) and female (F)	2. Equid's gender
Thin (T), moderate body condition (M), and obese (O)	3. Equid's body condition score
4. Body lesions	
Present (Pr) or absent (Ab)	4.1. Harness induced body lesions[a]
Present (Pr) or absent (Ab)	4.2. Mistreatment induced body lesions[b]
Present (Pr) or absent (Ab)	4.3. Overwork induced body lesions[c]
5. Equid's behavior	
Alert (A) or depressed (D)	5.1. Equid's attitude
Ignoring observer approach (IOA), aggressive response (Ag), avoiding approach (Av), or friendly response (F)	5.2. Response to being approached by a veterinarian[d]
	5.3. Response to being approached by the handler
Accept contact (Acc) or avoid contact (Avc)	5.4. Chin contact by veterinarian
	5.5. Chin contact by handler

[a] Harness-induced body lesions.
[b] Mistreatment-induced body lesions.
[c] Overwork-induced body: lesions were recorded as present when scars of old wounds, broken skin and/or subcutaneous tissue, visible muscle and/or bone or tendons of at least 2 × 2 cm^2 (quadratic lesion), 1 × 4 cm^2 (rectangular lesion), or 2.3 cm in diameter (circular lesion) were found.
[d] Response to the observer/handler approach was recorded to be either "IOA" ignoring observer approach, "Ag" aggressive response, "Av" avoiding observer approach, or "F" friendly response.

Table 3
Lesion categories

Description	Lesion category
Include neck/point of shoulder lesions due to poor-quality collars, lesions at sides of chest due to poorly fitted cart shafts, and lesions at withers and spine due to the use of the pack saddle without proper padding.	Harness-induced body lesions (HIL)
Include lesions at nasal bridge due to tightly fitted cloth or metal nose bands or at the commissures of the lips due to tightly fitted bit, lesions at hindquarters due to continuous and aggressive beating of the equids, and lesions at points of hocks due to hitting the cart when kicking back as a response for being beaten.	Mistreatment-induced body lesions (MIL)
Include pain and/or swelling of the forelimbs and/or hind limbs tendons and/or fetlock joints and lesions at the anterior aspect of the knee due to falling down while pulling overly heavy loads up and down the steep terrain.	Overwork-induced body lesions (OIL)
Lesions in which there were skin and subcutaneous layers broken and included broken skin with visible pink or red tissue present, visible muscle, tendon or bone, or granulation tissue were recorded separately irrespective to the body region as deep lesions	Deep lesions

observer approached the animal with slow and calm steps, stopped at about 30 cm away from the animal's head and recorded the animal's response. Finally, at the same position, the observer slowly raised his opened hand toward the animal's chin and touched it, then recorded the animal's response. The animal's own handler then identically repeated the last 2 steps.

Equids were classified based on their attitude into either alert (A) or depressed (D). Response to observer/handler approach was recorded as friendly response (F), ignore observer approach, avoiding observer approach (Av), or aggressive response (Ag). The animal's response to chin contact by observer/handler was assessed as accepts contact (Acc) or avoids contact (Av) as shown in Table 1. A comprehensive description for each of these categories was previously addressed by Ali et al. (2015 and 2016).

BCSs were assessed on a 5-point scale as described by Pearson and Ouassat (2000), from 1 (poor) to 5 (obese); then, categories were further categorized as follows: thin animals (T) including scores of 1 and 2, moderate BCS (M) including scores of ≥2.5 to ≤3.5, and obese (O) including scores of 4 and 5 as shown in Table 2. Finally, body lesions were assessed according to Dennison et al. (2007). A lesion might include scars of old wounds, broken skin, and/or subcutaneous tissue. Also, the surface area was recorded for lesions. The lesion had to be of at least 2 × 2 cm^2 (quadratic lesion), 1 × 4 cm^2 (rectangular lesion) or 2.3 cm in diameter (circular lesion) to be recorded. Lesions then were categorized according to their most likely initial cause as described by Ali et al. (2015), shown in Table 3.

Moreover, lesions in which there were skin and subcutaneous layers broken and included broken skin with visible pink or red tissue present, visible muscle, tendon or bone, or granulation tissue were recorded separately irrespective to the body region as deep lesions, shown in Table 3. Both the questionnaire and measurement variables were addressed in a thoroughly predesigned questionnaire checklist (Tables 1 and 2) to ease and facilitate handlers' interviews and data collection.

Data management and analysis

Data were entered into a spreadsheet (Microsoft Excel 2007, Microsoft Cooperation, USA) and analyzed using SPSS v17 (SPSS Inc, Chicago, Illinois, USA). Data analysis included checking for adequate randomization using Exact Binominal test for binominal data and chi squared tests for categorical data, and the statistically significant level was set at $P \leq 0.05$. Descriptive statistics were used for the analysis of the parametric data as follows: means and standard deviation for numerical continuous data. Relationships between aggressive response to observer approach with several nonparametric variables including handler's baseline data, common beliefs, and experiences with mule's aggression in addition to several parametric variables such as equids' age, BCS, and body lesions were determined by Spearman test.

Results

The 374 mule/handler dyads were assessed/interviewed, respectively. Twenty-nine animals were excluded due to either handlers' refusal to participate in the study (n = 14), because their mules were sick (n = 7), or due to handlers who were unable to take a break from work due to high production demands (n = 8).

Handlers' questionnaire approach

The average age of the handlers was 15.64 ± 5.55 years while the maximum and minimum values were 30 and 8 years, respectively. The handlers' years of experience working with brick kiln mules averaged 4.41 ± 3.90 years with maximum and minimum values of 20 and 1 years, respectively. The data showed that a majority of the handlers, (93.6%) had never been educated, while only 6.4% revealed low formal levels of education, having only attended formal schooling at the primary level. Most of the handlers held similar beliefs about mules. Of these, 78.87% believed that mules are inherently difficult to handle, and 64.43% used nose ropes/metal chain for driving mules, and 66.84% agreed that mules must be beaten to work properly.

Furthermore, 58.02% of participants believed that mules kick and bite often, but only 36.63% reported that they kick or bite only when being teased or beaten by handlers. However, when handlers were asked about their previous experiences with aggressive

interactions or encounters with mules, more than a third of the handlers (35.56%) confirmed that they were previously kicked or bitten by mules. Most mules (93.58%) were worked by the same handler on a daily basis. When evaluating the work at the kilns, the results indicated that both handlers and mules worked an average of 9.29 ± 2.39 hours, ranging from 6 to 12 hours daily. They pulled an average of 111.23 ± 19.86 loads per day, with an average load weighing 764.92 ± 170.1 kg, minimum and maximum values of 450 to 1000 kg per load, respectively. Also, when measuring husbandry procedures, 93.58% of the participants did not groom their mules not even once per week, and 77.8% never trimmed their hooves. Finally, a slight majority of the participants (56.14%) confirmed that they were able to administer oral medications to their mules; however, that still means that 44% were not able to do basic procedures of administering oral medications to their animals.

Equids' behavior, BCS, and body lesions assessment

Mules assessed in this study were classified according to their age into young (9.09%), medium age (83.42%), and old animals (7.49%). In terms of gender, only 25.67% of the assessed mules were females and 74.33% were males; none of them were castrated. Moreover, to investigate any possible influence of equid's gender on their behavior, BCS, the incidence of body lesions, binomial tests were applied and revealed no interaction.

Assessing the BCS of the brick kiln mules revealed that 28.87% equids were thin, while 66.84% scored moderate BCS and only 4.27% equids had more than moderate BCS ($P = 0.021$). Behavioral assessment of these mules revealed that a majority of mules (65.77%) were alert (Table 4). Furthermore, significantly ($P = 0.031$) more mules responded in a friendly manner when they were approached by their handler (13.1%) versus the unfamiliar observer (9.36%). More mules actively avoided approach by their handlers (43.85%) versus an unfamiliar observer (32.08%). A larger number of mules responded aggressively (e.g., bite threat) when being approached by the observer (29.67%) than by their handlers (15.78%), as shown in Table 4. Finally, significantly ($P = 0.005$), more mules accepted chin contact by their handlers (65.5%) than by the observer (45.72%; Table 4).

The assessment of body lesions showed that mistreatment-induced lesions (41.71%) were more predominant than other categories of body lesions, such as harness lesions (25.41%), overwork-induced lesions (20.05%), and deep lesions (28.34%; Table 5, Figure 2). Finally, significant correlations were found between aggressive response to the observer approach, with the mules' BCS, body lesions, handler's age and experience, handler's common beliefs about mule aggression, handler's previous experience of aggressive interactions with mules and the type and duration of the work they were involved with at the kilns (the detailed relationships are in Table 6). For instance, mules that exhibited either aggressive or avoidant response when approached by the observer were mostly driven by younger and less experienced handlers. Furthermore, relationships were found between the younger, less experienced handlers believing that mules are difficult to be handled, must be beaten to work properly, often kick and bite, and must be driven with a nose rope/metal chain (Figure 1). On the other hand, these mules were working shorter hours and pulling less frequent, but heavier loads than those animals that exhibited either a friendly response or even no response when approached by an observer. Mules that exhibited aggressive behavior were usually medium aged, with moderate BCS, a high incidence of mistreatment-induced lesions, and were almost never groomed.

Table 4
Behavioral observations in brick kiln mules

n (%)			Behavior observation
246 (65.77)		A (alert)	Equid attitude
128 (34.22)		D (depressed)	
X^2, *P* value	By handler	By observer	Response to approach
2.26, 0.031	49 (13.10)[a]	35 (9.36)	Friendly response
1.26, 0.26	102 (27.27)	108 (28.88)	Ignore approach
5.63, 0.019	164 (43.85)[a]	120 (32.08)	Avoid approach
6.96, 0.012	59 (15.78)[a]	111 (29.67)	Aggressive response
X^2, *P* value	By handler	By observer	Response to chin contact
9.36, 0.005	245 (65.50)[a]	171 (45.72)	Accept contact
8.16, 0.019	129 (34.49)[a]	203 (54.27)	Avoid contact

[a] Indicate statistically significant difference within the same parameter and between handler and observer.

Table 5
Body lesions found in brick kiln mules

Abs (absent), no. of animals (%)	Pr (present), no. of animals (%)	Body lesions
279 (74.59)	95 (25.41)	Harness-induced body lesions[a]
299 (79.94)	75 (20.05)	Overwork-induced body lesions[b]
218 (59.28)	156 (41.71)	Mistreatment-induced body lesions[c]
268 (71.65)	106 (28.34)	Deep body lesions[d]

[a] Harness-induced body lesions: Include lesions of the neck, point of shoulder, sides of the chest, withers, and spine.
[b] Overwork-induced body lesions: Include pain and/or swelling of the forelimb and/or hind limb tendons and/or fetlock joints and lesions at the anterior aspect of the knee.
[c] Mistreatment-induced body lesions: Include lesions at nasal bridge or at commissures of the lips, lesions at hindquarters, and lesions at points of hocks.
[d] Deep lesions: Include lesions in which there were skin and subcutaneous layers broken and included broken skin with visible pink or red tissue present, visible muscle, tendon or bone, or granulation tissue, recorded separately irrespective to the body region.

Table 6
Association between mules' aggressive responses and handlers' data, common beliefs, and experience, mules' age, body condition score (BCS), and body lesions

P value	Spearman correlation coefficient (r_s)[a]	Correlated variables
Mules' aggressive response results to unfamiliar observer		
0.029	−0.53	1. Handler's age
0.036	−0.34	2. Handler's experience in kiln work with mules
0.021	−0.63	3. Working hours/day
0.026	−0.58	4. Number of loads/day
0.038	0.38	5. Average load weight
0.016	−0.72	6. Grooming at least once weekly
0.018	0.64	7. Handlers with common belief that mules are difficult to be handled
0.021	0.57	8. Handlers with common belief that mules must be beaten to work properly
0.032	0.49	9. Handlers with common belief that mules must be driven by nose rope/metal chain
0.028	0.61	10. Handlers with common belief that mules often kick or bite
0.035	−0.34	11. Equid's age: young age
0.031	0.53	Medium age
0.041	−0.29	Old age
0.032	0.42	12. Equid's BCS
0.011	0.67	13. MIL (mistreatment-induced lesions)
0.016	−0.56	14. OIL (overwork-induced lesions)
0.035	0.32	15. HIL (harness-induced lesions)
0.038	−0.54	16. Deep lesions

[a] Spearman correlation coefficient (2-tailed) between mules' aggressive responses toward the observers' approach and handlers' basic data, experience, common beliefs, workloads in kilns, equid's age, BCS, and body lesions.

Discussion

Despite several literature reviews conducted by the authors, little scientific information has been found on mule behavior. Much of our collective information is based on anecdotal evidence and firsthand experience. There are also many myths, fallacies, and folklore "out in the trenches" when it comes to training or working with mules. Some have claimed that mules are highly intelligent due to an effect of hybrid vigor (*Equus asinus* × *Equus caballus*), possibly contributing to mules having significantly higher cognitive abilities compared to either parent (Proops et al., 2009). Some claim they should not simply be treated like horses with long ears (Burnham, 2002).

Working equid behavioral tests, such as the observer/handler approach tests and the chin contact test are considered important elements in assessing the nature of human-equid interaction and its implications on the equid's psychological status. These tests indicate the responsiveness of the equid to the surrounding environment and help identify fearfulness or aggression toward humans (Pritchard et al., 2005; Vollmayr and Henn, 2003).

In this study, there was a common perception among handlers that mules were aggressive, particularly to people they are unfamiliar with. When this theory was tested by an observer approaching the mules versus familiar handlers approaching, it was found that the mules did exhibit a higher frequency of aggressive, avoidance, or ignoring behavior toward the observer compared to when the handler of the mule approached it. In addition, the mules were more willing to accept chin contact by the handler versus the observer. These findings support reports by Bott et al. (2014) who found that when unfamiliar observers approached donkeys, mules, and horses, that donkeys were most tolerant in the behavioral examinations. McLean et al. (2017) found that mules were more accepting of familiar handlers approaching their forehead and left side of their neck and ears compared to unfamiliar handlers. Furthermore, in participatory interviews, McLean et al. (2017) reported that owners in Peru preferred working with mules compared to other equids and found them more intelligent and easier to train. So, perceptions about and attitudes toward mules may vary from different regions or geographical areas. Furthermore, other studies claimed that even basic routine procedures with mules often require more patience and effort than when working with a horse that has comparable training (Burnham, 2002; personal observations; McLean, 2013; McLean et al., 2017). Proops et al. (2009) have suggested that because mules seem to have an "enhanced ability" to form associations between certain stimuli and possibly even certain places or people, they can develop a "higher order" relationship with stimuli and possibly even certain places or people; thus, one should consider this factor when training or when performing routine procedures.

The idea that mules are aggressive by nature (as expressed by many handlers in the pilot data collection) is not supported by this study's results. Our data suggest that as the handlers increase in age and gain more experience working with mules, their perception that mules are all aggressive decreases. This idea is further supported by comparing the actual relationship of the handler's experience in the kilns working with mules; the more experience the handler had was associated with a decrease in mule aggression. Furthermore, negative correlations were found between mule's aggression with number of hours worked and loads per day. A possible explanation might be that the mules that work for less hours and pull less loads per day are not exhausted. Subsequently, they tend to exhibit responses to the observer's approach rather than ignoring it. On the other hand, exhausted animals tended to show unresponsiveness in similar situations of human approach as Popescu and Diugan (2013) and Pritchard et al. (2005) claimed that exhaustion due to overworking might be the primary cause of unresponsiveness and depression in working equids. These findings are also consistent with those of Vollmayr and Henn (2003) who concluded that the higher incidence of aggression and avoidance upon observer approach/contact are indicators for fear of humans as these equids are regularly slapped, beaten, or shouted at by their handlers.

Moreover, aggression and avoidance were more prevalent in medium-aged mules with moderate BCS than young or old mules with thin BCS. These findings support the previous assumption that exhaustion might be the leading cause for unresponsiveness rather than exhibiting aggression or avoidance responses because older or younger animals with low BCS are more likely to become quickly exhausted than medium-aged animals with moderate BCS.

These findings are also consistent with Burn et al. (2010b) who found that equids with frequent and severe physical problems usually demonstrate unresponsiveness. This indicates that the equids' resources are being stretched beyond their limits, and their fitness is compromised (Pritchard et al., 2009). It could be the case that the equids are conserving their energy by not responding to potentially threatening stimuli, such as approach by a human (Pritchard et al., 2009). This behavior could be indicative of several negative welfare states, such as exhaustion due to overwork (Tadich et al., 1997; Pritchard et al., 2009), chronic pain (Ashley et al., 2005), and general malaise (Millman, 2007). Furthermore, in the present study, mules that exhibited aggression or avoidance were less likely to suffer from deep lesions and overwork-induced lesions than the unresponsive mules. Animals with these types of lesions are supposed to suffer from exhaustion due to overworking or chronic pain due to deep lesions. This supports the previous hypothesis that exhausted equids tend to ignore potential stimuli, such as observer approach, to conserve their energy and vice versa for healthier animals. However, an increase in aggressive behavior was shown when the average weight of the load increased; an attempt of the mule to exhibit such a behavior (kicking or biting) indicates that the weight pulled is too heavy.

Mules that exhibited aggressive or avoidance response toward the observer's approach were more likely to suffer from mistreatment-induced lesions than other animals, which in turn supports that these mules were exposed to harsh handling and restraint procedures. These findings agree with those of Rousing et al. (2001) and Pritchard et al. (2006) who explained that fear and aversion increase the risk of handlers' injuries, which in turn increased the severity of restraint and violence of handling.

Many times, the stoic and cautious behavior of mules has been misunderstood as stubbornness (Miller, 2007). In some cases, this belief of stubbornness has led the animal to be treated more harshly than it should have been. Handlers who participated in this study shared many common beliefs that were positively correlated with mule aggression, for example, mules must be beaten to work properly, mules are difficult to handle, and they often kick or bite, and must be driven with a nose rope/metal chain. Participatory studies with mule owners/handlers have found that most mule owners who were interviewed replied with a surveyed response similar to the following: "you must work with a mule from the time it is a foal if you want a well-behaved mule" (Bott et al., 2014; McLean et al., 2017).

The present study did suggest that mules that were not groomed at least once/week were more likely to exhibit aggressive responses compared to mules that were groomed weekly. This may suggest that a possibly positive interaction with mules, such as grooming or even petting, may decrease aggressive behavior and establish a different human-animal interaction. Some who work regularly with mules claim that gaining trust can be achieved more quickly by using positive reinforcers such as food, petting, or voice commands

(Burnham, 2002; personal observations, 2009). Considering the lack of scientific data that are currently available on mule behavior, this study attempts to define not only certain aspects of mule behavior but also to test perceptions among handlers and further to test the mules' responses to both familiar and unfamiliar handlers. The findings could further aid professionals, for example, veterinarians and paraprofessionals (unlicensed veterinary technicians and assistants), how to safely and efficiently work with and treat mules. This study and others (McLean et al. 2017) have found that familiar handlers/owners have a higher success rate for approaching their mule from multiple locations such as the chin, face, and neck compared to an unfamiliar person. Therefore, such responses led us to believe that when performing some routine procedures such as administering oral dewormers, it may in fact be less stressful and more successful if the familiar person is asked to complete the procedure compared to the unfamiliar professional (e.g., veterinarian/paraprofessional).

Conclusions

Based on findings form the present study, we strongly suggest that the belief that mules are aggressive by nature is incorrect. We suggest that the strongly held belief among kiln workers that mules are aggressive by nature has initiated a fear response among handlers. This, in turn, has promoted a counter reaction of adding more force while handling mules to better control them and avoid any possible physical aggression.

However, we acknowledge that we know very little about how these mules were handled before they began their working life in the brick kilns. Their previous interaction with humans may have played a large role in the behaviors observed during the study period. Our work supports the concept that there is much to be done in terms of educating the owners/handlers of working mules, both for the welfare of the mules and also the safety of the handlers. More studies are needed to further define the behavior of the mule and how mules adapt to different training methods, different situations, and different people. Studies about how best to educate the mule handlers and impact beliefs, perceptions, and attitudes are also needed.

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Ethical considerations

Before the start of the study, all protocols were submitted to and approved by the Cairo University, Faculty of Veterinary Medicine, Institutional Animal Care and Use Committee.

Conflict of interest

The authors declare no conflict of interest.

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