PHYSIOLOGICAL EFFECTS OF EQUINE ASSISTED LEARNING ON ELDERLY ADULTS

By

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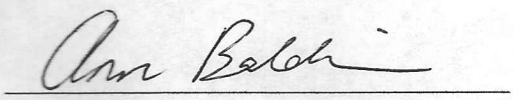

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Abstract

The calming effect of horses has been utilized in numerous therapies; however, few scientific data demonstrate the physiological benefits horses provide to humans. This study was completed to analyze some physiological effects Equine Assisted Learning (EAL) may have on adults above 55 years of age. The experiment examined how horses can affect the heart rate variability (HRV) in humans during a session of "Con Su Permiso", an interaction method to be explained later. Other effects, including immune system function and self-esteem, are analyzed as well. Human substitutes for horses were used as a control for this experiment. A total of 24 people participated in the experiment.

The results for the interactions with the horse substitutes (humans) were that there was an increase in heart rate (HR) and HRV (SDNN). For the interactions with the horses, there was an increase in the HR and the percent very low frequency component of HRV (%VLF). Overall results suggest interactions with horses through EAL benefits elderly adults by stimulating their sympathetic system without stressing them. As for self-esteem and immune function, the results show that both horse and human interactions significantly increase self-esteem in participants but there is no significant change in immune system function.

Introduction

As the leading cause of death in the US, cardiovascular diseases kill around 735,000 Americans each year through heart attacks. About 70% of these cases are a first heart attack and about 30% of the heart attacks occurred in people who have had a previous heart attack (Heart Disease Facts, CDC, 2014). One factor that has been shown to be indicative of mortality from cardiovascular diseases in elderly adults is a reduced HRV (Greiser, 2005). In the Framingham Heart Study, reduced HRV correlated with an increased risk of cardiac events in people who were free of clinical heart disease. These findings suggest that HRV might be a good indicator of cardiac events. HRV, or heart rate variability, is the ability of the heart to adjust to different stimuli, including physiological and emotional. High HRV indicates that the heart is healthy, meaning it can quickly adjust to stimuli from the parasympathetic and sympathetic nervous systems. Low HRV correlates with poor heart health, or the inefficiency of the heart to respond to parasympathetic and sympathetic system stimuli, predicts cardiovascular diseases (Tsuji, 1996).

According to Gerhke et al (2011), human and horse HRVs are observed to be in similar frequency dynamics making it useful to study horses' effects on human HRV. It is also useful to use horses because "it appears that HRV frequency cycles from the horse influence the human's cycle but not vice-versa," (Gerhke, 2010). For this reason, it is important to study how horses may have other physiological effects on humans to promote good health, especially for elderly adults who are more susceptible to mortality and heart diseases.

"Con Su Permiso" is the method we used for the interactions between the human and the horse. It is Spanish for "With Your Permission". This method requires the human to come up to

the horse and ask them for permission through “Saying Hello”, going back to where they stood, then beginning the interaction with the horse by coming up again and holding their hands 3-5 inches from the horse’s body to scan the entire body. Upon completion, the participant thanked the horse and returned to the starting point. “Saying Hello” involved the participant coming up to the horse with their arm out like a fake nose to greet the horse by touching his nose.

Other effects of the interactions with the horses were also observed in this study. The immune system function was monitored through the amount of salivary IgA (sIgA) present in the saliva samples from participants before and after the interactions. IgA is an antibody in the human body that acts as a first line of defense against pathogens. IgA is present in the intestines and airways because these body parts encounter pathogens from the external environment frequently. Since it is also present in saliva and the amount changes quickly, it was used as the indicator of immune system function for this study. Self-esteem was also measured during this study to observe any psychological effects EAL might have on the participants. The Rosenberg Self-Esteem Scale (RSES) was used to measure changes in self-esteem; scores below 15 indicates low self-esteem and scores between 15-25 are considered normal.

Overall, this study was performed to determine any effects EAL might have on HRV, immune system function and self-esteem. The hypothesis of this study is that EAL interactions will improve sIgA levels, increase HRV and raise self-esteem levels significantly more than interactions with human substitutes.

Methods

A total of 24 adults above age 55 participated in this study. Of the 24 participants, 5 were male and 19 were female. The location of the study was at the Borderlands Center for Equine Assisted Services in Sonoita, Arizona. The horses that participated in this study included 4 horses: Serra June, SumPunk, Brown and Chance. The study was done over a period of three weekends: October 18-19, 2014, October 25-26, 2014 and November 8-9, 2014. An additional Saturday was added in order to obtain clearer data since the original data had numerous artifacts; this was done on February 22, 2015.

The participants were separated into morning groups and afternoon groups. The morning groups arrived at 9am and left by 12pm. The afternoon groups arrived at 1pm and left by 4pm. The order in which the groups did the interactions, whether with the horse first or with the horse substitute first, varied each weekend. This was done in order to prevent any effect order may have on the results. The groups came at the same time each day to prevent any effect time may have on the results.

There were 4 horses that participated in this study. Their names are Brown, Chance, Serra June and SumPunk. The horse substitutes in this study were a man and a woman named David and Stephanie. These horse substitutes were used as a control for the study. They were asked to not show any reactions or responses to the participants. During the interactions, the horse substitutes were instructed to mentally sing a song and not have eye contact with the participants. They wore dark sunglasses to avoid eye contact.

Before starting the interactions, participants had their pre-measurements taken inside of the house. Consent papers for the Borderlands Equine Center and for the University of Arizona

were signed at this time. Prior to starting the measurements, the participants were instructed to turn off their cell phones and place them in another room; this was done to prevent any interference the cell phones may have on the HRV measuring device. The participants had the Zephyr Bioharness 3 heart monitor secured around their abdomen to measure their breathing and HRV throughout the interaction with the horse or horse substitute. After these monitors were placed, the participants stood still and quiet for 5 minutes for the baseline measurements. The participants also had their saliva samples taken using cotton swabs; these saliva samples were sent to the lab for testing. Lastly, participants filled out the RSES forms to assess their self-esteem levels. Simultaneously, the horses' baseline HRV was measured using a Polar heart rate monitor. Similar to the Zephyr, this device was placed around the horse's abdomen. The participants were then gathered into the living room of the home to learn about horse safety. They watched a video regarding how to move around horses to prevent injuries. They were also shown how to perform the "Con Su Permiso" interaction.

Outside, the participants used "heart scanning," an act of focusing the heart energy field to radiate love and appreciation to the horse or horse substitute, to mutually choose a horse or horse substitute. Mutually choosing a horse or horse substitute means that the participant chooses their horse or horse substitute based on any responses they receive during the heart scanning process; the participant is not the only being guiding the process of choosing. After the participant and horse or horse substitute pairs have been decided, a demonstration was performed to show the participants how the interaction may look like.

Before the interaction, the Zephyr monitors were again secured around the participant's abdomen. The Polar heart rate monitor was also placed around the horse if the participant interacted with a horse at this time. Horse substitutes did not have their HRVs measured in this

study. The participant did the “Say Hello” interaction with their horse or horse substitute first. They then returned to where they started and proceeded with the “Con Su Permiso” interaction. After thanking the horse or horse substitute, the participant returned to where they started and the Zephyr device was turned off.

A brief interview was conducted with the participant away from the rest of the group. They were asked to share their experience and what they felt during the interaction. The Zephyr monitor was turned on before the interview started to monitor how their HRV might have changed while recalling the experience. After the interview, they were asked to sit with the rest of the group and observe other participants’ interactions.

Once all the participants finished their interactions with a horse or horse substitute, the group was led back into the house to the room where the pre-measurements were taken. At this time, post-measurements were taken on the participants as well as the horses if they interacted this time. Participants then produced another saliva sample and completed another RSES form. Another HRV measurement was done on the participants with the Zephyr monitor to assess any changes there may have been between the baseline and post-measurements. The horses’ HRVs were again measured using the Polar heart rate monitor.

Upon completion of all post-measurements, the participants were gathered and asked to share their experience. They were also asked to comment on any suggestions they may have regarding improving the conduction of the study. After all the participants of the morning group left, the place was prepped for the afternoon group participants. If the morning group interacted with the horses, the afternoon group interacted with the horse substitutes first; the morning group would then interact with the horse substitutes the next morning and the afternoon group would interact with the horses. During the break in between the morning and afternoon groups, the horses' baseline HRV's were measured for the afternoon group.

Experimental Measures

- SDRR is the parameter used to quantify HRV. It is the standard deviation of normal to normal R-R or beat-to-beat intervals; it reflects HRV. An increased SDRR means that the HRV is increased and the interaction is beneficial to the person. A decreased SDRR, or decreased HRV, shows that the interaction is negatively impacting the participant's physiology.
- RMSSD is the root mean square of successive differences. This is reflective of the parasympathetic nervous system activity. An increase in this parameter indicates that the interaction is making the participant relaxed; a decrease means that the person may be excited or stressed.
- The %VLF mainly reflects the sympathetic nervous system stimulation in humans and it is the most slowly varying component of HRV.

Results

Horse Interaction Data

Parameter	Pre	During	N
Heart Rate (HR) (beats/min)	74.78 ± 9.36 (SD)*	84.72 ± 7.36*	18
SDRR (ms)	31.02 ± 10.81	37.89 ± 12.22	18
RMSSD (ms)	18.48 ± 13.55	17.05 ± 8.37	18
%VLF	36.11 ± 20.34*	24.84 ± 14.58*	18

Human Interaction Data

Parameter	Pre	During	n
HR (beats/min)	74.33 ± 9.07*	83.33 ± 8.37*	18
SDRR (ms)	29.62 ± 11.21*	42.41 ± 17.12*	18
RMSSD (ms)	17.44 ± 12.51	21.17 ± 12.74	18
%VLF	53.02 ± 17.77	58.77 ± 22.27	18

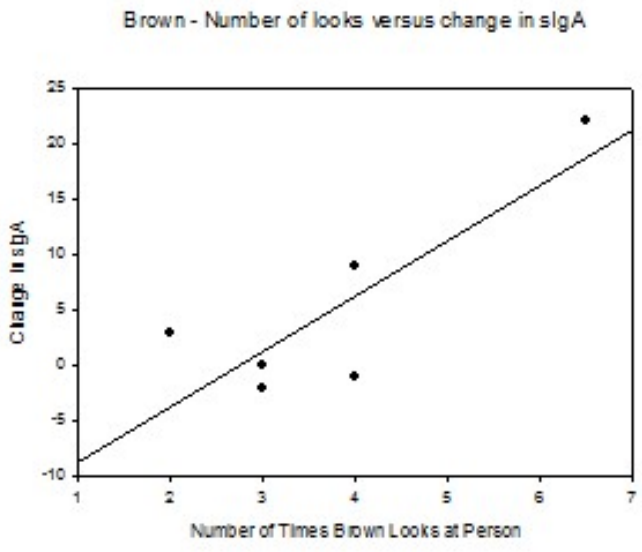
Self-Esteem Data

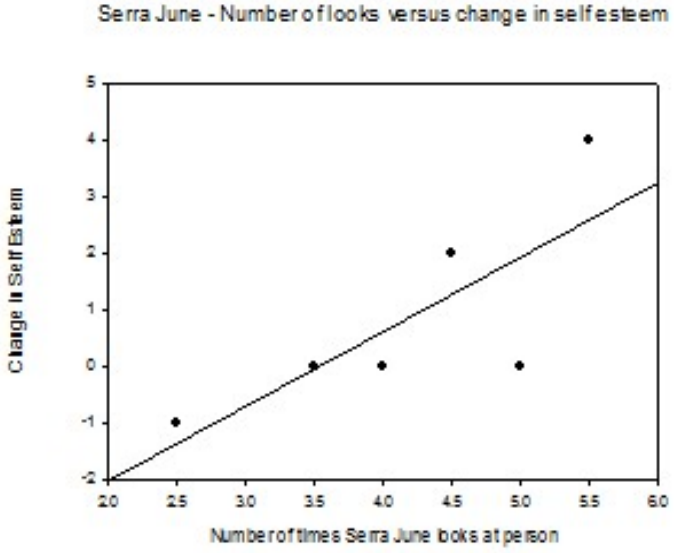
Parameter	Pre-horse	Post-horse	Pre-human	Post-human	n
Self-Esteem	25.42 ± 4.36*	26.62 ± 4.13*	25.35 ± 4.96*	26.13 ± 4.85*	24

sIgA Data

Parameter	sIgA (mg/dl)	N
Pre-horse	13.58 ± 8.15	24
Post-horse	12.17 ± 10.45	24
Pre-human	11.04 ± 6.21	24
Post-human	12.87 ± 9.31	24

*** Indicates that the value is statistically significant with a p value < 0.05**





The results suggest that there may be a correlation between the number of times or the amount of time a horse looks at a participant during the interaction with self-esteem and immune system function (sIgA). The correlation differed for each horse, suggesting that different horses have different effects on a person. *Serra June* affected the participants' self-esteem through the number of times she looked at the participant during the interaction. The correlation coefficient of this correlation is 0.80 with a p value of 0.05. *Brown* affected the participants' sIgA levels

through the number of looks he gave participants during the interaction. The correlation coefficient for this correlation was 0.84 with a p value of 0.02. *SumPunk* and *Chance* provided varied data with no significance. The number of times they looked at the participants and the total amount of time they looked at participants had no significant effect on the participants' sIgA levels or their self-esteem. For these two horses, it may be possible that another method of communicating with the participants was used and was not measured in this study.

Discussion

The data above indicate that both horse and horse substitute interactions have an effect on elderly participants. Both interactions resulted in significant increases in the heart rate (HR). Because the HR increased, it is likely the participants were excited during the interactions. For the human interaction, the results show that HRV can be increased and this is potentially beneficial to elderly adults. For the horse interactions, the results suggest that horses have a greater affect on the frequency of humans' HRV and it is possible that the increase in %VLF is due to the higher baseline %VLF of horses. Also, self-esteem was significantly increased by both types of interactions. The sIgA levels were not significantly affected by either type of interaction; this means that there was not a significant impact on the immune system function. This result further suggests that the participants were excited by the interactions rather than stressed. If the participants had been stressed, there would be a significant increase in HR and decrease in the sIgA and SDRR, implicating a negative effect on the participants.

Comparing the results, it seems that the horse interactions and horse substitute interactions provide similar results. The difference between these interactions lies in the %VLF.

In the horse interactions, there was a significant increase in %VLF. There was no significant change in the %VLF in the horse substitute interactions. This increase in %VLF indicates that there was a significant shift of the frequency of the participants' HRV response by the horse interactions to the sympathetic nervous system. The relevance of this increase in %VLF is currently being analyzed to determine the significance.

Limitations

During this study, it was discovered that in addition to the Zephyr heart rate monitor, EMWAVE devices should also be used when measuring the HRV of the participants. For several of the participants, the Zephyr monitors produced results with numerous artifacts. This made the results inaccurate and thus resulted in only 14 participants' data being useful in the horse interactions. EMWAVE devices were used in conjunction with the Zephyr monitors in participants after this problem was noticed. The EMWAVE device was clipped onto an earlobe free of earrings and the device was placed into the participant's pocket. Due to the unusable data, a few participants were asked to return for a retesting on February 22, 2015.

This study also had several limitations. A cat was present at the Borderland's Center throughout the study and though participants were asked to refrain from interacting with the cat, there may have been an interference of the cat's presence on the participants' HRVs. Also, there was a change in the horse handler every weekend, though this effect may be minimal to none. The weather was also a limitation for the study. On one of the weekends, it started raining at the beginning of the interaction with the horses. The rain may have affected the horses' HRVs which in turn can affect the participants' HRVs. Also, the change in location to avoid the rain made the area of interacting smaller which may play a role in affecting the HRV of both the horses and the

humans. Though there were several limitations in this study, there was no significant event that may have significantly impacted the results.

The hypothesis of this study was partly supported. There was a significant increase in HR and self-esteem levels through the EAL interactions. However, the sIgA levels did not have a significant change indicating no effect on the immune system function. Additionally, the mean HRV increase was also not significant for the horse interaction, although the p value was very close to significance ($p = 0.059$). The results of the control, the horse substitutes, and the results of the EAL were similar except for the increase in %VLF in horse interactions. This suggests that the effect of horses on human physiological systems is very subtle and other measures should be studied to analyze other effects horses may have on humans; an example would be psychological measures. EAL is still supported by this study however, since it was shown that interactions with horses do provide a beneficial response in elderly humans. The subtle increase in HRV may play a role in protecting the humans from cardiovascular diseases or cardiac events; the increase in %VLF may also play a role in affecting the cardiovascular function in humans. The interactions also provide elderly adults with a sense of excitement without stress, along with an increase in self-esteem, which may be psychologically beneficial to elderly adults during their later years in life.

Bibliography

Gehrke EK, Baldwin AL and Schiltz PM. Heart rate variability in horses engaged in equine-assisted activities. Journal of Equine Veterinary Science, 31: 78-84. 2011.

Gehrke, PhD, Ellen Kaye. "The Horse-Human Heart Connection, Results of Studies Using Heart Rate Variability." *Narha's Strides* (2010): 20-23. Web.

Greiser, Karin H., Alexander Kluttig, Barbara Schumann, Jan A. Kors, Cees A. Swenne, Oliver Kuss, Karl Werdan, and Johannes Haerting. "Cardiovascular Disease, Risk Factors and Heart Rate Variability in the Elderly General Population: Design and Objectives of the CARdiovascular Disease, Living and Aging in Halle (CARLA) Study." *BioMed Central*. N.p., 11 Nov. 2005. Web. 21 Apr. 2015. <http://www.biomedcentral.com/1471-= 2261/5/33#B35>.

"Heart Disease Facts." *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention, 29 Oct. 2014. Web. 21 Apr. 2015. <http://www.cdc.gov/heartdisease/facts.htm>.

Tsuji, MD, Hisako, Martin G. Larson, ScD, Ferdinand J. Venditti, MD, Jr., Emily S. Manders, BS, Jane C. Evans, MPH, Charles L. Feldman, ScD, and Daniel Levy, MD. "Impact of Reduced Heart Rate Variability on Risk for Cardiac Events." *Impact of Reduced Heart Rate Variability on Risk for Cardiac Events*. American Heart Association, 11 July 1996. Web. 21 Apr. 2015. <http://circ.ahajournals.org/content/94/11/2850.full>.