McDuffee, LA: Psychophysiological effects of Equine-assisted therapy on horses and in veterans diagnosed with post-traumatic stress disorder (PTSD)

Horses and Humans Research Foundation
Final grant reporting

Abstract of grant: As a necessary step in demonstrating the benefits of equine facilitated psychotherapy (EFP) as a positive treatment for veterans with PTSD, while eschewing the development of an adverse environment for either humans or horses, this study aims to obtain objective and subjective data from selected tests on the human-horse dyad. Efficacy of EFP on human-horse dyads will be determined through changes in measures of stress hormones: cortisol and oxytocin, and changes in heartrate variability in horse and human participants, concomitantly. Cortisol and oxytocin will be obtained in humans from passive drool, and from saliva and blood samples in horses. Heart rate variability (HRV) measures will be obtained from Polar HR monitors worn by horses and humans. PTSD symptoms based on the Beck Depression Inventory (BDI 2), the State Anger Scale (STAXI 2), and the Checklist: PCL-5 will be used to provide trait-based psychometric estimates, while behavioral indicators of stress in horses will be based on expert ratings using the BORIS system. The proposed analysis is novel in the representation of paired data from the human-horse dyad. Evaluation of entrainment, which we define operationally as the synchronization of selected physiological measures between the human-horse dyad during EFP will be assessed through Bland-Altman measures of agreement.

Final grant report should include the following:

1. **A full summary of research project results and findings.**

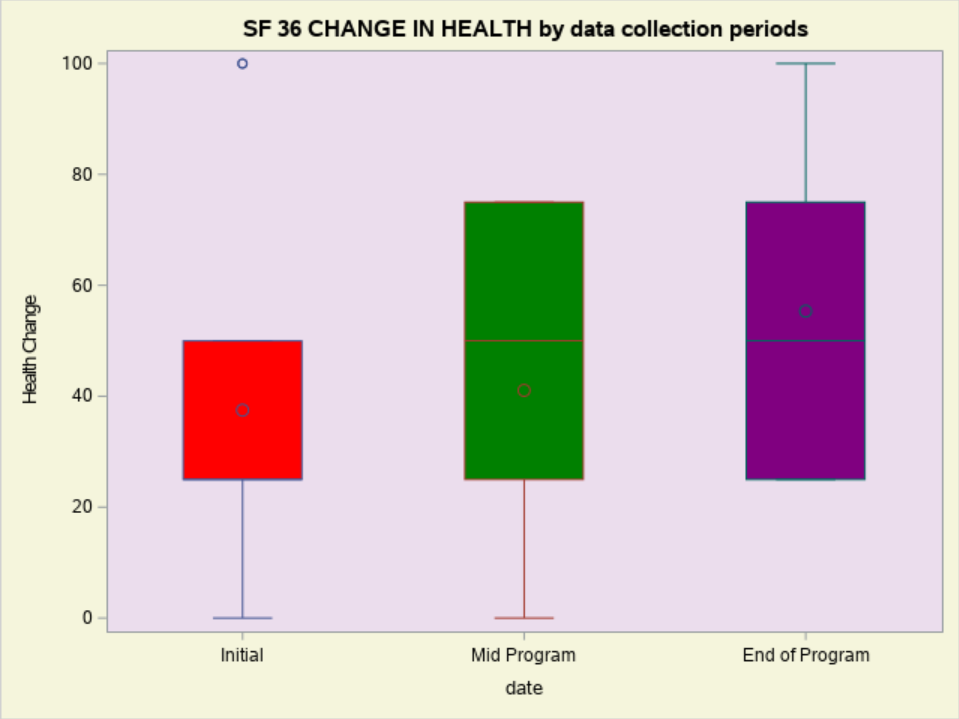
The purpose of this project was to explore the efficacy of equine facilitated psychotherapy (EFP) on veterans with PTSD and to explore the effect on horse participants. The study used a prospective cohort design consisting of an 8-week EFP intervention for veterans with PTSD where human-horse dyads interacted 1 hour each week over an 8 week period. Data from four cohorts (n=16) was collected simultaneously on the humans and horses.

McDuffee, LA: Psychophysiological effects of Equine-assisted therapy on horses and in veterans diagnosed with post-traumatic stress disorder (PTSD)

Specific research questions included:

1. Does EFP improve the wellbeing of **Veterans** with PTSD? Analysis of physiological and psychological data was used to address this question and the results showed that:
    a. Cortisol levels were significantly decreased after EFP sessions. This indicates stress decreased because of the EFP daily intervention.
    b. Oxytocin concentrations were significantly increased after daily EFP sessions. This indicates that EFP sessions increased physiological measures of wellbeing.
    c. Heart rate variability measures – particularly representing the parasympathetic and sympathetic nervous systems -- PNS1 and SNS1, were significantly different before and after daily sessions. There was an increase in the Sympathetic NS, and a concomitant decrease in the Parasympathetic NS. Because the SNS was increased without an accompanying increase in cortisol, we interpreted this change as an activation of the autonomic nervous system rather than a representation of stress. Activation of the SNS can be a positive result especially when depression is a daily symptom of PTSD.
    d. Daily self-reports of mood and perceived emotional well-being had significantly improved scores (well-being ↑, stress ↓, anxiety ↓) after each session. These findings support the contention that EFP sessions improved the feeling of wellbeing and decreased stress of veterans immediately following sessions.
    e. Psychometric surveys collected information at three times within each cohort session – i) at the start of the program, ii) at the mid-point, and iii) at the end of the program. The change in estimates across the three data collection times for each test were not statistically significant. However, some of the graphs showed a trend toward a positive change from the start to the end of the program. The lack of a statistically significant finding at the end of the 8-week EFP program was likely due to high inter-subject variability. As shown in the following image,

while the trend in most psychometric scores taken at three times in the program (initial, mid program, and end of program) showed a change, the statistical evaluation did not support a significant difference. Future research should consider larger participant cohorts that could be separated on specific similar characteristics.



In the present study, while it is obvious that individuals had great improvements, the differences were masked because of the sample size and implicit differences between participants that comprised the total participant pool.

The apparent trends in responses indicate that the EFP session had a positive effect on improving the overall long-term mental health of some of the veteran participants. An increased dose of EFP may lead to a significant long-term effect for veterans.

f. Are physiological and psychological results correlated?

Cortisol measures and daily self-reports of stress and anxiety were correlated. That is, when veterans indicated that they felt less stressed and anxious after an EFP session, the cortisol levels indicative of stress were also decreased.

Analysis of measures of agreement are being explored for these data and it is expected that an update will be provided at the HHRF AGM in August at Chagrin Falls 2022.

2) What was the effect of an 8-week course of EFP on **equine participants**' welfare based on behavioural and physiological measures (stress behaviours, HRV, cortisol and oxytocin levels)?
    a. Cortisol was not changed significantly because of EFP sessions. This indicates horses were not stressed as a result of the EFP sessions.
    b. Oxytocin was not changed significantly because of EFP session. This indicates that horses did not have a positive emotional response to EFP sessions.
    c. HRV measures were not changed significantly because of EFP sessions. This indicates that horses were not stressed as a result of EFP sessions.

       Overall, physiological measures indicated that horses perceived the EFP sessions as a neutral stimulus.
    d. The mean number of stress behaviours was increased significantly at the end of the session (immediately post walking) compared to baseline. Review of the individual horse data revealed that behavioural signs of stress were increased primarily in one horse who acted as an outlier. This horse was new to the program. This indicates that some horses may need an acclimation period to adjust to participating in EFP sessions with veterans with PTSD. Behaviour monitoring of horses during sessions should be part of a routine evaluation for equine welfare and is especially important when a horse is newly taking part in EFP sessions. This can be conducted using video recordings and a stress ethogram or in real time using the stress ethogram.
3) Does physiological synchronization occur between humans and horses during an EFP interaction?

   There appeared to be some coordination of physiological activity as a function of horses and humans interacting.

Based on Bland Altman plots of agreement, there was a strong agreement between the horses and the humans for the change in the cortisol levels from pre session to post session.

Likewise, our findings showed strong agreement in the changes in the Poincare Plot estimates of HRV (SD1/SD2) between baseline and post-walk activities within human-horse dyads.

Analysis of synchronization is ongoing.

2. **A summary that can be posted to the research page of the HHRF web site (if different than #1)**

This study was conducted to determine the effects of equine facilitated psychotherapy (EFP) sessions on horses and humans. Our human participants included both males and females that served with the Canadian Armed Forces, or the Royal Canadian Mounted Police, and who were diagnosed with PTSD. Our horse participants were eight mares ranging in age from 5 to 29 years and were a variety of breeds. Horses had been with the program from 1 to 7 years, and they were selected for their relatively calm demeanor.

Data was collected simultaneously from horses and humans before, during and after one-hour daily EFP session over the course of 8 weeks. Four cohorts, involving 4 humans each paired with a horse, underwent therapy over the course of 1.5 years. There was some delay in data collection due to COVID 19 protocols. EFP sessions consisted of one hour in-hand interactions of humans with horses where humans groomed the horses and led the horses around the arena sometimes through obstacles. Physiological data collected on horse-human dyads during EFP was analyzed, and psychological (human) and behavioral (horses) data was also analyzed for each species. Physiological data from humans (cortisol, oxytocin and HRV measures) indicated that EFP sessions decreased cortisol (stress) levels, increased oxytocin (feeling of wellbeing) levels and activated the sympathetic nervous system. Veterans also reported feeling better after sessions as indicated by a self-reported decrease in stress and anxiety scores and increase in well-being scores. Overall, horses were not affected by EFP sessions based on no significant changes in physiological data compared to before and after sessions. Mean stress behaviour scores were

significantly greater for horses near the end of sessions. This increase was attributed to one horse as an outlier. Further analysis of stress behaviour data indicated this increase was primarily due to one horse, newly introduced into the program, that had increased stress behaviours displayed on one specific day. This horse was considered an outlier statistically. Importantly, careful monitoring of horses, especially those newly introduced into EFP programs, is warranted to ensure that they are given appropriate acclimation time when participating in an EFP program, and appropriate rest periods when showing signs of stress, agitation or aversion.

This study indicates the efficacy of a particular EFP program for improving mental health symptoms in humans with PTSD. Primarily short-term positive effects were noted for humans. However, analysis also showed trends of improved wellbeing over the course of the 8 weeks indicating that an increase in the "dose" of EFP may show more pronounced and longer term positive physiological and psychological effects on veterans with PTSD. Implementing a program with an increased number of sessions along with further psychological and physiological evaluation may provide even stronger evidence of efficacy for human participants.

Overall, horses were not adversely or beneficially affected from participating in EFP sessions with veterans having symptoms of PTSD. There is much anecdotal evidence that the horses show affective behaviours toward the human participants during EFP. An increase in the "dose" of EFP through more sessions may result in objective data from horses that support this. In addition, an ethogram for behaviour monitoring could include signs indicative of an affective state in horses along with a stress ethogram. An increase in EFP interactions could result in human-horse bonding which could be a positive effect for both humans and horses. Conversely this could potentially cause an increase in behavioural signs of stress in horses due to additional "work". If an increased dose (based on increased number of sessions) were implemented in the interest of veterans' wellbeing, careful behavioural observation and/or further cortisol and oxytocin monitoring of horse participants is warranted to ensure ongoing equine welfare and assure longevity of the program.

3. **State both your final conclusions and how you feel these findings should inform/influence equine assisted activity practices.**

This study supports the continued exploration of the efficacy of EFP programs for improving mental health symptoms in humans with PTSD. Primarily short-term positive effects were noted for humans. An increase in the "dose" of EFP is expected to show more pronounced and longer term positive physiological and psychological effects on veterans with PTSD. Overall, horses were not adversely affected from participating in EFP sessions with veterans having symptoms of PTSD. Implementing a program with an increased number of sessions along with further psychological and physiological evaluation may provide even stronger evidence of efficacy for human participants.

It is also plausible from the results of this study, that an increase in EFP interactions could result in human-horse bonding which could be a positive effect for both humans and horses. Conversely this could potentially cause an increase in behavioural signs of stress in horses due to additional "work". If an increased dose (based on increased number of sessions) were implemented in the interest of veterans' wellbeing, careful observation using a stress ethogram and/or further cortisol and oxytocin monitoring of horse participants is warranted to ensure ongoing equine welfare and assure longevity of the program.

4. **Time line, show completed items and any changes/difficulties in completing the listed items from the original application noted and explained.**

V. PROPOSED TIMELINE: January 1, 2020 - August 31, 2020

Group 1: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch.
Group 2: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch.
Group 3: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch.
Group 4: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch.
Data collection will be ongoing, with data analysis to take place from September 2020 until February 2021. Manuscript writing and the presentation of findings is anticipated to take place from March to June 2021.

ACTUAL TIMELINE:
January 2020-Jan 2021 data collected during EFP sessions:
Group 1: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch. January 2020-March 2020

Group 2: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch. June 2020-July 2020
Group 3: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch. September 2020-November 2020
Group 4: Four Veterans and horses undergo 8 week EEA/T at Serene View Ranch. November 2020-January 2021
Sample preparation and analysis February 2021-May 2021
Data analysis June 2021-December 2021
Presentation of results January 2022 (HHRF Webinar)
Rerun of certain samples May-June 2022
Manuscript preparation Jan 2022-present (50% completed)
Presentation at HHRF conference August 2022

5. **Budget: final budget expenditures, with any variations from the original submitted application budget noted and explained.**

There were no changes from the midway report. While we had requested the use of funds for a piece of equipment to improve the ease of sample analysis, this equipment was not purchased because we were able to identify a colleague with similar equipment which became available for our use.

We requested (to Pebbles Turbeville by email) the use of remaining funds at the end of the grant period (see final accounting report: approximately $3000 USD) for knowledge dissemination of results which could include travel to a conference (HHRF) for the presentation of results and/or use for open access publication. This request was denied by the Board.

We understand that it is not an option to put funds for knowledge translation into the budget (per HHRF grant instructions) as a budget item. We respectfully suggest that you consider allowing this in future grants as this would promote knowledge translation of results obtained from funded research. Speaking as a professor from a university, I can tell you that there are professional and travel funds provided by most universities, but these funds are not adequate for publishing or travelling to conferences routinely; therefore, knowledge translation funds (travel to present and publishing fees) are an important part of the overall project expense.

For accounting details, please see two reports from UPEI accounting.

6. **Summary of any complications or challenges that have been encountered and how they have been addressed.**
    a. The major complication was COVID 19
        i. EFP sessions were interrupted due to COVID 19 Provincial Guidelines
        ii. When guidelines provided for reopening of businesses, biosafety protocols were submitted to UPEI and approved for continuation of the research program
        iii. EFP sessions and research protocols were resumed following biosafety protocols
    b. A minor complication was the loss of 2 participants in the final cohort due to vulnerability of the patients. Data analysis was conducted without complete data for these participants.
    c. Sample analysis required some repeat laboratory analysis.

7. **Share detailed plans for submitting material for publication; summaries of findings with the public.**
    a. The results have been shared with the public through an HHRF webinar (January 2022)
    b. Results have been shared with Veterans Affair Canada (May 2022)
    c. Results have been shared at local and national student conferences (2021)
    d. Two poster presentations have been accepted for presentation at the Canadian Institute for Military and Veteran Health Research conference in October 2022
    e. Results will be presented as a podium presentation at the 2022 HHRF conference
    f. An infographic is being produced for presentation to veterans
    g. A manuscript is in progress for submission to an appropriate journal

8. **Invoice signed by grant manager for expenses incurred (for the remaining 50% of grant award)**
    a. See report from UPEI accounting

9. **Photos from research project** activities that can be used in HHRF public marketing and outreach materials (such as newsletters, annual report, press release, etc.) Include a photo

release form from all participants that includes HHRF in the listing of those permitted to us the photos for public outreach (sample can be supplied upon request).

a. Photos were previously submitted with midway report
b. A pdf of the full HHRF Conference presentation is attached.