

## Heart rate, heart rate variability and salivary cortisol as indicators of arousal and synchrony in clients with intellectual disability, horses and therapist during equine-assisted interventions

Anna Naber<sup>1</sup>, Lena Kreuzer<sup>2</sup>, Roswitha Zink<sup>1</sup>, Eva Millesi<sup>3</sup>, Rupert Palme<sup>4</sup>, Karin Hediger<sup>5,6</sup>, Lisa Maria Glenk<sup>2\*</sup>

<sup>1</sup>E.motion Equotherapy, Vienna, Austria

<sup>2</sup>Comparative Medicine, The Interuniversity Messerli Research Institute of the University of Veterinary Medicine Vienna, Medical University Vienna and University Vienna, Austria

<sup>3</sup>Department of Behavioural Biology, University of Vienna, Austria

<sup>4</sup>Unit of Physiology, Pathophysiology und experimental Endocrinology, University of Veterinary Medicine Vienna, Austria

<sup>5</sup>Faculty of Psychology, University of Basel, Switzerland

<sup>6</sup>Swiss Tropical and Public Health Institute, Department of Epidemiology and Public Health, Switzerland

\*e-mail: [lisa.glenk@vetmeduni.ac.at](mailto:lisa.glenk@vetmeduni.ac.at)

### Summary

The aim of the study was to analyse interaction processes in equine-assisted therapy (EAT) sessions with ten female clients in the period of emerging adulthood with intellectual disability (ID). Heart rate (HR), heart rate variability and salivary cortisol levels have been analysed in humans and horses before, during and after a standardised therapy session as well as in a control condition. There was a trend of lower cortisol levels and higher variability and parasympathetic tone induced by horses. During challenge however, there was a significant lower HR in the horse condition. Significant correlations in heart rate between therapist, client and horse were found with stronger interaction with a familiar horse. Our findings suggest that EAT may effectively modulate stress in humans with ID. Our results further elucidate synchronisation patterns in HR highlighting the pivotal role of relationship quality and intensity as modulators of synchrony.

**Keywords:** Heart rate variability, equine-assisted therapy, cortisol

---

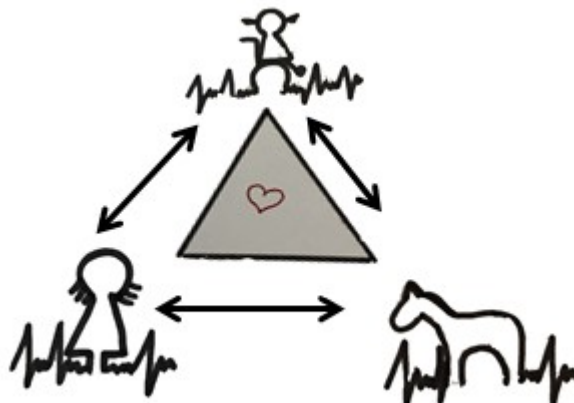
Pet Behaviour Science | 2019, Vol.7, 17-23  
DOI: [10.21071/pbs.v0i7.11801](https://doi.org/10.21071/pbs.v0i7.11801)

## Introduction

A growing body of research has attributed effects of human-horse interaction to improved bio-psycho-social health. Intellectual disability (ID) refers to impaired intellectual and adaptive functioning and equine-assisted therapy (EAT) has been considered a promising practice as complementary treatment of ID (e.g. Borgi et al. 2016), however its feasibility with regard to stress reduction has been questioned (Anestis et al. 2014). While evidence on physiological benefits such as increased motor control exists (Del Rosario-Montejo et al. 2015), psychological benefits and underlying mechanisms of EAT are not yet fully settled (Kendall et al. 2014). Effective autonomic and adrenal regulation of arousal plays a key-role in the maintenance of (mental) health and progression of diseases (Glenk & Kothgassner 2017). Coordination of nonverbal behaviors between interactive partners takes place during the process of synchronization in many mammalian species. The experience of synchrony roots in the mother-child relationship, and high levels of synchrony have been related to efficient bonding and stress reduction (Aztil et al. 2014; Leclère et al. 2014). Interactions with a high level of synchronization are more efficient, also across species (Julius et al. 2014, Pirrone et al. 2017).

This study sought to elucidate mechanisms and psychological effects of EAT within the therapeutic triangle (i.e. participating humans and horses, see Figure 1).

*Figure 1. Therapeutic triangle in EAT. Arrows indicate bi-directional relationships between client, horse and therapist.*









The aims of this study were:

- 1) to investigate physiological effects of a standardized EAT for young adults with ID
- 2) to explore synchronization patterns between humans and animals

## Material and Methods

Ten EAT-experienced women (Mn = 21.8, SD = 3.39) with mild (N=5) to moderate (N=5) ID according to the Glasgow Level of Ability and Development Scale (Cooray et al., 2015) participated in the study and were paired with their favourite (N=5) or an unfamiliar horse (N=5). The therapist (N=1) took part with familiar (N=2) and less familiar horses (N=2). Each client underwent two EAT sessions with horse and two control sessions with the same schedule (baseline, relaxation, challenge) but where on-horse activities were carried out on a barrel horse (see table 1). During relaxation phases, therapist-guided recreation exercises were carried out, while the challenge phase included a simple cognitive-motor task. HR was recorded with a Polar V800 telemetric system. Objective measures of autonomic activation were heart rate (HR) and heart rate variability (HRV), i.e. overall variability (SDNN); sympathicovagal balance (LF/HF ratio) and parasympathetic tone (RMSSD, SD1). Salivary cortisol served as an indicator for adrenocortical stimulation and was measured prior to (S1), during (S2) and after (S3, S4) EAT.

Table 1. Study design.  indicates 5 min intervals of HR recordings; BL...Baseline, CH...Challenge, R...Relaxation, S1-S4....Saliva Samples

		 5 min	2 Rounds	 5 min	 5 min		 5 min	 5 min		30 min	
Saliva sampling	S1					S2			S3		S4
Horse		BL1	Walk	R1	CH		R2	BL2		Rest	
Control		BL1	Walk	R1	CH		R2	BL2		Rest	

As shown in figure 2, HR of clients during challenge was significantly lower under the horse condition compared to the control ( $t(19) = -5.569$ ;  $p < 0.01$ ). Relaxation phase 2 and baseline 2 indicated a trend toward lower HR with horse.

No differences in salivary cortisol emerged between the conditions ( $\chi^2(15) = 2.13$ ,  $p = 0.344$ ) except for a non-significant trend toward lower cortisol levels after EAT ( $M_n = 4.74$ ) compared to control ( $M_n = 6.59$ ). RMSSD of clients tended to be higher in interaction with a horse compared to the control sessions (see table 2). The same trend was found also for SD1 and SDNN, however not for LF/HF ratio.

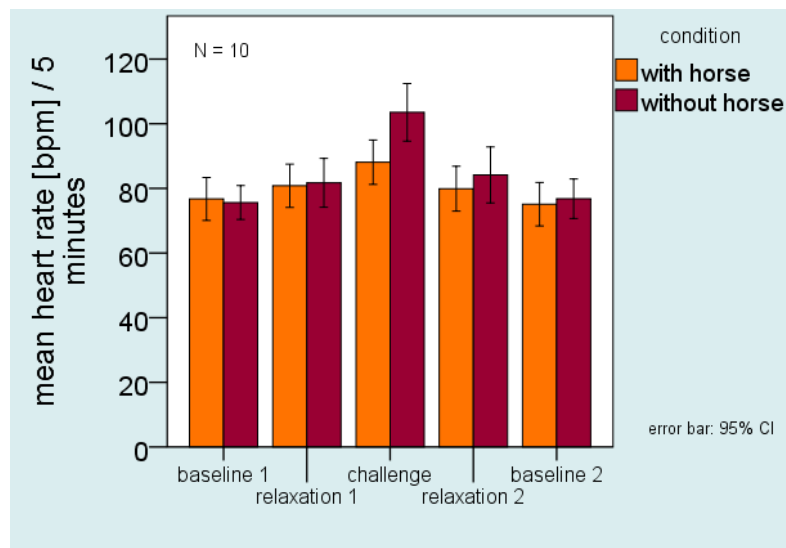


Figure 2. Mean ( $\pm$ SD) heart rate of clients over the course of a session compared between conditions. \* indicates  $p < 0.01$

Table 2. RMSSD values of clients over the course of a session compared between conditions E (experimental) and C (control).

	E	C	p	Z
m1	61.23	52.93	.911	-.11
m2	46.85	30.42	.351	-.93
m3	25.58	27.01	.391	-.86
m4	36.61	33.43	.191	-1.31
m5	62.08	44.24	.526	-.64

The quality of bond between humans and the therapy horse influenced the HR of the therapeutic triangle. Patterns of synchrony regarding mean HR were found for clients who interacted with their favourite horse ( $r_s=.38$ ,  $p<0.05$ ) but not for clients who interacted with an unknown horse (see figure 3).

A stronger correlation of mean HR was found between the therapist and her own horse ( $r_s=.70$ ,  $p<0.05$ ) compared to a less familiar horse ( $r_s=.55$ ,  $p<0.05$ ). The HR of horses appeared to be most stimulated in interaction with familiar humans.

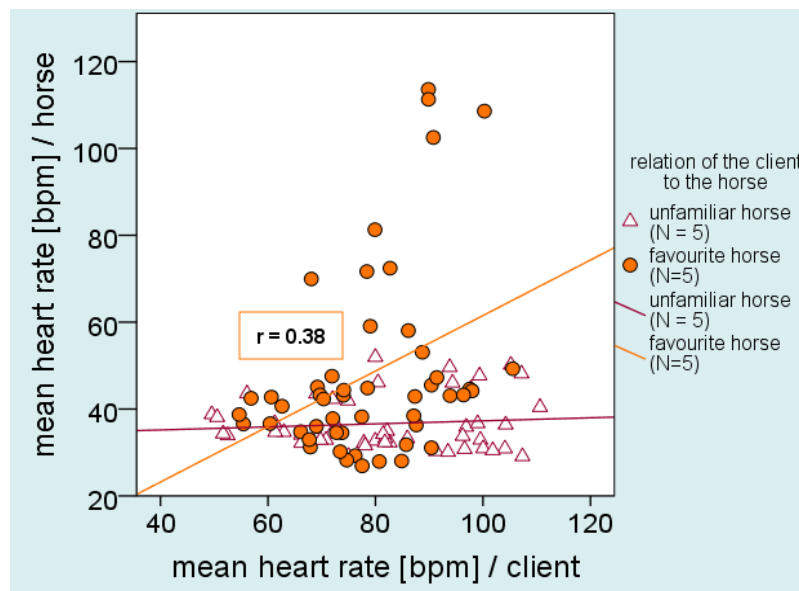


Figure 3. Correlation of mean heart rate (clients and horses).

## Discussion

Our findings suggest that EAT may effectively modulate stress in humans with ID. Despite the small sample, our data revealed that the horse condition led to decreased HR during a challenging cognitive-motor task. The trend of data in overall autonomic variability (SDNN) and parasympathetic tone (RMSSD, SD1) point at a stress reduction. Interaction with horses may help people with ID mobilize resources and feel more understood without needing words for communication. Our results further elucidate synchronization patterns in HR highlighting the pivotal role of relationship quality and intensity as modulators of synchrony in both, horses and people.

## References

- Anestis MD, Anestis JC, Zawilinski LL (2014). Equine-related treatments for mental disorders lack empirical support: A systematic review of empirical investigations. *J Clin Psychol* 70 (12):1115-1132
- Atzil, S., Hendler, T., & Feldman, R. (2014). The brain basis of social synchrony. *SCAN*, 9, 1193-1202.
- Borgi, M., Loliva, D., Cerino, S., Chiarotti, F., Venerosi, A., Bramini, M., Nonnis, E., Marcelli, M., Vinti, C., De Santis, C. (2016). Effectiveness of a standardized equine-assisted therapy program for children with autism spectrum disorder. *Journal of Autism and Developmental Disorders* 46, 1–9
- Cooray, S., Weber, G., Alexander, R., Roy, A., Bhaumik, S., Devapriam, J., ..., & Cooper, S. A. (2015). Towards Global Screening for Disorders of Intellectual Development (DID) – The clinical utility of Glasgow Level of Ability & Development Scale (GLADs). In ... (Chair), Symposium conducted at the meeting of the European Association of Mental Health in Intellectual Disability, Florence
- Del Rosario-Montejo O, Molina-Rueda F, Muñoz-Lasa S, Alguacil-Diego IM (2015). Effectiveness of equine therapy in children with psychomotor impairment. *Neurologia*. 30(7):425-32
- Glenk, L. M., & Kothgassner, O. D. (2017). Life out of balance: Stress-related disorders in animals and humans. In E. Jensen-Jarolim (Hrsg.), *Comparative medicine: Disorders linking humans with their animals* (S. 97-107). Cham: Springer

Kendall, E., Maujean, A., Pepping, C. A., & Wright, J. J. (2014). Hypotheses about the psychological benefits of horses. *Explore, 10*, 81-87

Leclère, C., Viaux, S., Avril, M., Achard, C., Chetouani, M., Missonnier, S., & Cohen, D. (2014). Why synchrony matters during mother-child interactions: A systematic re-view. *PLoS ONE, 9*, 1-34

Julius, H., Beetz, A., Kotrschal, K., Turner, D. C., & Uvnäs-Moberg, K. (2014). Bindung zu Tieren. Psychologische und neurobiologische Grundlagen tiergestützter Interventionen. Göttingen: Hogrefe

Pirrone, F., Ripamonti, A., Garoni, E.C., Stradiotti, S., Albertini M. (2017). Measuring social synchrony and stress in the handler-dog dyad during animal-assisted activities: A pilot study. *Journal of Veterinary Behavior, 21*, 45-52

