

### Effects of a walk phase at the warm up onset on physiological and behavioural parameters of ridden horses (*Equus caballus*)

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For human athletes, any physical performance classically begins with a warm-up including a phase of cardio-respiratory activation as well as a phase of neuro-muscular mobilization. For the equine athletes similar routines are widely followed despite limited scientific studies addressing its effectiveness. Although physiological bases are of a similar nature in humans and horses, the latter are showing a different "telos" related to their status of prey. Indeed, their survival depends on their ability to detect any predator or potential danger in their environment and to estimate the need to run away. Therefore warm-up techniques should be adapted to this specificity and we added a walk phase preceding the usual warm-up during which the horse was allowed to visually assess its environment without constraint imposed by its rider, reins being long. We assumed that this walk phase would allow a more relaxed mental state and then a decrease in cognitive resources involved in environmental monitoring. Consequently this would release cognitive resources then available for the communication between the horse and the rider.

The autonomous nervous system (ANS) regulates the heart rate via the sympathetic and the parasympathetic nervous systems. The sympathovagal balance and the heart rate variability are considered as good indicators of an acute stress state as well as emotional states. These measures are frequently used to estimate well-being in animals. During the walk phase, we observed a significant decrease of the heart rate (HR), a significant increase of its variability and

a significant modification of the sympathovagal balance in favour of a higher contribution of the parasympathetic control. We also measured the non-linear correlation dimension which reflects the degree of freedom of a system. To the best of our knowledge, this method was used until now only in humans to whom it was shown that its decrease is related to stressful events and is associated with a bad prognosis for survival. During the walk phase in horses, the dimension of correlation of cardiac activity was increased.

From a behavioural point of view, we observed a significant decrease of side movements related to head orientation as well as significant changes in ears position, the latter being preferentially directed forwards at the beginning of the walk phase and laterally at the end. As previous research suggests that ears position and head orientation can be involved in attentional mechanisms in horses, our results suggest a decrease of the attention focused on the environment. Furthermore, a significant lowering of the neck was observed as well as a significant decrease of behaviours related to stress.

To conclude our results suggest that a walk phase preceding the usual warm-up of horses would contribute to improve their mental state in favour of more relaxation and of a decrease of the attentional resources invested in environmental monitoring.

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