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The use of the technology in equitation science: A panacea or abductive science?

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ABSTRACT

Equitation encompasses a range of activities in which horses interact closely with humans. The need to ensure both horse management and equitation practice is ethical and sustainable is becoming emphasized globally. Robust and rigorous measurement is critical to objective assessment of practice. This review describes the outcomes of technology application within generic equine science and specific equitation science studies including heart rate monitoring, electromyography, infrared thermography, pressure algometry and remote recording of behaviour and cognitive functioning. The impact of pressure and tension applied by saddles, girths, head gear and gadgets is considered along with subtle behavioural measurements such as eye blink rate, behavioural switching and laterality, some of which reveal aspects brain functioning that have direct relevance to training. Well designed, reliable technology certainly has the potential to provide researchers with a panacea to problems relating to accuracy, precision and experimenter bias, ushering in a 'golden age of equitation'. However, to reach this stage careful consideration must be given to experimental logistics such as sample selection, device calibration and data processing. A series of potential drawbacks with the use of Technology are identified including managing noise and increasing signal strength, dealing with practical implementation issues and managing the volume of data in order to conduct appropriate analysis to reach meaningful conclusions. Technology users are warned against the temptation to engage in Abductive Science when discussing the output of equitation science methodologies. Putting good research into practice, and vice versa, is crucial to future-proofing equitation and horse welfare.

1. Introduction

Equitation Science is a discipline that specifically aims to promote and encourage the application of objective research and advanced practice which will ultimately improve the welfare of horses in their associations with humans (International Society for Equitation Science Mission Statement, accessed 2016). Equitation is traditionally defined as the 'art of riding' (Norman on Xenophon, 2006) but following the publication of numerous studies examining and quantifying the interaction between horses and humans engaging in a wide-range of equestrian pursuits this may now be better described as the 'art and science' of riding.

Equitation involves a range of activities in which horses interact closely with humans. Equestrian disciplines may be world-wide for example racing and most of the olympic horse sports such as dressage, show jumping, eventing, or country specific (e.g. tolting; campdrafting, reining, agility). Equitation may involve a horse being ridden or being worked by a human either being driven, or in-hand such as vaulting and more recently horse agility. A substantial number of horses have traditionally been used in educational and leisure environments such as in riding schools and colleges and trekking centres respectively. Particulary in the US and UK, many animals are being recruited to rehabilitation organisations that offer equine assisted activities in which horses are used to directly provide physical therapy (hippotherapy, Mutoh et al., 2016), equine-assisted therapy (EAT, Gehrke et al., 2011; Holmes et al., 2012), equine-facilitated psychotherapy (EFP, Lac, 2016) and/or equine-assisted learning (EAL, Burgon, 2011) for humans. Whilst the use of many of these horses is regulated, either by a discipline specific organisation such as British Dressage (BD), the British Horse Racing Association (BHRA), broader organisations such as Equestrian Australia (EA) or use-based organisations such as the

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Riding for the Disabled (RDA), the Association of British Riding Schools (ABRS) and the Australian Horse Riding Centres (AHRC), many are not. Overarching bodies such as the British Horse Society (BHS) and the Australian Horse Industry Council (AHIC) work at national industry levels to directly and indirectly address equine welfare issues. Horse welfare is coming under increased scrutiny world-wide with growing focus on the need to produce equine- and country- specific codes of practice relating to use and management for example during transport (Padalino et al., 2016), housing (Dalla Costa et al., 2016) and competition (Williams and Randle, 2017). The need to ensure that horse management and equitation practices are ethical and sustainable (Randle, 2010, 2016; Waran and Randle, 2017) is emphasized globally. Finally, the direct interaction between equid and human is particularly important because of the physical, physiological and related pyschological effects and impacts on the horse.

Explanation of the nature and nuances of relationships between humans and animals, and in particular with horses, is prone to anthropomorphism, that is the tendency to attribute human traits, emotions and intentions to non-humans (Randle, 2010). Whilst authors such as Kiley-Worthington and Lea (1996) emphasize the divergence in thought between technical and lay views (in the equitaiton context—experimental equitation scientists and horse practitioners), they acknowledge the merit of controlled constructive anthroporphism when describing human-animal relations. However the general consensus remains that when unmanaged anthroporphism leads to subjectivity and rapidly undermines the credibility of potentially extremely important research findings. Whilst it can be argued that an element of anthropomorphistic explanation is virtually unavoidable due to the long-standing relationship between horse and man, researchers and practitioners alike must be strongly encouraged to only reach conclusions that are based on objectivity and real evidence. Data collected on how the horse reacts, responds and performs within equitation, should always be objective if evidence-based conclusions are to be reached that can ultimately be used to improve horse welfare.

When discussing equitation and equestrian activities there is much focus on the physcial interactions between the horse and rider. Understandably, non-scientific every-day language is frequently used to describe the interaction between horse and rider particularly during training and competition situations. Riders are often encouraged to undertake tasks such as 'shifting their weight' and to work towards goals such as 'developing feel' and 'achieving a contact'. But, these actions and goals are rarely quantified, difficult to describe objectively, virtually impossible to define (especially globally) and consequently at best executed in a manner that varies from rider-rider, session–session and even from attempt-to-attempt. It is known that inconsistent application of signals can cause confusion and therefore conflict related behaviours in the horse with a consequent negative impact on welfare (Waran and Randle, 2017).

The statement '*What we can measure, we can manage*' emphasized by Waran and Randle (2013 and 2017) explains the importance of measuring, assessing and evaluating equitation theory and practice. A wide range of measurements can be taken from the horse and/or rider, including physical data such as pressure and tension, physiological measures such as heart rate and temperature and behavioural measures such as bolting, stereotypies and specific actions such as chewing, swallowing and blinking. Regardless of the aspect of equitation (and the horse-human relationship) being investigated, robust and rigorous measurement is critical to objective assessment of practice. The collection and analysis of equitation-related data should therefore align with the basic principles of scientific measurement (Holmes and Jeffcott, 2010) and where technologies exist utilize proven validated protocols (Pierard et al., 2015). This paper overviews of a range of aspects of equitation that have been explored and the technologies used to obtain empirical data.

2. Research and scientific measurement in equitation

Research is typically defined as the systematic investigation into, and study of, materials and sources in order to establish facts and reach new conclusions (Randle, 2009). Within the framework of Equitation Science, an overriding purpose of research should be to examine aspects of equestrian- and equitation- practice in order to identify and ultimately differentiate between practice that is not acceptable (i.e. has a negative impact on horse welfare) and practice that is (i.e. does not have a negative impact on horse welfare and preferably also improves it).

Equitation science research is likely to involve live animals and humans, therefore researchers must ensure that the global principles of ethical research are adhered to. It is imperative that horse use in these studies is governed by the 3 Rs of ethical research, namely Replication, Reduction and Refinement (see Rollin, 2009; Russel and Burch, 1959). Although this will normally be achieved through compliance with compulsory ethical procedures of the institution at which the experimenter is based, within equitation there is an increased likelihood of testing subjects recruited opportunistically (also known as convenience sampling whereby subjects are recruited from naturally occurring groups, e.g. a particular type/group of horse riders), therefore safeguards should implemented to ensure that equitation testing is not be conducted ungoverned. As equitation also involves humans appropriate human-ethics approval must also be secured along with a fitness to participate questionnaire as part of risk management (e.g. the Physical Activity Readiness Questionnaire, PAR-Q, Duncan et al., 2016), with special attention paid to the involvement of minors and less able bodied individuals. Questionnaire based studies are becoming increasingly popular as accessibility to global participants has increased through social media and world-wide electronic platforms, however these too should be scrutinized and gain ethical approval prior to launch.

All research that is conducted should adhere to a widely accepted set of measurement principles. The most important of the basic principles that should be considered when conducting equitation science research are summarised in Table 1. Equitation Science researchers should also establish the most appropriate time- and subject-sampling method to use in order to ensure representative data are collected. These are defined in Martin and Bateson (2007). A priority is that the experimenters ensure that they collect sufficient data to be representative whilst avoiding the effects of horse-, rider- and/or experimenter- fatigue described in Table 1 due to over-use. Particular attention should be paid to the confounding factors that may also influence the outcome of Equitation Science studies.

The use of automatic recording technology may be appealing on the basis of a perceived reduced work load (but this is rarely the case with data transcription, collation and reduction frequently taking up to three times as long as the duration of the raw material recorded, Martin and Bateson, 2007), whether information is recorded directly (e.g. rein tension) or provides a method for data capture for later transcription (e.g. video material). Regardless of recording method and technology used, it is important to adhere to a further set of four scientific measurement principles (Validity, Reliability, Accuracy and Precision) to ensure that the data are measured well (Table 2). Fig. 1 displays four scenarios based on achievement of these scientific measurement principles taking into account the impact of systematic and random errors which may well arise from the use of technological equipment for data recording. Only when the measurement recorded is accurate (i.e.