The Right Angle: Validating a standardised protocol for the use of infra-red thermography of eye temperature as a welfare indicator

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Abstract

Infra-red thermography (IRT) is a non-invasive tool for measuring eye temperature as an indicator of stress and welfare in animals. Previous studies state that images are taken from 90° but do not specify a reference point or method of standardisation. The aims of the current study were to determine whether the position of the IRT camera has an impact on recorded temperature and which camera position is optimal for indicating stress in a mammal with anterolateral eyes. IRT images were taken from 90° to the nasal plane, eye and sagittal plane on the left side of the horses’ faces (n = 14) at eye level before and after exposure to a novel object. Distance and angle of measurement was standardised using ground markers. Temperature at each point of measurement was compared against heart rate variability. A significant difference was found between recorded temperature at all three of the points of measurement, both before and after the novel object test, suggesting that IRT camera position has an impact on eye temperature results. There was a significant strong positive correlation between eye temperature taken from 90° to the sagittal plane and heart rate variability, but no such correlation was observed from 90° to the nasal plane or eye. This suggests that a 90° angle in relation to the sagittal plane is the optimal position for taking eye temperature measurements using IRT, whereas 90° to the eye is commonly used. This study offers a validated protocol for using IRT to measure stress and welfare in mammals with anterolateral eyes.

Keywords: angle of measurement, animal welfare, eye temperature, heart rate variability, horse, infra-red thermography

Introduction

A change in temperature at the eye, ear or nose is recognised as a stress response in mammals, caused by sympathetically mediated changes in blood flow to these areas in the presence of a perceived threat or novel event (Blessing 2003). Due to its association with sympathetic responses of the autonomic nervous system (ANS) and hypothalamic pituitary adrenal (HPA) activation, infra-red thermography (IRT) has been used to measure eye temperature in animal welfare studies concerned with arousal, stress, pain and fear (Stewart et al 2005; McGreevy et al 2012; Bartolomé et al 2013; Travain et al 2015; Fenner et al 2016). IRT of eye temperature is widely used in equine welfare studies, for example, in determining stress in response to the Pessoa training aid (Hall et al 2011) and to a common aversive handling procedure (Yarnell et al 2013). IRT has been used to detect potential stress in horses at showjumping (Valera et al 2012; Bartolomé et al 2013) and dressage competitions (Sánchez et al 2016). Trindade et al (2019) suggest IRT as a potential predictor for creatine kinase activity and therefore physical fitness in horses. Johnson et al (2011) suggest that IRT be used as a veterinary screening method for fevers. Therefore, IRT has widespread implications in equine welfare science.

Distance between the IRT camera and the target may have a significant impact on the accuracy of readings. One metre is often suggested as the optimal distance between the IRT camera and the target when measuring a small area (Al-Nakhli et al 2012). Images taken from other distances may suffer pixilation loss and are less precise. In all current studies using equine eye temperature as a measure of stress, where specified, the 1 m distance is typically utilised for taking thermal images (eg Valera et al 2012; Bartolomé et al 2013; Yarnell et al 2013). Critically, these studies do not specify how the distance is measured and controlled for. Despite validation of the distance between the target and the IRT camera, very few efforts have been made to validate the angle at which the camera is positioned in relation to equine eyes. In studies concerned with human ocular surface temperature, IRT images are taken from a 1 m distance and a 90° angle to the subject’s eye (Tan et al 2009) which, in humans, translates as directly in front of the face. Many of the studies using IRT to measure equine eye temperature do not specify the angle from which the images were taken (Hall et al 2011; Johnson et al 2011).

Where specified, much of the research reports taking images from 90° (eg Valera et al 2012; Bartolomé et al 2013; Yarnell et al 2013), however, there is little clarifica-