



Can ear postures reliably measure the positive emotional state of cows?



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ABSTRACT

Animal welfare science is increasingly concerned with the promotion of positive emotions in animals, yet little is known about how to measure them. We examined whether ear postures in dairy cows were reliable indicators of a low arousal, positive emotional state. We conducted a total of 381, 15 min focal observations, across a group of 13 cows, using stroking as a positive stimulus. Each focal observation was comprised of three, 5 min segments; pre-stroking (baseline), stroking (stimulus), and post-stroking (post-stimulus). Throughout the focal observation, one researcher filmed the focal cow's ear on the side which was to be stroked, and a second researcher recorded the focal cow's behaviour. During the stroking segment the third researcher, who was present in the cow pen throughout, stroked the habituated cow on certain regions of their head, neck and withers for 5 min. Following this, the stroker left and the filming and behavioural observations continued for another 5 min (post-stroking segment). To eliminate extraneous variables we controlled for activity levels and other behaviours thought to be positive such as feeding.

Prior to video analysis we identified four ear postures; an upright posture (EP1), a forward ear posture (EP2), a backward ear posture (EP3), and a hanging ear posture, where the ear fell loosely, perpendicular to the head (EP4). We then analysed the video footage to determine the duration of time spent in each of the four ear postures, and the number of ear posture changes performed during each segment. We performed One-Way ANOVA analyses, taking account of repeated measures, and found that EP1 and EP2 were performed for longer during the pre-stroking and post-stroking segments, than during the stroking segment (EP1; $F_{(1.87, 671.09)} = 241.22, p < 0.001$; EP2; $F_{(1.86, 668.87)} = 39.09, p < 0.001$). The opposite was found for EP3 and EP4, which were performed for longer during stroking than during either the pre-stroking or post-stroking segments (EP3; $F_{(1.95, 698.27)} = 81.20, p < 0.001$, EP4; $F_{(1.65, 591.02)} = 169.98, p < 0.001$). Furthermore, EP1 was performed for less time in the post-stroking segment compared with the pre-stroking segment, and EP3 was performed for longer during post-stroking compared with the pre-stroking segment (EP1; $p < 0.001$, EP2; $p < 0.001$). The number of ear posture changes increased during the stroking segment, compared with during both the pre-stroking and post-stroking segments ($F_{(2, 718)} = 17.89, p < 0.001$).

These results suggest that relaxed ear postures are indicative of what is suggested to be a positive, low arousal emotional state in dairy cows and could therefore be a useful, non-invasive measure of emotional state when used by trained observers. The results need further validation with other stimuli and arousal levels, but they have the potential to be incorporated into on-farm welfare assessments.

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1. Introduction

1.1. The importance of positive emotions

Animal welfare scientists are increasingly recognising that good animal welfare involves the promotion and provision of positive emotional states and experiences, not just the avoidance of negative states (Boissy et al., 2007; Mellor, 2012; Proctor, 2012). Despite this, there is still very little research seeking to understand and measure positive emotional states in animals (Boissy et al., 2007; Sandem et al., 2004). In a recent review, we found there to be a significant lack of research exploring the existence or nature of positive emotions in animals (Proctor et al., 2013). If we are to promote positive emotional states in animals, we need to know which emotions they can feel and how they are expressed (Désiré et al., 2002). This current study aims to advance our understanding of positive emotional states in animals by testing the validity of ear postures as a measure of a positive, low arousal emotional state in dairy cows.

1.2. Ear postures as indicators of emotional state

Ruminants have highly developed muscles around their ears, enabling them to independently rotate and position their ears in many different ways (Reefmann et al., 2009). A number of studies have explored the possibility that these ear postures may be indicative of emotional states in sheep and pigs (e.g. Reefmann et al., 2009; Reimert et al., 2012). As far as we are aware, however, no research to date has looked at cattle ear postures and their potential as emotional indicators. In sheep it has been found that the number of ear posture changes, forward ear postures and asymmetric ear postures were highest during negative experiences (social isolation) and lowest during positive experiences (feeding on fresh hay) (Reefmann et al., 2009). Furthermore, Reefmann et al. (2009) concluded that because attention was an intrinsic component of the emotional response, it did not adversely affect the ear postures, making the type of ear posture and the frequency of changes good indicators of the emotional state of sheep. Boissy et al. (2011) found similar results in their study, which exposed sheep to situations of varying degrees of suddenness, familiarity, negative contrast and controllability. They found that negative emotional experiences in sheep resulted in their ears rising up, whereas positive emotional experiences coincided with passive, 'plane ear postures'. The significance and meaning of ear postures differs amongst species and varies according to context. In dogs, pigs and horses, backward orienting ears have been associated with negative situations (Heleski et al., 2009; Reimert et al., 2012; Tod et al., 2005; von Borstel et al., 2009), whereas Reefmann et al. (2009) found them to be associated with positive experiences in sheep. It is therefore necessary to ascertain species-specific criteria prior to ear postures being used as a measure.

Ear postures and other behavioural measures are not only more practical than physiological measures like heart rate (Boissy et al., 2011), but they are also less likely to be affected by other variables such as diurnal fluctuations (Purwanto et al., 1990) or the level of physical activity (von

Borell et al., 2007). Furthermore, Sandem et al. (2004) highlighted the need for more research into 'finer' ethological measures, such as postures and facial expressions, suggesting that these may be helpful in identifying the strength or intensity of the emotion. 'Gross' spacio-temporal and ethological measures, such as flight distances, are also often impractical for many situations requiring welfare assessments (Reefmann et al., 2009; Sandem et al., 2004). As a result, there is a clear need for studies to find consistent behavioural patterns which are easily observed across a range of situations (Veissier and Boissy, 2007).

1.3. Emotions and moods

Emotions are characterised by their intrinsic valence and their associated level of arousal (Mendl et al., 2010). The valence of an emotion can either be positive or negative, depending on the rewarding or punishing nature of the eliciting experience (Reefmann et al., 2009). Furthermore, the degree of associated arousal or reported activation can vary from high to low (Mendl et al., 2010). For example, 'fear' could be described as a high arousal, negative emotional state, whereas 'relaxed' could be described as a low arousal, positive emotional state. Emotions tend to be short lasting states, and unlike mood states they are usually event-focussed, occurring only in response to the positive or negative experience (Mendl et al., 2010). Mood states on the other hand are longer lasting, and are not only responsive to an event or experience, but can occur in the absence of the stimulus (Désiré et al., 2002; Mendl et al., 2010; Reefmann et al., 2012).

1.4. Positive stimuli

The positive effects of grooming and tactile contact are already being utilised to improve interactions between stock-people and their animals (Schmied et al., 2008a; Windschnurer et al., 2009). Gentle handling and stroking of dairy cows and heifers has been shown to decrease their fear of humans (Breuer et al., 2003), reduce cortisol levels (Hemsworth and Barnett, 1989), and lower their heart rate (Schmied et al., 2010; Waiblinger et al., 2004) during various procedures. In their study, Bertenshaw and Rowlinson (2008) found that free-ranging cows would pursue the retreated experimenter following a stroking bout and accept a second bout. They suggested that the acceptance of the second bout showed that the cows were not just curious, but actually found the stroking pleasurable. In addition, a recent study found that dairy calves found the experience of being brushed by a familiar person to be positive, and actively chose to be brushed (Westerath et al., 2014).

In this study we emulated the species-specific behaviour of dairy cattle by stroking the areas which are most licked by other cows, and at the same rate as licking would occur. The stroking was performed by a familiar person, and was entirely optional for the cow, as they were never tethered or pursued. Therefore, it is expected that the stroking in this study also elicited the low arousal state seen in previous studies as a result of stroking (Hemsworth and Barnett, 1989; Schmied et al.,

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