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Investigating the motivation to play in lambs

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ABSTRACT

The aim of this study was to identify behaviours and ear postures linked to the appetitive, consummatory and post-consummatory motivational phases of play in male lambs, and to evaluate how cortisol was affected by play. Ten pairs of male lambs, *Ovis aries* were observed in a play arena three times a week for 4 weeks. They were kept in a holding pen for 5 min (appetitive phase) where they could look into the play arena (containing a ball, two chains and a tunnel) and thereafter released into the play arena for 20 min (consummatory phase). They returned to their home pen where they were observed for 6 min (post-consummatory phase). Direct observations were made in each location and behaviours were recorded as frequencies per min. Ear postures were recorded instantaneously every 15 s for 3 min per location. Saliva samples were taken in the 4th week for analysis of cortisol. Behaviours were analysed with a generalized linear model and cortisol with paired *t*-test. In the holding pen, the most common behaviours were walking, sniffing pen, standing facing play arena, standing facing alley, butting and pawing. Walking ($P<0.001$) and standing facing play arena ($P<0.001$) were higher during the 1st min whereas butting ($P<0.001$) was lower during the 1st min compared to the other 4 min. In the play arena, social play was more frequent than locomotor and object play (median: 1.85, 0.97, and 1.14 events per min, respectively). Total play and locomotor play decreased across the 20 min, whereas social play remained high until the 8th min. Total play ($P<0.001$) and social play ($P<0.01$) were most frequent during the 2nd week. Walking and standing were performed immediately after returning to the home pen but after the 1st min, lambs spent most of their time feeding. Raised and backward ear postures were common in the holding pen and play arena whereas plane ear postures were more common in the home pen. Salivary cortisol tended to increase after play ($P=0.08$). In conclusion, lambs showed different active behaviours together with raised and backward ear postures during the appetitive phase, high amounts of play together with backward and raised ear postures during the consummatory phase and mainly feeding together with plane ear postures during the post-consummatory phase.

1. Introduction

A theoretical framework which could provide useful insights into the objective assessment of positive affective states in animals was offered by Keeling et al. (2008). This framework integrates a functional approach, describing emotional processes as proximate mechanisms aiding survival, with a phenomenological approach focused on valence and arousal dimensions of emotions (Keeling et al.,

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2008). 'Arousal' indicates the degree of emotional activation and 'valence' expresses whether the state of activation is positive or negative (Mendl et al., 2010). In this model, reward acquisition is conceptualized as a cycle divided into a sequence of motivational stages related to positive affective states (Burman et al., 2011; Keeling et al., 2008). An appetitive phase, when the animal is waiting for or anticipating a reward (i.e. internally representing an expectation of a forthcoming reward; Spruijt et al., 2001), is followed by a consummatory phase, when the reward is consumed and enjoyed, and a post-consummatory phase, when the animal attains satisfaction and relaxation.

Behaviours such as play, social behaviour, reproductive behaviour, foraging, grooming and dust bathing appear to have rewarding properties (Boissy et al., 2007), with successful acquisition of these rewards inducing strongly positive affective states (Burman et al., 2011; Keeling et al., 2008). Appetitive motivational states are high in arousal (Keeling et al., 2008) and often lead to changes in behaviour reflecting emotional responses (Imfeld-Mueller and Hillmann, 2012). Consummatory motivational states produce medium arousal and are linked with pleasure or liking induced by innate or acquired positive reinforcement from the reward (Keeling et al., 2008). Post-consummatory motivational states involve low arousal and are linked with satisfaction and relaxation, aiding recovery once the reward is acquired (Keeling et al., 2008).

Anticipatory responses for food have been characterized in various species (e.g. rats, minks, pigs, silver foxes, horses) and are mostly reported as increases in activity (Dudink et al., 2006; Moe et al., 2006; Van den Bos et al., 2003), especially locomotion and exploration (Peters et al., 2012). However, little research has been directed towards teasing out positive affective states experienced during 'anticipation', 'consumption' and 'post-consumption' of play. Acquisition of play may invoke a broad spectrum of sensations leading to pleasure (Balcombe, 2009), whereas environmental stressors evoking negative emotions may inhibit the expression of play (Worsaae and Schmidt, 1980). A better understanding of affective experiences during play is relevant to the application of play behaviour as an animal welfare indicator. Here, we focus on play in lambs.

In sheep, Boissy et al. (2011) identified raised, backward and asymmetric ear postures in situations eliciting negative emotions whereas plane ear postures were observed during feeding. Reefmann et al. (2009) reported backward ear postures during hay feeding and forward and asymmetric ear postures during separation from group members. Therefore, we used ear postures as an indicator of emotional states of lambs during the different stages of the play motivational cycle.

Cortisol is of importance during physical activity (e.g. for recruitment of nutrients) and cortisol levels rise during physical activity (Few, 1974; Gatti and De Palo, 2011). Cortisol levels may, however, also reflect negative emotions induced by stressors that inhibit play behaviour. For example, cats subjected to unpredictable handling and husbandry routines showed higher urinary cortisol and suppressed play behaviour (Carlstead et al., 1993) and, in piglets, elevated basal cortisol levels were correlated with decreased play (Worsaae and Schmidt, 1980). In contrast, play may induce anti-stress effects through oxytocin release, thereby lowering cortisol levels (Uvnas-Moberg and Petersson, 2005). Horvath et al. (2008) reported that salivary cortisol concentrations of adult border guard dogs decreased after play with their handler, suggesting that the play contributed to stress reduction. Measurement of cortisol could, thus, provide valuable information about how play activity affects stress levels in lambs.

In this study, we describe and quantify the play behaviour of lambs and identify behaviours linked to the appetitive, consummatory and post-consummatory phases of the play motivational cycle. We expected that lambs would be active and initiate play during the appetitive phase, would be motivated to play and use the provided space and play objects during the consummatory phase, and show signs of being relaxed during the post-consummatory phase. We tested the effect of time within test and week of testing on some behaviours that may indicate anticipation to enter the play arena, play behaviours in the arena and behaviours that may indicate relaxation during the post-consummatory phase. We also investigated the predictions that salivary cortisol would be influenced by play, and that raised ear postures would be most common during the appetitive and consummatory phases of play whereas plane ear postures would be most common during the post-consummatory phase.

2. Materials and methods

The study was carried out at Götala research farm in Skara, Sweden. All procedures were approved by the Swedish Ethical Committee of Experimental Animals (Dnr: 123-2011).

2.1. Animals, housing and feeding

Twenty uncastrated male lambs (including five pairs of twin lambs) of Dorset breed ($n = 8$) and Swedish Fine Wool and Dorset mixed breed ($n = 12$) with an average age of 10 weeks and weight of 25 kg were used in the study. Lambs were taken from the pasture, weaned from their mother and transported to Götala research farm in a horse wagon by the farmer. They were housed in pairs in 10 straw-bedded pens (2 m × 3 m) built with galvanized steel hurdles. The pens stood next to each other so that the lambs could sniff at their neighbours through the hurdles. While assigning lambs to each pen, both breeds were mixed at random. Lambs having approximately equal weight were allocated to the same pen and twin lambs were housed in different pens. Lambs in each pen were marked with blue and red paint (Porcimark Marking Spray, Kruuse, Denmark) across the hips and shoulders. Marking was done twice, once after the lambs were placed in their pens and the second time 2 weeks after the start of study. A standard feed ration consisting of grass silage, distillers dried grains, barley and heat treated rapeseed in standard proportion was available ad libitum in the feed trough in front of each pen. New feed was given in the morning around 07:00–07:30 h every day. Water and mineral block were also provided ad libitum. The study was conducted during the month of