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Short communication

## A note on reward-related behaviour and emotional expressions in farmed silver foxes (*Vulpes vulpes*)—Basis for a novel tool to study animal welfare

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### Abstract

The present study aimed to investigate the profile and quantitative aspects of reward-related behaviour and emotional expressions during anticipation of positive (predictable or various unpredictable) or negative (predictable) rewards in a Pavlovian trace conditioning paradigm in farmed silver foxes. When anticipating a positive reward, silver foxes were more active, performed more stereotypical behaviour, had more erected ears and spent more time in the front of the cage compared to anticipating aversive stimuli. Foxes were only to a minor degree able to discriminate the two different positive paradigms. In conclusion, studies related to anticipatory behaviour may be useful for the development of indicators of positive emotional states and, thus, positive welfare, in farmed silver foxes.

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**Keywords:** Reward-related behaviour; Emotions; Animal welfare; Positive welfare; Fur animals; Conditioned learning; Predictability; Stereotypies

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## 1. Introduction

Studies of animal emotions are important approaches to animal welfare in applied ethology (Dèsirè et al., 2002). Emotions are brain states produced by anticipated or reinforced responses (Dawkins, 2001). Accordingly, one potential basis for studying animal emotions is behavioural expression during anticipation of rewards (Spruijt et al., 2001; Dawkins, 2001). Species-specific foraging patterns may influence the expression of anticipatory behaviour. When anticipating food rewards, rats (Van der Harst et al., 2003) and mink (Vinke et al., 2004) show anticipatory hyperactivity. In contrast, cats decrease their activity, which may be explained by the way cats catch their prey, i.e. a “sit and wait” strategy (Van den Bos et al., 2003). When anticipating aversive stimuli, rats decrease their locomotor activity (Van der Harst et al., 2003).

Changes in predictability may be associated with emotional expressions (Wiepkema, 1990), and in a case of unpredictability in a positive reward situation emotional expression indicating some form of pleasure or surprise may occur (Levine and Coover, 1976).

The aims of the present study were to analyse the profile and quantitative aspect of reward-related anticipatory behaviour as well as to identify emotional expressions during anticipation of rewards differing in their rewarding properties, i.e. positive (predictable or unpredictable), or negative (predictable), in order to form a basis of using anticipatory behaviours as potential indicator of emotions in farmed silver foxes.

## 2. Materials and methods

Six adult silver fox vixens previously responding positively to hand fed tit-bits were housed individually in wire mesh cages (1 m × 1 m × 1 m) with resting platforms in a sound proof laboratory at the Norwegian University of Life Sciences.

The experiment involved three consecutive conditioning paradigms; positive predictable, positive unpredictable, and negative predictable. Foxes were trained in three successive training periods to associate three different bell signals (conditioned stimulus; CS1, CS2 or CS3) with three different unconditioned stimuli UCS1 (positive predictable reward, i.e. pieces of salmon), UCS2 (positive unpredictable reward; feed related: dog biscuits, salmon, cattle humerus, or not feed related: a tennis ball or a wooden chewing stick), or UCS3 (negative reward, i.e. capture with a neck tong, known to be aversive in farmed foxes (Bakken et al., 1994)). When the association had formed, CS-UCS intervals were gradually increased, reaching a maximum of 10 min after 10 days. After the initial training periods, the experiments were performed. During each experimental period (5 days), CS were signalled 10 min before UCS twice daily at different times. The positive paradigm (training period and experiment) was performed before the training period and experimental period for the positive predictable paradigm, followed by the training period and experimental period for the negative paradigm. Foxes served as their own controls as they were repeatedly tested.

Behaviour and emotional expression were determined by individual video recording and instantaneous sampling at 1-min intervals (Martin and Bateson, 1993). Behavioural

Table 1  
Behavioural categories and emotional expressions observed in silver foxes in the experiment

Category	Description
Locomotor activity	Active/inactive; i.e. locomotor movement of any category such as walking, running, jumping, opposed to inactivity; such as standing still, sitting or lying still
Stereotypical activity	Invariable repeated behaviour fixed in orientation or place, more than two repeated observations within few seconds
Ear posture	Ears erected (“lucky face”, e.g. (Fox, 1975))/ears rotated or flat backwards rotated (see also Fig. 4)
Position in cage	Front or back, i.e. more than 50% of the animal in the front or back

categories and emotional expressions are listed in Table 1. Sampling started 5 s after the signal and for 15 min; i.e. during anticipation (10 min), and after reward/aversive treatment (4 min). No results from the minute of reward or aversive treatment are presented.

Behaviour and emotional expressions were analysed with the help of The Observer/Ethovision (Noldus, Wageningen, NL) Microsoft Excel and SAS. Analyses are based on the average % of observations within each behaviour category of each individual for each experimental set-up before and after reward. Differences between groups were tested by using Kruskal–Wallis one-way analysis of variance.

### 3. Results

In general, the results demonstrated that silver foxes have a capacity of distinguishing the announcement of positive incentives and aversive treatment and are able to maintain the display of anticipation during 10 min (Fig. 1). Differences in activity levels were found between the positive and negative paradigms during anticipation ( $\chi^2 = 62.38$ , d.f. = 2,  $p < 0.0001$ ) and after reward ( $\chi^2 = 5.8$ , d.f. = 2,  $p = 0.05$ ; Fig. 2). No differences in activity levels were found between the two positive paradigms (NS). The high activity levels during anticipation of both positive paradigms involved a substantial amount of locomotor stereotypical behaviours (Fig. 3). In contrast, nearly no stereotypical behaviour was found during negative anticipation (differences between groups,  $\chi^2 = 30.6$ , d.f. = 2,  $p < 0.001$ ). After reward, very low levels of stereotypies were found in the positive paradigms, whereas they increased after aversive treatment (differences between groups,  $\chi^2 = 9.45$ , d.f. = 2,  $p < 0.01$ ). No differences in stereotypies were found between the positive paradigms (NS).

The silver foxes spent most of the time in the front of the cage when anticipating the positive rewards, i.e. oriented towards the person delivering the incentives. In contrast, during anticipation of aversive treatment the foxes were observed more in the back of the cage ( $\chi^2 = 12.3$ , d.f. = 2,  $p < 0.002$ ; Table 2). There were no differences in location between the two positive paradigms (NS). Erected ears were seen in all paradigms. However, flat and backwards rotated ears were most frequently seen in the positive unpredictable and in the negative paradigm ( $\chi^2 = 8.2$ , d.f. = 2,  $p < 0.01$ ). For description of ear posture, see Fig. 4.

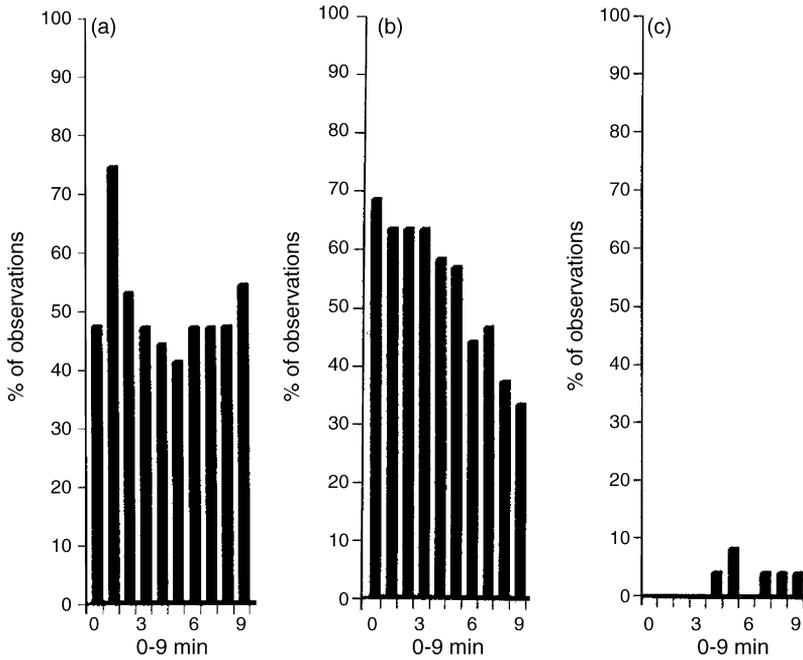


Fig. 1. Amount (%) of observations (9 min) spent active; whilst the foxes were anticipating a positive predictable (a), positive unpredictable (b), or predictable aversive reward (c).

#### 4. Discussion

This was the first study in farmed silver foxes using both positive and negative rewards in a Pavlovian trace conditioning paradigm to form a basis for the use of reward-related behaviours and emotional expressions as indicators of emotions. The results clearly

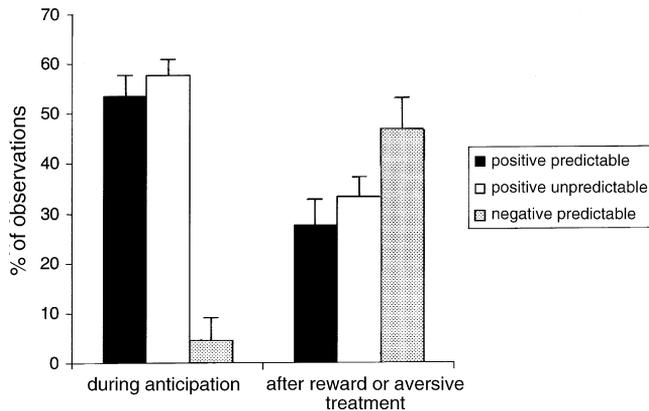


Fig. 2. Activity levels (% of observations in activity; +S.E.) during anticipation and after reward or aversive treatment in a positive predictable, positive unpredictable or negative predictable paradigm in farmed silver foxes.

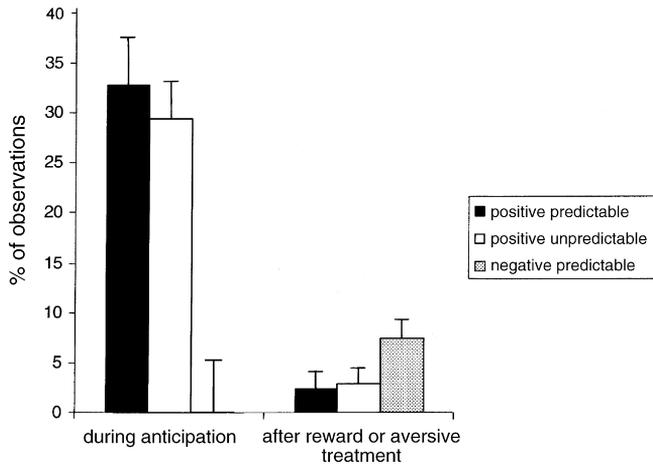


Fig. 3. Levels of stereotypies (% of observations; +S.E.) during anticipation and after reward or aversive treatment in a positive predictable, positive unpredictable or negative predictable paradigm in farmed silver foxes.

Table 2

% of observations ± S.E. of foxes located in the front of the cages, and foxes with erected ears during anticipation in the different paradigms; i.e. positive predictable, positive unpredictable and negative predictable

	Positive predictable	Positive unpredictable	Negative predictable
In front of cage	83.3 ± 3.54	81.3 ± 2.74	47.5 ± 3.95
Erected ears	97.3 ± 1.05	93.3 ± 0.81	94.12 ± 1.17

indicated that silver foxes were able to discriminate signals, and that anticipation to a signalled positive reward lead to increased activity levels. Pronounced differences in activity levels between anticipation of a positive incentive versus aversive treatment are in agreement with previous studies in rats (Van der Harst et al., 2003), but contrast earlier findings in cats (Van den Bos et al., 2003). Learning and discriminating ability in silver foxes was demonstrated previously (Bakken et al., 1993), however this is the first study

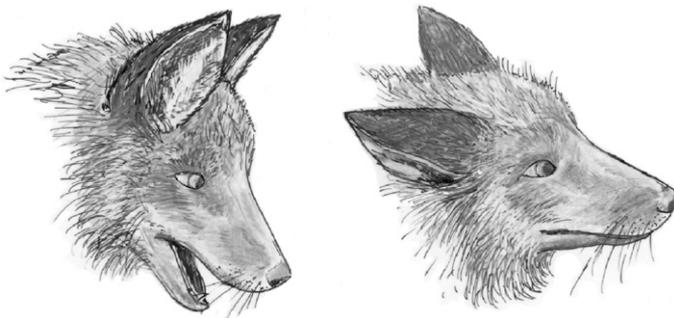


Fig. 4. Ear postures studied: erected ears or flat and backward rotated ears.

where behavioural and emotional expressions in foxes were observed during a time interval between signal and reward.

Activity during anticipation of positive incentives consisted of high levels of locomotor stereotypical behaviours. Being located mostly in the back of the cage during anticipation of aversive treatment, also during stereotypical behaviour following the aversive treatment, indicates elements of fear during anticipation and after cessation of this treatment (Bakken et al., 1993). In contrast, foxes were mostly observed in front of the cage and with erected ears, indicating lower levels of fear during positive anticipation (Fox, 1970). At the same time, they were very active and highly stereotyping. The occurrence of stereotypies during anticipation of food in canides has been openly discussed (Vinke et al., 2004; Mason and Mendl, 1997), but the underlying motivational systems involved need to be further elaborated.

Minor differences in ear posture may indicate that silver foxes were able to discriminate the two positive paradigms. The observed ear posture during positive unpredictability showed resemblances with the anticipation of aversive treatment. However, being very active and being mostly located in the front of the cage during positive unpredictability still indicates that the silver foxes were anticipating a positive incentive. Our study did not reveal clear answers in terms of whether some unpredictability and surprise in a positive context would result in more pleasure.

It has to be emphasized that the resources were presented consecutively, and that the same foxes were exposed to all three types of trial in the same order. Therefore, the results may have been influenced by the passage of time or the sequential nature of the trials. Furthermore, the results may have been affected by behavioural changes in season during the trial, changes due to expectations created by the previous phases of training; changes in responsiveness to the human tester, etc. These factors need to be further elaborated when further developing anticipatory behaviour as an indicator of emotions in farmed silver foxes.

In conclusion, studies related to anticipatory behaviour may be useful for the development of indicators of positive emotional states and, thus, positive welfare, in farmed silver foxes.

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