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Positive indicators of cattle welfare and their applicability to on-farm protocols

Fabio Napolitano¹, Ute Knierim²,
Fernando Grasso³, Giuseppe De Rosa³

¹Dipartimento di Scienze delle Produzioni Animali. Università della Basilicata, Italy

²Department of Farm Animal Behaviour and Husbandry. University of Kassel, Germany

³Dipartimento di Scienze del Suolo, della Pianta, dell'Ambiente e delle Produzioni Animali. Università di Napoli "Federico II", Italy

Corresponding author: Prof. Fabio Napolitano. Dipartimento di Scienze delle Produzioni Animali. Università della Basilicata. Via dell'Ateneo Lucano 10, 85100 Potenza, Italy - Tel. +39 0971 205078 - Fax: +39 0971 205099 - Email: fabio.napolitano@unibas.it

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ABSTRACT

Most of the research on animal welfare has focused on the negative aspects of the matter including an array of stress categories, whereas little has been done about the positive states of well being. The present study aims to describe indicators of positive animal welfare suitable for on-farm assessment. Appropriate environmental stimulation favours good welfare and, in an adequately enriched environment, positive indicators of welfare such as play behaviour tend to be more common. In addition, animals are motivated to perform these behaviours only if their primary needs are satisfied. In cattle, beneficial effects of social licking have been observed with positive correlation between being licked vs. milk production and weight gain, respectively. Ruminants are gregarious and a high degree of synchronisation within the herd may indicate a positive welfare state, in particular for subordinate animals. They may be able to meet their basic feeding and resting requirements performing these behaviours when the competition for a particular resource is low, however their welfare state would be improved if they could choose when and where (i.e. along with the other members of the group) to perform such behaviours. Due to the reduced applicability (mainly young animals), low feasibility (time consuming) and lack of research on reliability, play behaviour, albeit of proven validity, does not appear to be suitable for a rapid implementation in a welfare assessment scheme. Social licking is rarely expressed and its detection may be time consuming and scarcely feasible. Although validity and reliability need more studies, behaviour synchrony seems to be a promising positive welfare indicator as the instantaneous scan sampling technique makes this indicator easily applicable. Recently, a new methodology called "qualitative assessment of animal behaviour" has been developed. The method relies on a number of terms which are freely generated by observers. Thus, when positive aspects are observed they can be rated on a quantitative scale. Because of its high inter- and intra-observer reliability, this method appears to be the most promising.

Key words: On-farm welfare assessment, Positive indicators, Play behaviour, Social licking, Qualitative behaviour assessment.

RIASSUNTO

POSSIBILITÀ APPLICATIVE A LIVELLO AZIENDALE DEGLI
INDICATORI POSITIVI DI BENESSERE NEI BOVINI

Poiché nello studio del benessere animale vengono presi in considerazione essenzialmente gli aspetti negativi delle diverse condizioni in cui sono tenuti gli animali, gli Autori richiamano l'attenzione sull'importanza che può rivestire anche l'interpretazione delle risposte dei soggetti allevati attraverso la valutazione degli indicatori positivi di benessere. Infatti, se uno stato di scarso benessere può essere rilevato abbastanza facilmente in presenza di ferite, tumefazioni, dolore, immunodeficienza, riduzione delle potenzialità produttive, ecc., l'assenza di tale sintomatologia non assicura che gli animali si trovino in condizioni ottimali di benessere. E' stato osservato, però, che un'adeguata stimolazione ambientale favorisce l'espressione di indicatori positivi di benessere, quali il gioco, soprattutto nei giovani, e il reciproco leccarsi e che queste forme comportamentali vengono manifestate solo quando sono stati soddisfatti i fabbisogni primari (alimentazione, termoregolazione, ecc.). Anche il grado di sincronizzazione di alcune attività, quali il riposo e l'assunzione di alimento, può rivelarsi un indicatore positivo di benessere, in particolare per i soggetti subordinati. Questi, infatti, possono soddisfare i fabbisogni essenziali nei periodi in cui la probabilità di competizione è minore: per esempio, alimentandosi di notte e riposando mentre gli altri si alimentano. Dal momento che le principali specie di interesse zootecnico sono gregarie e in condizioni di allevamento estensivo manifestano un elevato grado di sincronizzazione, ne consegue che se ogni animale ha la possibilità di scegliere quando e dove svolgere le proprie attività contemporaneamente agli altri, il livello di benessere probabilmente risulta più elevato. Recentemente è stata messa a punto una metodologia, denominata valutazione qualitativa del comportamento, la cui applicazione risulta facile e veloce. Il metodo si basa sulla capacità degli osservatori di generare termini, alcuni dei quali hanno una connotazione negativa, altri, invece, hanno un significato positivo, per cui sono potenzialmente in grado di descrivere l'insieme dell'espressività di un singolo animale o di un gruppo. E' stato evidenziato che sia il gioco, limitatamente ai soggetti giovani, sia il leccarsi reciprocamente sono comportamenti poco frequenti che possono avere scarsa utilizzazione come indicatori positivi di benessere poiché richiederebbero un monitoraggio continuo. Il grado di sincronizzazione comportamentale, sebbene richieda maggiori studi volti a verificarne validità e ripetibilità, potrebbe fornire utili informazioni in tal senso, essendo possibile valutarlo con lo scan sampling, metodo facilmente applicabile e richiedente tempi non eccessivamente lunghi. Gli Autori concludono che, sebbene siano necessarie ulteriori ricerche per verificare la sua applicabilità a livello aziendale, il criterio di valutazione qualitativa del comportamento è destinato a trovare ampia utilizzazione, sia per la validità del principio che ha ispirato la sua messa a punto, sia per l'elevato grado di concordanza entro e tra gli osservatori.

Parole chiave: *Monitoraggio del benessere animale, Indicatori positivi di benessere, Gioco, Social licking, Valutazione qualitativa del comportamento.*

Introduction

Most of the research on animal welfare has focused on the negative aspects of the matter including an array of stress categories, whereas little has been done about the positive states of well being. A number of authors assumed that welfare can be considered as a continuum ranging from very bad to very good (e.g. Broom and Johnson, 1993) and even though disease, pain, low growth

rates, impaired immunity, high glucocorticoid levels, etc. can define poor welfare, the absence of these symptoms can not be considered indicative of good welfare. Veterinary practitioners perform clinical assessment of good welfare based on a general evaluation of the health status by visual appraisal. However, methods have not been refined and validated possibly because the aim is not detection of good welfare, rather it is recognition of illness (Knierim *et al.*, 2001).

Similarly, ethologists often focus on absence of stress rather than on positive behaviours. Therefore, as only limited data are available, the present study aims to describe the indicators of positive animal welfare promising for on-farm assessment.

Discussion of promising measures

Play behaviour

Appropriate environmental stimulation favours good welfare and, in an adequately enriched environment, positive indicators of welfare such as play behaviour and sociopositive behaviours tend to be more common (Kaiser *et al.*, 1999).

The expression of play behaviour is reinforcing, as supported by the observation that young animals actively look for play partners and solicit play (Fagen, 1981). This indicates the presence of good welfare and positive feelings. In addition, the opportunity to perform play behaviour can act as a reward in preference conditioning experiments (Calcagnetti and Schechter, 1992). Fagen (1981) and Lawrence (1987) suggested that the expression of play behaviour may indicate a good welfare state of juvenile animals in nature and captivity, respectively. These animals are highly motivated to perform playing only if their primary needs are satisfied. In fact, food availability and thermal comfort are essential for the expression of play behaviour (Schmidt and Alder, 1981; Newberry *et al.*, 1988), whereas illness and injury are associated with absence of playing activities (Fagen, 1981). In open field testing, Friend *et al.* (1985) and Dellemeir *et al.* (1985) observed a high degree of congruency between physiological and behavioural data collected on calves using different methods of confinement. Animals kept in more restrictive conditions showed higher adrenal response to exogenous ACTH and reduced immune competence as well as

increased locomotor (bucking, trotting and cantering), social play (rubbing and butting heads) and social licking behaviours when they were moved into a relatively open area. Most of these responses can be interpreted in terms of rebound behaviours indicating that these calves had little chance to express them in a restricted environment. Similar results were obtained by De Pasillé and Rushen (1995) and Jensen (1999).

Play, both social and non-social, is not easily defined; therefore, it is a difficult behavioural phenotype with which to deal (Bekoff and Allen, 1997). In calves, play is mainly expressed as locomotor and social activities. Locomotor play includes galloping, bucking and kicking and involves no interaction with other conspecifics, although several subjects usually perform it at the same time (parallel play). A stimulus for locomotor play can be the provision of fresh litter (Jensen *et al.*, 1998; Emmmerig, 2004). Often concomitant with locomotor play, social play includes play fighting and non-reproductive mounting (Reinhardt *et al.*, 1978). Unlike serious fighting, play fighting is terminated without injury, submission, flight or chase (Reinhardt and Reinhardt, 1982; Vitale *et al.*, 1986). In addition, Jensen *et al.* (1998) described playing activities directed towards the environment (object and straw butting and rubbing). In one study, a peak of calf playing was observed at sunset (Knierim, unpublished data). Jensen and Kyhin (2000) observed that space allowance inhibited locomotor play, whereas play fighting was unaffected by space restriction.

Although described also in adult cattle (Fregonesi and Leaver, 2001), play activities are more frequent in early life, which makes the measures mainly applicable to juvenile animals. In particular, locomotor play is more common very early (Jensen and Kyhn, 2000), whereas play fighting has been observed starting on the second week of life

(Reinhardt and Reinhardt, 1982). Differences in the timing of the two types of play behaviour have also been described by Gomendio (1988) in Couvier's Gazelle. The author observed that locomotor play reached a peak at two weeks of age, whereas play fighting increased from two weeks up to six months of age.

Socio-positive behaviour

Two main components of good welfare may be considered environmental control, which is achieved when animals are able to predict changes in their physical and social environment (Wiepkema, 1985), and positive social relations. In fact, inhibited negative endocrine and immune responses of animals are observed in the presence of a bonding partner such as the mother or a mate for a young, the mating partner for an adult, etc. (Sachser *et al.*, 1998). Social relationships are an integral part of the behaviour of most mammalian species. There are behavioural and physiological systems supporting beneficial and health-promoting social interactions. Active systems involved in the maintenance of positive components of homeostatic physiology are based on neural functions sustained by hormones such as oxytocin, vasopressin, opioids, etc.. For example, oxytocin is associated with positive social behaviours, social bonding, maternal behaviour and reduced reactivity of the hypothalamic-pituitary-adrenal axis and sympathetic nervous systems (Carter, 1998), whereas Keverne *et al.* (1989) observed changes in the brain opioid system as a consequence of social grooming in monkeys. In particular, opiates have a feedback interaction with grooming behaviour as demonstrated by the fact that opiate receptor blockade increased the motivation to be groomed, whereas morphine administration decreased it. These studies support the view that brain integrated neural systems

may provide the hormonal basis for positive emotions to be used as reinforcers. Physiological changes as a consequence of grooming have also been described by Boccia *et al.* (1989) in pigtail Macaque. Data on primates indicate that social licking is used as tension-reducing behaviour (Schino *et al.*, 1988). Also in cattle there are indications that licking is used for the purpose of appeasement in situations of tension or social conflict (Reinhardt, 1980; Sato *et al.*, 1991; Waiblinger *et al.*, 2002; Emmerig, 2004). Therefore, while for the individual cow this is a positive effect, high social licking frequencies in a herd can also reflect high social tension. However, social licking can also play a role in reinforcing and stabilising social relationships, thus functioning as cohesive interaction along with head resting (Winckler *et al.*, 2002; Wasilewski, 2003). On the other hand, there are at first glance unexpected findings that for instance tied dairy cows show more social licking than loose housed cows (Krohn, 1994; Laister *et al.*, 2006) or that beef bulls on fully slatted concrete floors tend to perform more social licking than bulls on fully slatted floors with an elastic cover (Bahrs, 2005).

Social licking is mainly constituted by head, neck and shoulder licking (Bouissou, 1985). Interestingly, in a herd all the animals are licked, whereas less than 75% perform grooming (Sato, 1984). Subordinate animals lick and are licked less frequently than high ranking animals (Emmerig, 2004). Social licking is likely to be associated to familiarity (i.e. time spent together). Therefore, it can be inhibited by frequent grouping as well as by group size as a possible consequence of disturbed social structure (Menke, 1996). It is often solicited using a special posture, in which the solicitor lowers the cheek close to the mouth of the solicited animal, and is frequently associated to gentle nudging or pushing. The latter behaviours suggest

that social licking may be beneficial to receivers, as also demonstrated by increased milk production and weight gain in animals receiving more grooming (Wood, 1977; Sato, 1984). The empirical observation of animals closing their eyes while being groomed also supports this hypothesis. However, Reinhardt (1980) suggests that social licking increases in intensive environments and, therefore, may also be a sign of 'boredom'. According to Fraser and Broom (1990), social grooming might be a way to cope with restrictive conditions by self narcotisation since opioids are involved in allogrooming (Keverne *et al.*, 1989; Niesink and van Ree, 1989). Sato *et al.* (1991), moreover, observed that the suppression of the afternoon feeding caused a tendency in calves to lick more, which might be considered as a displacement activity for feeding. Further disturbance elements are the weather, with reduced social licking on rainy and windy days, dirtiness, with increased licking directed towards dirty subjects, and ectoparasites, with infested cattle showing increased levels of social licking (Sato *et al.*, 1991). While all these interpretations are in line with the notion that social licking improves the current welfare state of the animal, social licking at herd level appears to be a less useful indicator of the general welfare state of the animals in the herd.

Social licking has been observed in adult (dairy and beef cows; Sato *et al.*, 1993) as well as young cattle (heifers and steers; Sato *et al.*, 1991). Therefore, this potential indicator of good welfare seems to be applicable to virtually any cattle category, although in calves it can have another motivational background as redirected sucking behaviour, and in adults may indicate 'boredom' or social tension.

Synchronicity

A prominent aspect of the social behaviour of cattle is that these animals, as

other ruminants, are gregarious and under semi-natural or extensive conditions their behaviour is highly synchronised as a consequence of a marked allomimetic motivation (Bouissou *et al.*, 2001). A high degree of synchronisation within the herd may indicate a positive welfare state, in particular for subordinate animals (Metz, 1983). Theoretically, low ranking animals may be able to meet their basic feeding and resting requirements performing these behaviours when the competition for a particular resource is low (e.g. feeding at night and resting while the majority is involved in ingestive activities), however their welfare state would be improved if they could choose when and where (i.e. along with the other members of the group) they perform such behaviours, thus allowing each subject, including the low ranks, to be a fully integrated herd member.

The synchrony of feeding behaviour may be measured soon after the provision of fresh food (1 or few hours), when the motivation to feed is higher, whereas the night time (by means of infrared cameras) or the last 1 or few hours before milking could be checked for synchrony of lying (Wierenga, 1983; Bock, 1990). Their synchrony should exceed 80% to allow a positive judgment on the welfare state of the herd (Bock, 1990). The synchrony of both behaviours could be measured using instantaneous scan sampling technique in the whole herd (Emmerig, 2004).

Although synchrony of behaviours has been studied in adult dairy cattle, theoretically it can be observed in and used as indicator of positive animal welfare in any other bovine categories.

Self-licking, scratching and other behaviours

Self-licking and scratching have been also proposed as indicators of adequate li-

ving conditions. A reduced expression of these behaviours has been related to slippery floors, thus reflecting poor housing conditions, whereas higher levels of self-grooming may be only observed when an at least sufficient flooring space has been provided to the animals (Winckler *et al.*, 2003).

Animals perform their integumentary care through licking and scratching themselves. Therefore, self-grooming is often associated with negative aspects of farming, such as dirtiness and ectoparasite loading, potentially impairing animal welfare. As a consequence, its use as an indicator of positive welfare may be questionable. Self-grooming has been studied in adult cattle only. However, it can be detected in virtually any bovine category and potentially used as an indicator of positive animal welfare.

Although resting behaviour in general can not be considered as an indicator of positive welfare since it is a basic need of cattle and reduced lying and ruminating times should be rather interpreted as a sign of reduced welfare, other parameters, such as diversity of lying positions, may potentially indicate a well-being state (Wierenga *et al.*, 1985). More comfortable lying postures (sternal recubancy with the head tucked against the flank and lateral recubancy with a higher number of outstretched legs) may be a sign of thermal comfort and/or reduced vigilance and are likely to be assumed only if the animal's confidence in the predictability of its environment is high.

A positive indicator of welfare could also be the quality of the human-animal relationship since it can be hypothesised that a good relation with the stockpeople may provide an additional social bond (i.e. with members of a different species) to the animals. However, these two latter variables (resting behaviour and human-animal relationship) for the sake of brevity will be not examined as they represent central aspects of animal

welfare requiring a specific discussion (for a review see Emmerig, 2004; Waiblinger *et al.*, 2006, respectively).

Qualitative assessment of animal behaviour

A new methodology called "qualitative assessment of animal behaviour" has been developed in pigs, which does not measure what an animal does, rather it describes how a subject interacts with the environment (Wemelsfelder *et al.*, 2001). Recently, this method has been successfully applied also to horses (Napolitano *et al.*, 2008), dairy cattle (Rousing and Wemelsfelder, 2006) and buffaloes (De Rosa *et al.*, 2003). In summarising aspects of an animal's behavioural style the qualitative assessment describes behaviour as an expressive process directly observable in the animals, thus demonstrating the general validity of the method (Wemelsfelder *et al.*, 2001). The method consists of two phases. The first one is a qualitative perceptive phase based on Free Choice Profiling (FCP): a panel of observers (12-14 people) are instructed to focus their attention on "how the animals behave" rather than on quantitative aspects, and generate their own vocabulary by integrating perceived details of behaviour, posture and context into descriptions of an animal's style of behaving, or "body language", using descriptors such as "relaxed", "tense", "frustrated" or "content". Such terms, both positive and negative, have an expressive, emotional connotation and provide information that is directly relevant to animal welfare. During the second phase, the observers watch the animals again and score them on each term of their freely generated vocabulary on a quantitative scale. This methodology allows for further statistical analysis, namely Generalized Procrustes Analysis (GPA), which does not rely on fixed variables while producing dimensions (axes) with positive and

negative ends. The latter can be named on the basis of the attributes generated by the observers. The integrative approach, on which the qualitative assessment of behaviour is based, may facilitate the interpretation of separate behavioural and physiological measurements while providing a useful tool for animal welfare assessment at farm level, with the advantage of being able to evaluate positive aspects of welfare, if detectable.

Although the qualitative assessment method has been studied in adult dairy cattle, theoretically it can be observed in and used as an indicator of positive animal welfare in any other bovine categories.

Research gaps

The indicators to be included in a scheme for on-farm assessment of animal welfare should be valid (meaningful with respect to animal welfare), reliable (reflecting the tendency to give the same results on repeated measurements) and feasible (concerning time and financial requirements).

Although many of the previously reported studies demonstrated the validity of play behaviour, which has been used several times to assess welfare in different farming conditions and animal species (Dannenman *et al.*, 1985; Blackshaw *et al.*, 1997; Jensen *et al.*, 1998; Jensen and Kyhn, 2000), this category of indicators has never been applied to on-farm welfare monitoring. Due to the low incidence (0.2 to 2% of the time budget) of play behaviour (Miller and Byers, 1991; Vila, 1994; Jensen and Kyhn, 2000), researchers are forced to register these activities using the continuous recording technique, which, at the moment, makes this parameter scarcely feasible. As a consequence, almost no data on reliability are either available or easily obtainable. A different situation occurs for social licking, with a low validity observed for this parameter at herd level

and few data available on reliability. Winkler *et al.* (2002) continuously recorded social licking and head resting behaviours in cubicle loose housed dairy cows. These authors observed low reliability as a consequence of high interday variations and a frequency of expression comparable to play (20 to 45 seconds per hour, corresponding to 0.6 – 1.3% of the time budget) in both young and adult cattle, although the distribution in time may be different. No data on both validity and reliability are available for self-grooming.

The willingness to perform behaviours such as feeding and lying in synchrony should be verified through comparative experiments with animals at pasture or in housing systems with low competition as a reference. Such studies should also consent to identify periods of the day allowing feasible and reliable recordings. In addition, data on reliability are also lacking.

Both inter- and intra-observer reliability of qualitative assessment of animal behaviour were studied (Wemelsfelder *et al.*, 2001). The Generalised Procrustes Analysis showed good consensus among the observers with the majority of them falling within the 95% confidence region. The intra-observer reliability was assessed calculating the correlation between the positions of the same individual animals when scored live or on video recorded clips and yielded good coefficients ranging from 0.88 to 0.99. However, these studies were performed at the individual level and more research is needed to assess its applicability on farm. In particular, the use of self generated terms seems not to be feasible as the animals should be observed twice: once to elicit the vocabulary, and the second time for scoring. Studies have been undertaken to assess the reliability of a simplified methodology relying on the use of predetermined scales for the rating animal behavioural expression (Wemelsfelder *et al.*, 2006).

Conclusions

Although certainly valid, the measures of various hormones (opioids, oxytocin, etc.) as indicators of positive welfare appears to be of low feasibility at farm level. Due to the reduced applicability (mainly young animals), low feasibility (time consuming) and lack of research on reliability, play behaviour, albeit of proven validity, does not appear to be suitable for a rapid implementation in a welfare assessment scheme for dairy herds, whereas further studies are needed to evaluate possible applications in calves. In particular, feasibility could increase if research is able to confirm daytime periods (i.e. sunset) of increased expression. Social licking seems to be applicable to a wider range of animal categories but, its validity is questionable. In addition, it seems not to have any day time prevalence, whereas interday variation resulted to be high, thus its detection may be time consuming and scarcely feasible. The confounding factors seem to be

the weak point of self-grooming, as often associated with poor farming conditions.

Although validity and reliability need more studies, behaviour synchrony seems to be a promising positive welfare indicator as the instantaneous scan sampling technique makes this indicator more easily applicable. However, it might be a problem to determine periods for the recording that allow unbiased comparisons between farms and that are feasible for the on-farm assessment.

Currently the qualitative assessment approach appears to be the most promising method as it has proven to be valid, it shows high inter- and intra-observer reliability (at least at individual level), and more studies are being conducted to make it more feasible at farm level.

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