

Play and social behaviour of calves with or without access to their dam and other cows

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Research Reflection

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Abstract

The aim of the study reported in this Research Communication was to compare play behaviour and social interactions of dairy calves either separated from their mother and reared in a calf group (*Artificial*) or with access to their mother and the cow herd (cow-calf contact: *Contact*). *Contact* calves had access to a calf area and also to the cow barn where they could suckle their dam. *Artificial* calves were fed whole milk up to 16 kg per day via an automatic milk feeder and were only kept in the calf area. We observed the animals on 3 d during the first three months of life. *Contact* calves showed solitary play, consisting predominantly of locomotor play, for longer than *Artificial* calves and mainly in the cow barn. This indicates higher welfare in *Contact* calves. In addition, *Artificial* calves hardly experienced any agonistic interaction, while *Contact* calves both initiated and received agonistic interactions, which might contribute to the development of higher social competence.

Under semi-natural conditions calves experience a complex social environment, engaging in social interactions not only with their dam but also with other conspecifics of different ages and sex (Kiley-Worthington and de la Plain, 1983). Today, dairy calves are usually separated from their mother shortly after birth and reared artificially, housed singly or in groups homogeneous with regard to age and sex. Systems allowing calves access not only to peers but also to their dam and other cows (cow-calf contact, CCC) offer a more complex social environment resembling the natural social structure better. The early social environment affects welfare, social behaviour and challenge response both in the short and long-term (Wagner *et al.*, 2012, 2013, 2015; Buchli *et al.*, 2017). However, play as a potential welfare indicator (Held and Spinka, 2011) and social interactions of calves were not investigated in CCC systems so far. Thus, we observed these behaviours in calves reared artificially or with CCC at three times during the first three months of life. We hypothesized that calves with CCC would both show more play behaviour and encounter more social interactions.

Methods

The experiments were conducted in accordance with Good Scientific Practice guidelines and national legislation.

Animals, housing and management

The study was conducted at the Thünen-Institute of Organic Farming, Germany. Two dairy herds of different breeds (Black-and-White German Holstein, GH and German Red Pied, GRP) each with 45–50 cows were kept in two identical cubicle loose housing systems. One calf area per cow herd was placed adjacent to the cow barn. Due to the dynamic group management the total individual space allowance in the calf area ranged from 3.5–16.8 m² per calf (mean ± SD: 6.4 ± 3.2 m²) depending on the actual group size.

Calves were randomly allocated to two rearing groups: *Artificial* ($n = 20$) and CCC (*Contact*, $n = 19$). Cows gave birth in individual calving pens where they stayed together with their calf for less than 1 d (*Artificial*) or for 5 d after calving (*Contact*). Afterwards, calves were moved to the respective calf pen, with deep-littered resting area and a running area, where they were kept until weaning. According to treatment calves had transponder-controlled access either to the cow barn and thus their dam and the cow herd via selection gates (*Contact*) or to the milk feeder (*Artificial*, milk amount increased from 4 up to 16 kg/d/animal). All calves had access to a transponder-controlled concentrate feeder, and to silage, hay and water ad libitum.

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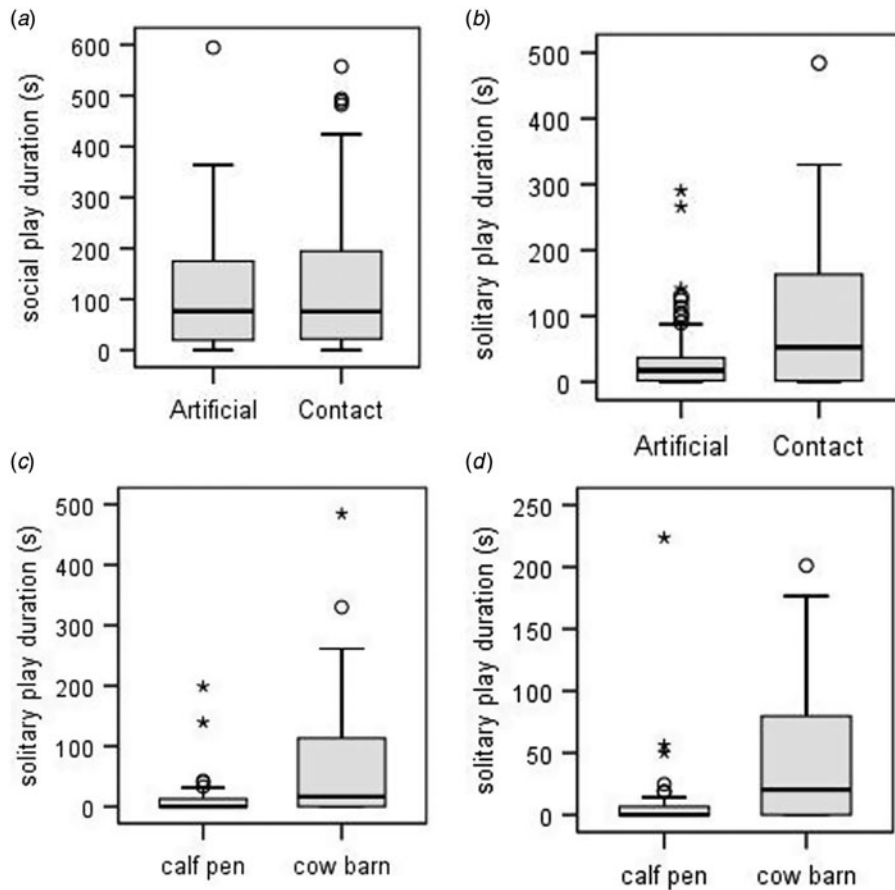


Fig. 1. Duration of social play (a) or solitary play (b) per 4 h observation for artificially reared animals (*Artificial* $n=57$ reduced number of data points due to a loss of observations in one of the 3 d in some animals) or animals with cow contact (*Contact* $n=56$). C and D depict the duration of solitary play for *Contact* animals only, according to location cow barn or calf area either as duration per 4 h observation (c, $n=53$) or as duration per 1 h presence in the respective location (d, $n=45$, reduced number of data points as some animals did not stay in the calf pen at one or several days).

Behavioural observations

Calves were observed at an age of about 30 (25–36), 44 (39–49) and 84 (74–88) days, for 4 h each day (14:00 to 18:00). Observations were performed directly in the cow barn and from video recording in the calf area by continuous focal animal sampling. Duration of play behaviour (object play, locomotor play and social play) and frequency of agonistic social interactions (threats, head butts, avoiding, submission) and affiliative social interactions (social licking, licking solicitation) were recorded as well as initiator and receiver of an interaction.

Statistical analyses

The program R 2.13.2 (R Core Team, 2011) was used for statistical analysis. Play behaviour and affiliative interactions were analysed using generalized linear mixed models with the fixed effects of treatment, day of observation and their interaction, breed, sex and space allowance in the calf area, and calf identity as random effect. To fulfil model assumptions (checked graphically) data were square root transformed. Due to data loss of three *Contact* calves, sample size was reduced to $n=16$. For comparing play according to location (cow barn/calf area) in *Contact* calves, data were calculated per hour to correct for the different duration of presence in the two locations. Agonistic social interactions were rarely observed and thus were dichotomized as ‘observed within the 3 d’, yes or no.

Results

Play behaviour

Contact calves showed longer duration of solitary play than *Artificial* calves ($F=4.561$, $P<0.05$, Fig. 1b) and this solitary play was performed mainly in the cow barn ($F=13.743$, $P<0.001$, Fig. 1c,d). Most of the solitary play was locomotor play (locomotor play in percent of solitary play: median, 25–75 quartile: *Artificial*, 100%, 60–100; *Contact*: 90%, 38–100). There was no difference between treatments regarding social play ($F=0.066$, $P>0.05$). The other variables had no effect on solitary or social play except that GRP showed longer duration of social play than GH ($F=4.533$, $P<0.05$).

Social interactions

Contact calves initiated agonistic interactions more often ($Z=3.473$, $P<0.001$ Fig. 2a) and were receivers of interactions more often ($Z=3.170$, $P<0.01$, Fig. 2b) than *Artificial* calves that were almost never involved in such interactions (in total: only one interaction as initiator and two as receiver). Most of the agonistic interactions (about 75%) received by *Contact* calves were initiated by cows other than the dam (Fig. 2c). The number of affiliative social interactions was not affected by treatment (Fig. 2d).

Discussion

The longer duration of solitary play in calves with CCC is likely caused by more available space. In addition to the calf area,

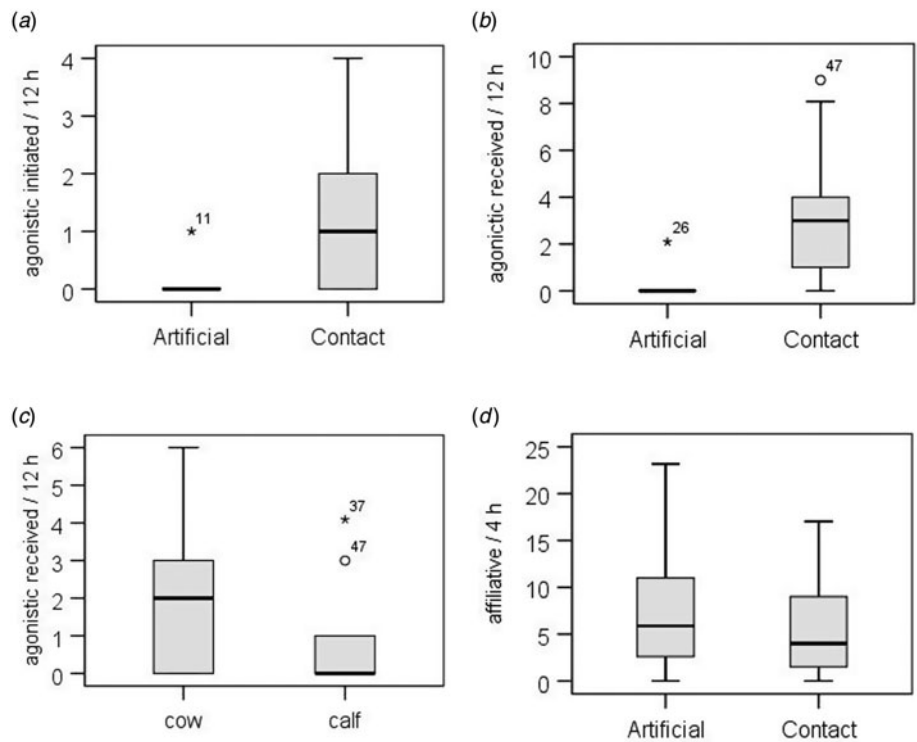


Fig. 2. Frequency of social interactions of artificially reared calves (*Artificial*) and calves with cow contact (*Contact*). Initiated (a) and received (b, c) agonistic interaction are shown per 12 h i.e. the total number observed per animal during the three observations days; affiliative social interactions (d) are shown per 4 h observation. Graph C depicts the number of agonistic interactions with *Contact* calves being receiver depending on whether the actor is a cow or another calf.

Contact calves had free access to the cow barn, where they had much more space and long alleys at their disposal (more than 25×3 m). More space leads to higher level of play behaviour, and calves show more locomotor play (running) in long-shaped/elongated areas compared to quadratic ones with the same supply of space (Jensen *et al.*, 1998; Mintline *et al.*, 2012). In line with this, we observed solitary play mostly in the cow barn. Although the average space allowance in the calf area was large in comparison to legal requirements or earlier studies (e.g. Jensen *et al.* 1998), it seems to have been insufficient to fulfil the *Artificial* calves' need for locomotion. Accordingly, the same *Artificial* calves showed more locomotor play as compared to the *Contact* calves in a test situation, which can be interpreted as a sign of deprived locomotor motivation (Jensen *et al.*, 1997; Wagner *et al.*, 2013). Reduced play indicates impaired welfare of calves due to factors such as social deprivation or pain (Jensen *et al.*, 1997, 1998; Mintline *et al.*, 2013) and play may elicit positive emotions (Held and Spinka, 2011). More solitary play thus indicates higher welfare in *Contact* calves. Long-term beneficial effects of play on mental and physical development are also suggested (Held and Spinka, 2011).

Treatments did not differ with respect to social play, which again is in line with Wagner *et al.* (2013). Calves were available as play partners in both treatments, explaining the lack of a difference as calves primarily play with other calves (Kiley-Worthington and de la Plain, 1983).

As expected, *Contact* calves experienced more agonistic interactions than *Artificial* due to their contact to cows. These early experiences of being in a subordinate position, may be important for development of social competence with both respect to learning of subtle social signals and accepting social rules. Evidence for higher social competence of animals reared with cow contact were found in calves confronted with an unfamiliar cow in a test pen

(Buchli *et al.*, 2017), and in heifers when being integrated into the cow herd (Wagner *et al.*, 2012), where *Contact* animals seem to follow strategies to avoid aggression (keeping more distance from cows, showing more submissive gestures). It would be interesting in future studies to investigate the ability of calves from different rearing experiences to recognize social signals and to accept social rules in more detail by trying to disentangle these two aspects, for instance by testing their ability to recognize different social signals in cognitive discrimination tests. The rare agonistic interactions in *Artificial* calves are in line with previous observations that interactions between calves are mostly non-agonistic up to an age of two months (Bouissou *et al.*, 2001). Because social licking is an important part of maternal behaviour (Bouissou *et al.*, 2001) more received affiliative behaviour in *Contact* calves was expected, but may have taken place at other times of the day.

In conclusion, and based on our findings, we suggest that the common space allowance in group housed calves still does not fulfil their need for locomotor activity. Enhanced level of social experience in a socially and spatially more complex environment may cause higher social competence later in life and potentially higher abilities to cope with social challenges in calves with cow contact.

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