Play behaviour of dairy and beef calves living in a semi-natural environment

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Abstract

The aim of this study was to examine the quantity, space requirements and types of play behaviour of calves living 24/7 on pasture. Observations were made on a daily basis, for 30 days, approx. 5.5 h a day, in 2 different herds. Herd A consisted of 23 beef calves (age 1-2 mo) living together with 80 female adult cows on 70 ha of grassland. Herd B consisted of 18 dairy calves (2 mo of age), living without dams on a 1 ha pasture. In total, 625 elements of locomotor play and 138 of social play were seen. The average number of calves playing was 1.44, the avg. group size (incl. non-playing calves) was 3.79. Running was observed the most often (458 times), followed by head butting (100 times), bucking (81), body butting (76), jumps (64), turns (48) and lastly mounts (17). Jumps had a mean height of 1.26 times withers height, bucks 0.57 and mounts 1.39. The mean running distance was 13.5 m; play fighting required an avg. of 3.50 m2. A high percentage of play involved multiple calves playing together (33.9%). Due to various differences between the two herds, a valid comparison could not be made; however, the impression was that the presence of the dam has a negative effect on the prevalence of play. To be able to perform 75% of the observed play behaviour, calves need more space than they are usually provided in intensive husbandry.

Introduction to housing and play behaviour of calves

In Western Europe, animal welfare has become increasingly more important to both consumers and farmers and as a result of this, the attention to the housing of farm animals has also increased. There has been a substantial amount of reports on the subject of cow housing, including the housing of calves, and in the European Union (EU) this has led to more regulations. For example, every calf in the EU must now have at least 1.5 m^2 of ground surface (*91/629/EEC*, 1991); but, is that enough?

In 1965, the Brambell committee formulated the five freedoms (Brambell, 1965): five conditions that must be met in order to achieve sufficient welfare for an animal. Animals must not only be free of negative factors such as hunger and thirst, pain and disease, but they also must be able to perform their natural behaviour. These five freedoms focus on the absence of negative sensations. More recently, scientists are increasingly considering ways to include positive feelings of animals in welfare assessments (Yeates, Main, 2007). Play behaviour is an important part in the development of young animals. Not only do these social interactions stimulate the release of positive neurochemical signals (Panksepp, 1998), it is also reported that it can improve the immune system and lower stress responses in rodents (Bartolomucci, 2007). There is a positive correlation between the occurrence of play and welfare (Yeates, Main, 2007), suggesting that animals will perform less play if their basic needs are not met. This is for example the case with calves that are being restricted in milk uptake (Krachun et al., 2010) or are individually housed while receiving less milk (Duve et al., 2012).

Spinka et al (2001) stated a number of possible advantages of play: it increases an animal's agility, which can be used to quickly correct balance in case of slipping or falling; it enhances an animal's ability to cope mentally with unexpected situations; also they propose that play leads to a positive emotional

state. Another possible use of play may be for an animal to alter its social status, for example by affirming its dominant status, as is seen in Oryx antilopes (Feuerriegel, 1997).

As to cows, there is no hard evidence that shows the benefits of play for them specific. However, the importance of rearing calves socially has been concluded. Multiple studies showed that paired housing improved the performance of calves, compared to individual housing. The calves that were housed in pens had a higher food intake and gained more weight (Bernal-Regali et al., 2012; De Paula Vieira, Von Keyserlingk & Weary, 2010). Babu et al. (2004) had similar findings and furthermore they concluded that grouped calves learned faster due to socialisation and group activity. These calves, pre-weaned, thus spent more time eating solid feed. Grouped calves displayed less negative responses to weaning as well (De Paula Vieira, Von Keyserlingk & Weary 2010; Chua et al., 2002). There also have been reports of negative effects of grouped housing: Richard et al. (1988) noticed a slightly higher average daily weight gain in individually housed calves. Such findings can be caused by a more competitive environment, such as in Von Keyserlingks et al.'s experiment (Von Keyserlingk, Brusius & Weary 2004), where calves drank significantly smaller amounts of milk whenever less teats were available. Another disadvantage is the higher prevalence of cross-sucking in grouped calves (Babu et al., 2004), but there are various techniques to prevent this unwanted behaviour (De Pasillé, 2001).

Experiments on calf behaviour by Jensen et al. (1999) indicated that socially housed calves are less fearful and more socially confident than the isolated calves. This is in accordance with results from experiments of Broom (Broom, Leaver 1978), Veissier (Veissier et al., 1994) and Duve et al. (2012). The latter found that although singly housed calves had a higher motivation for contact with a human, they struggled more when restrained. Experiments by Veissier et al. (1994) showed that when calves were put in new, mixed groups, calves that were previously housed in crates performed more agonistic behaviour and less non-agonistic behaviour than calves from grouped housing.
In 1997 she also examined the effect of housing on the stress-response of dairy calves. Although the extent of social contact had no influence on cortisol levels in the blood after ACTH stimulation tests and dexamethason suppression tests, the more isolated calves displayed more startled reactions after reactivity tests (i.e. water throws) (Veissier et al. 1997).
Regrouping of heifers or adult cows, can be a stressful experience, leading either to a decrease in milk-yield (Bøe, Færevik 2003, original study by Konggaard, Krohn 1978) or an increase in agonistic behaviour (Kondo, Hurnik 1990). Can socially reared calves have fewer problems with such regroupings or with other stressful events in their adult life? Long term effects of the type of housing for calves have not been studied, but Jensen et al. showed in 1997 that the difference between isolated calves and grouped calves at 3 months of age (isolated calves were more fearful in open-field tests), was gone at 6 months of age, after all calves had been housed similarly in individual stalls. This might indicate that the type of rearing does not have profound long term effects on fearfulness or stress response. Further research is needed to investigate the possible long term benefits of social rearing on the production of cows.

So cows, being herd animals, seem to benefit from social stimuli, at least on the short term; play behaviour in particular has been suggested to be an indicator of good welfare in calves (Stull, Reynolds 2008).
Jensen et al. also examined the effect of space allowance on the amount of play behaviour. 96 calves were housed in groups of four; size of the pen varied between 6 m^2 (1.5 m^2 per calf, the EU-minimum standard) and 16 m^2 (4 m^2 per calf). Calves in the bigger pens performed significantly more locomotor play (galloping, jumping, bucking and turning).The amount of play fighting (head and/or neck butting) was not linked to the size of the pen (Jensen et al, 2000). So especially locomotor play increases when calves are given a bigger housing; but what if calves are given much more space than the 4 m^2 per calf? There has been almost no research on play behaviour in which the calves have access to a multitude of space (e.g. outside in pasture) compared to the amount they have with indoor housing, so that eventually housing can be improved to achieve a higher level of welfare.

The purpose of this study is to examine the quantity, space requirements and type of behavioural elements of play behaviour in calves that are being kept in semi-natural conditions, i.e. a large pasture where they live 24 hours a day. This is the common situation in countries like New Zealand and Uruguay. It should be noted that this study is purely explorative and is meant as an inventory of the display of play behaviour in calves.

Subquestions in this will be:

- What types of play are performed?
- How much space do the calves use during their play?
- How high do the calves jump, buck and mount?
- What is the number of calves participating in play? How big are the groups in which the calves play?
- What is the effect of the presence of mother cows in the herd on the play behaviour of calves?

Materials & Methods

The study took place in June and July 2012 in Uruguay, with cows belonging to the Faculty of Veterinary Medicine of Uruguay. A single person made observations on three herds, during a period of six weeks, for approximately 5.5 hours a day. Observation times varied each day, because of climatic conditions and different day rhythms of the herds, but were mostly between 09:00 and 19:00h. Herd A consisted of 23 Hereford calves, living together with 80 female Hereford adults. At the start of the study, the calves were 1-2 months old. The herd lived on 70 hectares of grassland (approx. 6800m^2 per cow/calf), with some tree areas, providing shade, and received supplementary feeding of grain concentrate on weekdays. There was a drinking place as well.
Herd B consisted of 18 Holstein-Friesian calves and one Kiwi calf (crossbreed between Holstein-Friesian and Jersey). All were around 2 months of age. They were held on a rectangular 1 hectare pasture (approx. 530m^2 per calf), without adult cows. Every day supplementary feeding was available: hay and silage ad libitum and once in every three days a total mixed ration (±30 kg).
Herd C consisted of 26 calves, 3 months old. Of that 26, there were 15 Holstein-Friesian calves, three Jersey's and eight Kiwi's. They were situated on a rectangular pasture of 4 hectare (approx. 1540m^2 per calf), received ad libitum hay and once every three days a total mixed ration (±50 kg).
The observations were made visually, without any tools or shelter, with an estimated distance of 5 – 250m between observer and calf. No distinction could be made between the individual calves of a herd; consequently, it was never noted which individual calf performed a behavioural element.
All play behavioural elements were classified as being a jump, buck, turn, run, head butt, body butt or mount. An ethogram can be seen on the next page (table 1). For every jump, buck and mount the height was estimated, expressed in relation to the height of the withers. The distance of runs was estimated and for head butting and body butting the used surface was estimated.
Because of the age difference with the other calves herd C was observed solely to collect data regarding the height of mounts and not for any other parameter. Furthermore, in herd A, a distinction was made between play performed while the herd was on the move and while the herd was stationary. Herd B, living on a smaller pasture and in the absence of adult cows, scarcely showed herd movements.
Finally, the number of calves participating in play at a certain moment was noted, as well as the group size in which the play occurred, including non-playing calves.

An example of the description of an observation : 2 out of 5 calves were head butting, using 2 by 3 m^2 while the herd was stationary; or: 1 out of 2 calves performed a buck, his highest point reaching up to 1.3 times its withers height, while the herd was on the move.

Because no distinction between individual calves of a herd was made, the two groups of calves (i.e. herd A and herd B) are the experimental units. Statistical analysis is thus descriptive and applies to groups of calves, not to individual calves. Therefore, it is unknown whether or not certain calves contributed disproportionately to the amount of play behaviour in a group.

All statistical analysis was performed with SPSS version 20, except for the two-tailed Fisher's exact probability test, which was done with the online calculator of Vassar Stats (www.vassarstats.net).
An independent 2-sample t-test (α= 0.05) was used for the comparison of means between two groups, for example herd A vs. herd B, moving herd vs. stationary herd, social play vs. locomotor play or head butting vs. body butting. If Levene's test proved the variances to be too different, the Welch-Satterthwaite method was used. Pearson's product –moment correlation coefficients were calculated (α= 0.01).

Locomotor play	Jump	The two front legs are lifted from the ground and the anterior part of the body is elevated; the hind legs may as well be lifted.
	Buck	The animal lowers the head and simultaneously lifts both hind hoofs, optionally followed by a kick in a posterior direction.
	Turn	The animal makes a sudden rotation in the horizontal plane, of 45 – 90° to the left or right. Every 45-90° beyond 90° is counted as a new turn.
	Run	All gaits faster than walking: both galloping and trotting. Gallop is a fast four-beat gait. With the right foreleg as the leading leg, the sequence of hoof beats is left hind, right hind, left fore and right fore followed by a phase of suspension in air. Trot is a two beat gait with leg movements synchronised diagonally. The sequence of hoof beats is left hind together with right fore, followed by right hind and left fore.
Social play	Head butt	Type of *play fighting* in which two animals are butting each other's head with their own head, *in a playful manner*, i.e.: - the behaviour is not accompanied by displays of dominance, such as "stare's" or "head swings". - there is no flight/ withdrawal of the "losing" animal. - there is no apparent cause for fighting, such as a limited amount of food/water/space that both animals seem to want.
	Body butt	Type of *play fighting* in which one animal is butting the neck or body of another animal with its head, in a playful manner (*see head butt*).
	Mount	An animal mounts another animal's body or head from side, back or front.

Table 1: The ethogram describing play behavioural elements of calves. Parts of Jensen et al.´s ethograms are used (Jensen et al., 1998, 2000).

Photo 1: cows and calves of herd A at the drinking place.

Photo 2: three calves of herd A observing the observer, while the adult cows feed on grain concentrate.

Results

During 30-day of observation period, 819 play behavioural elements were seen, of which 625 were locomotor play and 194 were social play. Frequencies of locomotor play and social play in both herds separately can be seen in table 2. Fisher's exact probability test proved the differences between herd A and B to be significant (p= 0.0002); the calves in Herd B were relatively more often engaged in social play than the calves in Herd A.

	Herd A	Herd B	Total
Locomotor play	**217**	**409**	625
Social play	**39**	**154**	194
Total play events	256	563	

Table 2: Frequencies of locomotor play and social play in herd A and B. The difference is significant (p= 0.0002, two-tailed Fisher's exact probability test).

Of all 819 observations, the average amount of calves performing the play behaviour was 1.44; the average group size was 3.79. In herd A, the herd with the adult cows and the most space, playing occurred 159 times while the herd was moving and 97 times while the herd was stationary. 74.6% of the locomotor play took place in a moving herd; 92.3% of social play was performed in a stationary herd (figure 1). The exact frequencies of locomotor play and social play while herd A was either moving or stationary are seen in table 3. The different distribution of locomotor and social play in a moving or stationary herd is significant (p> 0.0001, Fisher's exact probability test). Calves engaged in social play relatively more often when the herd was stationary herd than when the herd was moving.

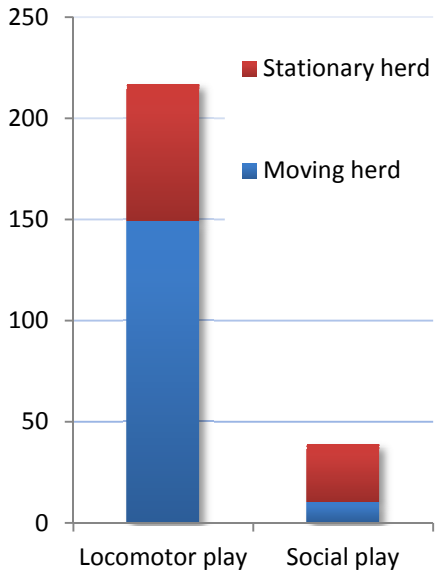

Figure 1: Number of observations made of social and locomotor play in herd A, while herd was moving or stationary. 74.6% of locomotor play took place in a moving herd; 92.3% of social play was performed in a stationary herd.

	Locomotor play	Social play	Total
Moving herd	**149**	**10**	159
Stationary herd	**68**	**29**	97
Total	217	39	

Table 3: Frequencies of locomotor play and social play in herd A, while that herd was on the move or stationary. The difference is significant (p> 0.0001, Fisher's exact probability test).

In 15 days an average of 30.32 play elements per calf were seen in B and 10.22 in A. In both herds together the most frequently seen play behaviour was running, 458 times, followed by head butting, 100 times. 81 bucks were seen, 76 body buts, 64 jumps, 48 turns and 17 mounts (figure 2).

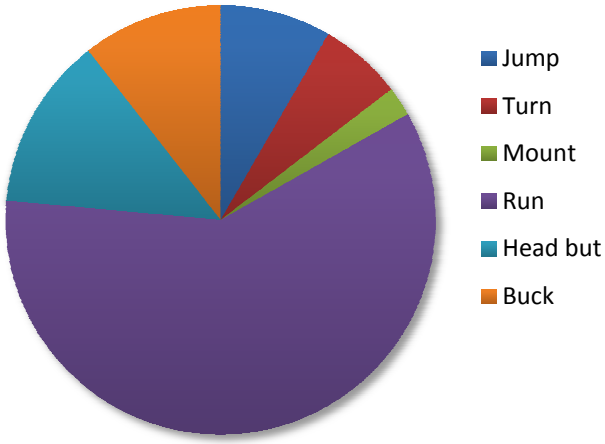

Figure 2: Relative frequencies of the different types of play behaviour in both herds together. Running was observed the most often (458 times), followed by head butting (100 times), bucking (81), body butting (76), jumps (64), turns (48) and lastly mounts (17).

Jump

Of all 64 jumps the average height was 1.26 times withers height with a standard deviation of 0.06. The majority of jumps was made while the herd was not on the move: 56, while 8 jumps were seen in a moving herd.
The median jump height was 1.25 (times withers height). The highest jump was 1.4. On average jumping was observed 2.84 times per calf (in 15 days) in herd B, versus 0.43 times per calf in herd A. There was no significant difference between the herds in jumping height (p=0.112).

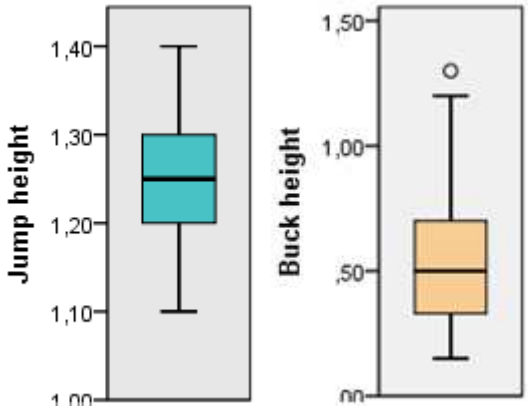

Figure 3: Left: Boxplot of jump height of both herds together. The average jump was 1.26 times withers height, the median 1.25. Right: boxplot of buck heights of both herds together. The average buck was 0.57 times withers height, the median 0.50.

Buck

The 81 bucks had an average height of 0.57 times withers height with a standard deviation of 0.28. The median buck height was 0.50. The highest buck was 1.3; the lowest 0.15. 21 bucks were seen in a moving herd and 61 in a stationary herd. Herd A showed on average 1.22 bucks per calf in 15 days; herd B 2.79. Herd A had an average buck height of 0.49, in herd B this was 0.61. This difference proved to be significant (p= 0.049).

Turn

A total of 48 turns were seen. A calf in herd B performed 16 turns consecutively by turning around in several circles. In 15 observing days, herd B showed an average of 2.00 turns per calf versus 0.43 per calf in herd A. In herd A 7 turns were seen while the herd was on the move; 3 turns were observed in a stationary herd.

Run

As mentioned before, 458 runs were observed, with an average running distance of 13.5 meters. With a standard deviation of 15.9, there was a great variation in distance. The longest observed runs were 150 m, both seen in herd A. The maximum distance in herd B was 80 m. Herd A had a mean running distance of 17.6 m, while in herd B this was 11.3 m. This difference is significant (p=0.000). In herd A 123 runs were made while the herd was moving; 48 runs were made while the herd was stationary; there is no significant difference between the average running distances of these two situations (p= 0.622). There was no correlation between the number of calves running and the running distance (Pearson's test r= 0.182, p= 0.000, n= 458)

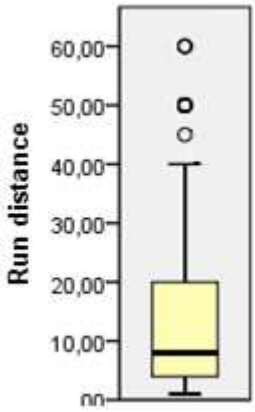

Figure 4: Boxplots of running distance of both herds together. The mean running distance was 13.5 meters, the median was 8 meters.

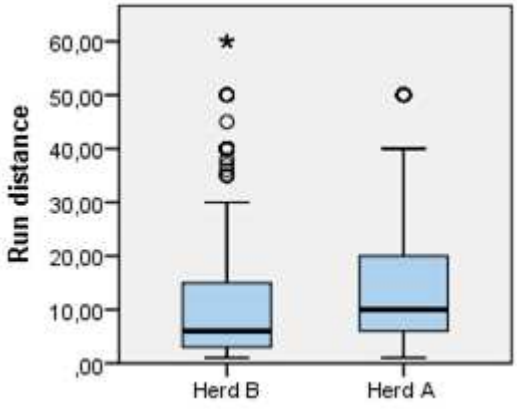

Figure 5: Boxplots of running distance in the different herds. The mean running distance was 17.6 m for herd A and 11.3 m for herd B (significant difference). The median distance in herd A was 10.0 m and for herd B this was 8.0 m. The longest runs were 150 m, both seen in herd A.

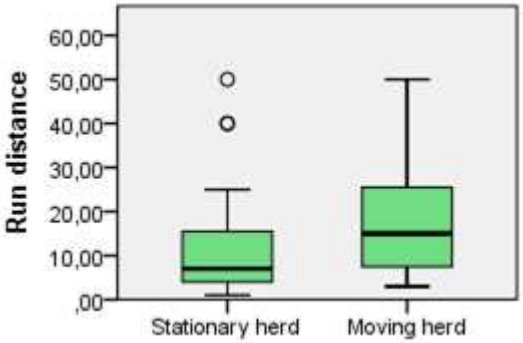

Figure 6: Boxplots of running distance in herd A. Run distance was not longer when the herd was on the move.

Head and body butt

A total of 176 head and body butts was seen, of which 80.8% were head butts and 19.2% body butts. An average 3.50 m^2 was used, with a standard deviation of 3.49. Head butting calves used 3.8 m^2 and body butting 3.0 m^2 (not significant). The duration for head butting was on average 9.55 s vs. 3.28 s for body butting (p= 0.001). Almost all play fighting in herd A happened in a stationary herd (98,6%). As with all so far mentioned play behaviour types, the

majority of play fight took place in herd B (on avg. 13.37 play fights per calf vs. 6.43 calf in herd A, over 15 days).
Body butting required less space than head butting: 3.0 m^2 vs. 3.8 m^2; this was not significant however (p= 0.240).

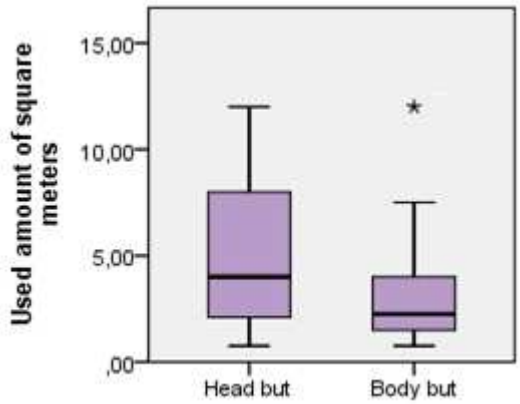

Figure 7: Boxplots of the amount of square meters used by the calves, while head butting and body butting. The average for head butting was 3.8 m^2, for body butting it was 3.0 m^2; this difference proved not to be significant. The medians were 2.5 m^2 and 2.2 m^2 respectively.

Mount

Because herd A and B did not provide many observations of mounting (17), herd C was included to analyse the mounting height. This resulted in 34 mounting observations, with a mean mounting height of 1.39 times withers height. The standard deviation of this was 0.15; the highest mount seen was 1.6 times withers height.

Number of calves performing play

As mentioned above, when there was play, the average amount of calves participating therein was 1.44, with a standard deviation of 0.80. The mean differed significantly between locomotor play, 1.39 calves, and social play, 1.61 calves (p= 0.000). There was no difference between herd A and herd B (p= 0.305). Head butting had the highest average amount of calves performing the play behaviour per observation (1.83) followed by running (1.5) and body butting (1.38). For turns this was 1.21, for jumps 1.13, for mounts 1.09 and for bucks 1.06. The difference between head and body butting was significant (p= 0.000).

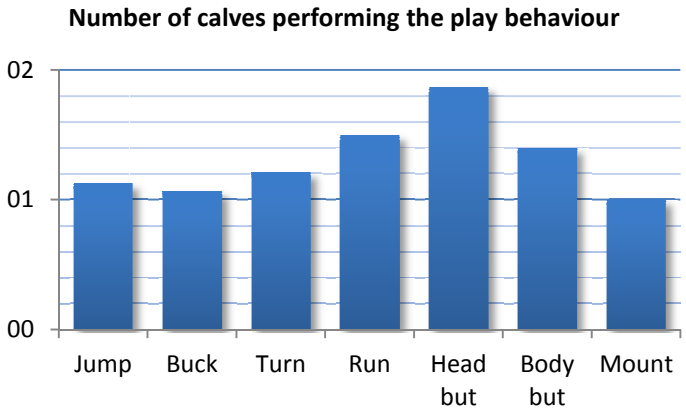

Figure 8: Graph showing the number of calves participating in the play, for each type of play (data of both herds combined). As can be seen, head butting had the highest average, with 1.83, followed by running (1.5) and body butting (1.38). For turns this was 1.21, for jumps 1.13, for mounts 1.09 and for bucks 1.06. The difference between head and body butting was significant (p= 0.000).

Groupsize

The mean groupsize was 3.79 calves, with a standard deviation of 3.53. Just like in the amount of playing calves, there was a difference between locomotor play, 3.41, and social play, 5.20 (p= 0.000). The same is true for the even bigger difference between herds A (1.88) and B (4.68).
The play behaviours with the highest mean group size were mounting (6.33), head butting (5.43), body butting (4.60) and turning (4.50). For running it was 3.40, for bucking 3.32 and for jumping 3.22 (see figure 9).

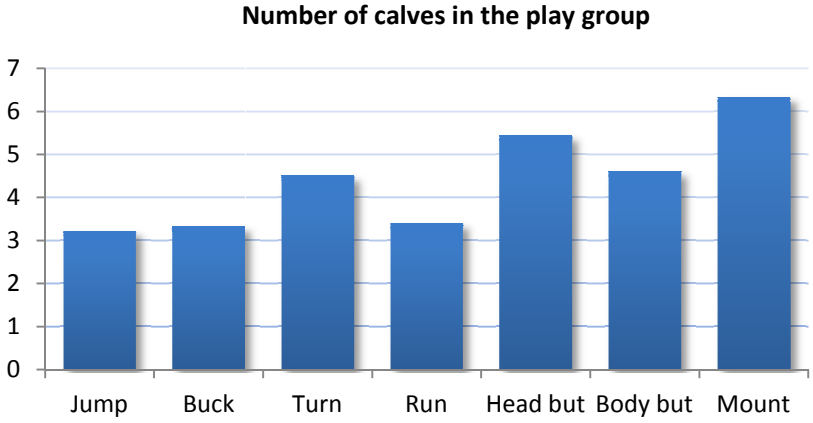

Figure 9: Graph showing the group sizes for every play type (data of both herds combined). The groups were the largest when mounting was observed (6.33), head butting (5.43), body butting (4.60) and turning (4.50). For running it was 3.40, for bucking 3.32 and for jumping 3.22.

Discussion

Behavioural research is never easy interpretable. We cannot be sure what motivations lie beneath the observed behavioural elements. This is for example the case with the runs in a moving herd. While the cows walk to keep up with the herd, the calves sometimes make runs and have frequently been seen to stop running when they reached their "destination" (such as their mother). This means that part of their motivation to run was simply to get from one place to another; but if that was the only motivation, they could have walked, like the cows. Furthermore, their runs were more than once accompanied by other locomotor play elements, like jumps, bucks or turns. Wood-Gush et al. (1991) noted that novelty and exploration elicit play behaviour in piglets. In Jensen et al.´s study the peak of play was when new straw and feeding were offered to the calves (Jensen et al., 1998). So if novel, safe events or objects can induce play, it seems likely that a herd that starts to move is able to elicit play as well. Still we cannot know exactly what proportion of the total motivation to run eventually is play motivation and how much is caused by the will to be at the "destination".
Something that should not be forgotten as well, is the mention of Bekoff and Byers in 1992 (Bekoff, Byers 1992), that the frequency of a certain behavioural element is not necessarily proportionally linked to the importance.

Besides some of the above mentioned difficulties that can be encountered in behavioural studies in general, the present study also had a number of specific limitations. Estimating heights and distances with the naked eye is a less accurate measuring method than using GPS or multiple cameras (from different angles), so especially the bigger distances are rough estimates. Observation times varied slightly each day, because of climatic conditions and because of a different distribution of play during the day in herd A and B.

The locations were chosen because of the "semi-natural" environment. Herd A roamed freely across a big pasture, where the cows ate grass and drank water from a natural pool. They had no enemies, which may lead to a distribution of the herd in the field that is different from that of a herd living in real natural circumstances. The provision of fresh food created excitement; this led in both herds to more play. Almost every day herd B even showed a wave of play around 18h: the time at which they used to receive a bucket of milk when they were younger. Next to their field, calves younger than 1 month were being held and they received milk at 18h as well; this led to excitement there, which was noticed every day by several calves from herd B. These calves were not the ones to start the playing, however. Still, the playing wave in herd B can be explained by both the memory of receiving milk at 18h or by the excitement of the younger calves in the adjacent field.

Photo 3: part of herd B feeding on silage in the afternoon.

Types of play

There was significantly more locomotor play than social play, overall and in both herds separately. Running was a large part of the locomotor play. The present study showed that social play takes place mostly in a stationary herd, while locomotor play takes place more often in a moving herd. It seems logical that it is a smaller step for a calf to start running when he is already walking towards a destination, than when it does not need to go anywhere. Social play requires close contact to at least one calf (exceptions were seen in herd A when there was social play between calves and cows), so this is the most easily initiated when other calves are standing still, instead of moving.

Jensen et al. found that locomotor play was limited by a decrease in space (Jensen, Vestergaard & Krohn 1998). In their study, where calves had 1.5 to 4 m^2, there was 4 times more play fighting than locomotor play. In the present study, with more available space per calf, there was 1.6 times more locomotor play than play fighting. This result might suggest that the extra space led to more locomotor play. Due to the limitation of having only one observer in the current study, no absolute frequencies for play could be made, because it was not possible to observe for 24 consecutive hours. Also, no durations could be recorded when several calves started playing just after each other. So we cannot be sure whether or not the amount of locomotor play was increased by the extra space, but the relative frequencies seem to point in that direction.

The frequencies of running, head butting, bucking, body butting, jumping, turning and mounting are mentioned in the results. Mounting was seen more in the older calves (herd C).

Amount of space used during play

Running

Herd A showed the longest runs and a longer average run; even though the size of the pasture was only one of the differences between A and B, this still suggest that more space means longer runs. In other words, a smaller pasture or pen restricts a calf in the length of its runs.

The average running distance of both herds together was 13.5 meters, but there was a great variation: distances were from 1 to 150 m. However, 75% of the observations concerned distances of less than 20 m. When calves are housed in groups of 4, with the EU minimum requirement of 1.5 m^2 per calf in a pen of 2 x 3 m, they can only perform approximately 28% of the 458 observed runs they made in the semi-natural conditions of this study, and only if they run diagonally. Even with groups of 10 calves, where the pen could be 3 x 5 m, the diagonal will only be 5.8 m, allowing around 40% of the 458 observed runs (of course, if the calves run in a meandering pattern, they can make longer runs). Although the fact that the calves in this study made such long runs does not mean that it will necessarily decrease their welfare if they cannot run these distances, the EU minimum will often be insufficient concerning run play. To allow the calves to make 75% of the runs they do in a surplus of space, the diagonal of their pen should be at least 20 m.

Play fight

Play fighting, especially head butting, was a large proportion of the observed play. As mentioned, there was an insignificant difference between the amount of space used for head butting and for body butting (3.8 m^2 vs. 3.0 m^2). This might inter alia be explained by the longer duration of head butting (average 9.55 s vs. 3.28 for body butting). With a free space of 4.0 m^2 calves can perform 75% of play fighting observed in this study, without being interrupted by the boundaries of their pen.

Height

Jumps had an average height of 1.26 times withers height, with a maximum of 1.4. The mean mounting height was 1.39 times withers height, with a maximum of 1.6. Bucks had an average height of 0.57 times withers height, with a maximum of 1.5. In the author's opinion, calves should be able to perform a 100% of the observed jumps, bucks and mounts in order to meet the fifth freedoms of Brambell (Brambell 1965). This means that the height of the housing should not be less than 2 times withers height (there can be some lower areas), so that there is some space above the highest point of the calf while it performs these types of play. This is especially important in mounting and jumping, because in those cases the head is the highest point.

Play groups

Whenever there was play, on average 1.44 calves were participating therein. The mean group size in which the play occurred, including non-playing calves,

was 3.79. If the exact locations of the calves are known, the number and sizes of groups in which the calves stand can be calculated. In the current study group size had to be estimated and as can be seen in figure 10, calf formations can be deceiving for the observer. Size of the pasture too can influence the observer's estimates (figure 11).

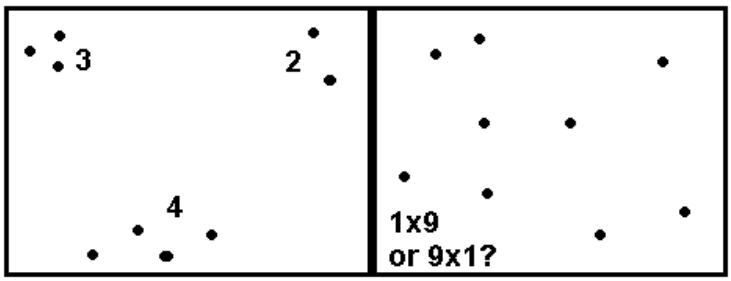

Figure 10: Schematic aerial views of calf positions. On the left one might count 3 groups and on the right 1 group, while the number of calves, the area they occupy and the total distance between all calves is equal.

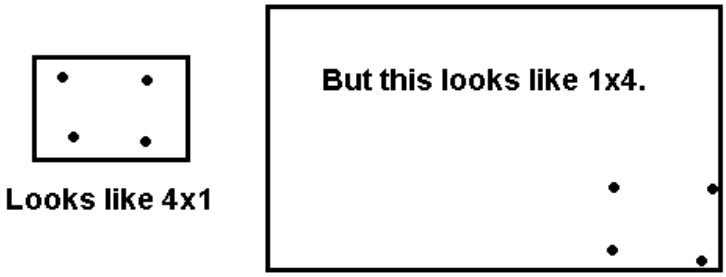

Figure 11: Schematic aerial views of calf positions. As seen here, also the size of the pasture can influence the impression of the amount and size of groups. The calves on the left seem to stand apart from each other, in 4 groups, while the calves on the right stand in the exact same position and appear to be standing in 1 group.

In herd A, where there was a lot of space, 80 cows and only 23 calves, the calves were more widespread than in herd B. The chance that two calves randomly meet each other here is not big; the average group contained 1.88 calves. In herd B, where there were no adult cows and less space, the average group size was 4.68. This does not mean that the calves preferred these group sizes: external factors play a big role in this.
The overall mean group size of 3.79 seems to imply that around 4 calves may be a good group size for the housing of calves, concerning play; but the playmates could be different calves every time. Compared to locomotor play, social play both had a larger amount of calves playing as a bigger group size. An explanation can be found in the fact that social play requires at least two calves (or as was rarely seen: one calf and one cow), whereas locomotor play can be performed solo.

Jensen et al. found that play was more synchronised in bigger pens (Jensen, Kyhn 2000). Two or more calves played simultaneously in 6.3 % (1.5 m^2 per calf) to 12.4% (4 m^2 per calf) of the times that at least one calf played. In the current study, 33.9% of observations included more than one playing calf, suggesting

that a surplus of space indeed increases the percentage of simultaneous playing (Note: group size in Jensen's study was only 4, where in the present study it was 19-23. Various other aspects of the design of both studies differed as well.) However, in herd B the percentage of play involving more than one calf was 38.2 and in herd A, which had much more space, it was 24.4%. So the amount of available space cannot be the only factor influencing this; but because between herd A and herd B there was a substantial amount of differences (age, breeds, sex ratio, size of the pasture, feeding protocols, weather circumstances, observation hours and off course the presence of adult cows) it is impossible to obtain certainty about the cause(s) of the different results of the two herds.

Photo 4: three calves from herd C lying together.

Presence of the dam

Herd B (only calves) showed much more play behaviour than herd A (calves and dams). Because of reasons mentioned in the paragraph above, this cannot be ascribed solely to the presence or absence of dams. The observer nevertheless had the impression that it certainly played a considerable part. Duve et al. saw more play in calves without dam, although the difference was not significant (Duve et al. 2012). Interactions with the dam, such as described by Von Keyserlingk and Weary (von Keyserlingk, Weary 2007), rarely include play. In herd A, of the 258 observations of play behaviour by calves, only 6 were between calf and dam. The absence of the dam leads to an increase in contact with other calves (Veissier, Le Neindre 1989). Calves in this study were often seen to 'tempt' other calves to play (walking/running towards or around them, sometimes butting them). So play between dam and calf is relatively rare, the absence of dams stimulates contact with other calves and other calves play with each other and stimulate each other to play. Considering all this, it seems likely that the presence of the dam has a negative effect on the amount of play behaviour by the calves. In future welfare assessments, where play might be

used as an indicator of positive welfare (Yeates, Main 2008), this should be taken into account, meaning that possibly two standards should be used: one for calves with dams and one for calves without.

In summary, the types of play that were performed are running (observed 458 times), head butting (100 times), bucking (81), body butting (76), jumping (64), turns (48) and mounting (17). Calves used on average 13.5 m for running, with a Q3 of 20 m. Play fighting took 3.50 m^2; the Q3 was 4.0 m^2. The mean jump was 1.26 times withers height with a maximum of 1.4; the mean buck 0.57 times withers height, the maximum was 1.5; and the mean mount 1.39 times withers height with a maximum of 1.6.
On average, 1.44 calves were participating in play together. The mean group size in which play occurred, including the non-playing calves, was 3.79.
The group with the dam present had a lower prevalence of play in the present, descriptive study, that included only one group with and one group without a dam. In the present study, with ample space available, calves used more space for 75% of the observed play behaviour than they are usually provided with in intensive husbandry.

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Photo 5: four calves from herd A walking in line. Note the difference in size, caused by some variation in age.

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