

# **Investigating cow-calf contact in cow-driven systems: Behaviour of the dairy cow and calf**

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## **SUPPLEMENTARY FILE**

### **Animals, Material and Methods**

This observational study took place at The Livestock Production Research Centre at the Norwegian University of Life Sciences NMBU from Nov 2019 to Mar 2020. The dairy herd consisted of two main compartments with each their AMS and 60 lactating cows. In the experimental compartment, up to 3 non-experimental cows were present in the cow area at any given time during the trial. In addition to the experimental cows, 57 non-experimental cows used the AMS, but were housed in a different compartment.

### **The suckling phase**

The cow-calf pairs were moved from the maternity pen to the compartment in S Fig 2 after a minimum of 3 d, but not during the weekends. The calf lying area was partially roofed, had two heat lamps, and the floor had rubber mats with saw-dust. Slatted rubber mats (art. No 89752205, DeLaval) were used to minimise the slot openings in the meeting area and the calf creep.

### **Collection of data**

#### ***Cow eating and resting behaviour***

Nedap accelerometer and neck collar activity sensors have been validated for detecting behavioural changes in dairy cattle (e.g Van Erp-Van der Kooij et al 2016).

## 25    **Supplemental Figures**

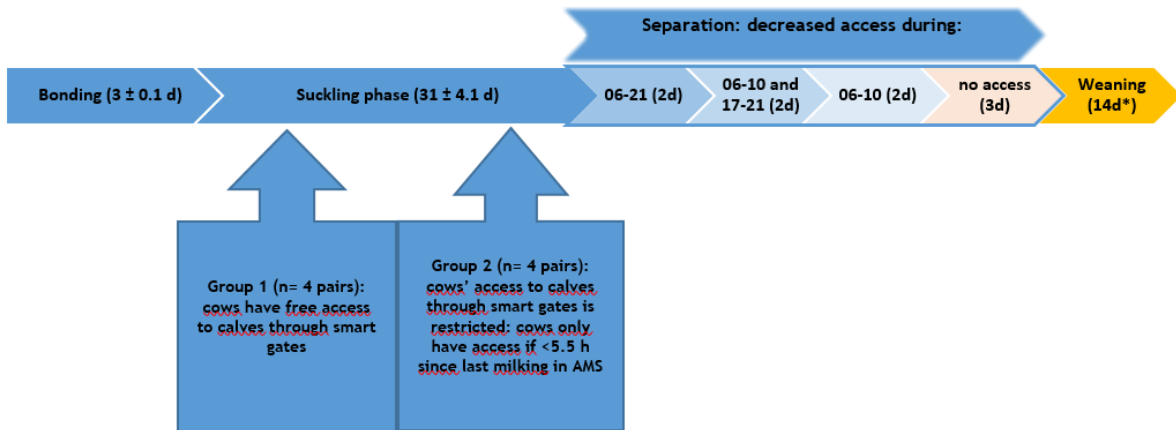
26    Supplementary Figure S1. Schematic drawing showing how the contact between the cow and her calf  
27    varied through the phases bonding, suckling, separation and weaning. \* The study period included the  
28    phases bonding, suckling and separation.

29    Supplementary Figure S2. Schematic drawing of the compartment of the cow-barn where cows could  
30    access their calves in the meeting area through a smart gate (→) and exit through another smart gate  
31    (←). In the cow area, cows had access to feed, cubicles and an AMS (1) and a concentrate feeder (2).  
32    Calves only had access to the meeting area and the calf creep in which supplemental milk and  
33    concentrate was accessible at *ad libitum* through an automatic milk feeder (3) and a concentrate feeder  
34    (4) respectively, and a lying area (5). Cows were prevented access to the calf creep by mean of two  
35    open entrances large enough for a calf to pass but not a cow. All cows were trained in using the smart  
36    gates during the first day of the suckling phase.

37    Supplementary Figure S3. Picture from the video monitoring system showing a cow-calf pair in the  
38    meeting area. (Photo: Anna Vøien Aaby)

39    Supplementary Figure S4. Mean daily duration of the behaviours suckling and allogrooming of 8 cow-  
40    calf pairs housed in a cow-driven cow-calf contact system using smart gates to allow the cow to visit  
41    the calf. Cows had free (group 1, n= 4 pairs) or restricted access to the calves based on previous  
42    activity in the automatic milking system (group 2, n= 4 pairs). The pairs were observed from 06.00 h  
43    to 21.00 h for two consecutive days (calf age 14 and 15 d)

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46 Supplemental figure 1

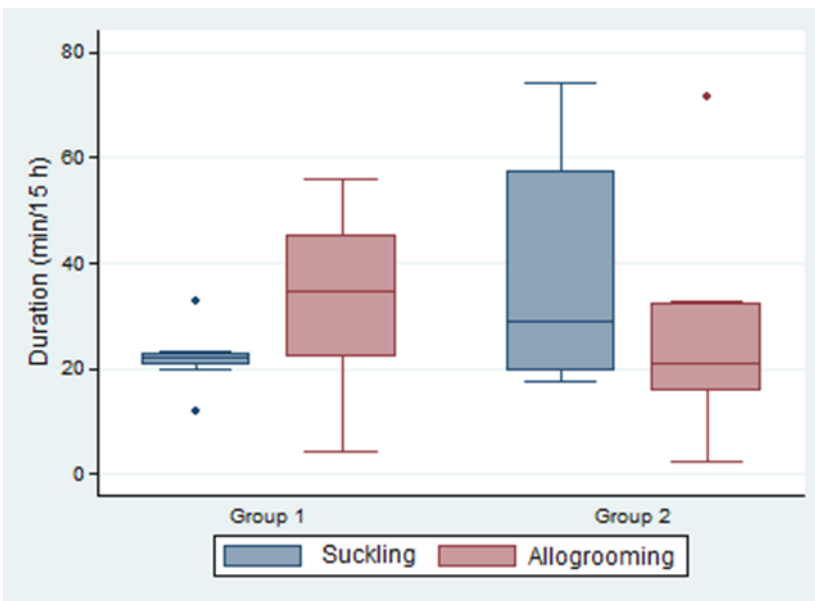


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48 Supplemental figure 2



**Supplemental figure 3**



**Supplemental figure 4**

## Supplemental Tables

Supplemental table 1 Definitions of behaviours recorded for cows and calf in a cow-driven cow-calf contact system.

<b>Behaviour<sup>1</sup></b>	<b>Definition</b>	<b>Observation method</b>	<b>Observed when</b>	<b>Observed for</b>
<b>Low pitched vocalization</b>	Single close mouthed `mmm` type vocalization with inhalation between two occurrences	continuous direct observation	2d during the suckling phase (baseline) and 2 first d of 0 cow access (separation)	cow and calf
<b>High pitched vocalization</b>	Single open mouthed “muuh” vocalization with inhalation between two occurrences			
<b>Suckling</b>	Calf is standing in a suckling position (with head directed ventrally). A new event was recorded if suckling was interrupted for more than 3 sec	behaviour encoded from video 06-21	calf age d 14 and 15	cow-calf pair
<b>Allogrooming</b>	Initiating or receiving licking (tongue touches cow/calf)/sniffing (nose < 5 cm from cow/calf air is pulled through nose) or rubbing (nose or other body part touches any other body part). A new event was recorded if allogrooming was interrupted for more than 3 sec			
<b>Cross- suckling</b>	Cow is standing in nursing position with other calf than own calf, or calf is standing in nursing position with other cow than own dam			

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62   **References**

63   **Van Erp-Van der Kooij E, Van de Brug M and Roelofs HAS JB 2016** Validation of Nedap

64   Smarttag Leg and Neck to assess behavioural activity level in dairy cattle. *Conference Proceedings:*

65   *Precision dairy farming. Editors Kamphuis C and Steeneveld W*

66   **Johnsen JF, de Passille AM, Mejdell CM, Bøe KE, Grøndahl AM, Beaver A, Rushen J, Weary**

67   **DM 2015** The effect of nursing on the cow–calf bond. 2015. *Applied Animal Behaviour Science*.

68