Supplementary material

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Section 1 Information on foster group composition and housing

Table S1. Foster groups. For each calf, fostering date (in, day/month) and leaving date (out) are indicated. If no leaving date is indicated, the calf left the group after the last test of the last experimental calf in the group, i.e. when the foster group was not involved in the experiment anymore. The cows' own calves were never involved in the experiment, and some cows did not have their own calf with them. Fostering and leaving date in italics indicate non-experimental foster calves. OBS calves (dates marked in bold) could witness gentle interactions of a person with their foster cow. PRES calves only experienced the person's presence and talking.

Cow	**Year**	**Own calf**		**Foster calf 1**		**Foster calf 2**		**Foster calf 3**		**Foster calf 4**		**Foster calf 5**		**Foster calf 6**	
		In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
4542	2022	17/08[2]	08/09	17/08	08/09	**04/09**	**26/09**	**06/09**	**26/09**	-	-	-	-	-	-
9394	2022	-	-	**25/08**	**-**	01/09	-	06/09	-	-	-	-	-	-	-
5744	2022	10/09	-	11/09	-	**23/09**[3]	**-**			-	-	-	-	-	-
4956	2022	12/10	24/10	**14/10**[2]	**07/11**	24/10	-	**25/10**	**-**	-	-	-	-	-	-
1598	2022	12/10	-	16/10	**-**	**20/10**	**-**								
9547	2022	28/10[1]	-	25/10	**-**	**26/10**[2]	**-**	**26/10**	-	-	-	-	-	-	-
0390	2023	-	-	**12/07**	**26/08**	*31/07*	*13/09*	31/07	-	-	-	-	-	-	-
9538	2023	31/07	31/08	**02/08**	**28/08**	20/08	12/09	**28/08**	**25/09**	**31/08**	**25/09**	*29/09*	*05/10*	07/10	-
1594	2023	11/09	26/09	11/09	05/10	**28/09**	**-**	**29/09**	**-**	05/10	-	-	-	-	-
0187	2023	13/09	25/09	**14/09**	**06/10**	15/09	23/10	**21/09**	**10/10**	29/09	31/10	**15/10**	**-**	-	-

[1] Six cows gave birth on the same day, so two new foster groups were established, cow 9547 being one of the foster cows. Each foster cow's own calf was cross-fostered to the other one. Two days after calving, the foster group of the second cow was dissolved due to the cow's health issues, and cow 9547's own calf was moved back to her.

[2] Received suckling assistance by the farmer once.

[3] Received suckling assistance by the farmer twice

Figure S1. Pens for foster cows with calves.
For interacting with the cows, the person stood at the corner of the trough (A, two pens) or in front of the gate (B, C).

Section 2 Behaviors of the calves during the approach test

Twelve calves witnessed gentle interactions including stroking, feeding and gentle talking between their foster cow and the handler. 14 calves only witnessed the presence of the handler and gentle talking. At three weeks of age, all calves were tested in an approach test consisting of a habituation phase, in which the calf was alone in the testing area, and a test phase, in which the handler was standing in a corner of the test pen.

Table S2. Ethogram for video observation of the approach test, modified after Boissy and Dumont (2002) and Lürzel et al. (2015b). Elimination is coded as number of occurrences, all other behaviors are coded as durations.

Behavior	Description
Elimination	The calf assumes the body posture typical for elimination, i.e. hind legs positioned more cranially and apart, arched back, lifted tail. It may be possible to see the excretion of urine or feces.
Escape attempt	The calf walks or runs towards the fence and, in one single movement, puts the head between the bars until establishing physical contact with the chest or the dorsal neck/withers and pushes against the fence. The escape attempt is counted from the moment the calf pushes against the bar, and stops when the calf is not in contact with the fence anymore.
Tail flicking	The calf moves its tail to the side, sometimes with an upward motion. A bout starts with the first active movement and ends when the tail hangs down loosely or is motionless for at least 1 s.
Vigilance	The calf is standing still, and the head is held at or above the height of the withers and the ears are directed forwards. Adjustments of the head direction do not interrupt the behavior.
Exploring	The calf's muzzle is within one muzzle length from and directed toward the floor, the fence or wall or towards an item outside of the fence. If the muzzle is farther away from the item for < 3 s but close again afterwards (often to another item or another place on the floor), the behavior is not recorded as interrupted. If the calf is showing the vigilance position, the behavior is not recorded as exploring, even if the muzzle is close to an item.
Self-grooming	The calf scratches its body with a hind foot, or the calf directs its head towards a body part and no distance between the muzzle and the body part is visible.
Locomotion	The calf takes at least two steps with any of its legs within 2 s.

Table S3 Number of calves that eliminated per phase of the approach test. OBS = 12, PRES = 14.

Phase	PRES	OBS
Habituation	5	2
Test	2	4

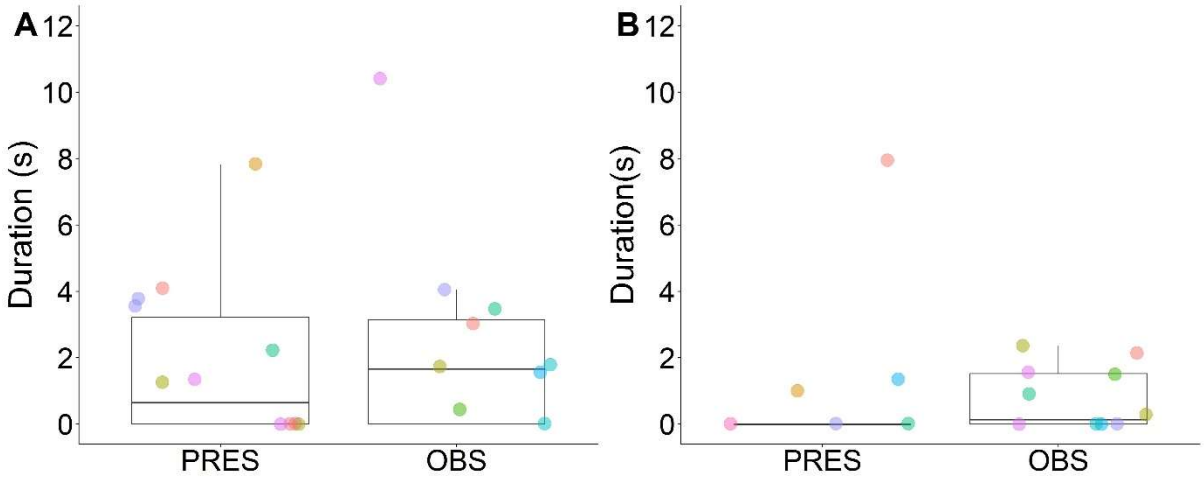

Figure S2 Duration of escape attempts. OBS = 12, PRES = 14. The duration of escape attempts was recorded during A) the habituation phase and B) the test phase of the approach test.

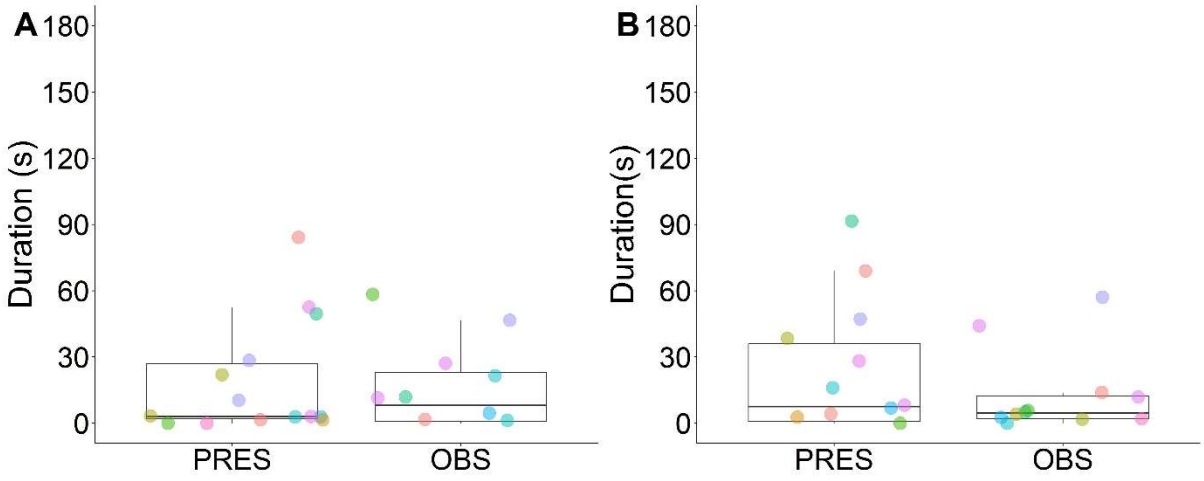

Figure S3. Duration of tail-flicking. OBS = 12, PRES = 14. The duration of tail-flicking was recorded during A) the habituation phase and B) the test phase of the approach test.

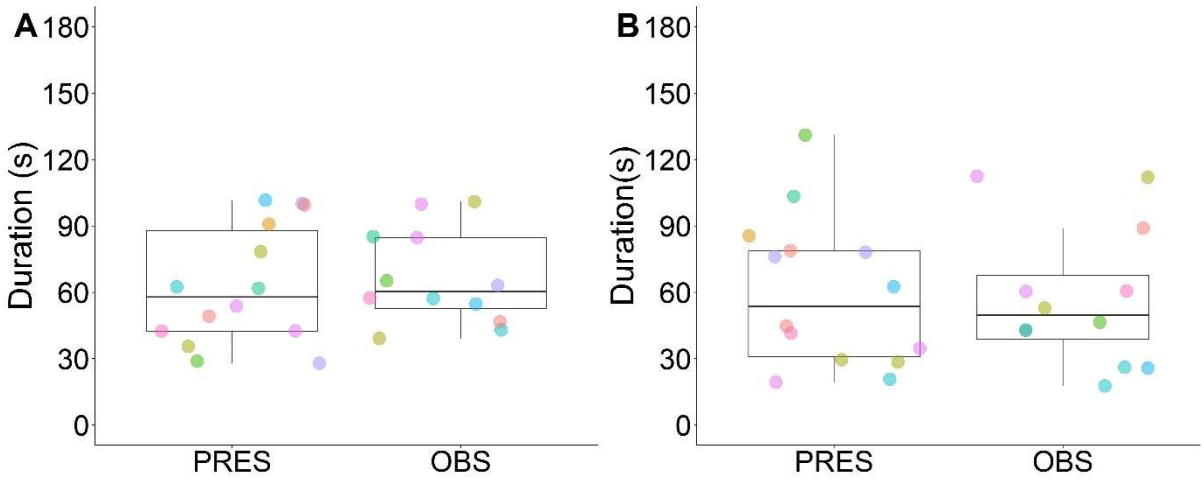

Figure S4. Duration of exploring. OBS = 12, PRES = 14. The duration of exploring was recorded during A) the habituation phase and B) the test phase of the approach test.

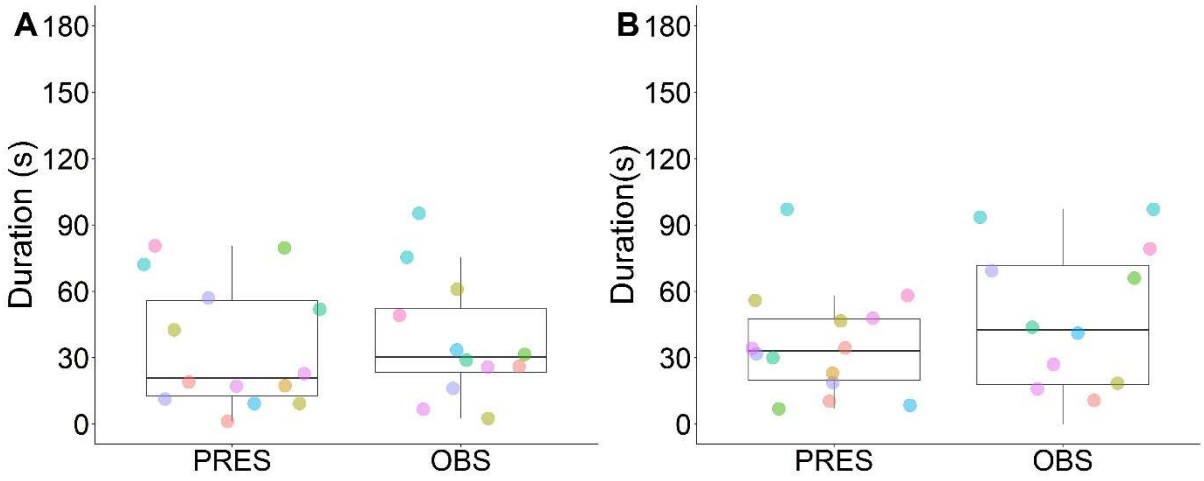

Figure S5. Duration of vigilance. OBS = 12, PRES = 14. The duration of vigilance was recorded during A) the habituation phase and B) the test phase of the approach test.

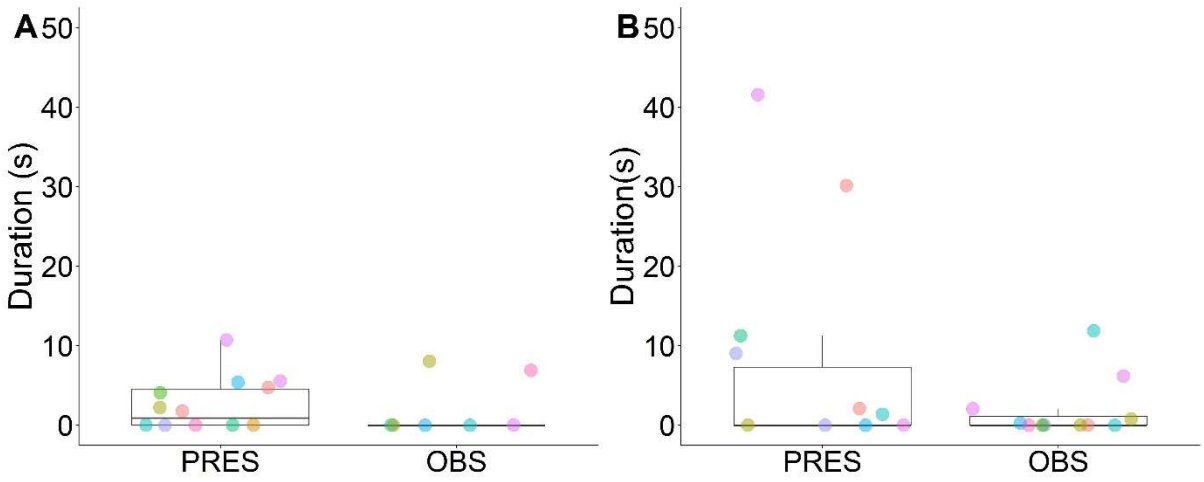

Figure S6. Duration of self-grooming. OBS = 12, PRES = 14. The duration of self-grooming was recorded during A) the habituation phase and B) the test phase of the approach test.

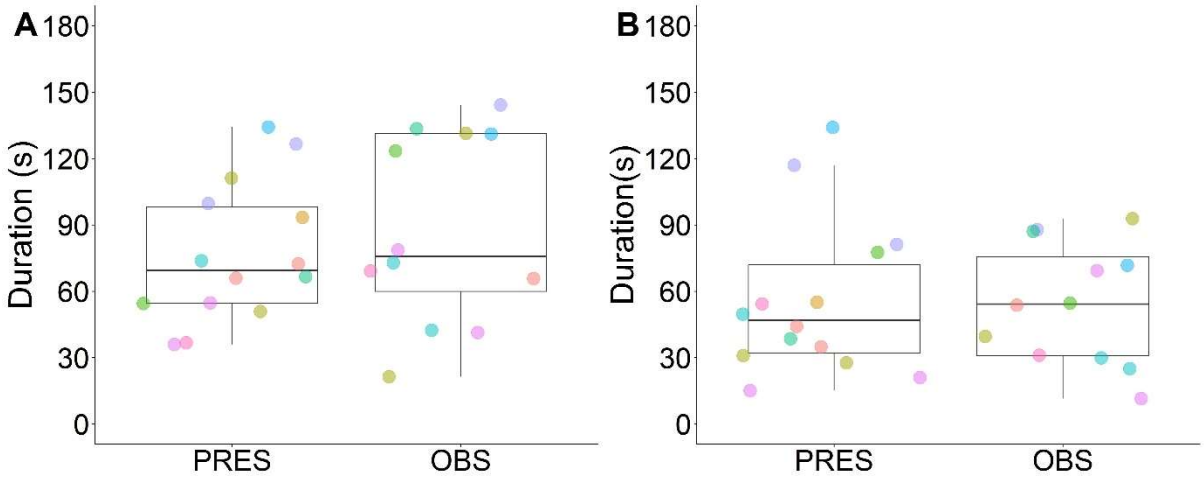

Figure S7. Duration of locomotion. OBS = 12, PRES = 14. The duration of locomotion was recorded during A) the habituation phase and B) the test phase of the approach test.

Section 3 Power analysis

We performed a power analysis to determine the sample size, treating the avoidance distance as the main variable of interest. We had previously found an effect size of Cohen's dz = 0.8 for the difference between calves that were stroked and calves that only experienced routine handling (Lürzel et al., 2015a). Suitable data on the random effects could not be obtained, so we calculated the sample size for a matched-pairs t-test, using the G*Power software (Faul et al., 2007). Under the assumption of two calves being fostered to the same cow as a matched pair and a similar effect size as in the previous study, the analysis indicated that we must test 15 pairs (with one calf per treatment) to find a significant effect between the two groups at $\alpha = 0.05$ with a power of 0.9.

Section 4 Details about the calculation of statistical models

Assumptions of GLMMs were checked graphically using the package "DHARMa" (version 0.4.6 Hartig, 2022). We used plots of residuals versus predicted values and qq plots for the LMMs and qq plot and plots of observed ordinal categories versus fitted values for CLMMs. For model comparison, LMMs and GLMMs were calculated with maximum likelihood estimation; LMMs were recalculated with restricted likelihood for reporting the p values. For graphical depiction of the data we used the packages "ggplot2" (Wickham, 2016) and "cowplot" (Wilke, 2020). GLMMs based on a beta distribution were calculated using the package "glmmTMB" (version 1.1.7; Brooks et al., 2017). LMMs were fitted using the function "lme4" (version 1.1-33; Bates et al., 2015).

Section 5 Results of statistical models

Supplementary Table S4. Models of the effect of day on cow behavior during the treatments. CL: confidence limits. Statistics: CLMM (n = 10).

Effects	Coefficients	SE	CL_{lower}	CL_{upper}	z	p
Model including all treatment sessions						
Threshold 2|3	-4.235	0.962	-6.120	-2.349	-4.403	
Threshold 3|4	0.771	0.858	-0.910	2.452	0.899	
Threshold 4|5	5.422	0.962	3.536	7.308	5.636	
Day	0.048	0.015	0.019	0.077	3.327	< 0.001
Model including first 30 treatment sessions						
Threshold 2|3	-3.910	0.979	-5.829	-1.992	-3.995	
Threshold 3|4	1.281	0.893	-0.469	3.031	1.434	
Threshold 4|5	5.824	1.028	3.809	7.839	5.665	
Day	0.092	0.023	0.048	0.137	4.061	< 0.001

Supplementary Table S5. Models of the effect of treatment on avoidance distance (AD) at 3 weeks of age. The degrees of freedom for the effect of interest were calculated to be infinite (package emmeans) and are therefore not indicated in the table. CL: confidence limits. Statistics: GLMM.

Effects	Coefficients	SE	CL_{lower}	CL_{upper}	z	p
Model AD towards handler in home pen (n: PRES = 14, OBS = 18)						
(Intercept)	-1.468	0.269	-1.996	-0.940	-5.451	– [1]
Treatment (OBS)	-0.324	0.366	-1.041	0.392	-0.887	0.375
Batch (2)	-0.479	0.397	-1.257	0.299	-1.206	0.228
Treatment (OBS) * batch (2)	0.634	0.529	-0.403	1.671	1.198	0.231
Model AD towards helper in home pen (n: PRES = 14, OBS = 18)						
(Intercept)	-1.541	0.328	-2.023	-0.899	-4.702	– [1]
Treatment (OBS)	0.077	0.423	-1.025	0.906	0.182	0.856
Batch (2)	-0.549	0.472	-1.468	0.376	-1.164	0.244
Treatment (OBS) * batch (2)	0.696	0.612	0.161	1.895	1.137	0.255
Model AD towards handler in unfamiliar environment (n: PRES = 13, OBS = 14)						
(Intercept)	-1.535	0.249	-2.023	-1.046	-6.160	– [1]
Treatment (OBS)	-0.441	0.298	-1.025	0.143	-1.481	0.139
Batch (2)	-0.724	0.379	-1.468	0.019	-1.907	0.057
Treatment (OBS) * batch (2)	1.013	0.435	0.161	1.865	2.331	0.019

[1] not shown because of having a very limited interpretation

Supplementary Table S6. Models of effect of cow behavior during the treatment on avoidance distance (AD) of OBS calves at 3 weeks of age. The degrees of freedom for the effect of interest were calculated to be infinite (package emmeans) and are therefore not indicated in the table. CL: confidence limits. Statistics: GLMM.

Effects	Coefficients	SE	CL_{lower}	CL_{upper}	z	p
Model AD towards handler in home pen (n = 18)						
(Intercept)	-2.597	1.350	-5.243	0.049	-1.923	– [1]
Cow behavior	0.389	0.684	-0.950	1.729	0.570	0.569
Batch (2)	- 0.363	1.463	-2.505	3.232	0.248	0.804
Cow behavior * batch (2)	0.282	0.921	-1.522	2.086	0.306	0.759
Model AD towards helper in home pen (n = 18)						
(Intercept)	-2.019	1.485	-4.929	0.891	-1.360	– [1]
Cow behavior	0.266	0.755	-1.213	1.745	0.352	0.725
Batch (2)	-0.580	1.624	-3.764	2.604	-0.357	0.721
Cow behavior * batch (2)	1.297	1.042	-0.745	3.338	1.245	0.213
Model AD towards handler in unfamiliar environment (n = 14)						
(Intercept)	-2.633	1.191	-4.967	-0.298	-2.210	– [1]
Cow behavior	0.359	0.625	-0.865	1.583	0.575	0.565
Batch (2)	- 1.157	1.439	-1.664	3.977	0.804	0.422
Cow behavior * batch (2)	-0.649	1.175	-2.951	1.653	-0.552	0.581

[1] not shown because of having a very limited interpretation

Supplementary Table S7. Model of effect of treatment on approach score. CL: confidence limits. Statistics: LMM (n: PRES = 13, OBS = 12).

Effects	Coefficients	SE	CL_{lower}	CL_{upper}	t	df	p
(Intercept)	1.011	0.328	0.391	1.645	3.081		– [1]
Treatment (OBS)	-0.352	0.416	-1.241	0.426	-0.845	15.6	0.411
Batch (2)	-0.378	0.475	-1.265	0.524	-0.795		0.439
Treatment (OBS) * batch (2)	0.842	0.618	-0.324	2.125	1.364		0.193

[1] not shown because of having a very limited interpretation

Supplementary Table S8. Model of effect of cow behavior during the treatment on approach score of the OBS calves. CL: confidence limits. Statistics: LMM (n = 12).

Effects	Coefficients	SE	CL_{lower}	CL_{upper}	t	df	p
(Intercept)	1.008	2.492	-3.321	5.337	0.404		– [1]
Cow behavior	-0.193	1.307	-2.464	2.078	-0.148	4.4	0.886
Batch (2)	0.671	3.030	-4.594	5.936	0.221		0.830
Cow behavior * batch (2)	-0.548	2.569	-5.011	3.914	-0.213		0.836

[1] not shown because of having a very limited interpretation