



**Supplemental material to: Evaluation of a composite pain scale including facial expressions for detecting orthopedic pain in lame dairy cows, *Journal of Dairy Science*, 2025**

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**Table S1.** Scale item definitions of Cow Pain Scale<sup>1</sup>

Scale items:	Score 0	Score 1	Score 2
Attention towards the surroundings	Active and attentive The cow is active: eating, ruminating, grooming etc. The cow is attentive and/or attention seeking/curious	Quiet/depressed The cow is not active, avoiding eye contact, may move away from the observer	
Head position	High/level of withers The cow is active, eating, ruminating or is contact seeking/curious	Level of withers The cow is <i>not active</i> , not eating, ruminating, grooming or sleeping	Low The cow is <i>not active</i> , not eating, ruminating, grooming or sleeping; may lay down quickly after getting up
Ear position	Both ears forward <i>or</i> one ear forward or back and the other listening	Ears back/asymmetric ear movements Both ears back or moving in different directions (not forward or back)	Lambs' ears Both ears to the sides and lower than usual; the pinna facing slightly down
Facial expression	Attentive/neutral look The cow is attentive, focused on a task (eating, ruminating) or sleeping	Tense expression/strained appearance The cow has a worried or strained look, furrows above the eyes and puckers above the nostrils	
Response to approach	Look at observer, head up, ears forward or occupied with activity (grooming, ruminating)	Look at observer, ears not forward, leave when approached	May/may not look at observer, head low, ears not forward may leave slowly
Back position	Normal	Slightly arched back	Arched back

<sup>1</sup> Cow Pain Scale item definitions according to Gleerup et al., 2015

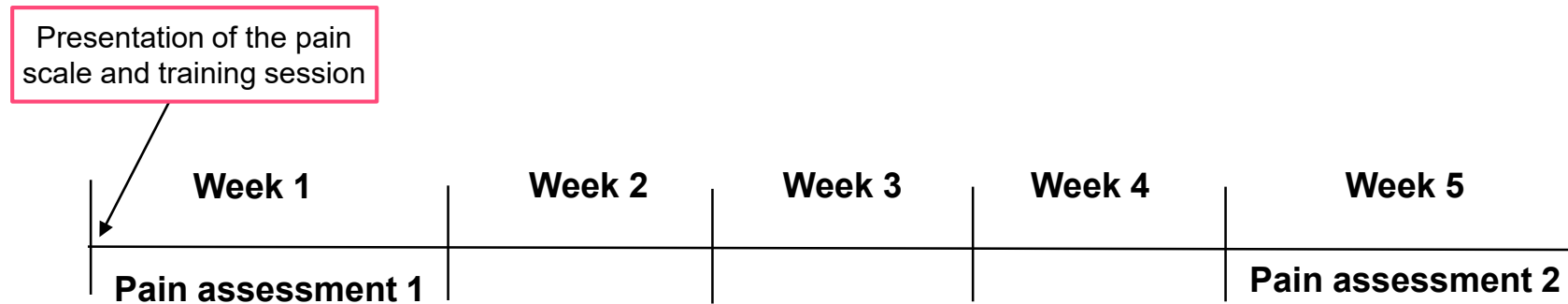
# Supplemental Material S1

## Pain assessment of dairy cattle with orthopedic disease

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# Time-plan



- Pain scoring:
  - All videos are assessed during the same week
  - Individual assessment
  - All videos are assessed twice by each observer
  - A three week "wash-out-period" in between the two assessment-weeks

# Practical information

- USB-stick/hard-drive:
  - Video recordings
  - Pain-scoring sheet
  - Folder for filled-in scoring sheets
  - Instructions for pain scoring
- Video recordings:
  - 76 films, ~2 minutes each
  - Same cow twice: lame and improved (blinded)
  - Assess in chronological order, 101-176
  - May be watched unlimited times
- Hand in USB-stick/hard-drive at the end of each pain assessment week!

101	141
102	142
103	143
104	144
105	145
106	146
107	147
108	148
109	149
110	150
111	151
112	152
113	153
114	154
115	155
116	156
117	157
118	158
119	159
120	160
121	161
122	162
123	163
124	164
125	165
126	166
127	167
128	168
129	169
130	170
131	171
132	172
133	173
134	174
135	175
136	176
137	Filled in scoring sheets ←
138	New scoring sheet ←
139	Instructions for pain scoring ←
140	

# Practical information

- Scoring sheet:
  - One for each film
  - Save in assigned folder: name by film-number
- Fill in:
  - Film-number
  - Starting and ending time
  - Face and ear visible entire film: YES/NO
- The pain assessment must be finalised, and the scoring sheet saved, before starting the next film

Film number: \_\_\_\_\_

Start-time: \_\_\_\_\_ End-time: \_\_\_\_\_

Scoring sheet below: Write the assigned score for each scale item in the right column.

Scale item:	0	1	2	Score:
<b>Attention towards the surroundings</b>	Active and attentive The cow is active: eating, ruminating, grooming etc. The cow is attentive and/or attention seeking/curious	Quiet/depressed The cow is not active, avoiding eye contact, may move away from the observer		
<b>Head position</b>	High/level of withers The cow is active, eating, ruminating or is contact seeking/curious	Level of withers The cow is not active, not eating, ruminating, grooming or sleeping	Low The cow is not active, not eating, ruminating, grooming or sleeping; may lie down quickly after getting up	
<b>Back position</b>	Normal	Slightly arched back	Arched back	
<b>Ear position</b>	Both ears forward or one ear forward or back and the other listening	Ears back/asymmetric ear movements Both ears back or moving in different directions (not forward or back)	Lambs' ears Both ears to the sides and lower than usual; the pinna facing slightly down	
<b>Facial expression</b>	Attentive/neutral look The cow is attentive, focused on a task (eating, ruminating) or sleeping	Tense expression/strained appearance The cow has a worried or strained look, furrows above the eyes and puckers above the nostrils		

Face and ears were visible during the entire film (mark with "X"): YES: \_\_\_\_\_ NO: \_\_\_\_\_

Scoring sheet below: Only for facial expression and/or ear position if scored 1 or 2. Mark with an "X" the most appropriate time definition.

Time definition:	Seldom/short-term: Behaviour seen more than once briefly (few seconds), but for a minor part of the observation time	Occasionally/to some extent: Behaviour seen, in total, for less than half of the observation time	Repeatedly/prolonged Behaviours seen, in total, for approximately half of the observation time	Frequently/continuously Behaviours seen, in total, for the majority of the observation time
<b>Ear position</b>				
<b>Facial expression</b>				

# Pain assessment

- Scale items (behavioural categories)
  - Attention towards the surroundings
  - Head position
  - Back position
  - Ear position
  - Facial expression
- Score
  - 0, 1 or (sometimes) 2
- **Score 1 or 2 should be assigned:**
  - If the behaviours described are shown **more than once**
 OR
  - If the behaviours described are shown **more than briefly** (a few seconds)

Scoring sheet below: Write the assigned score for each scale item in the right column

Scale item:	0	1	2	Score:
<b>Attention towards the surroundings</b>	Active and attentive The cow is active: eating, ruminating, grooming etc. The cow is attentive and/or attention seeking/curious	Quiet/depressed The cow is not active, avoiding eye contact, may move away from the observer		1
<b>Head position</b>	High/level of withers The cow is active, eating, ruminating or is contact seeking/curious	Level of withers The cow is not active, not eating, ruminating, grooming or sleeping	Low The cow is not active, not eating, ruminating, grooming or sleeping; may lie down quickly after getting up	2
<b>Back position</b>	Normal	Slightly arched back	Arched back	1
<b>Ear position</b>	Both ears forward or one ear forward or back and the other listening	Ears back/asymmetric ear movements Both ears back or moving in different directions (not forward or back)	Lambs' ears Both ears to the sides and lower than usual; the pinna facing slightly down	0
<b>Facial expression</b>	Attentive/neutral look The cow is attentive, focused on a task (eating, ruminating) or sleeping	Tense expression/ strained appearance The cow has a worried or strained look, furrows above the eyes and puckers above the nostrils		1



# Pain assessment

## Time-definitions:

Only for facial expression and ear position if scored 1 or 2

- **Seldom/short-term:**
  - Behaviour seen more than once briefly (few seconds), but for a minor part of the observation time
- **Occasionally/to some extent:**
  - Behaviour seen, in total, for less than half of the observation time
- **Repeatedly/prolonged:**
  - Behaviours seen, in total, for approximately half of the observation time
- **Frequently/continuously:**
  - Behaviours seen, in total, for the majority of the observation time

Scoring sheet below: Only for facial expression and/or ear position if scored 1 or 2. Mark with an "X" the most appropriate time definition.

Time definition:	Seldom/short-term: Behaviour seen more than once briefly (few seconds), but for a minor part of the observation time	Occasionally/to some extent: Behaviour seen, in total, for less than half of the observation time	Repeatedly/prolonged Behaviours seen, in total, for approximately half of the observation time	Frequently/continuously Behaviours seen, in total, for the majority of the observation time
Ear position				
Facial expression				



# Pain assessment

## Scale item definitions:

- Attention towards the surroundings

Scale item:	0	1	2
<b>Attention towards the surroundings</b>	Active and attentive The cow is active: eating, ruminating, grooming etc. The cow is attentive and/or attention seeking/ curious	Quiet/depressed The cow is not active, avoiding eye contact, may move away from the observer	

## Attention towards the surroundings



Score 0  
"Attentive"



Score 1  
"Depressed"

# Pain assessment

## Scale item definitions:

- Head position:
  - Score 0: The head may be lowered in order to perform an obvious task (e.g. eat)
  - “Level with withers”: Score 0 or 1 depend on activity-level

Scale item:	0	1	2
Head position	High/level of withers The cow is active, eating, ruminating or is contact seeking/curious	Level of withers The cow is not active, not eating, ruminating, grooming or sleeping	Low The cow is not active, not eating, ruminating, grooming or sleeping; may lie down quickly after getting up

# Head position



Score 0  
"High"



Score 1  
"Level, not active"



Score 2  
"Low"

# Pain assessment

## Scale item definitions:

- Back position:
  - Score 0: “Normal” is defined as a flat back (an almost straight line between the withers and the sacrum)

Scale item:	0	1	2
Back position	Normal	Slightly arched back	Arched back

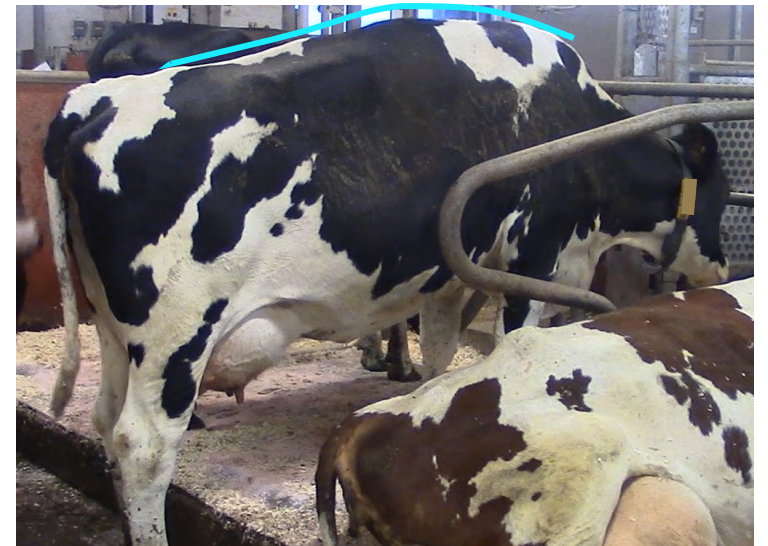
## Back position



Score 0  
"Normal"



Score 1  
"Slightly arched"



Score 2  
"Arched"

# Pain assessment

## Scale item definitions:

- Ear position

Scale item:	0	1	2
<b>Ear position</b>	Both ears forward or one ear forward or back and the other listening	Ears back/asymmetric ear movements Both ears back or moving in different directions (not forward or back)	Lambs' ears Both ears to the sides and lower than usual; the pinna facing slightly down

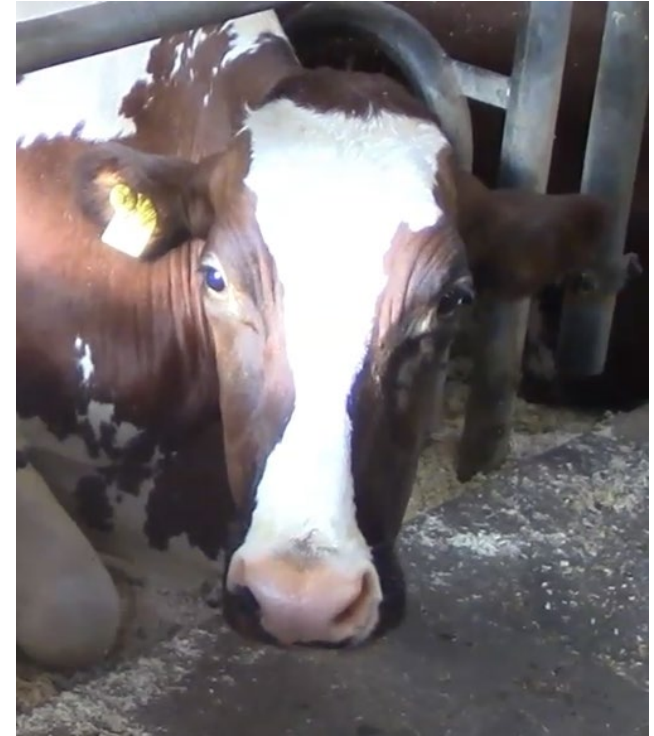
## Ear position



Score 0  
"Both forward/  
one forward one back"



Score 1  
"Both backwards"



Score 2  
"Low"



# Pain assessment

## Scale item definitions:

- Facial expression

Scale item:	0	1	2
<b>Facial expression</b>	Attentive/neutral look The cow is attentive, focused on a task (eating, ruminating) or sleeping	Tense expression/ strained appearance The cow has a worried or strained look, furrows above the eyes and puckers above the nostrils	

## Facial expressions



Score: 0  
"Neutral"



Score: 0  
"Attentive"

# Facial expressions



Score: 1  
"Tense/strained"



Score: 1  
"Tense/strained"



Film number: \_\_\_\_\_

Start-time: \_\_\_\_\_

End-time: \_\_\_\_\_

Scoring sheet below: Write the assigned score for each scale item in the right column.

Scale item:	0	1	2	Score:
<b>Attention towards the surroundings</b>	Active and attentive The cow is active: eating, ruminating, grooming etc. The cow is attentive and/ or attention seeking/ curious	Quiet/depressed The cow is not active, avoiding eye contact, may move away from the observer		
<b>Head position</b>	High/level of withers The cow is active, eating, ruminating or is contact seeking/curious	Level of withers The cow is not active, not eating, ruminating, grooming or sleeping	Low The cow is not active, not eating, ruminating, grooming or sleeping; may lie down quickly after getting up	
<b>Back position</b>	Normal	Slightly arched back	Arched back	
<b>Ear position</b>	Both ears forward or one ear forward or back and the other listening	Ears back/asymmetric ear movements Both ears back or moving in different directions (not forward or back)	Lambs' ears Both ears to the sides and lower than usual; the pinna facing slightly down	
<b>Facial expression</b>	Attentive/neutral look The cow is attentive, focused on a task (eating, ruminating) or sleeping	Tense expression/strained appearance The cow has a worried or strained look, furrows above the eyes and puckers above the nostrils		

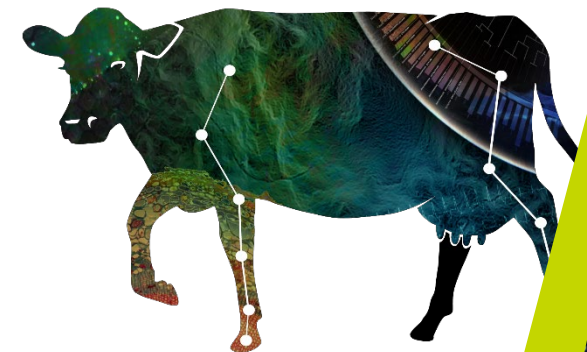
Face and ears were visible during the entire film (mark with "X"): **YES:** \_\_\_\_\_ **NO:** \_\_\_\_\_

Scoring sheet below: Only for facial expression and/or ear position if scored 1 or 2. Mark with an "X" the most appropriate time definition.

Time definition:	Seldom/short-term: Behaviour seen more than once briefly (few seconds), but for a minor part of the observation time	Occasionally/to some extent: Behaviour seen, in total, for less than half of the observation time	Repeatedly/prolonged Behaviours seen, in total, for approximately half of the observation time	Frequently/continuously Behaviours seen, in total, for the majority of the observation time
<b>Ear position</b>				
<b>Facial expression</b>				

# Exercise!

# Questions?



**Supplemental materials to:** Evaluation of a composite pain scale including facial expressions for detecting orthopedic pain in lame dairy cows, *Journal of Dairy Science*, 2025

**Table S2.** Diagnosis at initial trial and lameness score (LS) at the initial and follow-up trial for each lameness case. The limb that the lameness was located to is also stated. BH = both hindlimbs, LF = left forelimb, LH = left hindlimb, RF = right forelimb, RH = right hindlimb

Case	Diagnosis <sup>1</sup>	LS <sup>2</sup> initial trial	LS <sup>2</sup> follow-up	Lame limb
1	Sole ulcer RH	2	0	RH
2	Sole ulcer BH, chronic laminitis LH	3	1	RH
3	Trauma LH	3	0	LH
4	Trauma RH	2	0	RH
5	Sole hemorrhage, mild foot rot RH, sole ulcer RF	1	0	RH
6	Sole ulcer BH	2	0	RH
7	Limax LH	3	1	LH
8	Trauma, double sole LH	1	0	LH
9	Abscess, foot rot, white line fissure LH	3	0	LH
10	Sole ulcer LF	3	0	LF
11	Limax LH	1	0	LH
12	Sole ulcer RF, sole hemorrhage LF and BH	1	0	RF
13	Not found	2	1	LH
14	White line hemorrhage RH, sole hemorrhage LH	3	0	RH
15	Abscess RH	2	0	RH
16	Abscess RF	1	0	RF
17	Foot rot LF, trauma LH	2	1	LF
18	Sole ulcer, double sole RH	1	0	RH
19	Not found	1	0	RH
20	Foot rot RH	3	1	RH
21	Abscess RH, sole hemorrhage LH	2	0	RH
22	Sole ulcer BH	1	0	LH
23	Abscess RH, sole hemorrhage LH	3	0	RH
24	Trauma LF	3	0	LF
25	Trauma, digital dermatitis LH	1	0	LH
26	Sole hemorrhage BH, foot rot LH	1	0	LH
27	Abscess LH	3	0	LH
28	Sole hemorrhage, trauma RH	2	0	RH
29	Foot rot RH	3	1	RH
30	Digital dermatitis LF	3	0	LF

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31	Sole ulcer RF, sole hemorrhage RH and LF	2	0	RF
32	Trauma RH	3	0	RH
33	Sole ulcer RH	3	0	RH
34	Sole ulcer and foot rot RH, sole hemorrhage BH and LF	2	0	RH
35	Abscess RH, digital dermatitis LH	3	0	RH
36	Not found	1	0	RF

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<sup>1</sup> Diagnosis according to Nordic claw atlas (NAV, 2020). The diagnosis “abscess” includes abscesses in all locations in the claw and is modified from the definition in the Nordic claw atlas that includes white line abscess and toe abscess

<sup>2</sup> Lameness score according modified Sprecher lameness scale ranging from 0-4 (Sprecher et al., 1997, Coetzee et al., 2014)

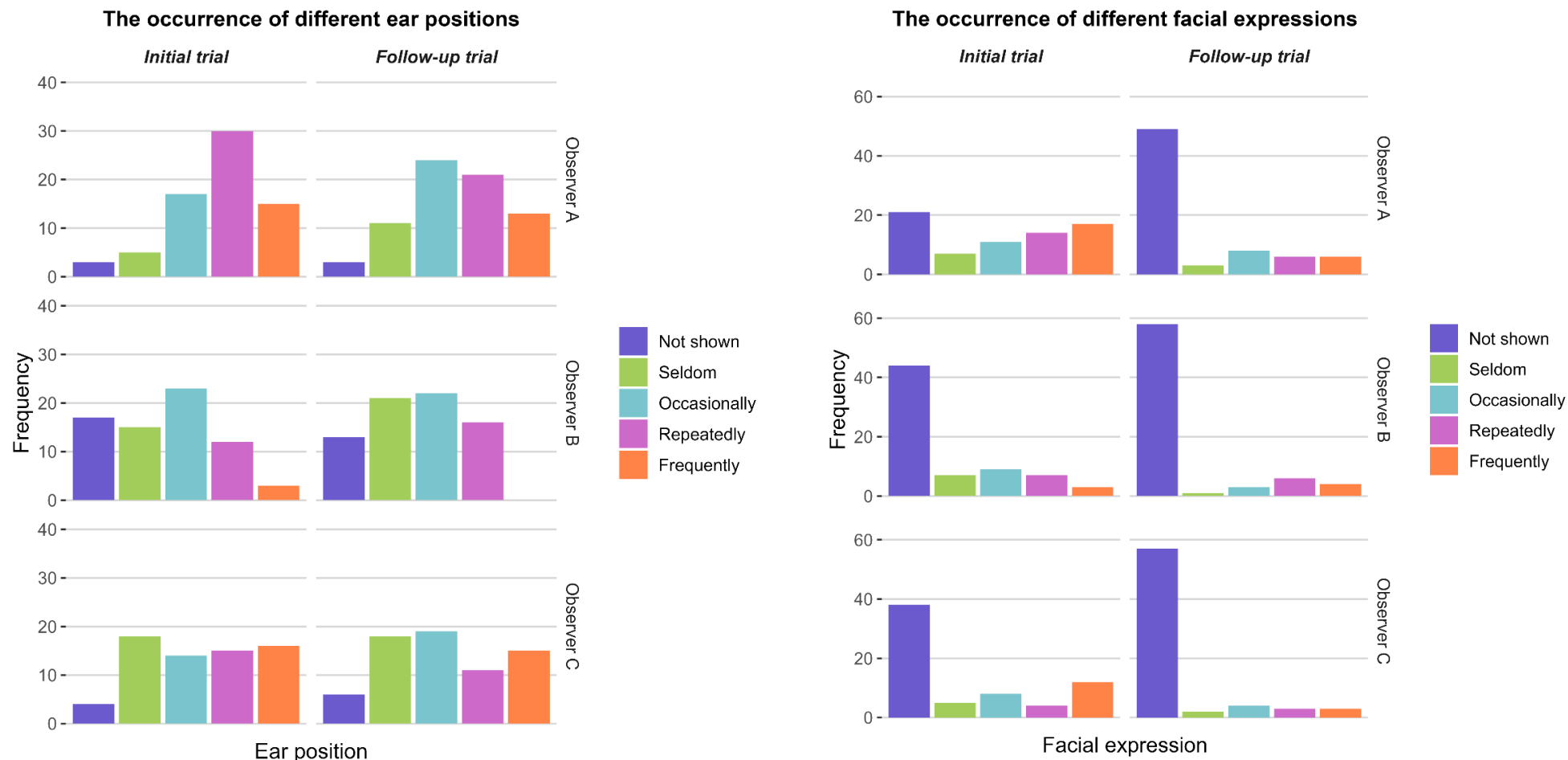
**Supplemental materials to:** Evaluation of a composite pain scale including facial expressions for detecting orthopedic pain in lame dairy cows, *Journal of Dairy Science*, 2025

**Table S3.** Coordinates for each scale item and score, and for each of the ten dimensions identified by the multiple correspondence analysis

(MCA). att = attention towards the surroundings; head = head position; back = back position; ear = ear position; fe = facial expression; resp = response to approach

Scale item and score	Dimension 1	Dimension 2	Dimension 3	Dimension 4	Dimension 5	Dimension 6	Dimension 7	Dimension 8	Dimension 9	Dimension 10
att_0	-0.457	-0.05	0.076	-0.025	0.099	0.026	-0.025	-0.148	0.042	0.261
att_1	1.426	0.154	-0.236	0.077	-0.309	-0.082	0.077	0.461	-0.131	-0.814
head_0	-0.743	0.338	-0.184	-0.158	-0.03	0.126	-0.068	-0.109	0.46	-0.262
head_1	0.168	-1.41	0.215	0.533	1.274	-0.315	0.752	0.379	-0.234	-0.008
head_2	0.993	0.225	0.158	-0.042	-0.603	-0.023	-0.283	-0.035	-0.549	0.384
back_0	-0.66	0.352	-0.728	0.198	-0.261	-0.013	0.354	0.625	-0.095	0.205
back_1	0.111	-0.546	0.529	-0.528	0.077	0.242	-0.386	-0.09	-0.001	-0.143
back_2	1.133	0.799	0.078	1.086	0.353	-0.669	0.336	-1.117	0.212	-0.041
ear_0	-0.259	-0.17	2.008	0.915	-1.363	0.465	0.849	0.352	0.496	0.04
ear_1	-0.018	-0.092	-0.304	-0.163	0.055	-0.148	-0.061	-0.097	-0.063	-0.016
ear_2	1.232	2.719	1.12	1.085	2.868	2.125	-1.152	1.23	-0.009	0.27
fe_0	-0.573	0.14	0.103	0.059	0.012	0.155	0.113	-0.168	-0.345	-0.164
fe_1	1.001	-0.244	-0.18	-0.102	-0.021	-0.271	-0.197	0.293	0.602	0.286
resp_0	-0.235	-0.008	0.098	0.171	-0.015	-0.225	-0.209	0.082	-0.02	-0.032
resp_1	1.154	0.671	0.082	-1.683	0.319	0.531	1.407	-0.237	0.063	0.185
resp_2	1.322	-1.896	-2.276	1.624	-0.671	3.019	0.014	-0.961	0.22	0.096





**Figure S1.** Occurrence of different ‘ear position’ and ‘facial expression’ time-duration scores. The figure illustrates the frequency of the time-duration noted for the scale items ‘ear position’ and ‘facial expression’ by each of the three observers – Observer A, B, and C – during both the initial and the follow-up trials. The scale item scores and time durations are represented as follows: dark blue indicates no pain behavior observed (score 0), green indicates pain behavior (score 1 or 2) shown seldom/short term, light blue indicates pain behavior shown occasionally/less than half of the observation period, pink indicates pain behavior shown repeatedly/half of the observation period, and orange indicates pain behavior shown frequently/more than half of the observation period.