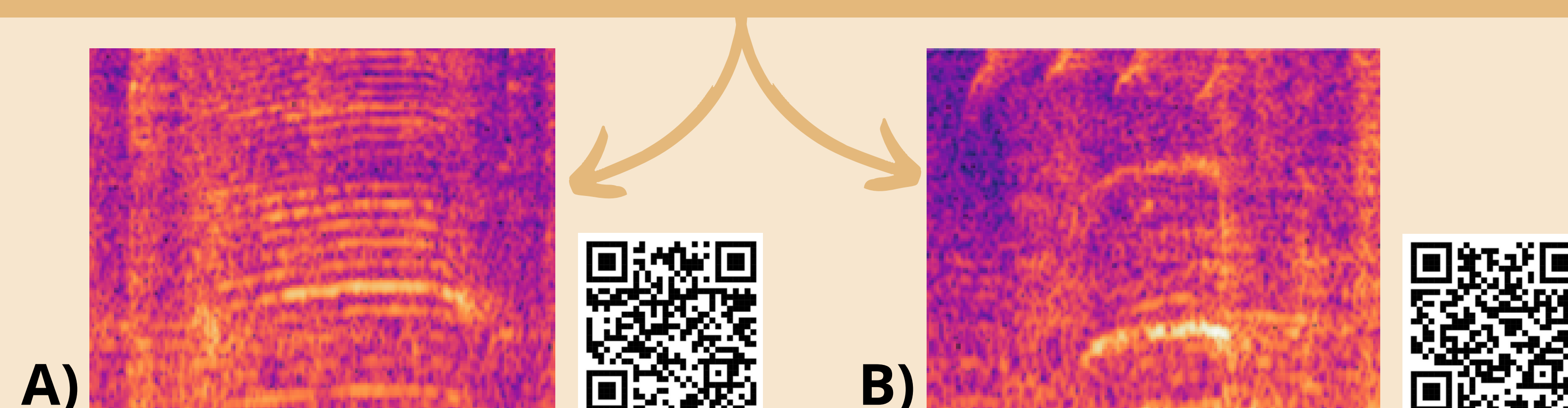


## Introduction

Recently, bovine vocalizations have been disruptively incorporated into precision livestock farming. In the analysis of the vocalizations, different types of vocalizations related to the emotional state are differentiated. The formation of a new hierarchy is a time of stress where vocalizations can be influenced.

## Objectives

- To study if there is a relationship between the establishment of the hierarchy and vocalizations.
- Elaboration and exemplification of the Elo ranking evaluation method
- Evaluate whether pain influences the formation of the hierarchy and vocalizations.
- Generate scientific evidence on the interpretation of vocalizations in cattle



**Figure 1:** Spectral shapes made with Audacity from the studio recordings. **A)** Vocal low, long with a constant low intonation; **B)** Vocal high, short with rising acute intonation. **Scan QR** to access examples of vocalizations

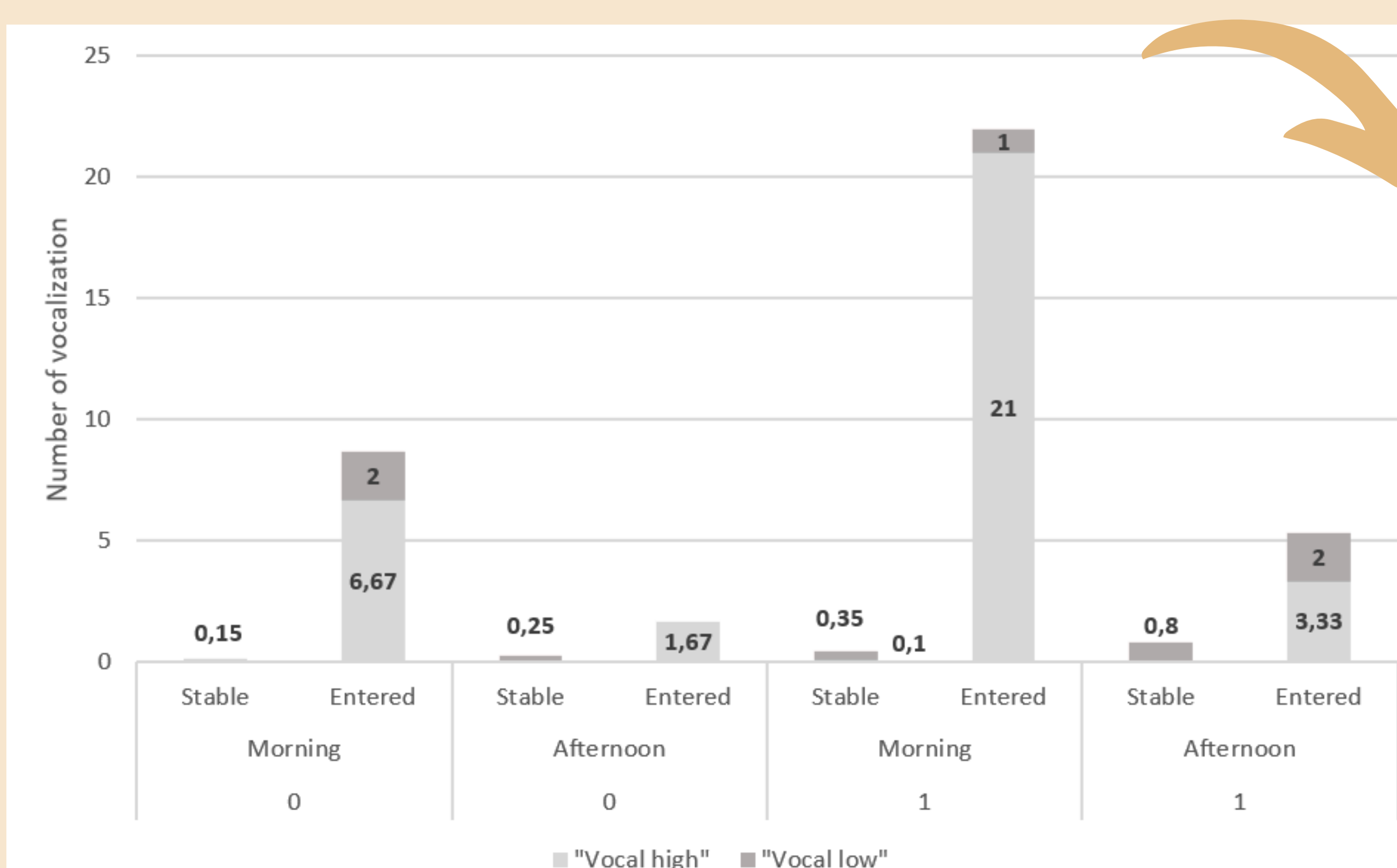
**Table 1:** Characterization of vocalizations (duration (s), frequency (Hz) and amplitude (Hz); mean+/- standard error) according to type (Vocal high (VH) and vocal low (VL)) of the study.

	VH	VL	p valor
<b>Duration (s)</b>	1,28 +/- 0,032	1,99 +/- 0,106	0,0042
<b>Frequency (Hz)</b>	229,22 +/- 8,93	147,80 +/- 14,80	<0,0001
<b>Amplitude (Hz)</b>	2934,44 +/- 52,76	3420,63 +/- 90,16	<0,0001

## Material and methods

3 cows (introduced group) and 20 cows from the herd (stable group) were used for this study. It was studied in two periods of 1,5 hours a day during the first two days after dry-off. Interactions (negatives and positives), pain (algometer and pain scale) and vocalizations (direct observation and recorder) were studied. A statistical analysis was subsequently carried out using SAS Software and setting  $P < 0,05$ .

## Results



**Figure 2:** Relationship of individual vocalizations per observation, according to the type of vocalization (VH or VL) and group (stable or introduced). The numerical value indicates the sum of vocalizations.

The amount of vocalizations was higher in the submissive individual compared to the dominant; it also made more vocal high compared to the neutral.

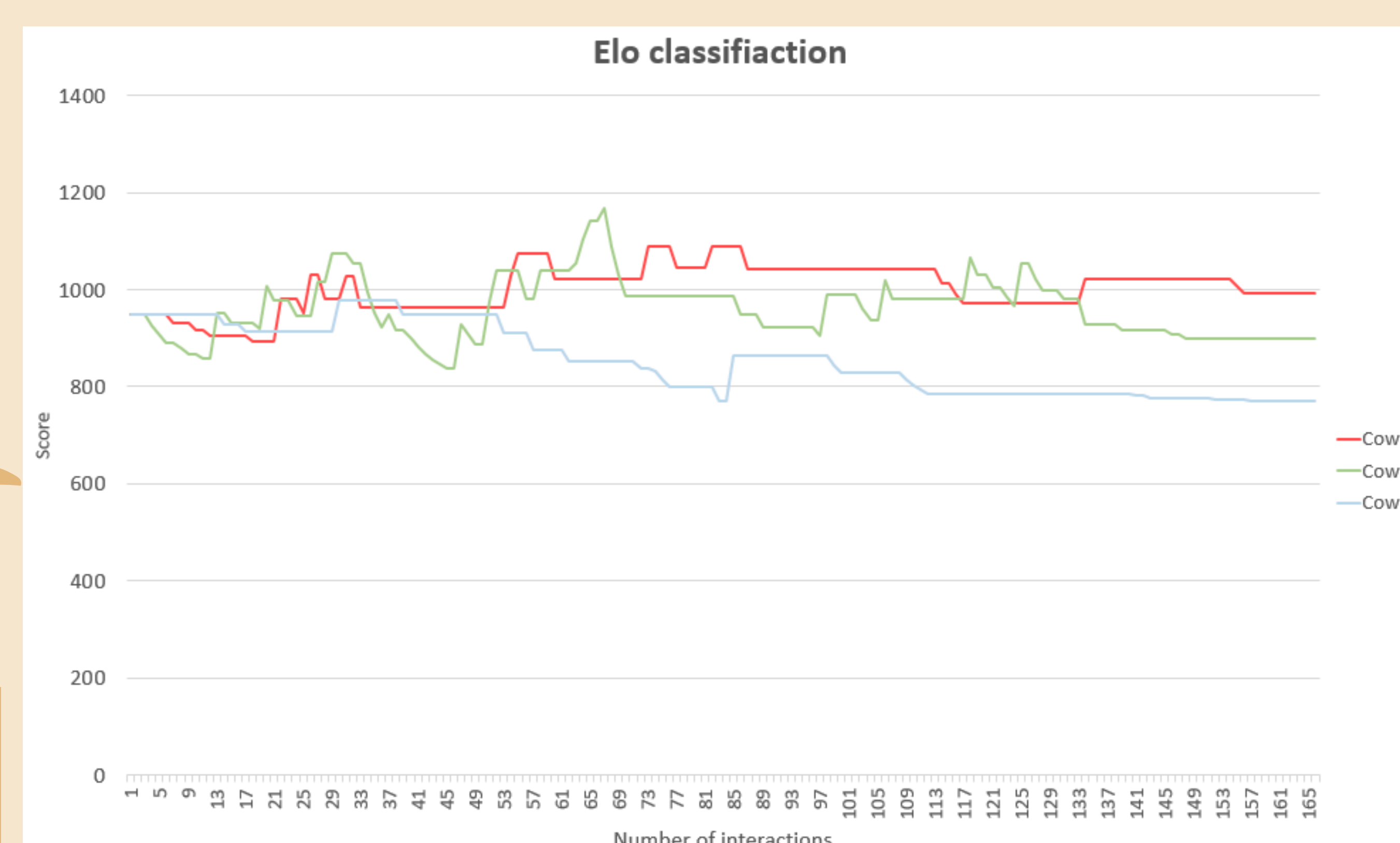
**Table 2:** Number of vocalizations (quantity of vocalizations per individual and observation; mean +/- standard error) and percentage of vocalizations (vocal high (VH) or vocal low (VL); mean +/- standard error) according to the animal studied (cow 1, cow 2 or cow 3) and its hierarchical status (dominant, neutral or submissive) taken from the Elo classification.

	Hierarchical status	Number of vocalizations	VH	VL
<b>Cow 1</b>	Dominant	1 ± 1	75,00% ± 21,65%	25,00% ± 21,65%
<b>Cow 2</b>	Neutral	6,5 ± 3,47	60,87% ± 10,18%	39,13% ± 0,18%
<b>Cow 3</b>	Submissive	21,5 ± 11,79	94,19% ± 2,52%	5,81% ± 2,52%

## Conclusion

Taking into account the limitations of the study, a relationship between vocalizations and the establishment of the hierarchy studied individually in the animals of the introduced group and comparatively between groups has been demonstrated.

Introduced animals vocalize significantly more frequently than animals in the established group. Descriptively introduced cows also make more vocals highs, but it's not statistically significant.



**Figure 3:** Elo classification. Evolution of the Elo score with respect to each interaction of the introduced animals.