Monitoring individual behaviours and the social hierarchy of dairy cows using electronic drinkers

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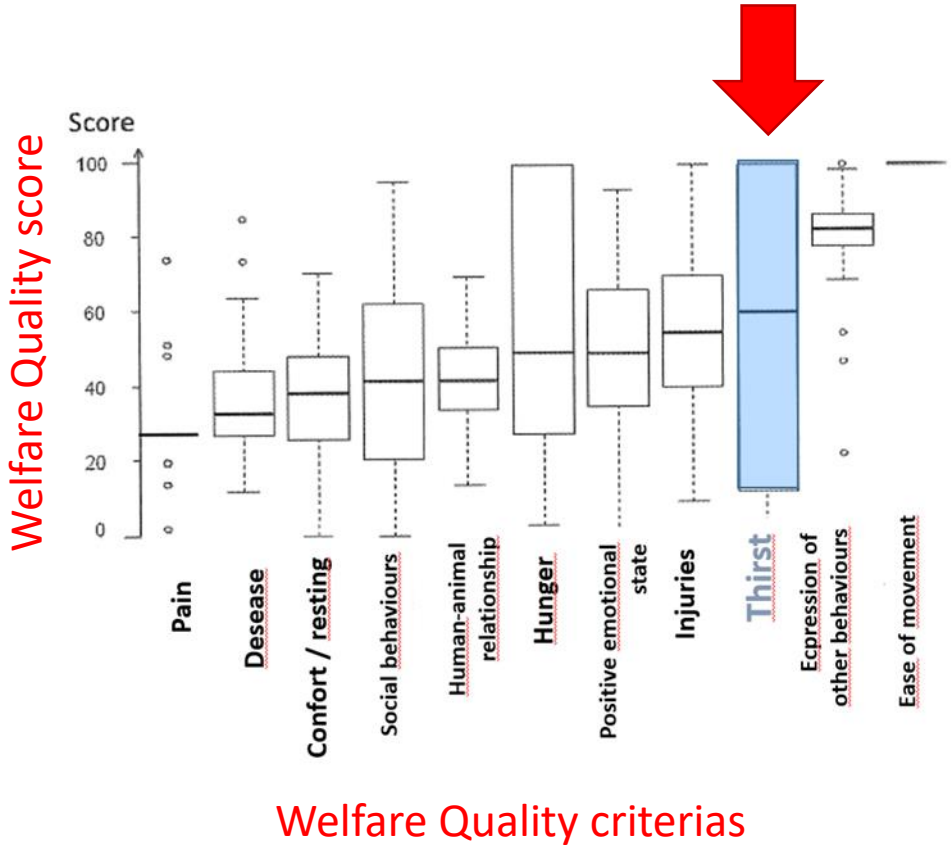
LA BUVETTE®
The Specialist in Livestock Drinking Solutions

THE UNIVERSITY OF BRITISH COLUMBIA
Animal Welfare Program
Faculty of Land and Food Systems

Context: real need to develop new tools to assess watering equipment in dairy farms

- **Freedom from thirst**: a key criterion for dairy cattle welfare
- Welfare Quality ® protocol: **extremely heterogeneous** drinking management between dairy farms *(de Boyer des Roches et al. 2012)*
- An insufficient drinking equipment: some deletorious consequences on some individual in the herd

- **New tools to measure and understand individual heterogeneity of drinking behavior**



Welfare Quality criterias

Survey based on more than 100 french dairy farms

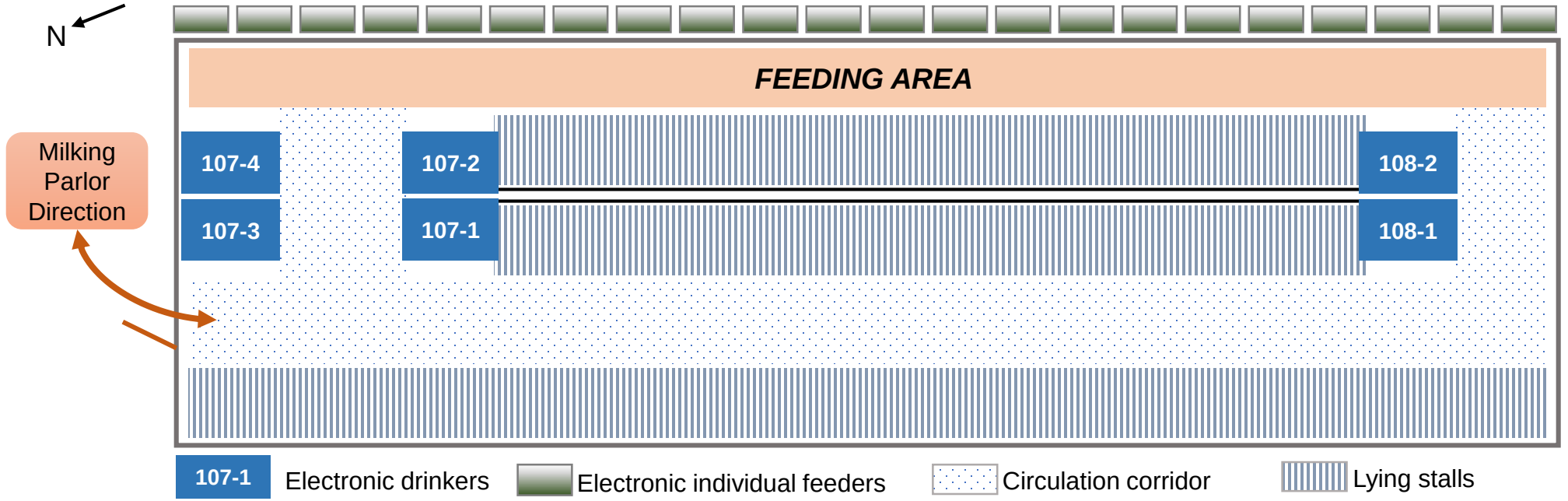
Objective: can precision tools be used to measure individual drinking behaviors in relation with social ranks of cows within herds ?

- Little known about the **influence of social rank on individual drinking behaviour,** especially when water is not fully available
- **Automated methods** ↑ to monitoring individual animals
- **Connected feeders combined with electronic drinkers :** determine social rank of individual cows *(Foris et al., 2019)* → *connected devices with automatic gates*

- **Aim :** determine the ability of a **different drinker design** (without automatic gates) to identify **alone** the social hierarchy within a group of dairy cows

Materials and methods: animals and housing

- 22 mid lactating cows observed during 9 days
- Housed in a free-stall pen
- 6 electronic drinkers (3.7 cows/drinker)



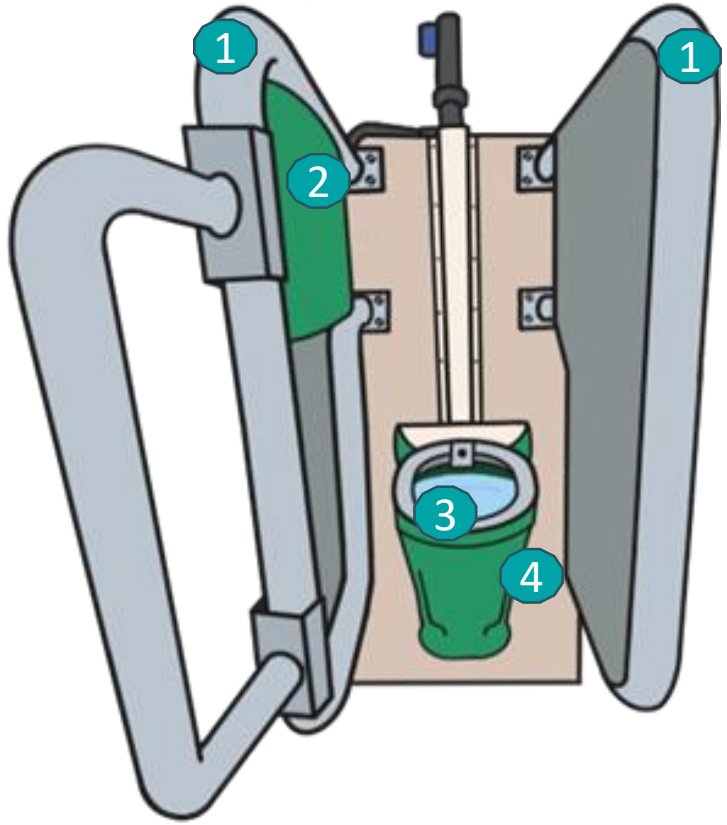
Pen design in the experimental farm of Mejusseaume (INRAE, Rennes, France)

Materials and methods: the model of individual monitoring system used in this experiment

1. **2 partitions to isolate cows**
2. **RFID antenna to identify cows**
3. **Constant water level bowl**
4. **Electronic flow meter**

❖ For each individual drinking visit: time, duration and ID of the drinking cow were recorded and **centralized**

❖ Originalities : electronic flow meter measurement + no automatic gates



Electronic drinker, La Buvette ®

Social hierarchies measurements

What

How

Identify social hierarchies by video

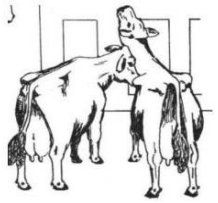
Identify social hierarchy by algorithm

- 7 cameras continuous recording (5:00 am to 10:30 pm)
- Cows identification → colored symbols on back and ribs

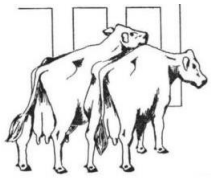
4 agonistic interactions (AgI)

Replacements at the drinkers (Rep)

❖ **4 agonistic interactions** *(Dickson et al.,1967)*:

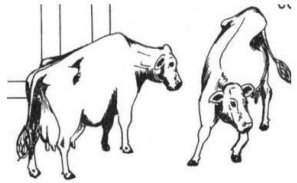


Butting



Pushing

Fight-contact



Thread-avoidance

❖ **Replacements** *(Foris et al., 2019):*

- ❖ ***Aggressive physical contact*** *(i.e., butt, push) from a cow leads to the other cow leaving the drinker and the actor occupying her place*
- ❖ ***in the first 60s*** *after the departure*

Social hierarchies measurements

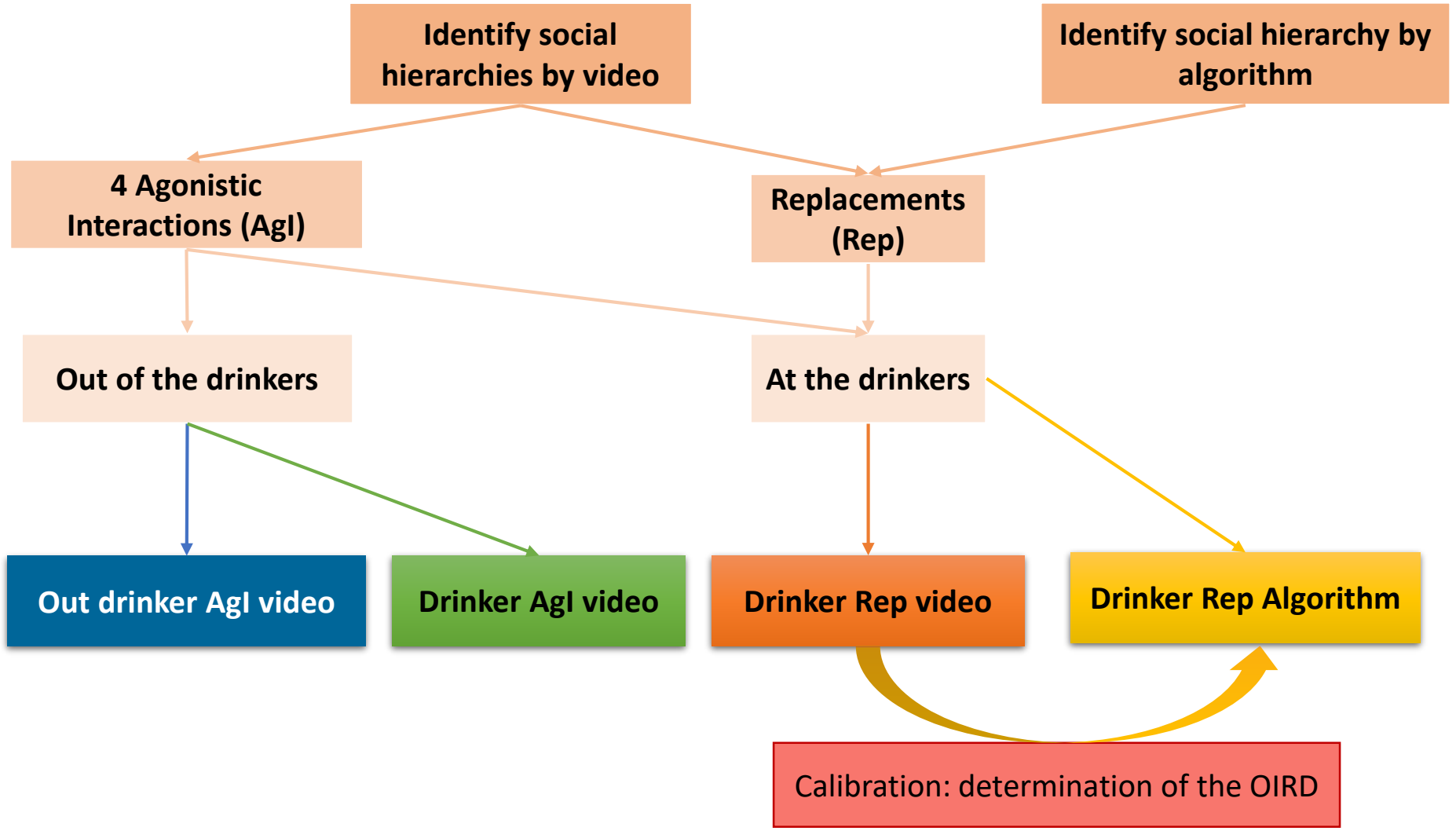
What

How

Where

Social Hierarchies David's Score

(De Vries et al., 2006)



Materials and methods: calibration of OIRD

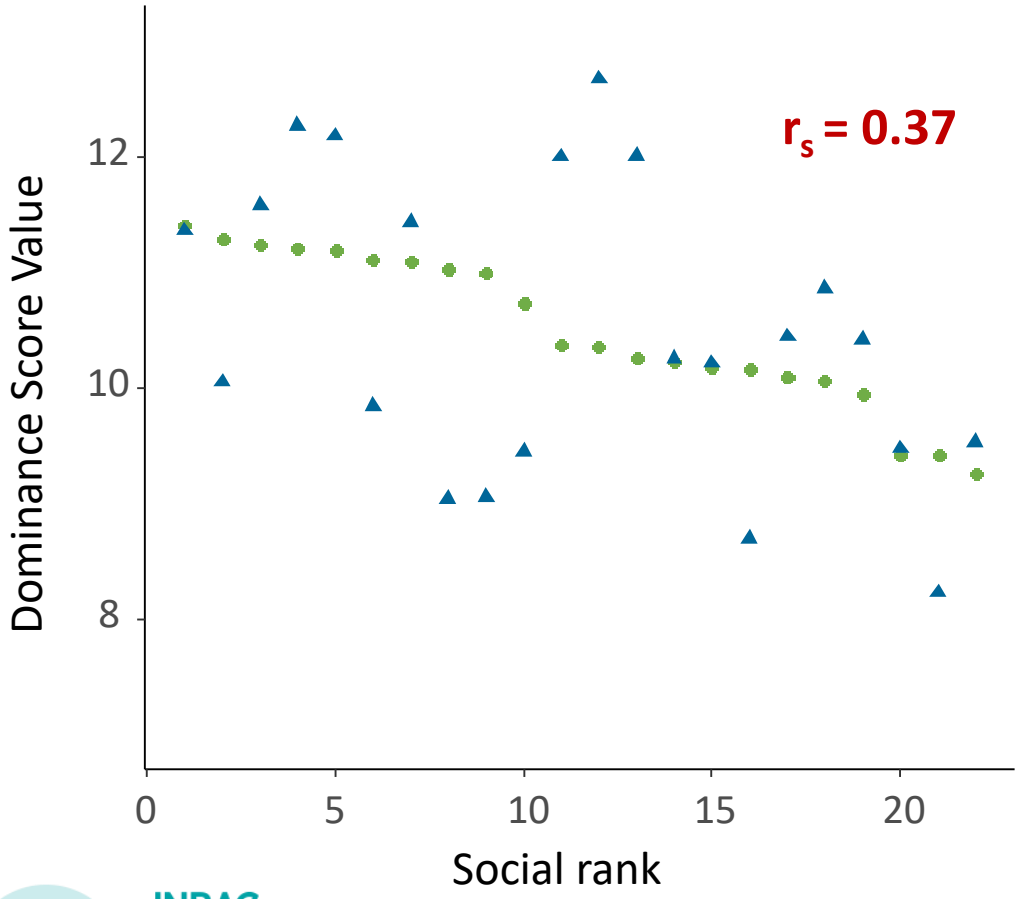
- **Issue**: Replacement = aggressive contact → impossible detection by drinkers
- **Alternative**: duration of interval between two visits?

- determine the **optimal interval for replacement detection (OIRD):**

the threshold of duration interval between two visits below which we can considered that one cow has replaced another

- **Recall** and **Precision** with values of OIRD between 0 and 60s (for each 1s interval). **Replacements observed** = **gold standard**

Results: two distinct social hierarchies at the drinker or out the drinker



9 days :

Out drinker AgI video → n=406

Drinker AgI video → n=336

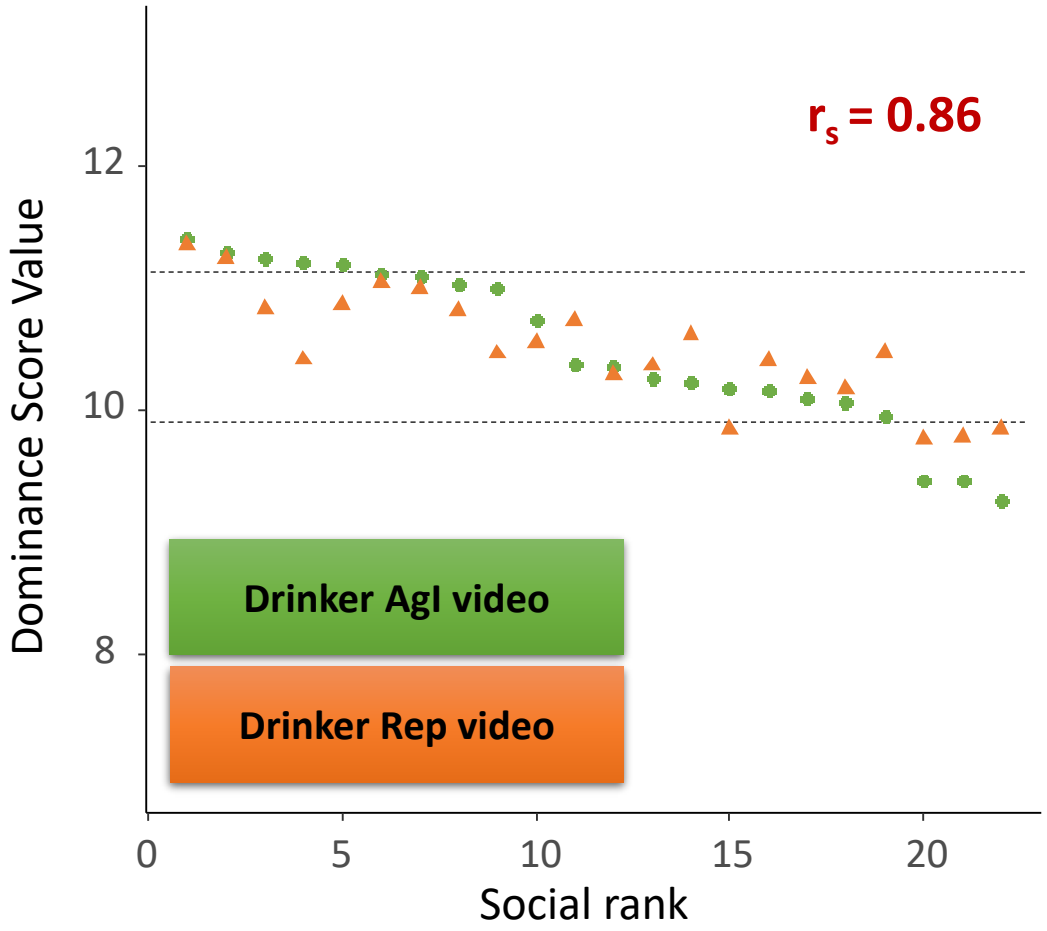
→ Quite competitive drinking conditions in this experiment

→ Despite a high number of drinkers

Drinker AgI video

Out drinker AgI video

Results: using replacements allowed us to obtain a rather good representation of agonistic interactions at the drinkers



→ High proportion of AgI at the drinker is Rep :

Drinker AgI video → n=336
Drinker Rep video → n=257

+ Good Spearman correlation
+ Good detection of the **2 most dominants** and the **3 most subordinates**

- Loss of information on the social ranks of intermediate cows

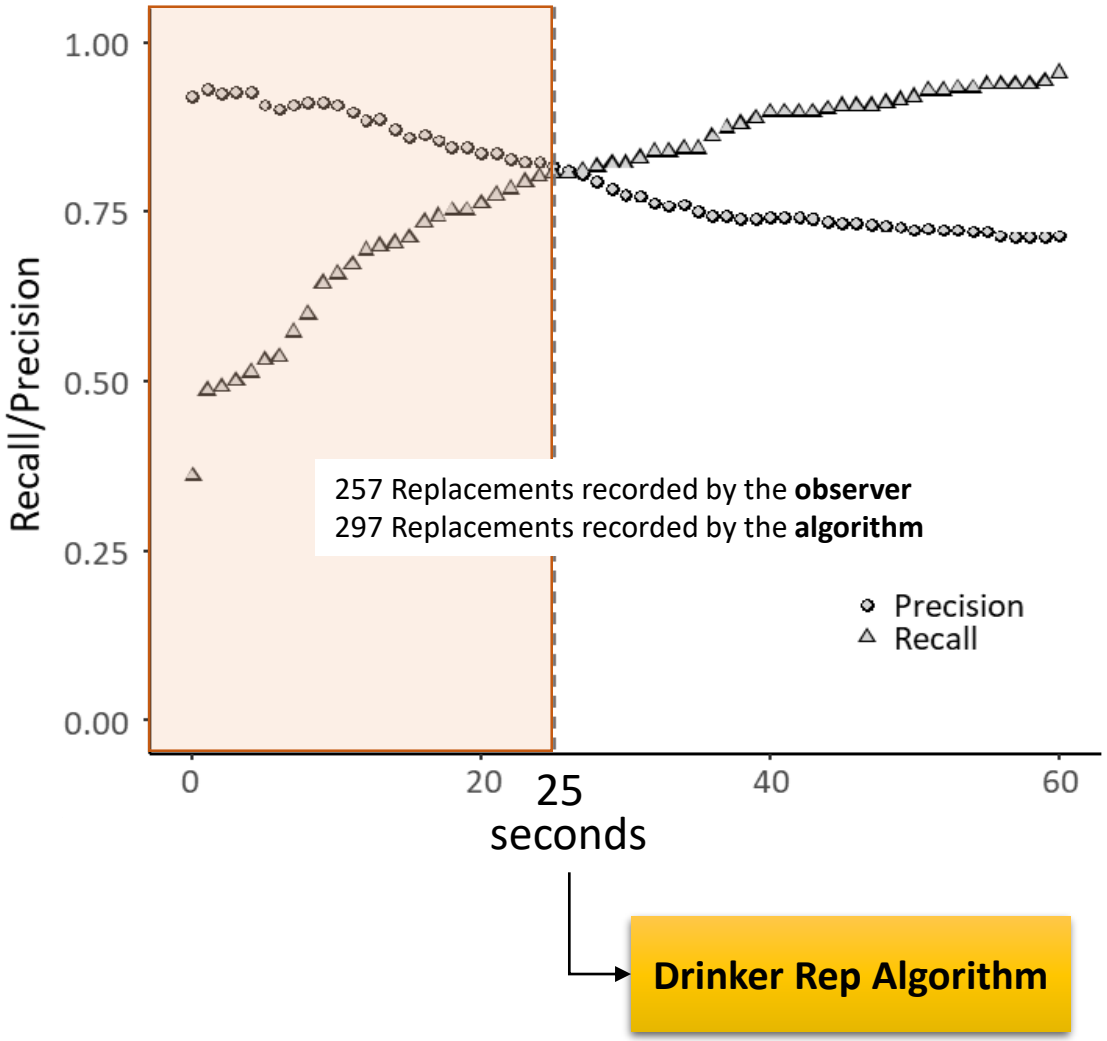
Results: the OIRD in this experiment (no automatic gates) is consistent with other experiments (automatic gates)

→ **OIRD** = better compromise between recall and precision

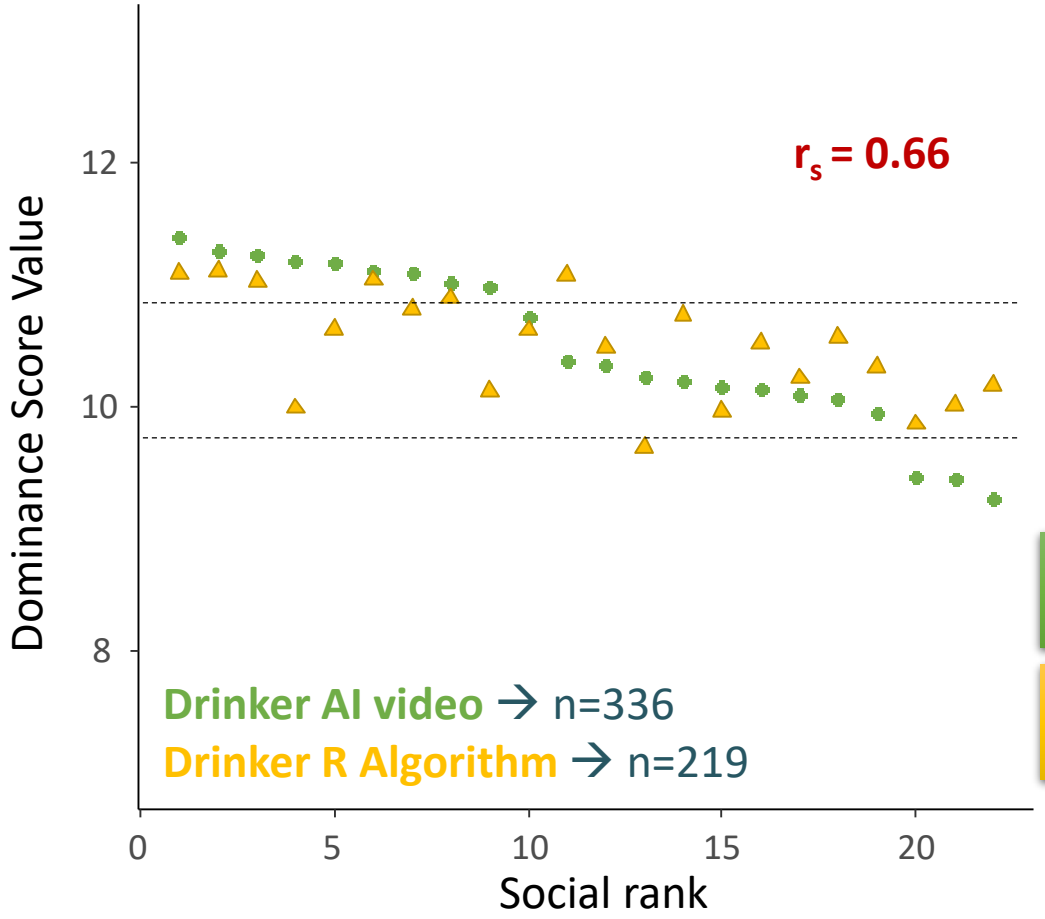
OIRD = 25s

In **total accordance with the bibliography**, independently of the electronic tools used

(Foris et al., 2019, Huzzey et al., 2014; McDonald et al., 2019)



Results: using replacements detected by the algorithm is not enough reliable to illustrate all the agonistic interactions at the drinkers



+ Detect some **most dominants**

- No detection of the **most subordinate** cows

Drinker AgI video

Drinker Rep Algorithm

Conclusion and open questions

- In this experiment, it has been **possible to measure a social hierarchy thanks to 9 days** of AgoI recording at the drinker likely because the drinking conditions were quite competitive

- The social hierarchy measured at the drinker (***Drinker AgI video***) **differed** from that measured out of the drinker (***Out drinker AgI video***)

  → *Drinker AgI video* is **more adapted to investigate** the individual drinking behaviors of cows as a function of their social rank

- The **replacements** identified by video are a **reasonable representation** of agonistic interactions which take place at the drinkers

- The replacements detected by the **algorithm: not reliable enough** to represent the hierarchy at the drinker
  - **No automatic gates**: reduce the number of replacements identified (cows only detected when the flow meter is working)
  - **The lack of automatic gates did not allow reliable automatic detection of replacements but likely allow a measurement of drinking behavior that is more representative of « real life »**

Thanks for your attention

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Acknowledgments :

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