

# Carmela Calabrese

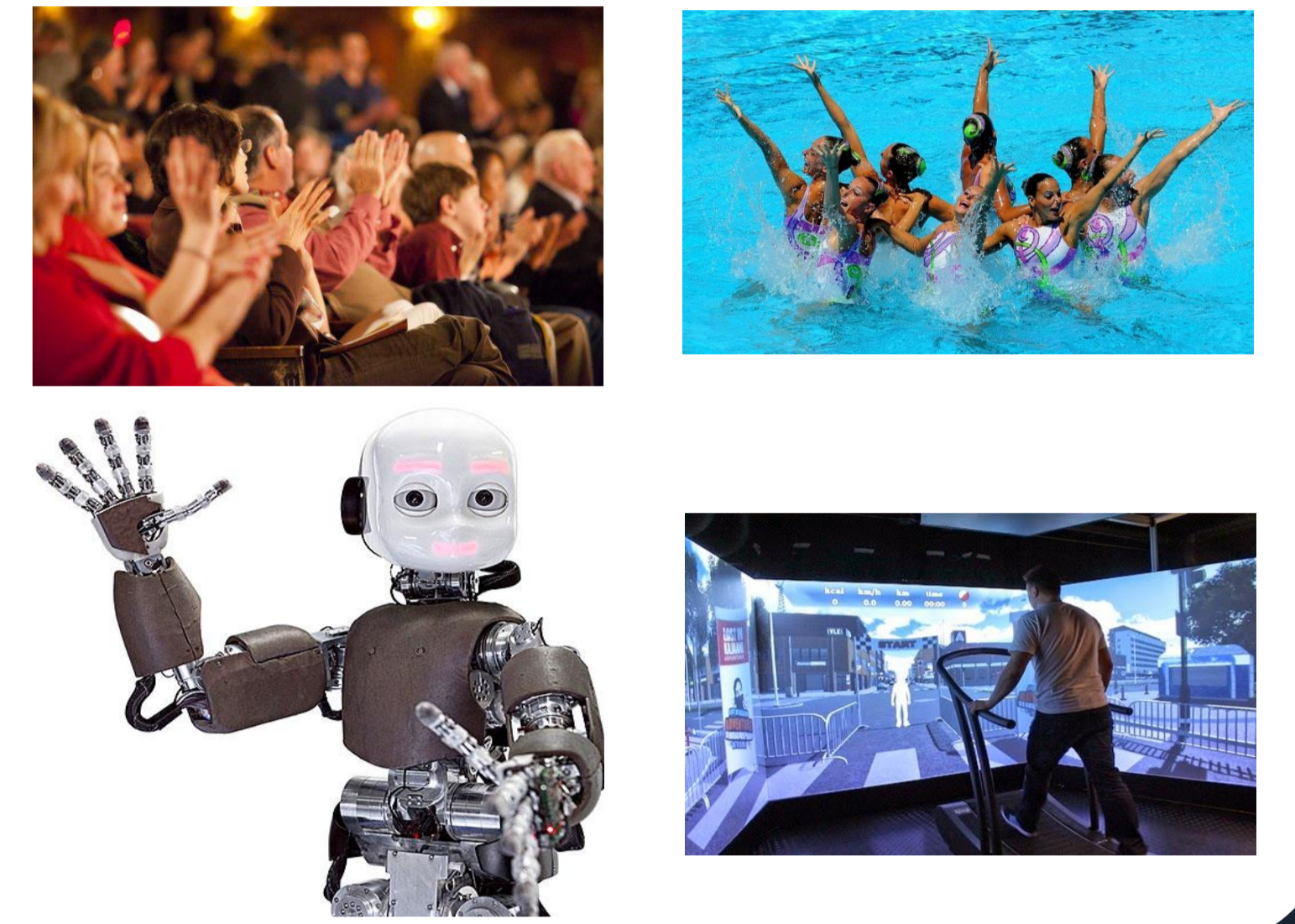
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XXXIII Cycle - II year presentation

## Analysis and control of leadership emergence and human group coordination

### Key research questions

- Many day-to-day activities rely on human group coordination.
- Which factors affect the synchronization?
- How do individual dynamics or the specific interaction pattern affect leadership emergence?
- Which movement strategies are employed by the leaders to steer the dynamics of the rest of the group?



### Applications

- Rehabilitation via exergames in small groups.
- Effective leadership in working and educational groups.

### Methods

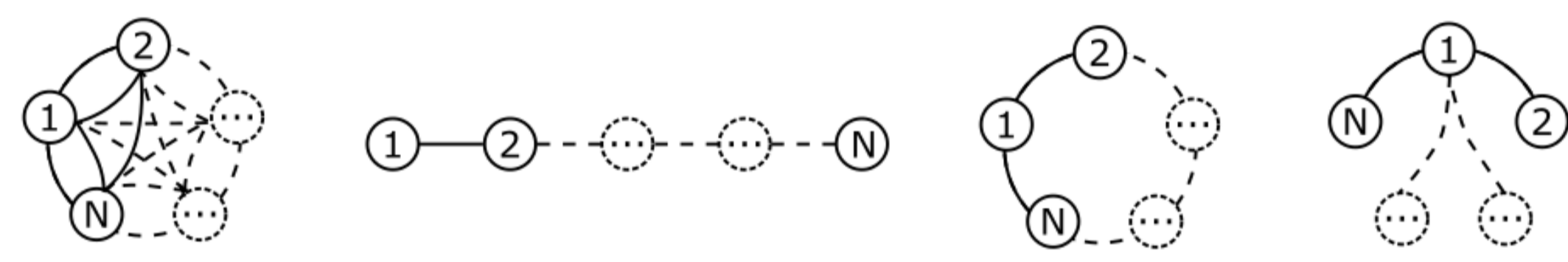
To analyse social dynamics, we considered a group version of an experimental paradigm called *mirror game*.



Experiment 1: Pendula



Experiment 2: Chronos  
(no social dimension)



Spatial configurations of the players

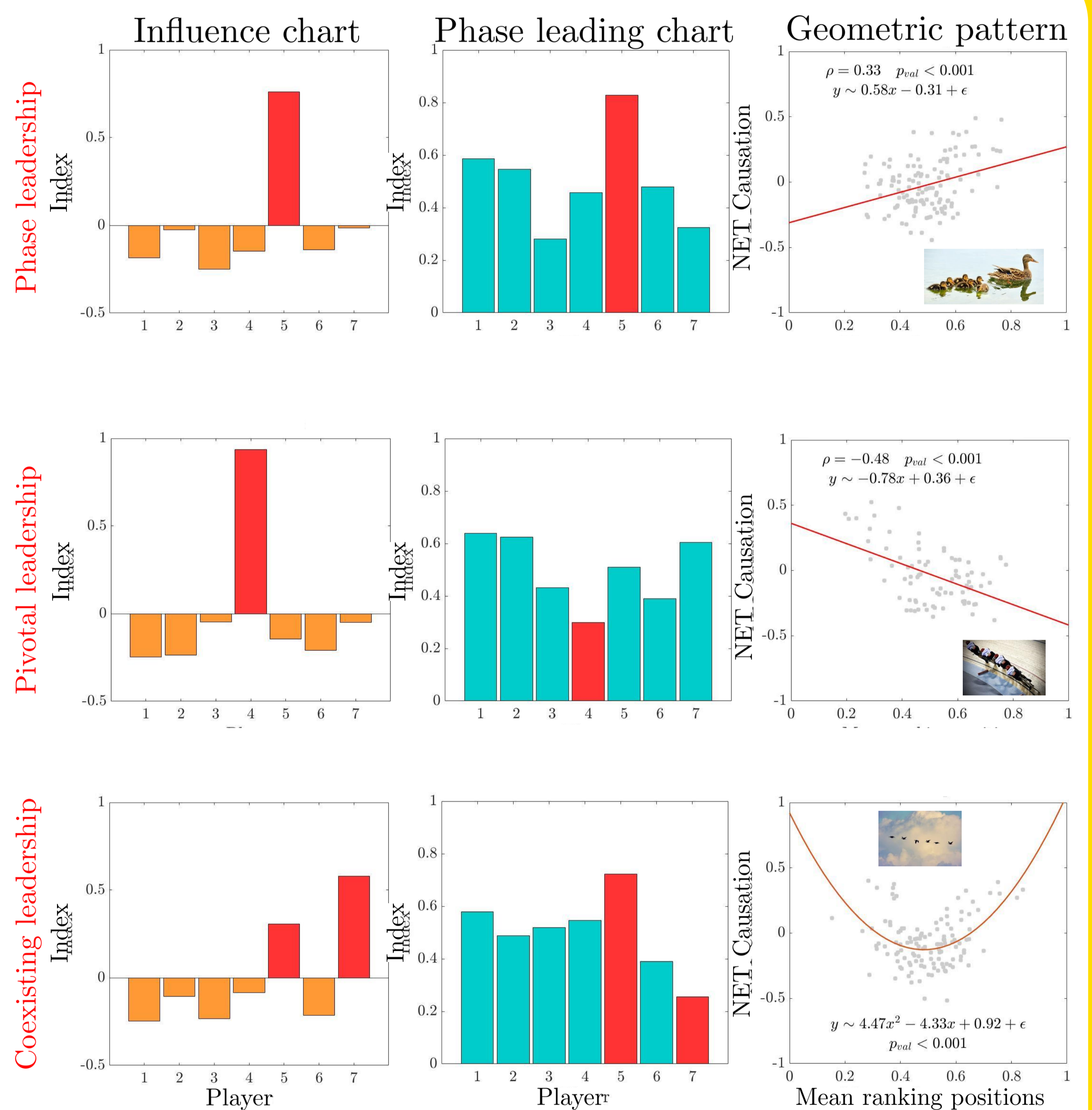
Metrics used to quantify leadership:

- a-mean ranking position in phase,
- b-Net Causation Entropy among the agents,
- c- Gini index.

Polynomial linear regression analysis was run to extract leadership patterns between the metrics a,b.

### Results

1. Three **leadership scenarios** emerge towards group motor synchronization, characterized in terms of **geometric patterns** (see Figure).
2. Spatial configuration influence the emergence of leadership scenarios.
3. Leader role is distributed across group agents (**shared leadership**).
4. Social dimension **does not affect** leadership patterns occurrence.



### Contacts and Acknowledgements

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### Future developments

$$\dot{\theta}_i(t) = \omega_i + c \sum_{j=1}^{N_{players}} a_{ij} \sin(\theta_j(t) - \theta_i(t))$$

- Experimental work: human behavioural rules behind collective decision making are still unknown but the assumption of unweighted interactions is unrealistic. How could we infer them?
- Theoretical work: exploring synchronization in a network of stochastic Kuramoto oscillators.