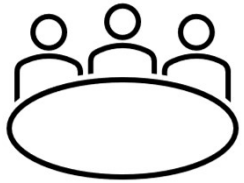


# Project presentation

Jeanne Bruneau--Bongard

Supervisor: Thomas Brochhagen

Universitat Pompeu Fabra Barcelona

Computational Linguistics and Linguistic Theory

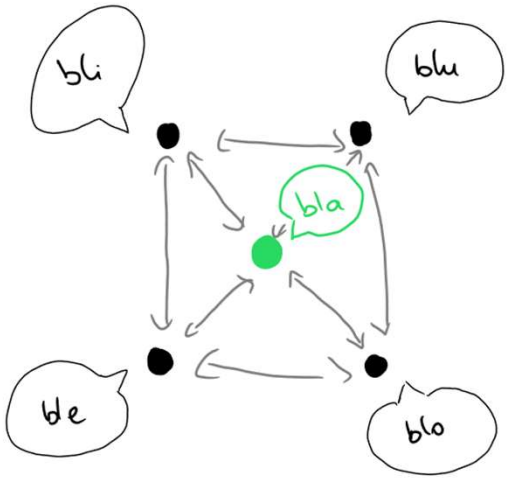
# Emergent Communication with NN agents

- Computational simulations of language emergence
- Agents are presented with a task, and communication is a means to achieve their goals
- No ex-ante semantics / usage rules for the symbols in the beginning
  → Meaning and syntax emerge through game play

Lazaridou, Angeliki, and Marco Baroni. 'Emergent Multi-Agent Communication in the Deep Learning Era'. arXiv, 14 July 2020. https://doi.org/10.48550/arXiv.2006.02419.

# Project @COLT

- Study the influence of central agents on communication protocols in communities of deep neural agents



# Project @COLT

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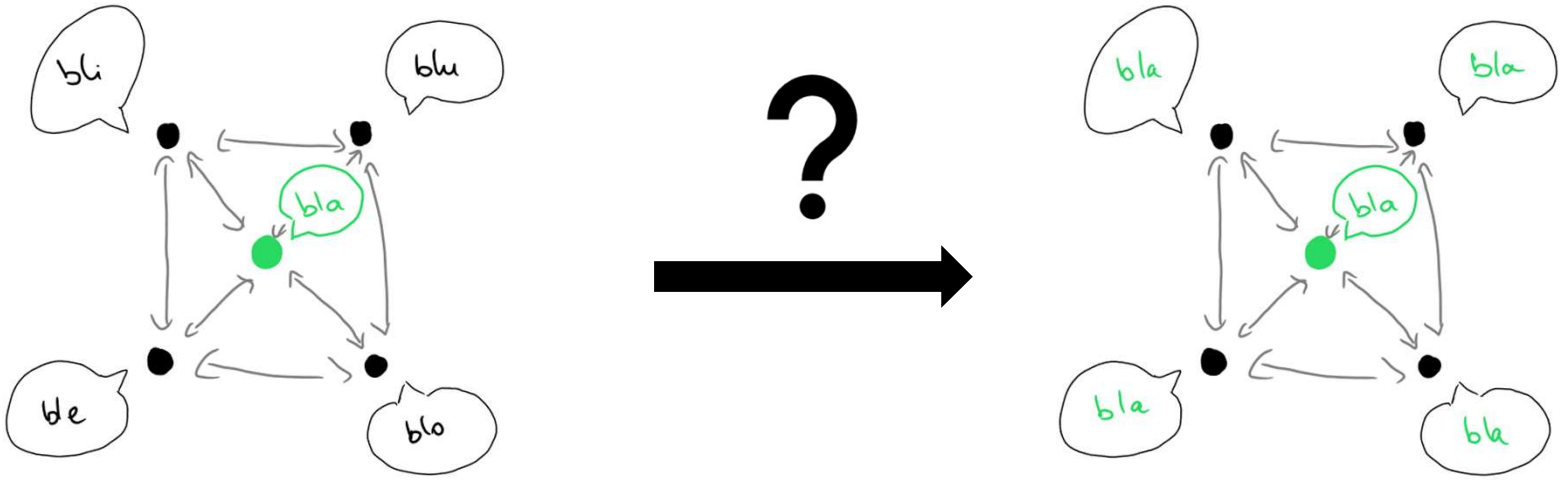
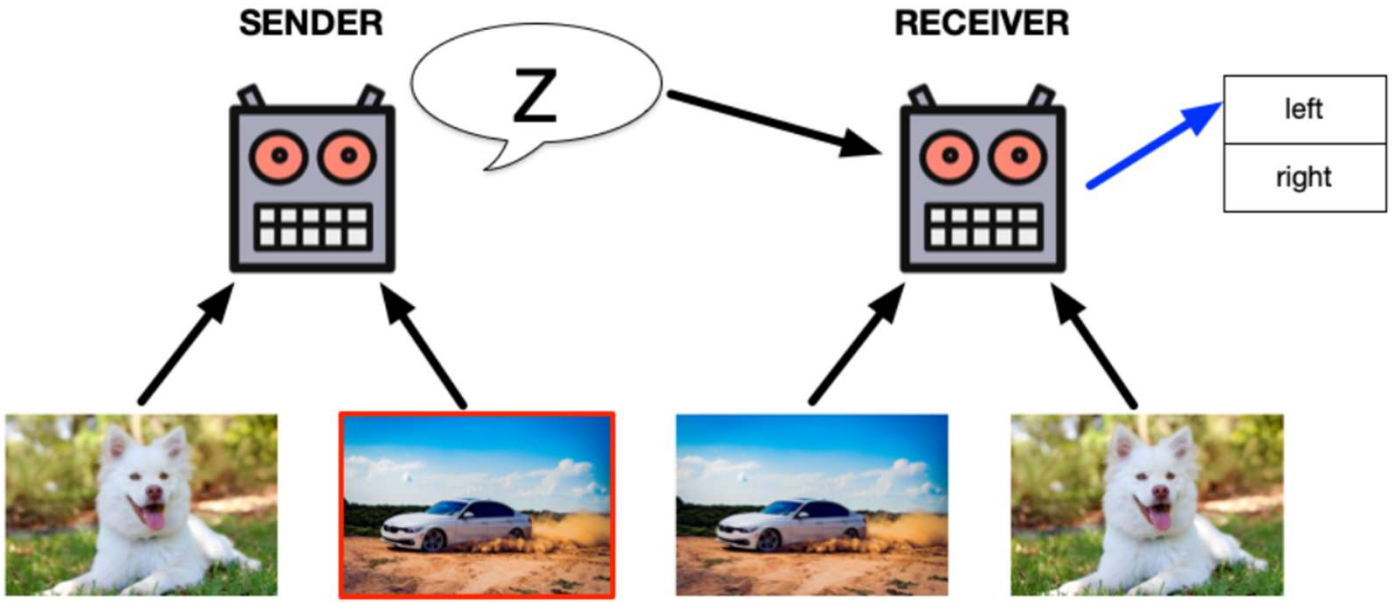


# General framework: communication task

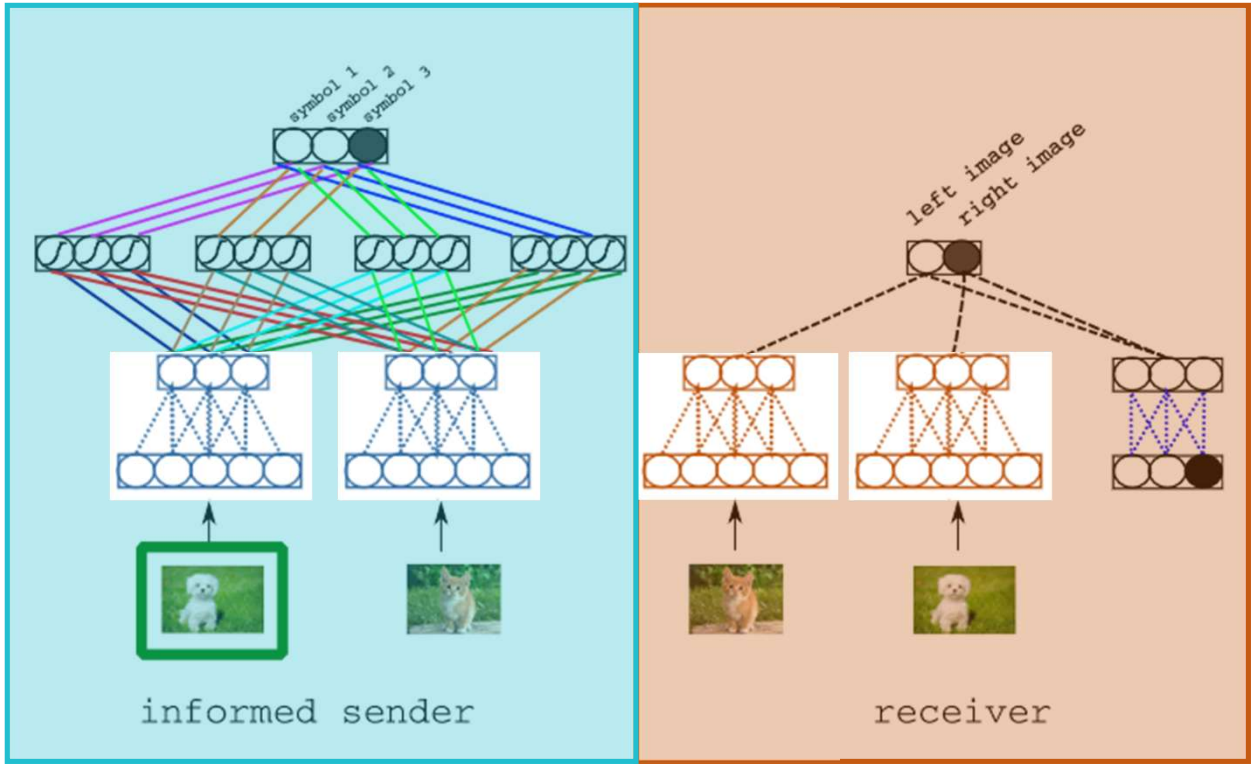
## Referential game




Lazaridou, Angeliki, and Marco Baroni. 'Emergent Multi-Agent Communication in the Deep Learning Era'. arXiv, 14 July 2020. https://doi.org/10.48550/arXiv.2006.02419.

# General framework: architecture of the agents

Sender = an agent

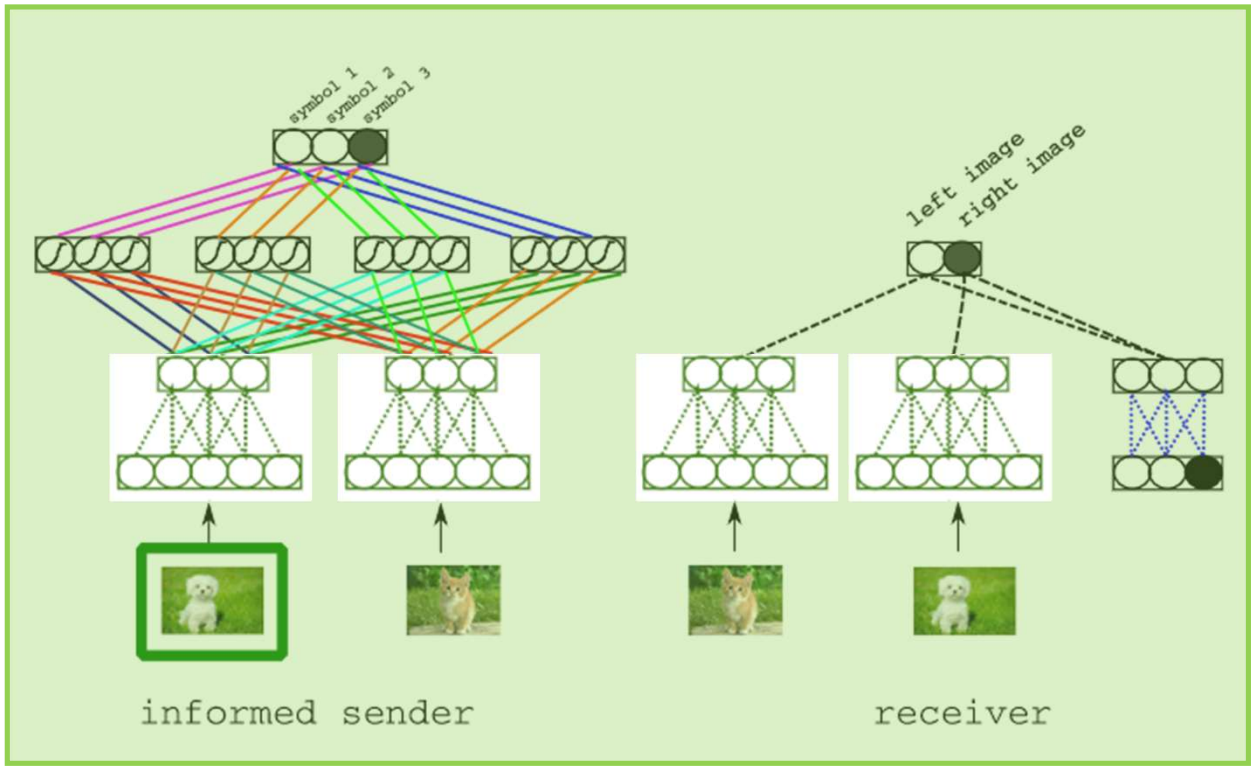



Receiver = another agent

Lazaridou, Angeliki, Alexander Peysakhovich, and Marco Baroni. 'Multi-Agent Cooperation and the Emergence of (Natural) Language'. arXiv, 5 March 2017. http://arxiv.org/abs/1612.07182.

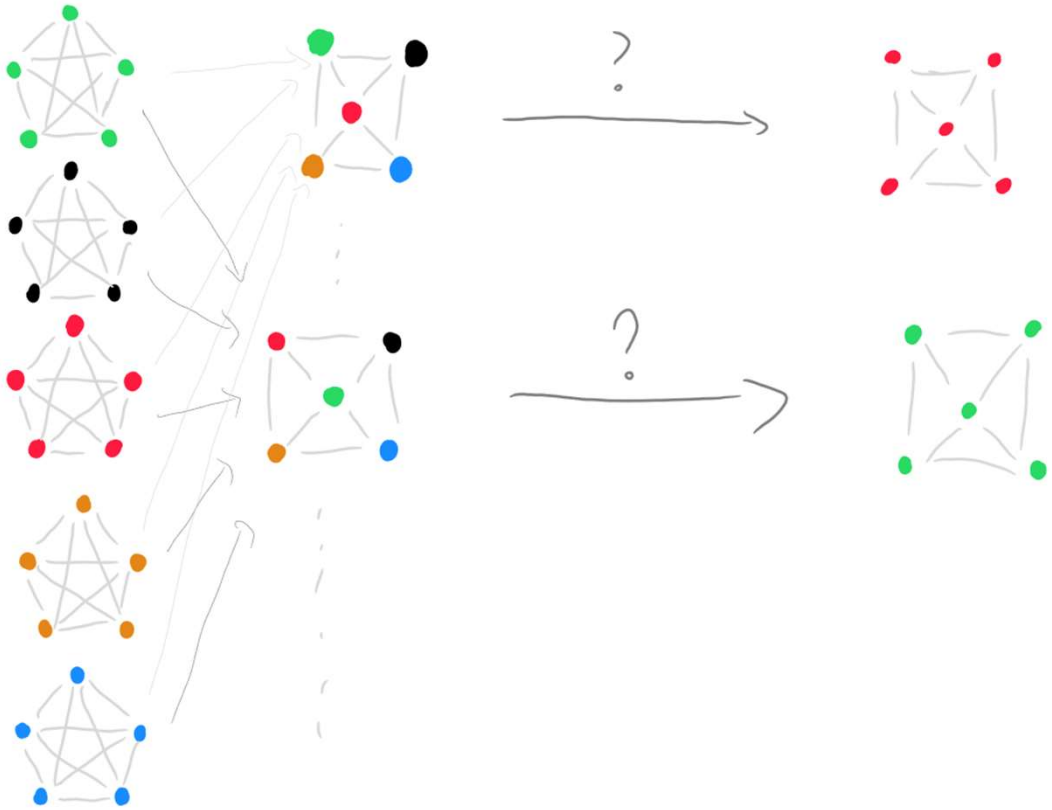
# General framework: architecture of the agents

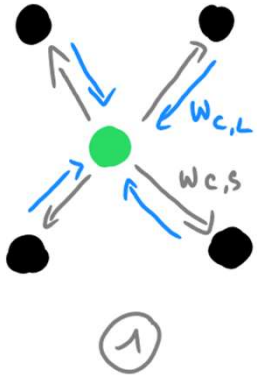
Agent =
Sender + Receiver

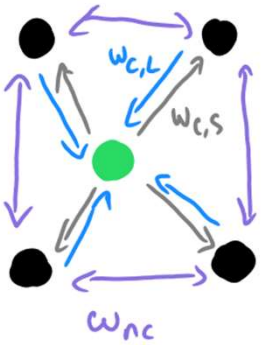


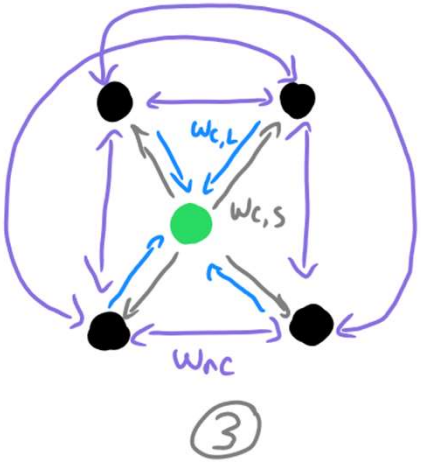

Lazaridou, Angeliki, Alexander Peysakhovich, and Marco Baroni. 'Multi-Agent Cooperation and the Emergence of (Natural) Language'. arXiv, 5 March 2017. http://arxiv.org/abs/1612.07182.

# 1st experiment: influence of a central node



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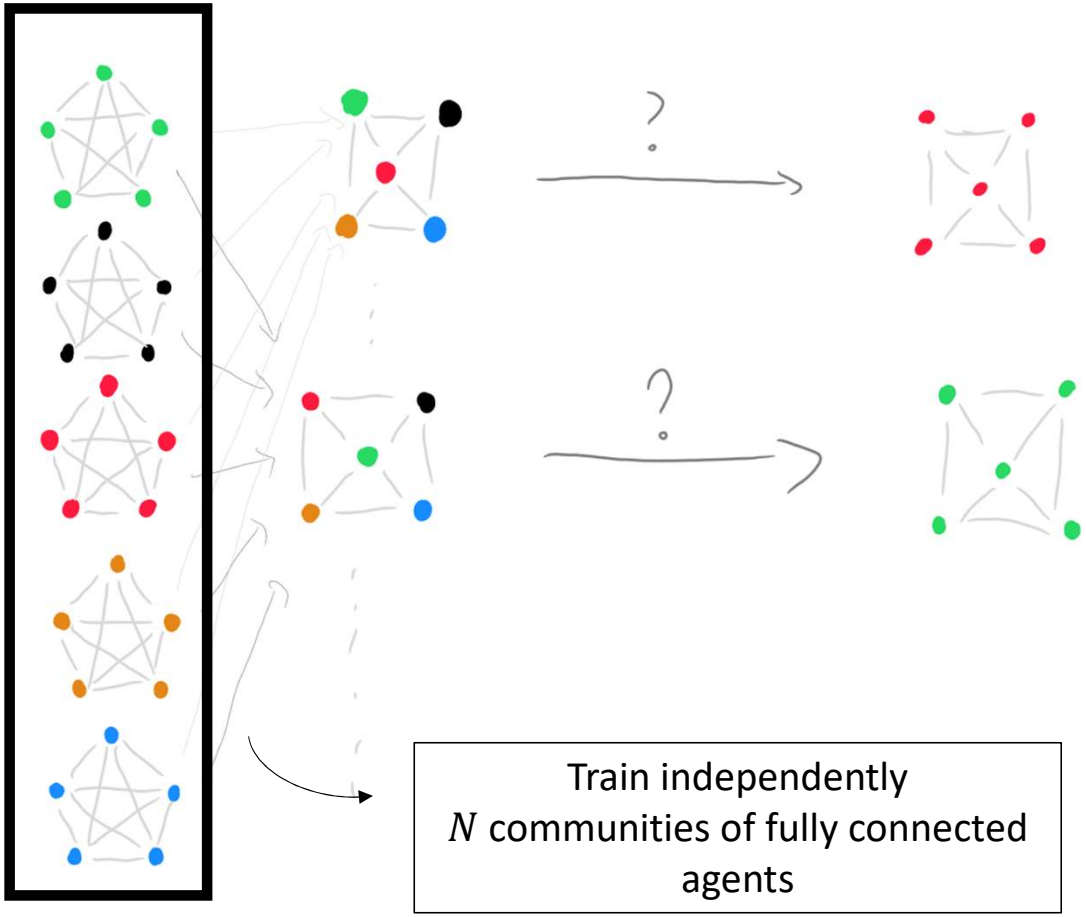
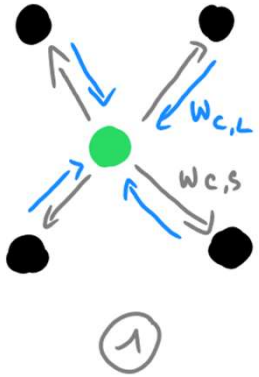
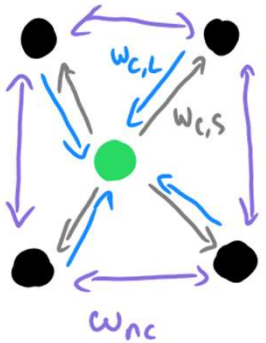
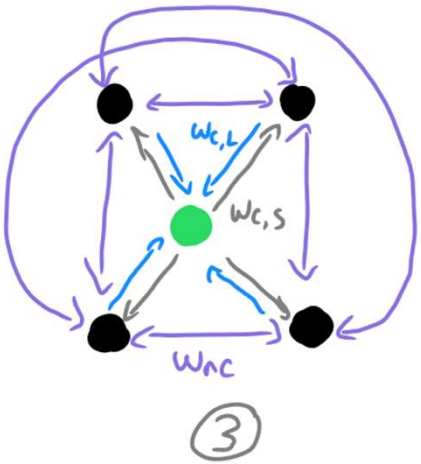



Train independently
$N$ communities of fully connected agents



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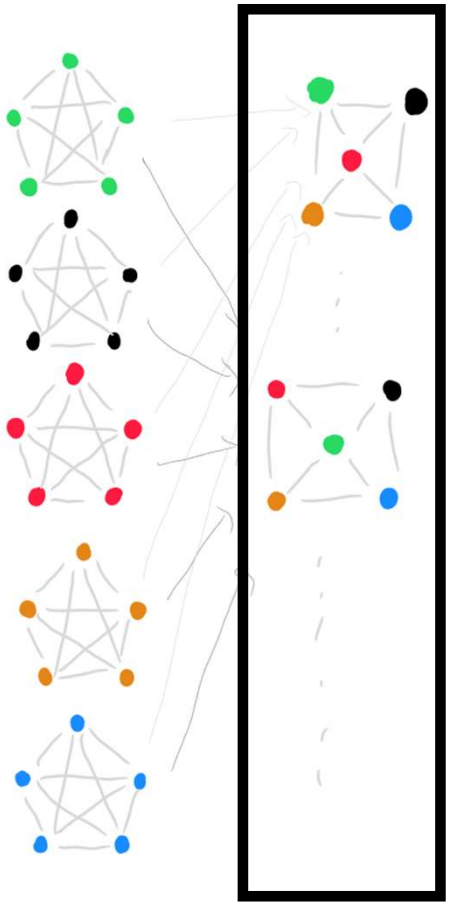
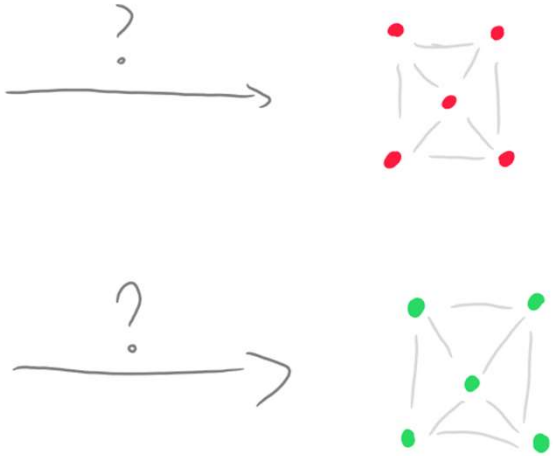
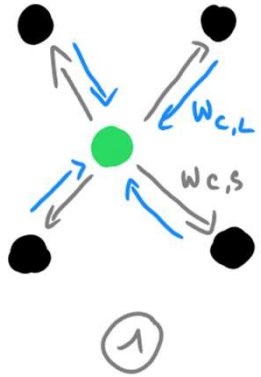
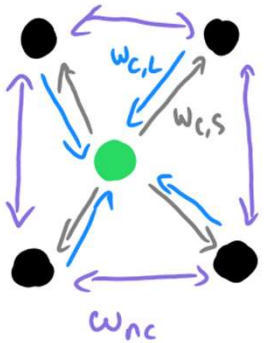
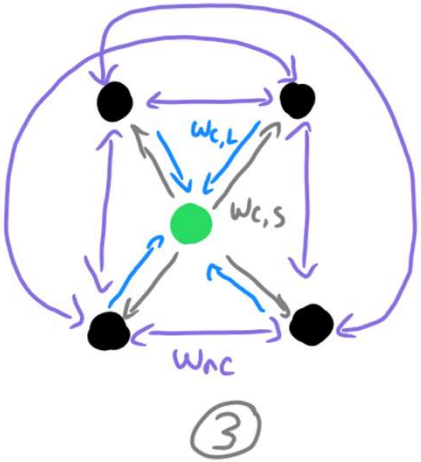




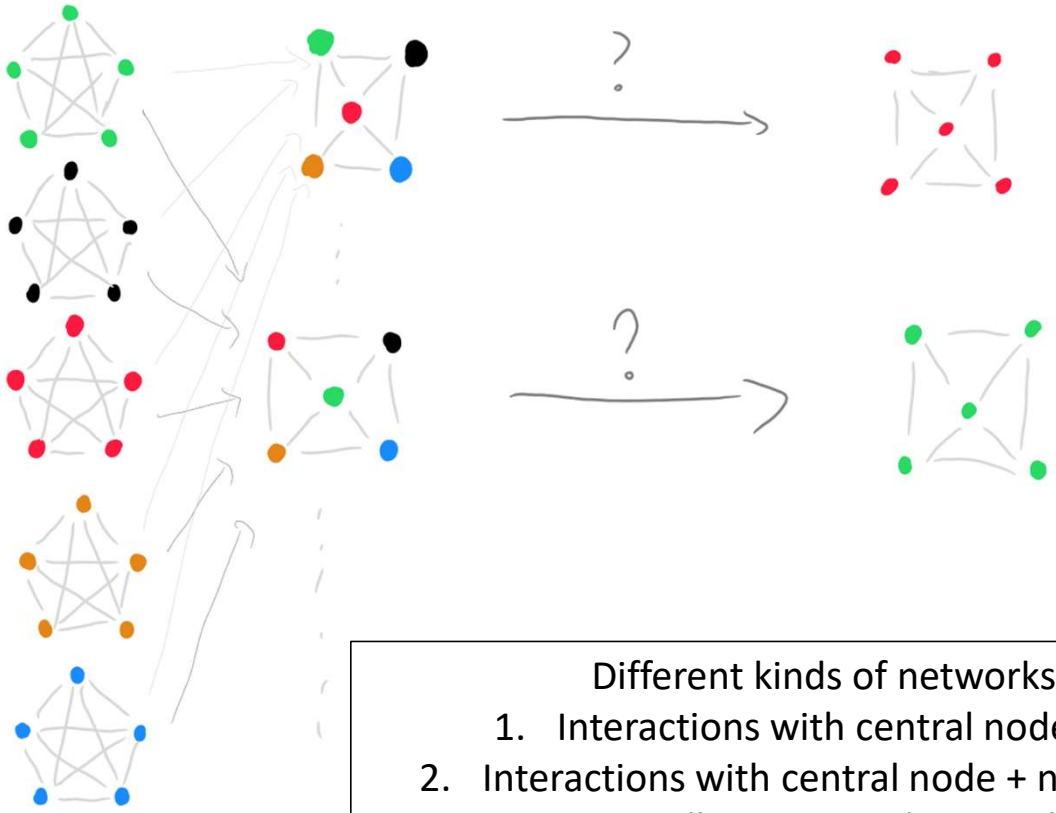



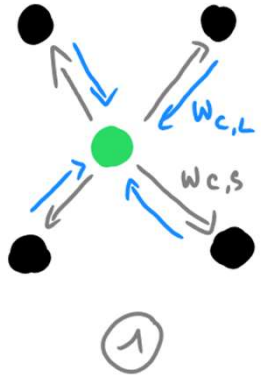



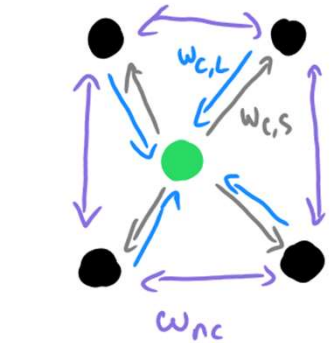



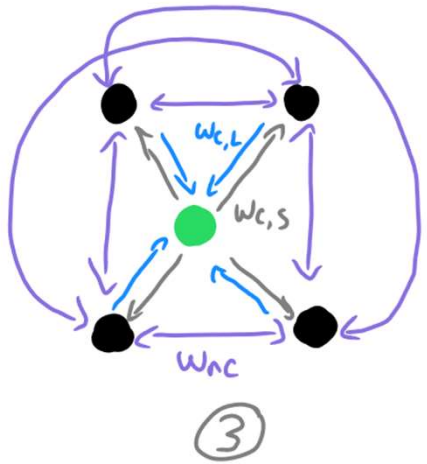

Create new communities with agents from different previous communities → central agent

# 1st experiment: influence of a central node



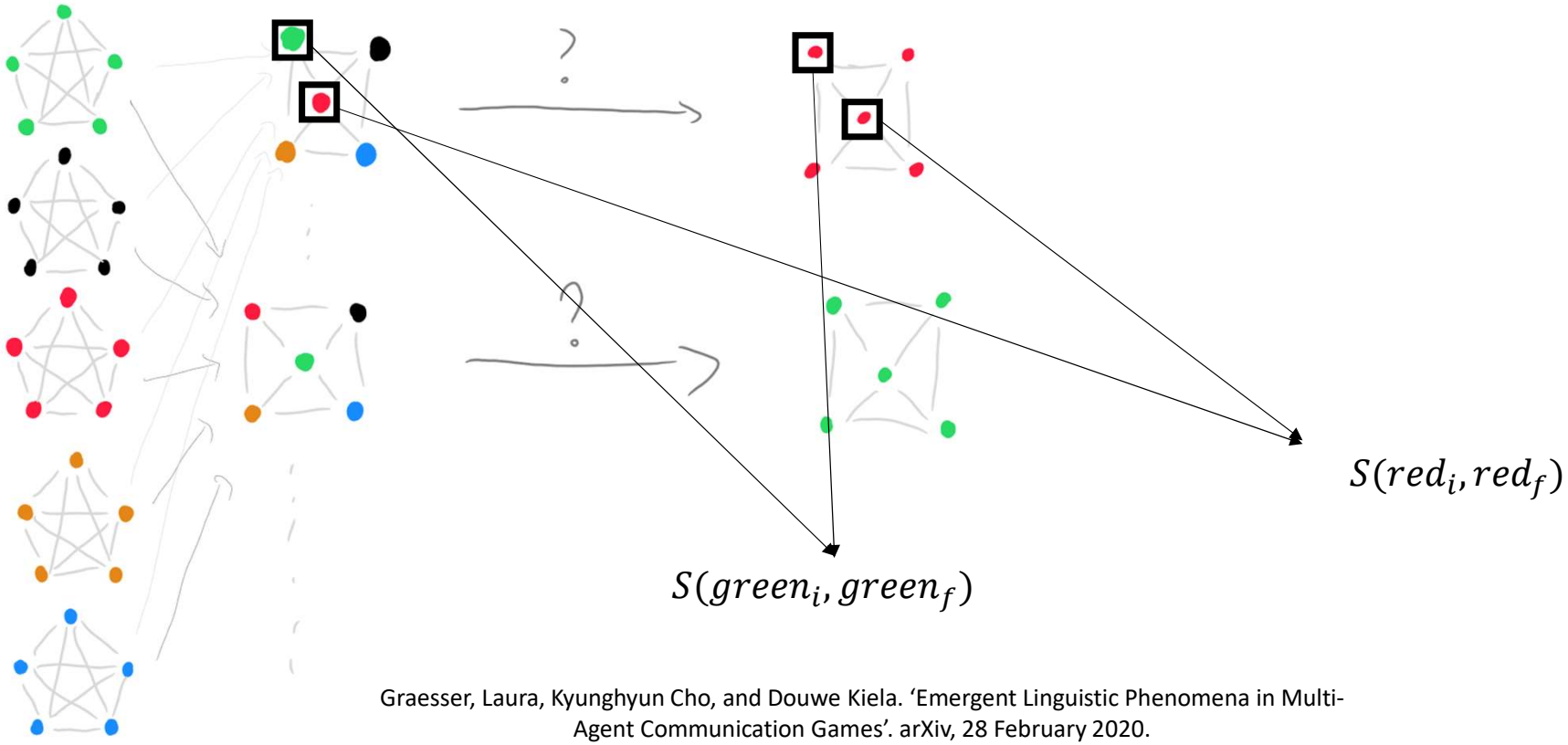




Different kinds of networks

1. Interactions with central node only
2. Interactions with central node + neighbours
3. Fully connected network

# 1st experiment: influence of a central node

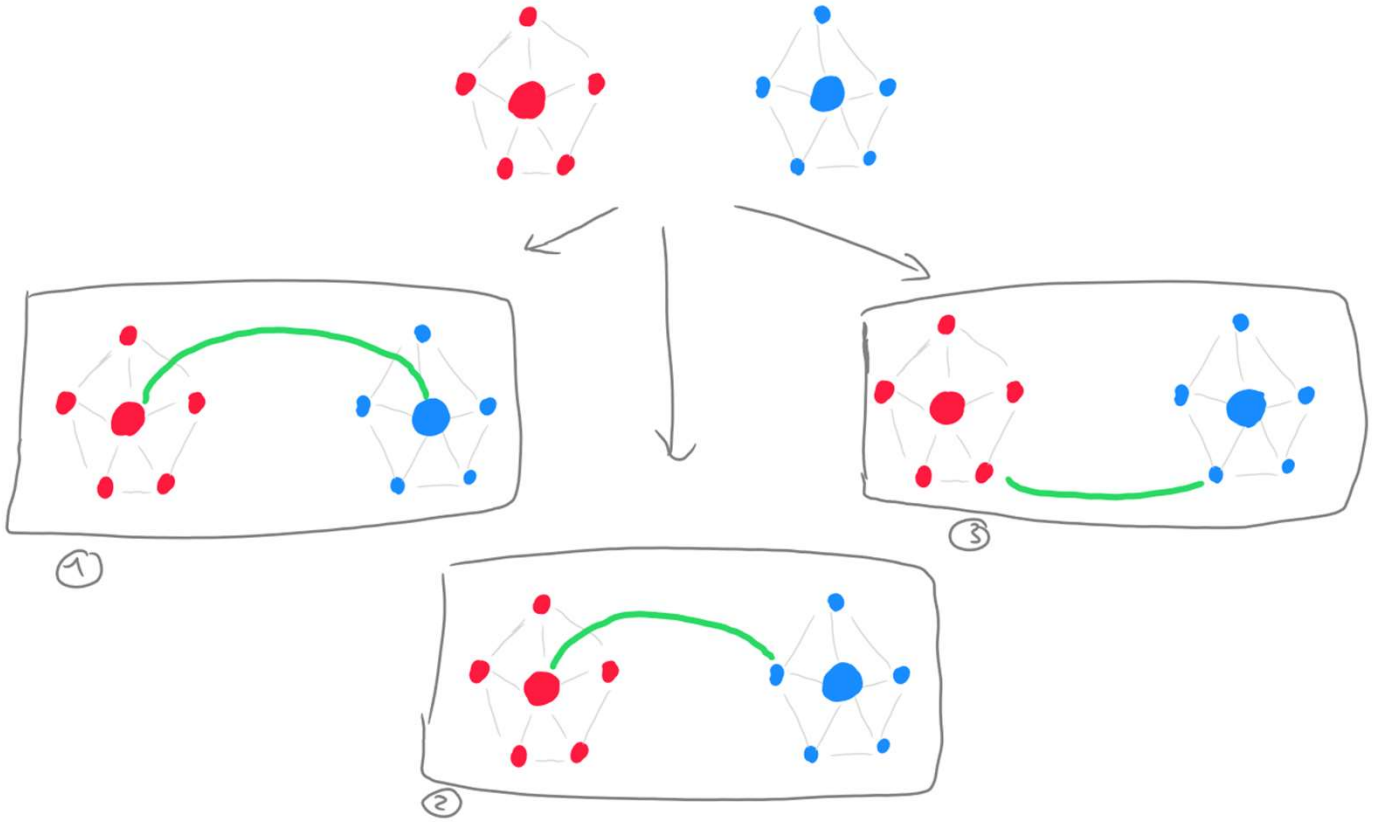



Graesser, Laura, Kyunghyun Cho, and Douwe Kiela. 'Emergent Linguistic Phenomena in Multi-Agent Communication Games'. arXiv, 28 February 2020. https://doi.org/10.48550/arXiv.1901.08706.

# 1st experiment: influence of a central node

- Is centrality useful for coordination?
- Influence of centrality on the speed of convergence
- Degree of unilateral / bilateral adaptation as a function of network topology

# 2nd experiment: merging 2 communities with central agents



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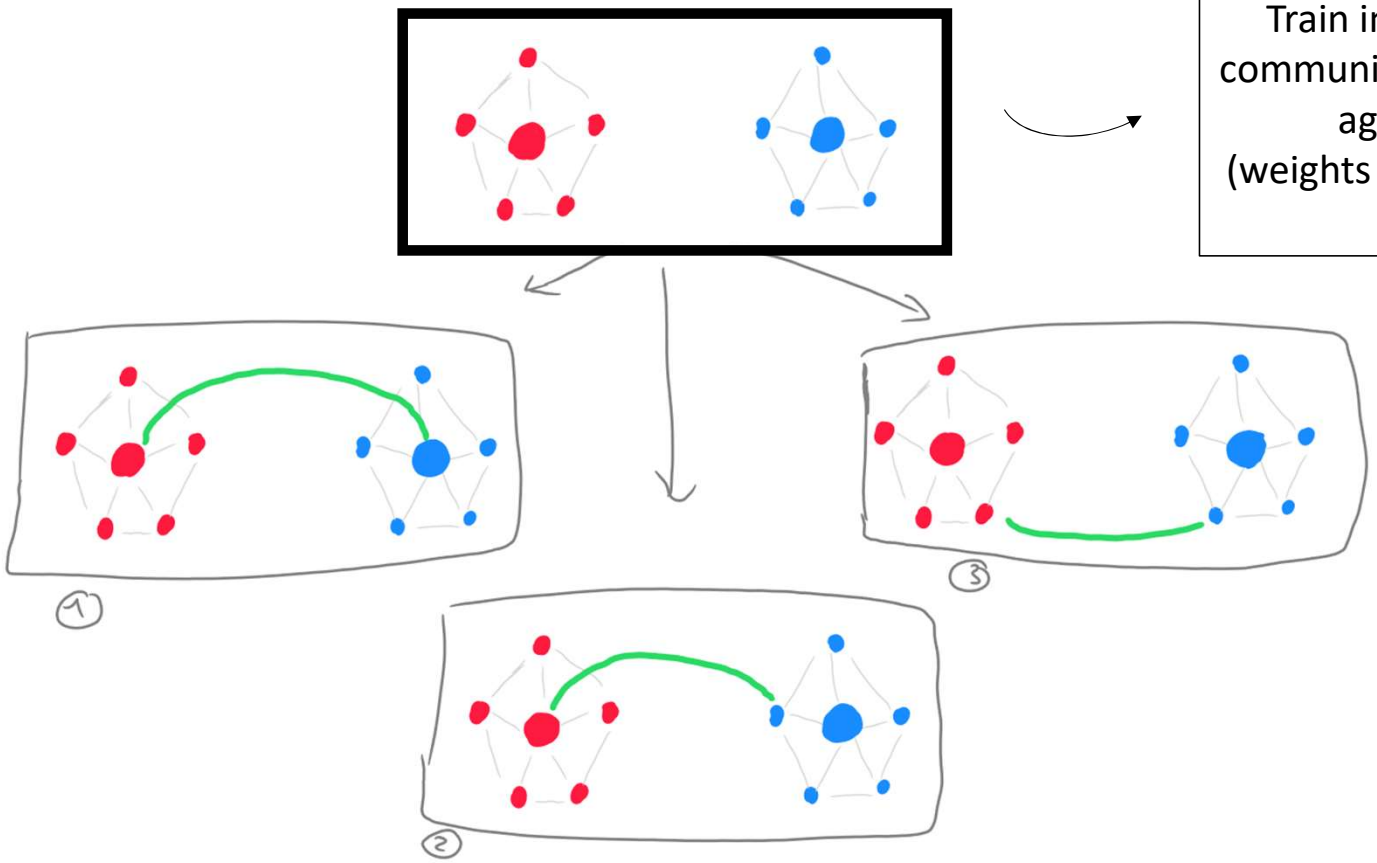
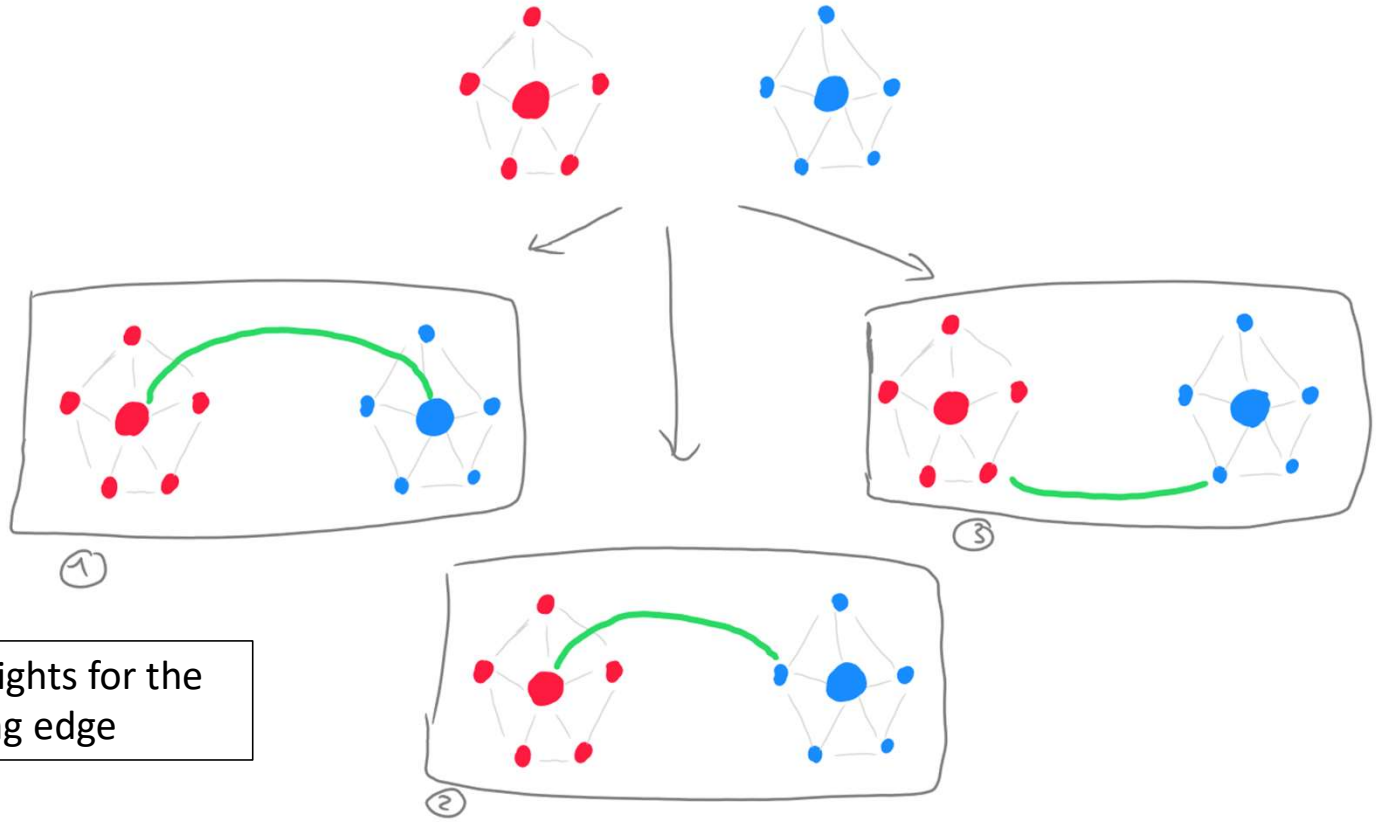


Train independently 2 communities with a central agent in each (weights chosen according to exp 1)

# 2nd experiment: merging 2 communities with central agents

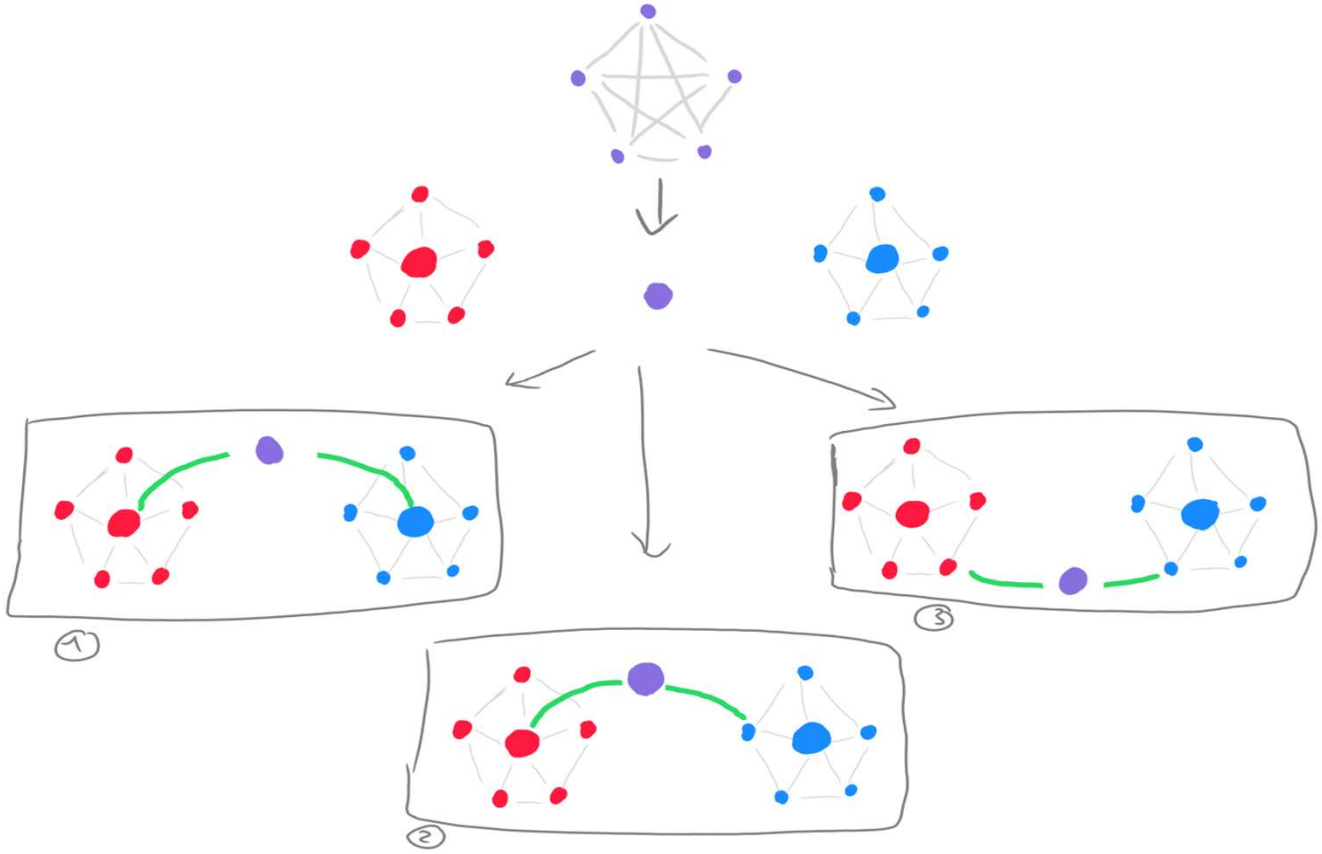


Variable weights for the bridging edge

# 2nd experiment: merging 2 communities with central agents

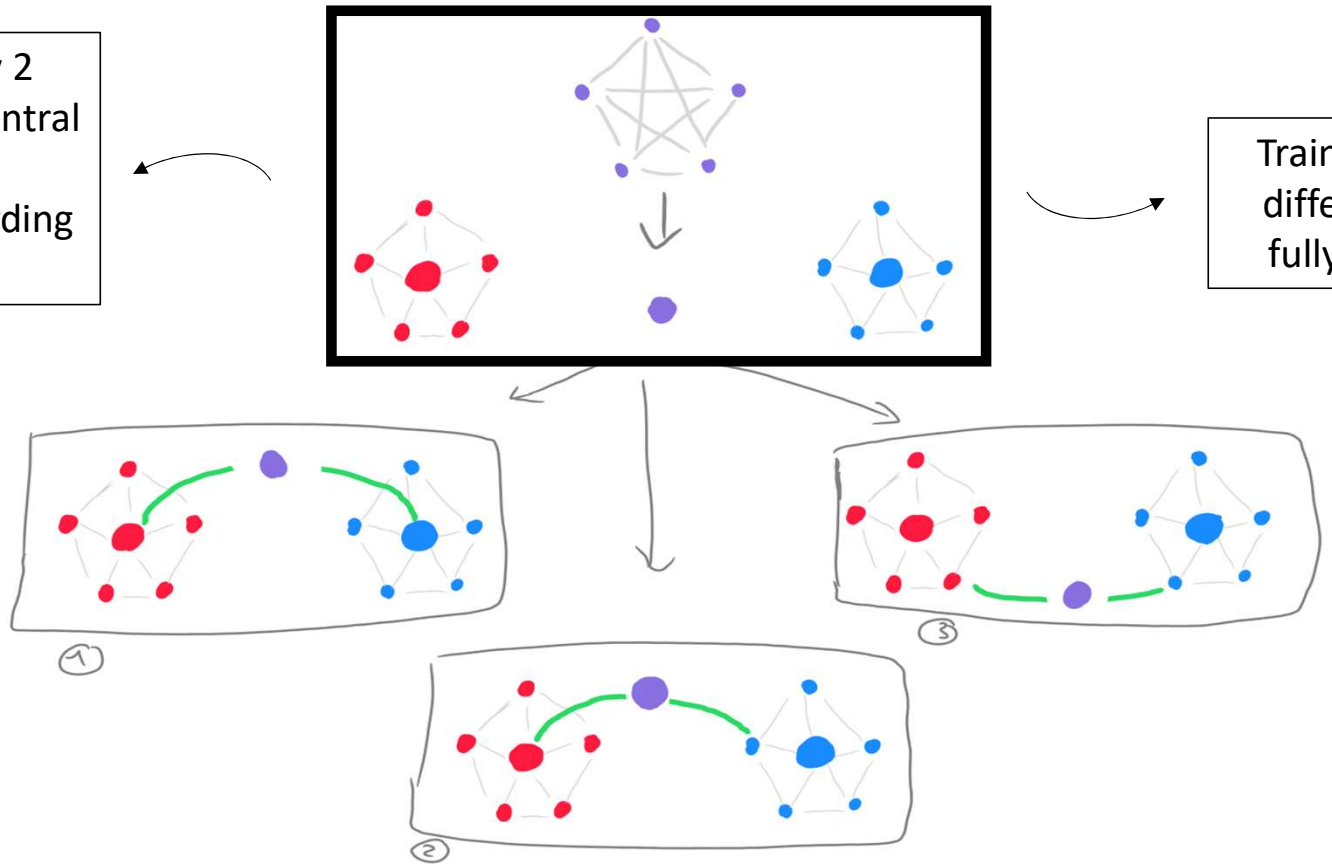
- Does centrality come with broadcasting power?
- Are central agents necessary for the whole community to adapt?
  (control setup where initial communities have no central nodes)
- Do central agents speed up the process of adaptation?
- Do agents further away from the bridging edge have trouble adapting?

# 3rd experiment: merging 2 communities with central agents | bridge agent



# 3rd experiment: merging 2 communities with central agents | bridge agent

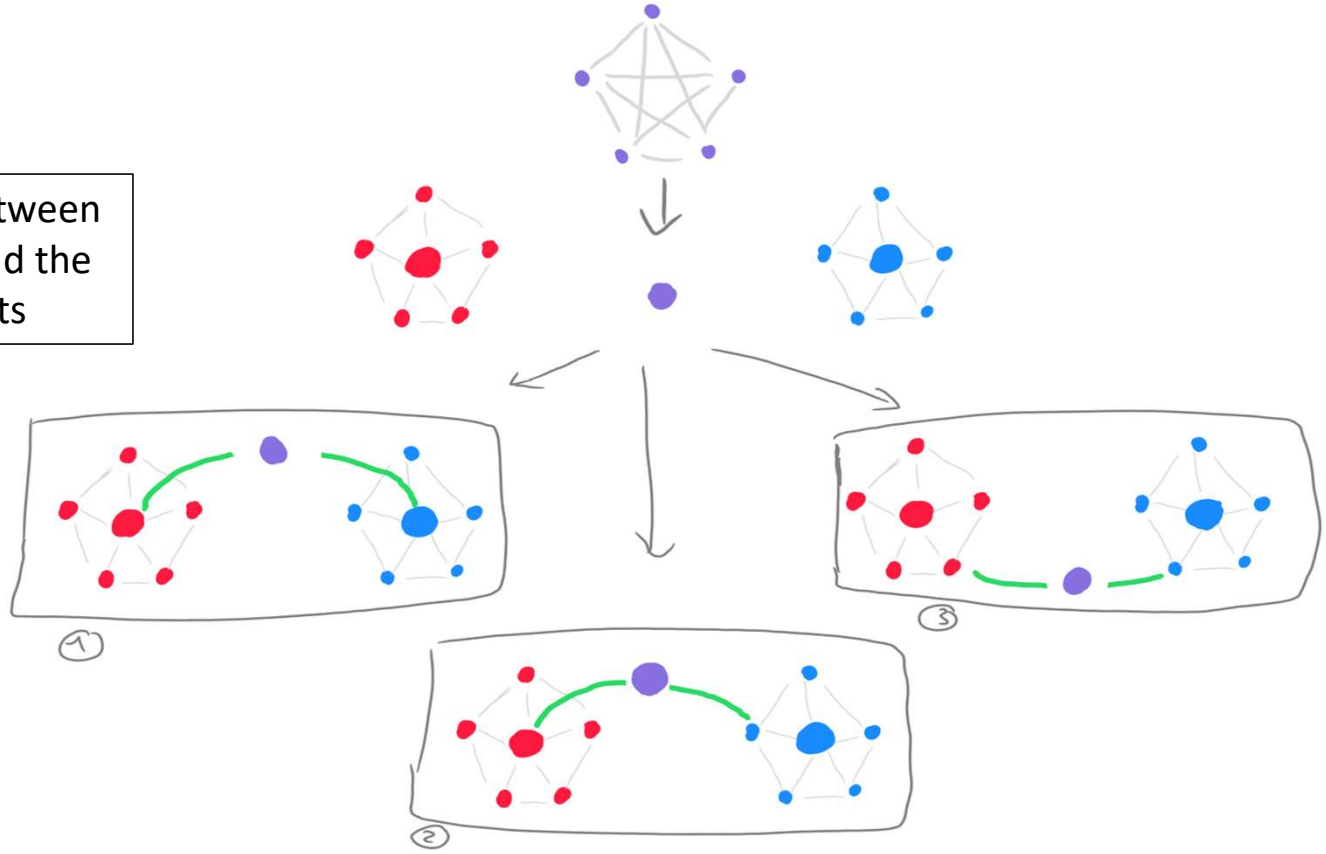
Train independently 2 communities with a central agent in each (weights chosen according to exp 1)



Train another agent in a different community of fully connected agents

# 3rd experiment: merging 2 communities with central agents | bridge agent

Variable weights between the bridge agent and the two other agents



# 3rd experiment: merging 2 communities with central agents | bridge agent

- How useful it is to have a bridge agent rather than communities interacting directly?
- Does the bridge agent influence other agents or does he act more as a translator?