P34 - RU1

Weighing personal and social information in cooperative problem solving

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This poster uses **augmented reality**

(1) **Scan** the code on the left with your phone.
(2) **Watch** AR content by aligning the camera with an image labelled with AR
(3) **Pin** content using the pin icon ( ) to keep watching on the go

How to balance your own knowledge with observation from others?

- This is a **fundamental challenge** in cooperative problem solving.
- Being **too individualistic**, useful information can not spread in the group.
- Being **too social**, the group might not explore enough available solutions to a problem.

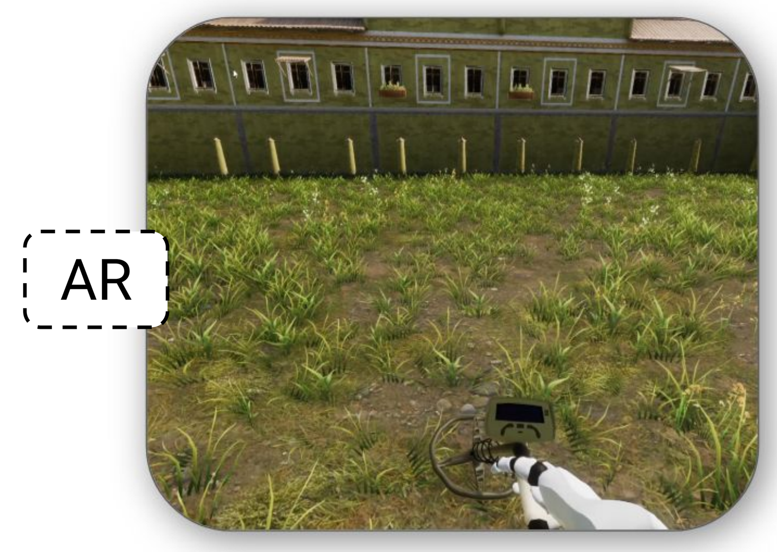
Why we study collective foraging to answer this question?

- **What is it?** Searching for resources in the environment as a group.
- **Examples?** Think about mushroom hunting or looking for hidden treasures with friends, or search and rescue after natural disasters.
- **Is it a good testbed?** Yes! For optimal foraging, your own knowledge about discovered resources (private information) and observations about the discoveries of others (social information) has to be balanced.

How humans forage together in immersive reality?

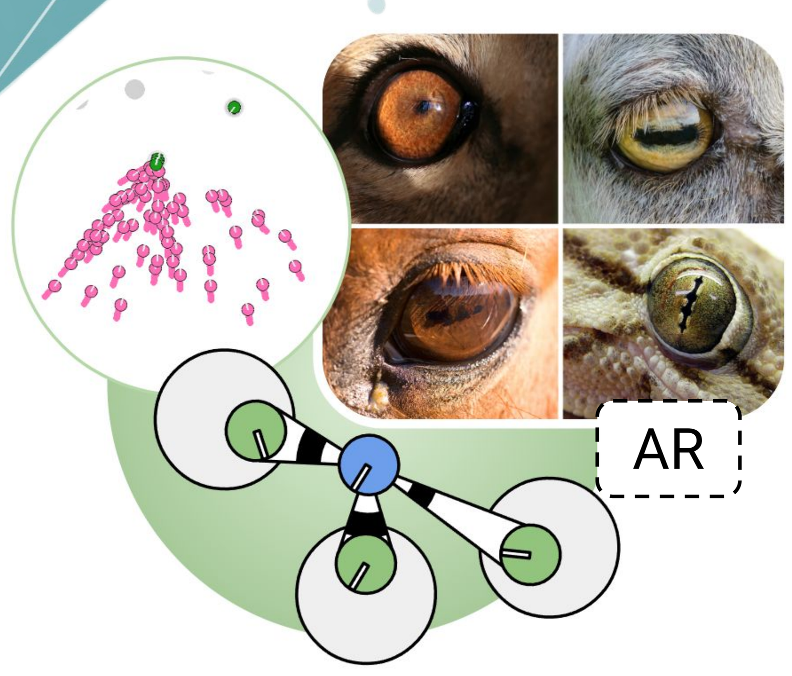
Avatar in immersive reality
by Benjamin Kahl
(watch in 3D with AR)

- **Immersive reality?** Participants search for hidden coins underground with a metal detector in a videogame. They can also see when others find something.
- **What is the optimal foraging strategy?** It depends on the environment!
- **Role of environment?** When there are few rich patches with many coins it is better to rely on others. When coins are distributed evenly in the environment it is better to search on your own.
- **Competitive vs. Cooperative?** The goals and incentives of participants change how they behave. When rewarded as a group (and not on an individual basis) participants stopped overusing social information and became more efficient.



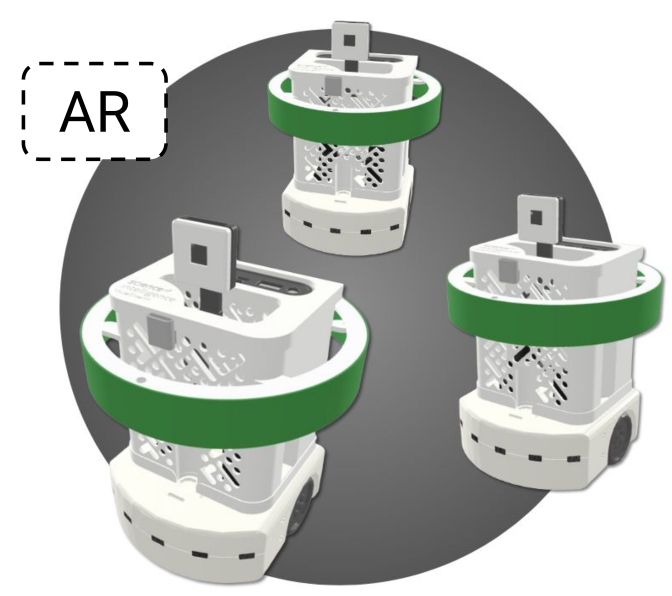
Immersive reality experiment
Deffner et al. @ NatComms
(watch video/paper in AR)

How do we synthesize collective foraging behavior?



Agent-based modeling framework
and inspiration photo by Banks et al.
Mezey et al. @ PLOS
(watch video/paper in AR)

- **Computational models?** We developed a novel computational model to study social information use in collective foraging.
- **Why novel?** Agents in our model only use their vision. This allows to study the effects of embodiment and perception on foraging behavior, such as field of view or visual occlusions.
- **Embodiment and perception?** Limitations of a real world shape behavior and optimal strategies. We have to account for these in models to understand and synthesize intelligent behavior in the real world.
- **Why Foraging robots?** As a next step we transfer our model to a swarm of robots foraging in a mixed reality environment (CoBe) to better understand the impact of such limitations.

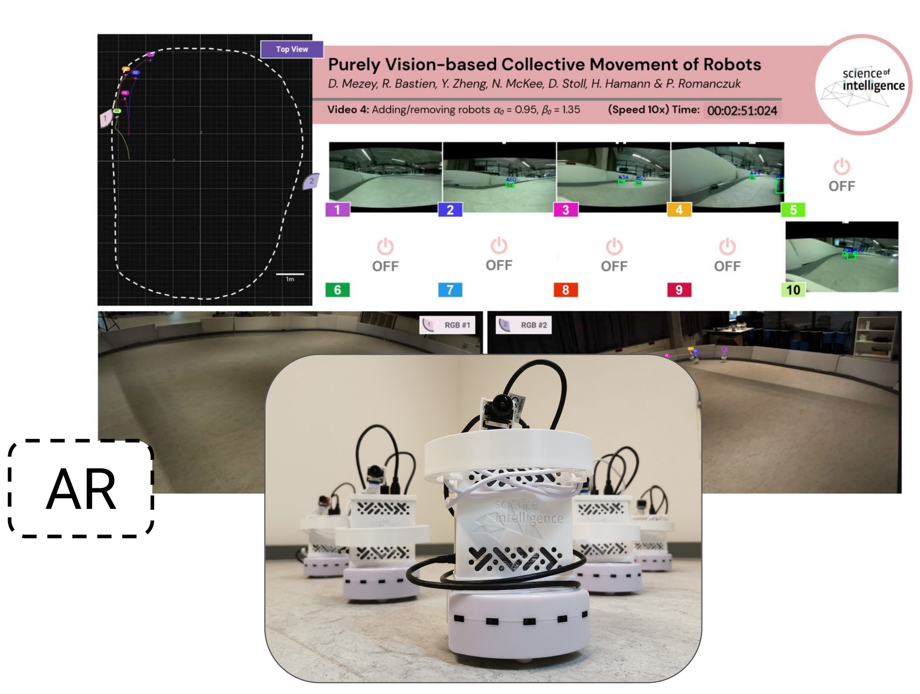


VSWRM Thymio robot platform
(watch in 3D with AR)

Related Projects and The Loop

Visual Swarm

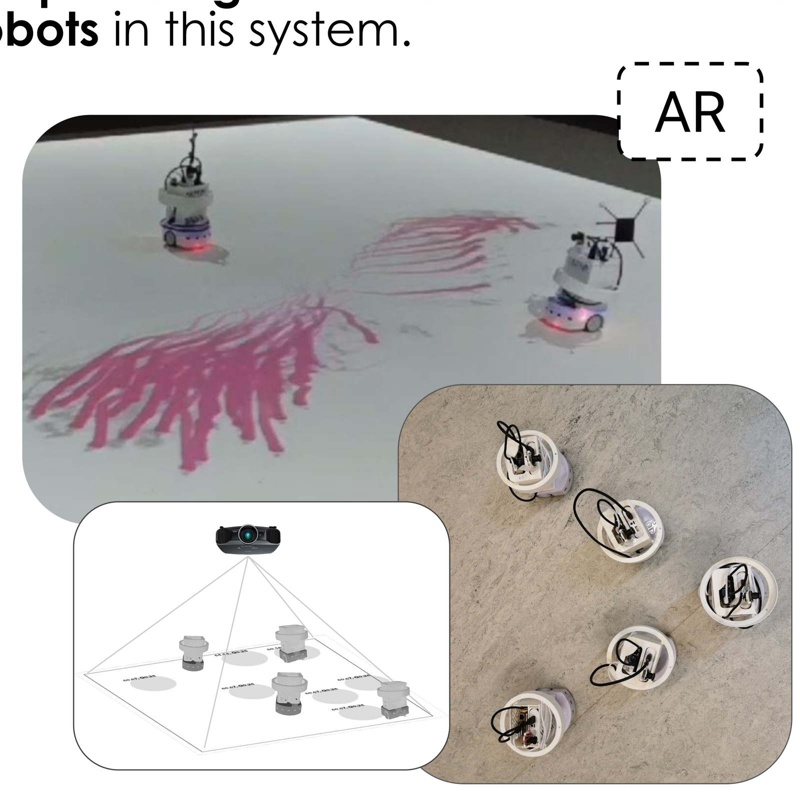
We lay the groundwork for our robot platform (later used in P34) and implement **the first purely vision-based decentralized robot swarm** without central infrastructure, direct communication or marker localization.



Purely vision-based collective movement of robots, preparing robot platform
Mezey et al. @ arXiv
(watch video/paper in AR)

Collective Behavior XR (CoBe)

We created a mixed reality environment (later used as the foraging landscape for robots in P34) and we currently **study shepherding behavior with humans and robots** in this system.



CoBe mixed reality system
Bartashevich & James* & Mezey**
(*shared initial ownership
watch video/project in AR)

Analytic-Synthetic Loop

Our human behavioral, simulation and robot experiments are designed along similar features to facilitate SCIoI's loop concept. Observations from one system inform the others and vica versa. Read more about how we implemented the analytic-synthetic loop in our project in the **press release below.**

Article

How can we make good decisions by observing others? A videogame and computational model have the answer.

By Maria Ott and Solveig Steinhardt

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