

Collective Self-awareness in Multi-Robot Systems

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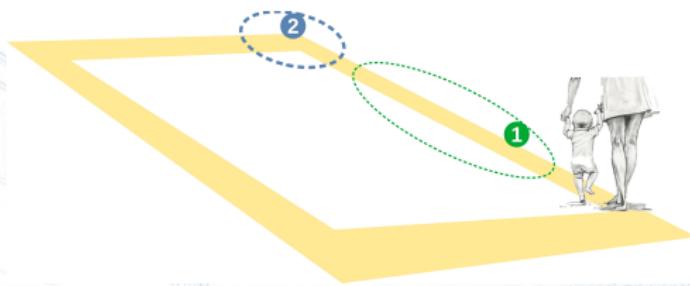
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Biological Self-awareness (SA)

A baby walking around a rectangular courtyard for the **first time** with her mother.

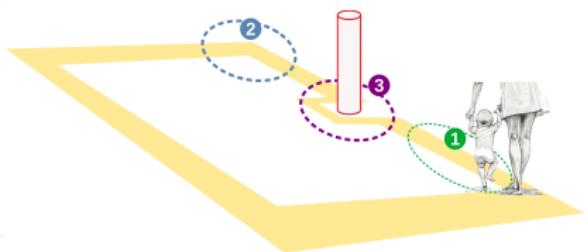
- Gradually she learns how to use her feet when moving **straight** and moving on **corners**



Biological SA

The next time, when the path is interrupted by a column, the baby learns how to use its feet to **turn around an obstacle** with the help of her **mother**. Now the baby can

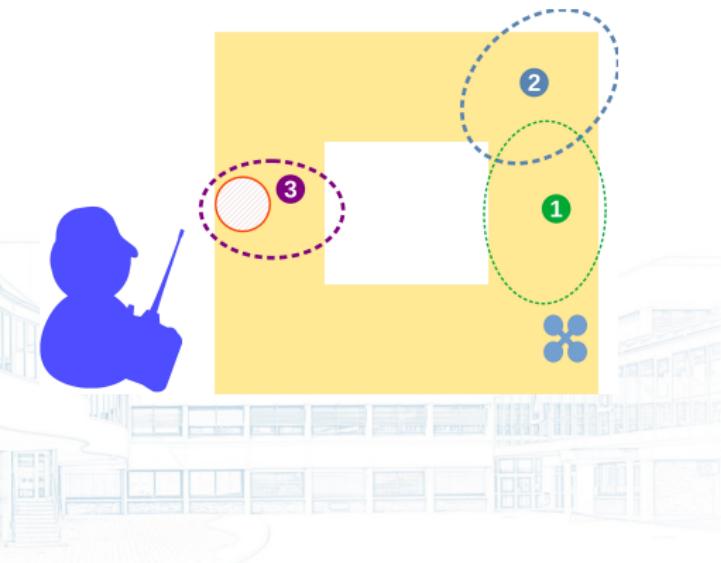
- distinguish a **new** experience from the previous (**Self-awareness**)
- **memorize** it to predict its future
- **invoke** it when necessary
- relate **vision** with **feet** to repeat the right experience **without mother**



Single Intelligent Agents (IA) SA

A **human pilot** flies a drone. Similar to biological SA, an IA should be able to

- **encode sub-experiences** such as **straight/corner movement**
- **distinguish** news experiences (**collision avoidance**)
- **invoke** them when **necessary**
- **Relate** its rotors' power to its **camera** to repeat the right experience without **pilot**

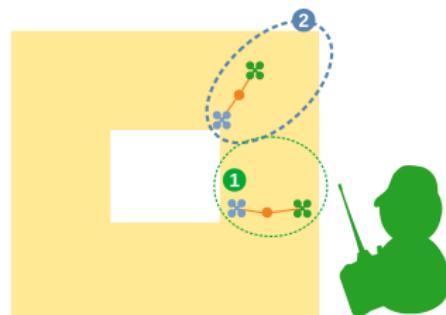


Collective Intelligent Agents (IA) SA

In single awareness
we were after making a single
IA aware of experiences such
as moving **straight**, **turning**
and **collision avoidance**.

In **collective** awareness
we are after **distinguishing**
experiences such as

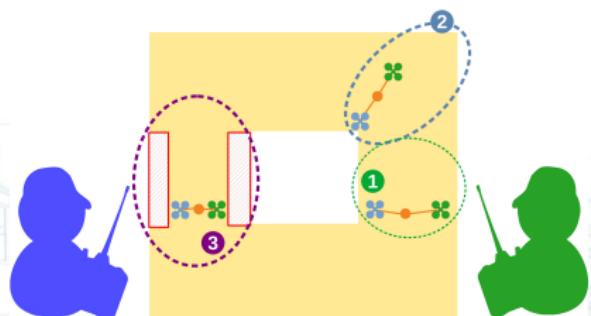
- **Moving along each other**
- **Turning around each other**



Collective Intelligent Agents (IA) SA - New experience

If in a new experiment, the two pilots face a narrow corridor, then the two drones should be able to memorize the solution as:

- **Getting closer to each other**
- Invoke it without pilots then after



Summary

Not much studies have been done in Collective awareness. The **Goals** of our research are as follows according to the given example: If two drones are piloted by two **human** pilots,

- We want them to encode an initial experience in their memory. Like turning around a square.
- We want them to be able to break the experience into smaller pieces such as **moving along each other** or **turning around each other** for 90 degrees to have better **prediction** of their future state given such **abstract behavioral states**



Summary - 2

- If in a new experience, an **abnormal** case happens (**prediction doesn't match observation**) for which the **intervention** of human pilots is needed (eg: arriving to a narrow corridor where they should fly closer to each other), then they should be capable of **distinguishing** it for memorization.
- They should be able to memorize the new experience as a **new version** of previous experience.
- They should be able to **invoke** appropriate experiences according to their observations for **current state estimation** and **future state prediction** without the pilots