

Universal quantification without language?

10 month-old infants represent the universality of visually presented properties

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ELM 2 - 5.20.22

Two different concepts of universal quantification

“Each frog is green”

$\forall x:\text{Frog}(x)[\text{Green}(x)]$

Individuate the frogs

Object-
Files

Kind: Frog

Hue: Green

Size: .8"x

Kind: Frog

Hue: Green

Size: .8"

...

Kind: Frog

Hue: Green

Size: .8"x. 95"

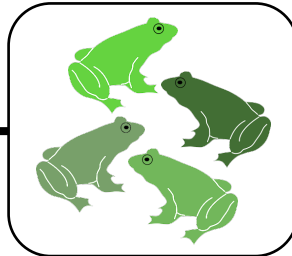
...

Kind: Frog

Hue: ...

Size: .8"x .95"

...



“Every frog is green”

The $F:\text{Frog}(F)[\forall x:F(x)[\text{Green}(x)]]$

Group the frogs

Kind: Frogs

Average Hue: Green

Average Size: .8" x .95"

Cardinality: 4

...

Ensemble

Do pre-verbal infants have access to these concepts?

Are **first-order universal** and **second-order universal** concepts
part of humans' initial logical repertoire?

Do pre-verbal infants have access to these concepts?

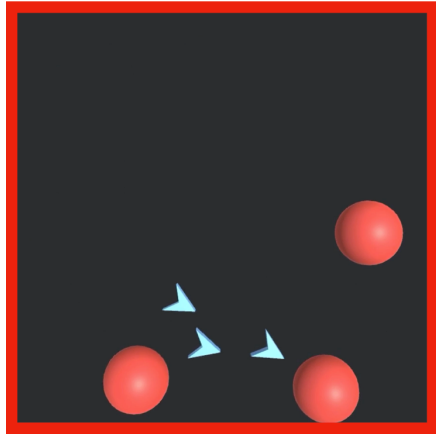
Are **first-order universal** and **second-order universal** concepts part of humans' initial logical repertoire?

Or are these concepts absent at the pre-verbal stage?

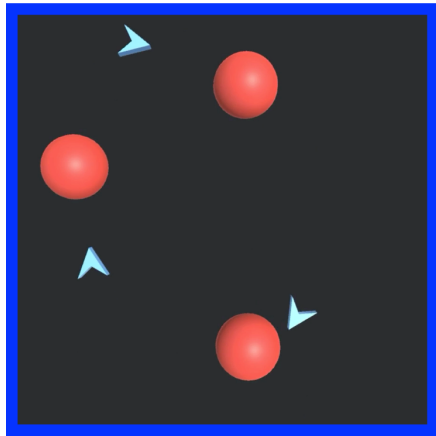
➡ As has been argued for other logical concepts

(e.g., Pea 1978; Feiman, Mody, Sanborn & Carey 2017; Leahy & Carey 2020)

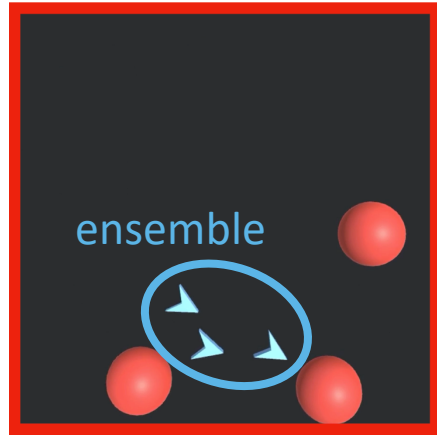
Collective
Universal
Chasing



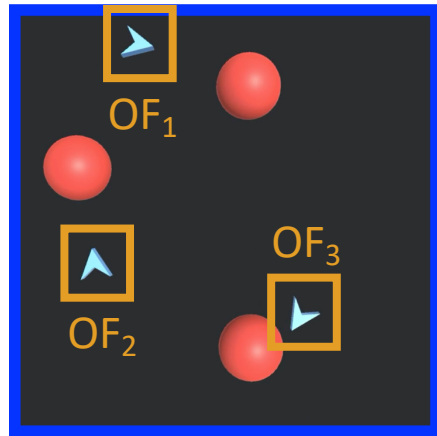
Individual
Universal
Chasing



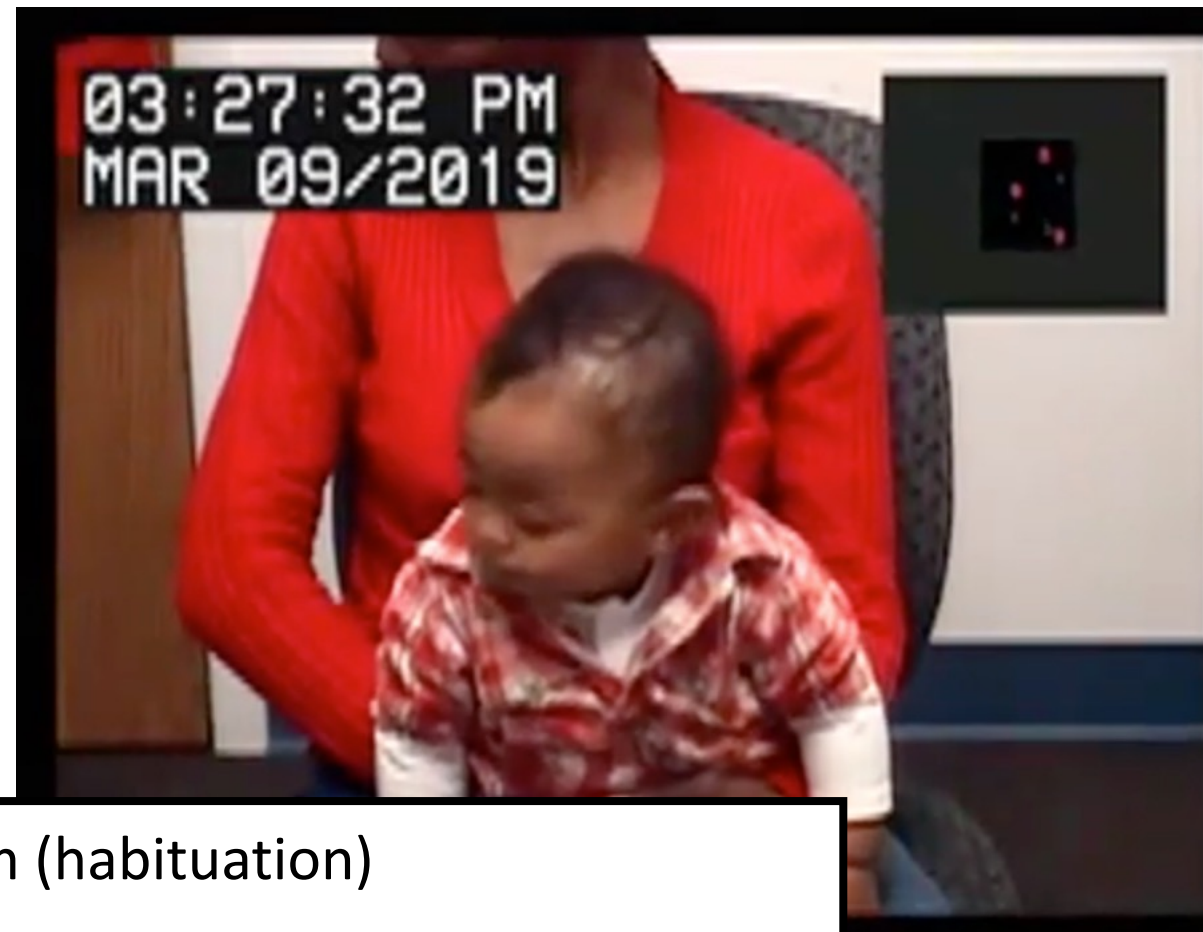
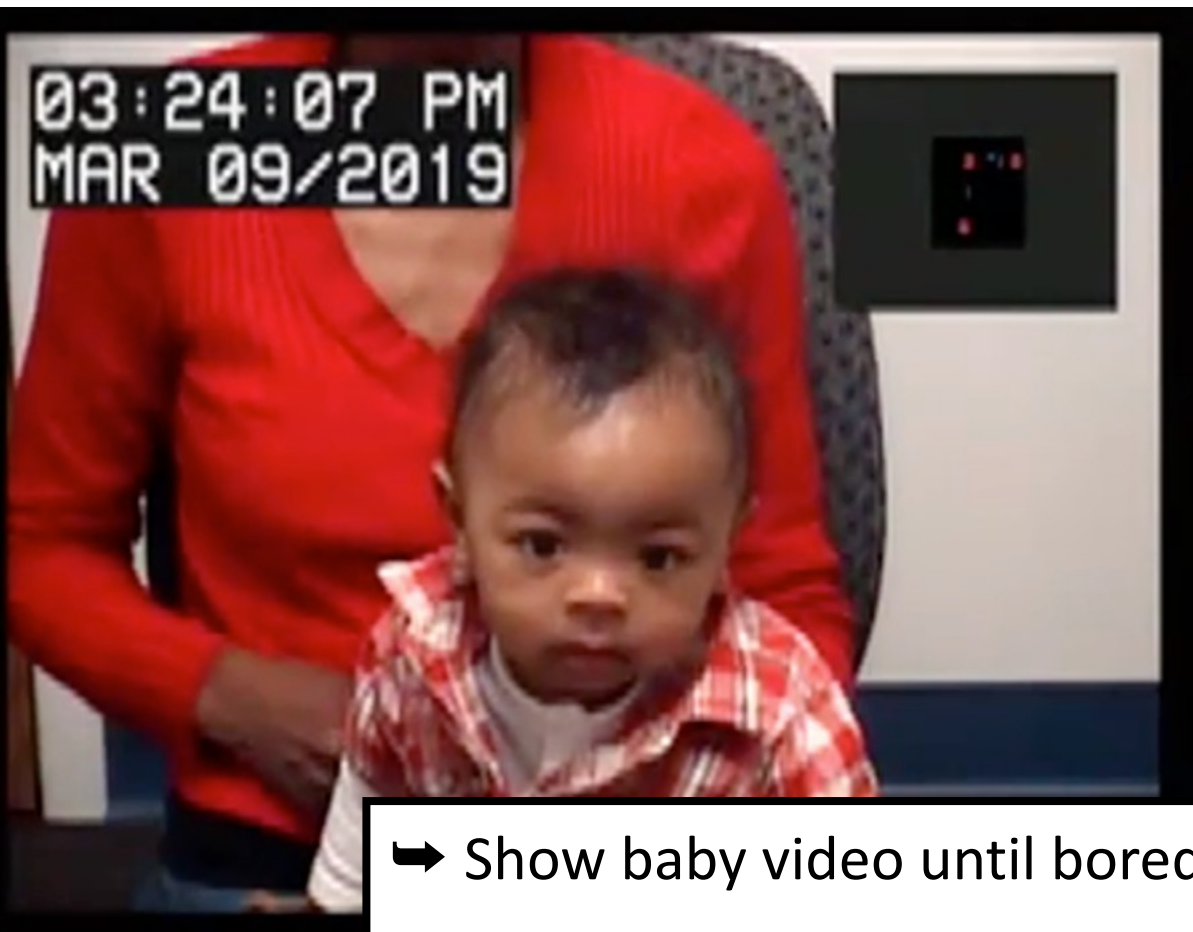
Collective
Universal
Chasing



Individual
Universal
Chasing

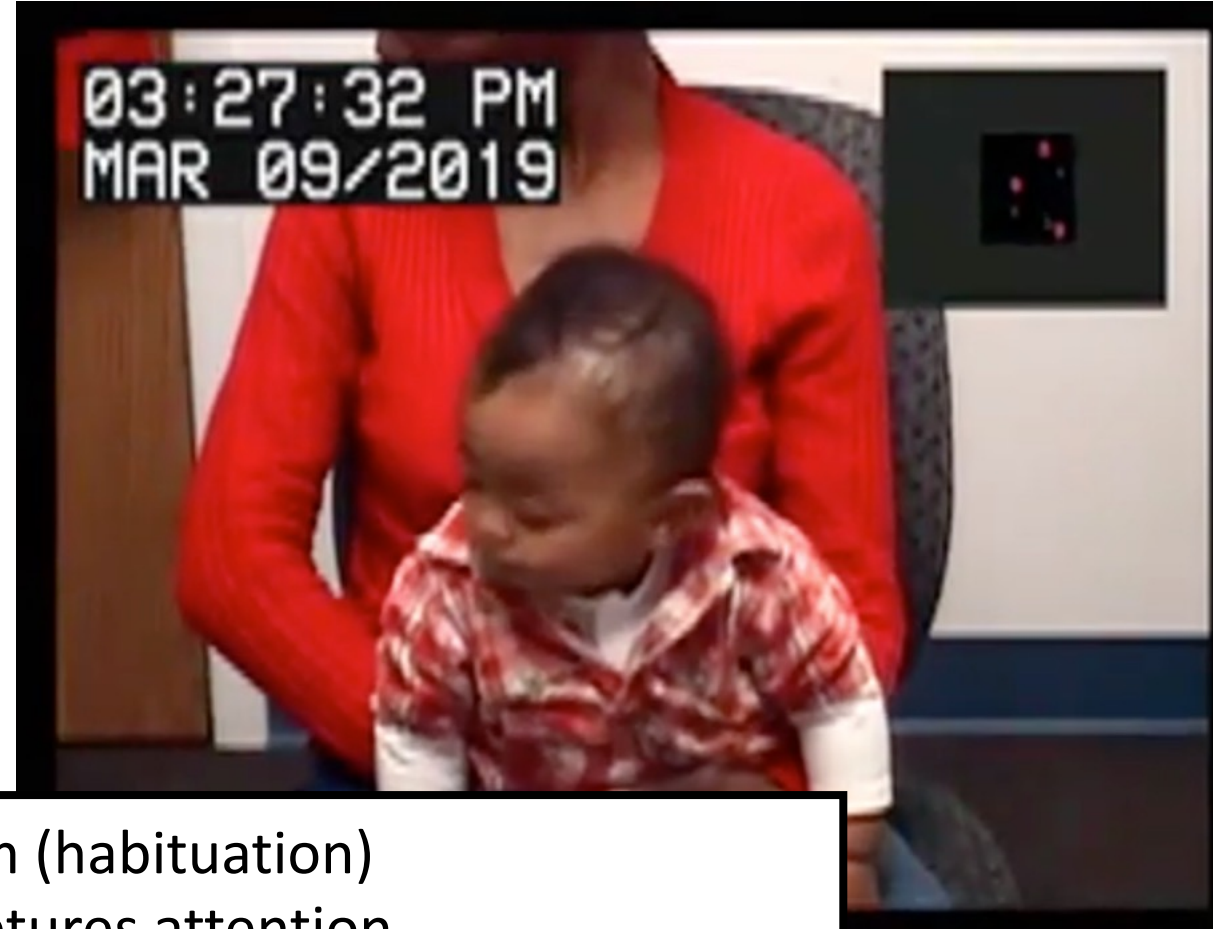


The logic of habituation experiments



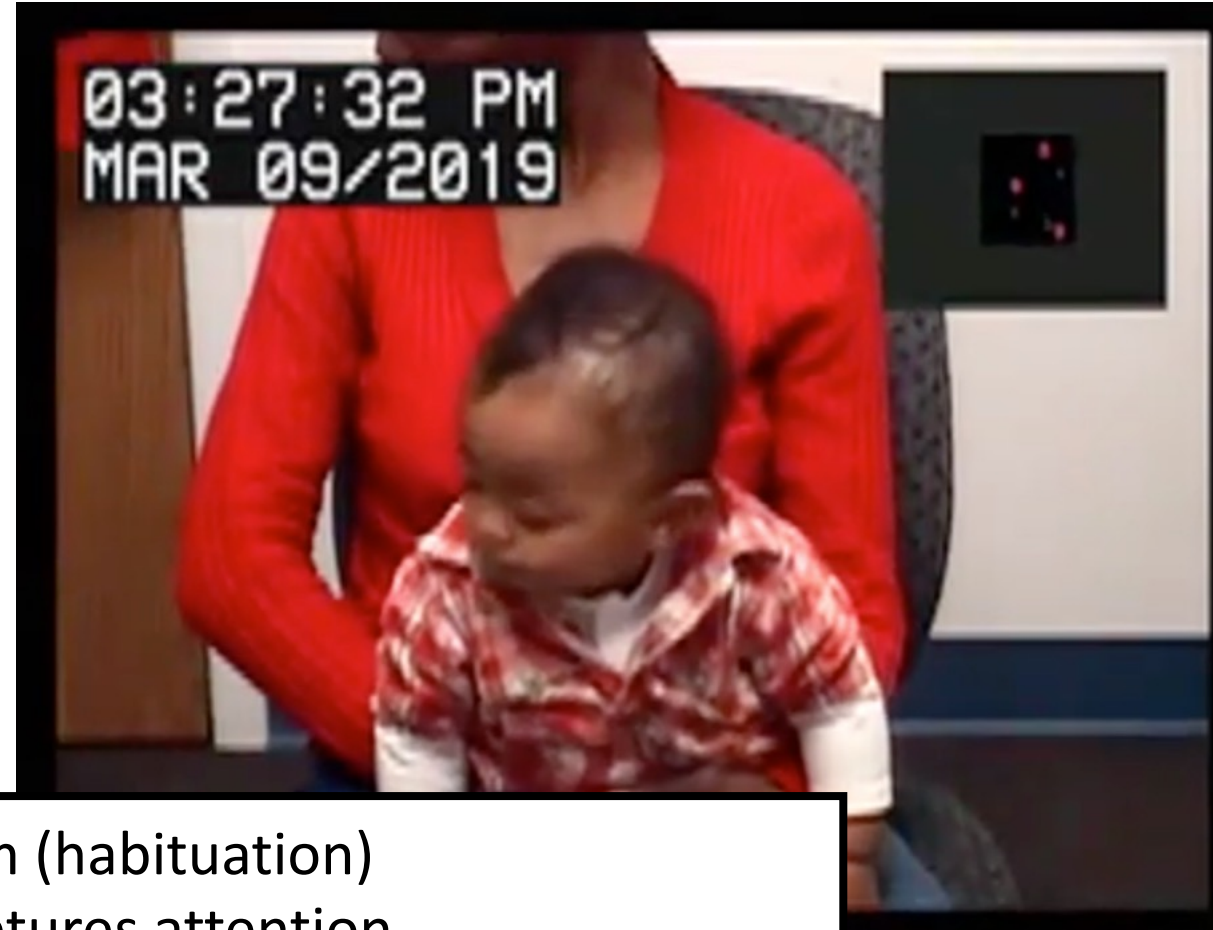
➡ Show baby video until boredom (habituation)

The logic of habituation experiments

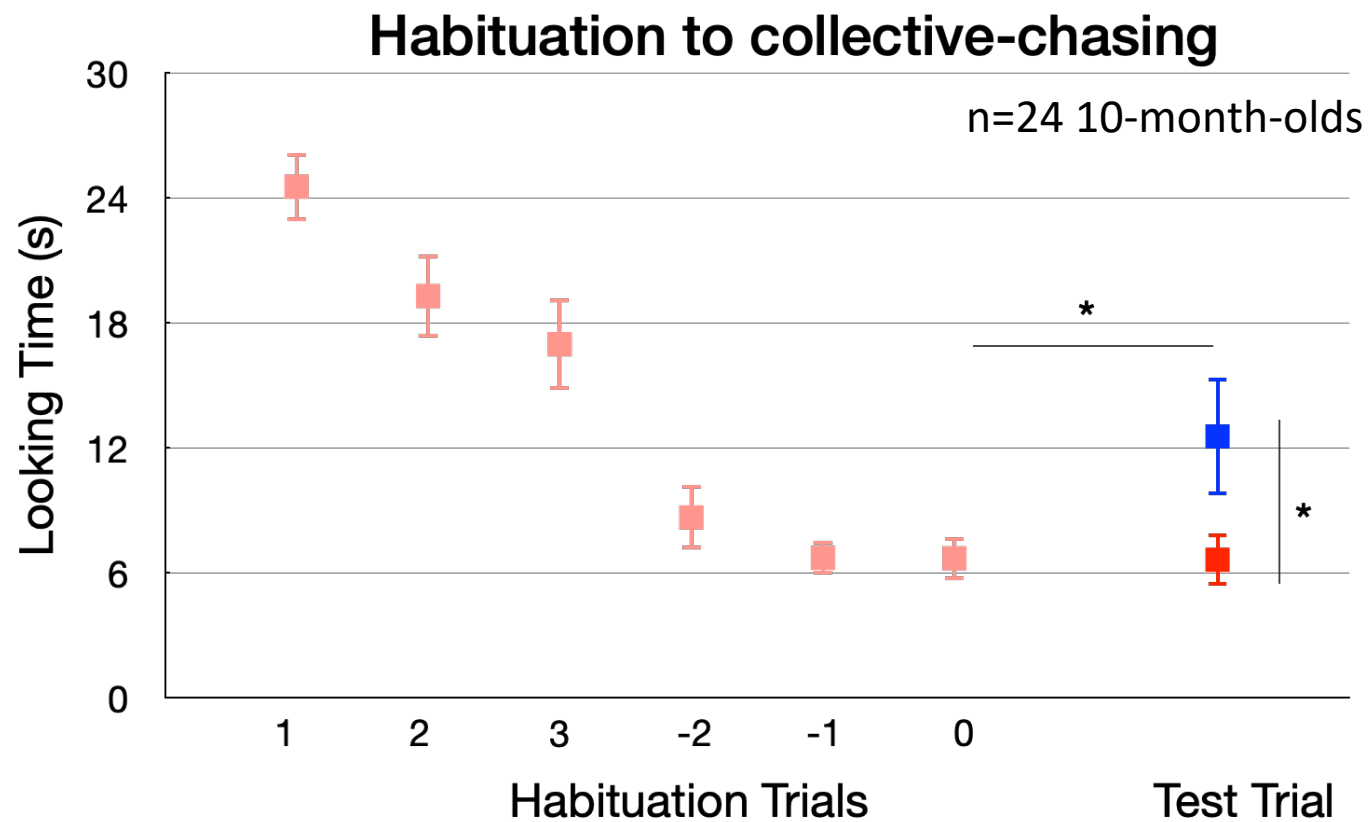
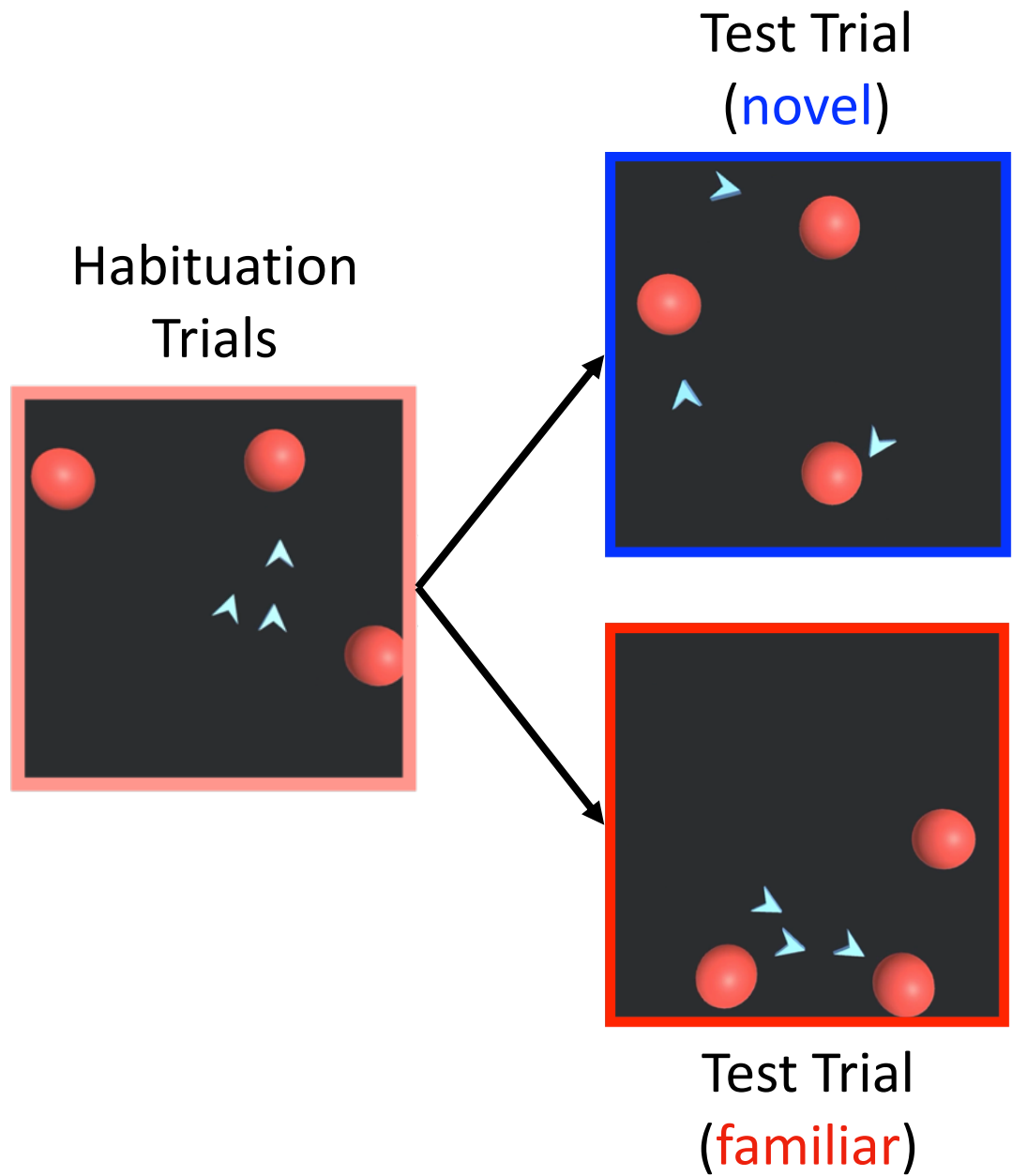


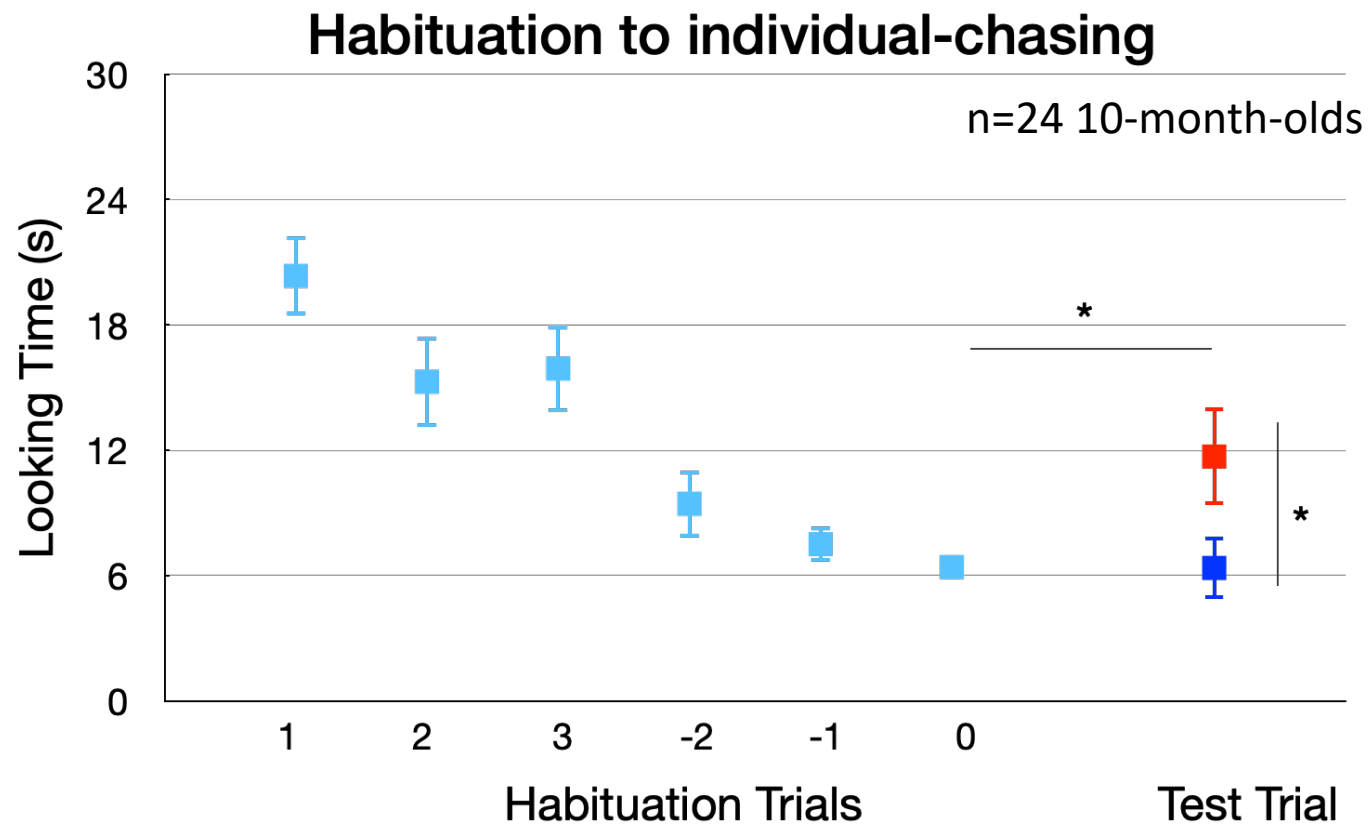
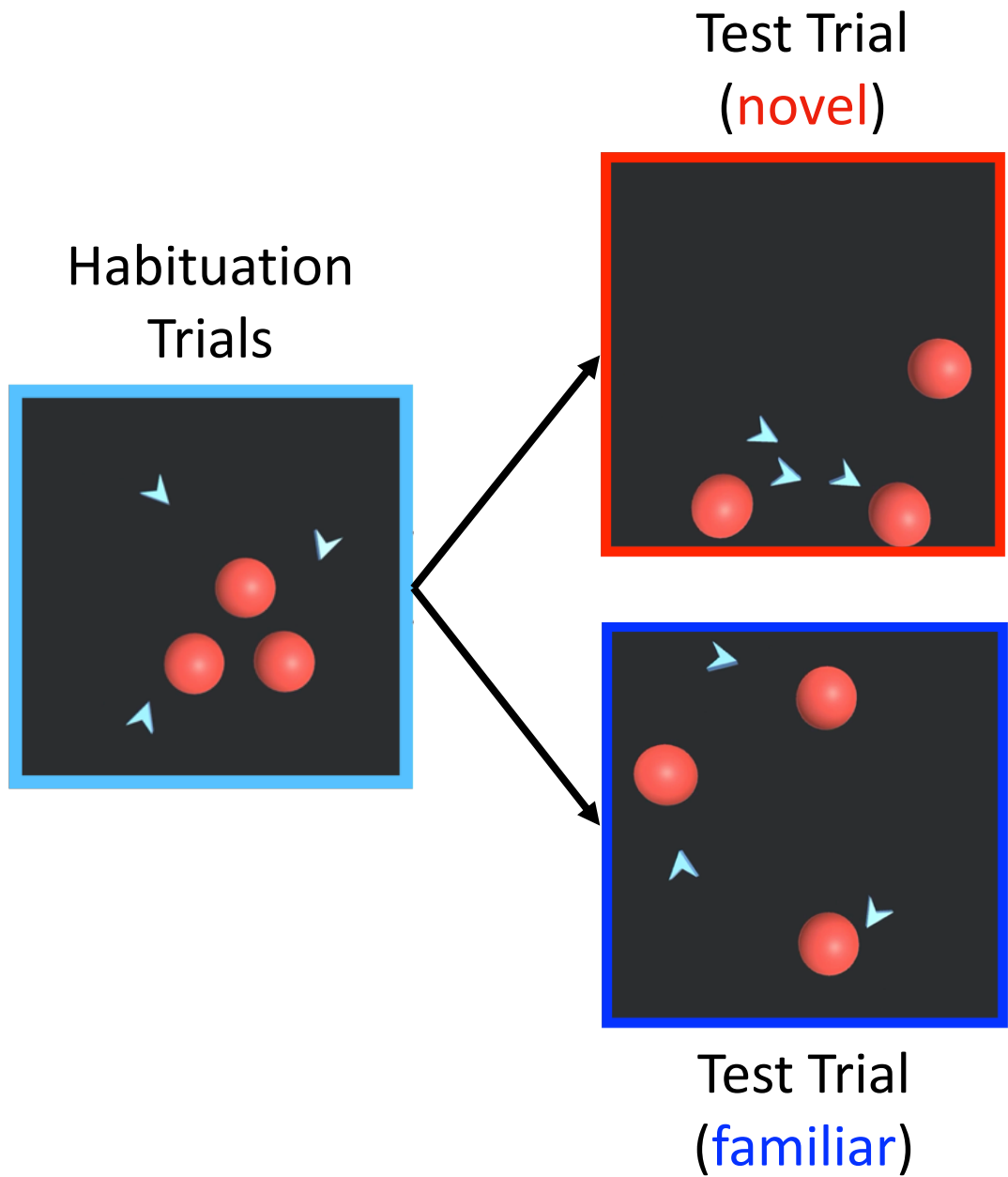
- ➡ Show baby video until boredom (habituation)
- ➡ Ask whether a new video recaptures attention

The logic of habituation experiments

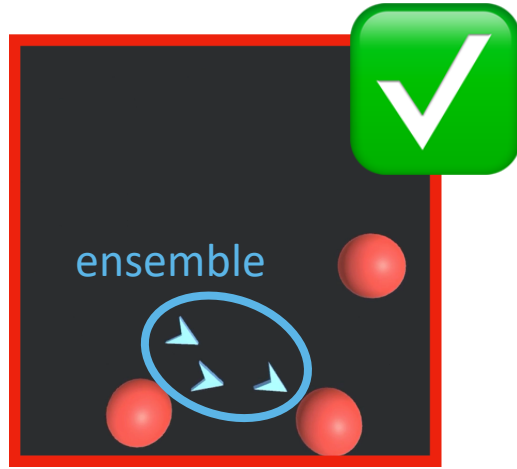


- ➡ Show baby video until boredom (habituation)
- ➡ Ask whether a new video recaptures attention
- ➡ If yes, baby represents those events under different concepts

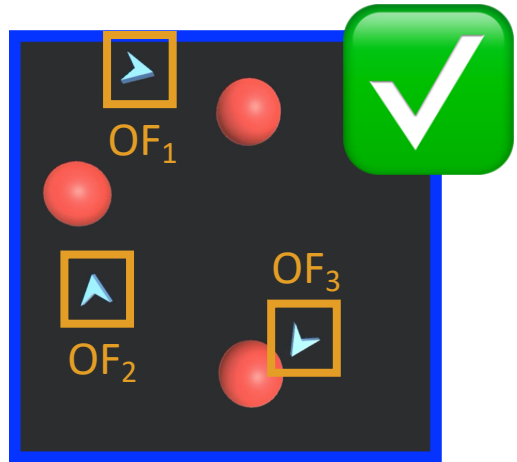




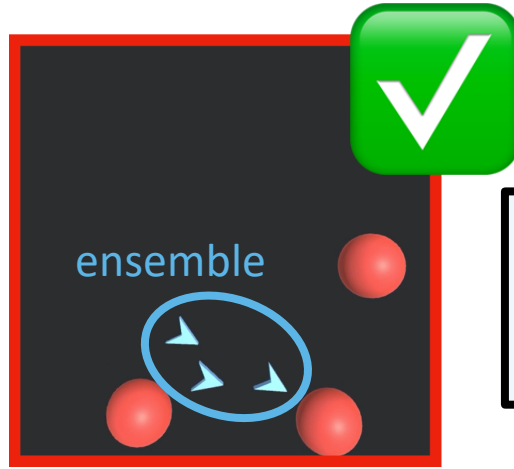
Collective
Universal
Chasing



Individual
Universal
Chasing



Collective Universal Chasing

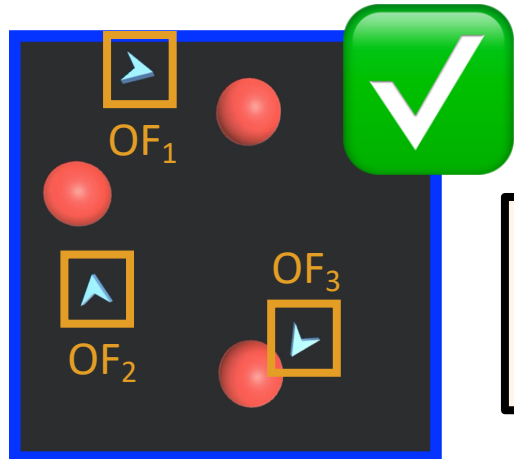


Ensembles

➡ No working memory limit

(e.g., Halberda et al. 2006; Zosh et al. 2011; Alvarez & Oliva 2008; Im & Halberda 2013)

Individual Universal Chasing



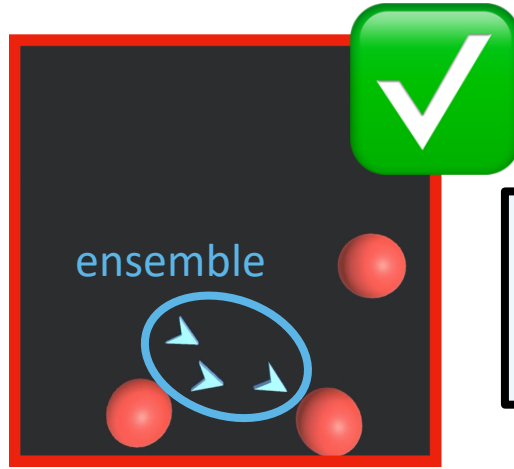
Object-files

➡ Strict working memory limit

(e.g., Vogel et al. 2001; Feigenson & Carey 2005; Wood & Spelke 2005; Alvarez & Franconeri 2007)

Collective Universal Chasing

3 agents

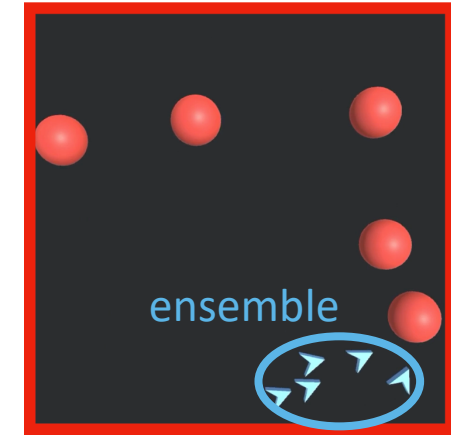


Ensembles

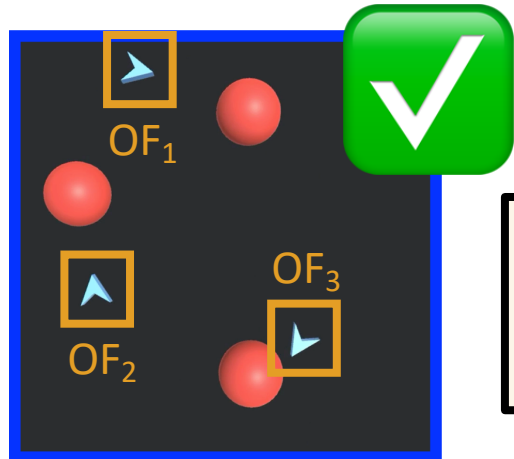
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(e.g., Halberda et al. 2006; Zosh et al. 2011; Alvarez & Oliva 2008; Im & Halberda 2013)

5 agents



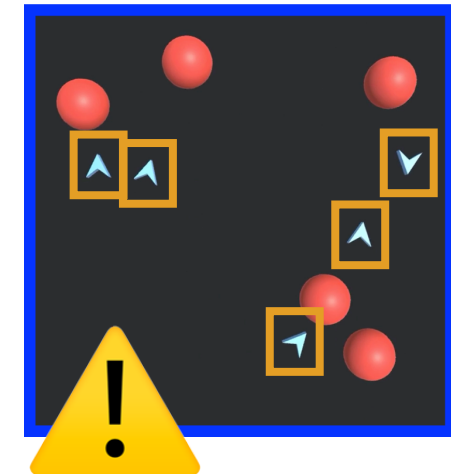
Individual Universal Chasing

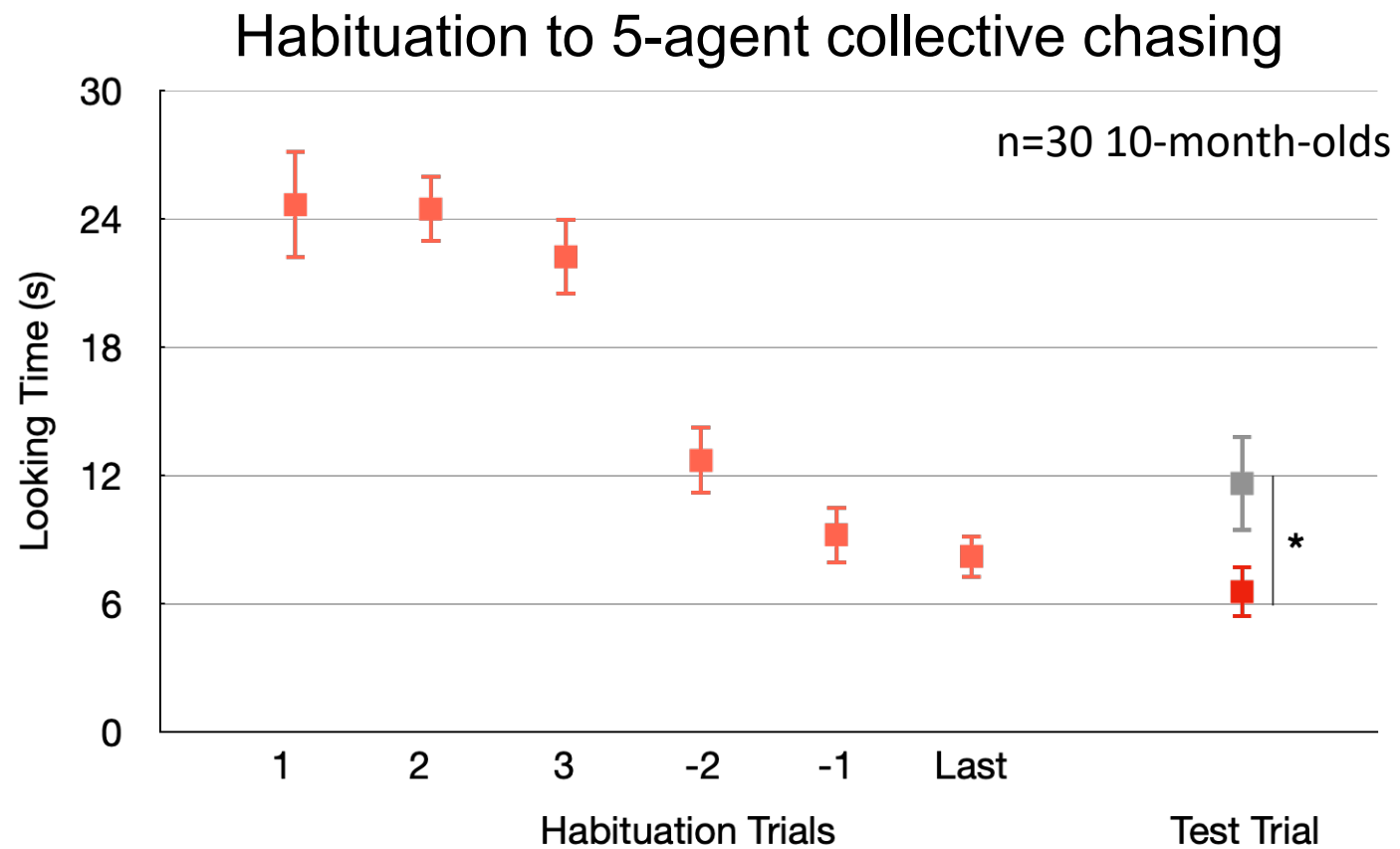
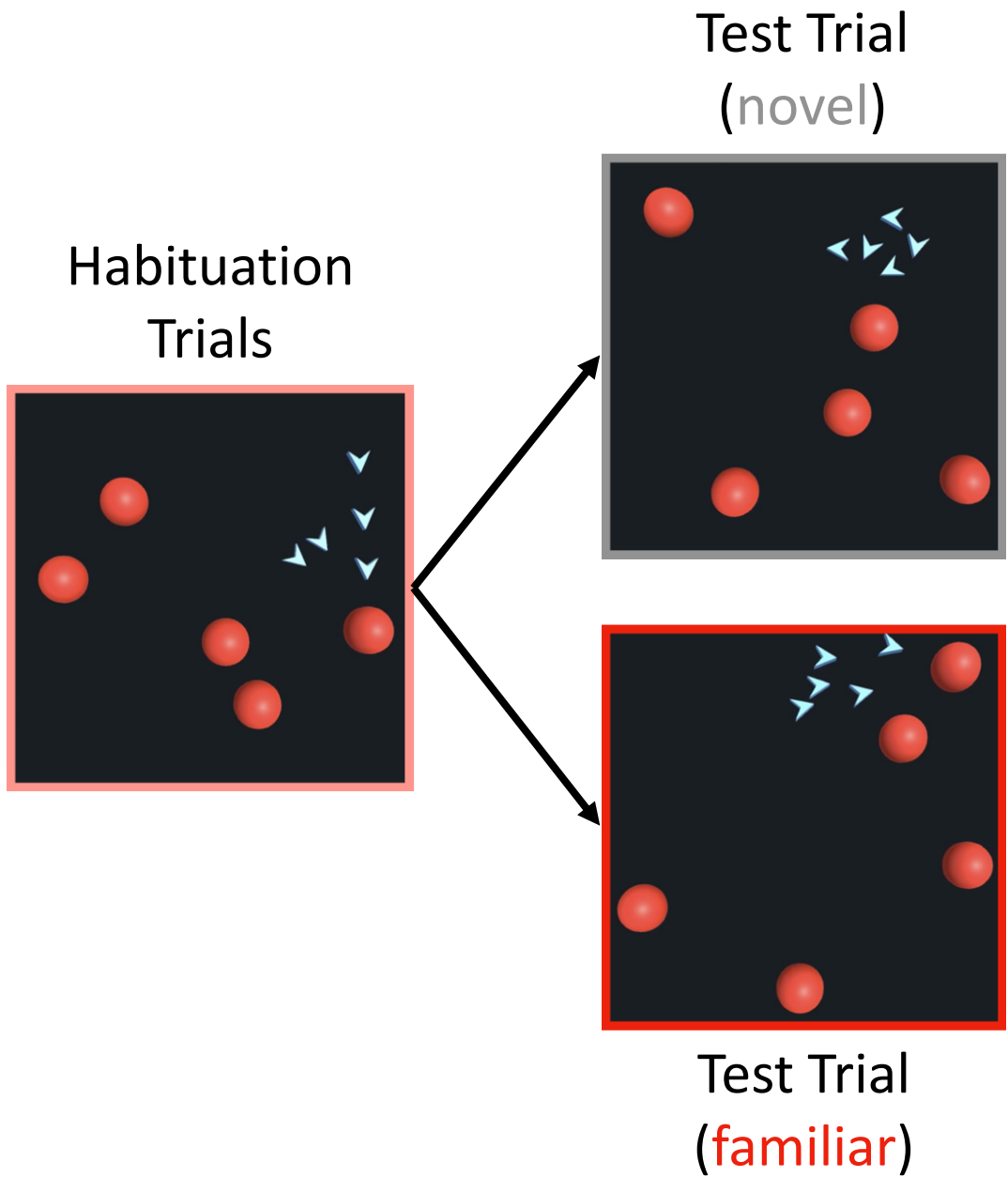


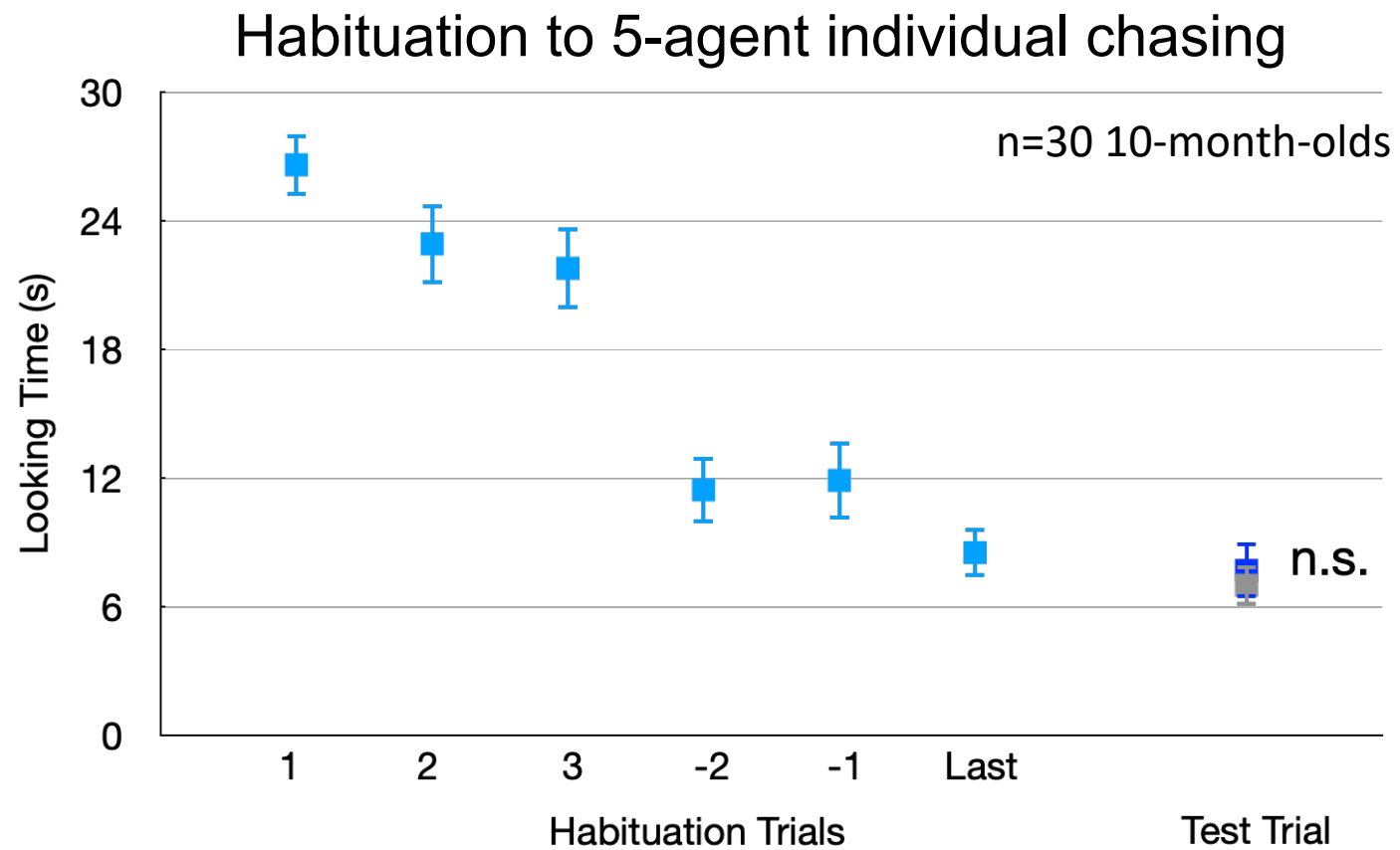
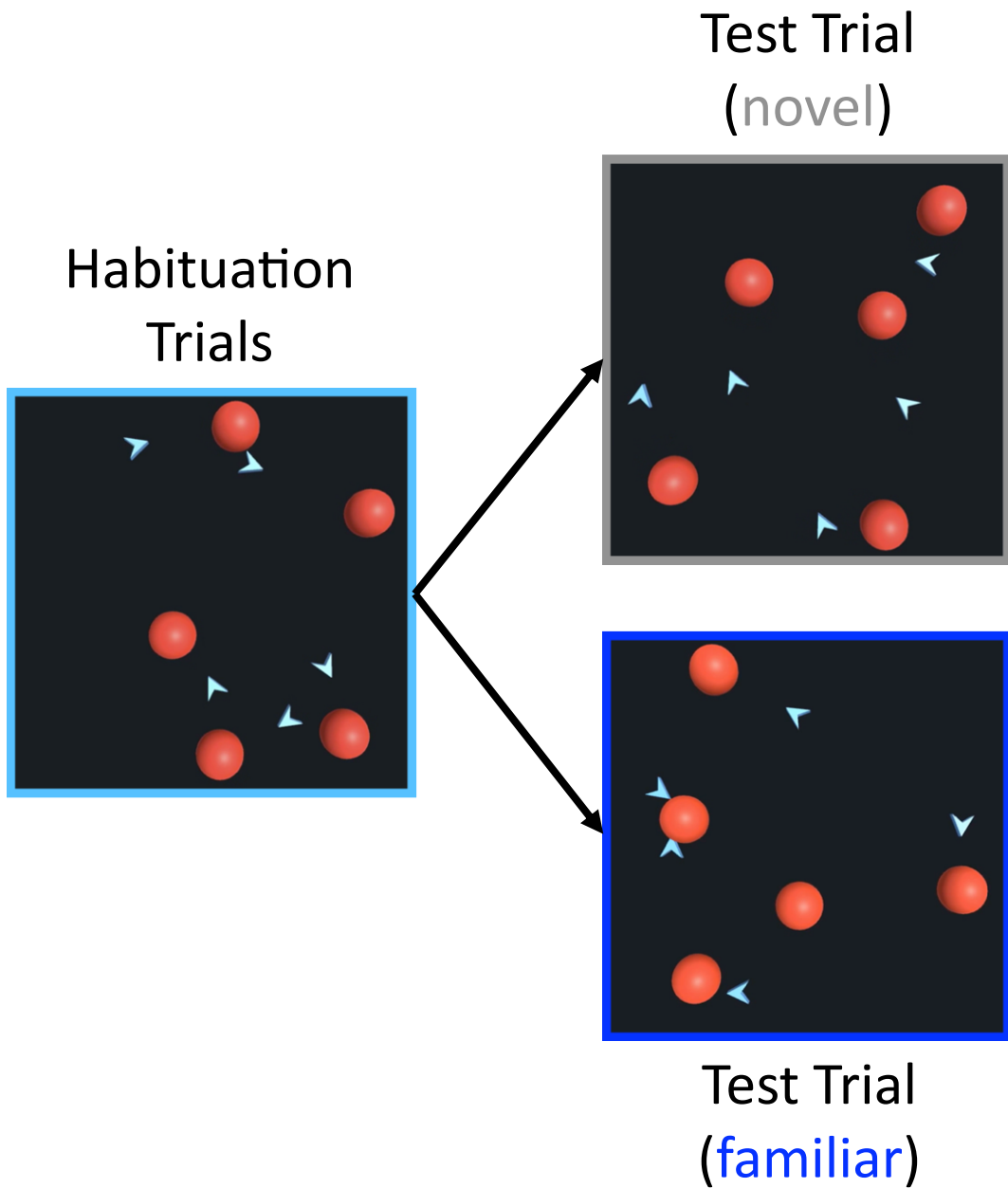
Object-files

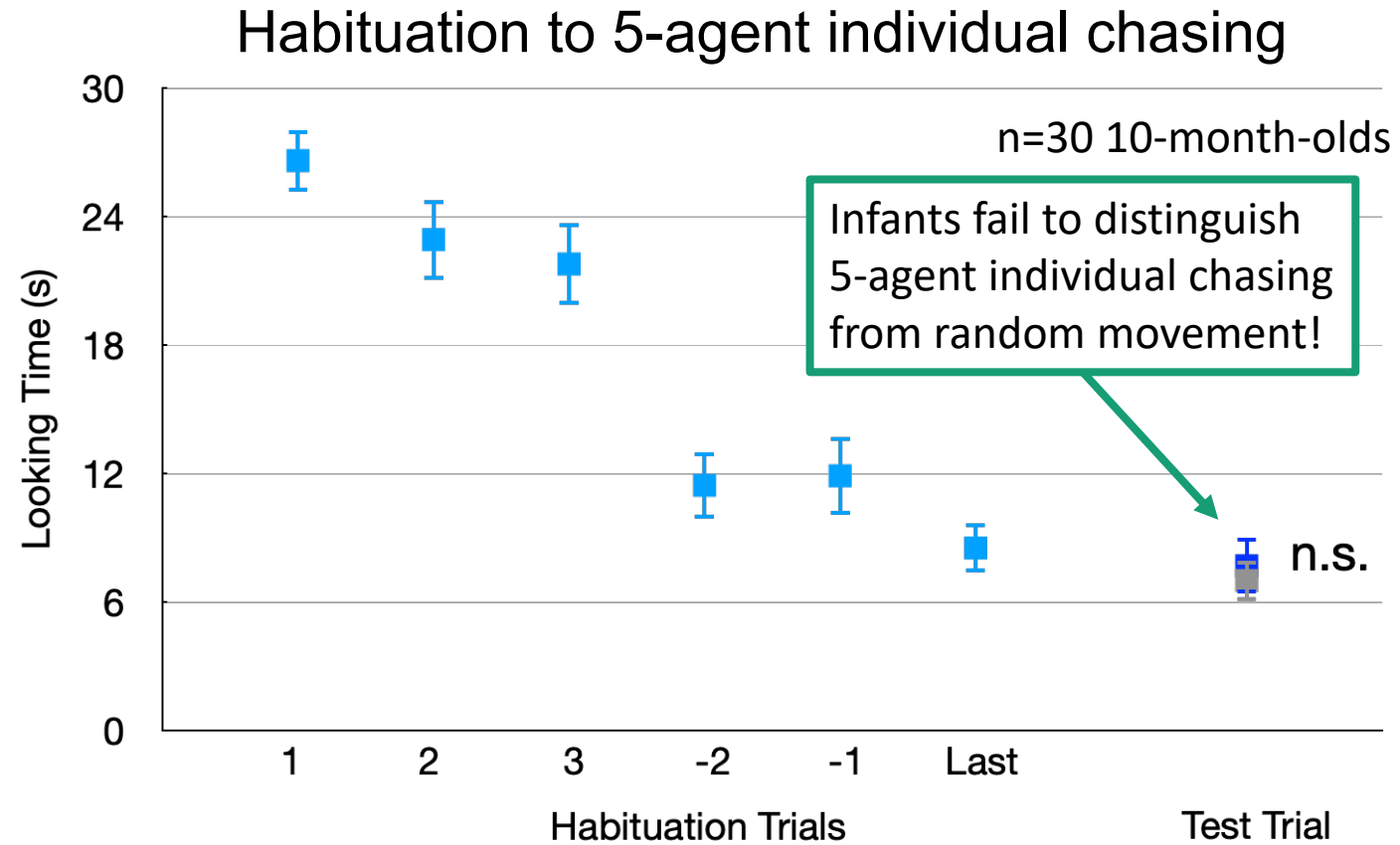
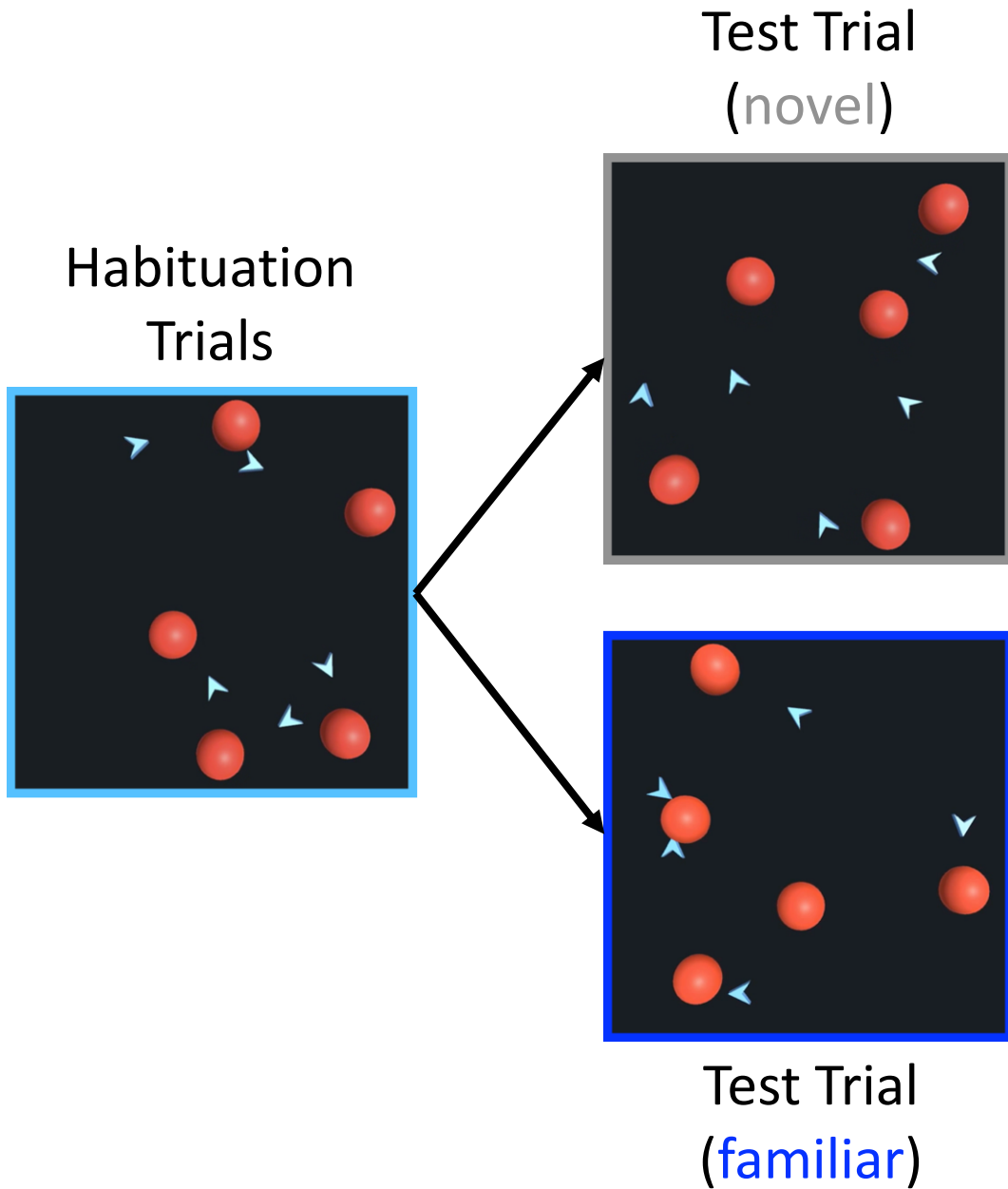
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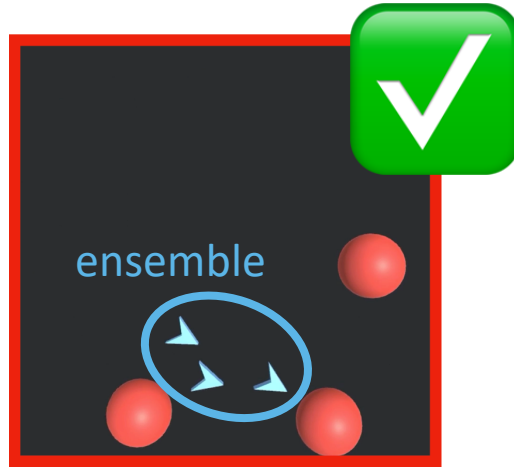




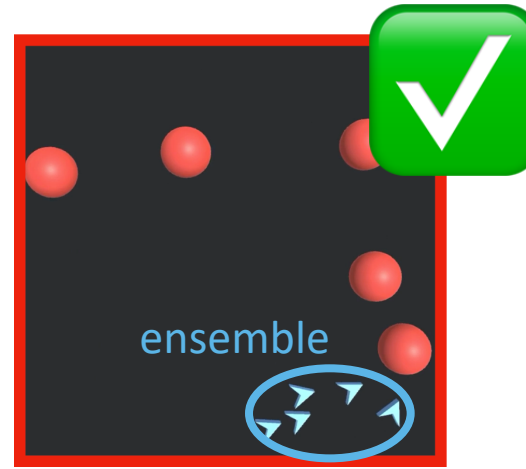


Collective
Universal
Chasing

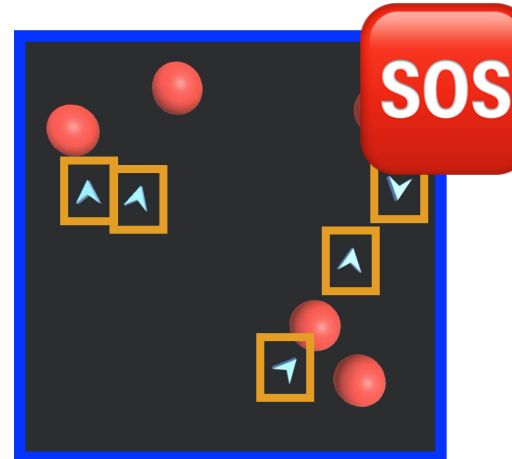
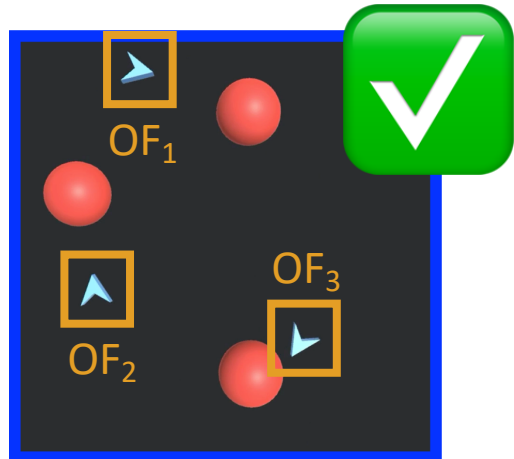
3 agents



5 agents



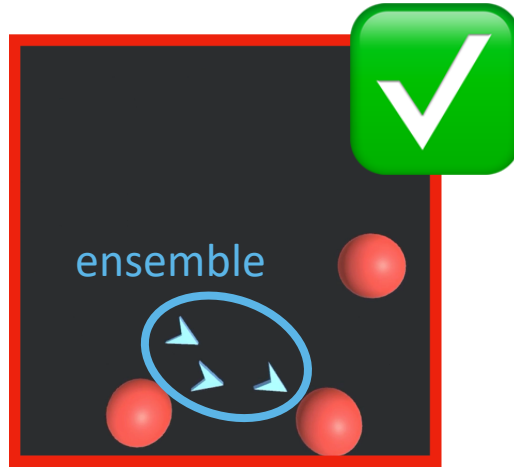
Individual
Universal
Chasing



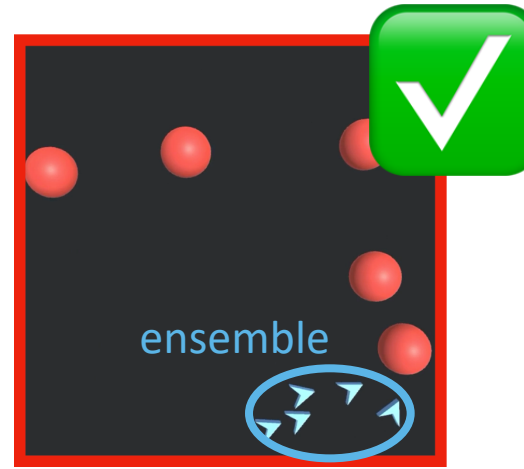
Failure to form a representation of
this event predicted by working
memory limit on **object-files**!

Collective
Universal
Chasing

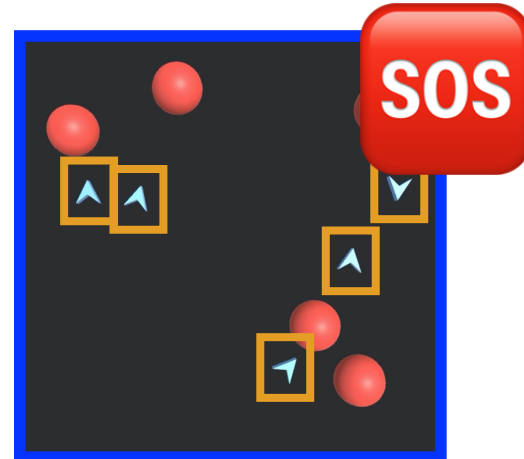
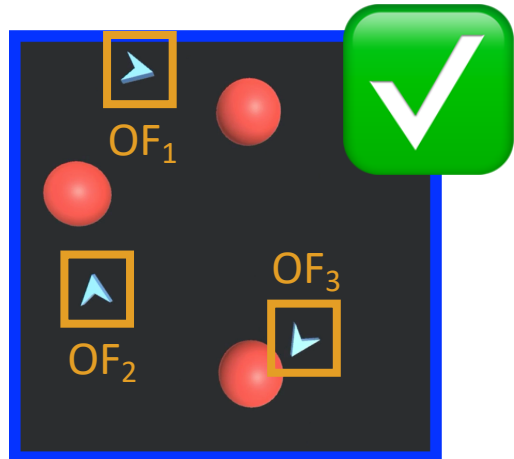
3 agents



5 agents



Individual
Universal
Chasing



Tentative conclusion:

➡ Infants have access to adult-like concepts of universal quantification long before acquiring quantifier words

Thanks!

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