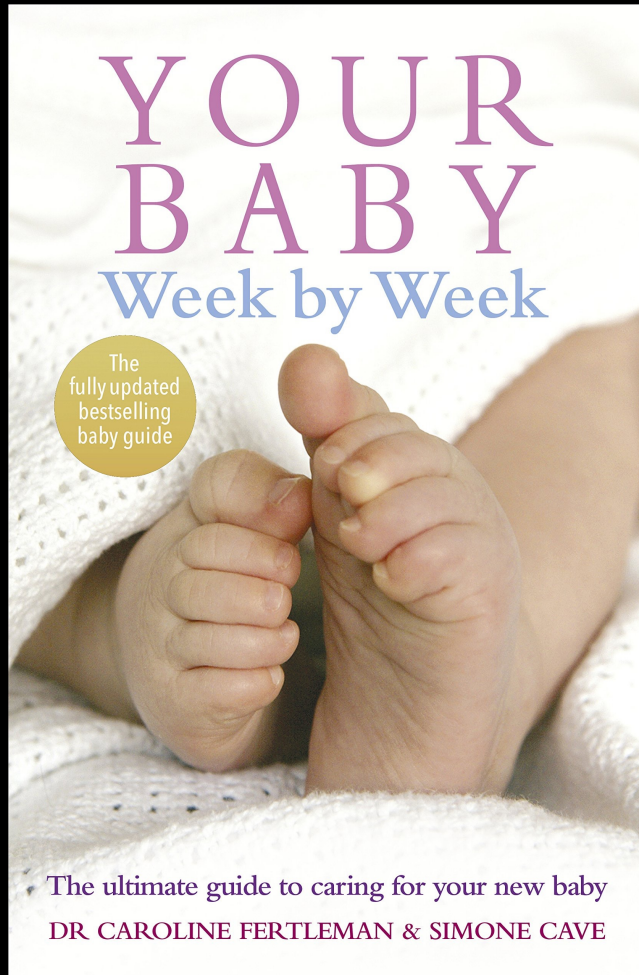


# What Can We Learn From Baby Minds?



# Why Study Development?

# Why Study Development?



Provide guidance for  
parents & pediatricians

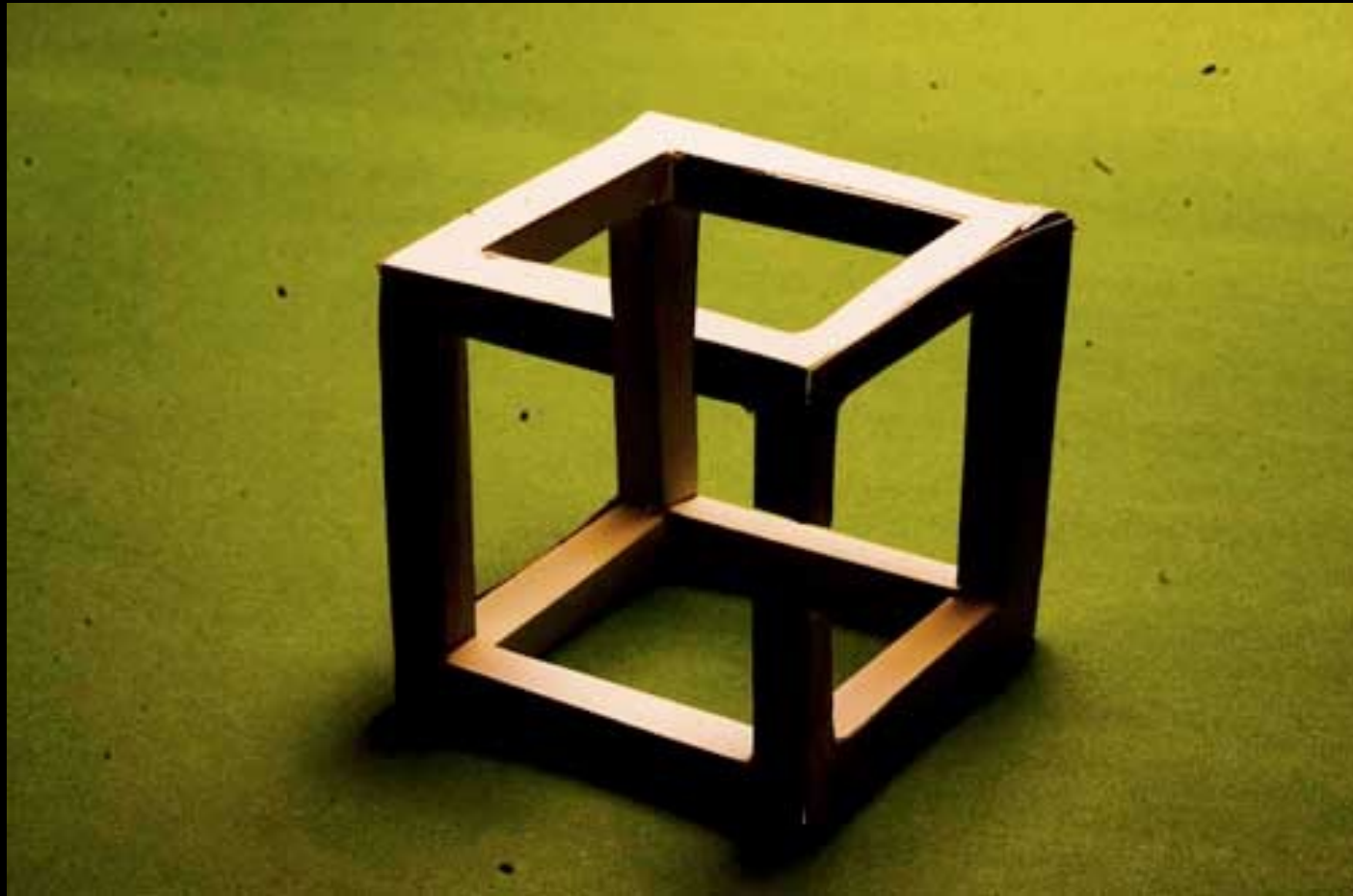


Infant as a “model organism”

# Why Study Development?













# How do we know about the world?

Let us then suppose the mind to be... white paper, void of any characters, without any ideas; how comes it to be furnished? To this I answer in one word: from *experience*.



John Locke  
1632-1704



René Descartes  
1596-1650

## Empiricism

# How do we know about the world?



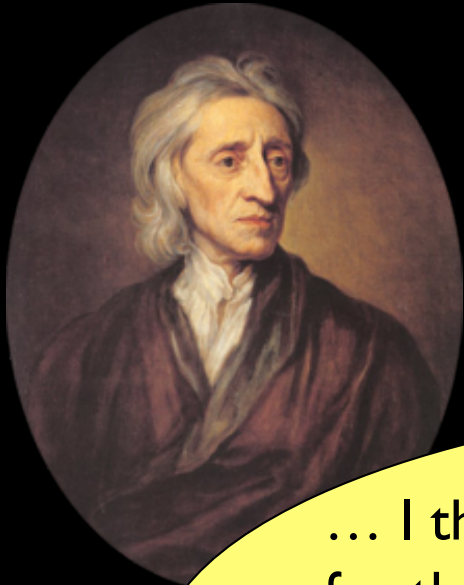
We come to know (stuff about the world) by the power of our own *native intelligence*, *without any sensory experience*.

John Locke  
1632-1704



René Descartes  
1596-1650

# How do we know about the world?



John Locke

... I think that all those (ideas) ... are innate in us; for the sense organs do not bring us anything which is like the idea which arises in us on the occasion of their stimulus, and so *this idea must have been in us before.*

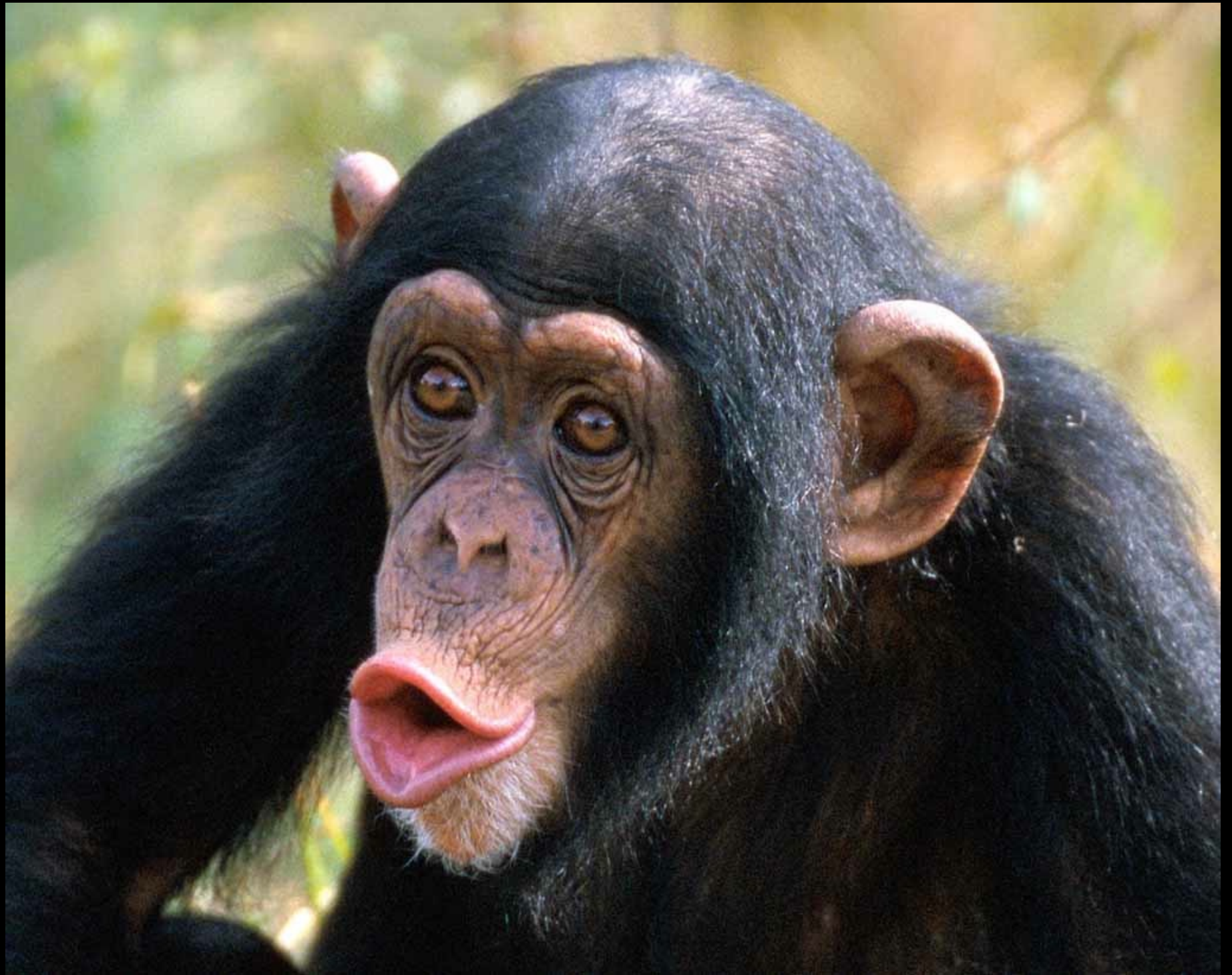


René Descartes  
1596-1650

## Nativism









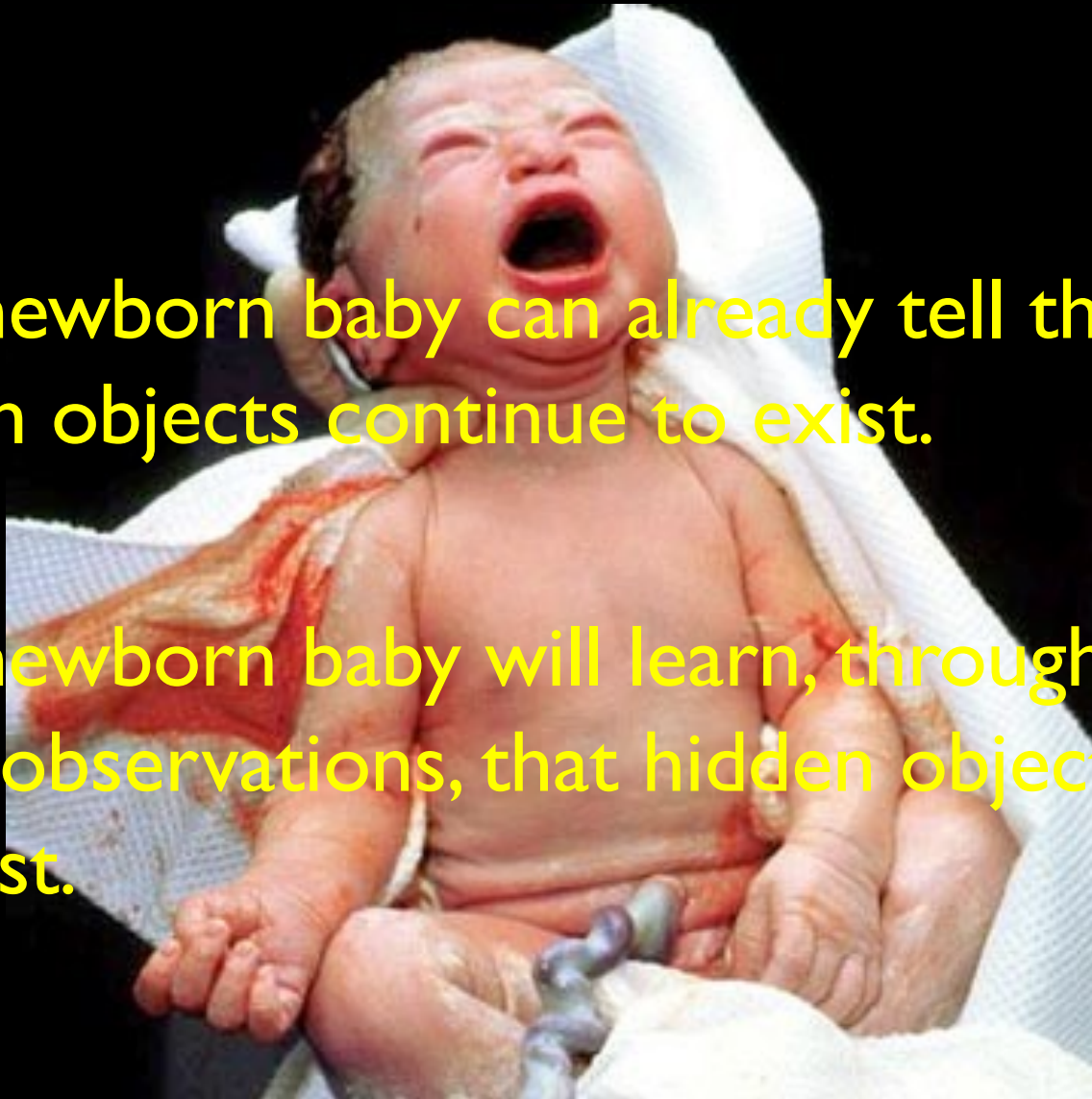




# What Do You Think?

**A** This newborn baby can already tell that hidden objects continue to exist.

**B** This newborn baby will learn, through many observations, that hidden objects continue to exist.



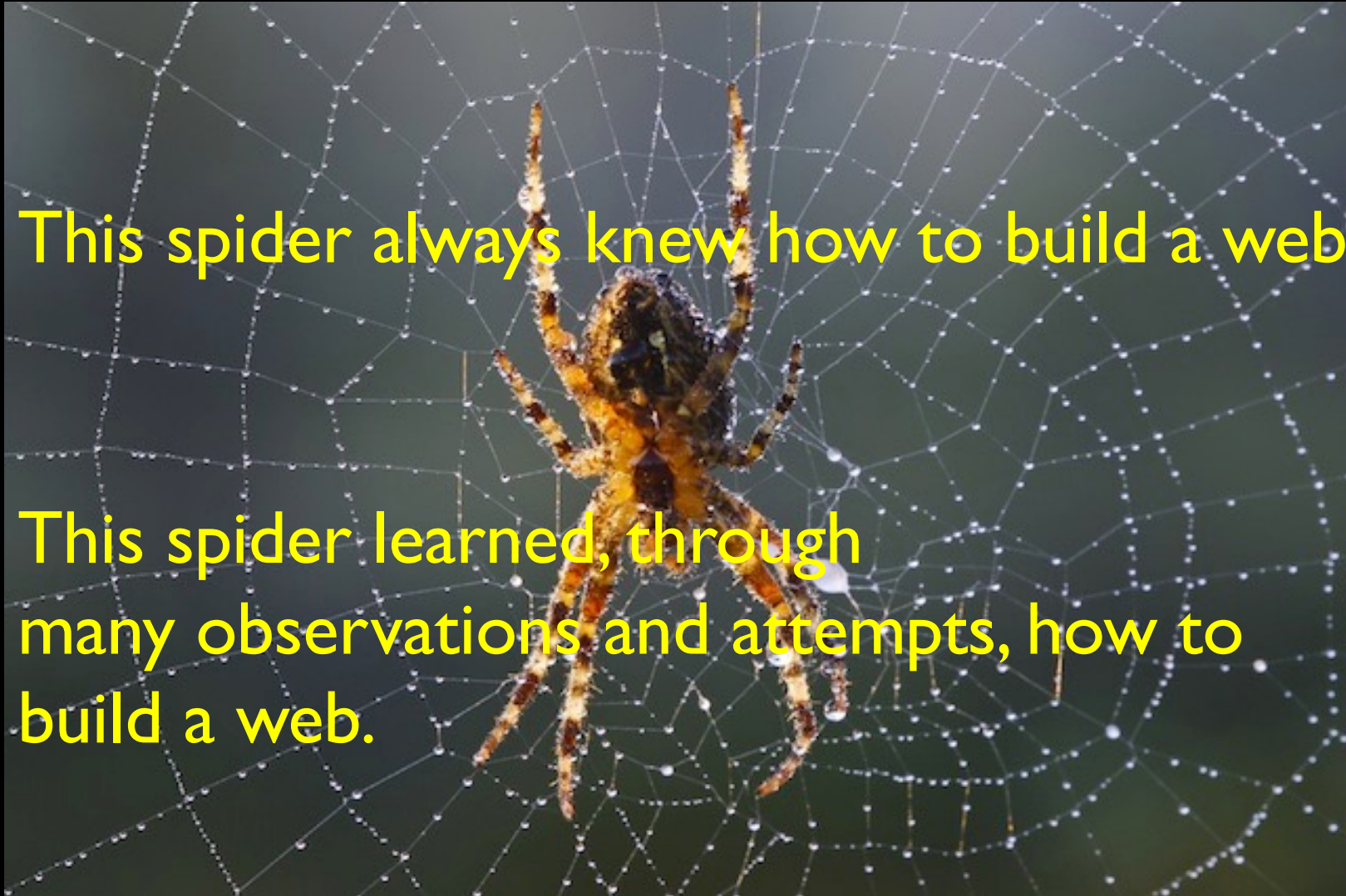
# What Do You Think?

**A**

This spider always knew how to build a web.

**B**

This spider learned, through many observations and attempts, how to build a web.



Are our Intuitions about  
where Knowledge comes from  
correct?

How can we find out?

# How do we come to perceive depth?



How do we come to perceive depth?

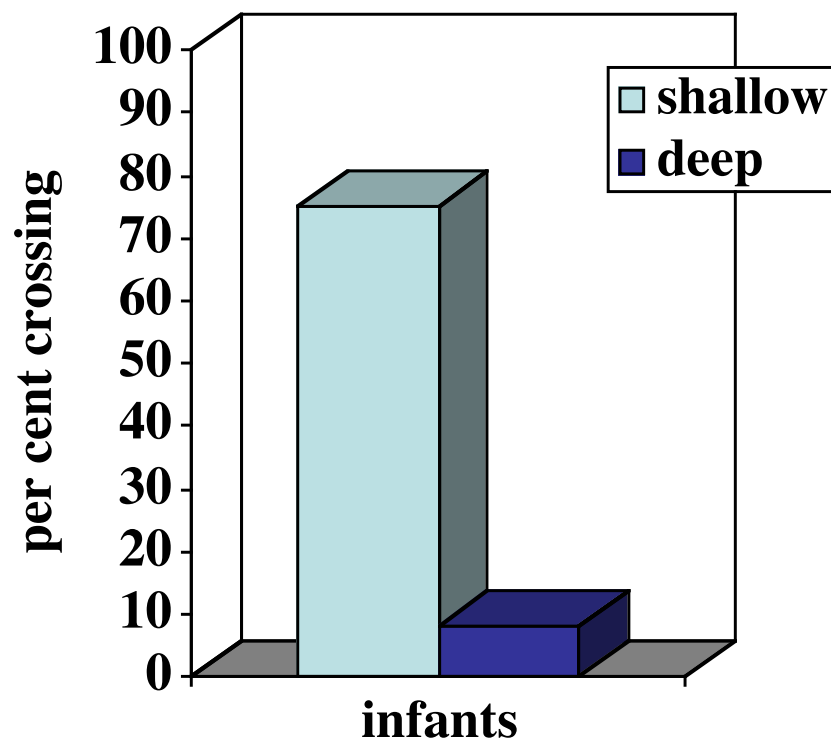


How do we come to perceive depth?



# How do we come to perceive depth?

Eleanor Gibson: Visual Cliff (1950s)

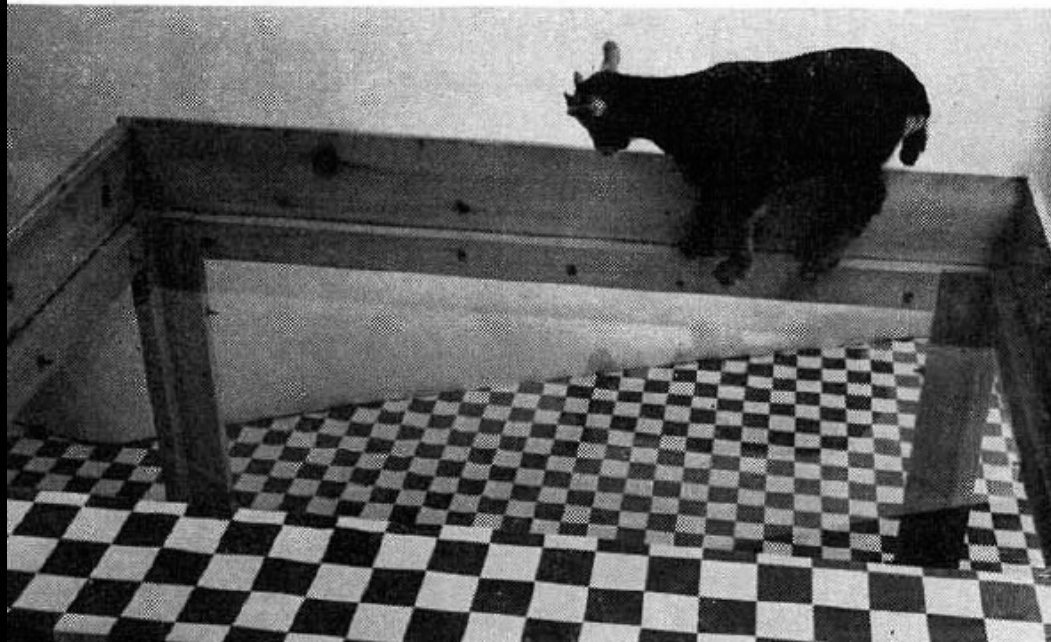


How do we come to perceive depth?

The Visual Cliff  
Neuropsychologie: Serie 3



# How do we come to perceive depth?

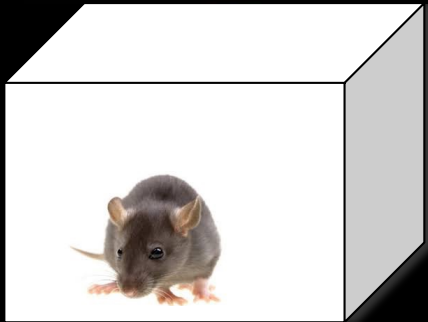


1-day old goat

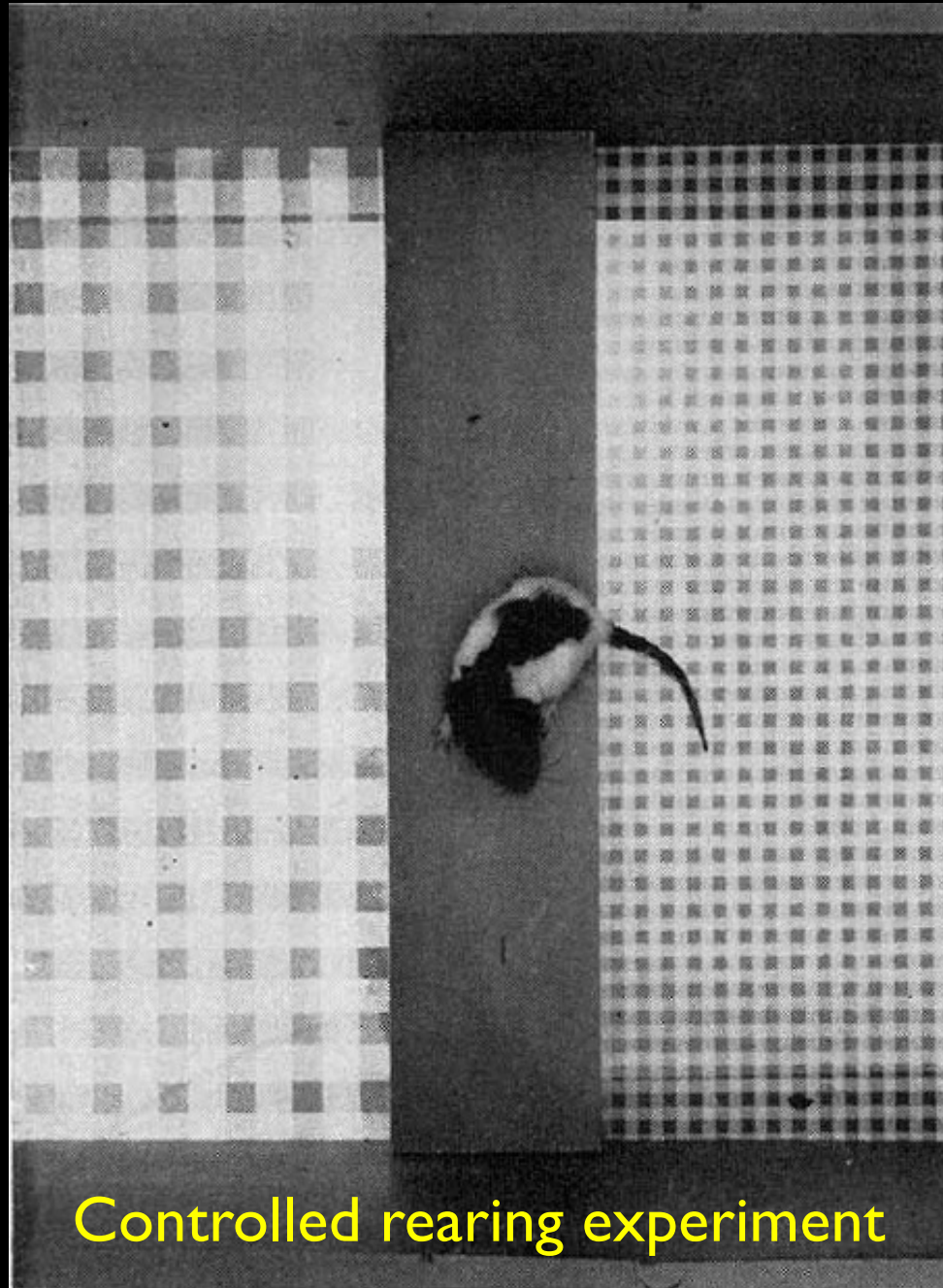


© [www.Julietubick.com](http://www.Julietubick.com)

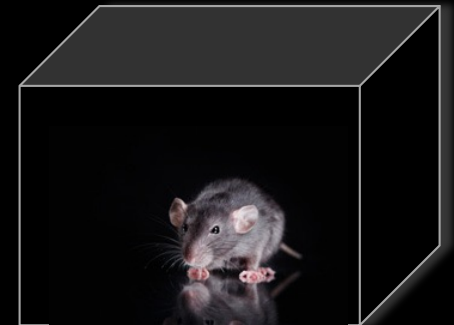
# How do we come to perceive depth?



Light reared

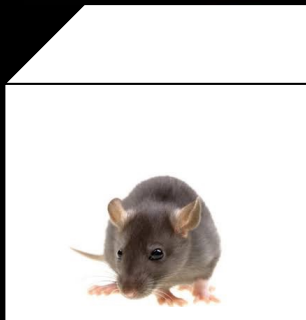
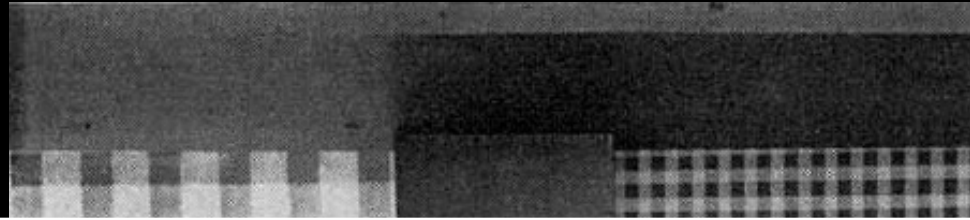


Controlled rearing experiment

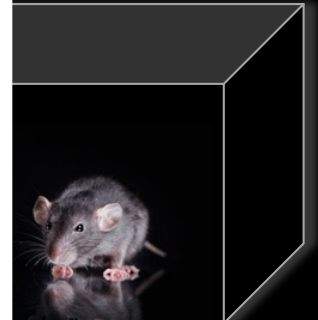
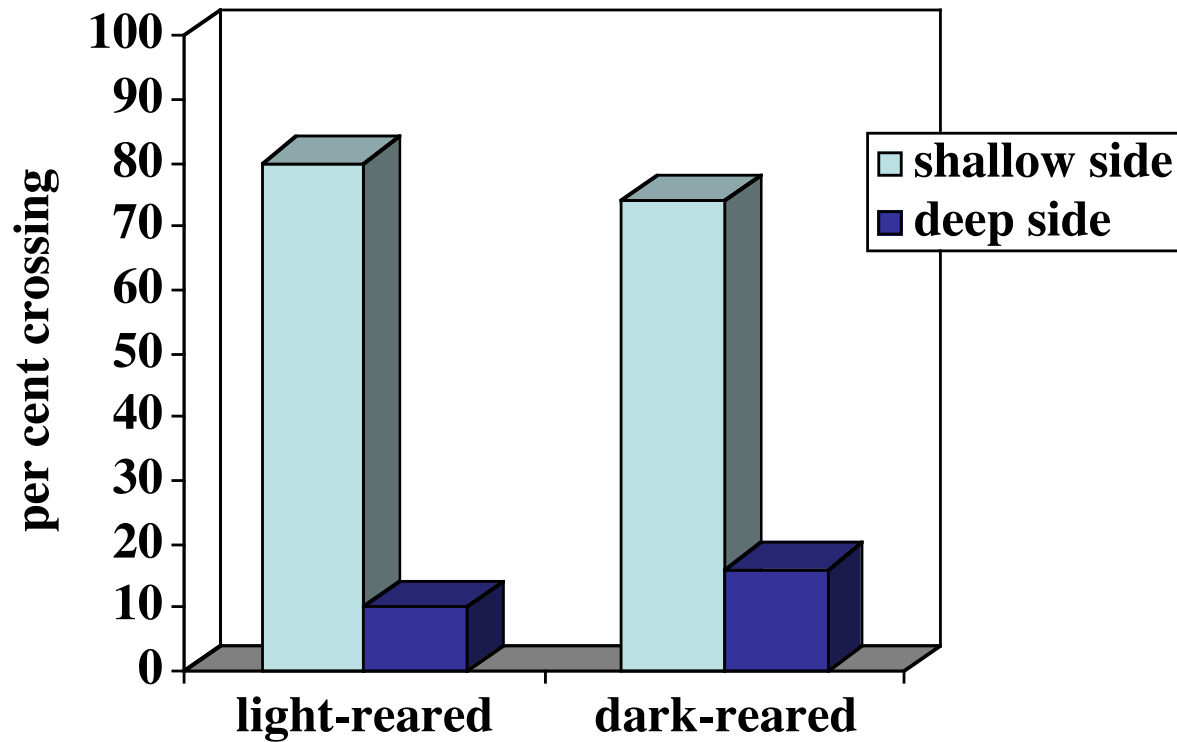


Dark reared

# How do we come to perceive depth?



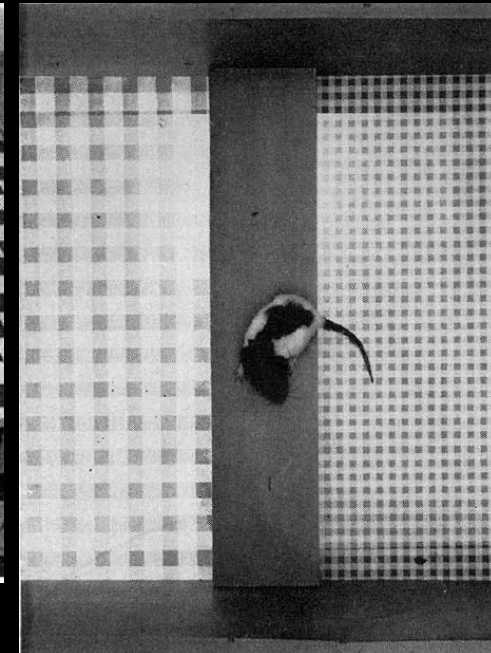
Light reared



Dark reared

Controlled rearing experiment

# How do we come to perceive depth?



Perception of depth appears to be independent of visual experience... AKA, innate

# How do we come to perceive depth?



... but that doesn't mean learning isn't also critically important!

How do we come to perceive depth?



# Learning to use depth judgments to assess risk....

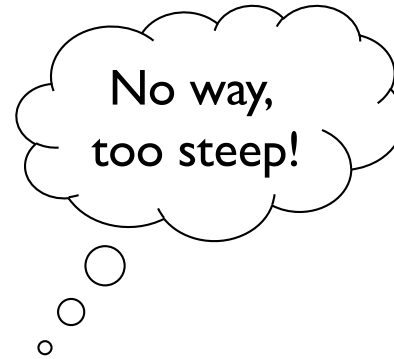


9 months:  
Novice crawler on  
steep slope

**Fails to judge risk**



# Learning to use depth judgments to assess risk....



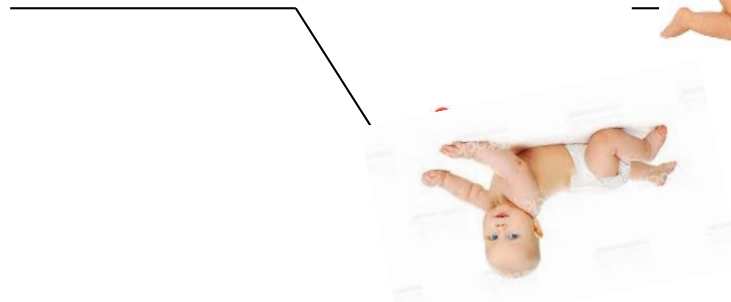
9 months:  
Novice crawler on  
steep slope

**Fails to judge risk**

11 months:  
Experienced crawler on  
steep slope

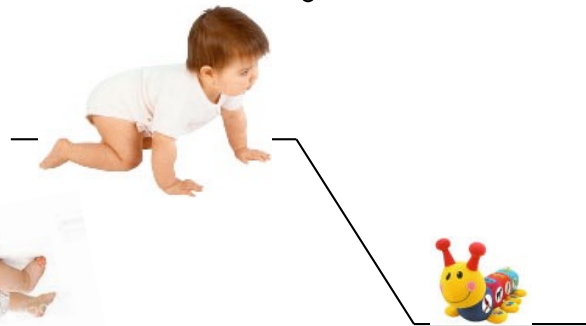
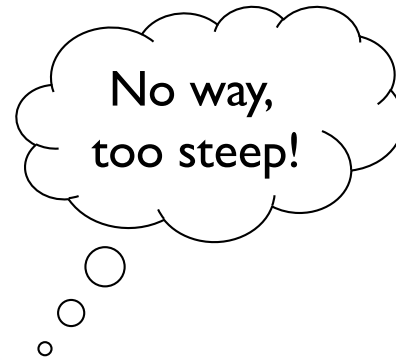
**Correctly judge risk**

# Learning to use depth judgments to assess risk....



9 months:  
Novice crawler on  
steep slope

**Fails to judge risk**



11 months:  
Experienced crawler on  
steep slope

**Correctly judge risk**



13 months:  
Novice WALKER on  
steep slope

**Fails to judge risk**

Learning to use depth judgments to assess risk....

Babies automatically perceive depth....

but have to learn what's safe / risky...

and *re-learn* this in every new posture!

# Learning to use depth judgments to assess risk...




But what about human knowledge....?



# Oooph, how do we even ask the question?

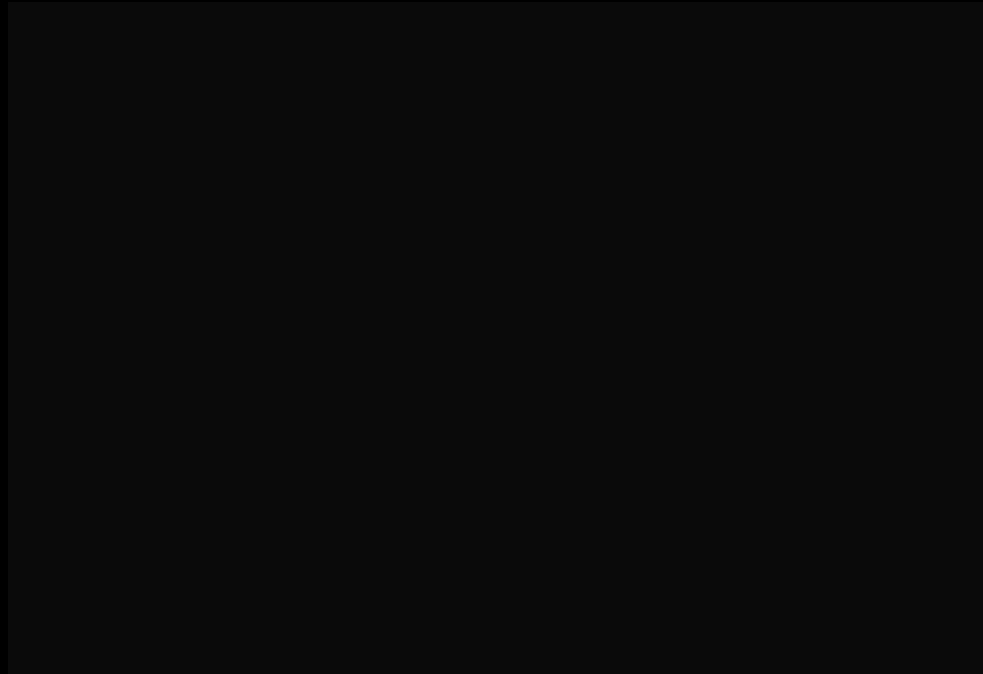
A newborn baby is shown crying, with its mouth wide open. The baby is wrapped in a white cloth. A speech bubble points to the baby's mouth.

Blerfgh....

A newborn baby is shown crying, with its mouth wide open. The baby is wrapped in a white cloth. A speech bubble points to the baby's mouth.

Hey, do you think objects are solid?  
Will they fall if you drop them?  
Do they continue to exist when hidden?

Oooph, how do we even ask the question?



One option: test babies who CAN do something...

But what if the task is causing babies to fail?





But what if the task is causing babies to fail?

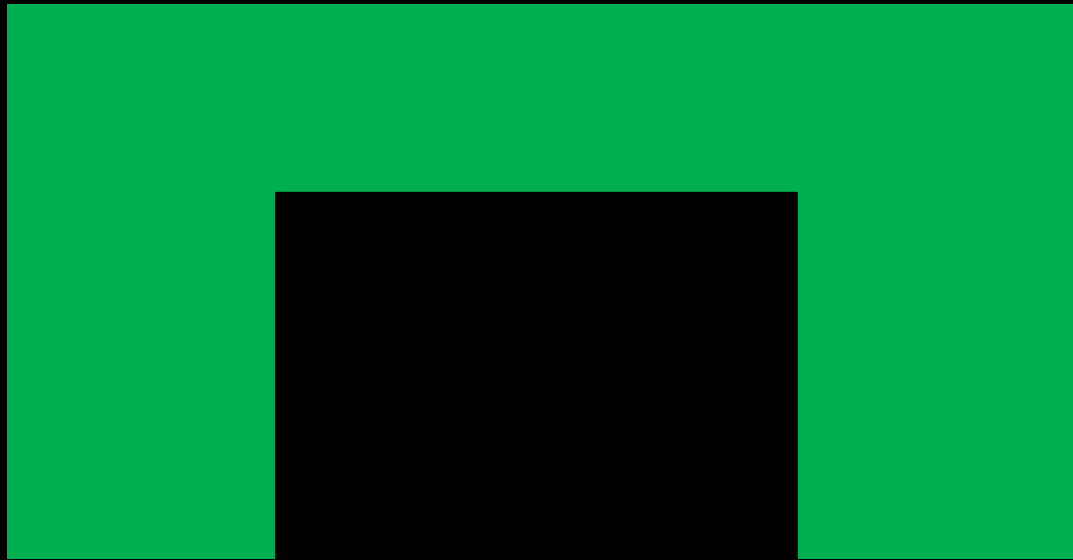


Can we make the task any easier?



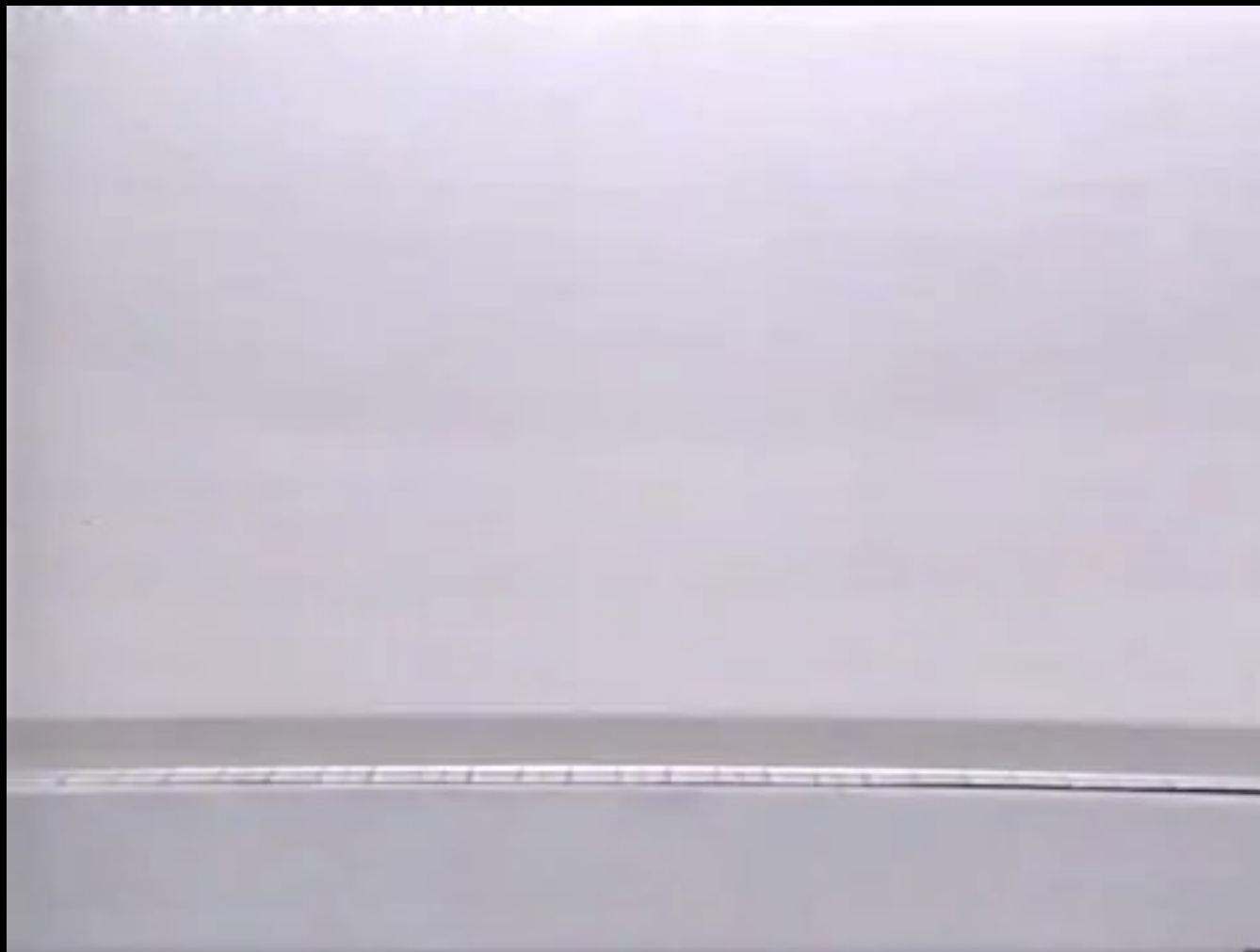
Helpful tool: Infants tend to look longer at things that are surprising than things that are expected

# Ok, so do Infants know anything about Objects?



....compared to when an *object*  
*appears to behave in impossible ways!*

Ok, so do Infants know anything about Objects?



Ok, so do Infants know anything about Objects?

Young babies  
look  
longer when:

An object seems to  
magically disappear  
(or appear)!

# Ok, so do Infants know anything about Objects?

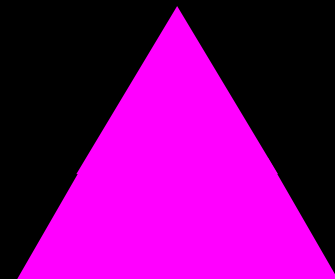


Object passes through solid barrier

Young babies  
look  
longer when:



Object floats in mid-air



Object breaks into pieces

Yeah yeah, but maybe babies learned about objects?



Test newborns' object knowledge (prior to learning)

(Hard.)



Raise baby without visual experience w/ objects?

(Nope.)

Yeah yeah, but maybe babies learned about objects?





Yeah yeah, but maybe babies learned about objects?



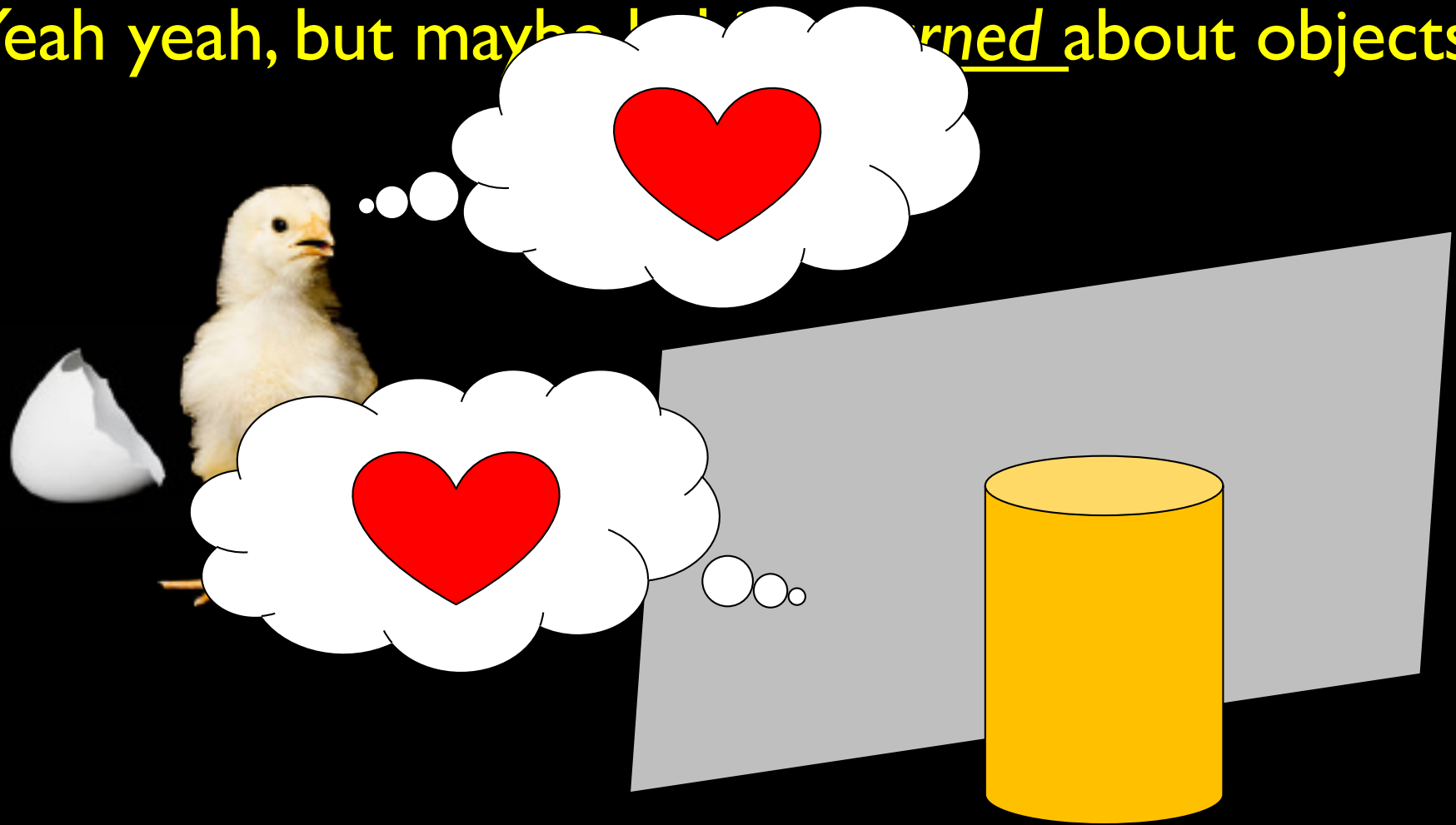
Avian imprinting

Yeah yeah, but maybe babies learned about objects?



Avian imprinting

Yeah yeah, but maybe I've learned about objects?



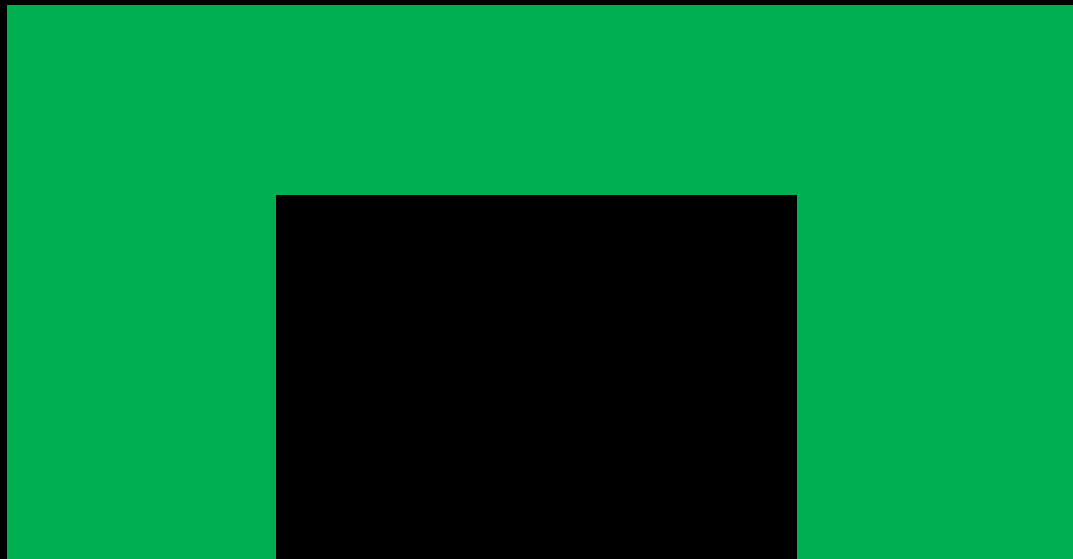
Yeah yeah, but maybe babies learned about objects?



Object knowledge appears early in humans;  
is innate in chicks.... So potentially innate in humans.

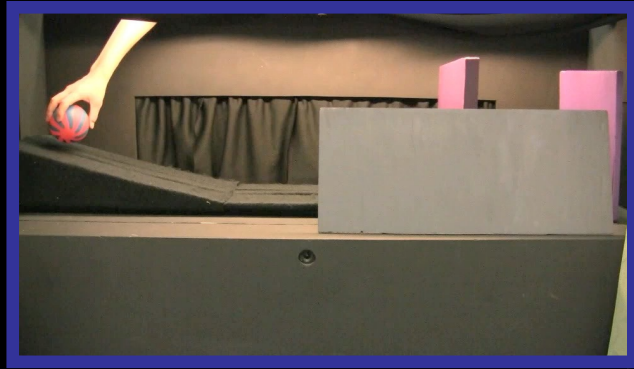
... but that doesn't mean *learning* isn't  
also critically important!

- Made in a factory
- Called “doll” (in English)
- Belongs to my sister ..... Etc etc..

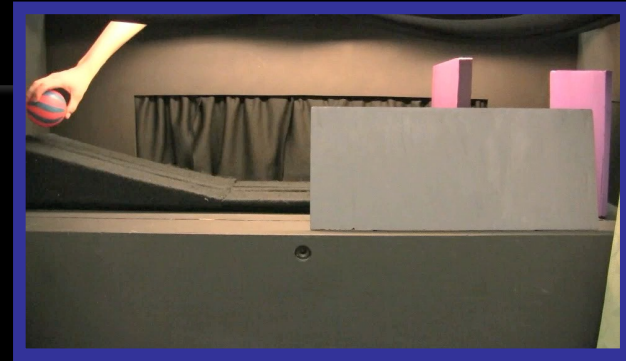


- Feigenson Lab studies how innate object expectations may enhance early learning

# What's the Point of Babies' Surprise Reactions?



Solidity Expected



Solidity Violation



Support Expected



Support Violation

That's a  
TOMA!



Babies play more with surprising objects, and even learn better about them!

# Core Knowledge Domains



Depth



Objects



Number







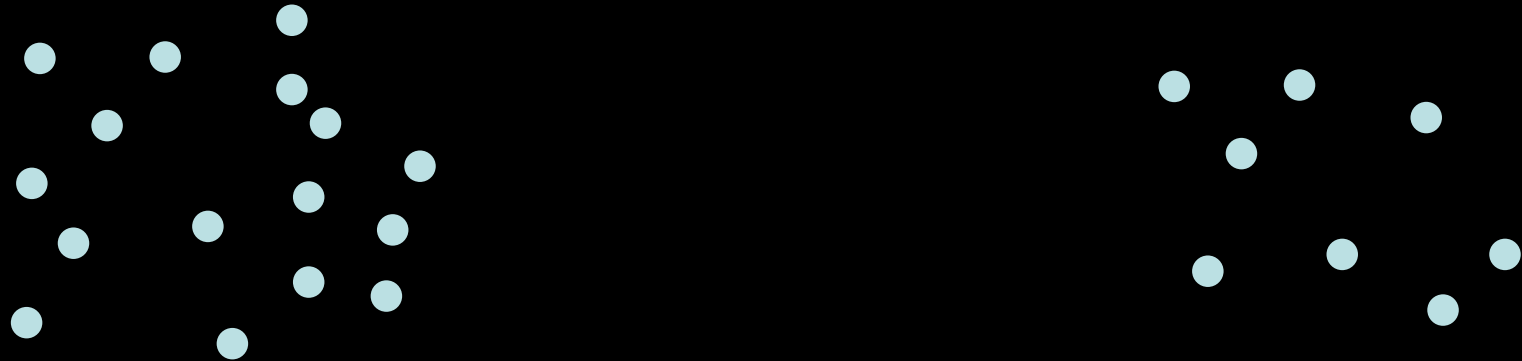
# Core Knowledge of Number?



# Core Knowledge of Number?



# Core Knowledge of Number?



(Another) Helpful tool: Infants tend to look longer at things that change over things that stay the same

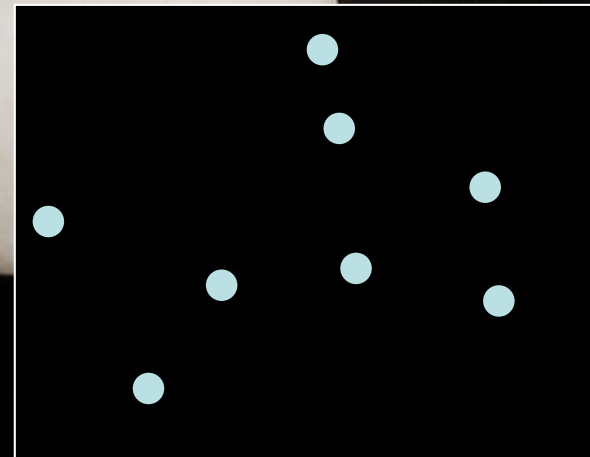
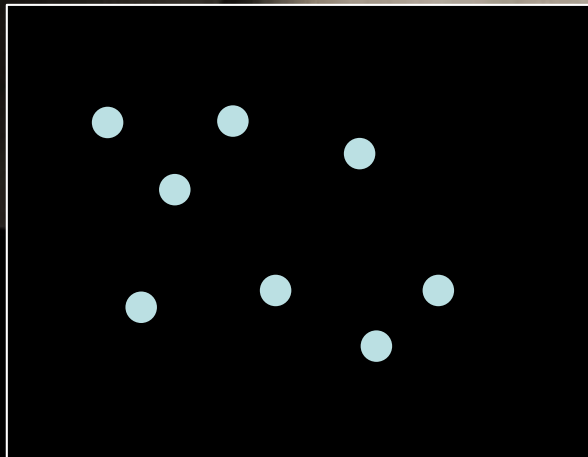
# “Change Detection” task can Measure Number Representations in Preverbal Infants



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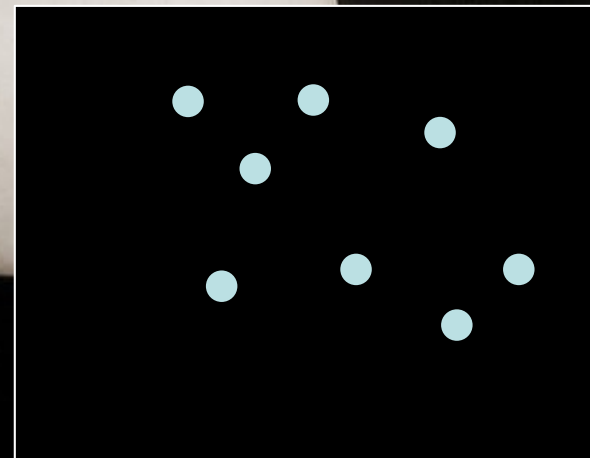
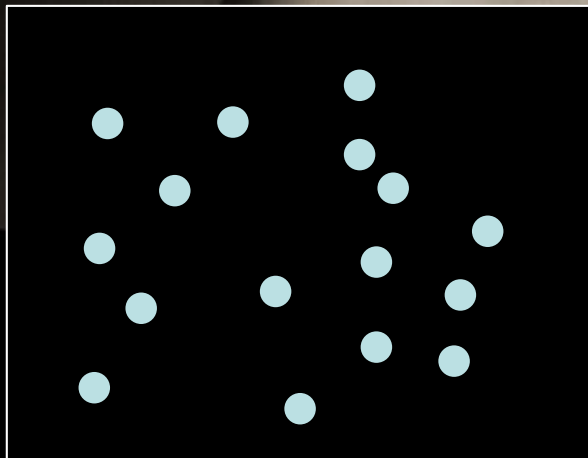


# “Change Detection” task can Measure Number Representations in Preverbal Infants





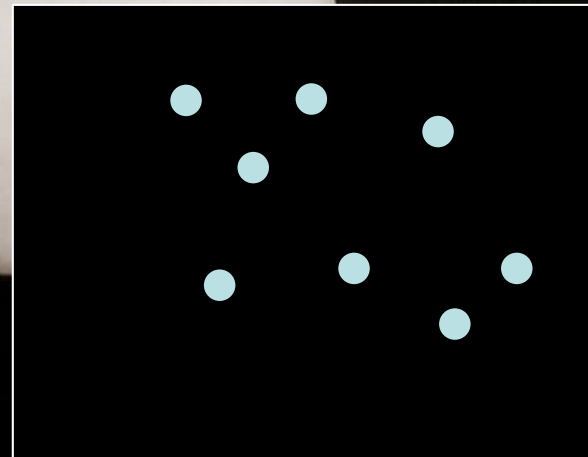
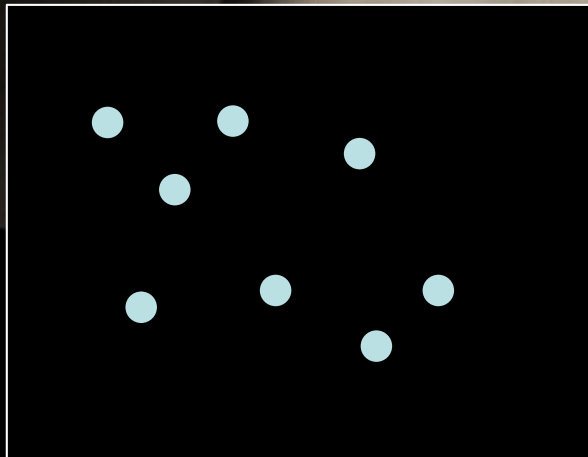
# “Change Detection” task can Measure Number Representations in Preverbal Infants



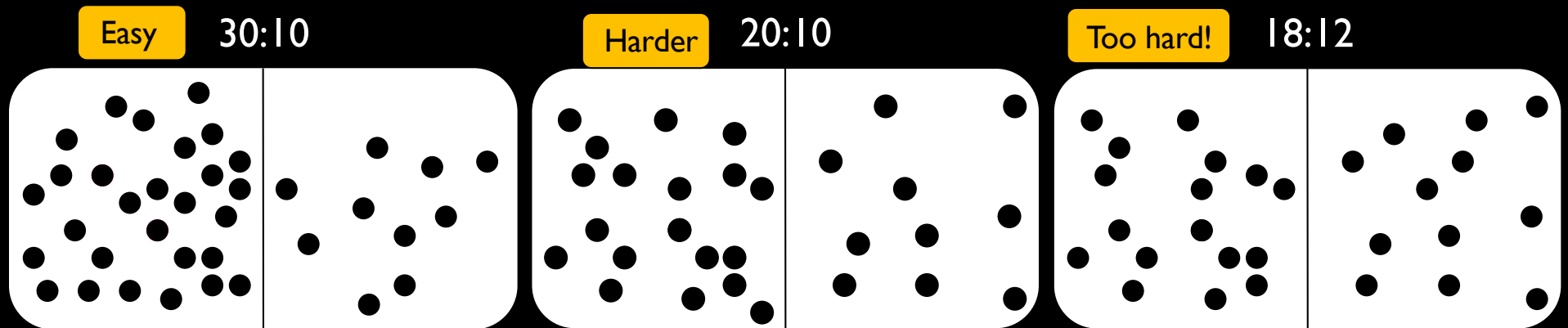
# “Change Detection” task can Measure Number Representations in Preverbal Infants



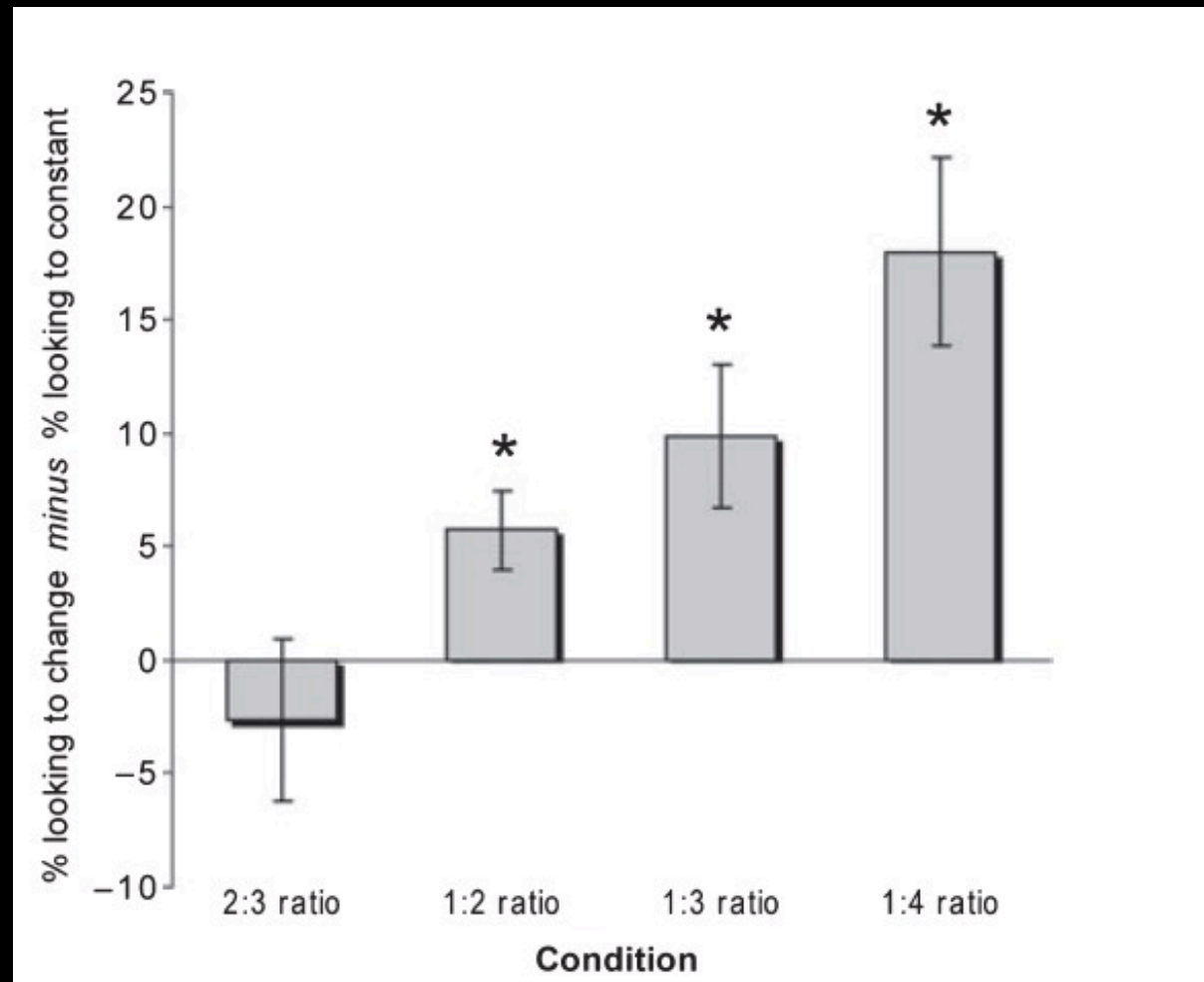
# “Change Detection” task can Measure Number Representations in Preverbal Infants



# “Change Detection” task can Measure Number



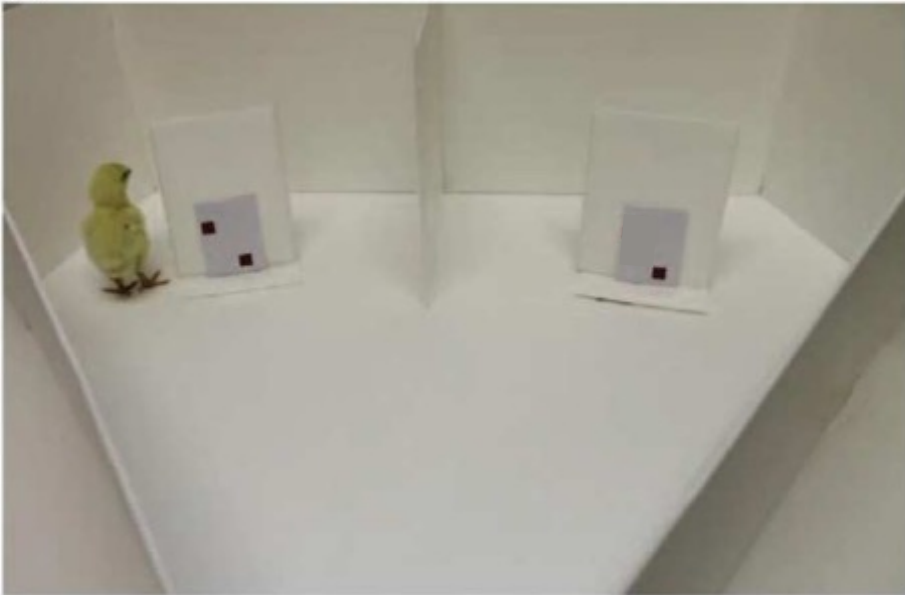
# “Change Detection” task can Measure Number Representations in Preverbal Infants



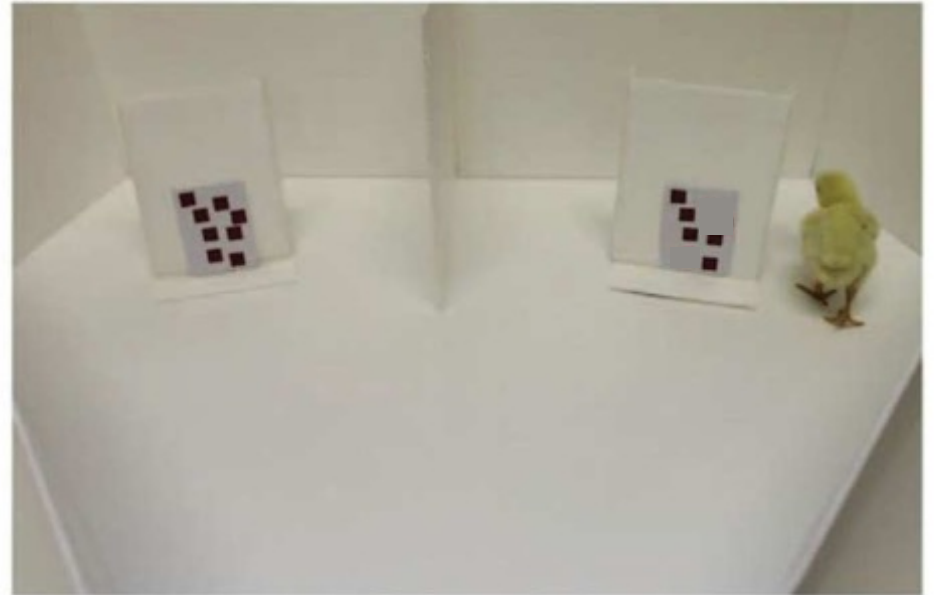
*Libertus & Brannon, 2010*

# Can Simpler Brains Represent Number?

A



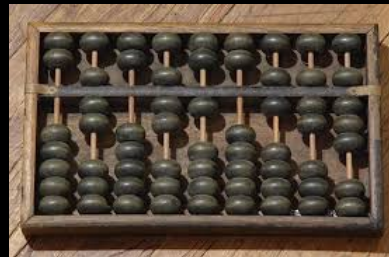
B



# Core Knowledge of Number?

Born with intuitive sense of approximate number....

But we must learn



$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

...with great effort!!!

# Core Knowledge Domains



Depth



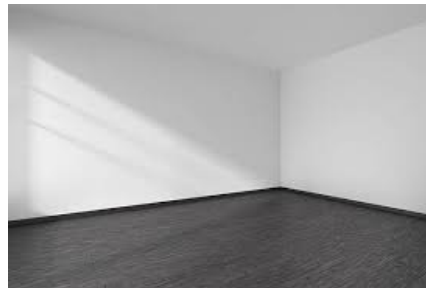
Objects



Number



Other minds



Spaces & places





# Core Knowledge of Other Key Stuff

## Learning Builds on these Foundational Abilities

Gotta see depth to *learn* about what's safe....

Gotta know stuff about objects to learn to interact with them...

Gotta sense quantities to be able to learn symbolic numbers...

# How do we know about the world?



John Locke  
1632-1704



René Descartes  
1596-1650

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