9.85 Cognition in Infancy and Early Childhood

Perception and Object Knowledge

Today

- Critical responses due today; proposals due a week from today.
- Perception
- Objects

“What’s it like to be a baby?”

- Babies as Martians
  - Big heads
  - Big eyes
  - Take over our lives

- “Blooming, buzzing confusion”?

Blooming buzzing confusion?

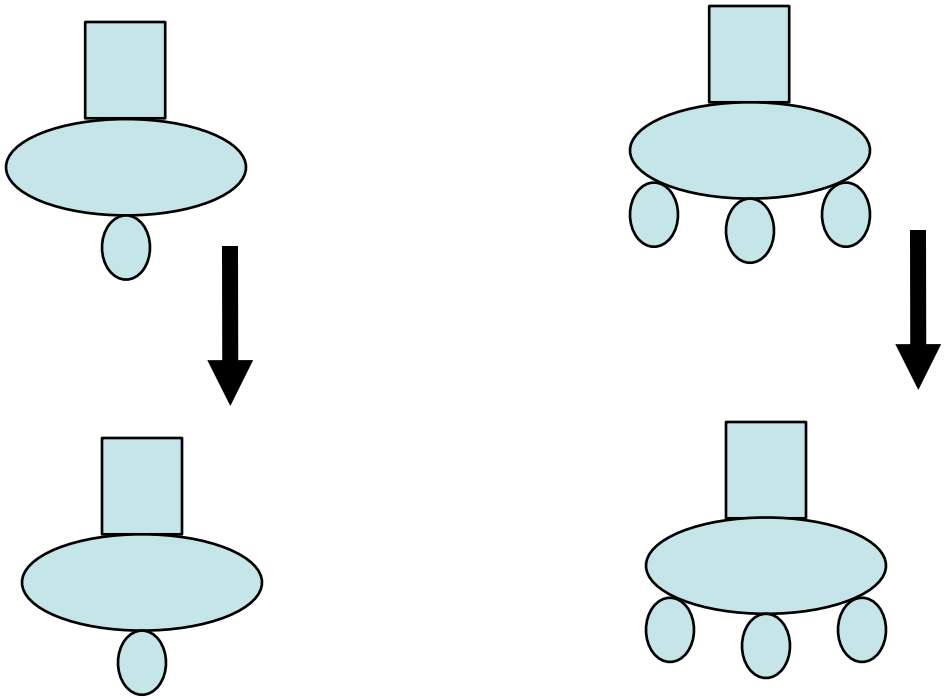
- Even neonates can see, hear, smell, touch, and taste.
- But it might still be “blooming, buzzing confusion.” Why?
- Importance of cross-modal integration.

Cross-modal integration

Figure removed due to copyright restrictions.
Figure 1. Sample photographs from videotape recordings of 2- to 3-week-old infants imitating tongue protrusion, mouth opening, and lip protrusion demonstrated by an adult experimenter.
Meltzoff, Andrew N., and M. Keith Moore. "Imitation of facial and manual gestures by human neonates." *Science* 198 (1977): 75-8.

Cross-modal integration

Sucking without seeing



Looking time preference

“What’s it like to be a baby?”

- Babies as Martians
  - Big heads
  - Big eyes
  - Strange ways of seeing
  - Exercise mind control over us

“What’s it like to be a baby?”

- “The fact that we cannot ever expect to accommodate in our language a detailed description of Martian or bat phenomenology should not lead us to dismiss as meaningless the claim that bats and Martians have experiences fully comparable in richness of detail to our own …(Nagel, Psych Review, 1974)

The object mystery

- Sensory input is continuous
- But we operate on individuals
  - We count them
  - We name them
  - We manipulate them
  - We represent spatial relations among them
  - We represent causal relations among them
  - We have preferences, goals and beliefs about them

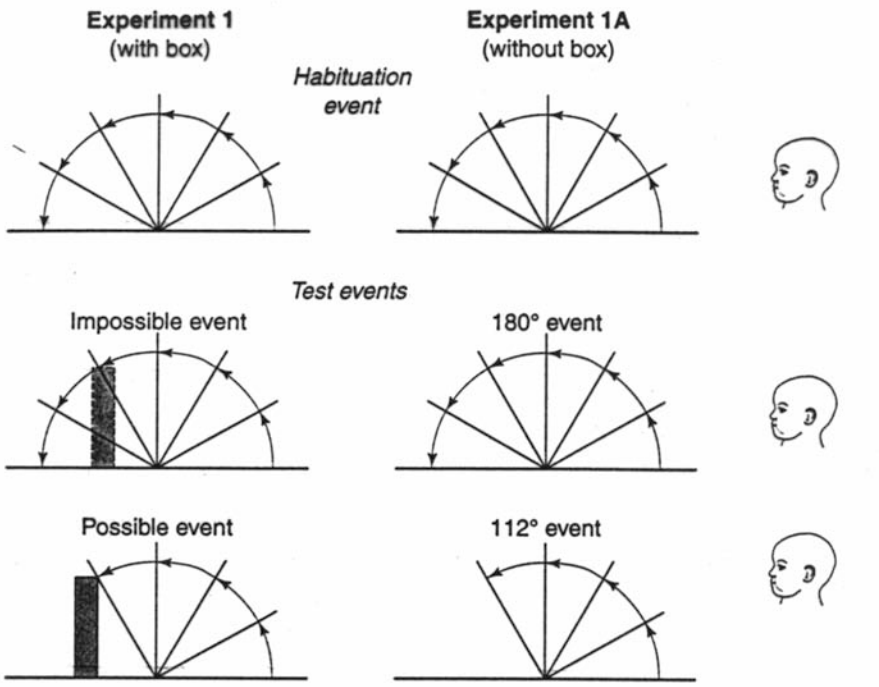
Object ... as opposed to what?

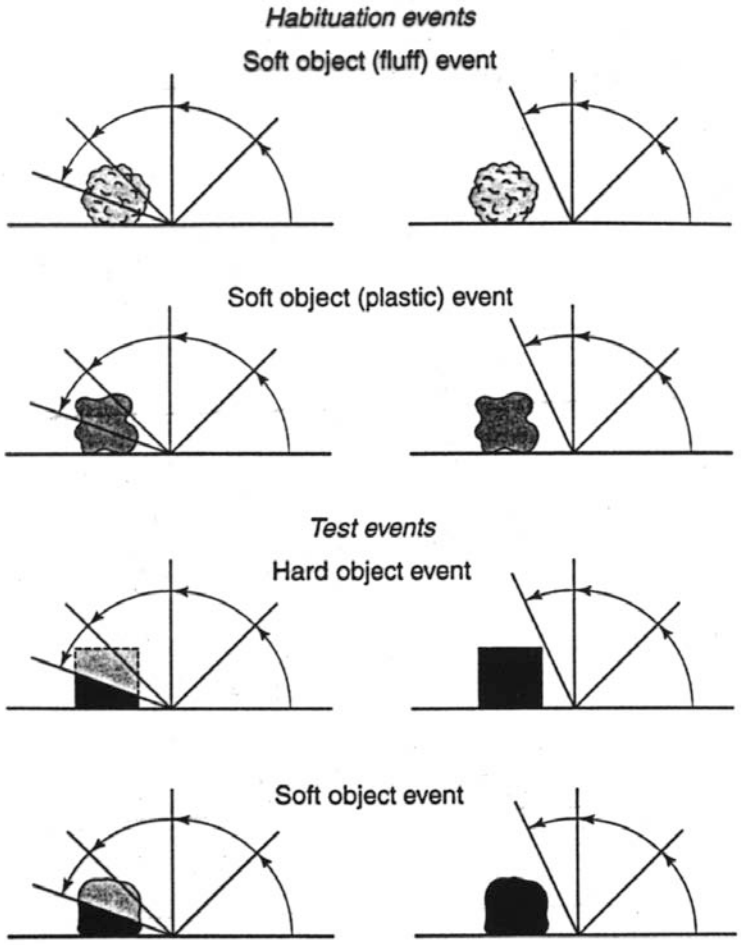
- Object properties
  - shape
  - number
  - color
  - material (substance)
  - parts
- Agents
  - all agents are also objects but of course not all objects are agents

What do infants know about objects?

- Piaget -- not much. Infants lack an 'object concept' ... they only represent whatever is immediately accessible to their sensorimotor system.

- Renee Baillargeon. Infants have abstract representations of objects and some of their properties.drawbridges





In fact, infants represent not only hidden objects but their properties(Baillargeon, 1987).

- Baillargeon

By 9.5 months can represent the presence of hidden objects even if the objects are never seen at all ...

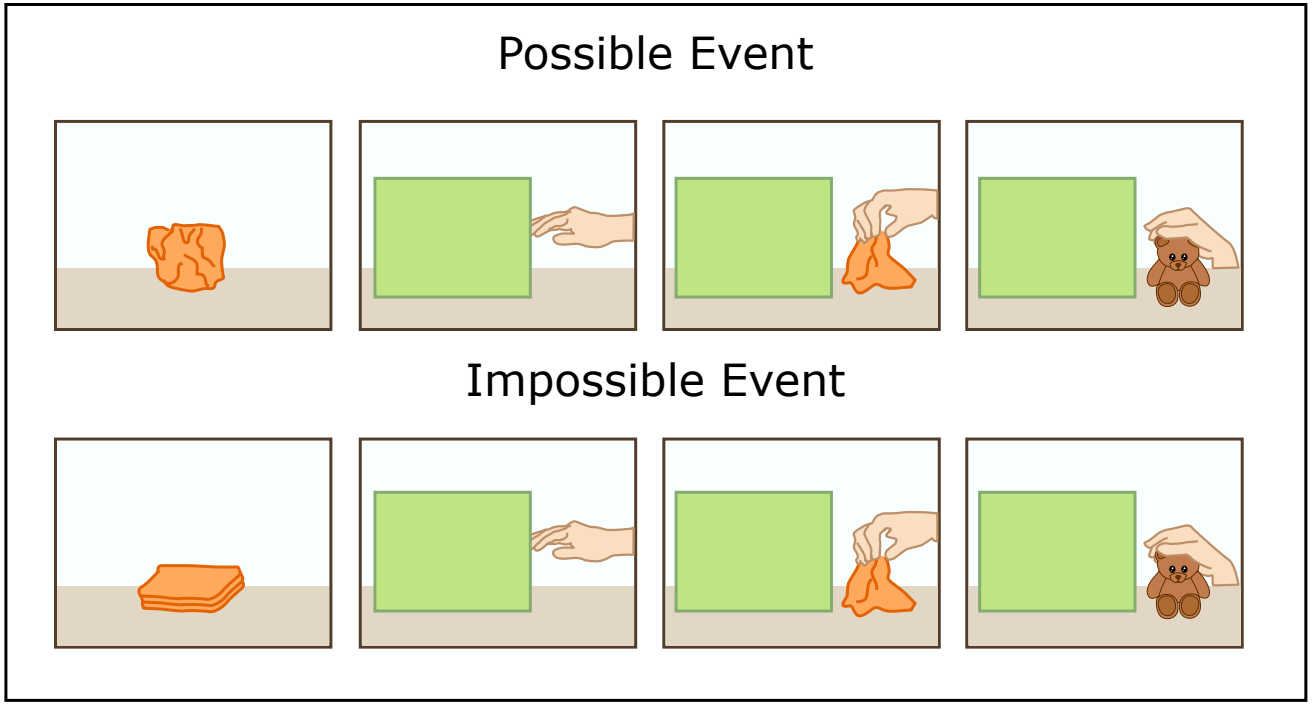


Image by MIT OpenCourseWare.

Why then do babies fail to reach for hidden objects?

- Discrepancies between looking and action planning occur across numerous studies.
- Recognizing something has disappeared is easier than figuring out what to do about it.
- Infants‘ inability to plan actions to retrieve hidden objects, related to ability to change motor response set. (Esther Thelen)
- Infants‘ inability to plan actions to retrieve hidden objects, related to prefrontal cortex maturation (Adele Diamond)

Why do babies make the "A not B" error?

- Esther Thelen: Perseveration at A is related to:
  - number of initial trials at A location
  - postural issues
- Adele Diamond: Perseveration at A is related to:
  - Maturation of the dorsolateral prefrontal cortex: Between 8 and 9 months infants begin to succeed at the task at successively longer delays.
  - A-not-B-error occurs in infant monkeys and in adult monkeys with lesions to the dorsolateral prefrontal cortex.

Effect of different retrieval delays

- Performance/competence distinction

Figure removed due to copyright restrictions. Figure 2. Diamond, Adele. "Development of the Ability to Use Recall to Guide Action as Indicated by Infants' Performance on A-not-B." *Child Development* 56 (1985): 868-83.

So babies represent hidden objects ... what else do they know about objects?

- What seems particularly central to our notion of an ‘object’? ... What are those features without which an object would not be an object?

Spelke, et al., Origins of Knowledge

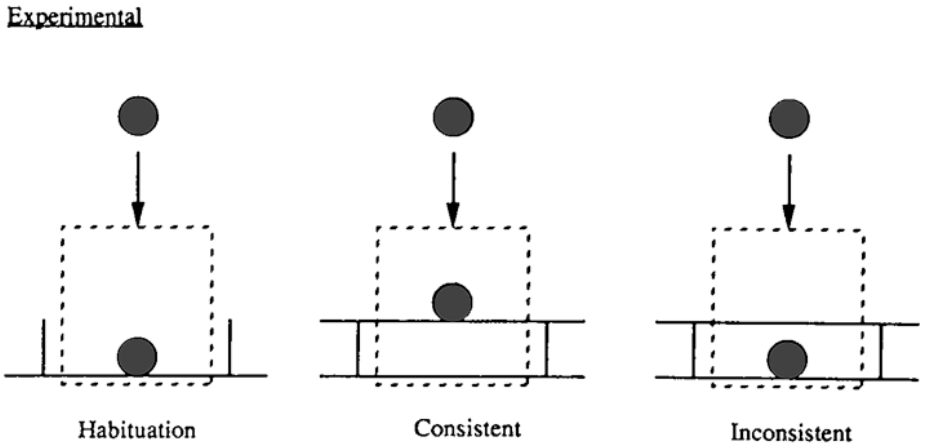
- **investigate four constraints on object knowledge ...**
- **Core**
  - Continuity -- objects only move on connected paths; they do not jump in place of time
  - Solidity -- objects only move on unobstructed paths; no two objects occupy the same place at the same time.
- **Not core**
  - Gravity -- objects move downward without support
  - Inertia -- objects do not change their motion spontaneously.

Spelke, et al., Origins of Knowledge

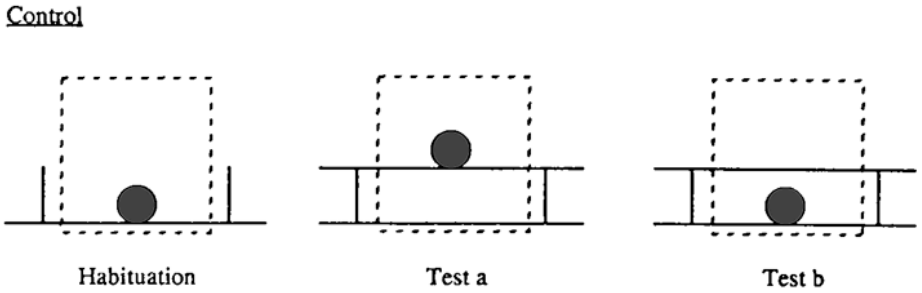
- **What's the argument for why we should (a priori) think continuity and solidity are "core" and gravity and inertia aren't?**
- Argument from adult patterns of error.
- Adults never judge that objects will move discontinuously or pass through other objects
- But frequently misjudge object trajectories

Do 3-month-olds assume objects are solid and move on continuous paths?

Consistent = superficially novel but respects solidity & continuity.
Inconsistent = superficially familiar but violates solidity and continuity.



- http://web.uvic.ca/~lalonde/Psyc435A/object/



Sensitivity to continuity and solidity

- **Are you convinced? What are alternative accounts?**
- Greater the distance between initial and final position of the ball = longer looking
- Longer looking at the expected position -- where the ball landed in the past.
- (not reflect knowledge about solidity; just expectations based on the habituation).

Sensitivity to continuity and solidity

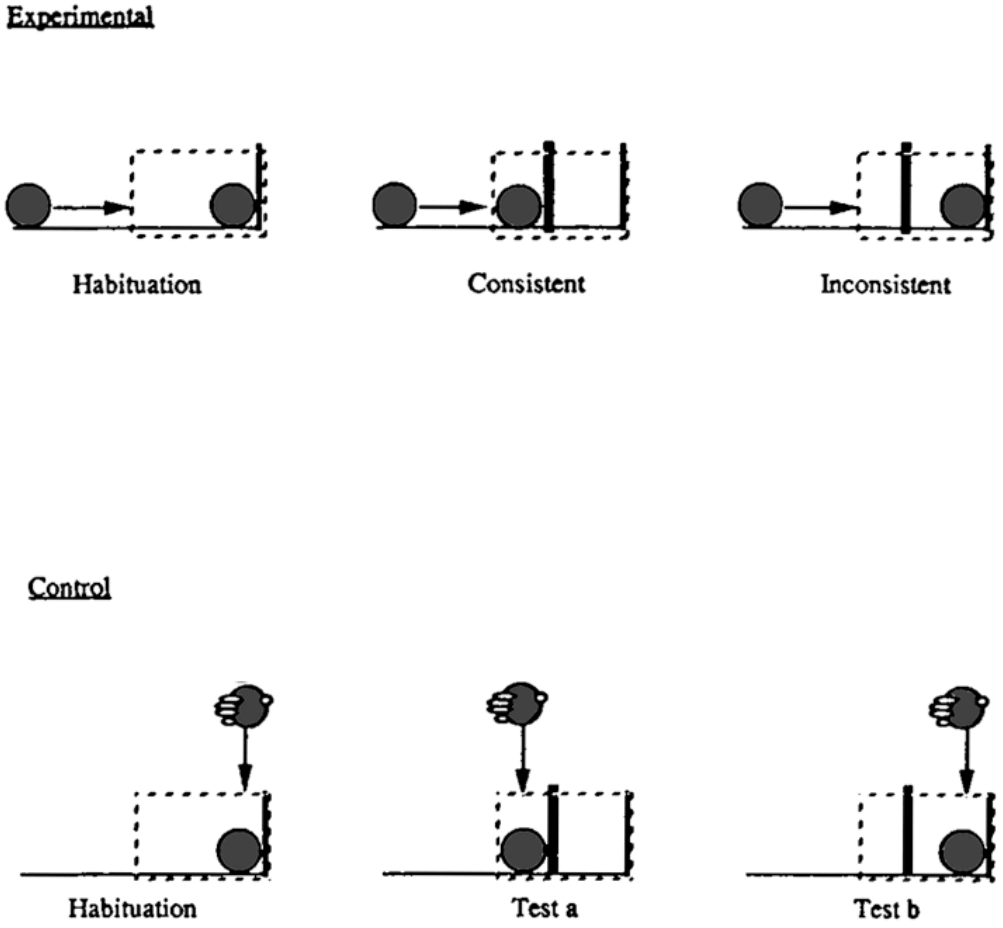


Figure 6. Schematic depiction of the events from Experiment 3.

No particular sensitivity to inertia

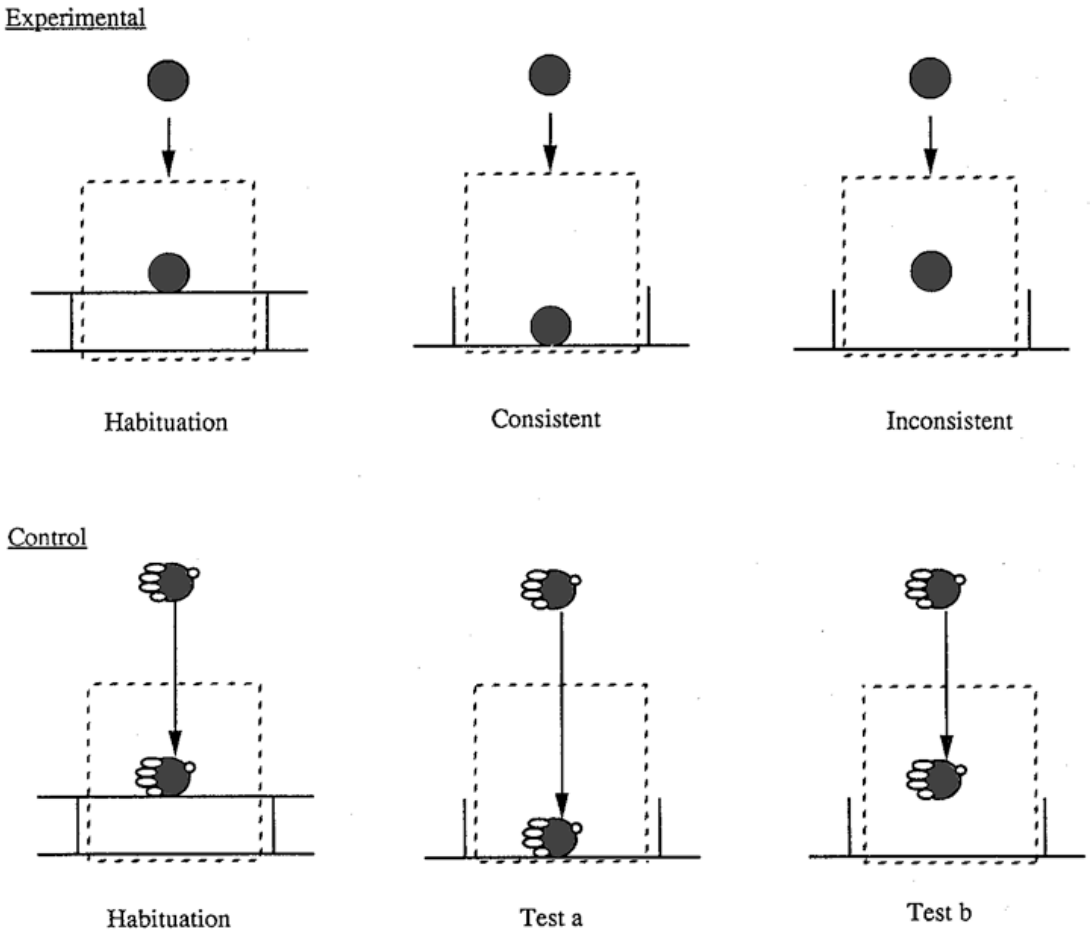


Figure 9. Schematic depiction of the events from Experiment 4.

No particular sensitivity to gravity ...

Figure removed due to copyright restrictions. Figure 11. Schematic depiction of events from Experiment 5. Spelke E. S., K. Breinlinger, et al. "Origins of Knowledge." *PsycholOgical Revolution* 99, no. 4 (1992): 605-32.

Knowledge of gravitational constraints seems to develop over infancy ...

- At 3.5 months, don't distinguish any contact v. contact from below

- Gradually become more and more sophisticated about support relations ...

Core object knowledge

Spelke Objects

i. Continuity. Objects exist continuously and move on paths that are connected over space and time.

ii. Solidity/cohesion. Objects are solid and cohesive: they are internally connected and externally bounded entities that maintain both their connectedness and their boundaries over time and space.

***iii. Contact.* Objects influence each others' motions if and only if they touch.**

Objects should move when contacted

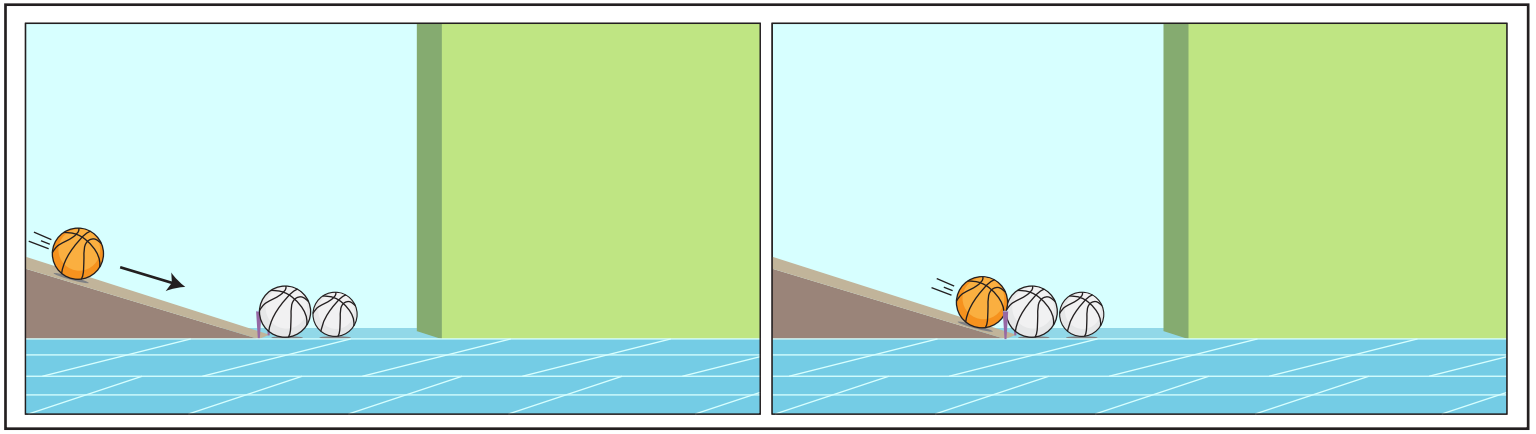
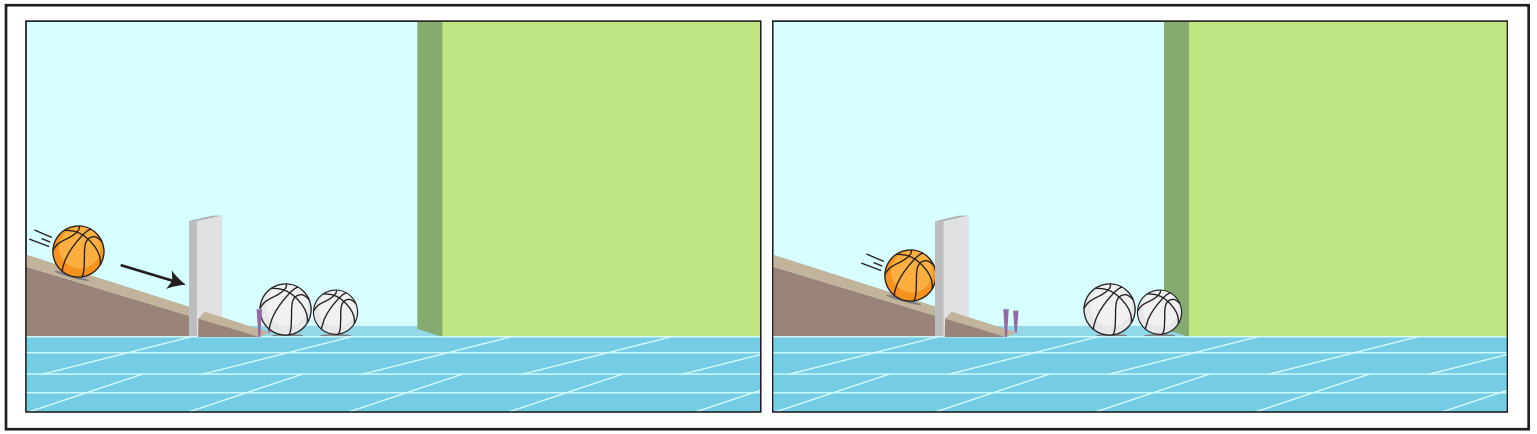


Image by MIT OpenCourseWare.

Objects should not move when not contacted



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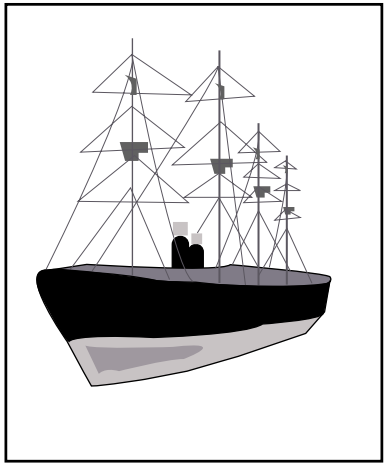
Okay -- so babies know lots about objects ... but what is an object anyhow?

- Might think an object is just the sum of its parts:
  - An apple is its skin and its stem and its seeds and its fruit …
- But …

Philosophical puzzles

- “The ship … was preserved by the Athenians down even to the time of Demetrius Phalereus, for they took away the old planks as they decayed, putting in new … timber in their place, insomuch that this ship became a standing example among the philosophers, for the logical question o things that grow; **one side holding that the ship remained the same, and the other contending that it was not the same**.” (Plutarch, Vita Thesei)



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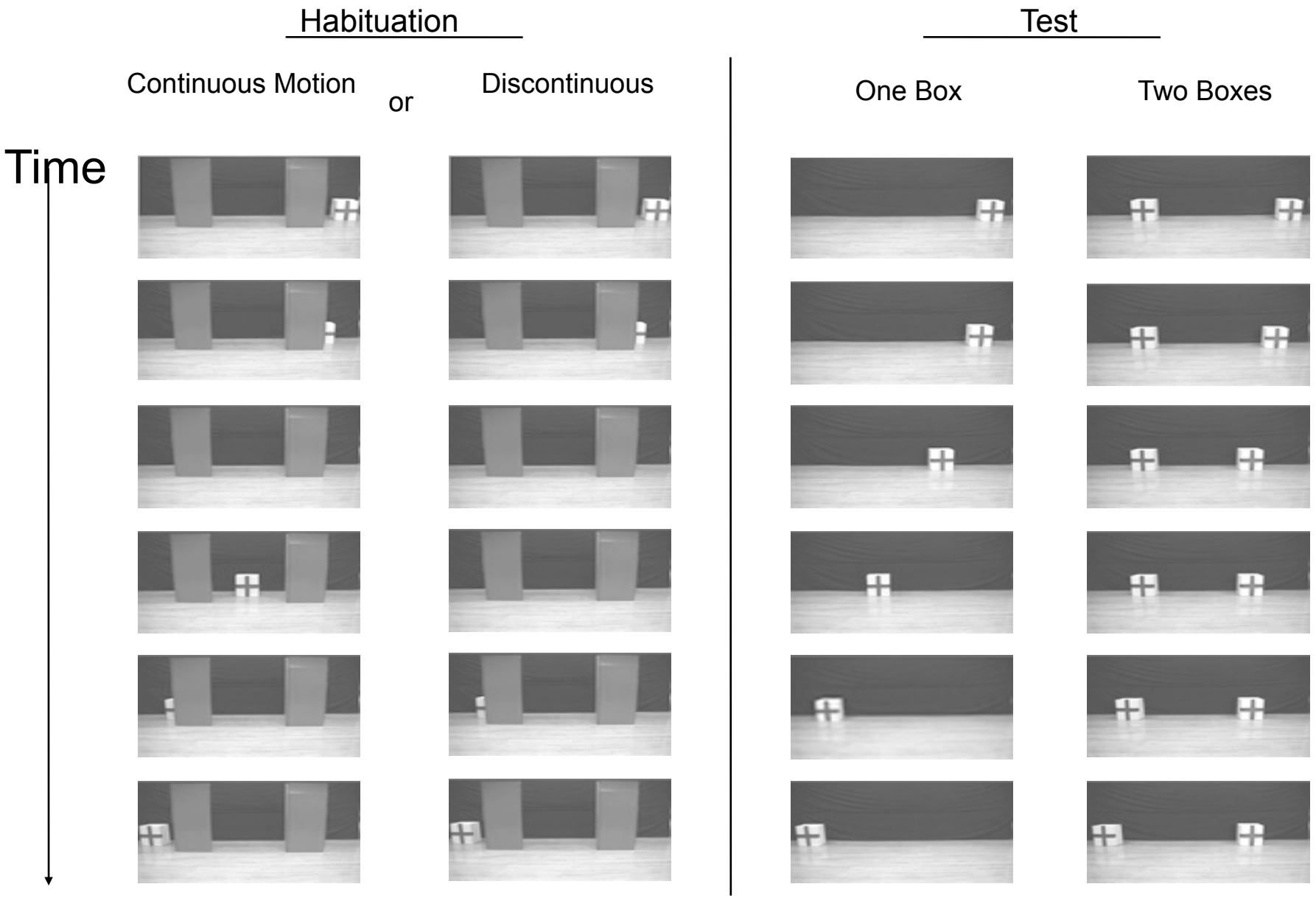
Puzzle of object identity

- Objects can change many (all?) of their constituent parts.
- Are they still the same object or not?
  - Metaphysical questions about identity
  - But also an epistemological question -- how do we identify something as one and the same object?



Spatiotemporal object individuation

- Five-month-olds expect two objects when the motion is discontinuous
- One object when the motion is continuous.

Spatiotemporal continuity

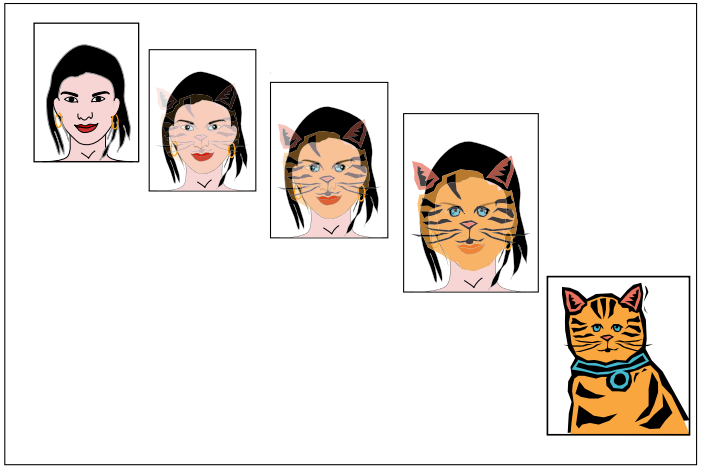
- Maybe an “object” is not the sum of its parts.
- Maybe an “object” is anything that traces a continuous path through space and time.
- Multiple object tracking paradigm

Spatiotemporal continuity

- But even if spatiotemporal properties were preserved and all transformations across space and time continuous,
- we might still be tempted to call things with quite different properties different objects.
- one woman?

Two representational systems

- Argues for a distinction between:
- Processes that individuate and track objects through time … **Spatiotemporal object individuation** (Mid-level visual processing)
- Processes that bind representations of features to individuals **-- Kind-based object individuation**



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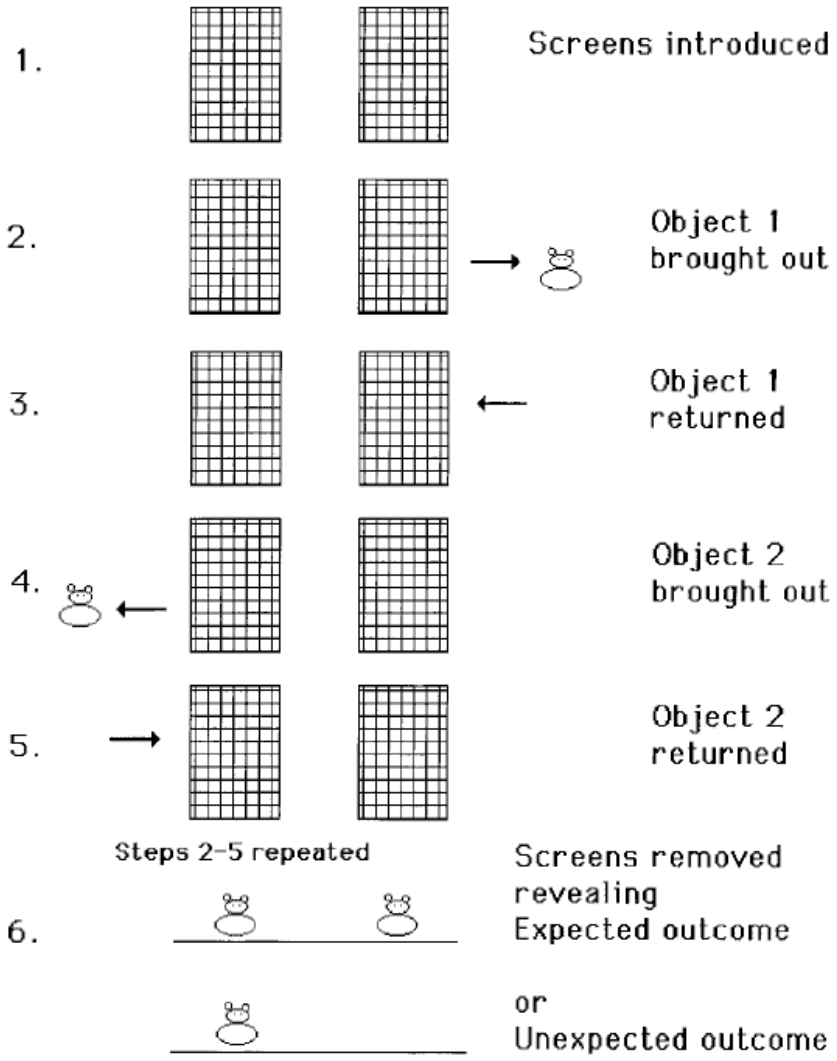
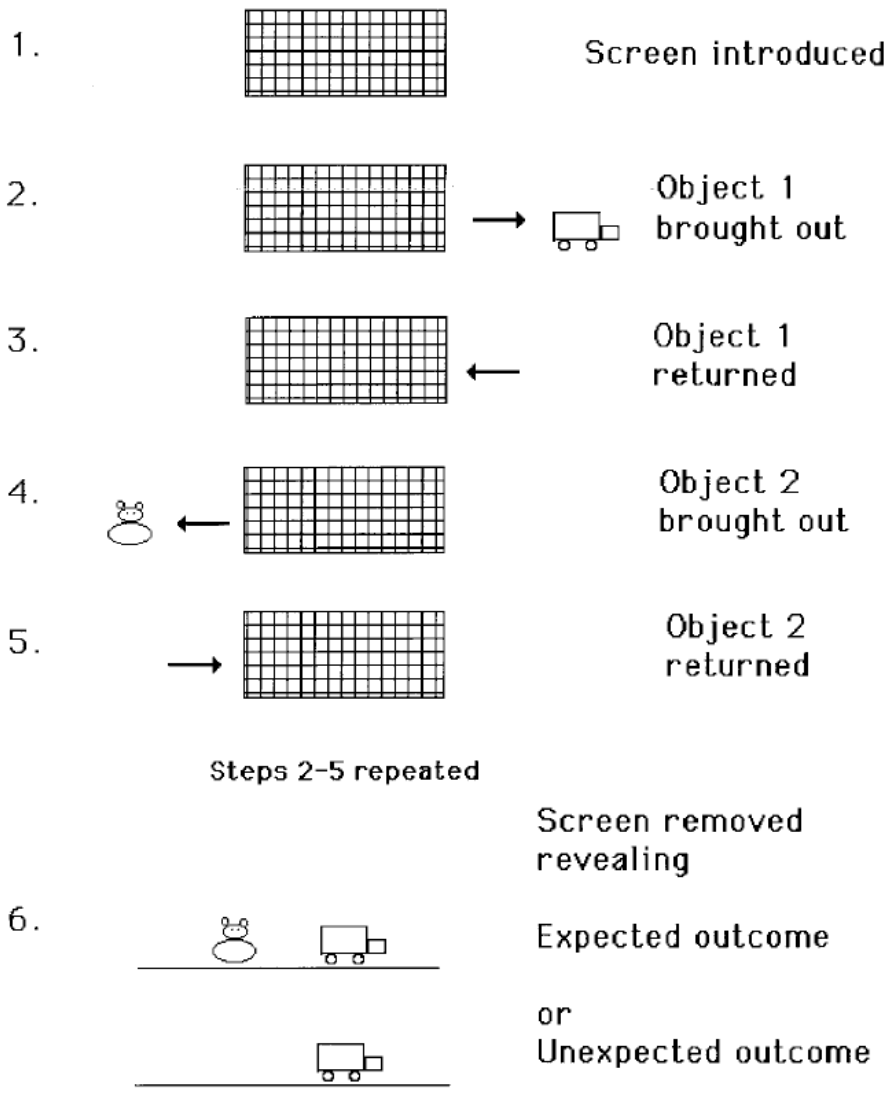
Object individuation

- What if you eliminate spatiotemporal cues and just provide property-kind information?

Just kind information



Spatiotemporal & kind information



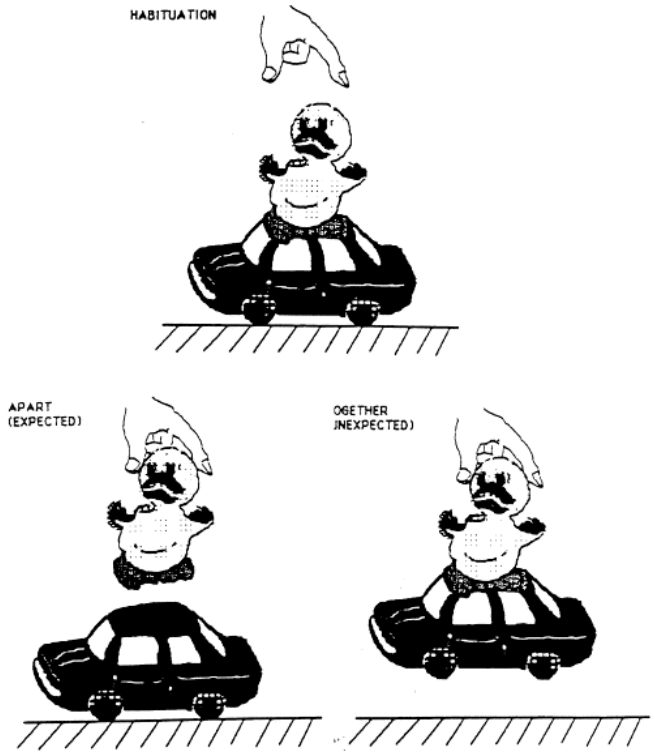
Xu & Carey, 1996

- Found that 10-month-olds:
  - preferred 2 objects to 1 at baseline
  - continued to prefer 2 objects to 1 if given only property/kind cues suggesting that there were 2 objects
  - did not show the preference for 2 objects if given spatiotemporal information suggesting that there were 2 objects.
- 12-month-olds were able to use both property/kind and spatiotemporal cues to expect 1 objects.

Spatiotemporal cues v. property kind cues

- Suggests that processes involving object individuation may be different from processes involving object identification.
- But when both objects are never visible at the same time, you have to remember which object is behind the occluder. Could it just be that 10-month-olds have trouble remembering?

Spatiotemporal cues v. property kind cues



- Again, 12 but not 10-month-olds differentiated based on property/kind (Xu, Carey, & Welch, 1999).

But … “look at the **toy**” “look at the **toy**”

Image by MIT OpenCourseWare.

Object labels help 10-month-olds: “Look at the **ball**”; “Look at the **duck**”

Image by MIT OpenCourseWare.

9.85 Infant and Early Childhood Cognition
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