


Learning & Development in Middle-School Children

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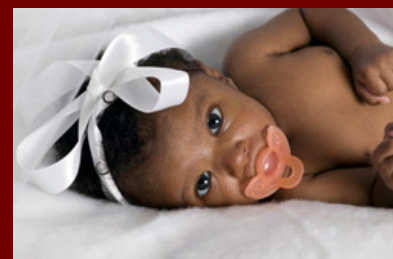
http://www.uc.edu/ccrl/Events.html

- Age is not a good indicator of much!
  - a child's knowledge
  - a child's development stage
  - a child's learning ability
  - a child's potential

- Principles of learning apply to all ages!
  - preschooler through adulthood
  - toddlers
  - infants



Lesson 1

Age is not a good indicator of much!

- How is this possible?

- Differences between age groups are easy to find

Attention
Brain
Memory
Motor Coordination
Planning
Scientific Reasoning
Abstract Thinking
Social Competence
Language
Problem-solving

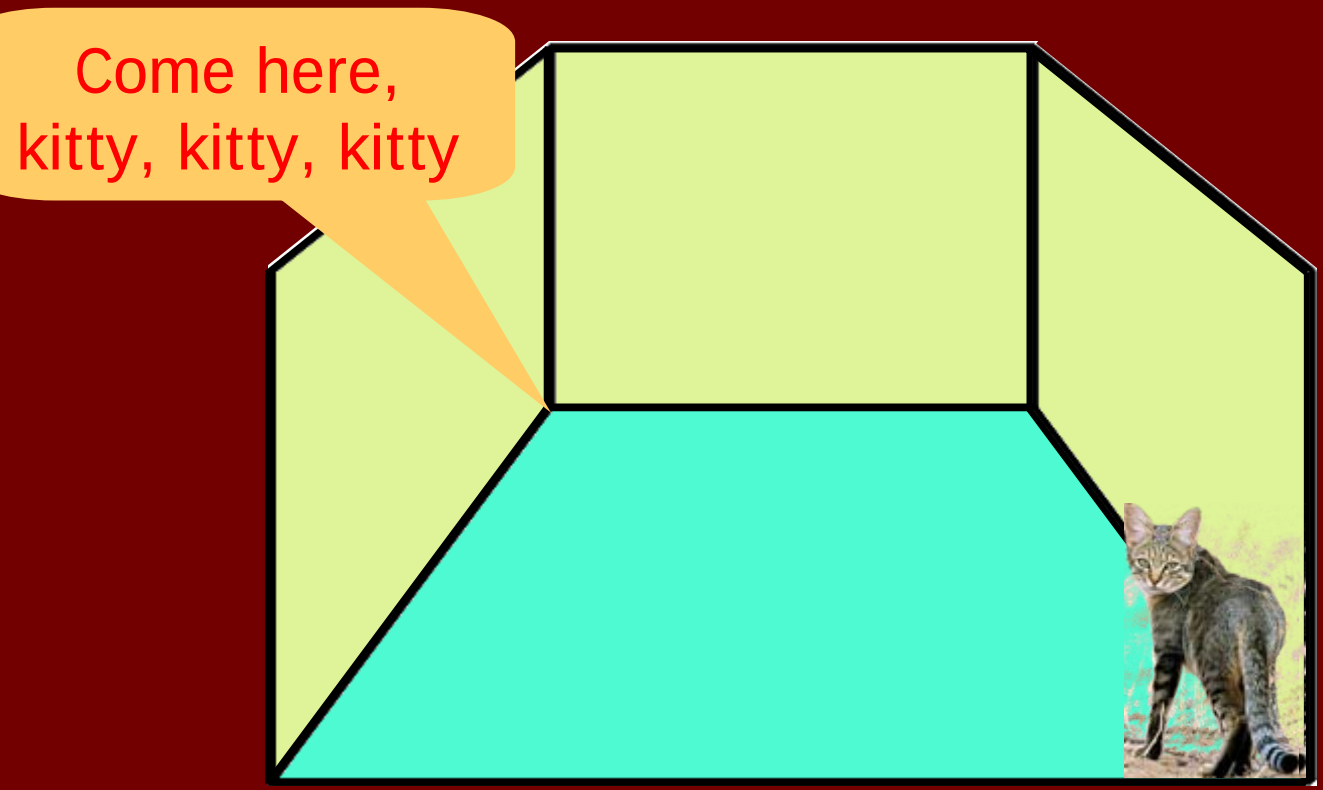
Lesson 1

Age is not a good indicator of much!

- because performance is not indicative of
  - a child's knowledge
  - a child's development stage
  - a child's learning ability
  - a child's potential

- performance measures constraints in the immediate context

Constraints



Performance is always a function of the existent constraints – never a mere reflection of a competence.

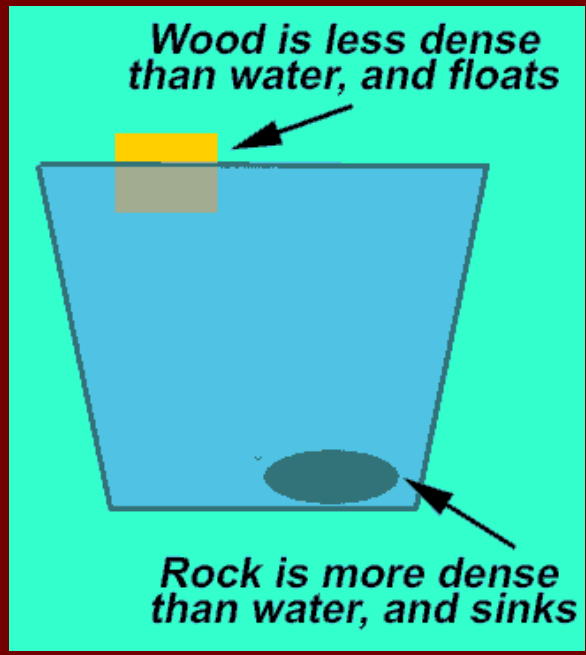
If constraints matter...

- Performance should be highly dependent on the immediate task context.
  - The same child should be perform differently under different constraints.
  - As constraints loosen, older children should perform worse than younger children
  - No stable competence (or incompetence) at a particular age group

Two Examples from Physics

1. Concept of Density
   (how ‘packed’ or ‘crowded’ material is)

   Children tend to have
   difficulty with this concept



   – even 12-year-olds perform incorrectly in this task
   – even 5-year-olds perform correctly in some context

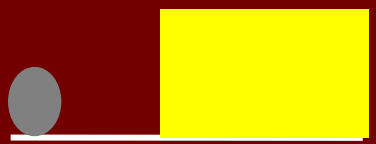
Two Examples from Physics

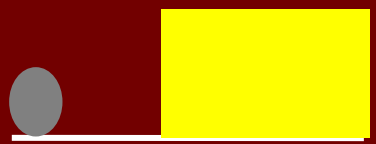
2. Concept of Solidity

(solid objects cannot pass through each other)

- 4-month-olds recognize violations of solidity

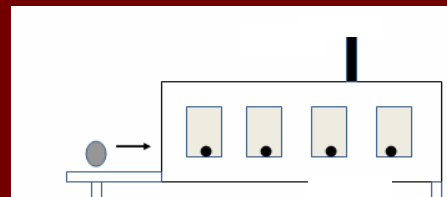
Spelke, E. S., Breinlinger, K., Macomber, J.,&Jacobson, K. (1992). Origins of knowledge. *Psychological Review, 99,* 605–632





But even 2-year-olds fail to understand solidity in a search task

Berthier, N. E., DeBlois, S., Poirier, C. R., Novak, M. A., & Clifton, R. K. (2000). Where's the ball? Two- and three-year-olds reason about unseen events. *Developmental Psychology*, *36*, 394–401.



- In Sum – Lesson 1
  - Age is not a good predictor of performance
  - no stable competence (or incompetence) at a particular age
  - The same child performs differently under different constraints.

- Why does Lesson 1 matter?
  - Don't attribute differences in performance to difference in age-related limits in
    - brain,
    - memory
    - planning
    - abstract thinking, etc.
  - Age differences are easy to find, but meaningless

Lesson 2

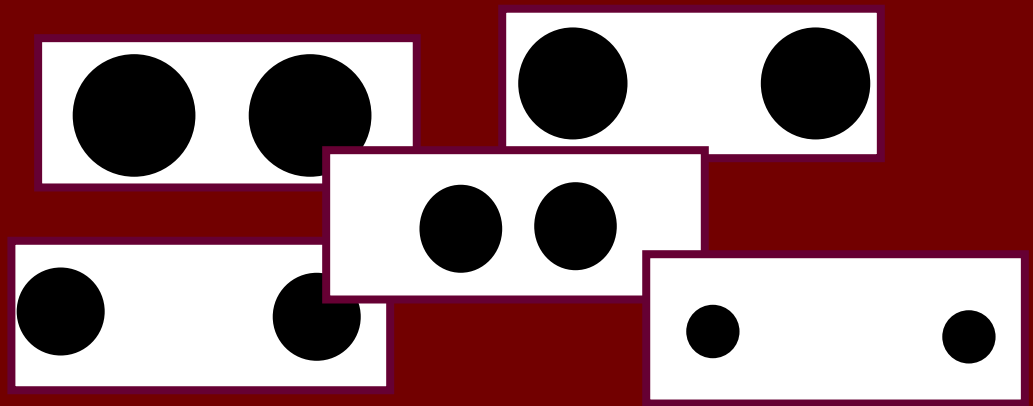
Principles of learning are the same across development

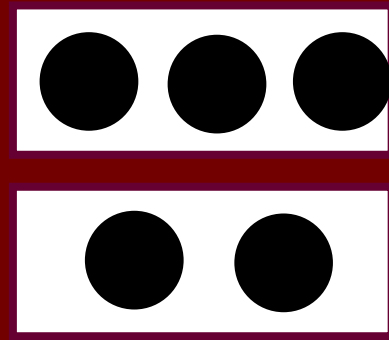
- What is learning?
  - Remembering of facts
    vs.
  - Integration of information
    'coordination'

- Learning always consists of integration!

Can babies integrate?

- Evidence with newborns: number concept





Antell, S. E., & Keating, D. P. (1983). Perception of numerical invariance in neonates, *Child Development, 54*(3), 695-701

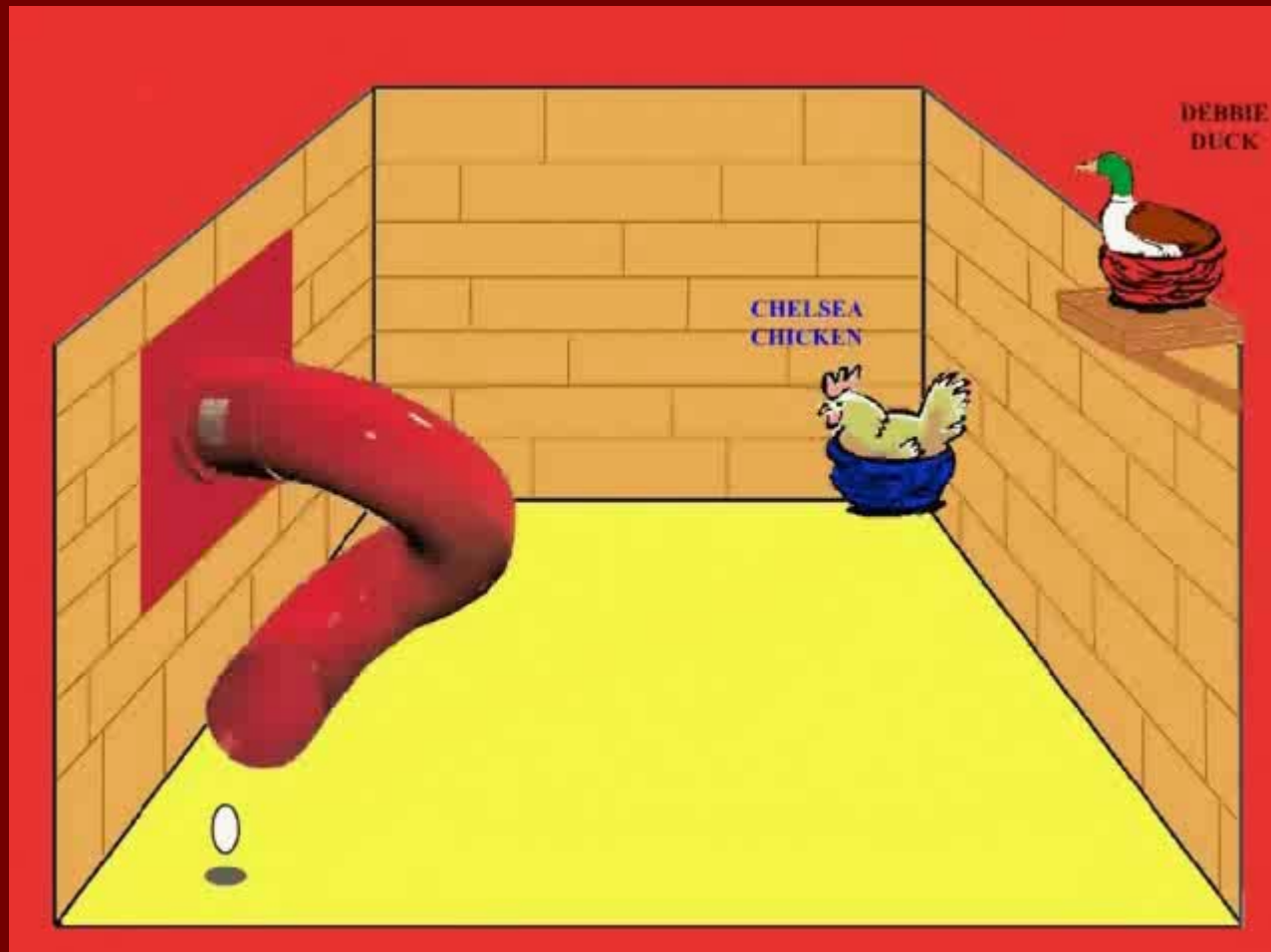
- Evidence from infants: language learning

pel-wadim-puser-vot	pel-wadim-puser-tood
pel-loga-taspu-vot	pel-loga-taspu-tood
dak-deecha-coomo-tood	dak-deecha-coomo-vot
dak-wadim-hiftam-tood	dak-wadim-hiftam-vot

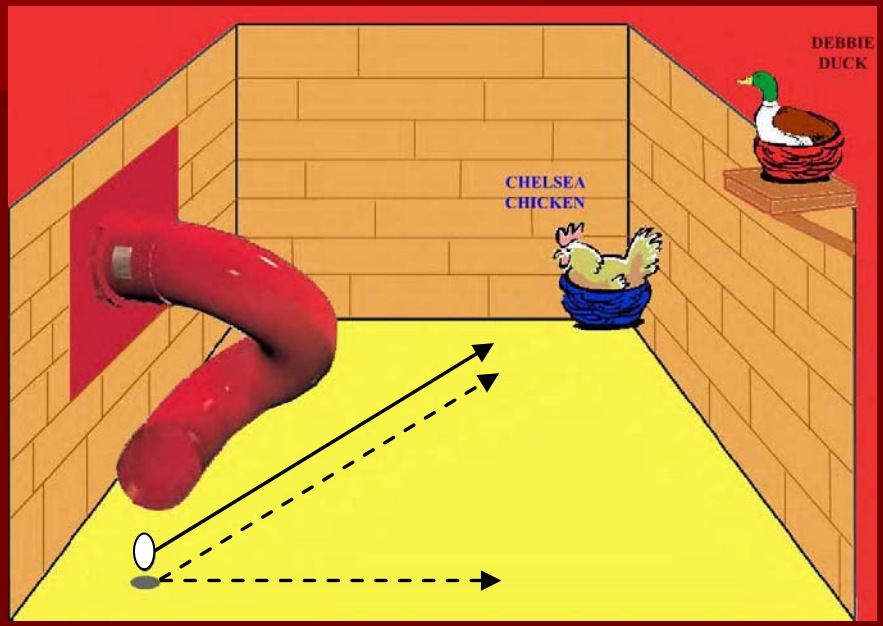
Gomez, R. (2002). Variability and Detection of invariant structure, *Psychological Science, 13*(5), 431-436

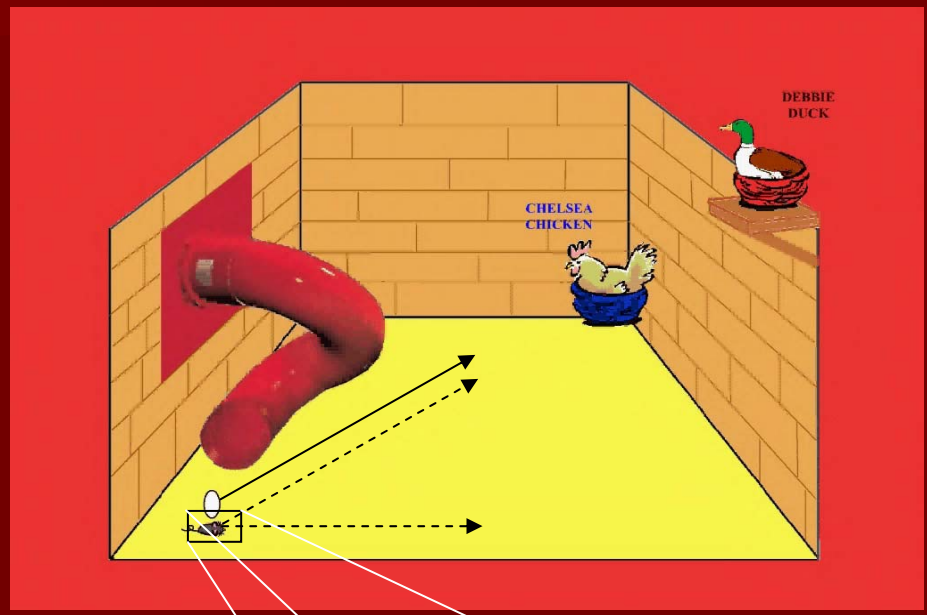
Then what develops?

- ‘Distance’ between what can be integrated
  - Spatial distance
    - close
    - far
  - Conceptual distance
    - Similar
    - different



Types of Trials





shadow moves parallel to egg
shadow moves away from egg
mouse moves parallel to the egg
mouse moves away from the egg

spatial distance

conceptual distance

- In Sum – Lesson 2
  - Principles of learning are the same across age
  - Even infants integrate pieces of information
  - Younger children integrate across ‘shorter distances’ than older children

- Why does Lesson 2 matter?
  - Children of all ages are ready to learn
  - But the right constraints need to be provided

How to provide the right constraints?

- Hands-on explorations

- Lesson 1 + 2: Not necessarily!
- If appropriate constraints are missing, children will incorrectly integrate pieces of information
  - They will form misconceptions

Two Examples from Physics

1. Concept of Density

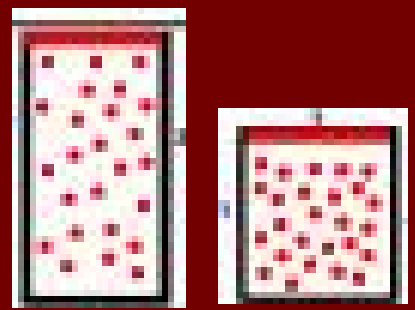
   (how ‘packed’ or ‘crowded’ material is)

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

   – Focus on mass and volume

   vs.

   – Focus on density directly

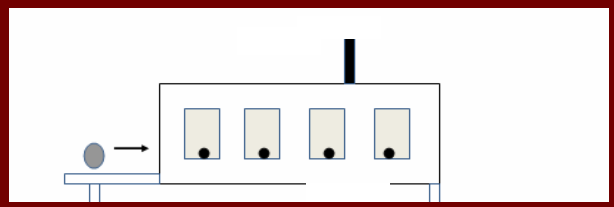


Two Examples from Physics

2. Concept of Solidity

   (solid objects cannot pass through each other)

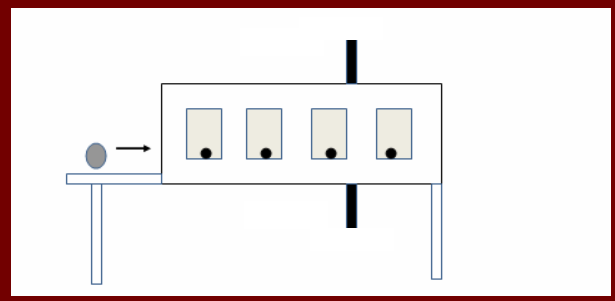
- search task:



Focus on the barrier

Focus on link between barrier and door

vs.



Focus on link between barrier and ball

In Sum: Lesson 1 + 2

- Learning principles stay the same across age
  - Children always attempt to integrate pieces of information into congruent wholes

But:

appropriate integration requires appropriate constraints

- Hand-on explorations are fun, but they must be structured and guided appropriately

Conclusions

- Children are ready for learning
  - They can coordinate facts already as newborns
- Successful integration requires the right constraints in the environment
- Without them, children come up with an alternative integration, often incorrect
- How to provide the right constraints:
  - Be clear about the concepts that need to be conveyed
  - Simplify integration by making links obvious
    - models
    - schematics
    - causal mechanisms

Thank You

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