بسم الله الرحمن الرحیم

علوم شناختی

جلسه ۲۱ (الف)

مانایی شیء
و استدلال فیزیکی در نوزادی

Object Permanence and Physical Reasoning in Infancy

کاظم فولادی قلعه
دانشکده مهندسی، دانشکدگان فارابی
دانشگاه تهران

http://courses.fouladi.ir/cogsci

PART 3:
APPLICATIONS

Chapter 11:
Object Perception and Folk Physics

CAMBRIDGE

Chapter 11.1: Object permanence and physical reasoning in infancy

CAMBRIDGE UNIVERSITY PRESS

Overview

- Introduce the dishabituation paradigm

- Introduce the physical symbol system model of infants' knowledge of objects

Infants' knowledge of objects

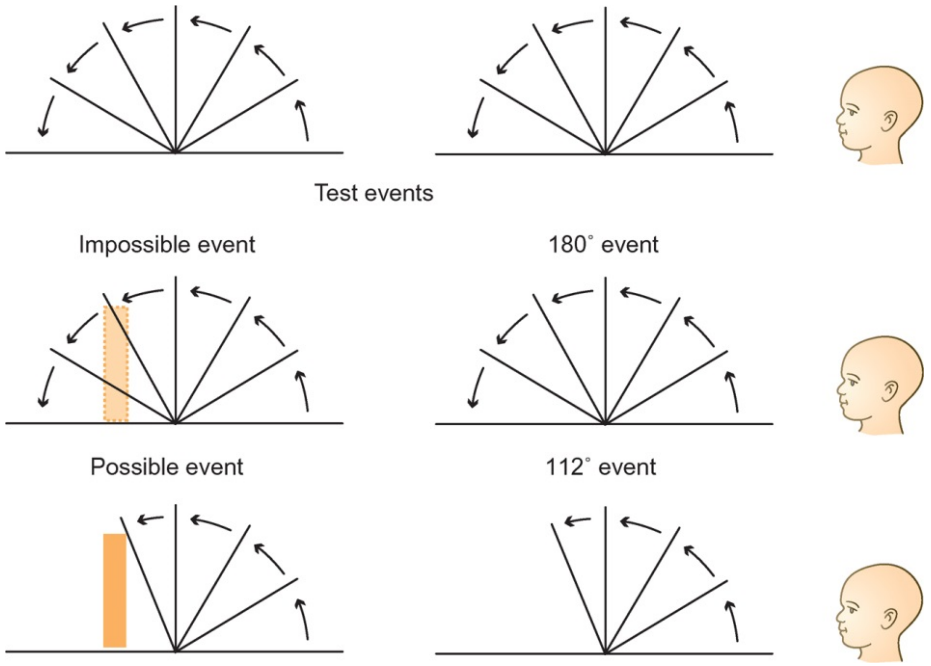
- Habituation experiments allow us to measure what infants know about the world

- Violation of expectation: infants will show a greater degree of surprise (as measured by looking time) when an unexpected event occurs

    - Habituating infants to specific events provides a baseline level of expectation

Habituate to the drawbridge rotating 180 degrees

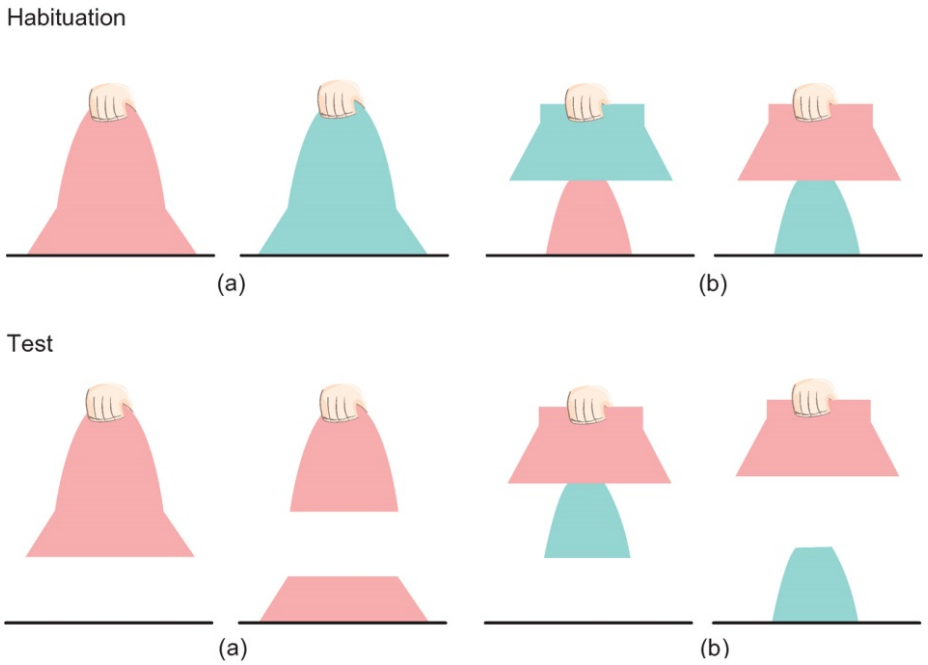
Infants find the first test case surprising. The solidarity constraint (no two different things can be at the same place at the same time) leads them to expect that the screen will stop at an obstacle.



Solidarity constraint

Habituate to two objects (one homogeneously coloured)

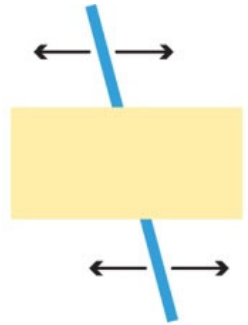
Infants find the second test case surprising. The principle of cohesion (surfaces belong to a single individual if and only if they are in contact) leads them to expect that it is a single object.



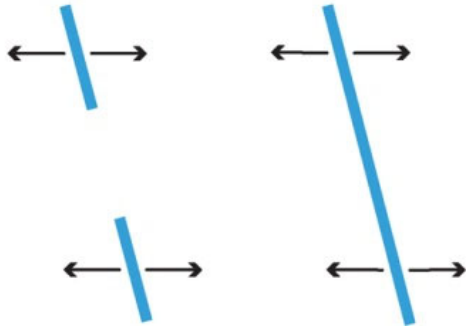
Principle of cohesion

Habituate to synchronous movement in the same direction

Infants find the left-most case surprising. Synchronous movement leads them to expect a single contiguous object.



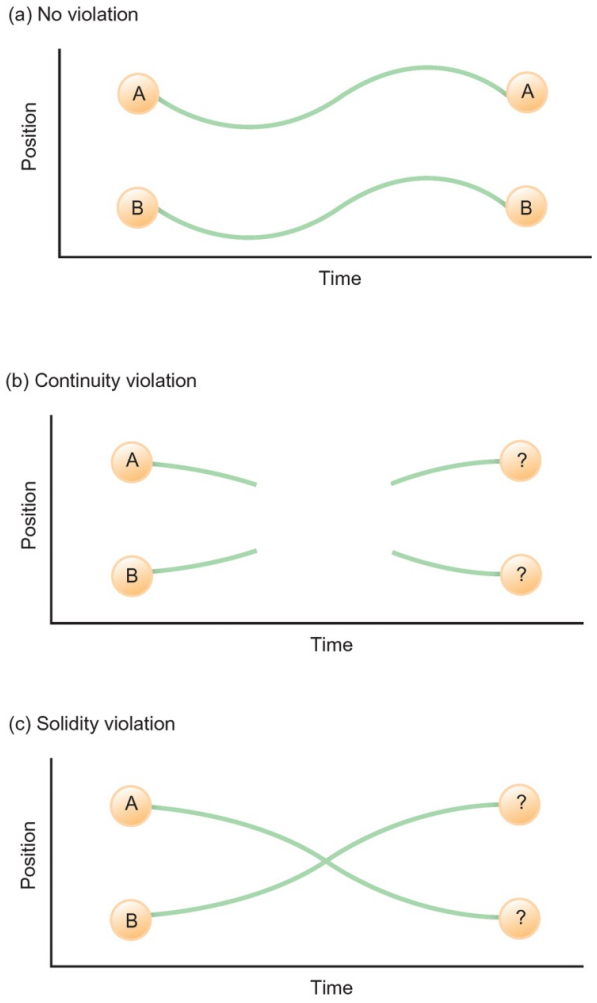
Test



Principle of contact

Schematic depiction of events

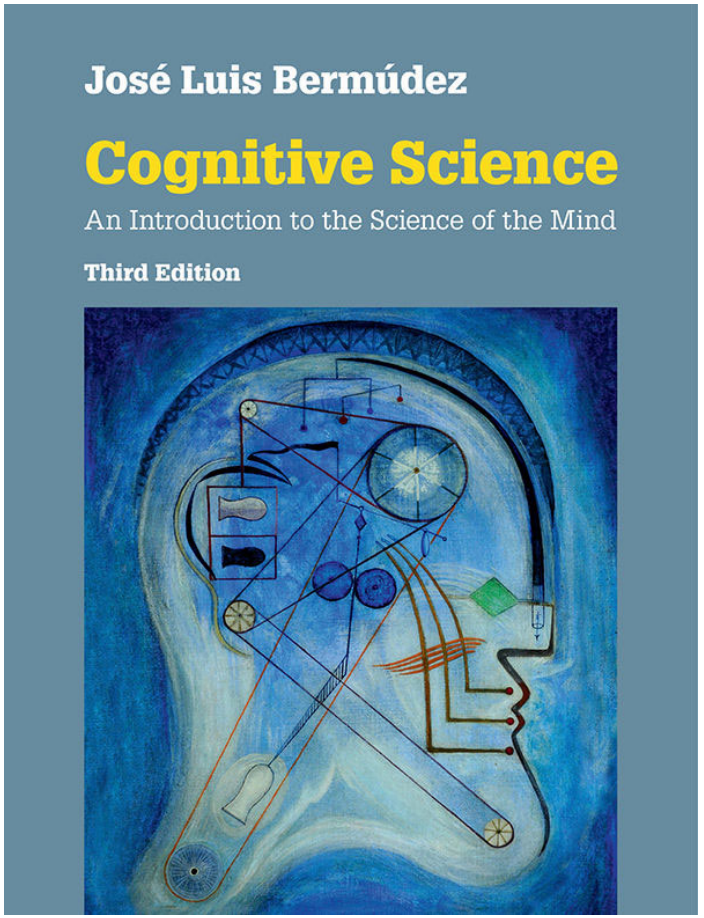
Schematic depiction of events that accord with, or violate, the continuity or solidity constraints. Solid lines indicate each object's path of motion, expressed as changes in its position over time. Each object traces (a) exactly one connected path through space and time, (b) no connected path through space and time, or (c) a path through space and time intersecting another object's path. (Adapted from Spelke and Van de Walle 1993)



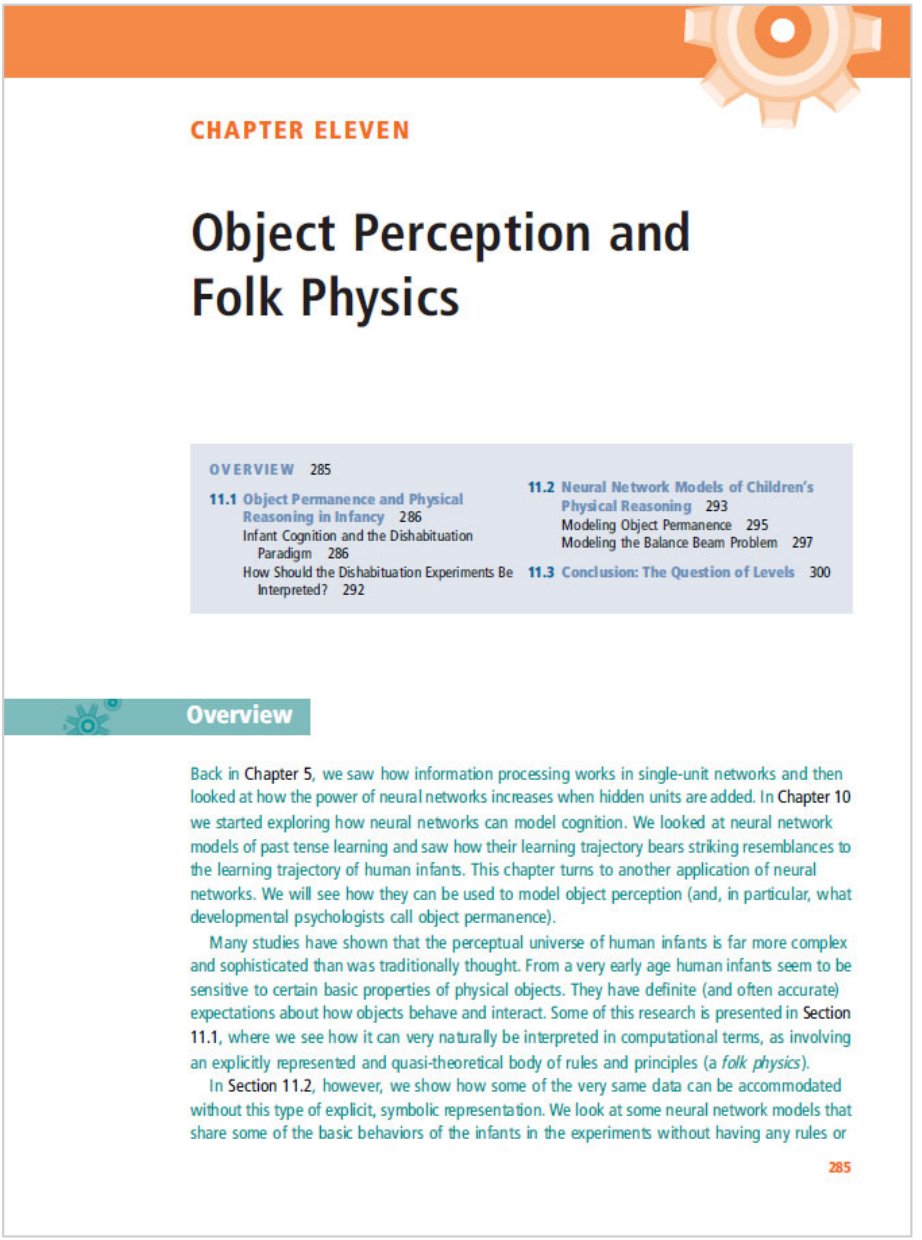
PSS model of infants' knowledge of objects

- The basic principles of infant folk physics are symbolically represented.
- These symbolically represented principles allow the infants to compute the probable behavior and trajectory of the objects in the dishabituation experiments.
- They show surprise when objects do not behave according to the results of the computations.

منبع اصلی



José Luis Bermúdez,
Cognitive Science:
An Introduction to the Science of the Mind,
3rd ed., Cambridge University Press, 2020.
Chapter 11 (Section 11.1)



CHAPTER ELEVEN

Object Perception and Folk Physics

OVERVIEW 285

11.1 Object Permanence and Physical Reasoning in Infancy 286
Infant Cognition and the Dishabituation Paradigm 286
How Should the Dishabituation Experiments Be Interpreted? 292

11.2 Neural Network Models of Children's Physical Reasoning 293
Modeling Object Permanence 295
Modeling the Balance Beam Problem 297

11.3 Conclusion: The Question of Levels 300

Overview

Back in Chapter 5, we saw how information processing works in single-unit networks and then looked at how the power of neural networks increases when hidden units are added. In Chapter 10 we started exploring how neural networks can model cognition. We looked at neural network models of past tense learning and saw how their learning trajectory bears striking resemblances to the learning trajectory of human infants. This chapter turns to another application of neural networks. We will see how they can be used to model object perception (and, in particular, what developmental psychologists call object permanence).

Many studies have shown that the perceptual universe of human infants is far more complex and sophisticated than was traditionally thought. From a very early age human infants seem to be sensitive to certain basic properties of physical objects. They have definite (and often accurate) expectations about how objects behave and interact. Some of this research is presented in Section 11.1, where we see how it can very naturally be interpreted in computational terms, as involving an explicitly represented and quasi-theoretical body of rules and principles (a *folk physics*).

In Section 11.2, however, we show how some of the very same data can be accommodated without this type of explicit, symbolic representation. We look at some neural network models that share some of the basic behaviors of the infants in the experiments without having any rules or

285