



The development of relational processing in infancy

Susan Hespos, & Dedre Gentner
Department of Psychology, Northwestern University



Definitions

Analogical ability – the ability to make relational comparisons between objects, events, or ideas, and to see common relational patterns across different sets of participants – is a cornerstone of higher reasoning abilities and one in which humans are vastly superior to other primates (Gentner, 2003; Penn, Holyoak, & Povinelli, 2008).

Questions

- What is the origin of our analogical processing ability?
- How does analogical processing develop?

The goal of the research is to trace the development of whether and when relational processing takes place in infants.

Initial evidence

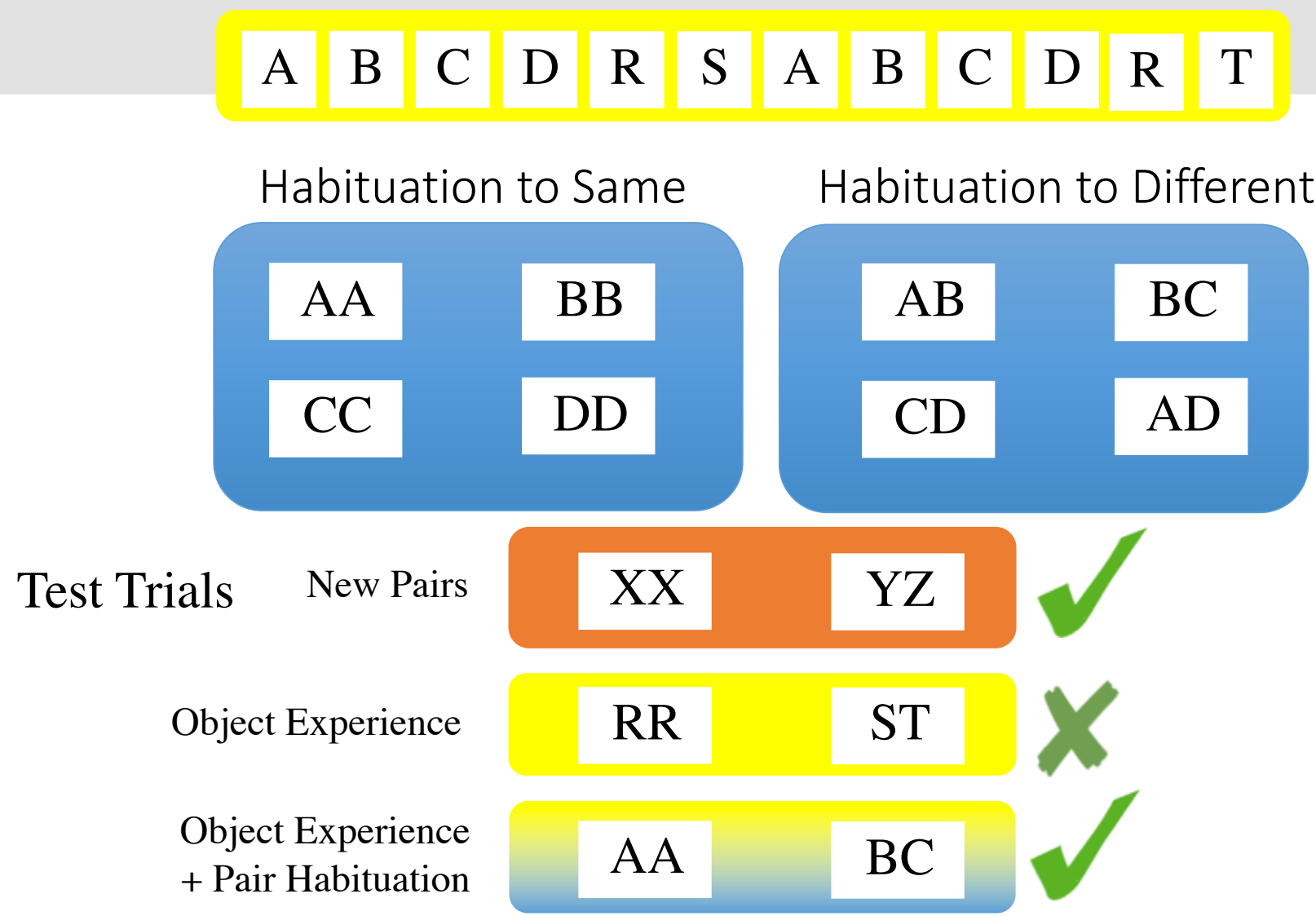
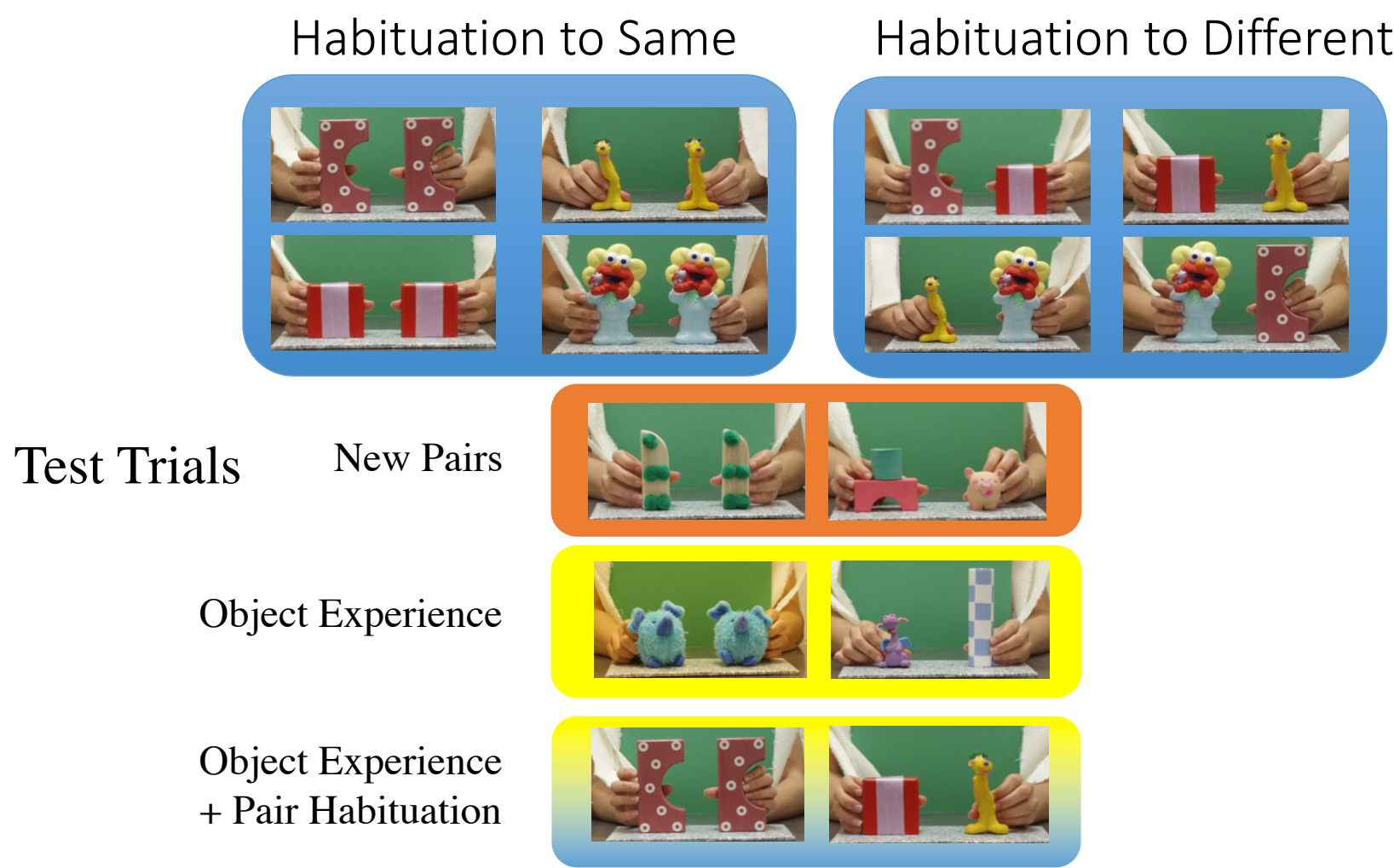
The starting point for this research is a recent demonstration the 7-month-old infants can form abstract *same-different* relations, and apply them to new pairs of objects (Ferry, Hespos & Gentner, 2015). These studies demonstrate that infants show two key characteristics of relational learning seen later in development:

- facilitating comparison across exemplars promotes abstracting the common relation
- rendering individual object salient disrupts relational learning

Acknowledgements

This research was supported by a grant from the National Science Foundation (BCS-1729720). We thank the parents and infants for their participation and the staff of the Northwestern Infant Cognition Lab for their help in collecting data.

Series 1	Series 2
<i>Examine the processes that promote relational learning in 3-month-olds</i>	<i>Investigate how agency and common motion influence learning</i>
<ul style="list-style-type: none">• Analogical processing ability is present in 3-month-old infants• Language is not a necessary prerequisite for analogical processing• Two repeating exemplars allowed infants to learn the relations but six exemplars did not	<ul style="list-style-type: none">• What induces spontaneous comparison in preverbal infants?• Two likely candidates are goal-directed actions (Woodward, 1998) and common motion patterns (Johnson & Aslin, 1996; Quinn et al., 1997; Spelke, 1982)
<ul style="list-style-type: none">• <i>We are presently testing whether progressive alignment fosters learning</i>• <i>Next we will conduct computational modeling of the learning patterns found in our studies</i>	<ul style="list-style-type: none">• <i>We will vary these two cues to delimit the conditions under which infants carry out comparison-based abstraction</i>



Series 3	Series 4
<i>Test how language influences relational learning in infants</i>	<i>Investigate whether these effects generalize to other abstract relations</i>
<ul style="list-style-type: none">• Does relational language help infants' relational learning?• Does labeling the objects hinder relational learning by drawing attention to the individual object?	<ul style="list-style-type: none">• Consistency in relational learning across age groups suggests that the structure-mapping process is continuous through development• If this is true, infants should be able to learn other relations such as symmetry.
<ul style="list-style-type: none">• <i>For 7- and 9-month-old infants, there is no evidence that relational labels facilitate performance, but object labels hinder relational learning</i>• <i>Current studies are testing older infants</i>	<ul style="list-style-type: none">• <i>We will ask whether and when infants are able to abstract symmetry</i>• <i>We will test whether the basic signatures of analogical learning are evident in relations beyond same and different</i>

Intellectual Merit

- Our goal is to identify the ontogeny of relational learning processes
- Our studies will begin to characterize how the analogical process begins and how it interacts with later learning – specifically with language learning.
- We plan to trace the origins of relational learning from 3 months of age
- This research is innovative because it uses a combination of behavioral studies as well as modeling studies

Broader Impacts

- The studies will be important for our understanding of human cognition and how it differs from that of other species.
- By delineating the conditions that promote relational learning in infants, we will gain insight into how to promote relational learning in young children and in those who show delays in abstract learning.
- This work will produce tools that can be used by teachers and caregivers to support relational learning.

References

Ferry, A., Hespos, S.J., & Gentner, D. (2015). Prelinguistic relational concepts: Investigating analogical processing in infants. *Child Development*, 86 (5), 1386 - 1405.

Gentner, D. (2003). Why we're so smart. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind: Advances in the study of language and thought*. (pp. 195-235). Cambridge, MA: MIT Press.

Johnson, S. P., & Aslin, R. N. (1996). Perception of object unity in young infants: The roles of motion, depth and orientation. *Cognitive Development*, 11, 161 – 180.

Penn, D. C., Holyoak, K. J., & Povinelli, D. J. (2008). Darwin's mistake: Explaining the discontinuity between human and nonhuman minds. *Behavioral and Brain Sciences*, 31(2), 109-130. doi: 10.1017/s0140525x08003543

Quinn, P. C., Brown, C. R., & Streppa, M. L. (1997). Perceptual organization of complex visual configurations by young infants. *Infant Behavior and Development*, 20, 35 – 46.

Spelke, E. S. (1982). Perceptual knowledge of objects in infancy. In J. Mehler, M. Garrett, & E. Walker (Eds.), *Perspectives on mental representation* (pp. 409 – 430). Hillsdale, NJ: Erlbaum.

Woodward, A. L., (1998). Infants selectively encode the goal object of an actor's reach *Cognition*, 69, 1 – 34.

Contact
Hespos@northwestern.edu