

Competition between topology and shape in children's representations of object kinds

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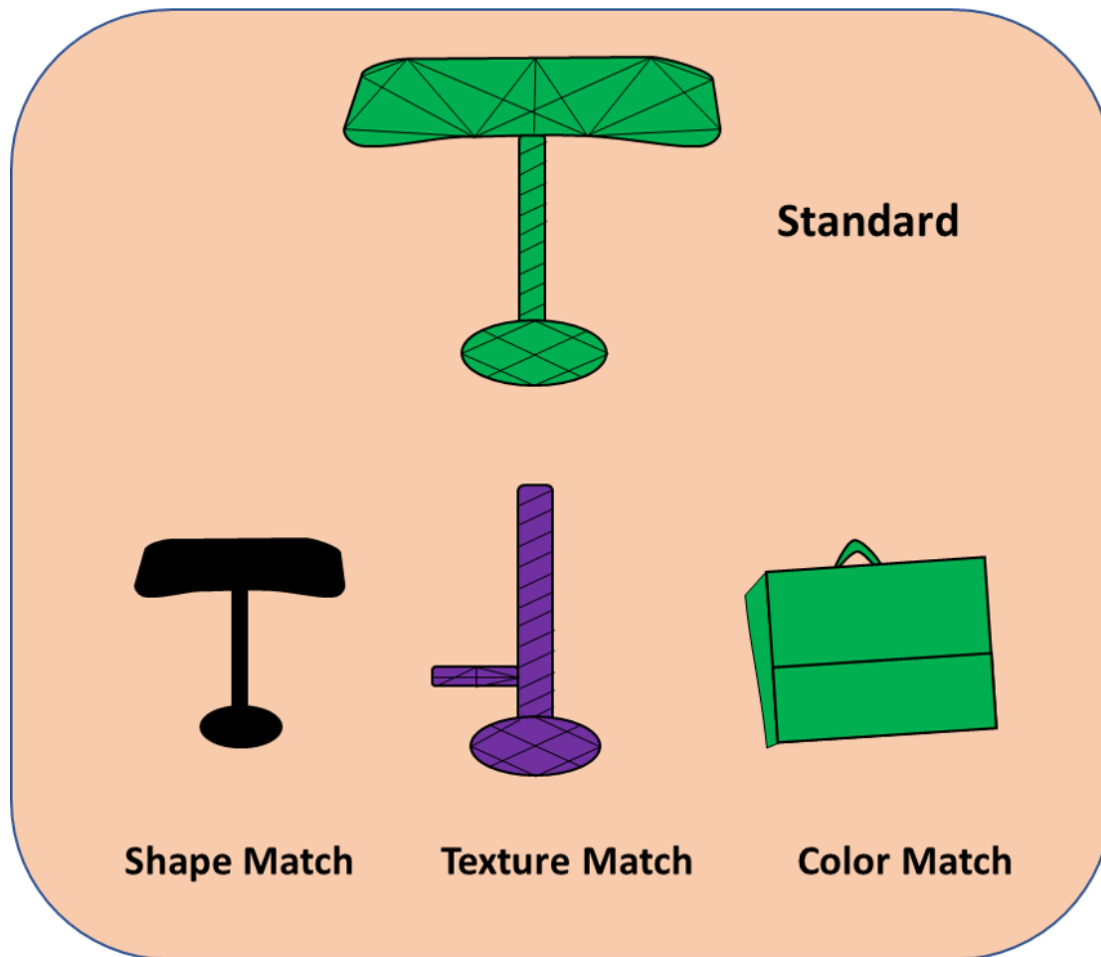


PRESENTED AT:



BACKGROUND

- Children extend novel labels of the novel objects to the other objects that share similar shape. This phenomenon called “shape-bias” is observed from age 2 (Landau et al., 1988).
- Diesendruck and Bloom (2003) suggested that children prioritize shape over other features like color and texture in extension of labels because shape is most informative for object kind membership.



Schematic illustration of Name Generalization Task

- *Topological properties* of objects (whether an object has a hole or not) are fundamental to visual representations of objects (Chen, 1982). Infants and adults are faster at recognizing changes in topological properties of objects compared to changes in shape (Chen, 1982; Chien et al., 2012). And the ability to track multiple objects is disrupted when objects change topology but not shape (Kibbe & Leslie, 2016; Zhou et al., 2010) suggesting that **topological properties play a structural role in representing objects**.
- We asked whether topological properties play a fundamental role in children and adult's representation of object kinds using variations on the name generalization task of Landau et al. (1988) and Diesendruck & Bloom (2003).

EXPERIMENT 1

PIT TOPOLOGY AND SHAPE AGAINST EACH OTHER IN A NAME GENERALIZATION TASK

Participants: 66 2-8-year-olds ($M = 5.0$)

Stimuli: Cardboard cut-outs of objects

Data collection: In-person @ Museum of Science, Boston

Procedure:

[VIDEO] <https://www.youtube.com/embed/AO9drYGvufk?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0>

- Experimenter showed the standard object to the child and said “Look at this. It’s a [TOMA]. See, it’s a [TOMA]. This is a [TOMA]”
- Experimenter then presented three test objects: one with the *same shape* as the standard, one with the *same topology* as the standard, and a *distractor object* (different shape from standard and bite taken out of its contour) and asked “See these? Which one is also a [TOMA]”
- Children completed 4 trials: 2 in which the standard object had a hole and 2 in which the standard object had no hole.

Trial	Standard	Shape match	Topology match	Distractor
<i>toma</i>				
<i>blicket</i>				
<i>ziff</i>				
<i>wug</i>				

Schematic of stimuli used in Experiment 1

EXPERIMENT 2

EQUATE TOPOLOGY BUT CHANGE FIGURE/GROUND RELATIONS ACROSS OBJECTS

Participants: 21 2-8-year-olds (M = 5.01)

















Stimuli: Cardboard cut-outs of objects

Data collection: In-person @ Museum of Science, Boston

Procedure:

[VIDEO] <https://www.youtube.com/embed/ouPXu9JGkeg?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0>

- Procedure was the same as in Experiment 1, except that holes were replaced by gray patches, equating topology across the shapes but changing figure-ground relations across objects.

Trial	Standard	Shape match	Feature match	Distractor
<i>toma</i>				
<i>blicket</i>				
<i>ziff</i>				
<i>wug</i>				

Schematic of stimuli used in Experiment 2.

EXPERIMENT 3

EXPLICITLY ASK ABOUT KIND MEMBERSHIP

Participants: 30 3-7-year-olds ($M = 5.3$) and 25 adults ($M = 32.48$)

Stimuli: Animated cartoons of stimuli from Experiment 1

Data collection: Online via Qualtrics

Procedure:

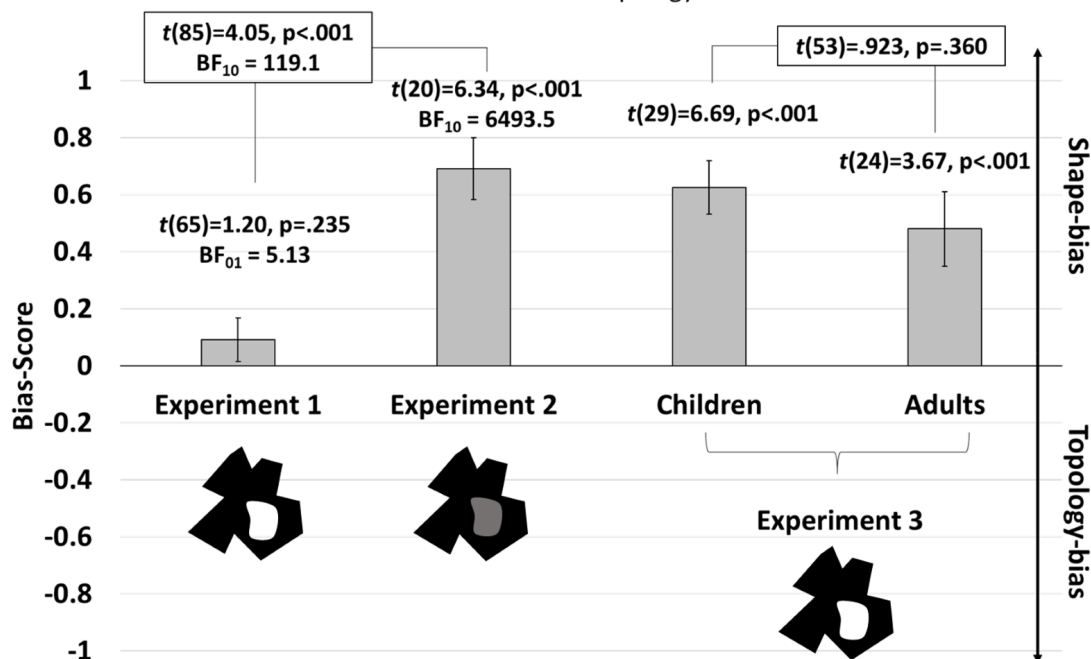
[VIDEO] <https://www.youtube.com/embed/U7FMfMKtjxY?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0>

- Stimuli was the same as in Experiment 1.
- Procedure was similar to Experiment 1, except that the objects were not labeled. Instead, children were shown the standard object, "Look at this!" and then shown the three test objects and asked which was the same *kind* as standard object.

RESEARCH QUESTION

Do topological properties compete with shape in children's and adult's representations of object kinds?

Bias-Score: Mean proportion of trials children selected shape match minus mean proportion of trials children selected topology match



DISCUSSION AND FUTURE DIRECTIONS

1. Topological properties compete with shape when children are asked to extend novel labels to other objects, suggesting that topology and shape may play a similar priority role in representations of object kinds. (Experiment 1)

2. Children's extension of topological class to other objects with same topology is due to presence of hole/lack of hole, not figure/ground relations (Experiment 2)

3. Children and adults showed a shape bias when asked explicitly to choose an object that was the *kind* as the standard. (Experiment 3). However, these results should be interpreted with caution: Stimuli were animated and were not physically interacted with by an experimenter, which may not have accurately conveyed their topological class (as compared with the physical, manipulable objects used in Experiments 2 and 3). We plan to replicate experiment 3 by collecting data online (via zoom) using real objects.

4. These results predict that, if topological class is pitted against other features like color or texture, children should show a strong bias toward topology as they do for shape. Future work will examine this prediction.

AUTHOR INFORMATION

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