Children's perception of holes and wholes: Sound-shape correspondence for holes across development

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Background

Holes create a paradox in figure/ground organization and shape perception (Palmer, 1999); the contour bounding a hole is assigned to the surrounding object, but still 3-year-old children as well as adults can identify, track, and count holes similar to material objects (Giralt & Bloom, 2000). Using the Bouba/Kiki effect (sound-shape congruency) as an implicit, direct measure of shape perception, we tested whether young children, whose global shape processing abilities are still developing but who show the sound-shape congruency effect for whole objects (Mauer et al, 2006), also perceive the shape of holes and whether and how this ability changes over development.

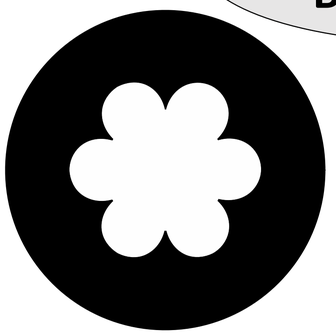
Research Questions

1. Is children's shape-sound association based on the shape of the interior region (a hole) or local material edges?
2. Does shape perception of holes change over development?

Method

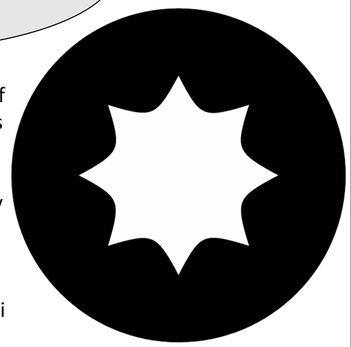
Participants 67 2-8-year-old children (M = 62.8, SD = 19.9 months)

Which one is **Bouba/Kiki?**



Flower like hole surrounded by pointy edges with rounded concavities

- Stimuli were made of cardboard with holes cut from the center
- Children were asked to respond as quickly as possible
- Whether children were asked to identify Bouba or Kiki was counter-balanced across participants.

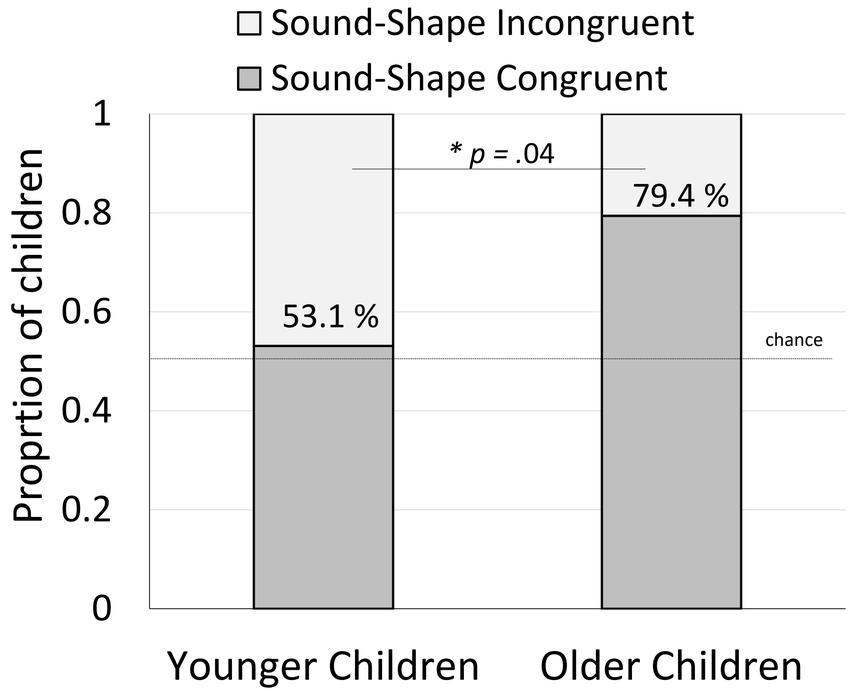


Star like hole surrounded by bulges connected with sharp concavities

Since the contour is defined relative to a material figural side, holes and their complement give rise to opposite shape perceptions without any change in the actual contours.

- If children more readily perceive the shape of the interior region (the hole), they should select the flower-like hole when asked which is Bouba, and the star-like hole when asked which is Kiki.
- If children instead more readily perceive the inner region as the material edge of the object, they should show the opposite pattern.

Results



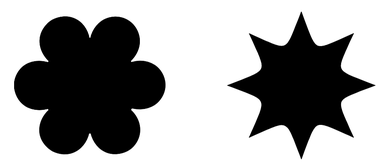
- Selecting the sound-shape-congruent hole was significantly correlated with children's age in months (Spearman's r=.357, *p*=.003).
- Older children (above the mean age) selected the sound-shape-congruent hole at rates significantly above chance (27/34 (79.4%), binomial test *p*<.001)
- Younger children selected the congruent and incongruent holes at roughly equivalent rates (17/32 (53.1%), binomial test *p*=.86

Conclusions

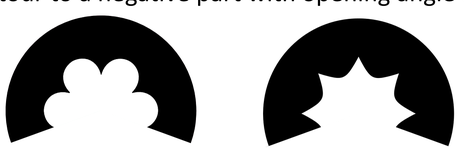
- Children's ability to directly perceive the shape of holes increases with development.
- Our results suggest that shape representations of holes require global shape processing which undergoes development between 2 and 8 years.

Future Directions

Confirm that young children show Bouba/Kiki correspondence for the shape of whole objects (after Mauer et al. 2006)



Examine whether older children assign the contour to a negative part with opening angle of 60^0



References

1. Palmer, S. E. (1999). Vision science: From photons to phenomenology. Cambridge, MA: MIT Press.
2. Kim, S. H. (2020). Bouba and Kiki inside objects: Sound-shape correspondence for objects with a hole. *Cognition*, *195*, 104132.
3. Giralt, N., & Bloom, P. (2000). How special are objects? Children's reasoning about objects, parts, and holes. *Psychological Science*, *11*(6), 497-501.
4. Maurer, D., Pathman, T., & Mondloch, C. J. (2006). The shape of boubas: Sound–shape correspondences in toddlers and adults. *Developmental science*, *9*(3), 316-322.