Mind over Material: Manipulating 3-Year-Olds out of a Shape Bias and into a Material One

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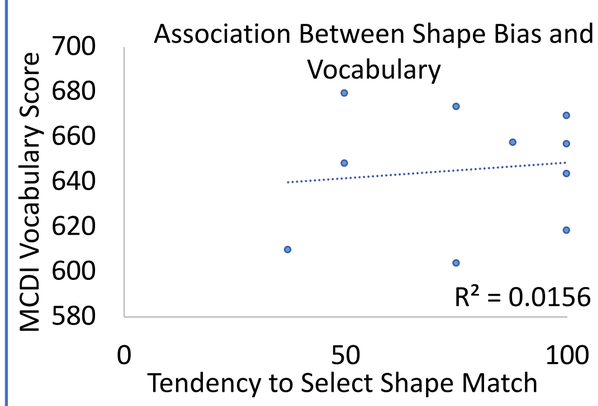
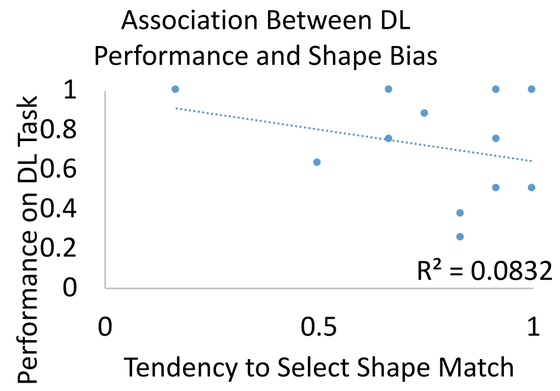
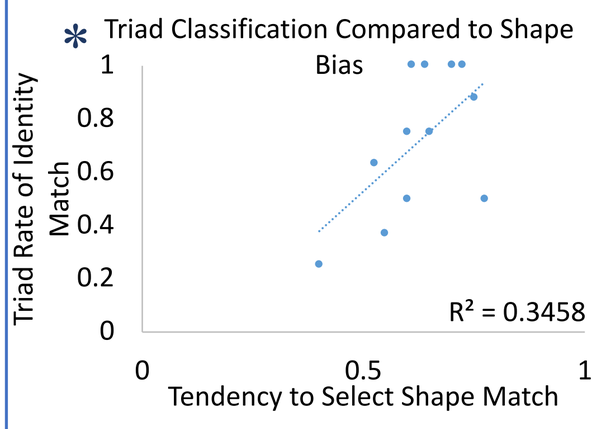
Introduction

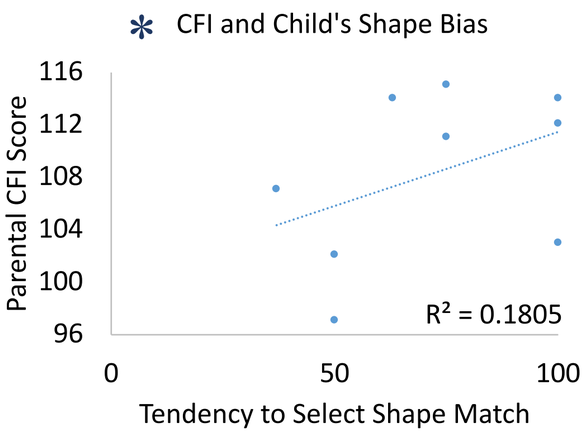
- Shape bias is the tendency to attend to shape when learning a novel label.
- This tendency first appears at speech onset at around age 2.
- Three-year-olds cannot be manipulated out of the shape bias[1]—the current study examines the role of familiarization trials in this bias.
- Previous research has familiarized children with the novel noun extension task using familiarization trials with known shape-based labels.
- In the current study, we administered two conditions. One condition replicated previous work by familiarizing children with known shape-based labels. In a second condition, children were familiarized with known material-based labels.
- We also measured dimensional attention with the triad-classification task and knowledge of shape labels with a shape comprehension task.
- fNIRS measured neural activity across bilateral frontal, temporal, and parietal cortices.
- Shape bias is associated with language development and reaches a peak in rigidity around age 3 where 2- and 4-year-olds can be manipulated out of the shape bias, but 3-year-olds robustly attend to shape. This may be due to (1) 2-year-old's weaker shape bias than 3-year-olds and (2) 4-year-old's more developed executive functioning ability. Once the shape bias is established, it may take some level of executive function abilities (i.e. rule switching) to attend to a different feature dimension (material). Thus, 3-year-olds that are able to sort by the material dimension after material training should show more frontal activation, which is associated with executive function.

Survey Results





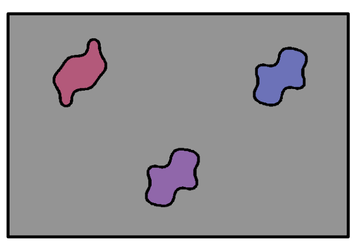




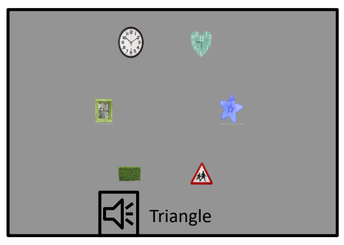
Tasks and Stimuli

11 3.5-year-olds completed 3 tasks: Novel noun generalization, triad classification, and shape label comprehension

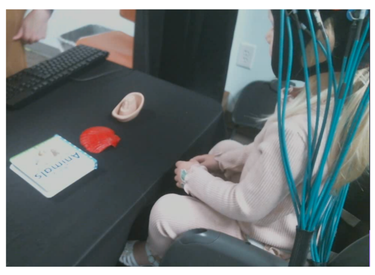
Trial Types	Items
Shape Training	Book, playdoh jar, block, sea shell, crayon, boat, egg, pillow
Material Training	Beads, Easter grass, kinetic sand, cotton, beans, orbees, playdoh, slime
Novel Trials	Two trials each of Rel, Hux, Kiv, Gaz



Triad Classification

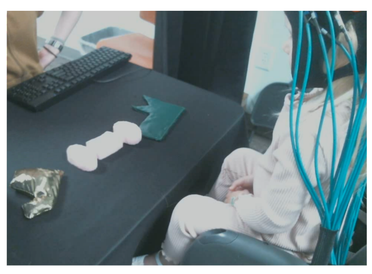


Shape Label Comprehension



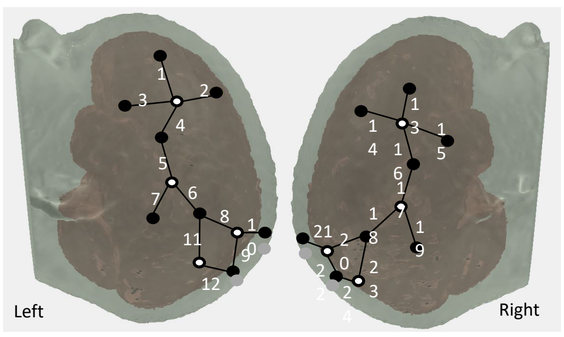
Shape Training

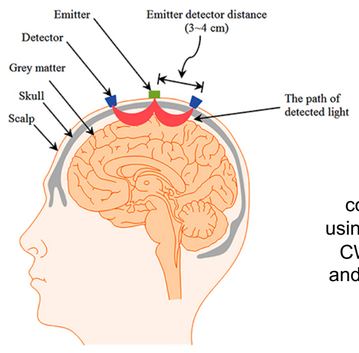
Material Training



Novel Trial

fNIRS Data Collection and Analyses



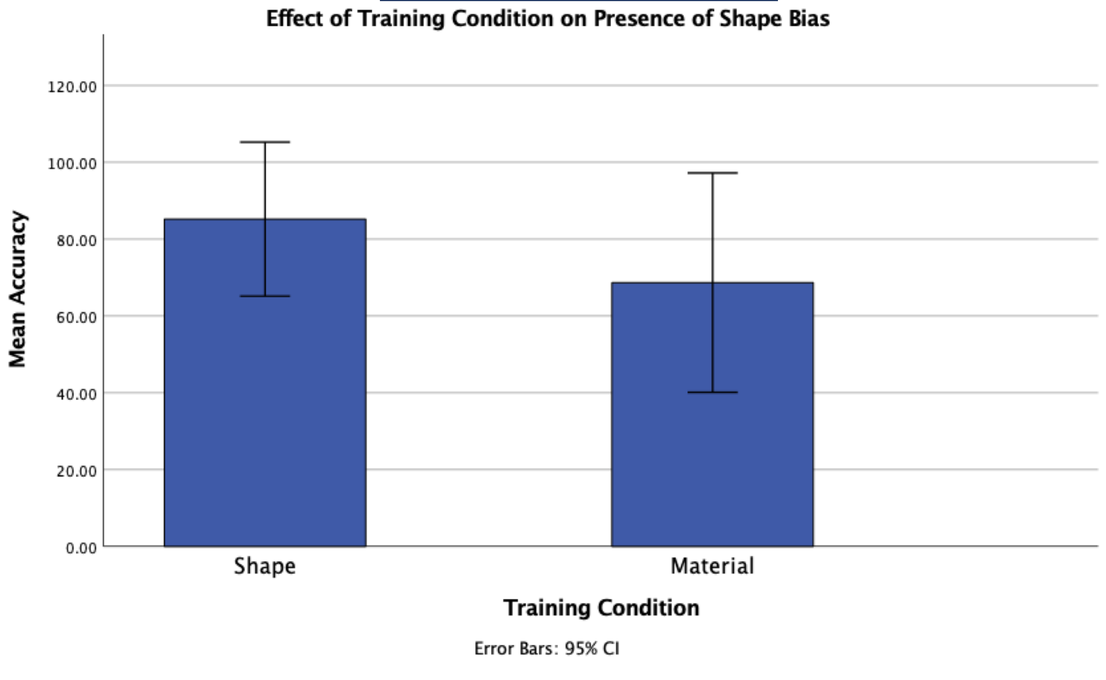


Data collected using TechEn CW7 (690 and 830 nm)

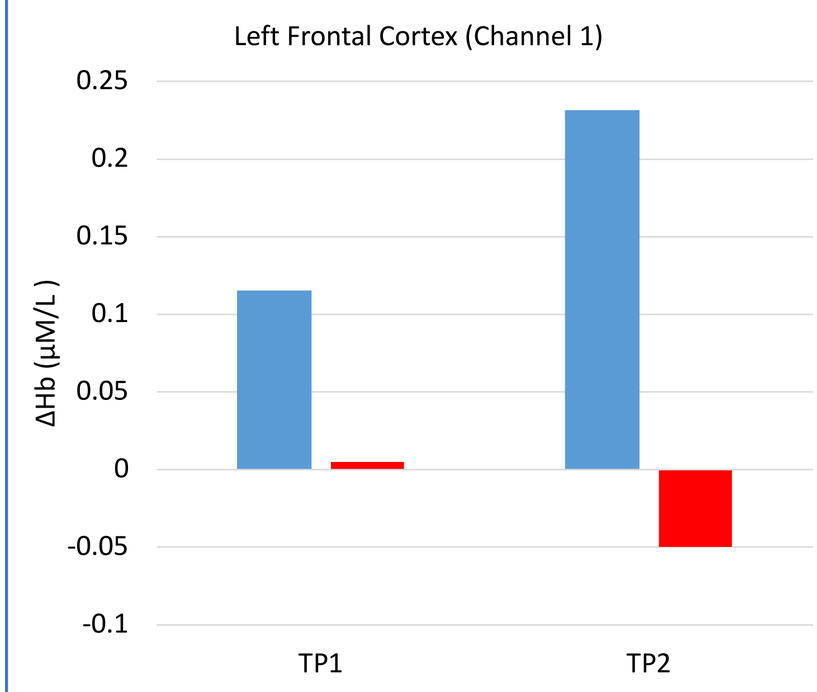
Pre-processing and connectivity analyses using Homer2 Toolbox

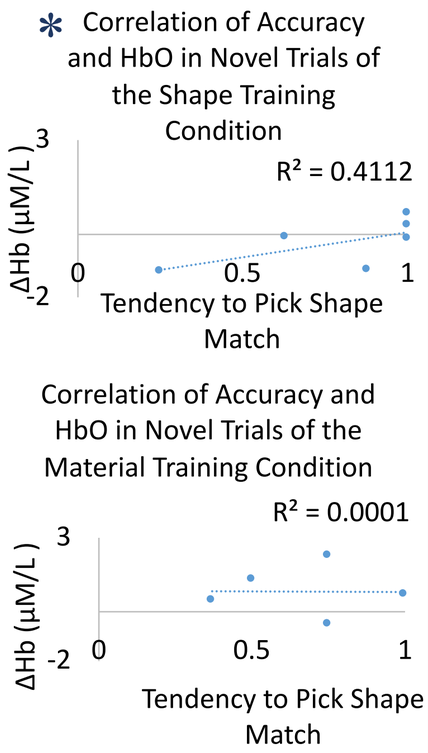
- Data were converted to optical density
- Wavelet filtering was used to smooth motion artifiacts.
- Conversion to concentration values using modified Beer-Lambert equations (dpf=ppf=6.0)
- Average HbO and HbR calculated within 4-6s time window during each time-point of interest

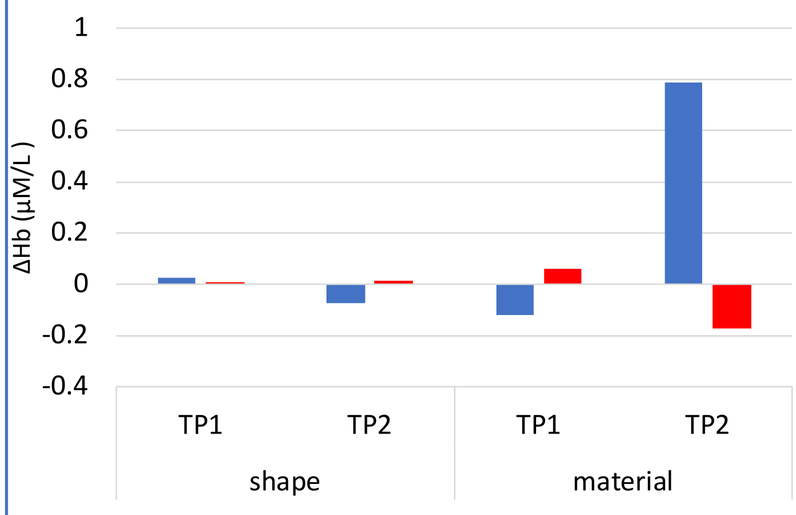
Behavioral Results

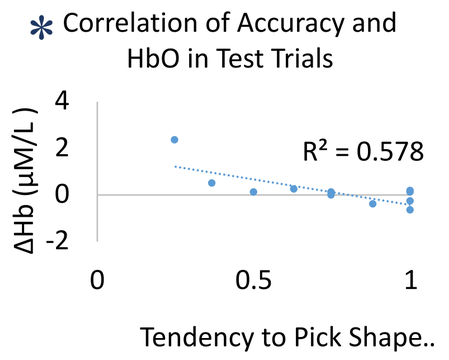


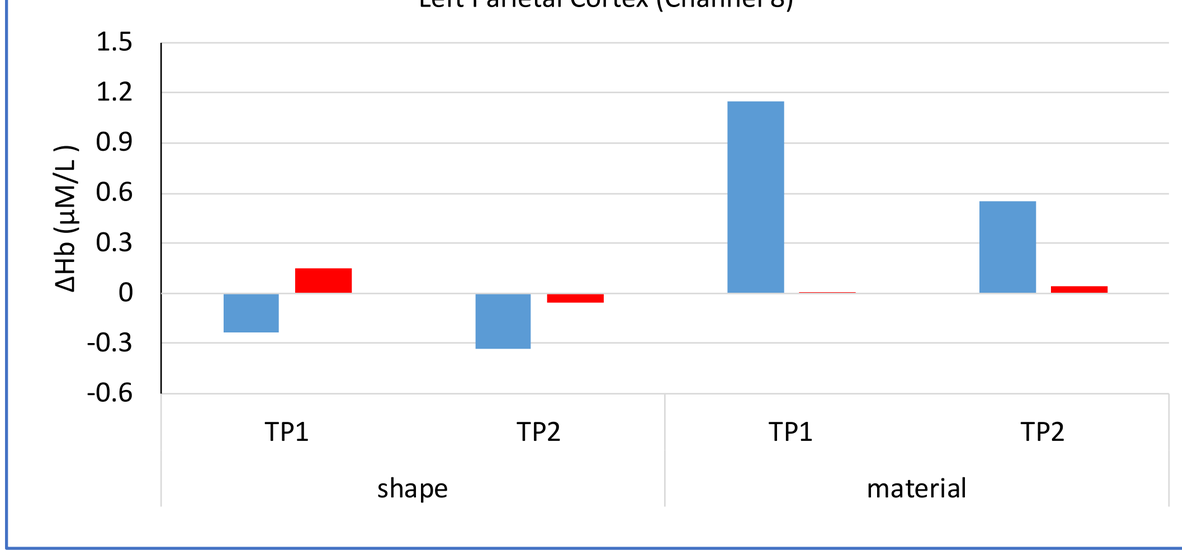
Neural Results











References

Buss, A. T., Fox, N., Boas, D. A., and Spencer, J. P. (2014). Probing the early development of visual working memory capacity with functional near-infrared spectroscopy. *NeuroImage, 85,* 314–25., Lowery, K., Nikam, B., & Buss, A.T. (2022). Dimensional label learning contributes to the development of executive function. *Scientific Reports, 12*(1), 1-12., Samuelson, L., Horst, J. S., Schutte, A. R., & Dobbertin, B. N. (2008). Rigid thinking about deformables: do children sometimes overgeneralize the shape bias? *Journal of Child Language*, *35*(3), 559–589. https://doi.org/10.1017/S0305000908008672 .