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Learning to see the 3D world

Background

We perceive our 3D world effortlessly, but abilities to do this are developing throughout childhood. This is evident e.g. in children's different use of shading[1], lighting assumptions[2], and combined depth cues[3]. Late into childhood, children seem to see scenes differently to adults, and sometimes to each other. There are exciting opportunities to investigate this development, including:

• In "hands-on" settings where they can manipulate objects, what strategies to do participants of different ages use to disambiguate visual scenes?

• Do neural signatures (e.g. using NIRS) reveal differences in underlying internal models of light-material interactions – and show development and learning in these?

• Can individual differences in development be explained by mis-calibration[4], and can this be improved with training?

Aims and Methods

Stimuli are typically rendered using 3D modelling software (e.g. Blender) and embedded in fun, child-friendly tasks. Some stimuli are simpler, and some can be real objects or objects that move in VR. Analysis compares performance with different predictions – for example, in a shape-from-shading task, whether answers are consistent with assuming that the light is coming from above or below.

Participants are usually typically developing school-age children and comparison groups of young adults.

Relevance

The work will advance our understanding of the organisation and development of perception, of individual differences in "how we see the world", and of the scope to change our perception. It has future applications to understanding atypical perceptual development and to inform training for perceptual expertise in humans or artificial systems.

Training

The project will provide training in child development, perceptual psychophysics, computer graphics (3D modelling and/or VR), programming and advanced data analysis (e.g. in Matlab), and (for projects incorporating this) neuroimaging methods, e.g. NIRS.

Suitable for

PhD and MSc by Research students.

References

1. Thomas R, Nardini M, Mareschal D (2010). Interactions between 'light-from-above' and convexity priors in visual development. *J Vis*; 10: 6.

2. Wedge-Roberts R, Aston S, Beierholm U, et al (2023). Developmental changes in colour constancy in a naturalistic object selection task. *Dev Sci*; 26: e13306.

3. Dekker TM, Ban H, van der Velde B, et al (2015). Late Development of Cue Integration Is Linked to Sensory Fusion in Cortex. *Curr Biol*; 25: 2856–2861.

4. Negen J, Slater H, Bird L-A, et al (2022). Internal biases are linked to disrupted cue combination in children and adults. *J Vis*; 22: 14.