Development of multisensory integration

In sighted and non-sighted individuals

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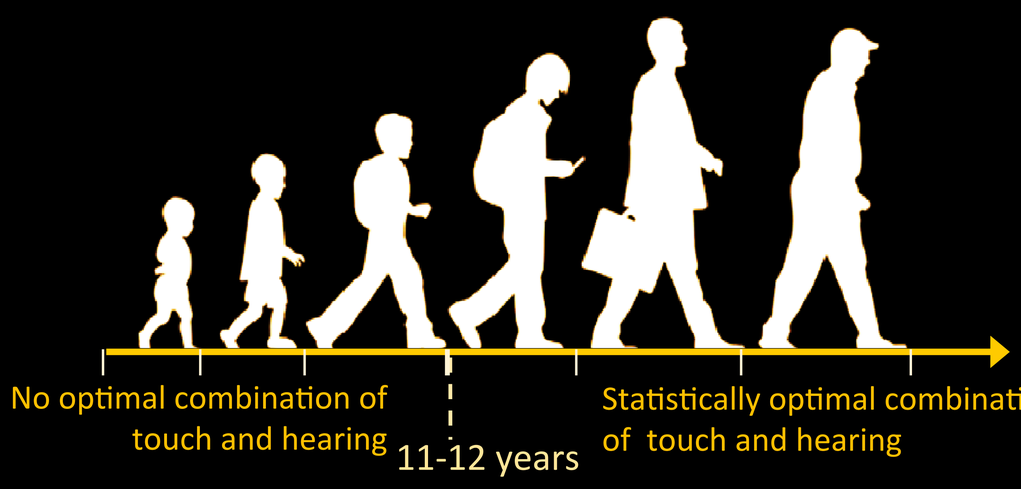
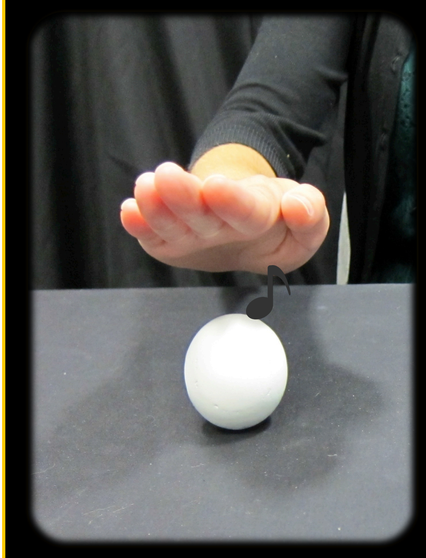
Introduction

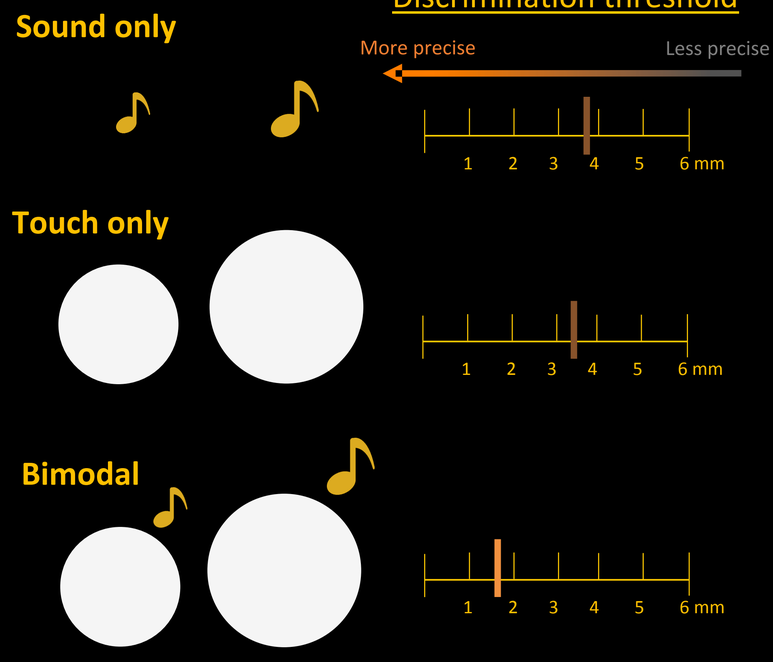
In order to perceive the world around us, we often use multiple senses at the same time to gain as much information as possible. Our brains combine this information in a 'statistically optimal' way – this helps us getting the most precise percept we can possibly get (Ernst & Banks, 2002).
However, in order to assess object size, children do not combine hearing and touch information in an optimal fashion up to eleven years of age (Petrini et al., 2014).



During this developmental process visual information seems to play an important role during development for the calibration of senses (Gori et al., 2008).
Hence, we are trying to understand if **blind people**, who rely a lot on more hearing and touch, can combine this information at an earlier age or if they cannot combine this information at all.

Method





Method build on Petrini et al. (2014). Method has been modified using a Psi adaptive staircase

Participants & Recruitment

	Adults (>18years)	Children (7-14years)
Sighted	48 (University of Bath, general public)	48 (Local school, general public)
Blind/Visually Impaired (early & late onset)	48 (Moorfields Eye Hospital, Sensory Support Service Bristol, general public)	48 (Moorfields Eye Hospital, WESC Exeter, Sensory Support Service Bristol, general public)

Multisensory benefit

Multisensory benefit

Development

Blindness

Influence of vision on the development of optimal combination of hearing and touch

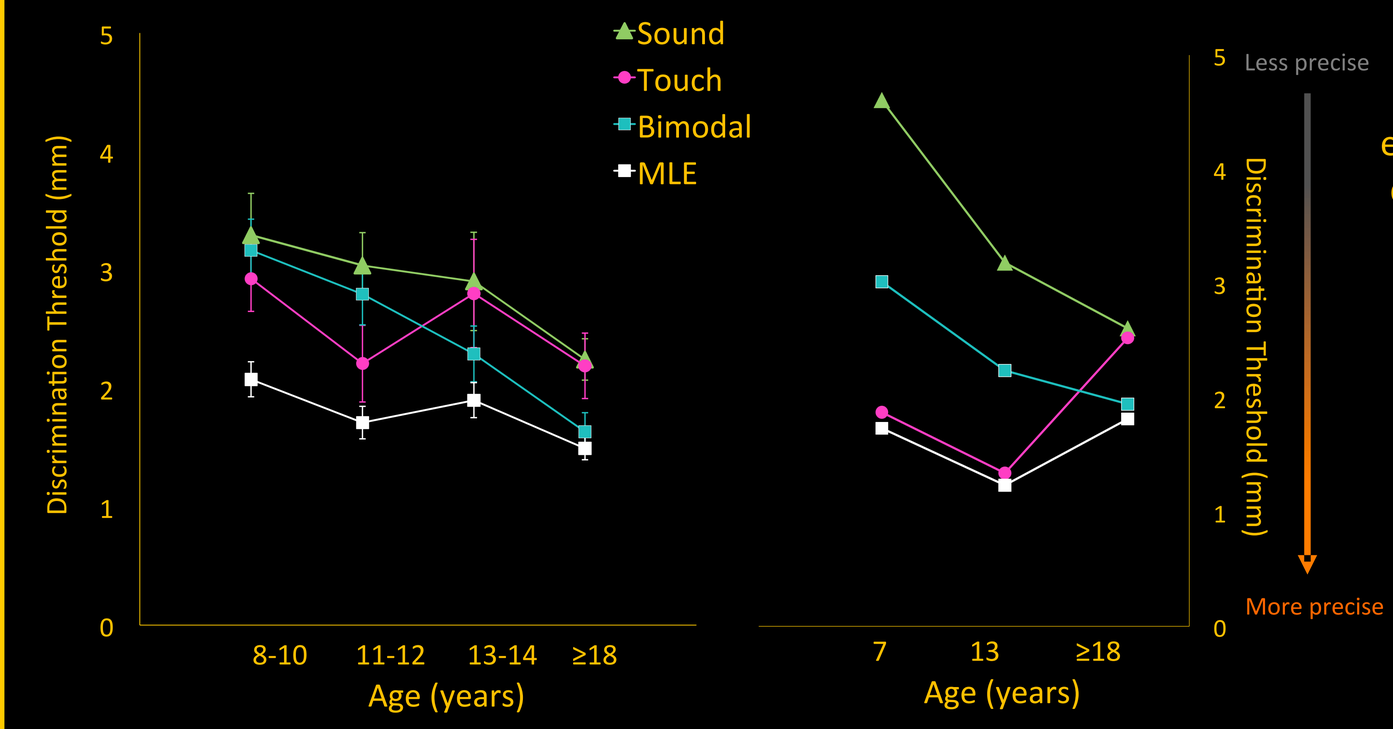
Preliminary results

Normally Sighted (n=61)

Adults combine touch and hearing optimally. Children below the age of 13 do not.

Visually Impaired/Blind (n=3)

The adult combines touch and hearing near optimally. Both children, aged 7 and 13, do not.



Conclusion and Outlook

Our new method has been shown to successfully measure statistically optimal multisensory integration in sighted adults. It replicates and extends the findings from Petrini et al., 2014, despite using different psychophysical measures and participants.

Typically sighted adults integrate audio-haptic size information in a statistically optimal fashion, while children don't integrate before adolescence.
Very preliminary data suggests that visually impaired/blind children express a stronger haptic dominance than sighted children, and that they don't integrate non-visual information earlier. However, one (late) blind adult showed integration comparable to typically sighted individuals.

Understanding when optimal integration of sound and touch emerges in the absence of vision is fundamental to develop new, or enhance available assistive technologies that translate visual information into touch and sound (Scheller, Petrini, Proulx, in press). It further deepens our understanding about developmental mechanisms before optimal integration emerges.

References: **Ernst M.O., Banks M.S. (2002):** Humans integrate visual and haptic information in a statistically optimal fashion. Nature 415:429-433. **Gori M., Del Viva M., Sandini G., Burr D.C. (2008):** Young children do not integrate visual and haptic form information. *Curr Biol. 18(9)*: 694-698. **Petrini K., Remark A., Smith L., Nardini M. (2014):** When vision is not an option: children's integration of auditory and haptic information is suboptimal. *Dev Sci. 17(3)*: 376-387. **Scheller M., Petrini K., Proulx M.J. (in press):** Perception and Interactive technologies. In J. T. Wixted & J. Serences (Eds), *The Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience* (4th Edition, Volume 2: Sensation & Perception). New York: Wiley.

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Crossmodal Cognition Laboratory

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