Learning to combine the senses

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Learning to combine sense and experience for optimal perceptual judgements

Making decisions based on uncertain sensory information, such as recognising somebody in the dark, involves taking a “best guess”. This depends on knowing the reliability of the sensory information (e.g., at night vision is poor, so we should place less confidence in it), and knowing the prior likelihood of different events (e.g., if a friend lives abroad, it is unlikely to be them across the street). In using both sensory reliability and prior probability information, human adults approach statistical optimality in some perceptual tasks. This reveals several new requirements for the development of a mature perceptual system. Perceptual systems must learn their own reliabilities, and use this reliability information to weight different sensors in multi-sensory judgments. They must also learn the probability distributions associated with different objects and events in the world, and use these distributions in combining sensory and prior likelihood information. How this information is acquired and used is not yet understood. This project will therefore study the developmental trajectory for optimal perception in a series of novel tasks. This will be the first major investigation into these new aspects of perceptual development, and into the developmental basis for optimal perception.
Learning to combine sense and experience for optimal perceptual judgements
Approach

Studying developmental changes in the brain’s sensory-motor computations
Learning to combine the senses efficiently takes a surprisingly long time: 10 years+

Visual-vestibular navigation

*Curr Biol* 2008

Visual-haptic size

Gori et al,
*Curr Biol* 2008

Visual-proprioceptive pointing

*JEP:HPP* 2013

+ many others..
Visual cue combination (*within a sense*) also not until 10 years+

*PNAS 2010*

Not a “multisensory” immaturity but a more general information processing immaturity
Visual cue combination absent in sensory brain areas until 10 years+

*Curr Biol 2015*

In absence of any task

**Adults and older:** area V3B averages motion + stereo cues to depth

**Under 10 years:** not
Why does it take so long to learn to combine signals efficiently?

Challenges

• Correct model – which estimates go together (*Child Dev* 2015)

• Correct calibration (*Cognition* 2019)

• Correct representation of probability (*Dev Sci* 2016)

Could we learn to use new signals like our native senses? ERC project *NewSense* 2019-2024
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Example: training new cues to depth in VR (*Sci Rep* 2018)
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1 x **PhD studentship** to start in 2020 – closing Jan 8th

1-2 x **Post-docs** (behaviour / fMRI) to start in 2020 (advertising soon)

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Thank you, CBCD!

Here’s to the next 21 years!

See you in 2040...