CBCD 21st Anniversary, November 2019

Learning to combine the senses

Marko Nardini

Durham University

1998

2008

Economic and Social Research Council

Shaping Society

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 (eg at night vision is poor, so we should place less confidence in it), and knowing the prior likelihoods of different events (eg 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.

Start date
01 February 2008

End date
31 October 2011

Grant holder
Professor Denis Mareschal

Co-applicants
Dr Marko Nardini

Grant amount
£317,011.86

Grant reference
RES-062-23-0819

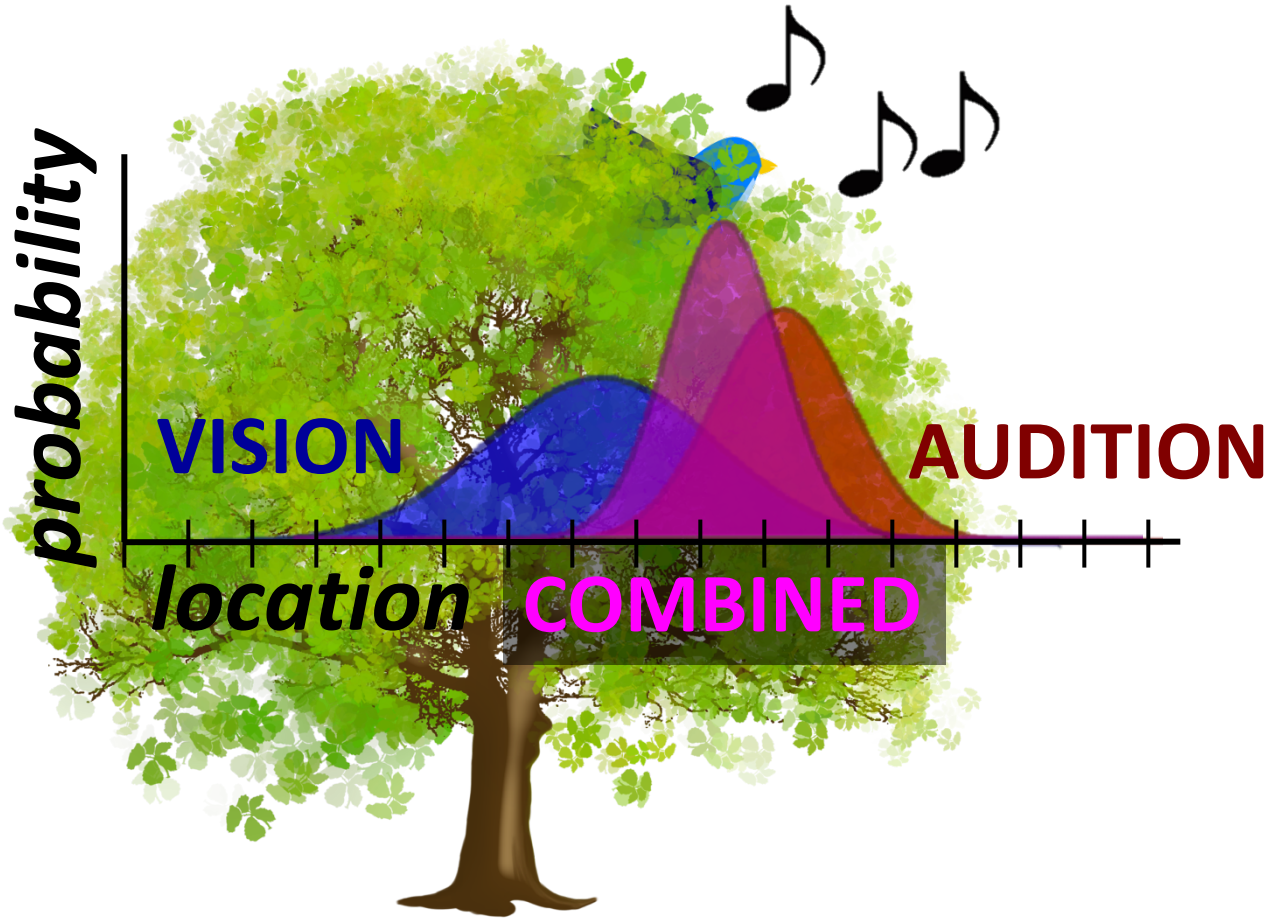
Discipline
Psychology

Grant type

Economic and Social Research Council

Shaping Society

Learning to combine sense and experience for optimal perceptual judgements



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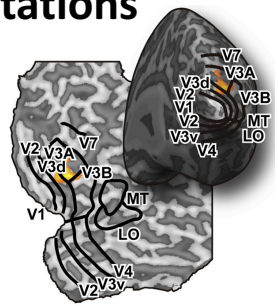
Approach

Studying developmental changes in the brain's sensory-motor computations

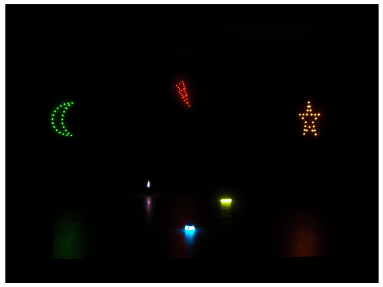
Behavioural tasks

Alternative model predictions

Neural representations



Learning to combine the senses efficiently takes a surprisingly long time: 10 years+



Visual-vestibular navigation
Curr Biol 2008

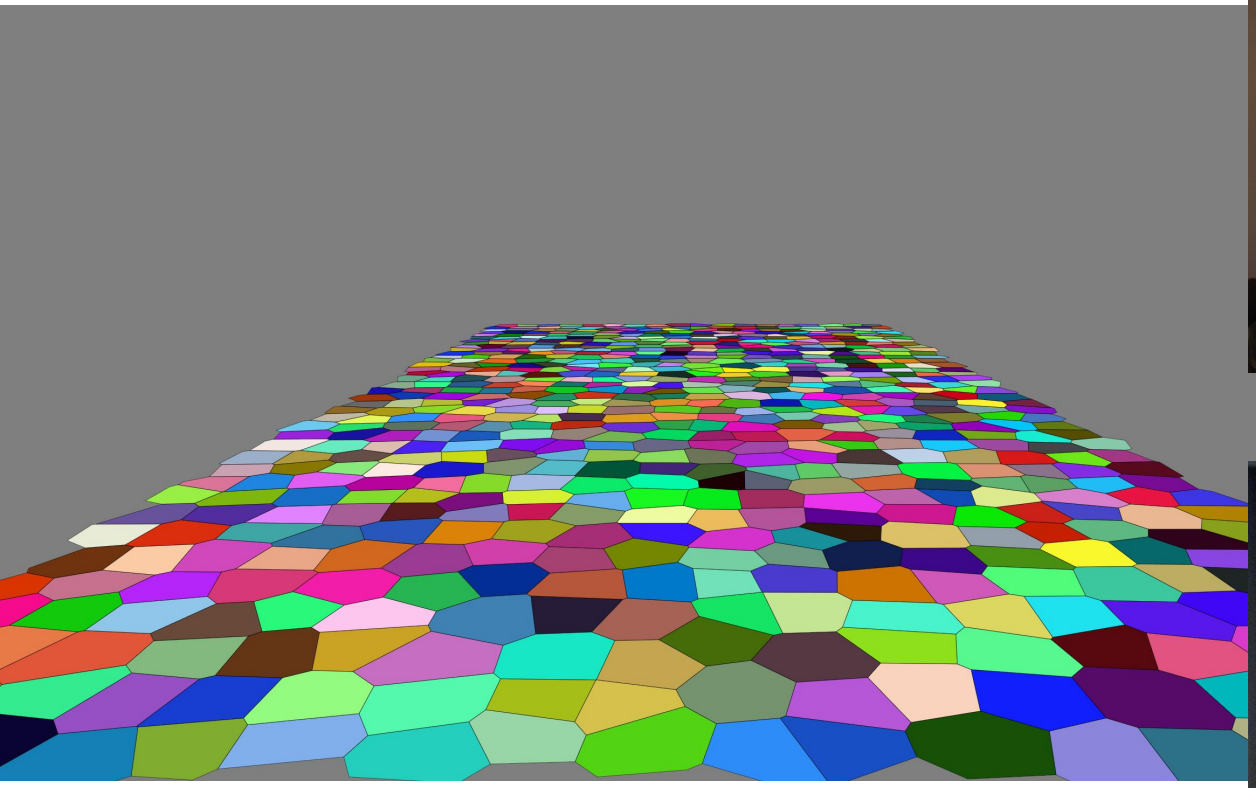
Visual-haptic size
Gori et al,
Curr Biol 2008

Visual-proprioceptive pointing
JEP:HPP 2013

+ many others..

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

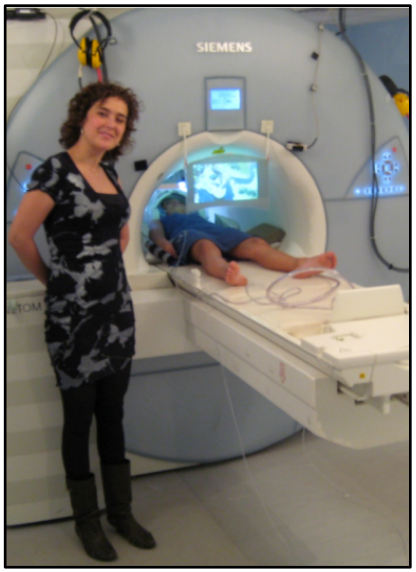
PNAS 2010



Not a “multisensory” immaturity but a more general information processing immaturity

Visual cue combination absent in sensory brain areas until 10 years+

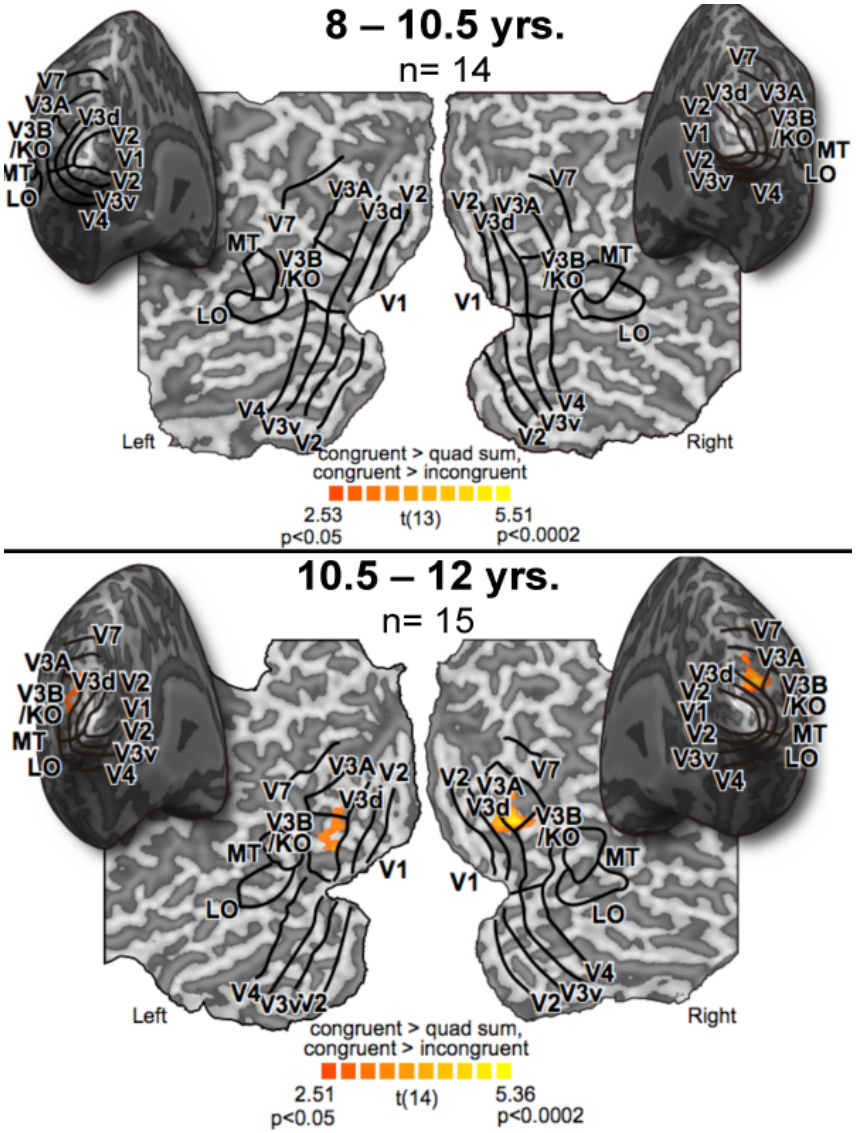
Curr Biol 2015



In absence of any task

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

Under 10 years: not

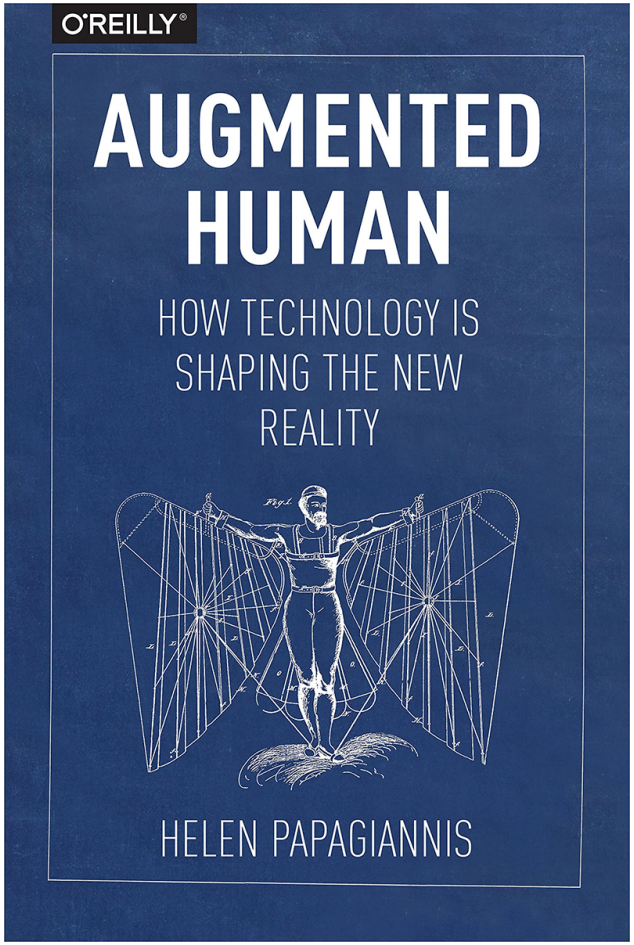


Why does it take so long to learn to combine signals efficiently?

Challenges

- Correct model – which estimates go together (*Child Dev* 2015)
- Correct calibration (*Cognition* 2019)
- Correct representation of probability (*Dev Sci* 2016)
- Neural mechanism for weighted averaging (*Curr Biol* 2015, *Sci Rep* 2018)

Could we learn to use new signals like our native senses? ERC project *NewSense* 2019-2024



Low vision

Specialist tasks

Social

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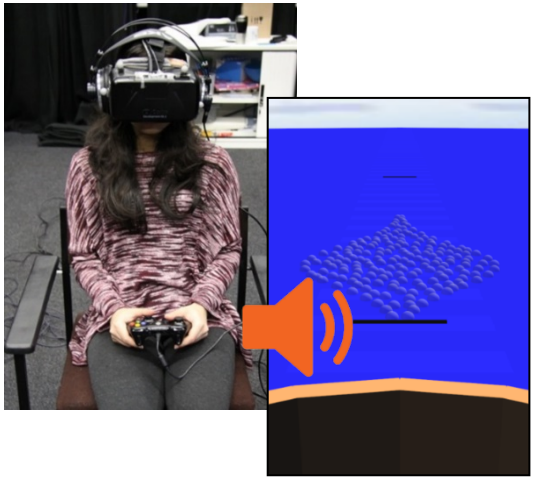
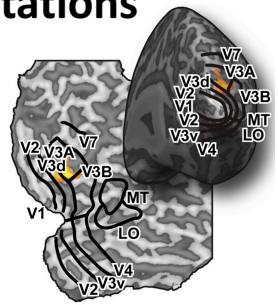
Behavioural tasks

Alternative model predictions

Example: training new cues to depth in VR (*Sci Rep* 2018)



Neural representations



Could we learn to use new signals like our native senses? ERC project *NewSense* 2019-2024

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…