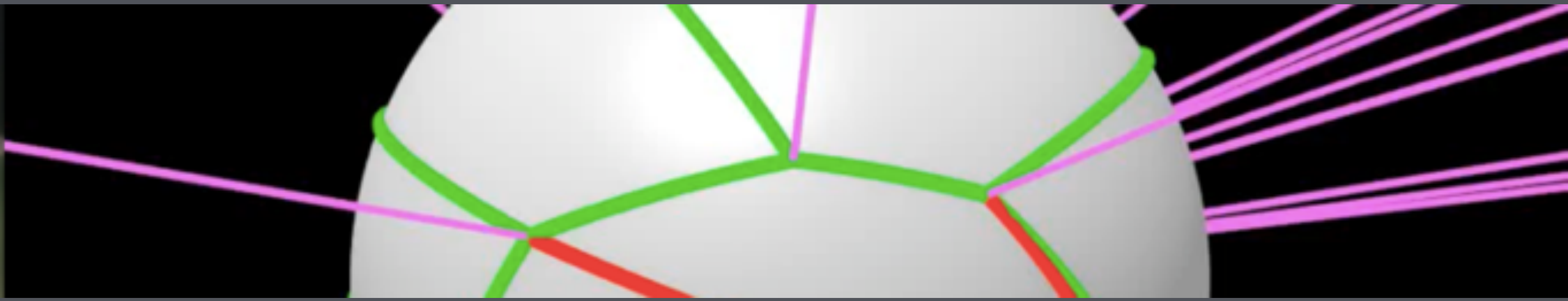
School of Psychology and
Clinical Language Sciences

University of Reading

THE NEED FOR FRESH THINKING ON CORTICAL PROCESSING FOR 3D VISION



Andrew Glennerster

Questions for this symposium:

- Do we have a coherent approach to the general problem of 3D vision?
  - No
- Is there consensus about the nature of the perceptual output or the representation of 3D information?
  - No
- Do we understand much about how neural mechanisms contribute to 3D processing?
  - No

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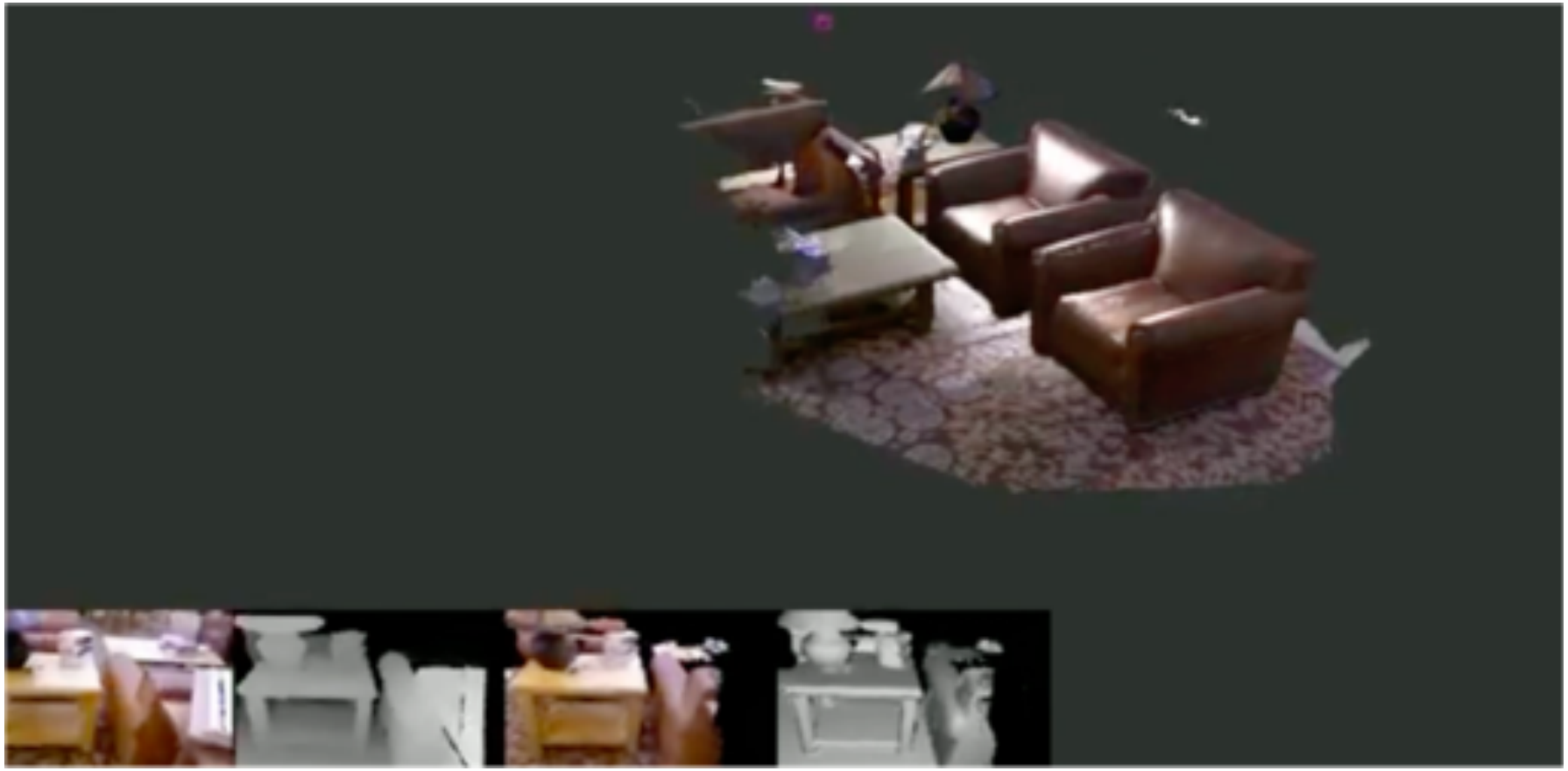
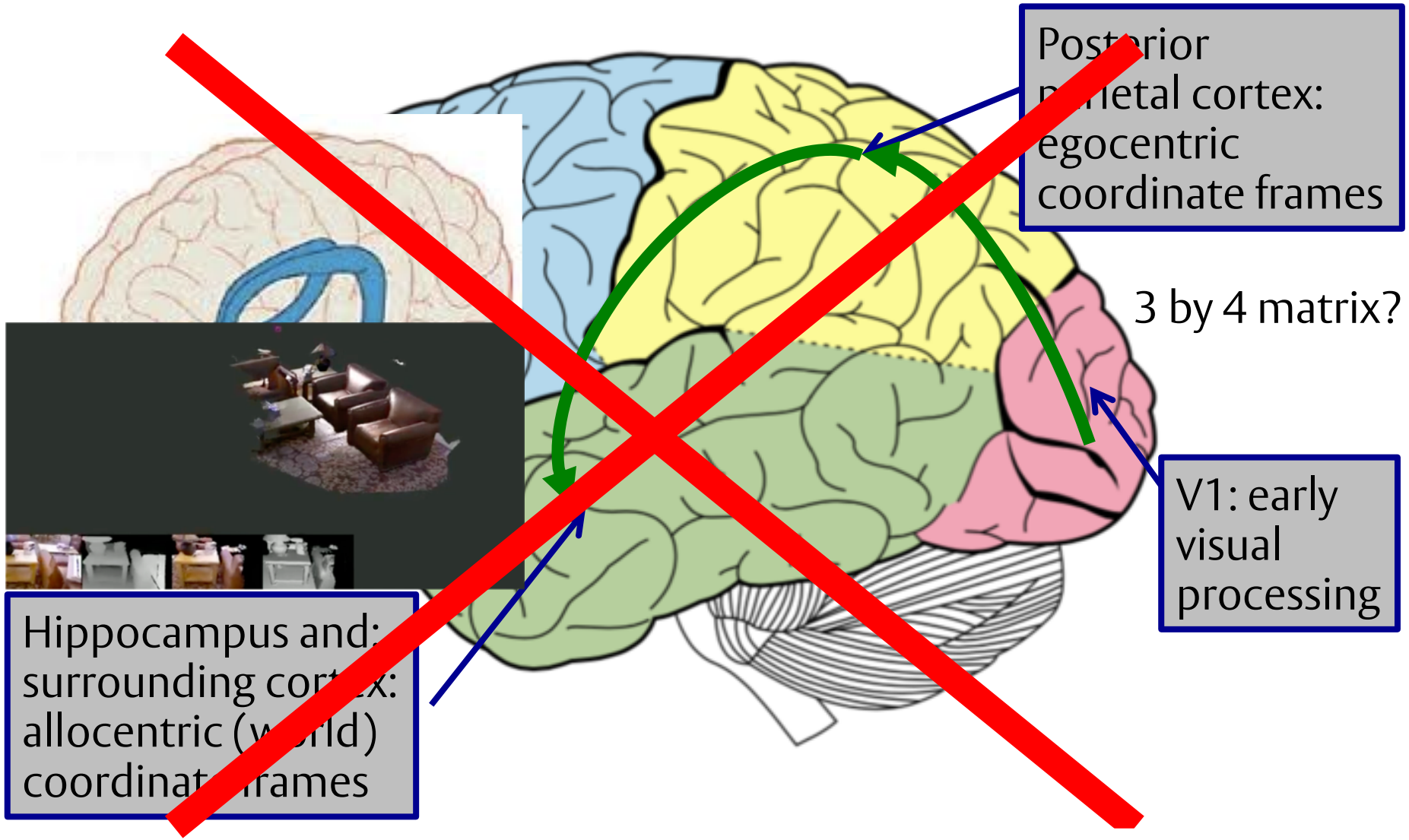
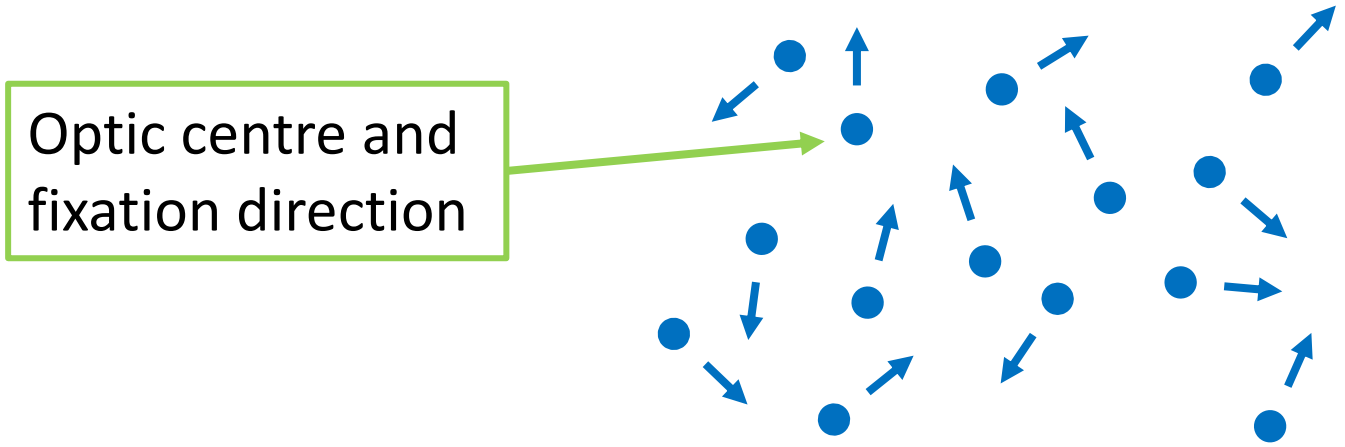


Current hypothesis



Solve the general problem first:



Solve the general problem first:

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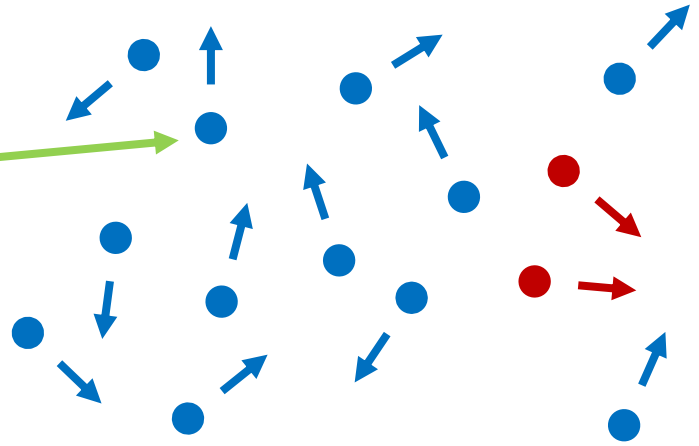
Optic centre and fixation direction



Binocular viewing (and monocular viewing) are just impoverished cases of the information available to a moving observer.

Not true for static predators

We have to solve the general problem first (3D representation in a moving observer) and then understand binocular vision as a limited version of this.

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Jenny Vuong

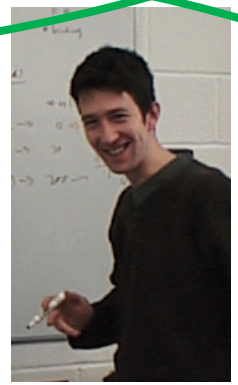
Alex Muryy

Luise Gootjes-Dreesbach

Peter Scarfe

James Stazicker

Miles Hansard



Andrew Fitzgibbon

Microsoft Research

EPSRC

[dstl]

Psychophysical evidence against 3D reconstruction

- Intransitivity of depth relations (A>B>D but A<C<D)
  - Svarverud *et al* (2012)

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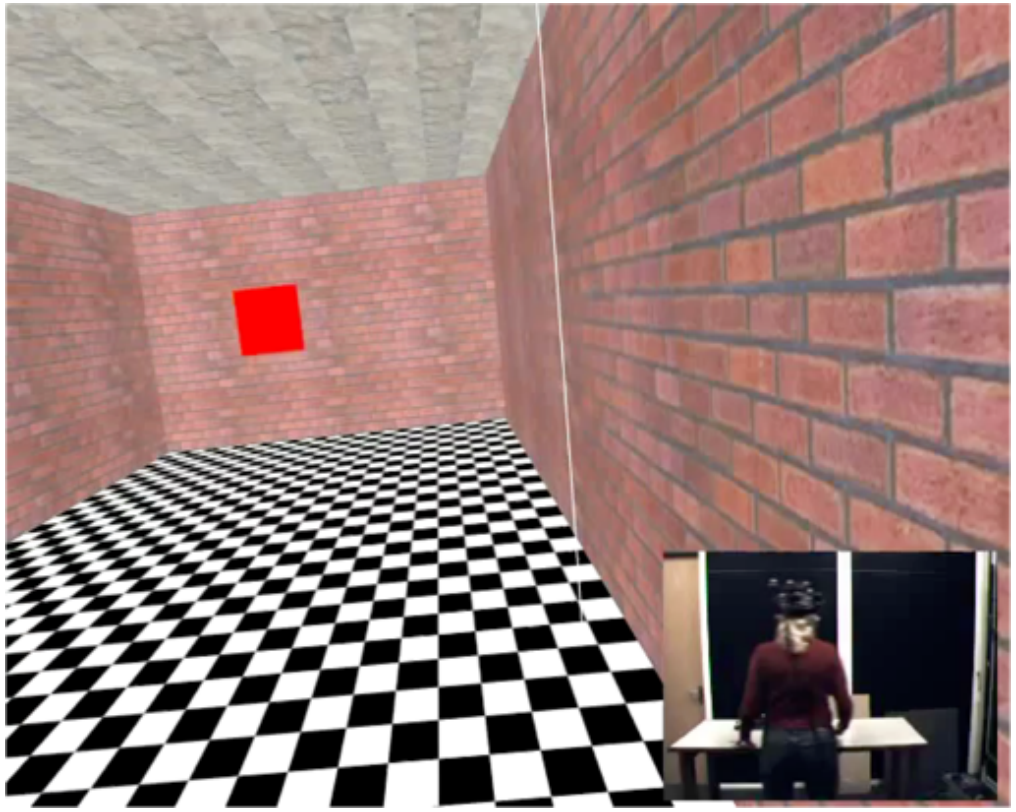

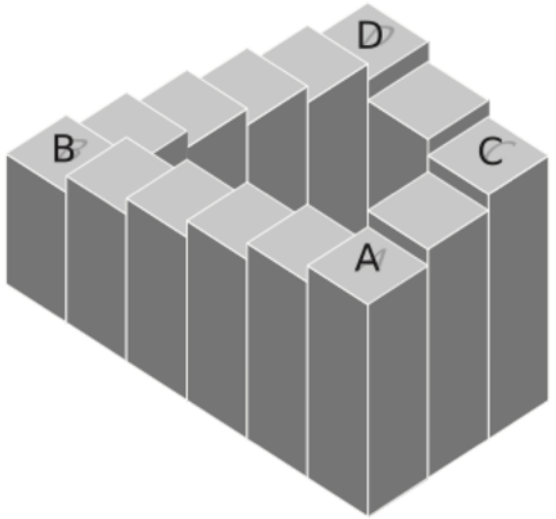

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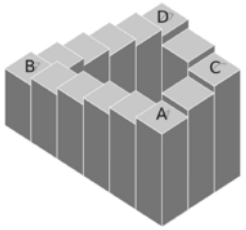

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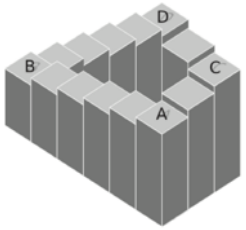

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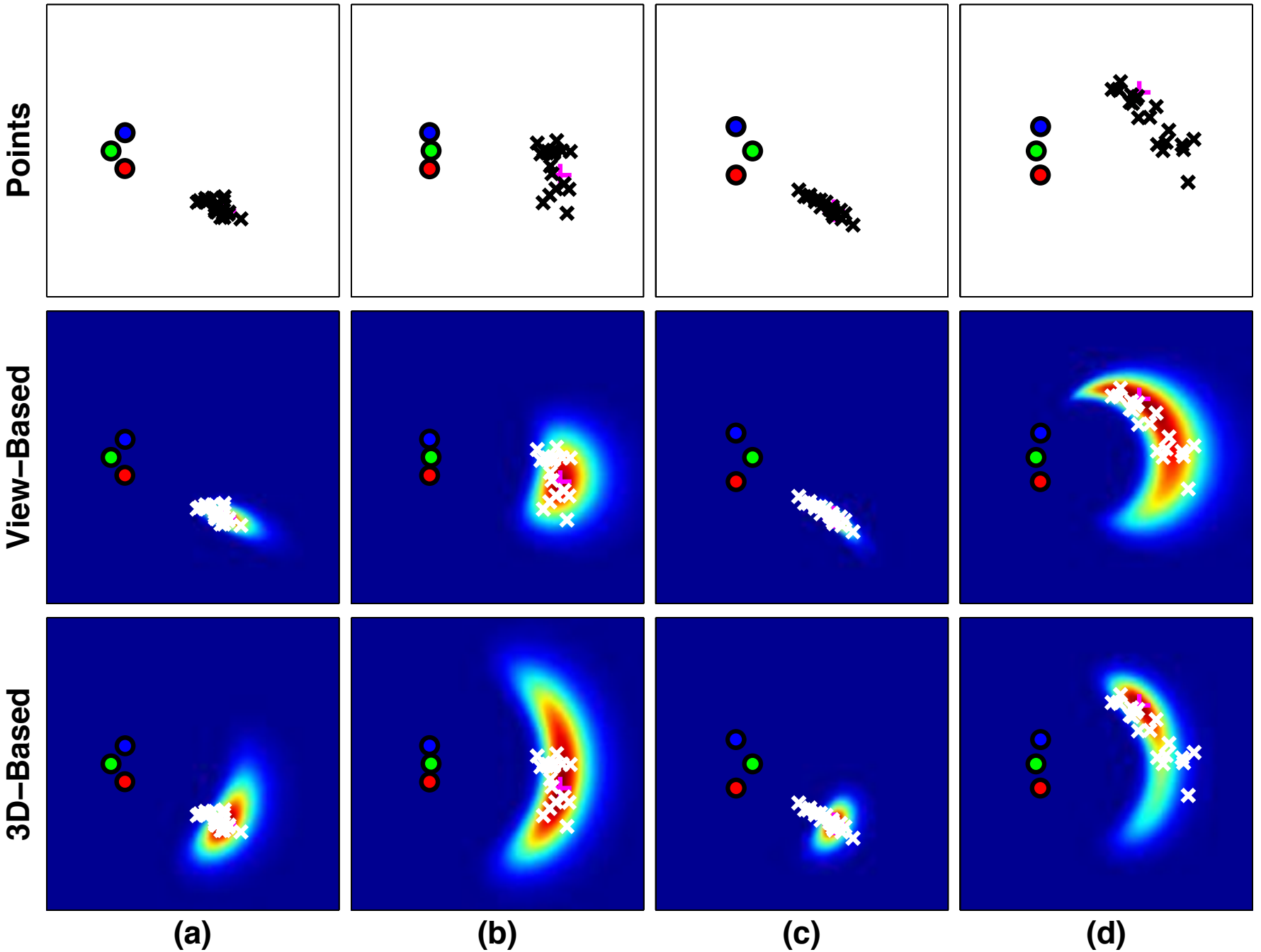

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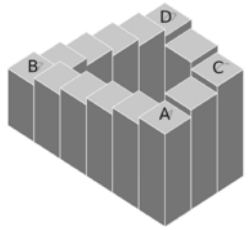

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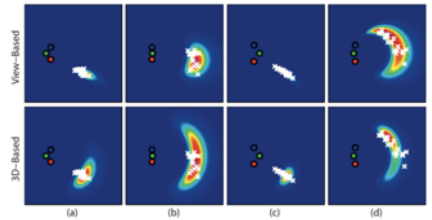

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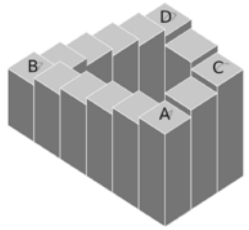

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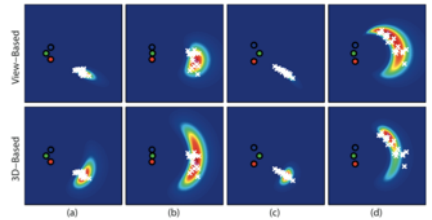

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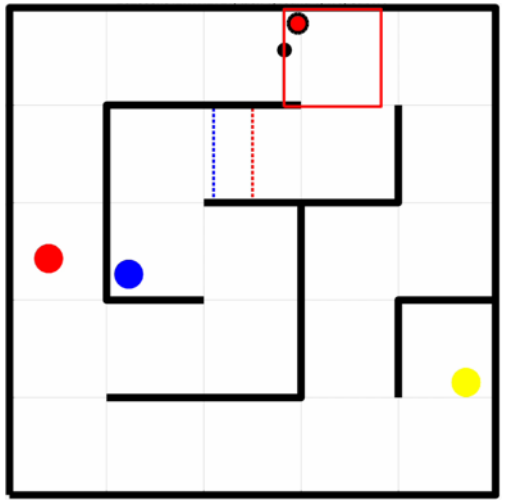

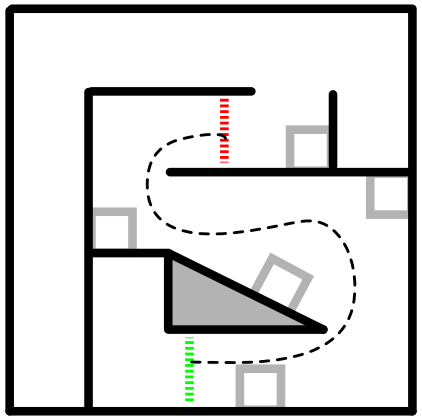

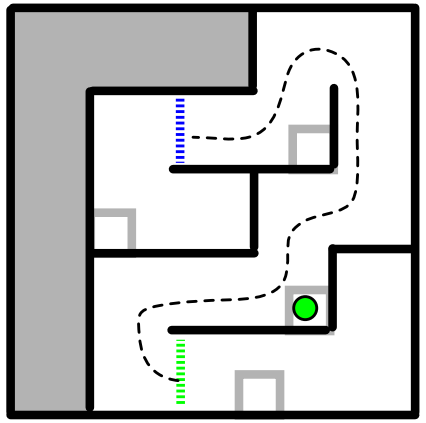

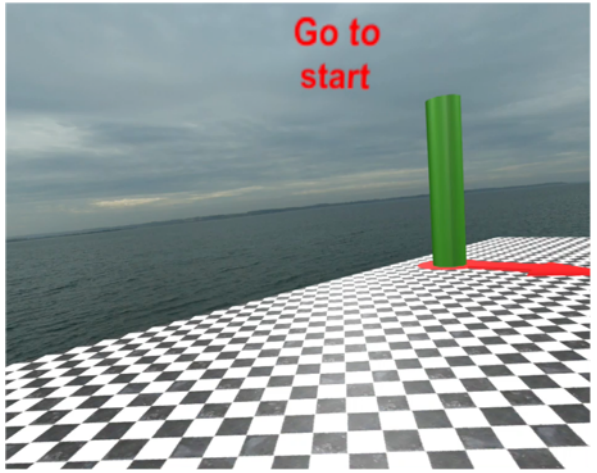

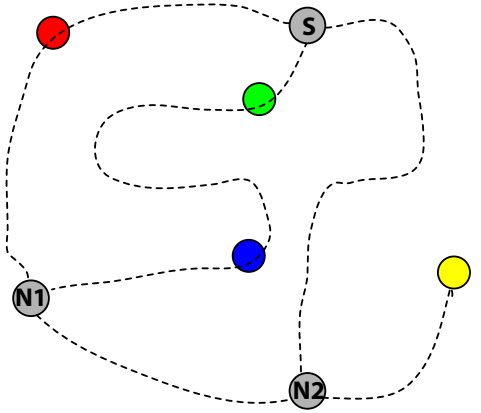

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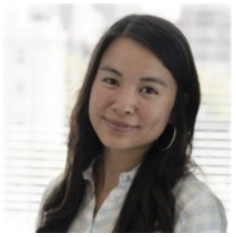

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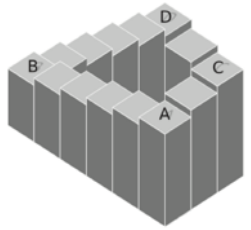

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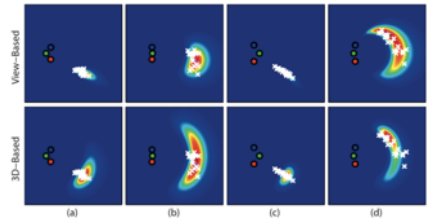

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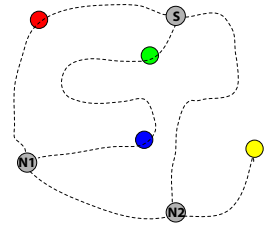


- Shape judgements depend on the task
  - Glennerster et al, 1996

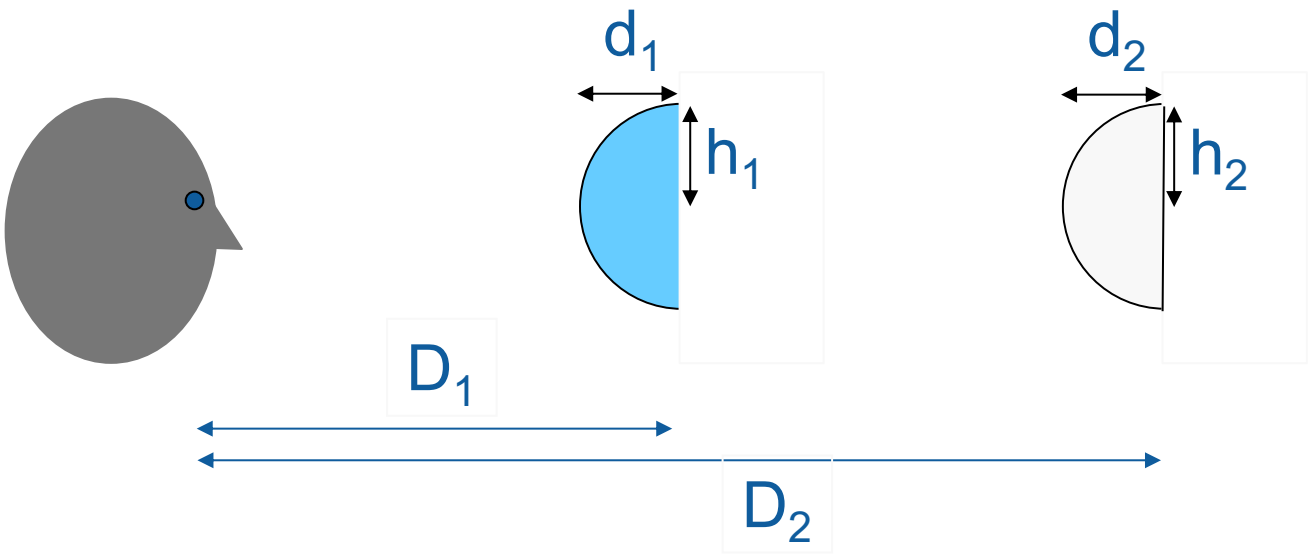
Psychophysical evidence against 3D reconstruction

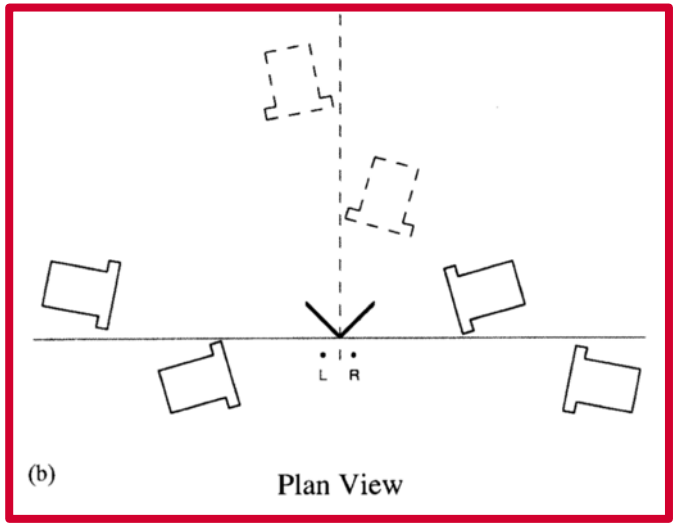
Size constancy: $h_1 = h_2$

Depth constancy: $d_1 = d_2$

Depth-to-height ratio: $d_1/h_1 \neq d_2/h_2$

} Inconsistent





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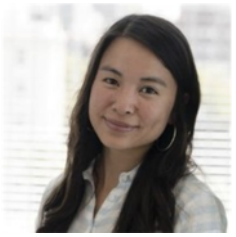

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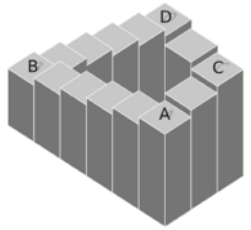

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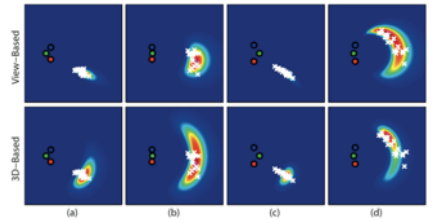

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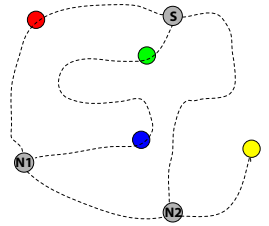

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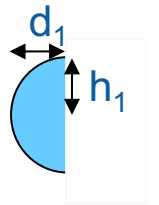
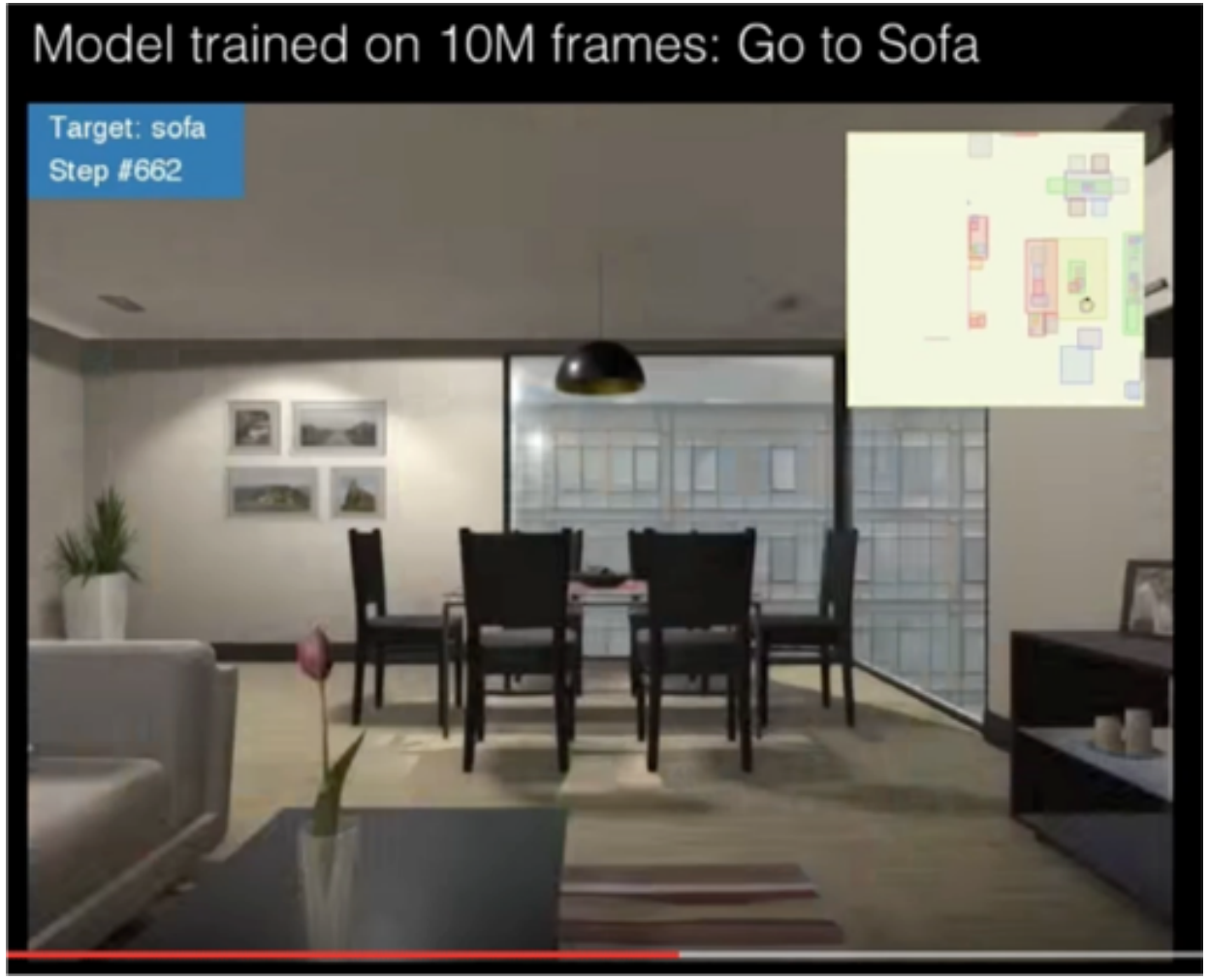
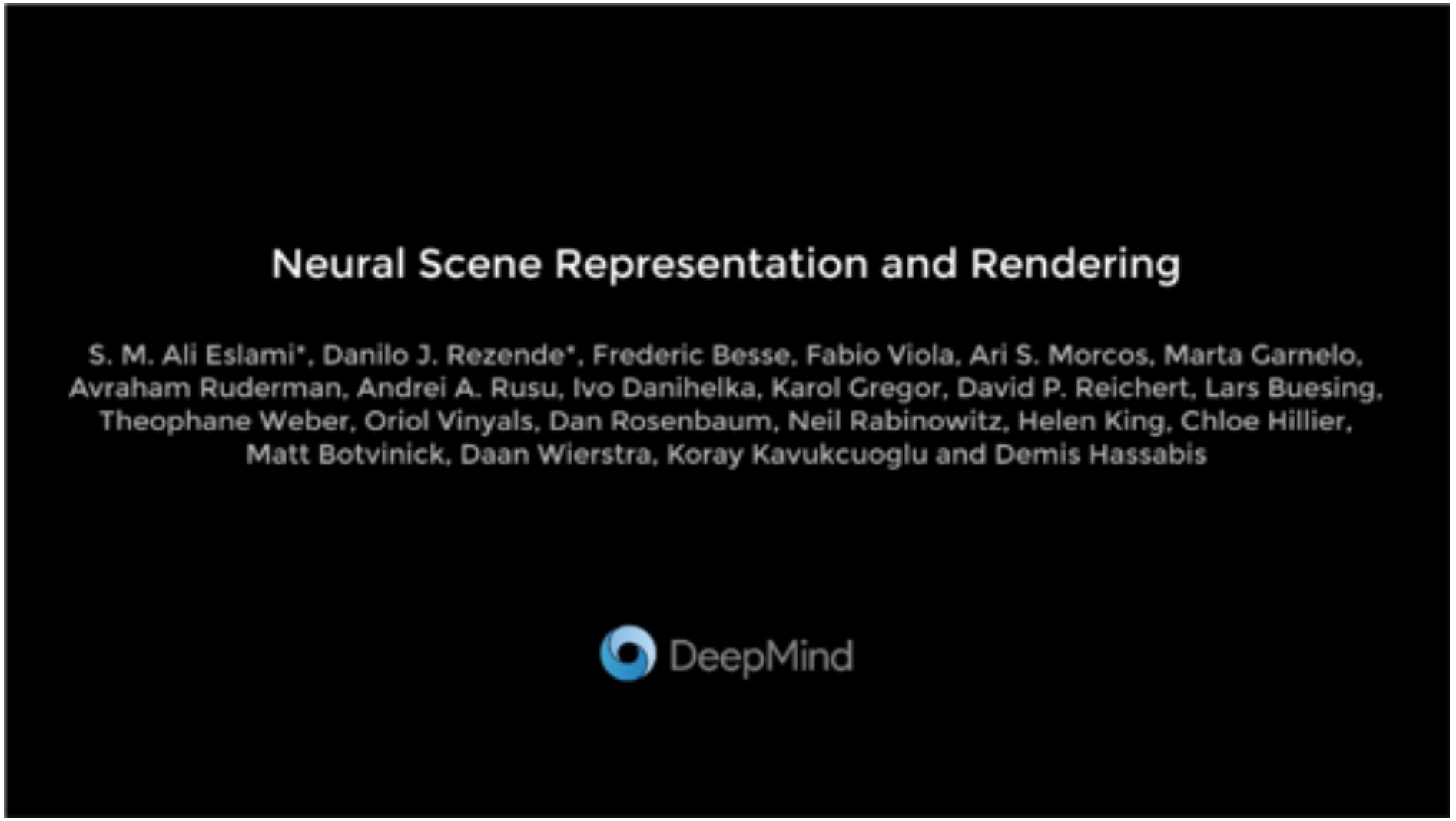


Navigation without a 3D reconstruction



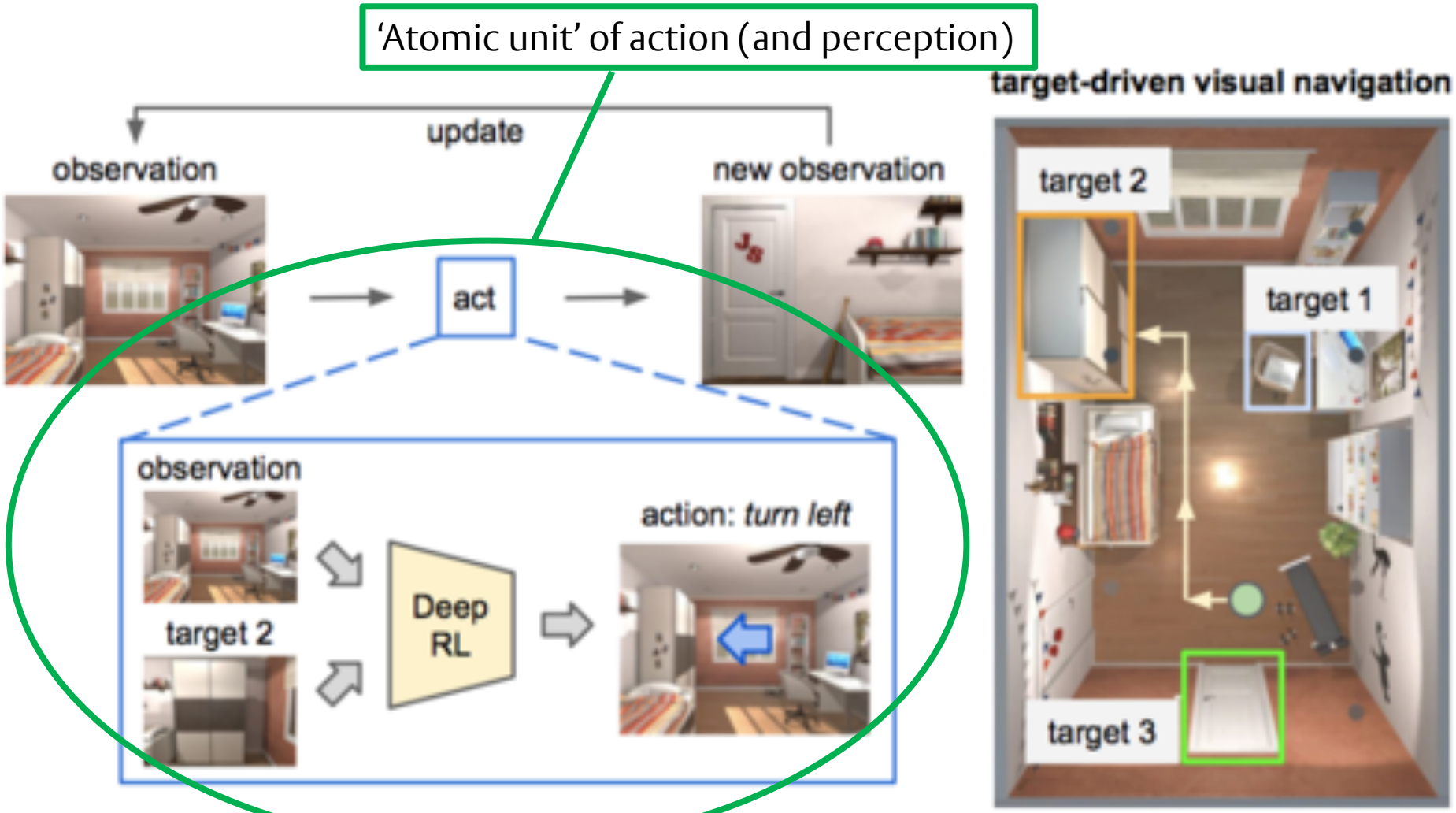
Zhu et al, 2016 https://youtu.be/SmBxMDiOrvs.

‘Neural rendering’ without a 3D reconstruction



Eslami et al (2018) https://www.youtube.com/watch?v=G-kWNQJ4idw

Computer vision navigation without a 3D map



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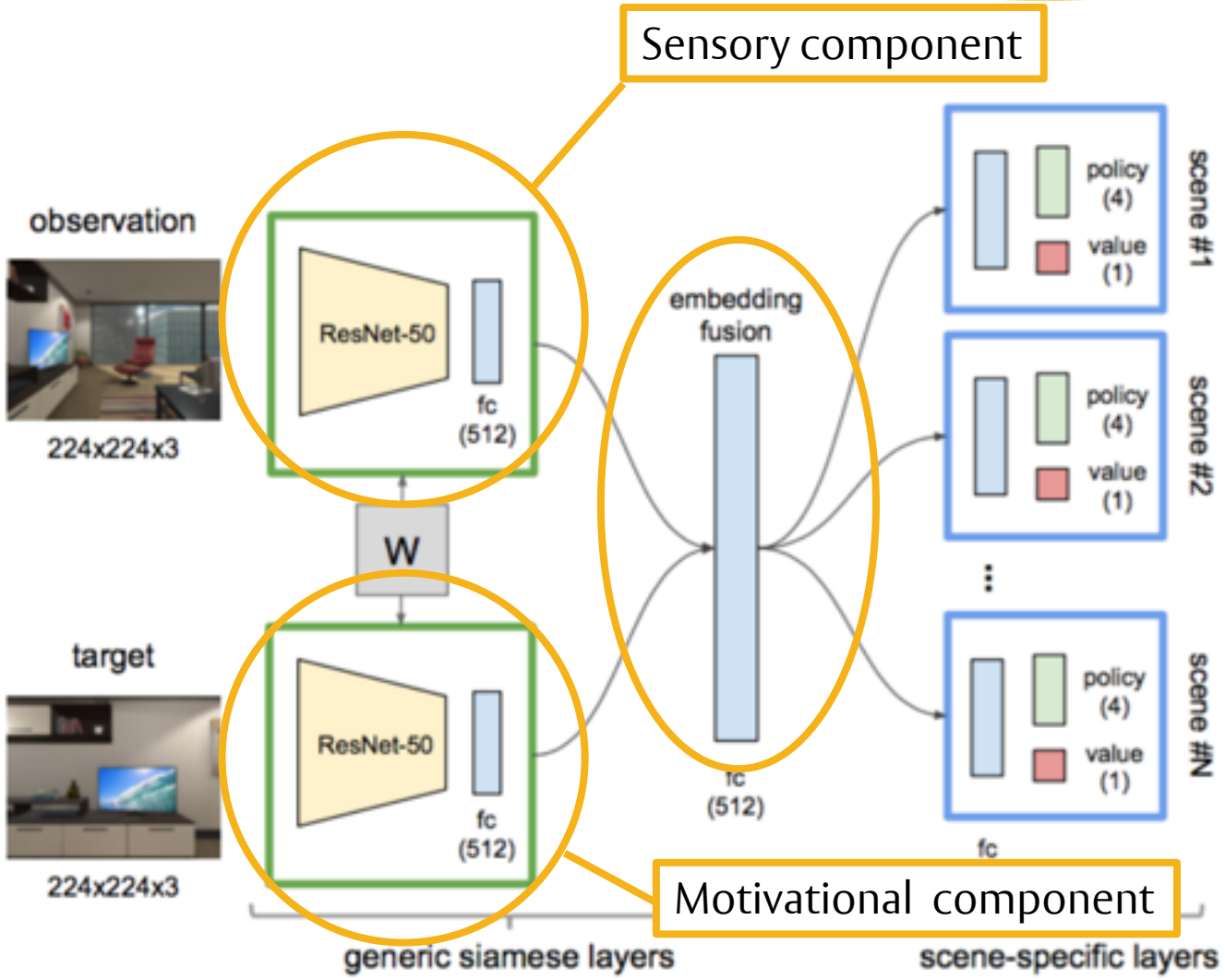


A different hypothesis

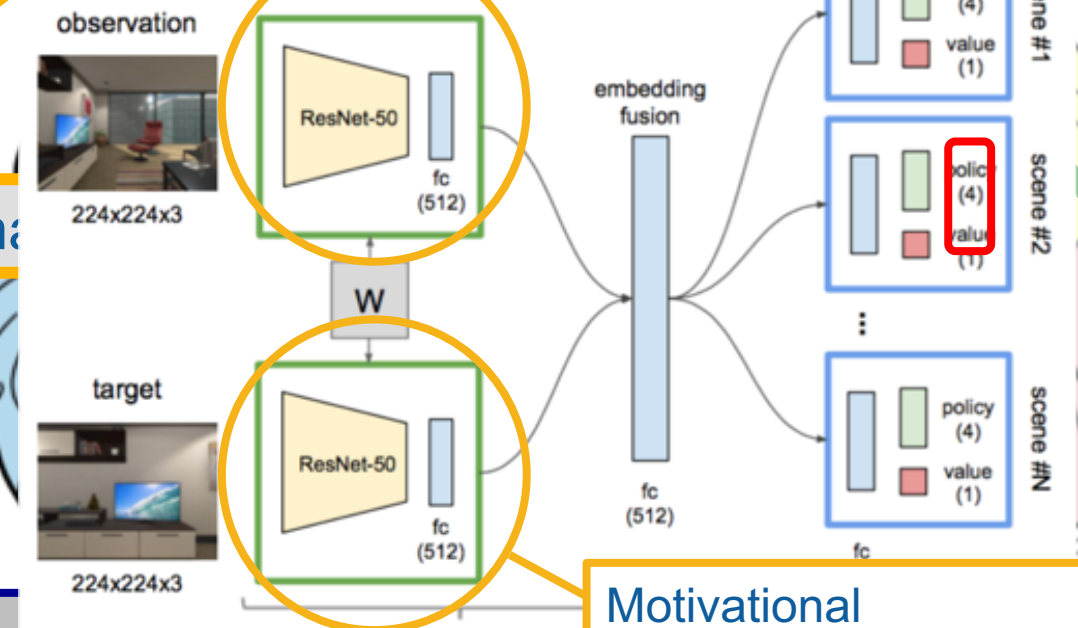
r

Sensory component

Sensory context

parietal cortex: egocentric coordinate frames

Motivationa



V1: early visual processing

Hippocam

nding cortex:
ntric (world)

Motivational component

Stored contexts

W

$k = argmax_i(W\vec{r})$

$w_{(k,*)}$ is the 'recognised context'

Questions for this symposium:

- If reinforcement learning algorithms can achieve 3D vision without geometry, why can't we?

Navigation without a 3D reconstruction

Zhu et al, 2016 https://youtu.be/SmBxMDiOrvs.