

Effects of development on low-level feature processing during natural viewing of dynamic scenes

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Introduction

As the brain matures and ages, what are the relative roles of top-down (goal-driven) and bottom-up (stimulus-driven) processes in guiding attention?

Specifically, how do the changes of attentional processes affect free viewing behavior when there is no cognitive task?

Summary

This study investigates the **effect of development** (maturation and aging) on **overt attention allocation** while **free viewing dynamic natural scenes** when **no cognitive tasks** are given.

As the brain matures,

- faster visual processing time, faster decision, and/or faster saccade initiation resulting in shorter inter-saccade interval.
- young adults look more toward highly salient locations possibly due to (1) the balance between top-down and bottom-up attention and/or (2) learning to extract visual information effectively.

As the brain ages,

- bottom-up attention of the elderly is as effective as that of young adults during free viewing (no cognitive tasks).
- overall attention allocation changes significantly (presumably by top-down attention), but young adults are more similar to the elderly than to children.

Methods

Record Eye Movements

Participants:

18 children (10.7±1.8 yr)
18 young adults (23.2±2.6 yr)
24 elderly (70.3±7.5 yr)

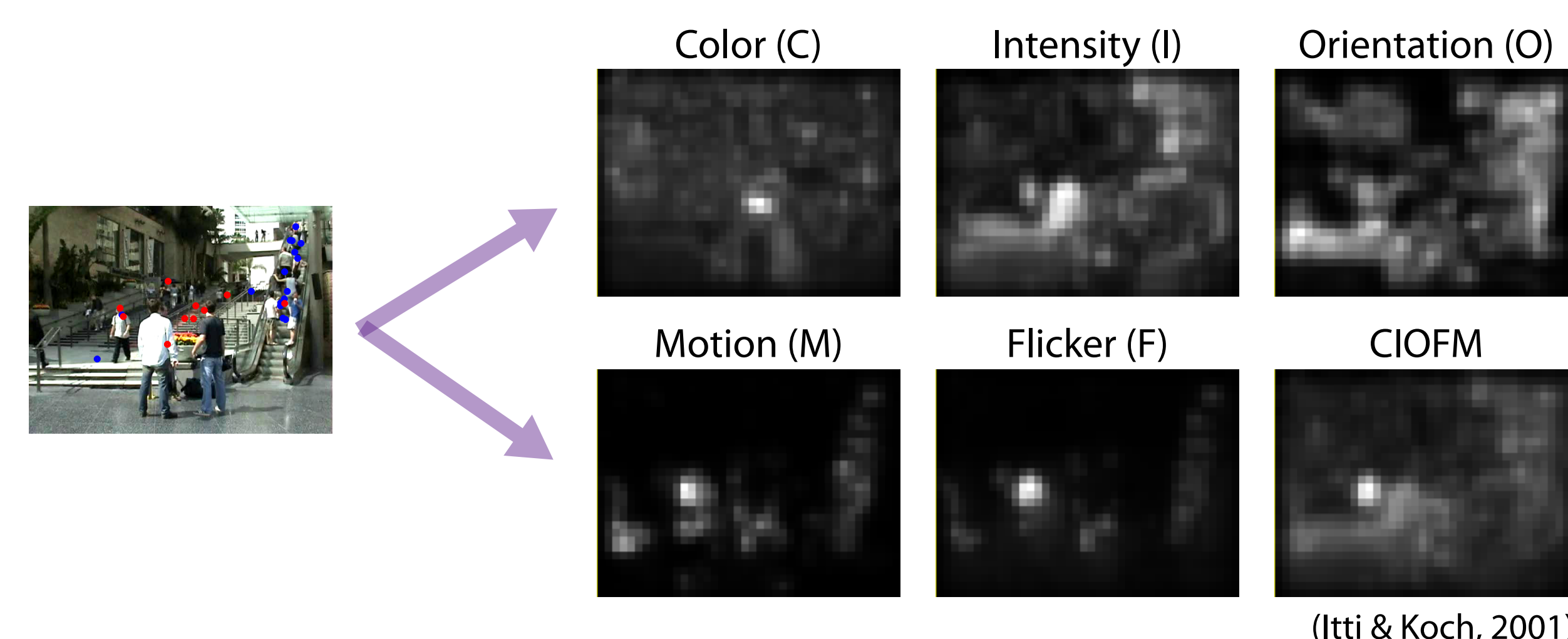
Stimuli: Natural scene MTV-style videos (20 minutes - 40 videos, ~30 sec. each). MTV-style video is a continuous video whose scene changes every 2-4 seconds.

Instruction:

"Watch and enjoy the clips"

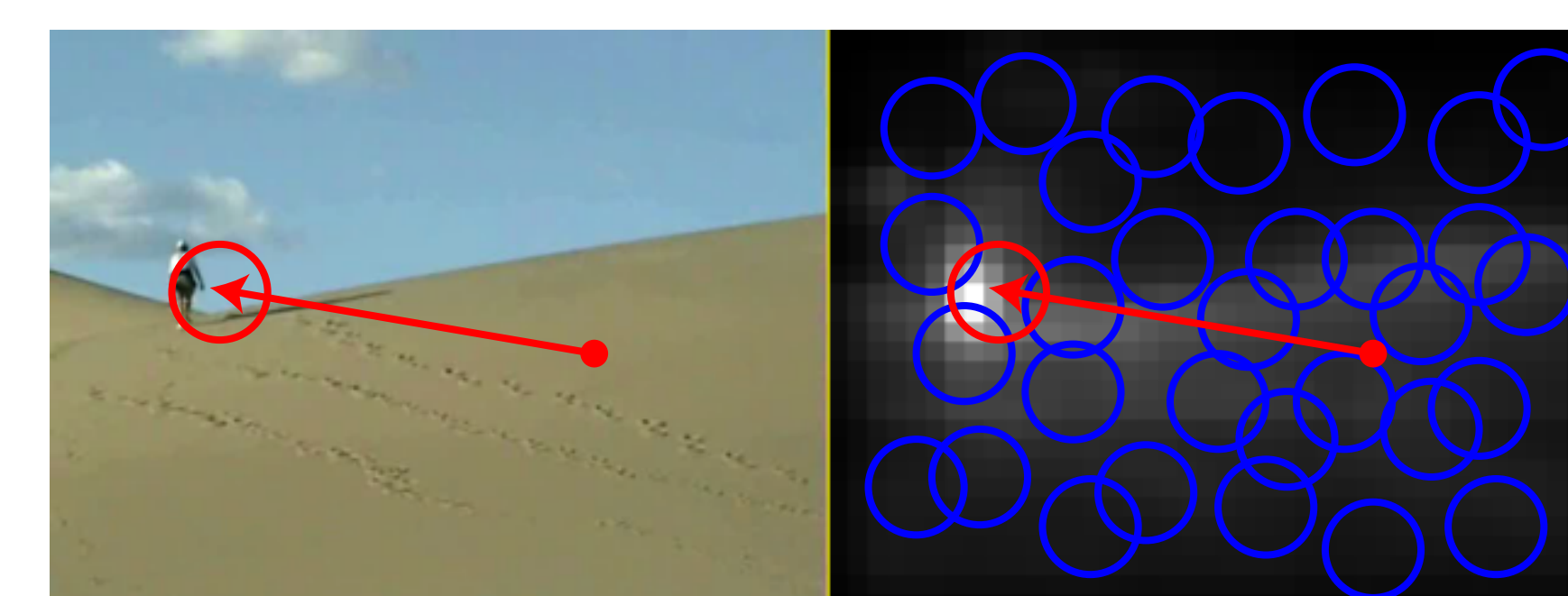


Compute Saliency Maps

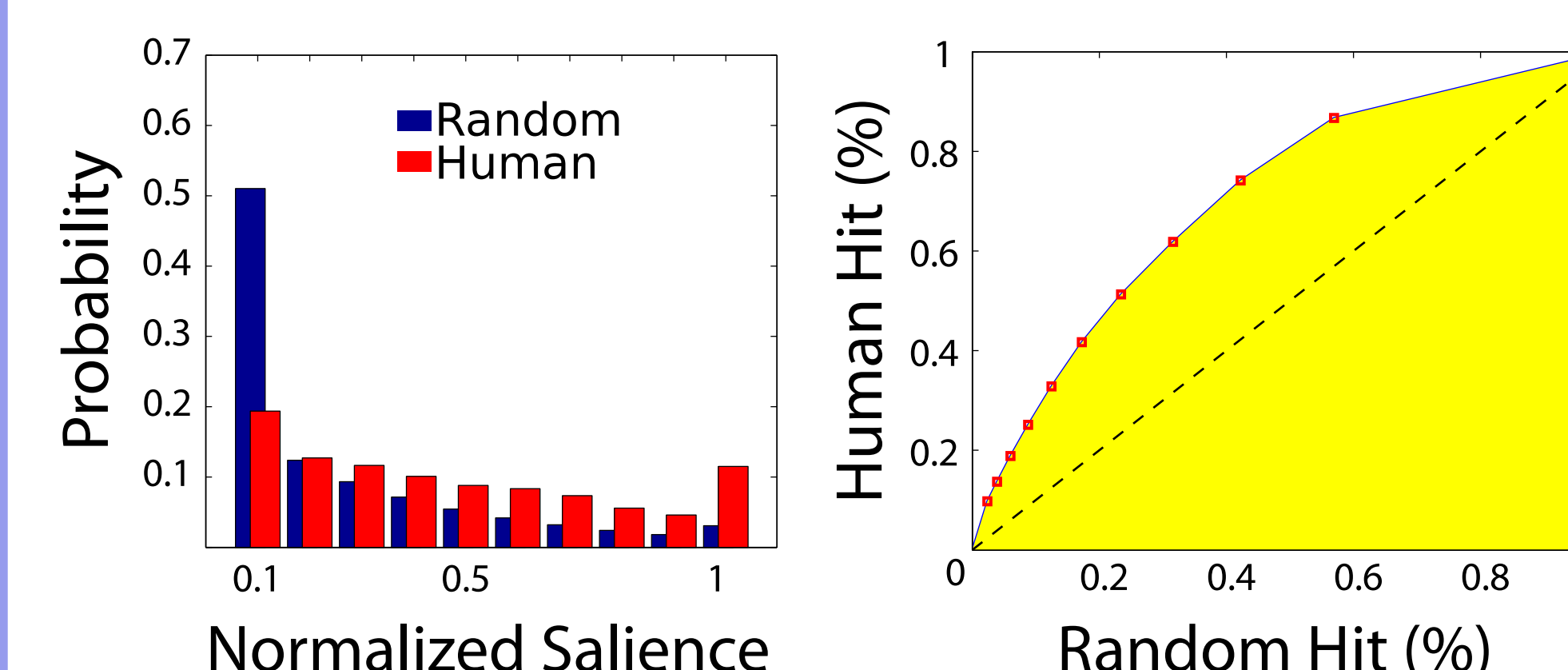


Bottom-up Process Estimation

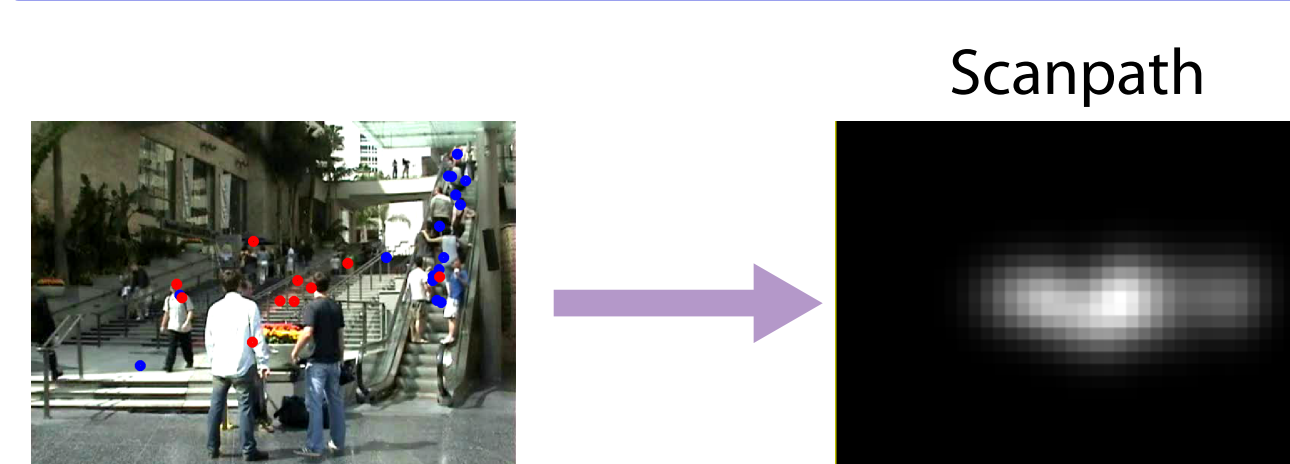
Compare the saliency value at saccade endpoint (red) to randomly sampled values (blue) from the saliency map



Quantify the correlation by ordinal dominance analysis



Overall Attention Allocation

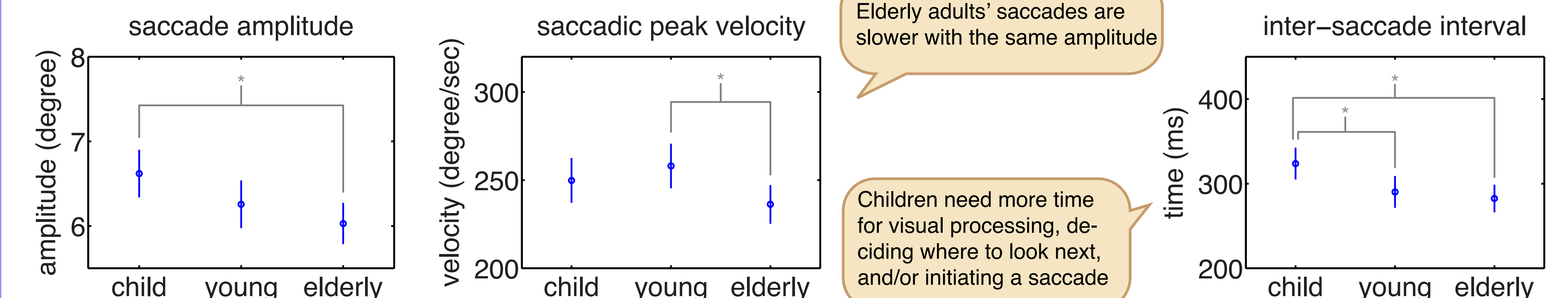


Oculomotor Functions

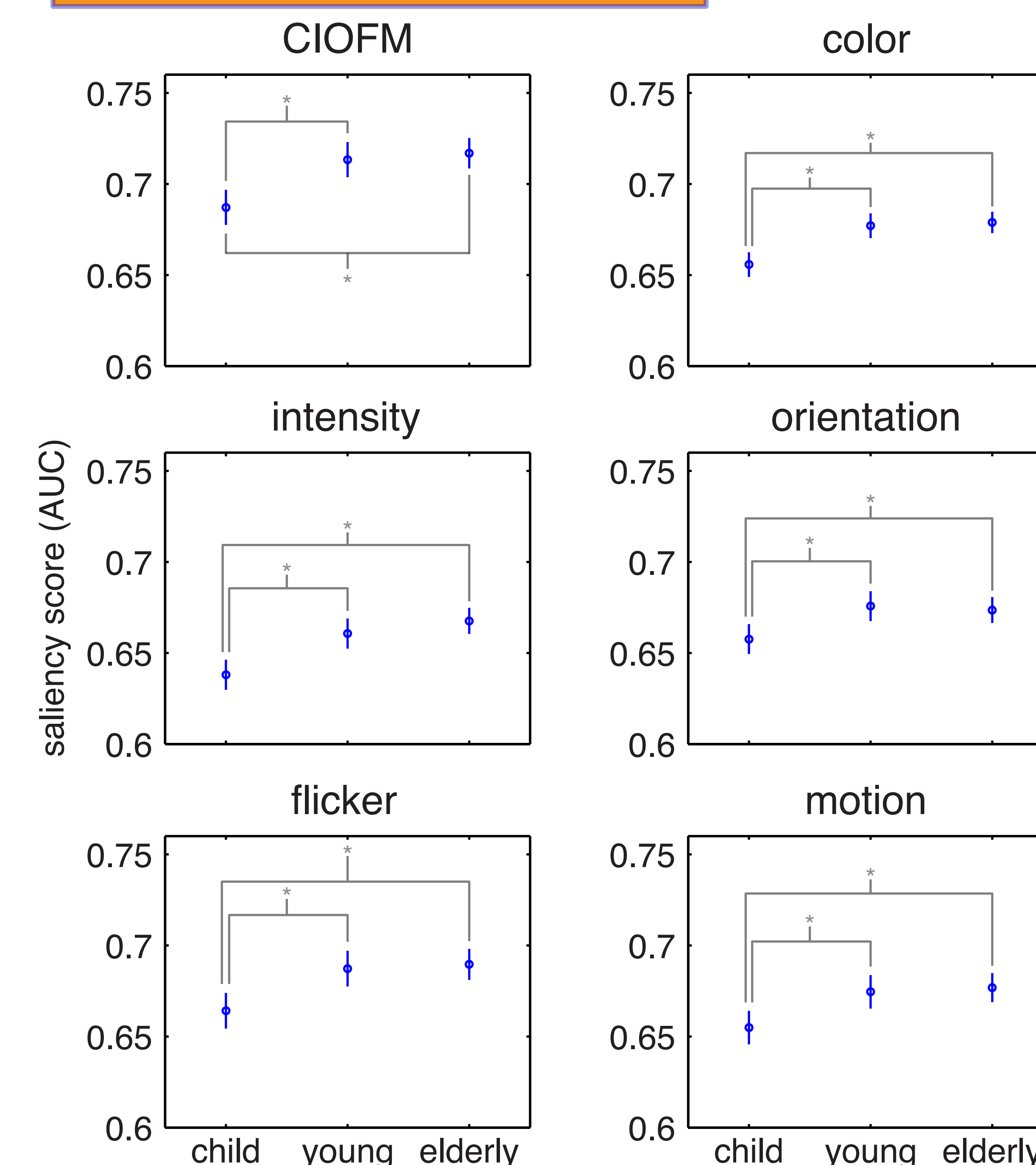
- saccade amplitude
- saccade peak velocity
- inter-saccade interval

Results

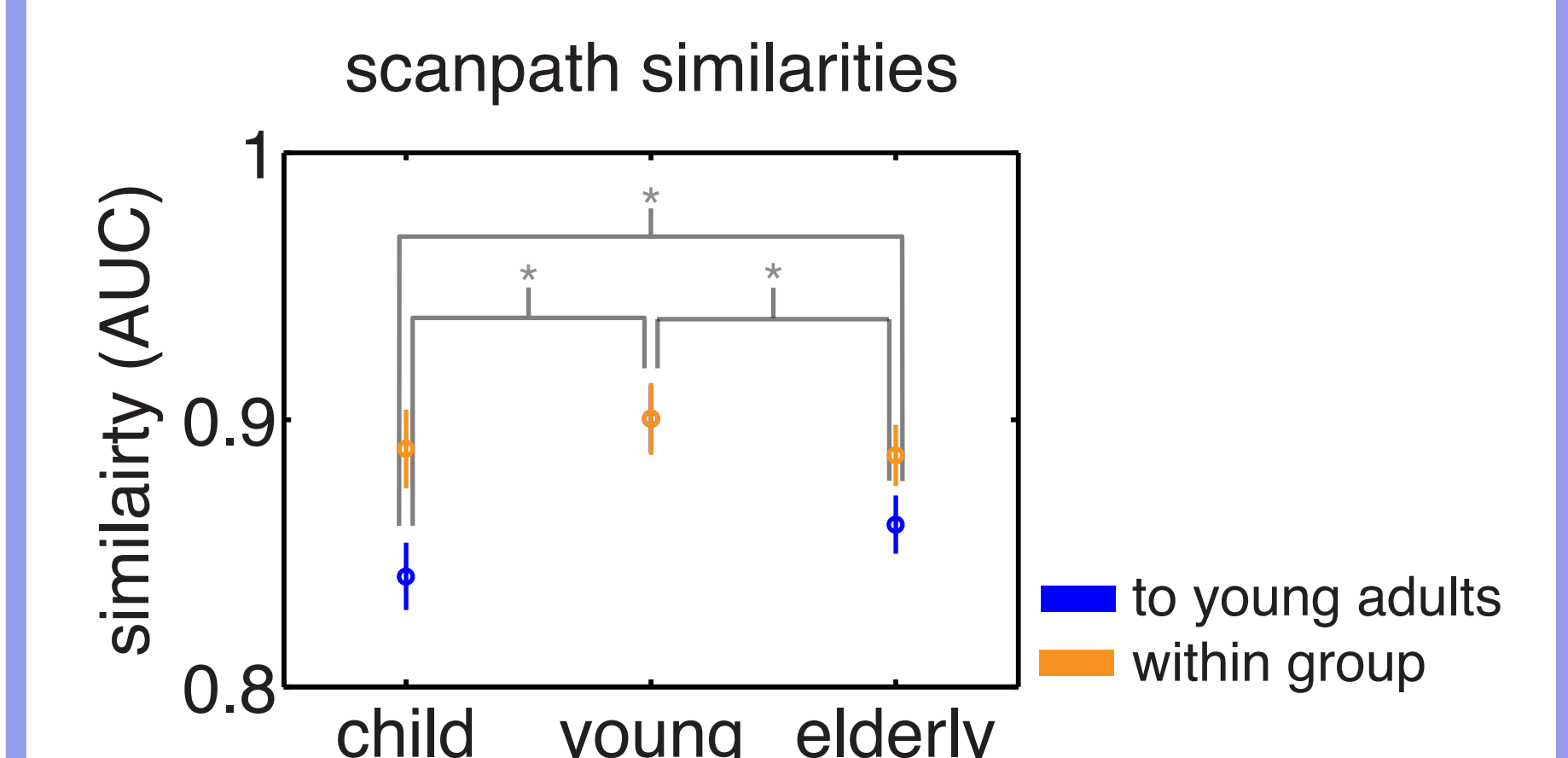
Oculomotor Functions



Bottom-up Process Estimation



Overall Attention Allocation



- Children allocate attention very differently from young adults, but similarly to other children
- Same for the elderly, but their scanpath is more similar to young adults as compared to children

- Children look at low saliency locations when there is no cognitive tasks. Why?
- Engaging stimuli with different ideas in mind
 - Still learning to extract visual information effectively
 - Contrast sensitivity hasn't fully developed yet
 - Etc.

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