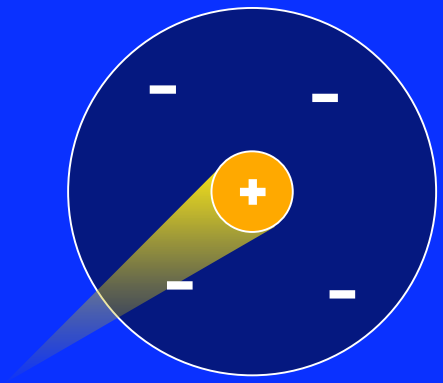
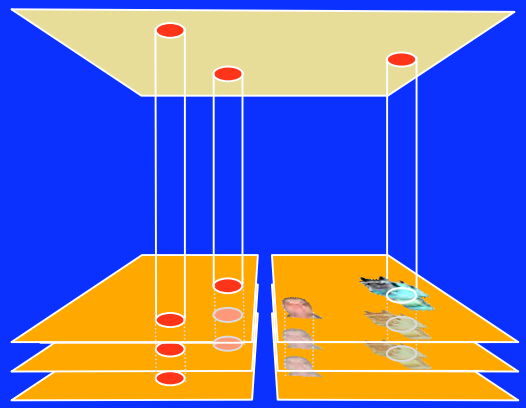
Laboratoire Psychologie de la Perception

Object-based integration and moving attention

Movies have been removed from these slides
Some of these available at
http://visionlab.harvard.edu/Members/Patrick/QTMovies/Demonstration_Movies.html

Patrick Cavanagh
Université Paris Descartes

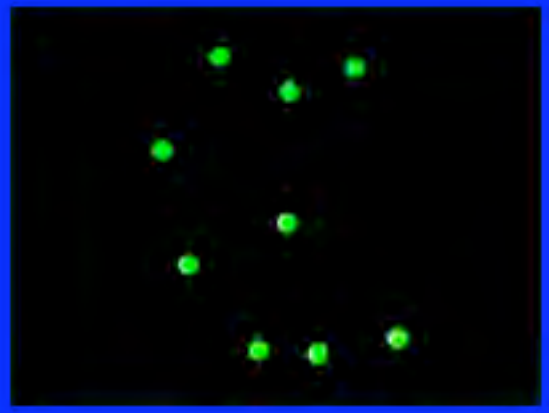




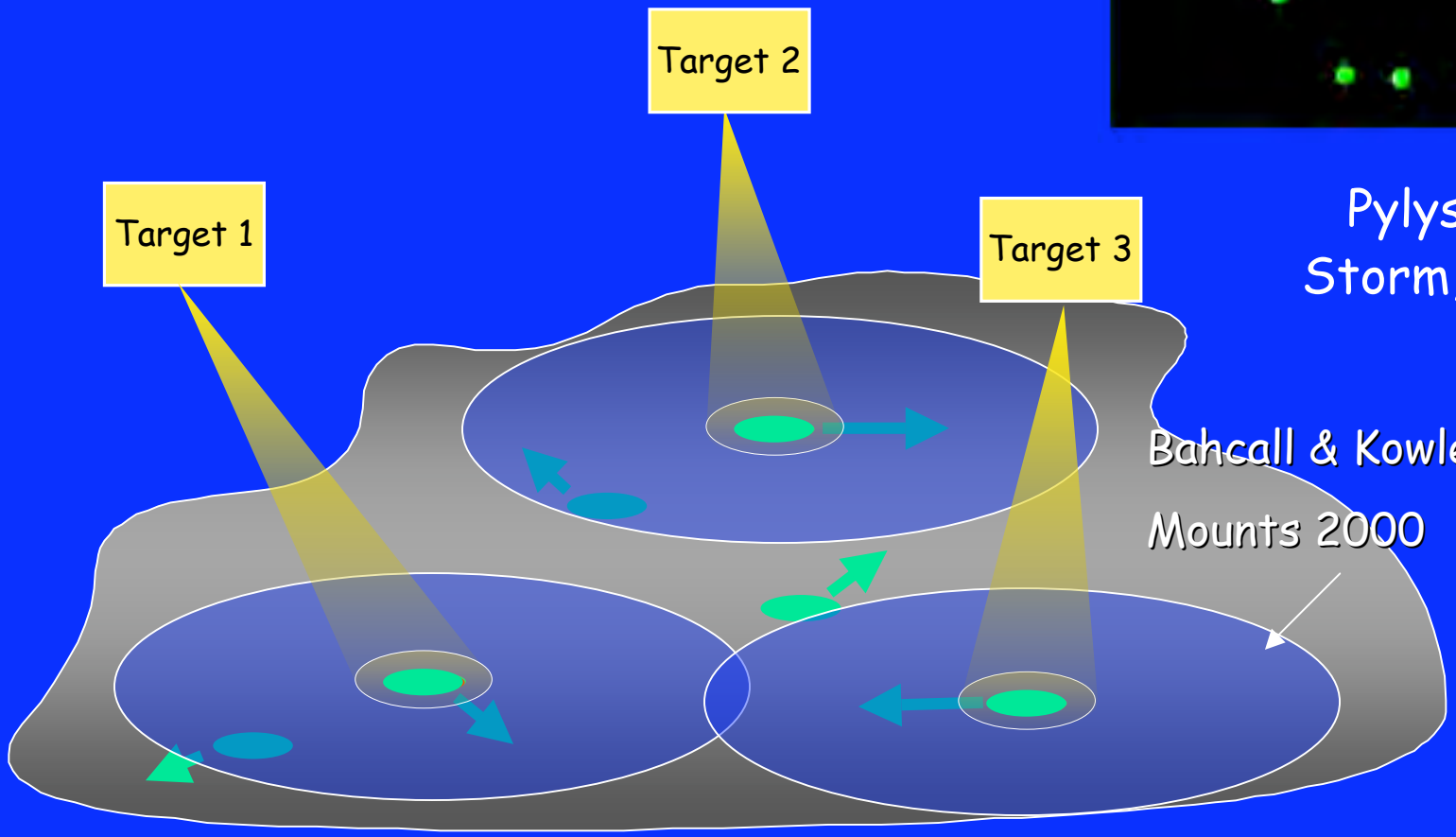
- Multifocal attention limited by target-target interference
- Attention and non-retinotopic integration
- Attention remapping and spatiotopic apparent motion

Multifocal Attention

Multiple object tracking:
subjects can follow 4 or 5 targets



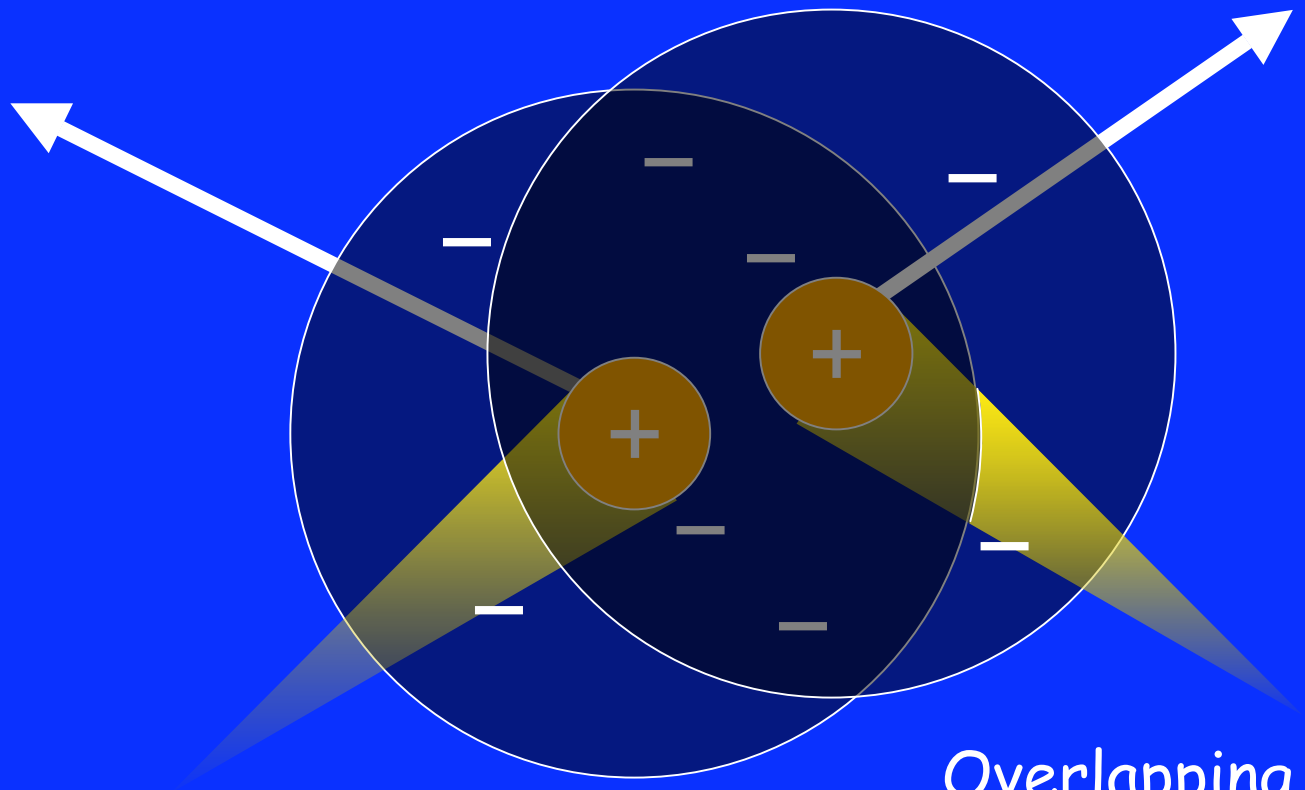
Pylyshyn &
Storm, 1988



Bahcall & Kowler, 1999;

Mounts 2000

Capacity limited by *inter*selection suppression

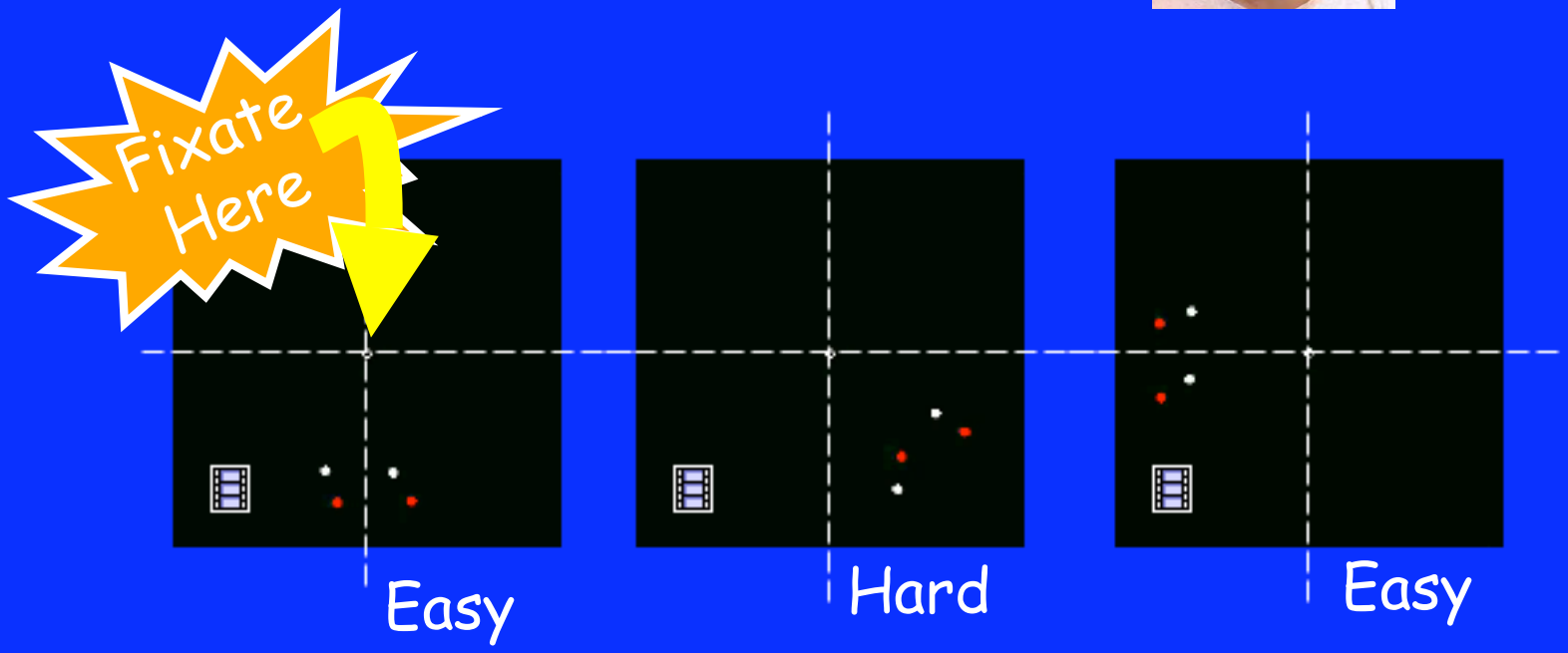


Selection zone (+) has large suppressive surround

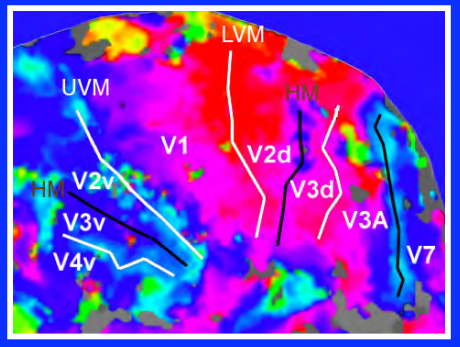
Overlapping surrounds degrade selection

Independent quadrant limits

Alvarez & Cavanagh, *PS* 2005



Carlson, Alvarez, Cavanagh, *PNAS* 2007



Press et al, 2001

Attention: suppressive surround limits

Where

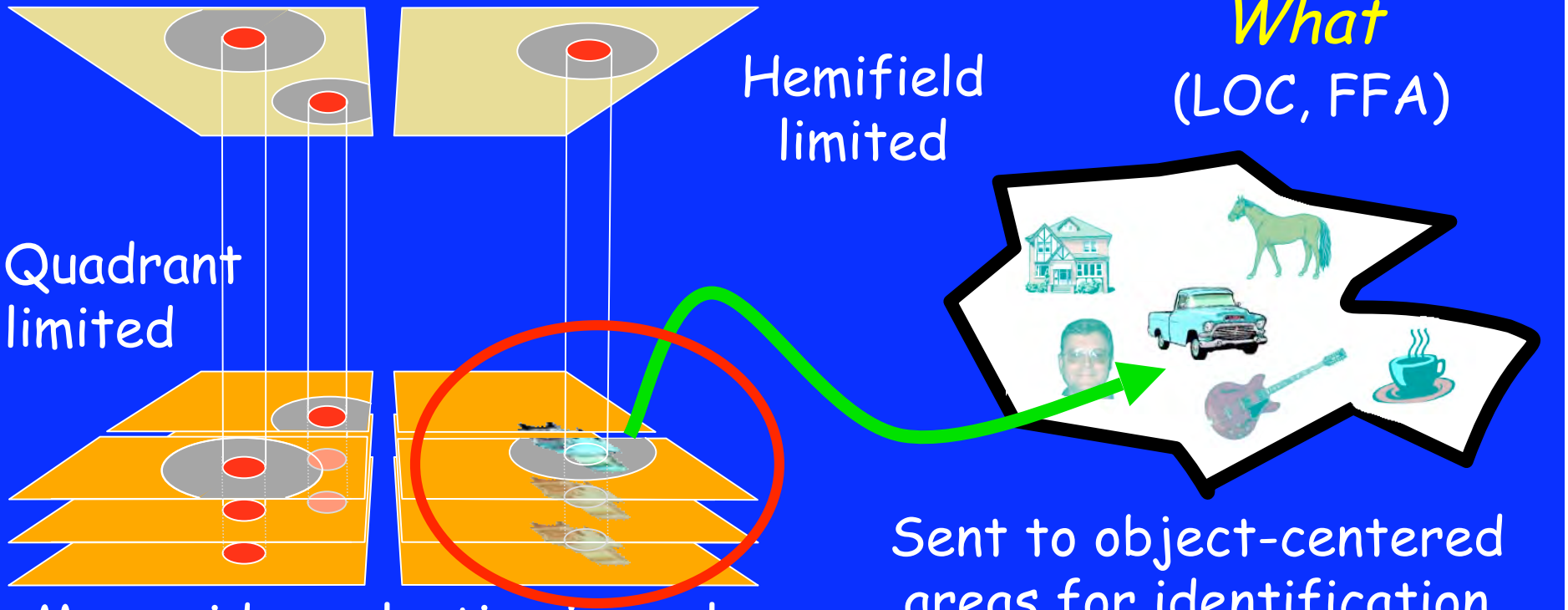
Target Map (LIP, FEF, SC)

Quadrant limited

Hemifield limited

What

(LOC, FFA)



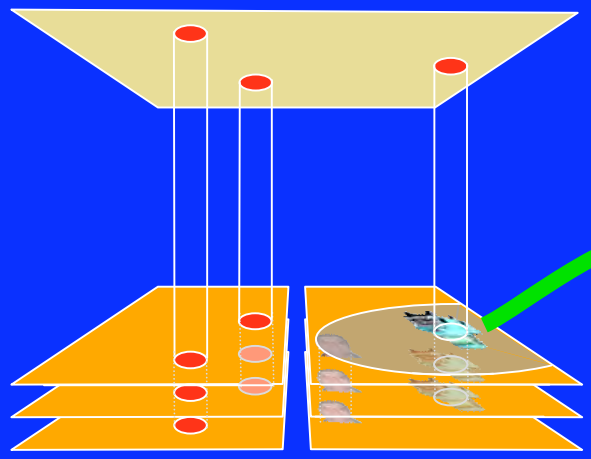
Map guides selection in early retinotopic areas (V1-V4, MT)

Sent to object-centered areas for identification

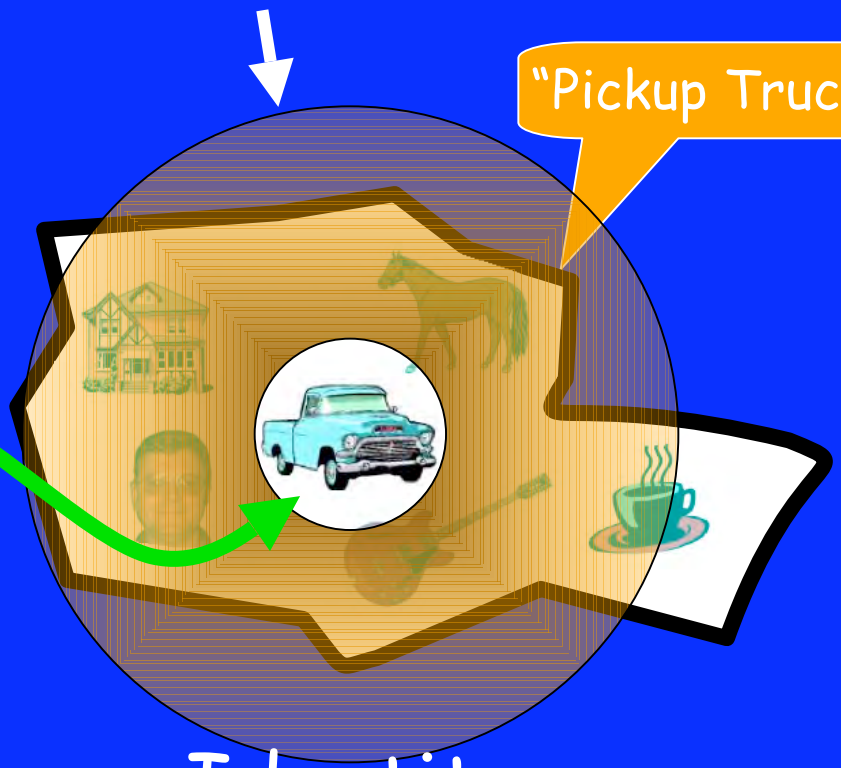
Target Identification

Limited to target input by suppressive surround

Location



Data

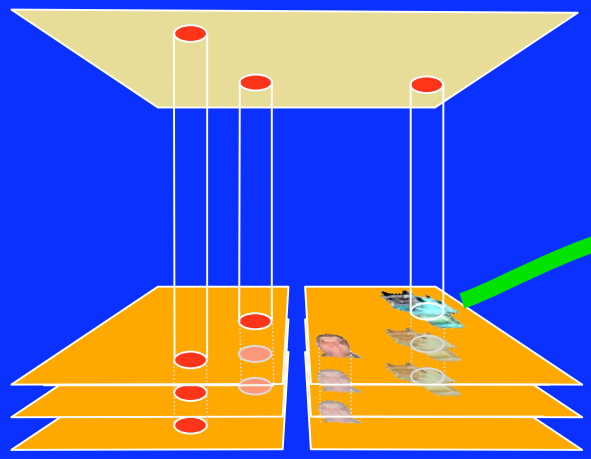


Identity

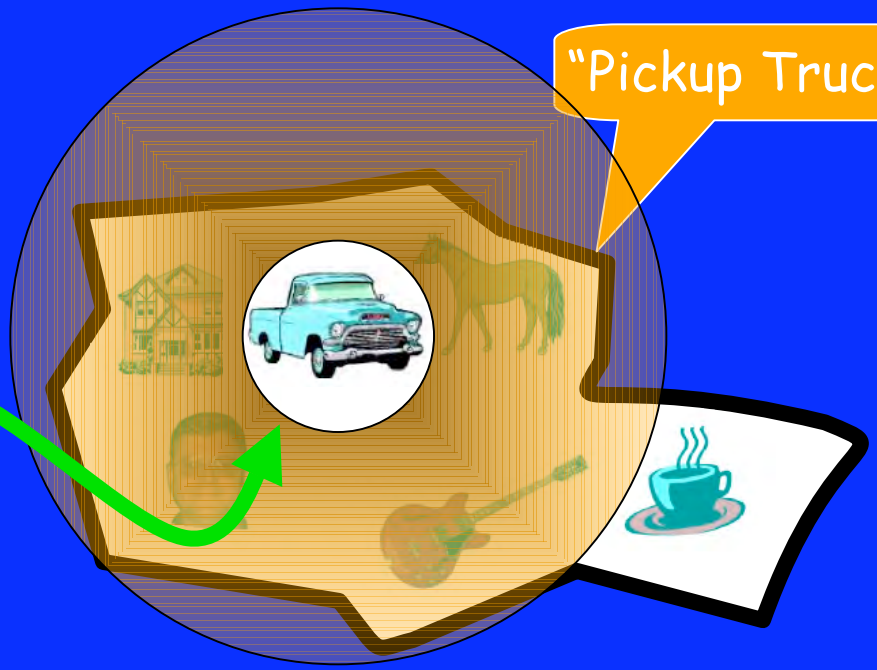
Large receptive fields in object identification areas

Object continuity when object moves

Location



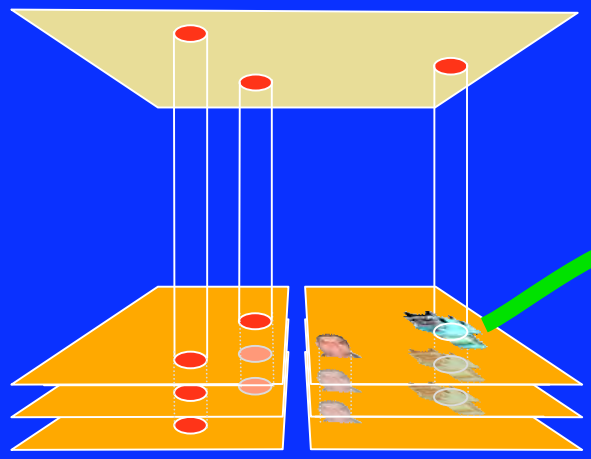
Data



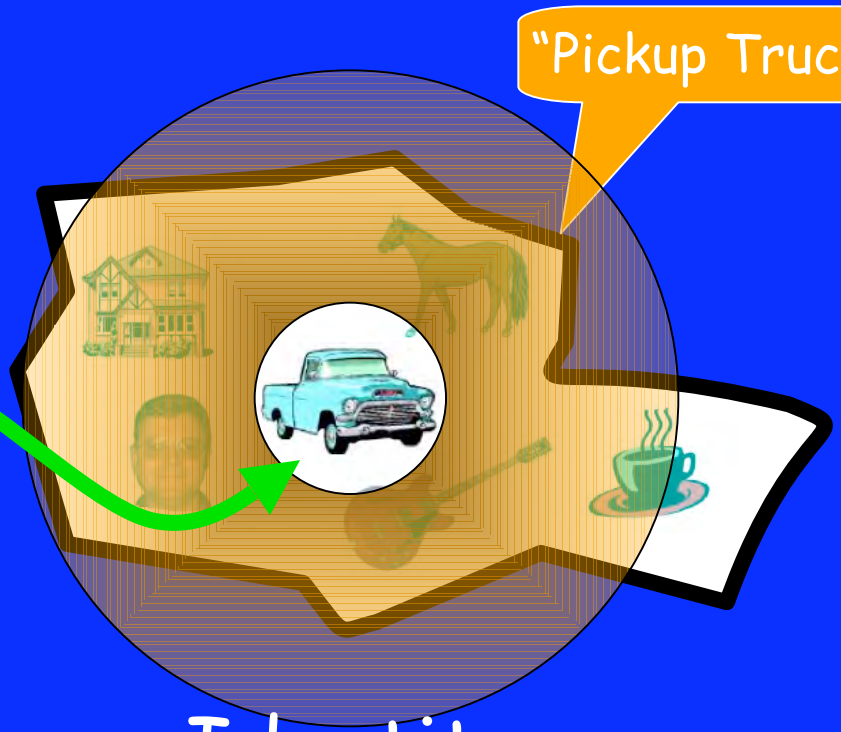
Identity

Object continuity when object moves

Location

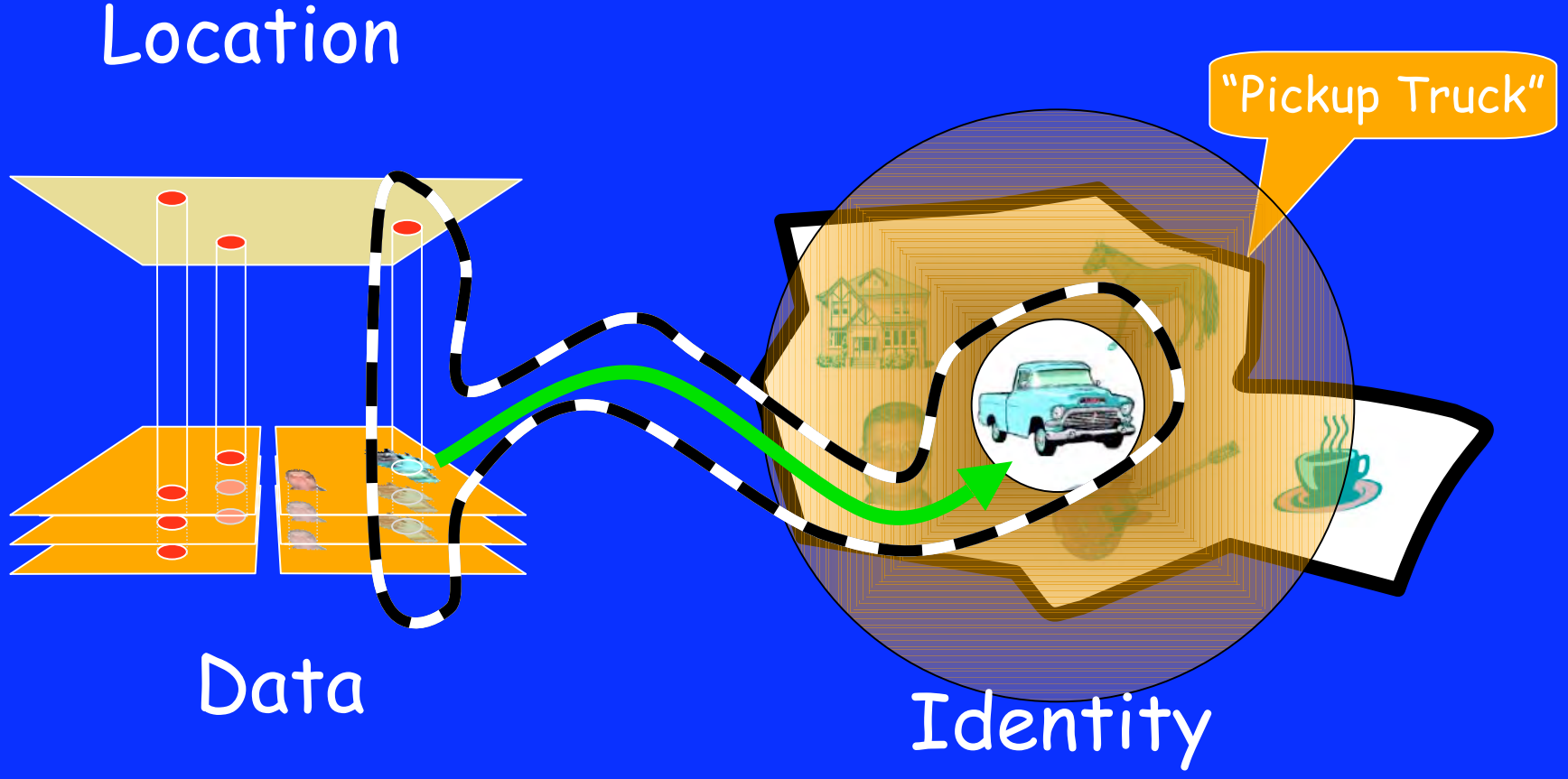


Data



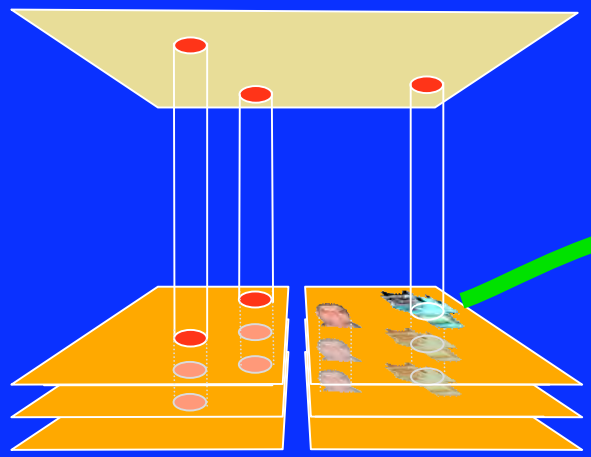
Identity

Object continuity when object moves

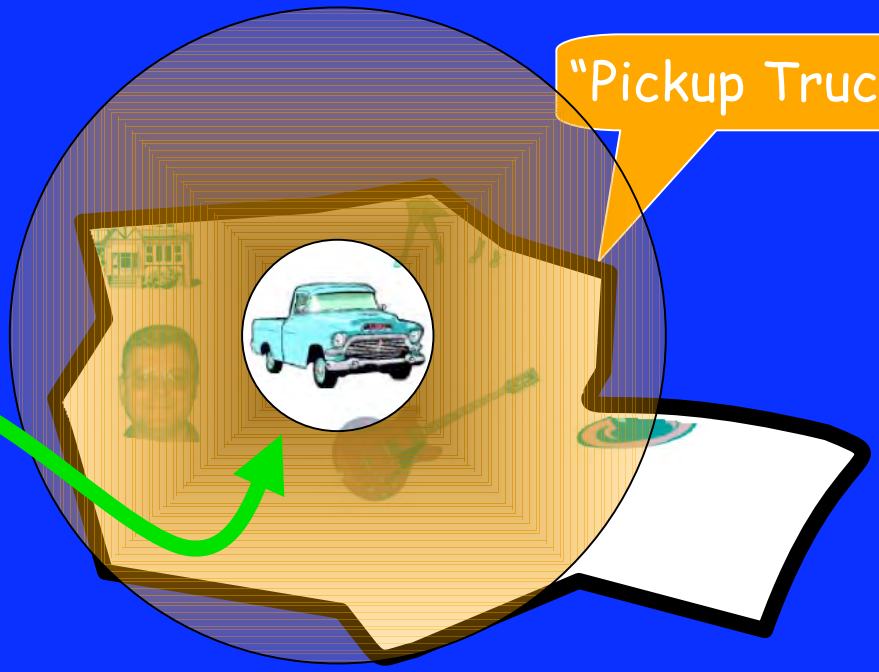


Object continuity when eyes move

Location



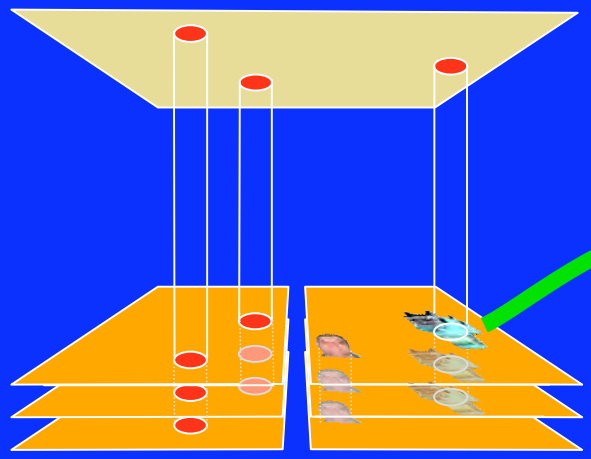
Data



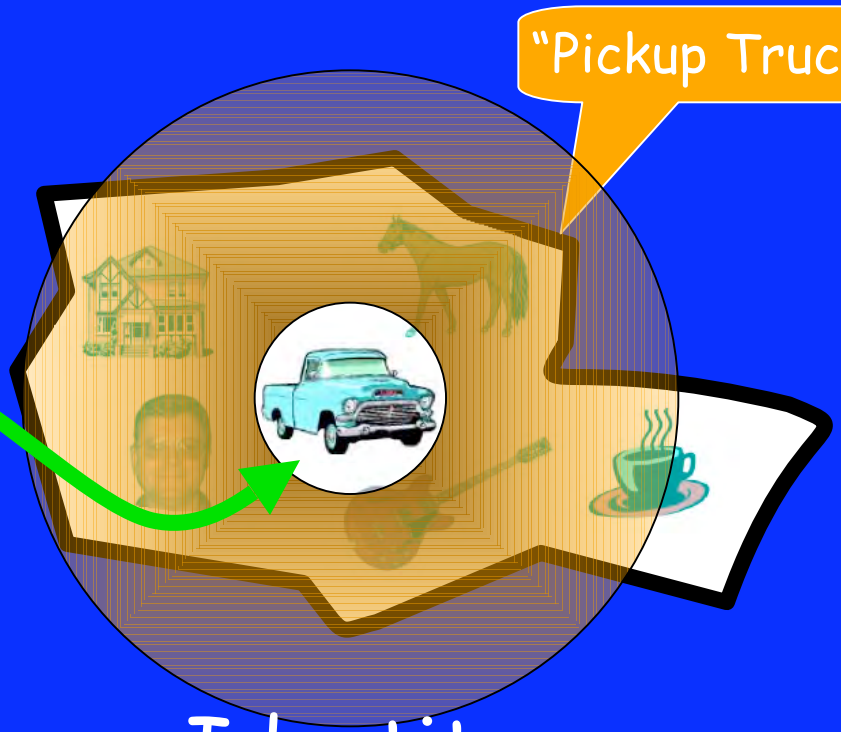
Identity

Object continuity when eyes move

Location

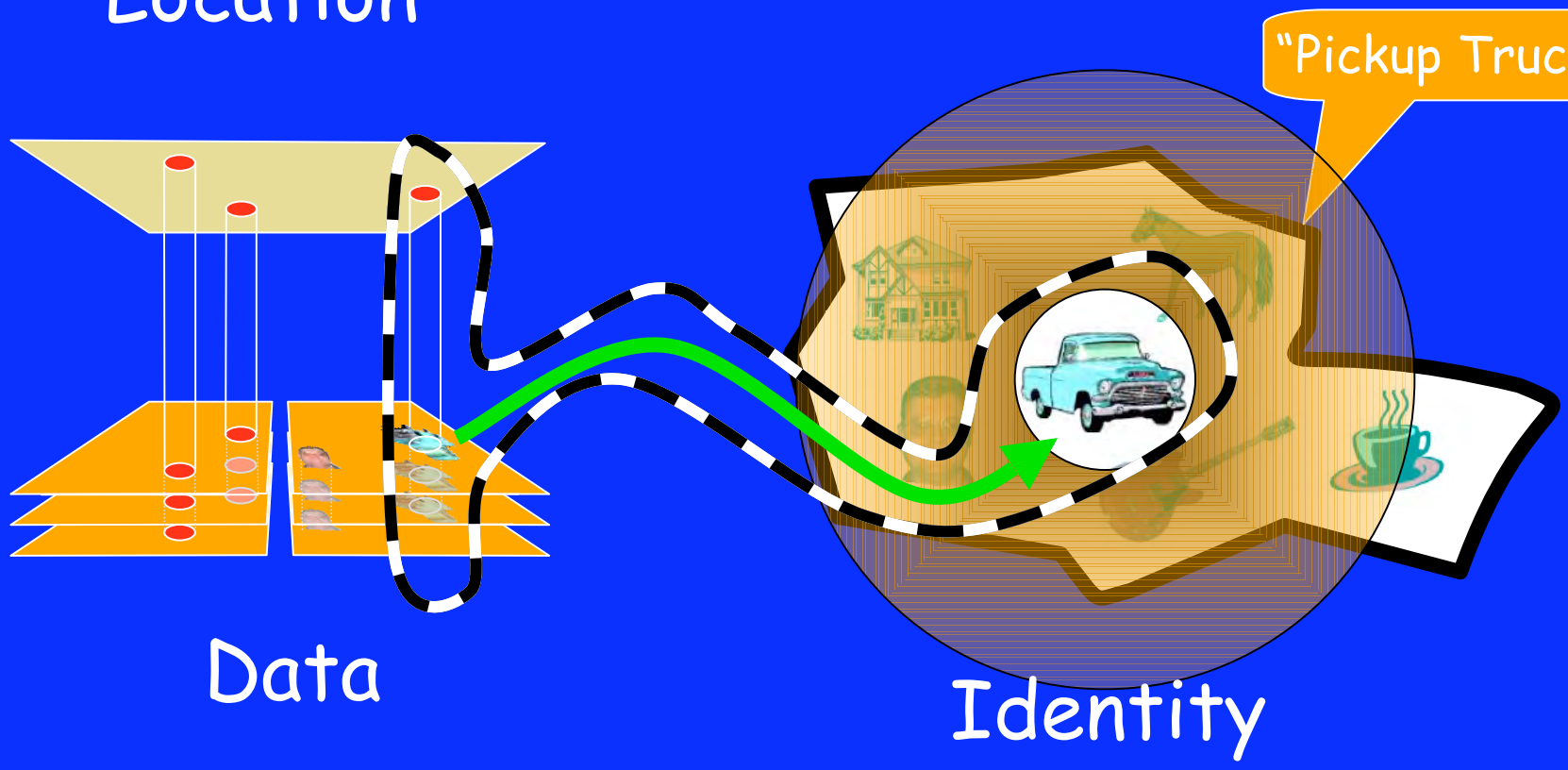


Data

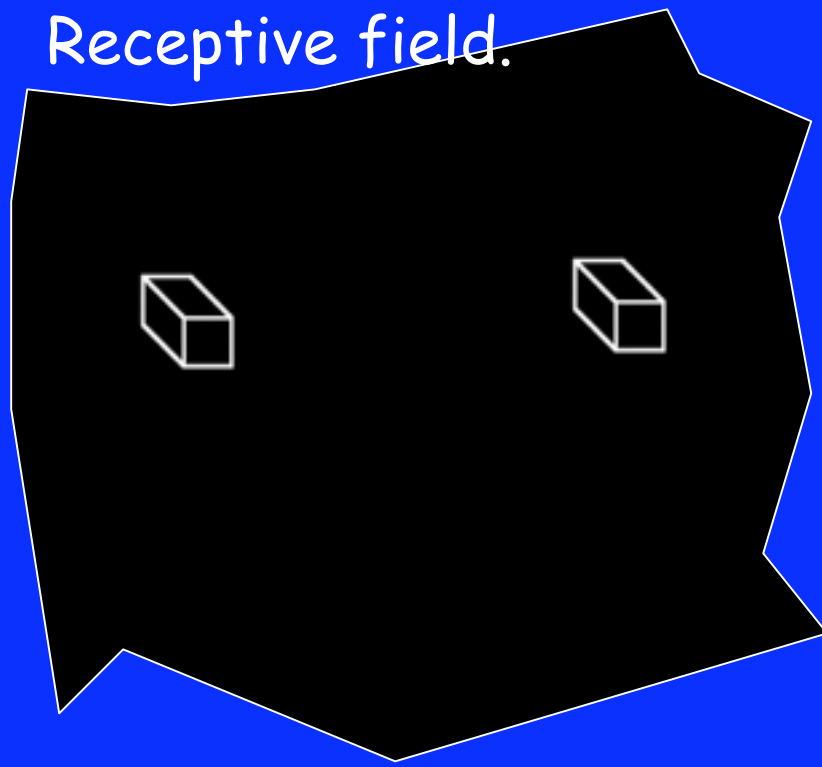


Identity

Object continuity when eyes move



Isolating nonretinotopic integration with eye movements

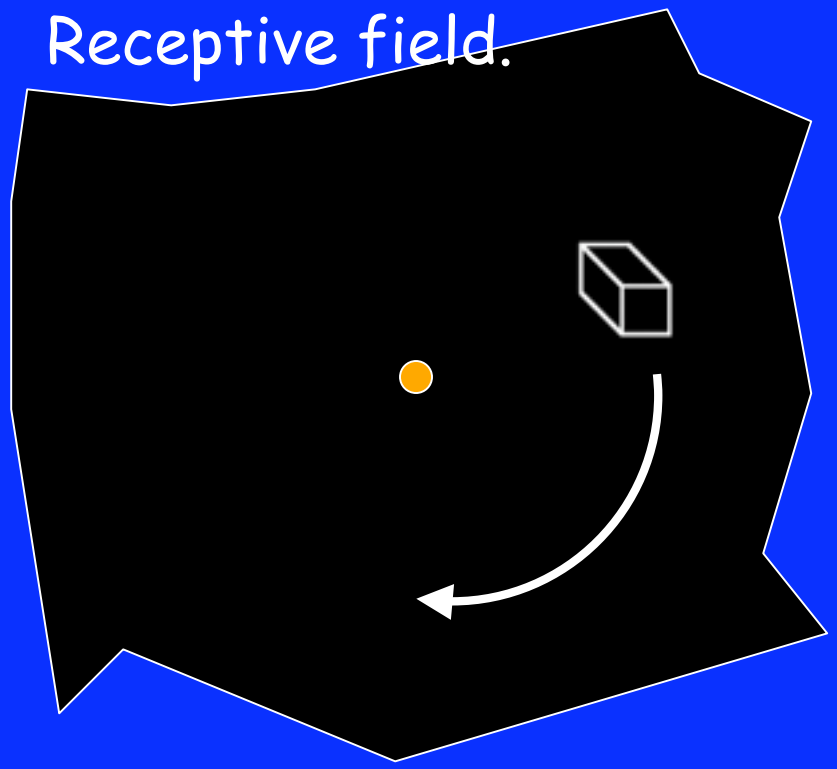


Spatiotopic integration poor

Reported for motion (Melcher & Morrone, 2003)

Not found for shape (O'Regan & Levy-Schoen, 1983)

Isolating nonretinotopic processes with moving targets

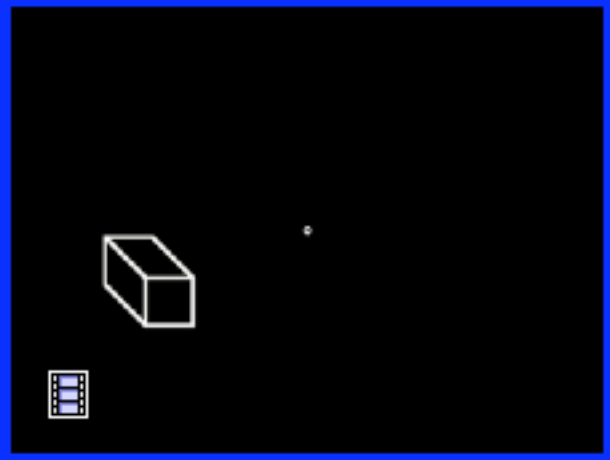


Object speed too fast to complete local analysis at each location

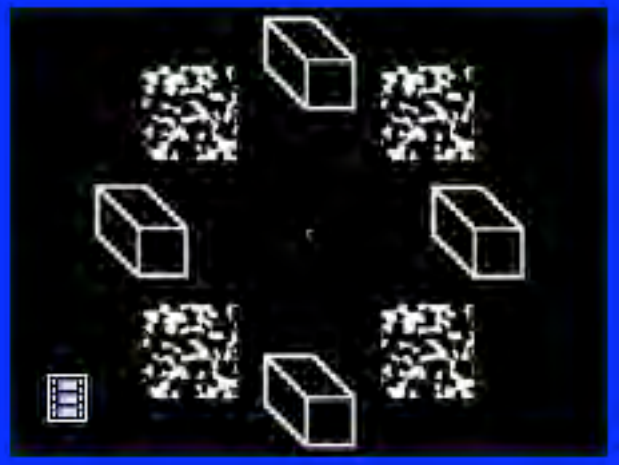
Requires cumulative, non-retinotopic analysis

Alex Holcombe

Testing Moving Selection

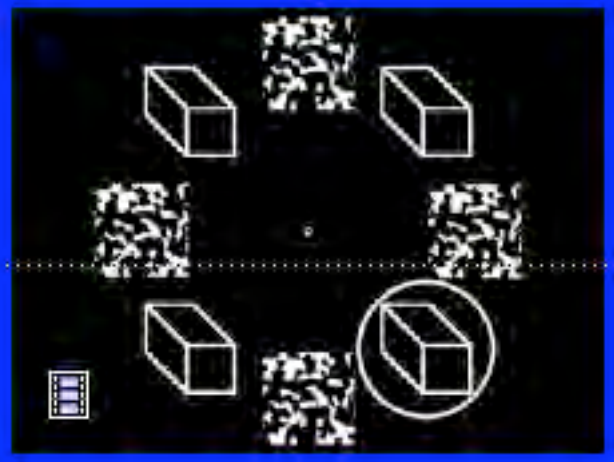


Smooth motion:
How to determine local processing?



Use apparent motion

Mask each location



Provide a guide

What does integrate? Color and Motion

Colors and motion reverse together

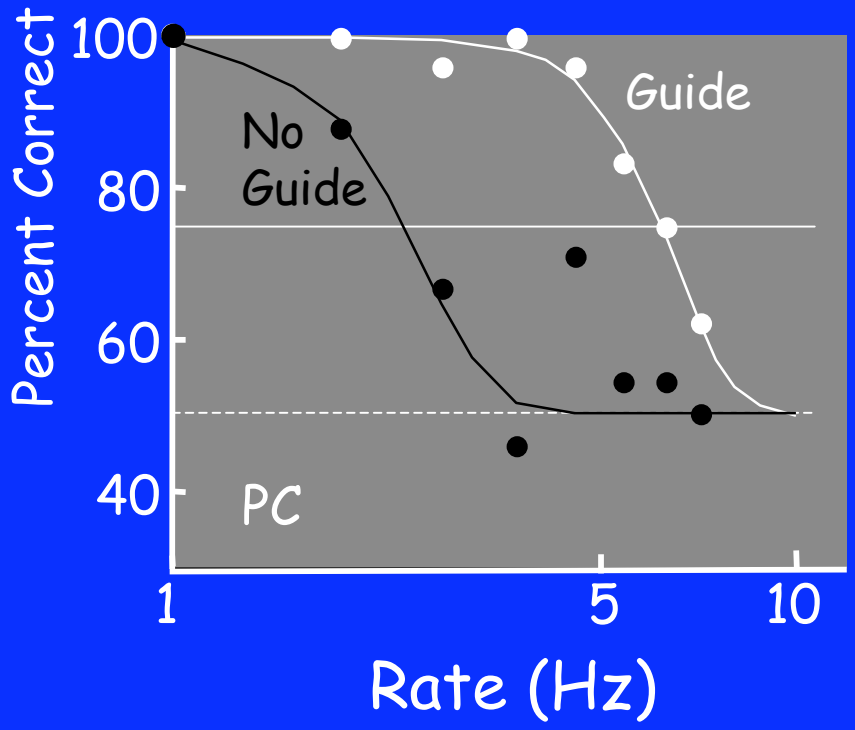
Attend to fixed location

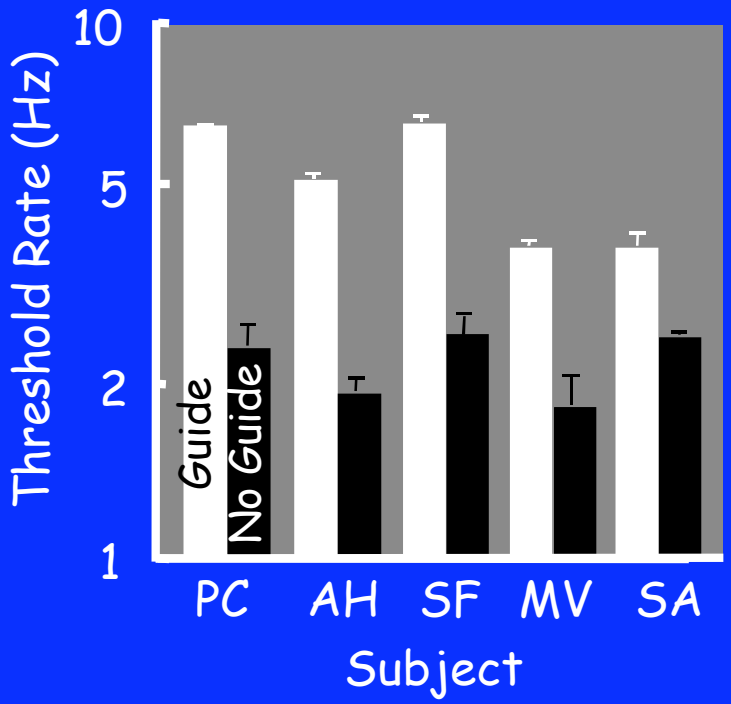
Color and Motion

Colors and motion reverse together

Attend to moving guide

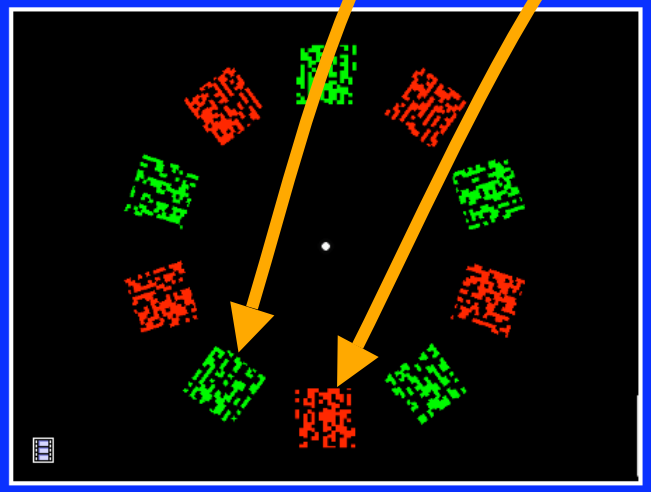
Color and Motion

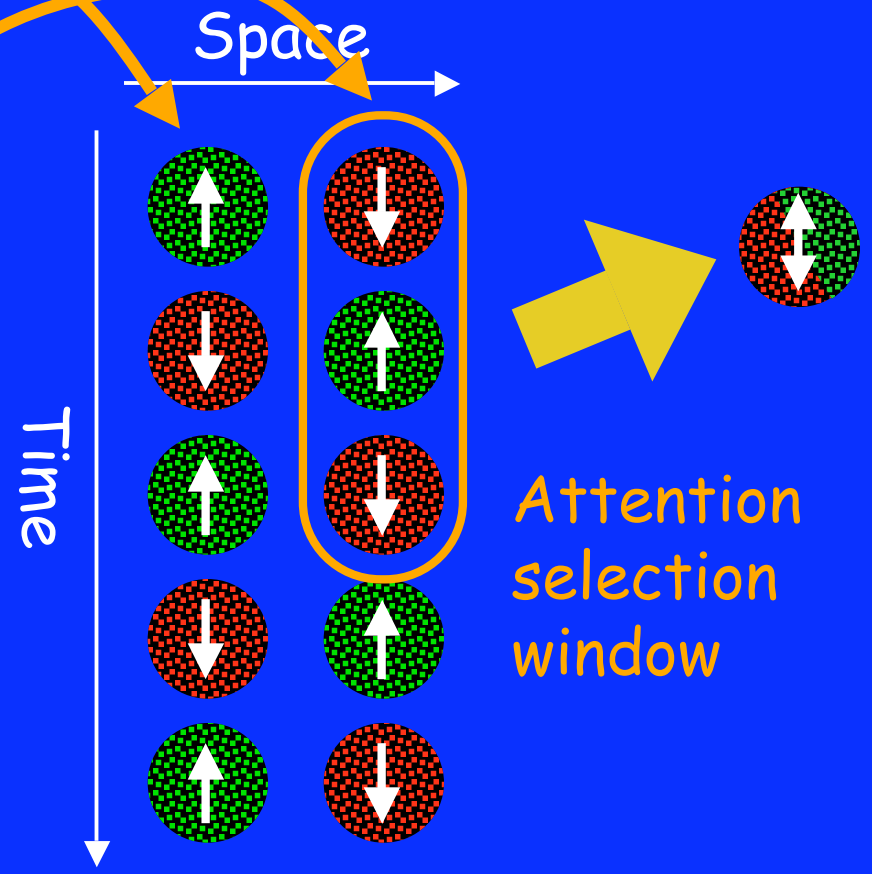




Moving attention helps -- up to 300% improvement

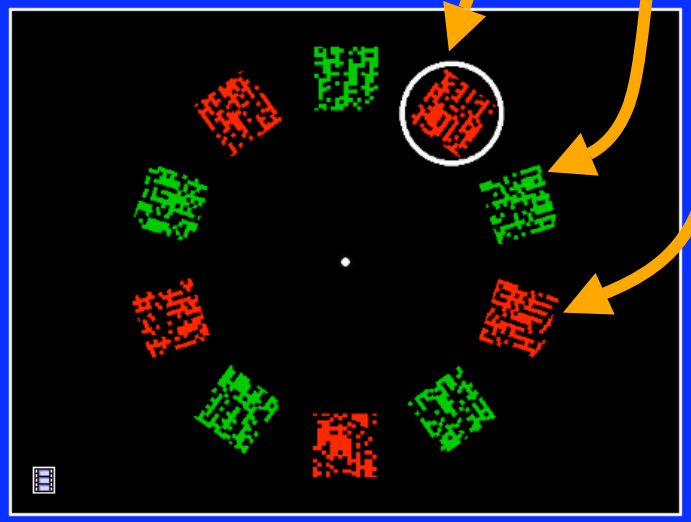
Attention to fixed location

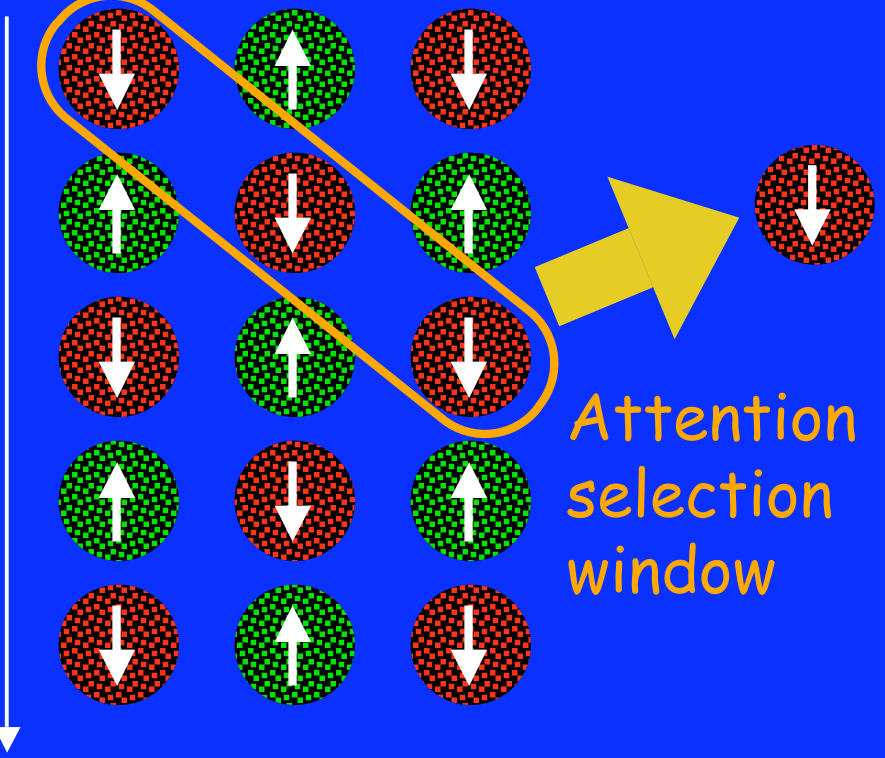




Attention's window cannot open and close fast enough to individuate one color / motion

Attention in moving guide

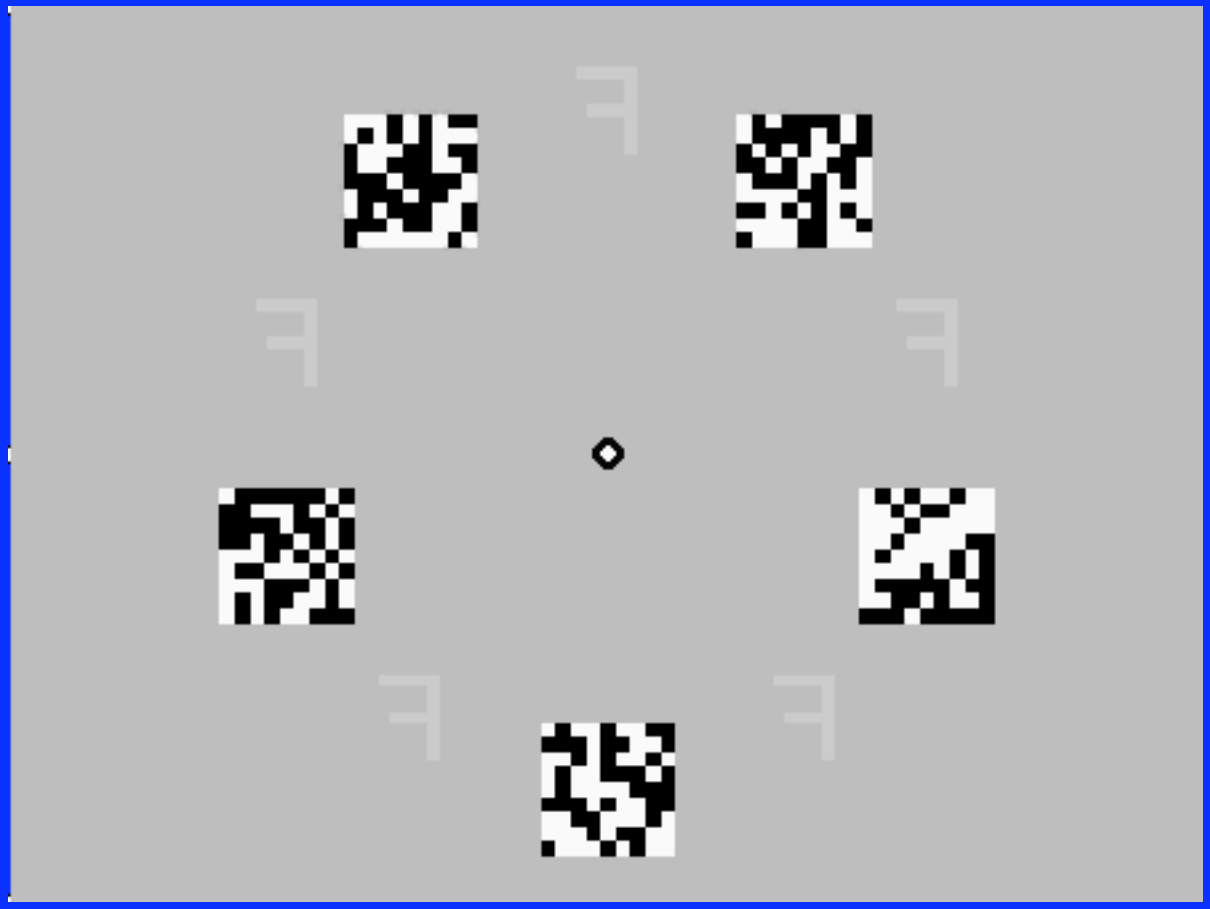




Integrating from different locations.
Attention window open only briefly at each location

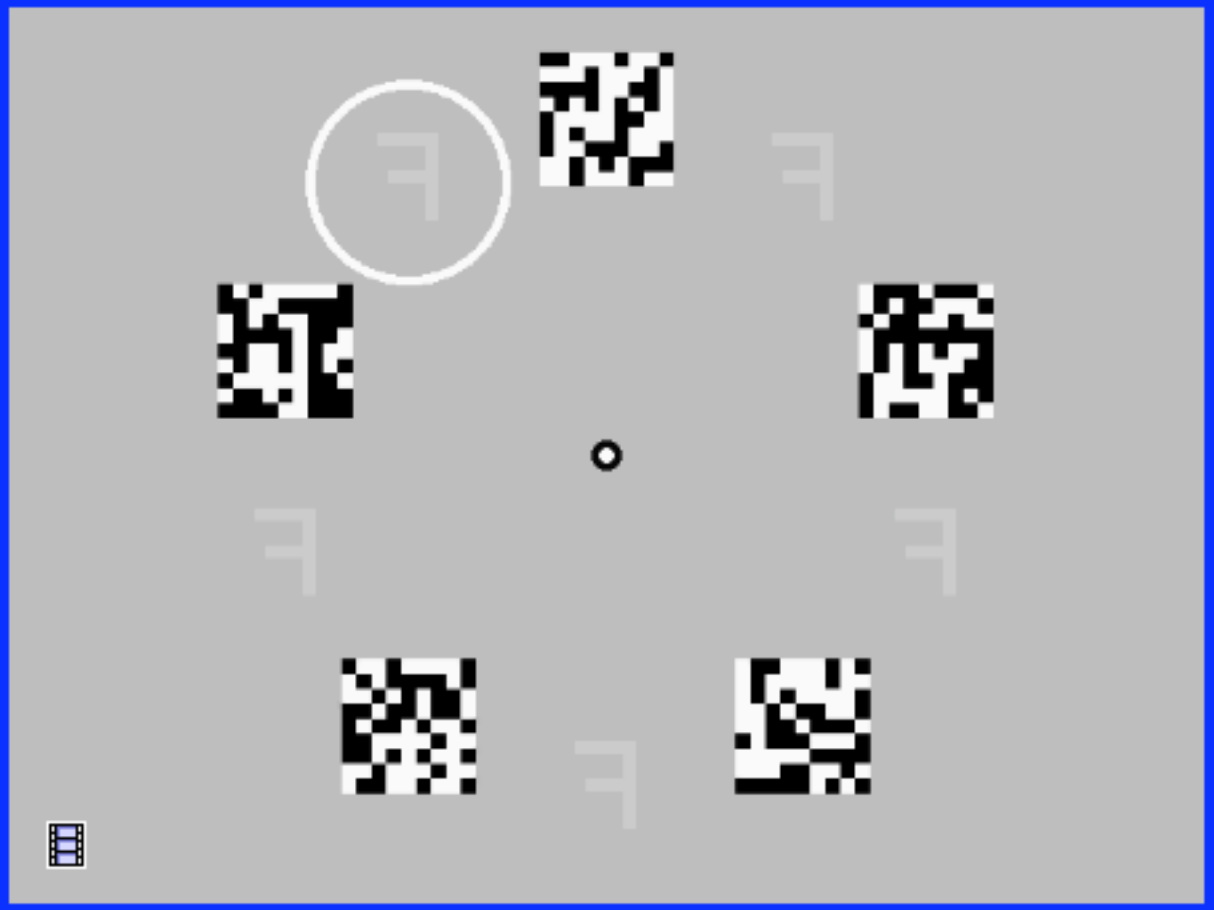
Nonretinotopic integration for shape?

At fixed location, target alternates with mask



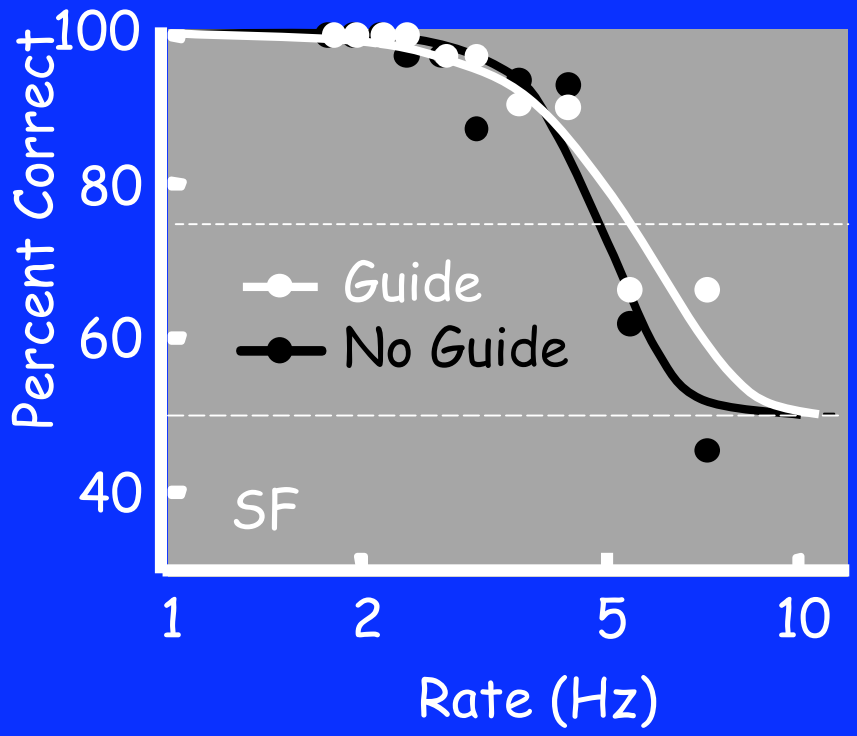
Nonretinotopic integration for shape?

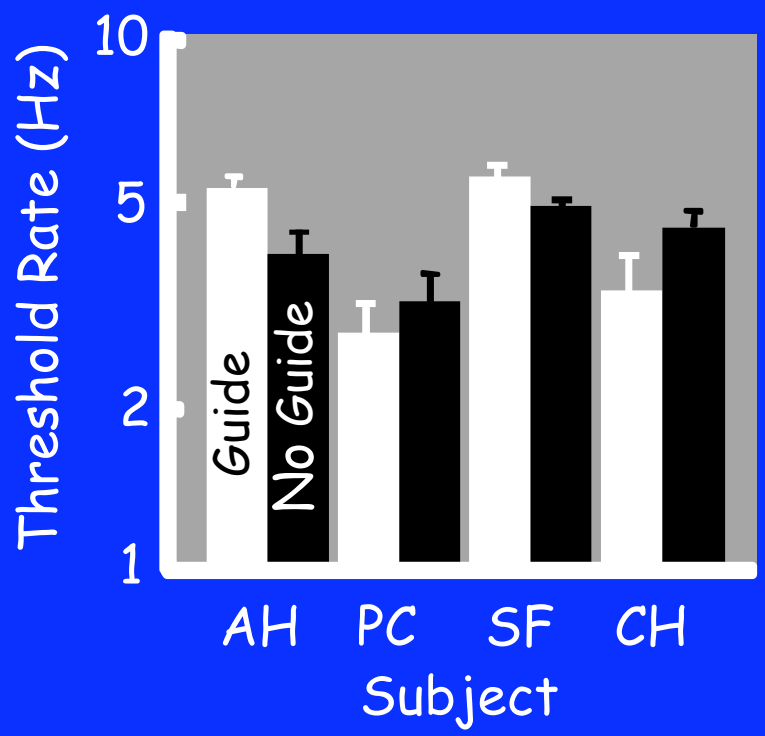
At fixed location, target alternates with mask



In moving window, target is not masked

No shape integration across locations





Masking is retinotopic, cannot avoid it by attending only to target.

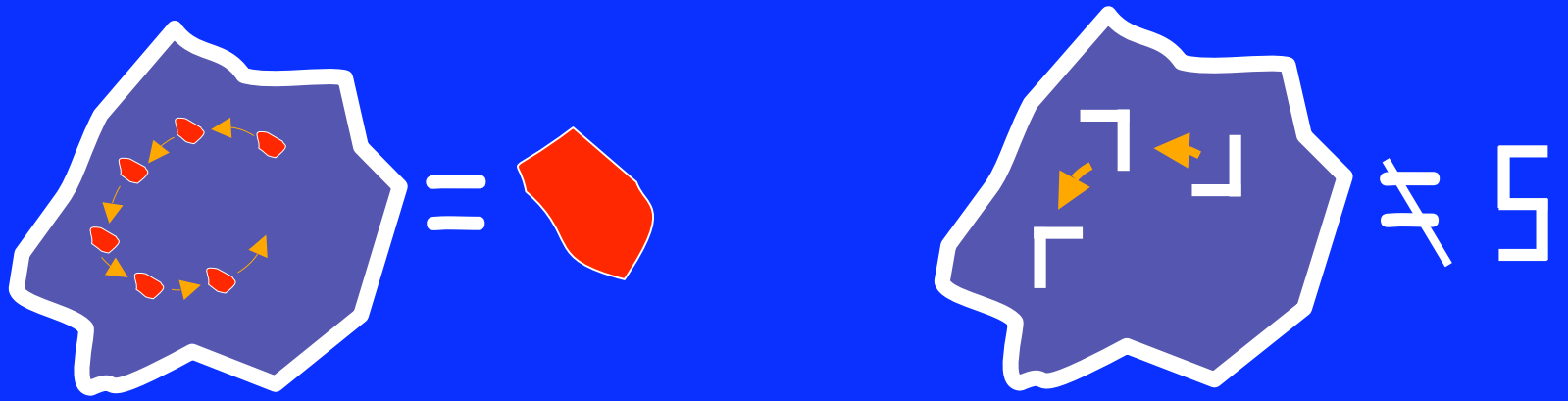
And no subthreshold shape integration across location

Isolating nonretinotopic processes with moving targets

Accumulation across locations (nonretinotopic integration) for colors and motion but not shape

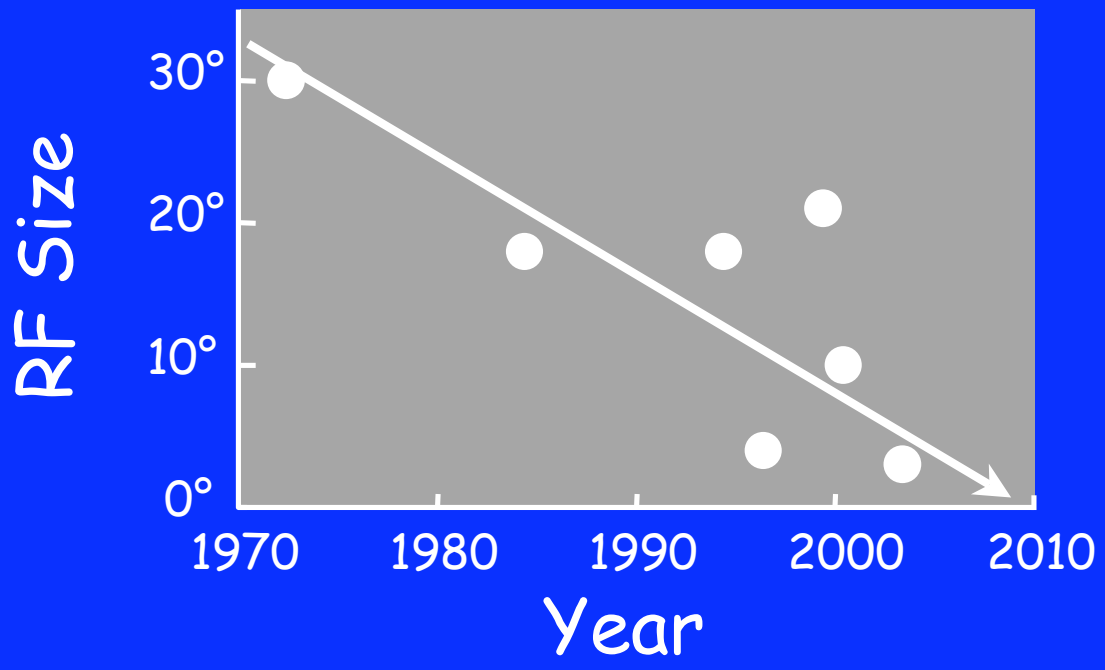
Could be --> Dumb integration (summing everything within large receptive fields)

Combined with smart tracking (passing only target information, suppressing distractors)



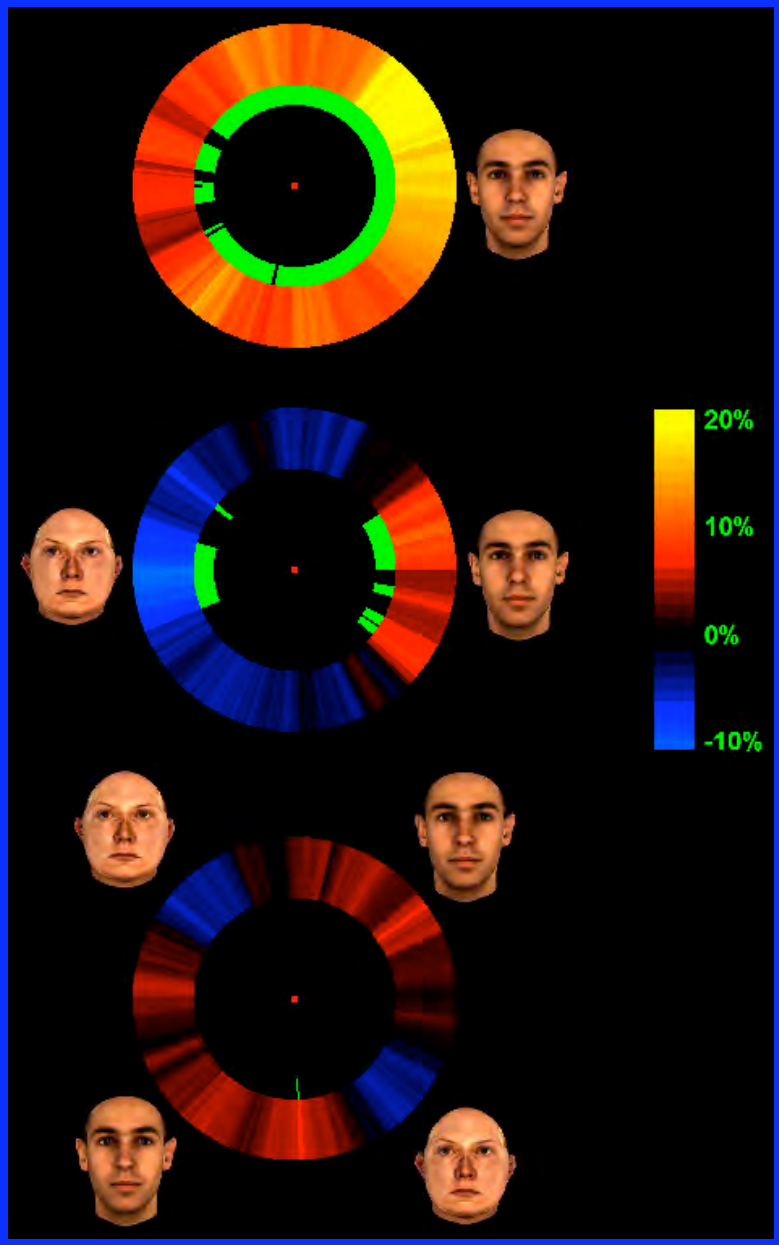
How big are those big receptive fields?

IT cells, Gross et al 1972 to Di Carlo & Maunsell, 2003
Courtesy, Arash Afraz

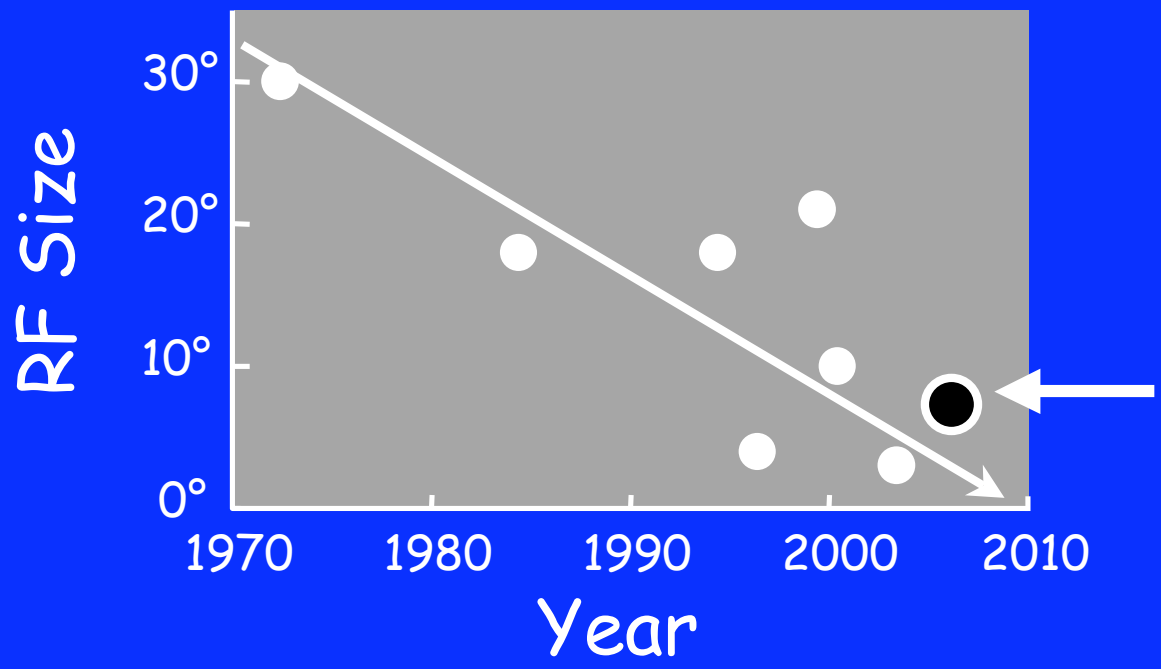


Arash Afraz

Retinotopy of the Face Aftereffect. Afraz & Cavanagh, 2008



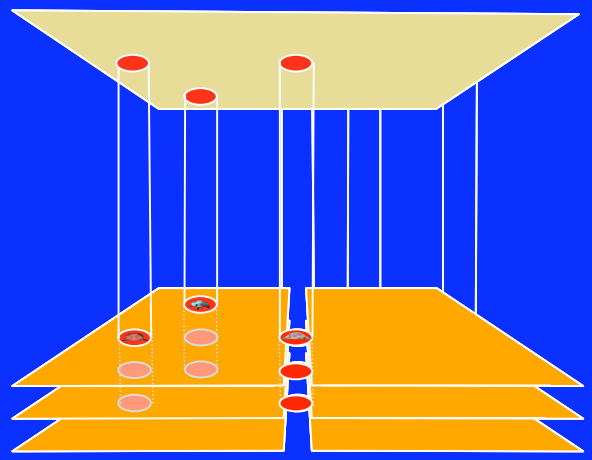
How big are those big receptive fields?



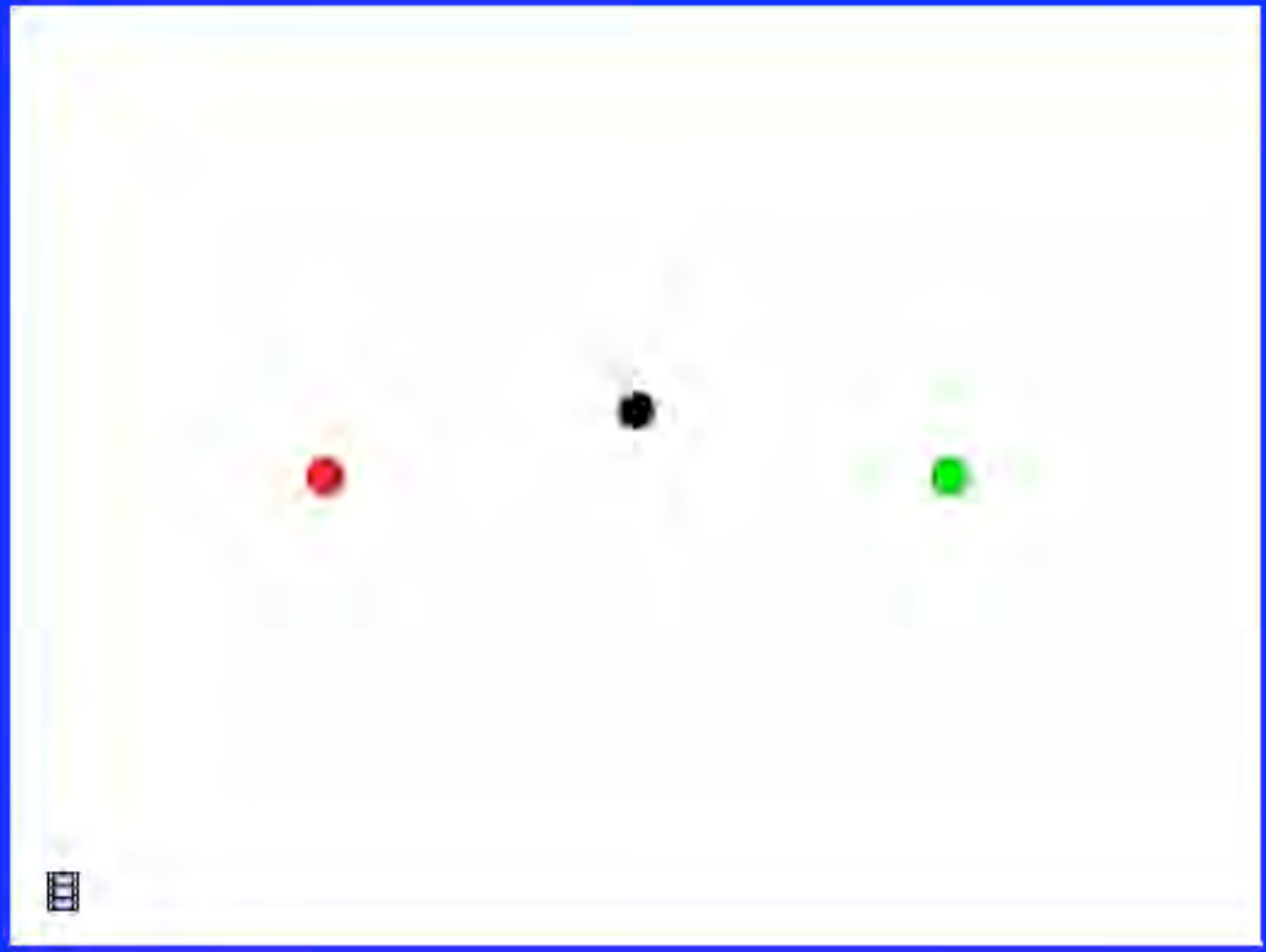
6°
Spatial extent of Face Aftereffect at 3° eccentricity,

Afraz & Cavanagh, 2008

Attention remapping



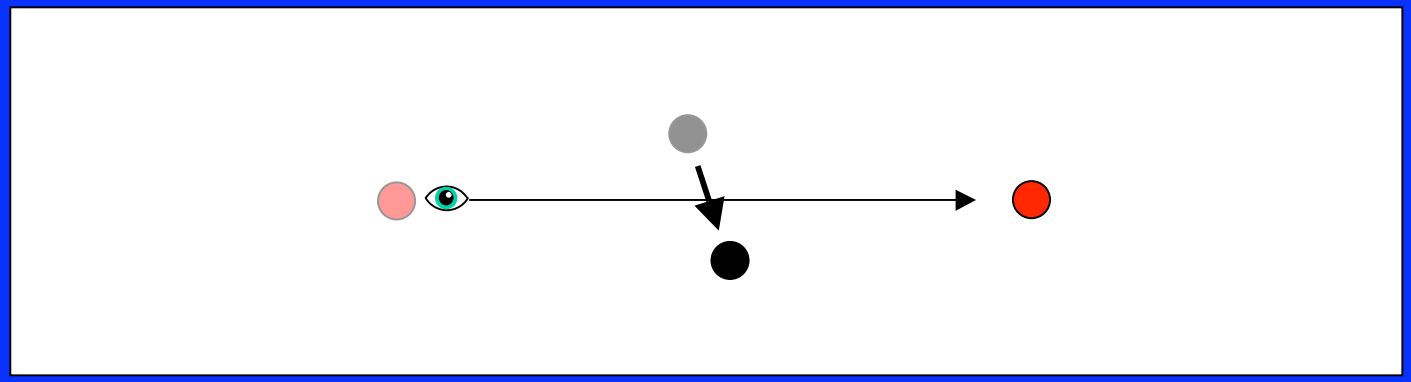
- Attention pointers to targets remapped to post-saccade target locations
- Apparent motion shows accuracy of remapping



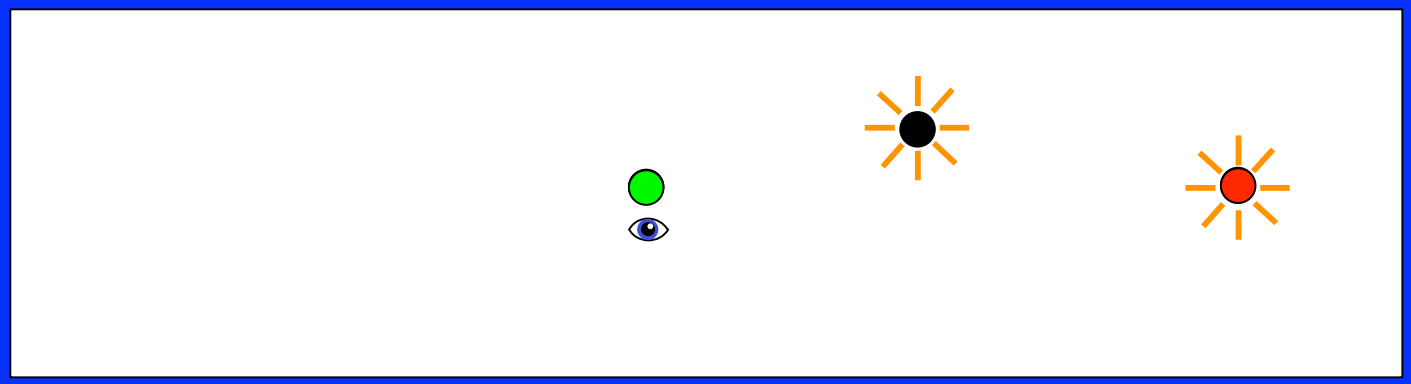
Spatiotopic apparent motion movie

Follow red dot with eye, report motion of black dots

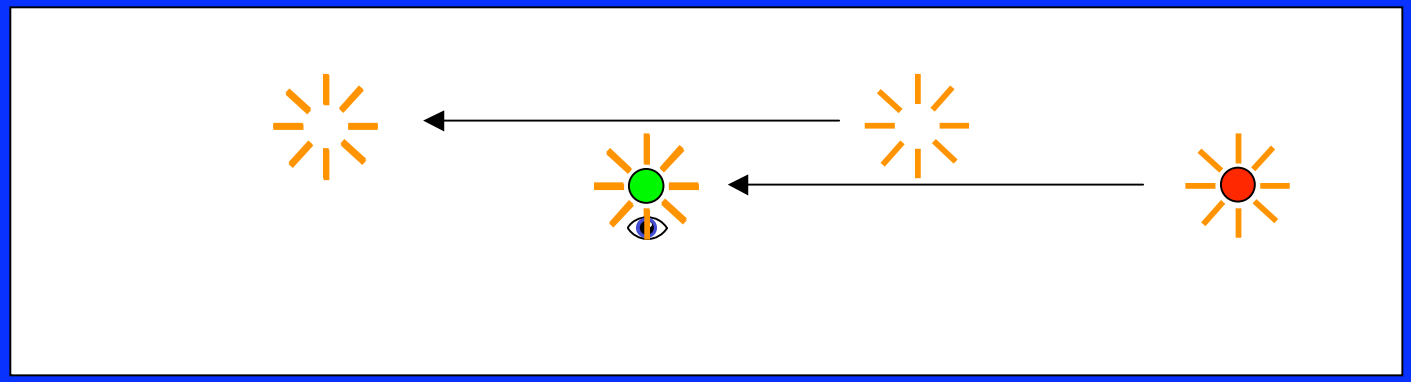
1. Motion
2. Tilted

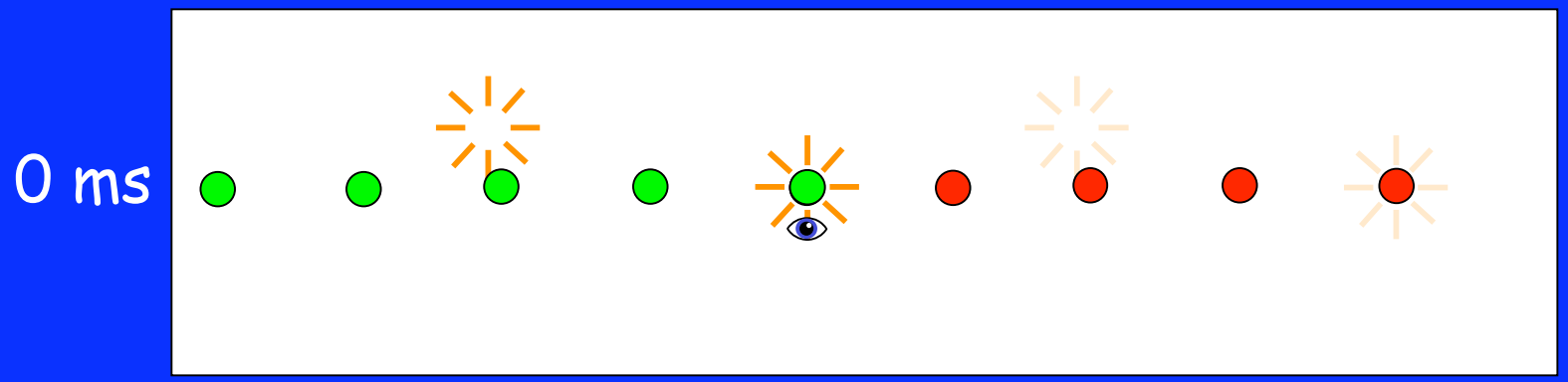


-100 ms

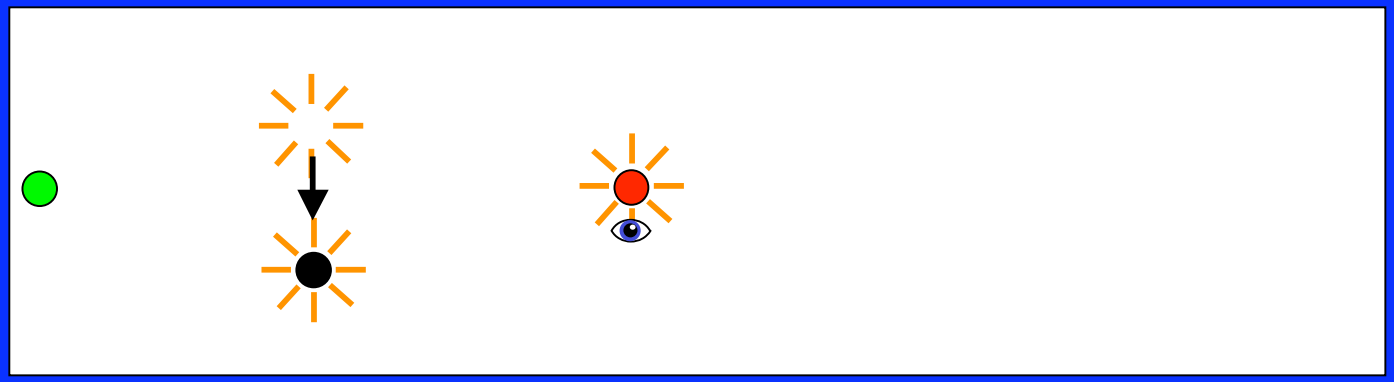


-50 ms

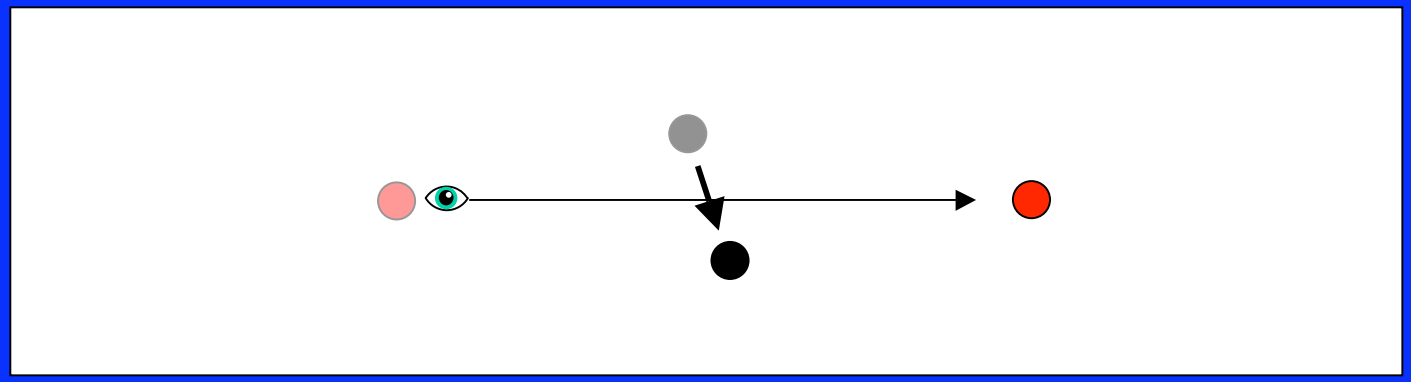


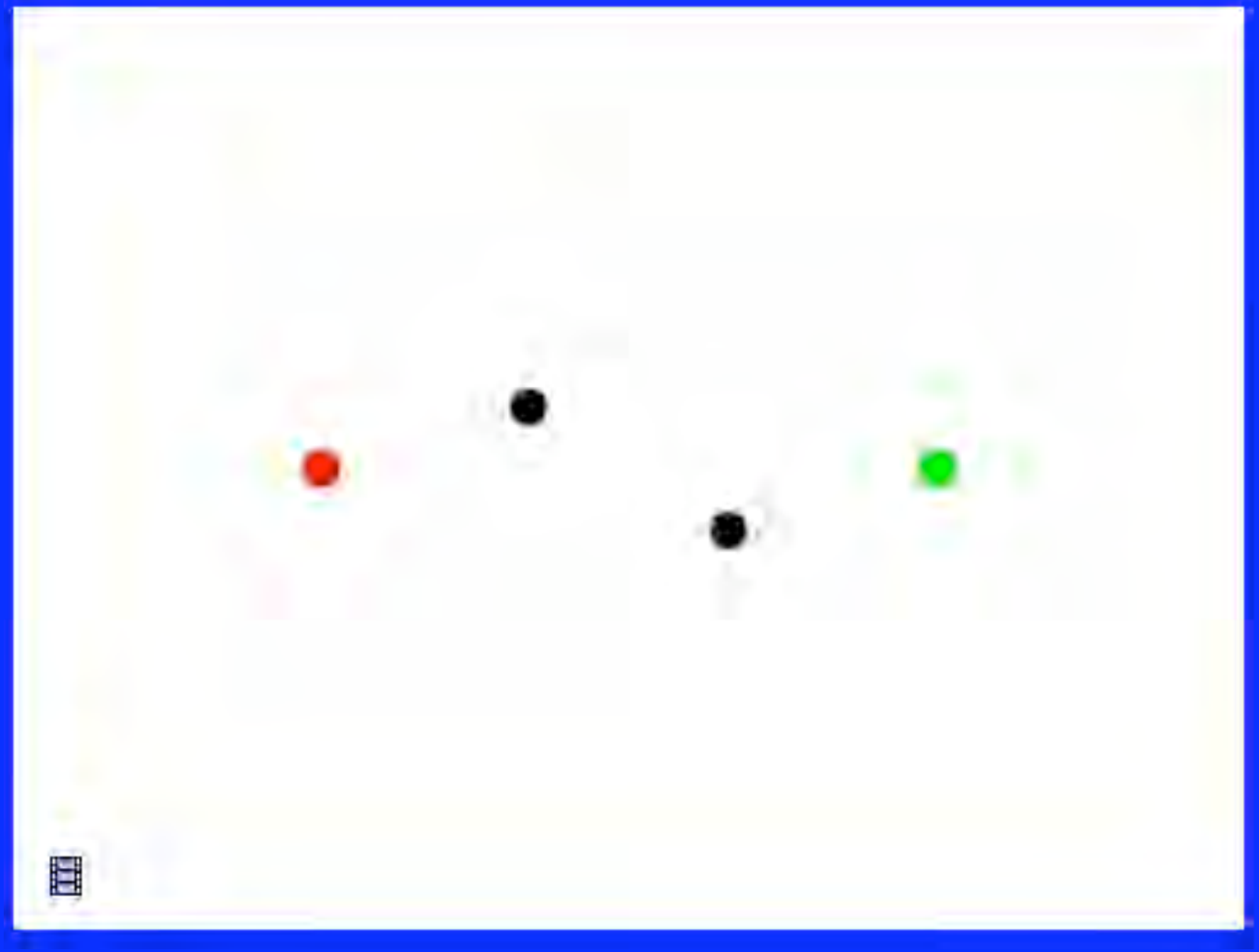

0 ms

+100 ms



1. Motion
2. Tilted





Two possible motion paths

Presaccadic remapping

Many LIP neurons fire for stimuli that will land on their receptive fields after saccade. Duhamel, Colby, & Goldberg, 1992

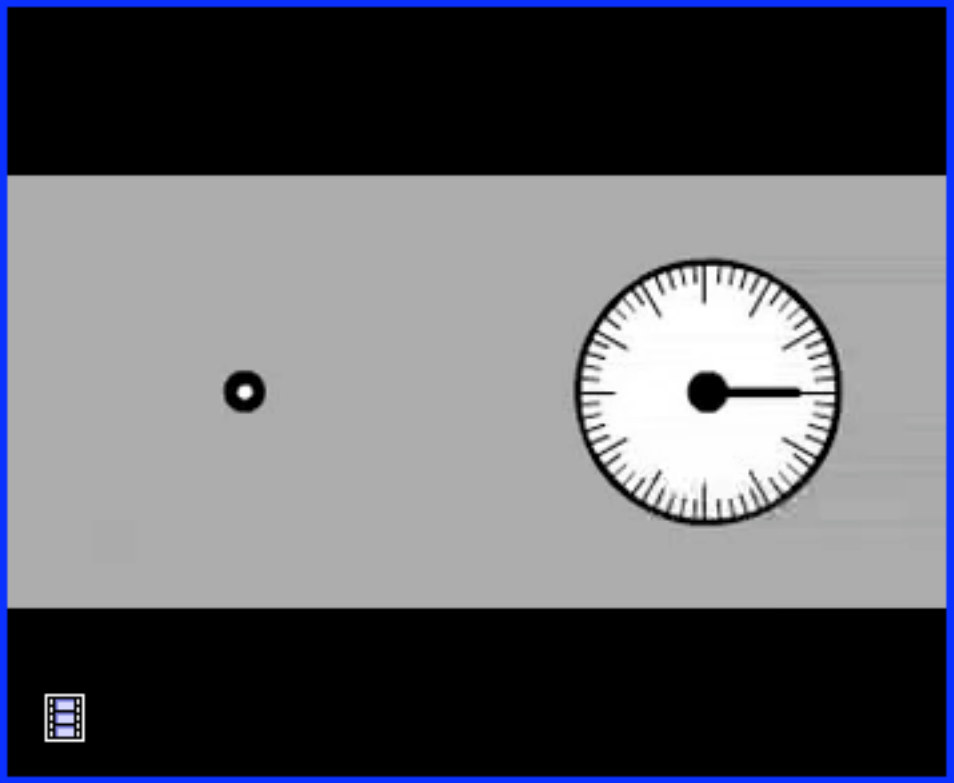
Shifting receptive fields in FEF under control of mediodorsal nucleus of thalmus. Sommer & Wurtz, 2006

Attention pointers remapped to post-saccade locations just prior to saccade

Amelia Hunt

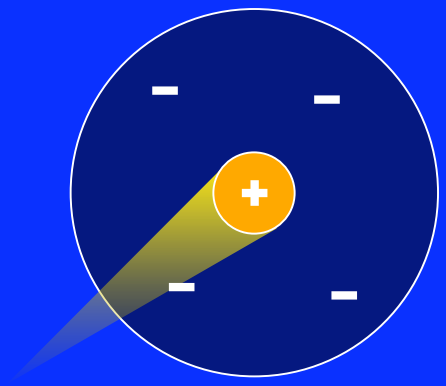
Subjects report that they are already looking at the saccade target before they make saccade Deubel. Irwin & Schneider, 1999

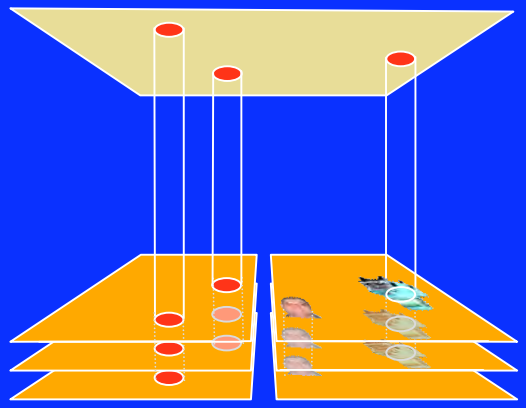
Measure with a clock: Make saccade, report time when you land.



66 msec too soon.

Summary





- Multifocal attention limited by target-target interference
- Attention and non-retinotopic integration
- Attention remapping and spatiotopic apparent motion