~~IOR~~

Facilitation

Joe

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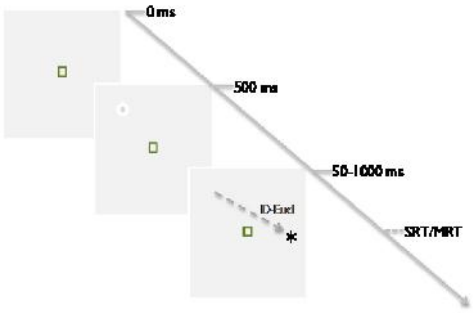
Attentional gradient

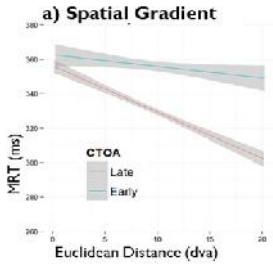
- Cue at one of 4 locations
- Probe randomized in onset time and spatial location
  - *Continuous* random variables
  - Any spatial location apart from central fixation
  - 50-1000ms after cue
- Both button press (MRT) and saccadic (SRT) responses

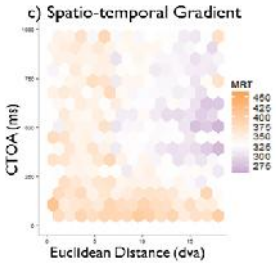


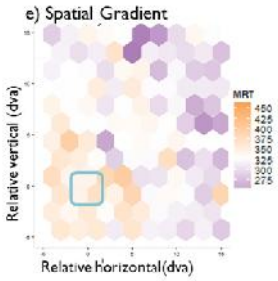
MacInnes, Neural Computation, 2017

E1a MRT: Spatial gradient

- Slower responses at early CTOA
- Slower responses near cued location
  - Clear spatial gradient of IOR
- Interaction with IOR increasing over time
  - But no early facilitation?

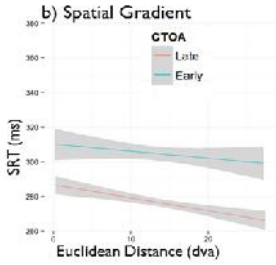


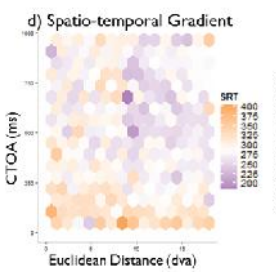


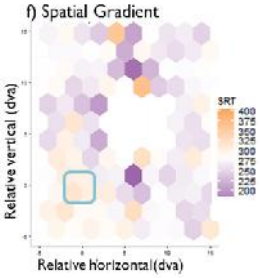


E1b SRT: Spatial gradient

- Slower responses at early CTOA
- Slower responses near cued location
  - Clear spatial gradient of IOR
- No facilitation…

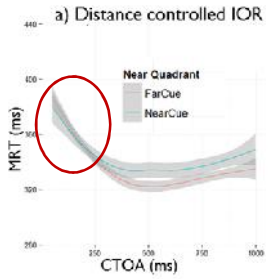


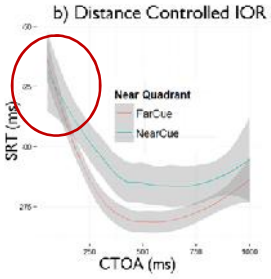


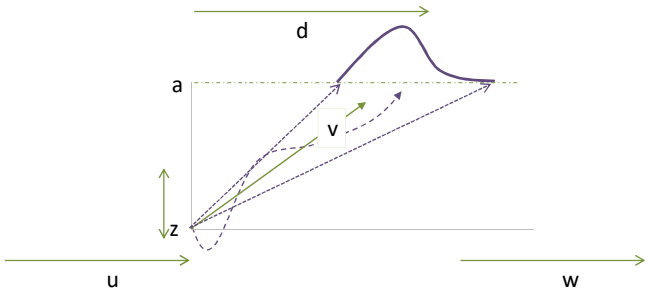


Distance controlled IOR

- Control for distance for direct valid/invalid comparison
- Both show robust IOR and no early facilitation
- Saccadic responses show earlier onset of IOR







Decision components
z – starting point
a – decision boundary
v – drift rate signal
S(v) – variability (noise) in signal within trial
h – between trial variability
S(z) – flat distribution range for starting point

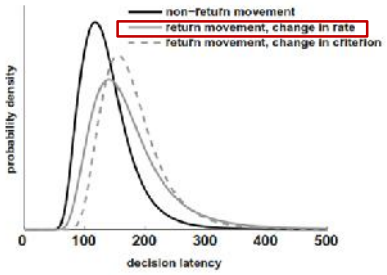
Non-decision components
S(t) = u+w – across trial variability of all other non decision components (Pre and post decision, possibly overlapping)

RT = (u+w) + d

Single threshold diffusion models typically do not require S(z) (Ratcliff 2011)

IOR Diffusion

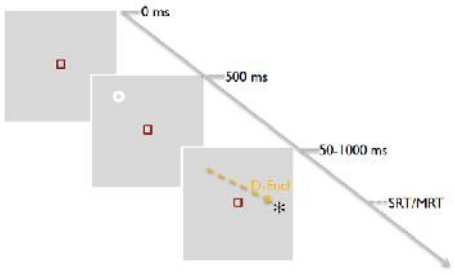
- We can ask which parameters lead to a best fit of human data
- Also which parameter(s) best fit a particular experiment manipulation
- Ludwig et al modelled distributions from IOR/ISR
  - Saccadic response to cue and target
  - two cue/target locations
  - Both peripheral and central cues
- Reduced accumulation rate and increased threshold both result in delayed mean RT, and its only the distribution that differentiates the underlying mechanism
- Best fit was change in accumulation **rate (v)**
  - Interpreted as desirability of course of action

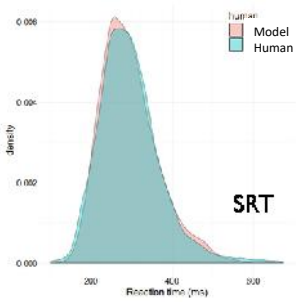


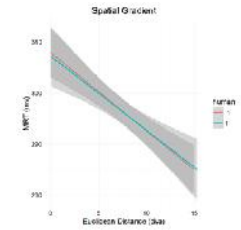
Ludwig et al, 2009

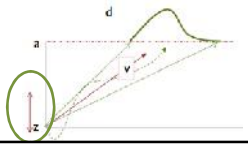
Gradient(s) of

- IOR has a spatial and temporal gradient
  - IOR decreases as distance from the cue increases
- Diffusion modelled spatial and temporal gradients for manual and saccadic responses
- Gradient best described as change in starting point variance for both modalities









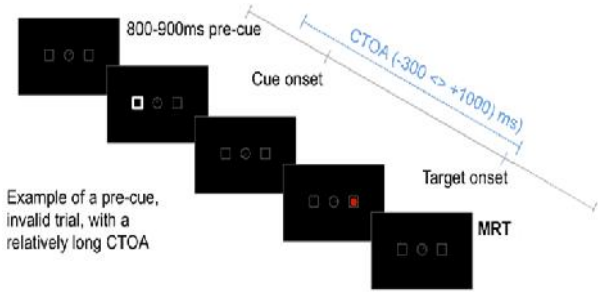
MacInnes, Neural Computation, 2016

Facilitation

- Unusual, but there are a few papers without early facilitation
- Taylor, Chan, Bennet & Pratt, 2015 (replicating Bennet & Pratt,, 2001)
  - No facilitation without placeholders
- Danzinger & Kingstone (1999)
  - IOR without cuing when the spatial cued location was less likely.
- Klein (2000)
  - attentional control settings can influence attentional dwell time on a cue, and subsequent patterns of IOR.
- Maruff et al. (1999)
  - also found IOR without facilitation when there was no cue-target spatial overlap.
  - Due to perceptual merging of cue and target ? (Kruger, MacInnes & Hunt, 2014)

CTOA only

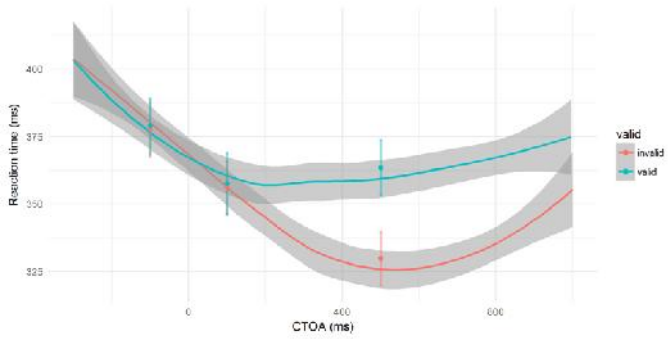
- Spatial placeholders
- 2 traditional locations to focus on timecourse
- MRT (~~and POT~~)
- Pre-cue ~~and post-cue for additional transition~~



Malevich, Ardasheva, Kruger & MacInnes, APP, 2017
Design based on Kruger, MacInnes & Hunt, 2014

2 location with placeholders

- Robust IOR
- No facilitation or perceptual merging
- Similar with Gamma distribution (50% weighted to early CTOA)



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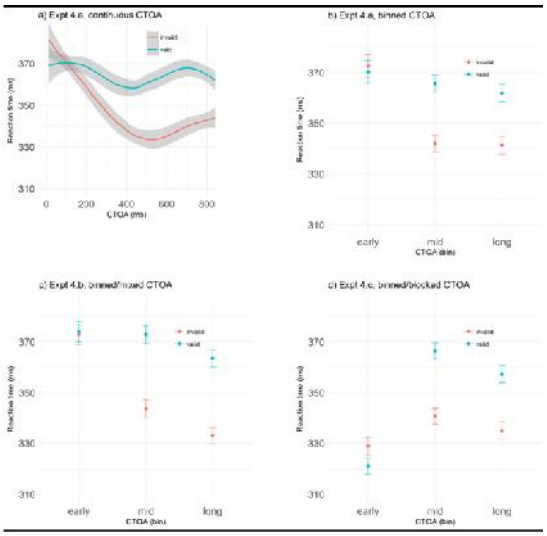
CTOA?

- H1: Russians don't show facilitation
- H2: Probably CTOA, but we won't know for sure until we generate facilitation in some condition

- E3a: continuous, mixed, 3 Gammas (50, 400, 750)
- E3b: Binned, mixed, 3 CTOAs (50, 400, 750)
- E3c: Binned, Blocked, 3 CTOAs (50, 400, 750)
-

facilitation

- Only binned, blocked show facilitation



Facilitation

- Attentional control settings can influence how engaged attention is to the cue (Klein 2000)
- Temporal expectations

- IOR without facilitation
  - More evidence they are separate processes

- No perceptual merging without facilitation
  - Consistent with Kruger's suggestion of attentional feedback mechanism

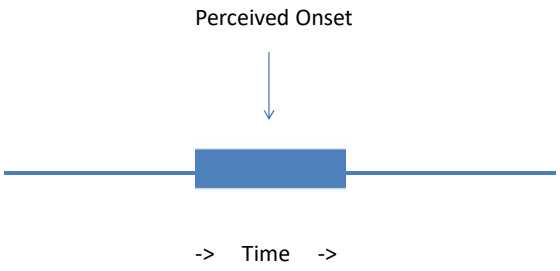
Perceptual merging and attention

- (Oh, and neuronal dynamics)
- This story starts in 2014

Three Accounts of Cueing

1. Attention: Attention is oriented to the cued location and facilitates the target response (Posner, 1980).
2. Pro-active Inhibition: Facilitation is the result of a release of a pro- active inhibition (Albares et al., 2011).
3. Perceptual Averaging: Cue and target are perceived as one event as a result of the very brief temporal proximity between them (Kruger, MacInnes & Hunt, 2014).

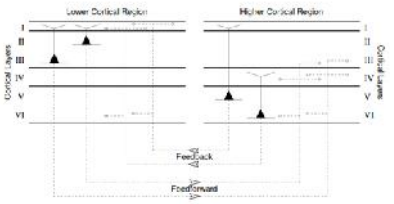
Perceptual Averaging



Not for first time: Schneider et al. (2003) suggest the “Prior Entry” is a result of the temporal attraction between the two stimuli

Re –entrant processing

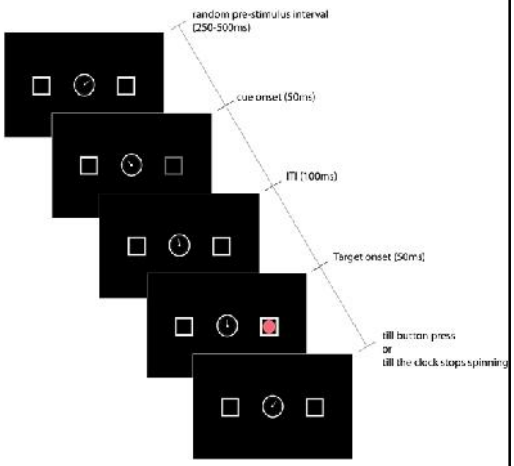
- Perceptual merging of cue and target could be caused by re entrant processing
- In vision, this is seen as a two stage process
- Feed forward processes trigger feature detection in striate and extra striate areas
- Later stages of visual processing feed back signal as series of reiterative loops
  - Reduce noise, refine, re-analyze and even add context
- Backward masking effects for example, can be explained by the conflict in re entrant processing
  - Re entrant is required to confirm
  - But original signal is absent by the time re entrant signal returns



Model of re entrant processing from Spratling and Johnson, 2004

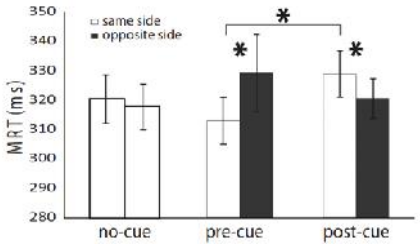
Kruger, MacInnes and Hunt, JOV, 2014 Two key manipulations

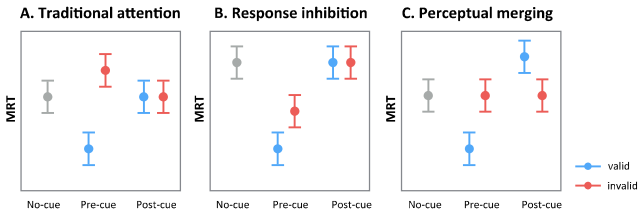
- Pre-cue/ post-cue
  - Response always to red dot
  - 30% typical cue-target
  - 30% of trials target came on *after* cue
  - 30% target only
  - 10% catch trials
- Two responses (blocked)
  - Simple MRT
  - Perceived onset time (POT) with clocks from Hogendoorn & Carleson (2007)



Predictions

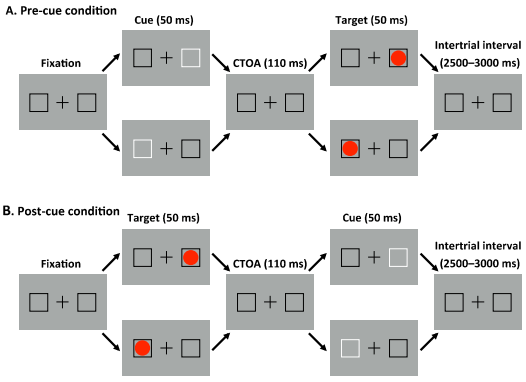
- Krueger etal found a pattern of perceptual merging for MRTs
  - But POT resembled attention account
- Malevich, et al 2017 replicated the perceptual merging
  - E1, E2, E3 post-cue
  - Very small effect, and only merging first three experiments





Alpha, facilitation and perceptual merging

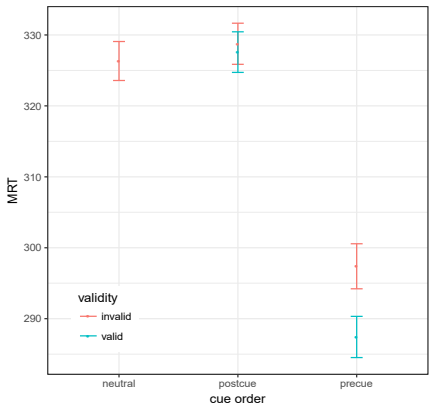
- 1100 trials for small effects
  - -110 ms/+110 ms CTOA
  - (Mixed, Binned)
  - Pre-cue/post cue for perceptual merging
- Do individual neuronal dynamics predict differences in small attentional effects ?
  - 64 channel EEG
  - 2 resting state alpha measurements
  - Prestimulus prior to each trial



Malevich, T., Blagovechtchenski, E., Iscan, Z., Nikulin, V., & MacInnes, W. J., In prep

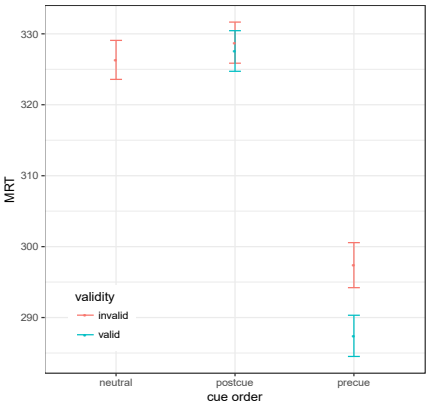
MRT

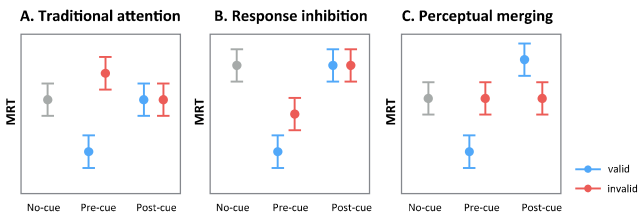
- Faster design, 20 trial sequences
- 5 blocks, 2+ hours (with breaks!)
- No perceptual merging
- More Russian facilitation!



MRT

- For those paying attention…
- A perfect match of the response inhibition prediction
- But > 20% errors





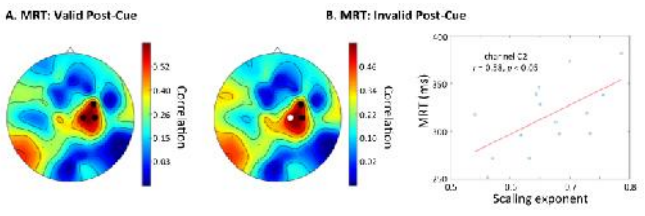
Resting Neuronal dynamics

- Amplitude of alpha oscillations
  - Linked to overall alertness
  - No results
- Long Range temporal correlations (LRTC)
  - Detrended Fluctuation analysis (DFA)
  - Individual differences in fluctuations between inhibitory and excitatory states might help predict behavioural results
  - ‘Fast adaptation to changing task demands’

Post-cue MRT

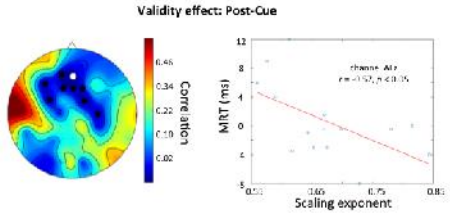
- LRTC correlation with post-cue MRT
  - Lower (8-10 hz alpha band)
  - Right lateralized sensorimotor areas
- Slower MRT with higher LRTC

- Right handed participants, right hand manual response
  - Task demands created hyperactication in contralateral left hemisphere
  - Heightened Interhemispheric inhibition



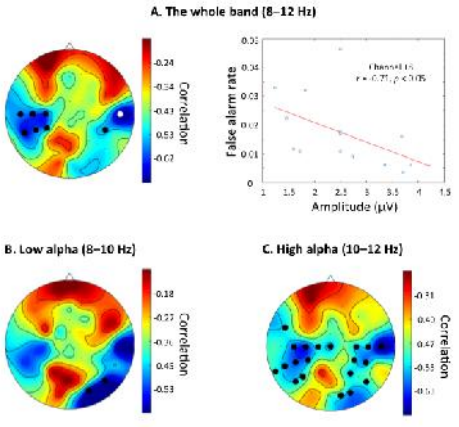
Frontal validity

- LRTC correlation with validity in post-cue condition
  - (perceptual merging)
  - Also lower alpha band
  - Frontal
- Stronger LRTC associated with more merging
  - Slower valid compared to invalid



False alarms

- False alarm rates associated with greater alpha amplitudes
  - All sub-bands bilateral temporal
  - Lower bands right occipital
- Alpha oscilations may reflect inhibitory processes
  - In our case to maintain response inhibition prior to target
  - Lemi etal, 2017 found similar correlation with false alarm rate



Alpha and speed/accuracy trade off

- What does it mean???
- Current story
- Task demands pushing participants to an extreme end of a speed/accuracy trade-off
  - Rapid-fire response, 1000+ trials
- Optimal strategy of hyper ready state with response inhibition, released by first event

Facilitation == attention?

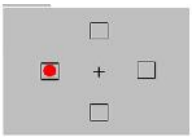
- Is the cue attended at all?
- Attention removed too quickly?
- Other measures of attention in cuing paradigm?

Attention to cues

- Saccadic curvature(Van derStigchel & Theewes, 2007)
  - Shows same biphasic pattern as RT (McSorley, 2006)
- Microsaccades (Laubrock, Engbert, & Kliegl, 2005)
  - Temporal dip in microsaccade rate after cue followed by later surge
  - Spatial bias toward cue (others found bias away…Hafed & Clark, 2002)
- Pupil size
  - Linked to attention and many cognitive factors..
  - As a general measure of alertness, may explain amount or lack of facilitation
  - Pupil size/IOR corellation (Gabay et al , 2011)

Experiment

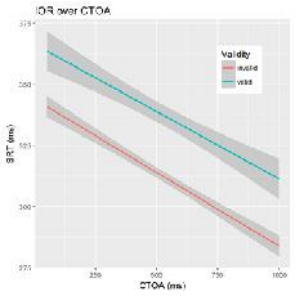
- 4 location SRT, 50…1000 CTOA

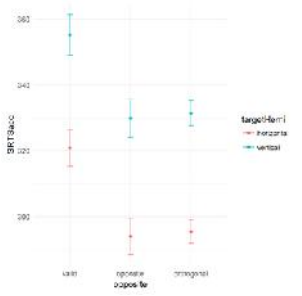


- Pupil size change as result of cue
  - Account for luminosity and individual differences
- Saccadic curvature
  - Walker et l, 2006
  - Area under curve/amplitude
- Microsaccades
  - Velocity based detection (Engbert & Kleigl, 2003)
- Validity (valid, opposite, orthogonal)
- Hemifield (horizontal, vertical)

SRT

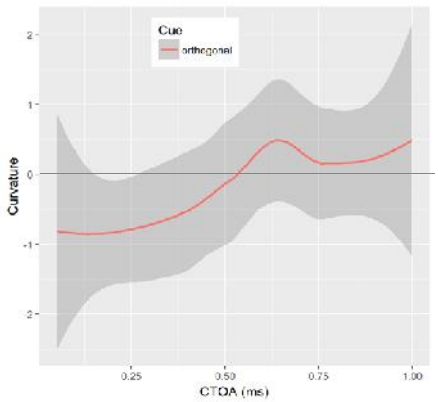
- Main effects of hemifield, CTOA and validity
  - No difference between opposite and ortogonal, so merged as 'invalid'
- No validity CTOA interaction
  - And validity is significant at 50ms

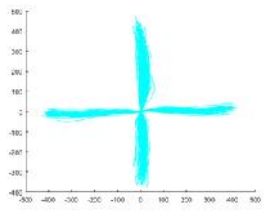




Curvature

- Early curvature away
- Attended, but curvature away linked to IOR (McSorley etal 2006)

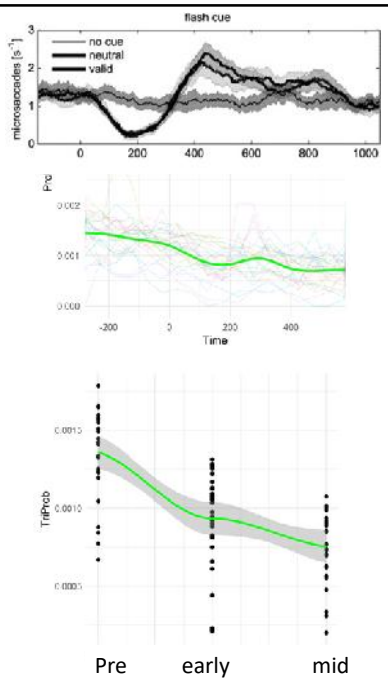




Microsaccade rate

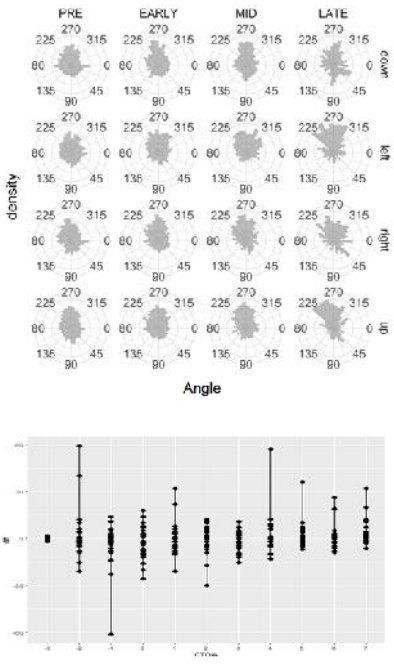
- Slight dip in frequency
  - Laubrock saw reduction to nearly 0
- no surge or even rebound

- I'm still not happy with reduced rate on mid/later
  - But these are prior to target, so perhaps a state of overall oculomotor inhibition



Microsaccade direction

- Again, does not replicate Laubrock
- Measuring towards minus away from cue
  - Effect of time
  - But no bin differs from 0
- Again timing? Laubrock used fixed CTOA to build expectation of timing



Salience models

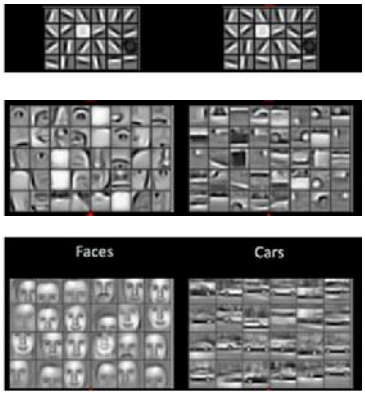
- Bottom up processing only, can we predict fixation locations
  - Input image, output fixation prediction
- Itti & Koch, 2001
  - Theory rich (Feature integration, pyramidal cells, IOR, integrate and fire)
  - Great spatial accuracy for its time
  - Makes temporal prediction… (poor)
- Deep learning
  - Deep belief with stacked restricted Boltzman Machines
  - Deep convolution use neurons with receptive fields

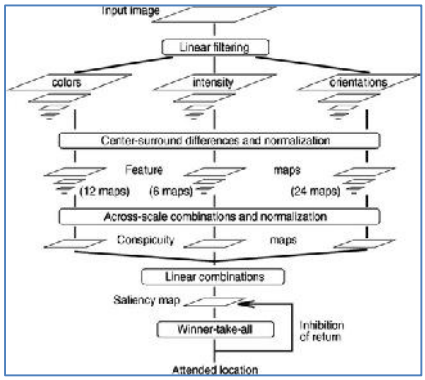
Convolution NN

- Accurate
  - MIT salience benchmark
- Theory agnostic
- Biologically plausible?
  - Untested!
- Discriminative
  - Classifier only, predicts in space
  - Recent attempts at generative GANs)

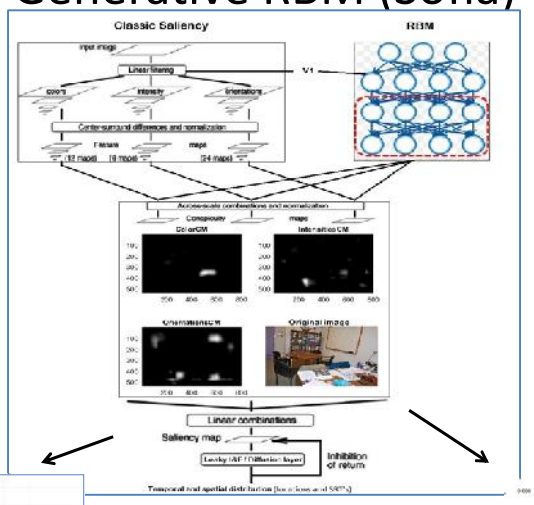
I&K

- Accurate for its time
  - Now quite poor
- Theory rich
- Biologically inspired
- Generative
  - Simulates saccades in time and space

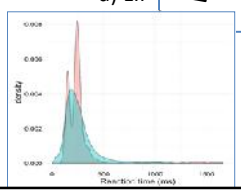




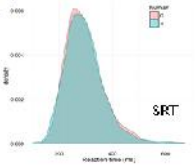
Generative RBM (Sofia)



a) LIF

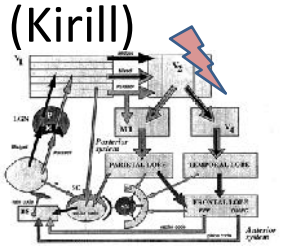


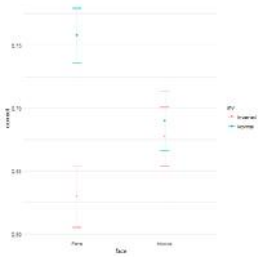
b) diffusion

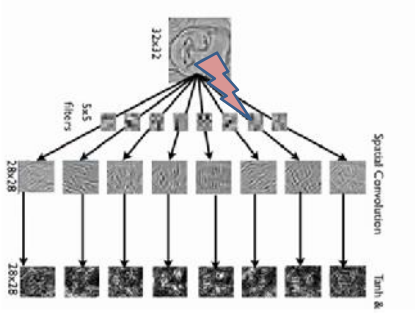


Deep classification (Kirill)

- Visually, DLNNs as visual corrtex are convincing..
- But what about direct tests
- Do they replicate errors
  - Face inversion effect when trained with upright faces
- Lesion effects
  - Can we lesion FFA in participants (TMS) and nodes in the Conv net to produce the same impairment?







Большое спасибо

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- Halifax
  - …

Backup