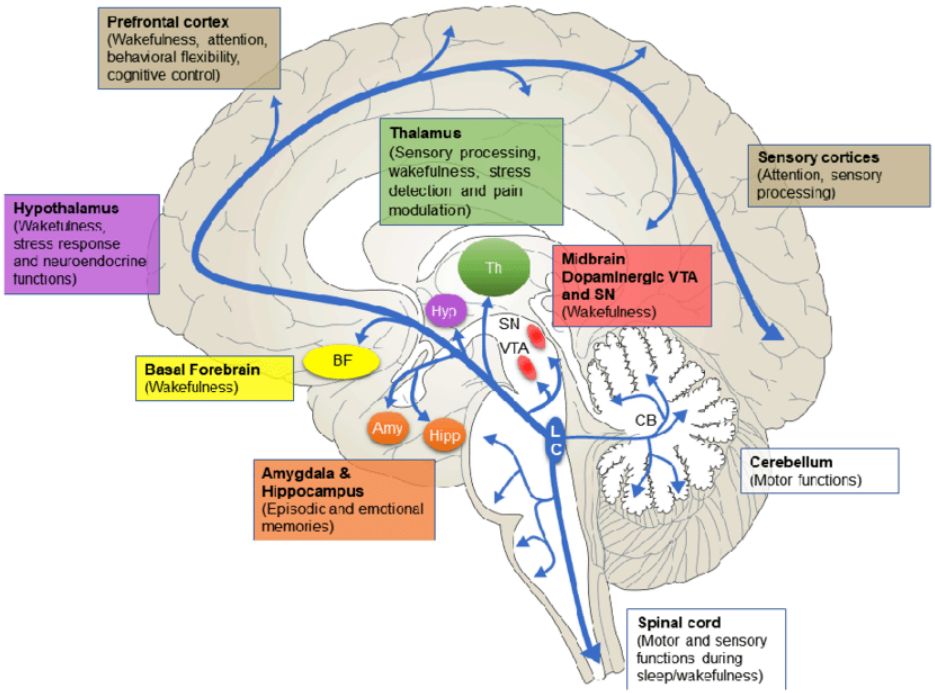
Tutorial 2

Locus Coeruleus

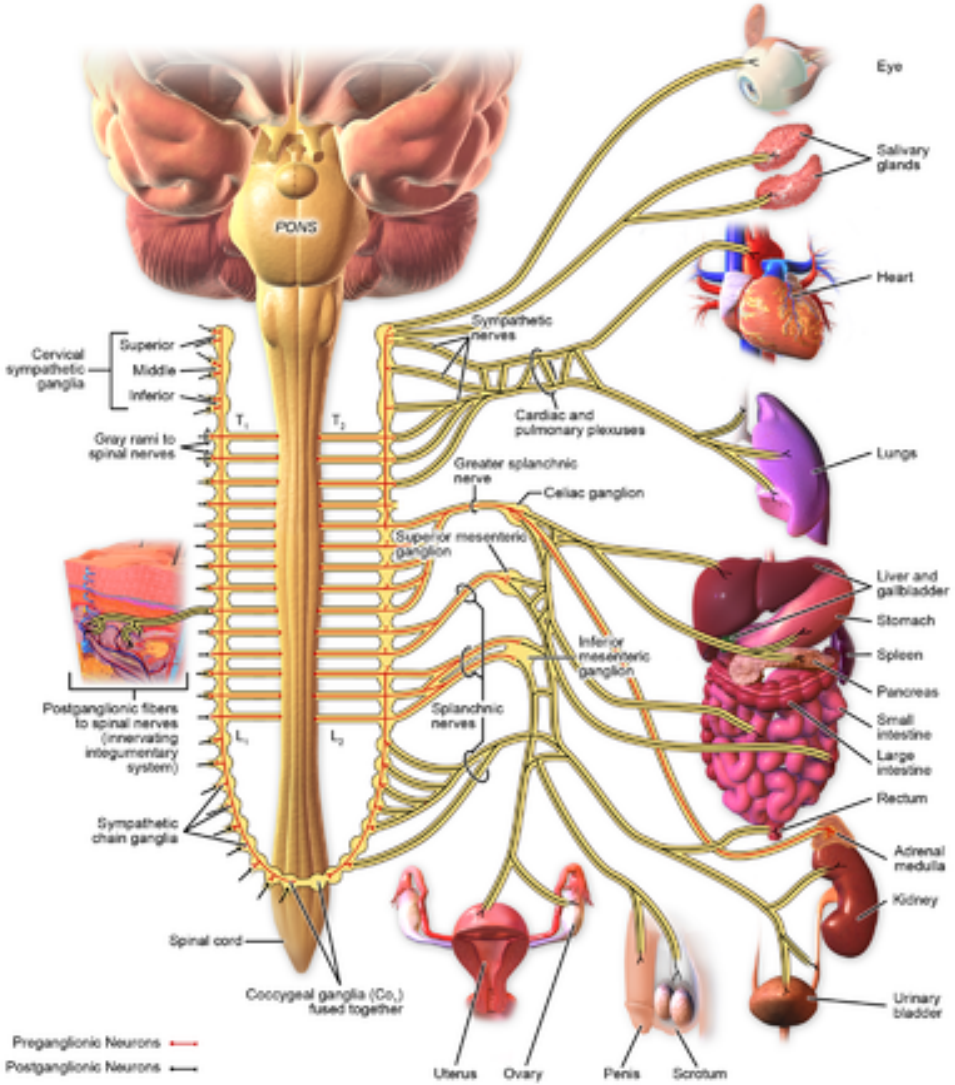
Increases:

- Heart-rate
- Sweating
- Blood pressure
- Pupil Diameter



Nonepinehrine/noraderaline: neurotransmitter/hormone responsible for flight/fight response

Locus Coeruleus

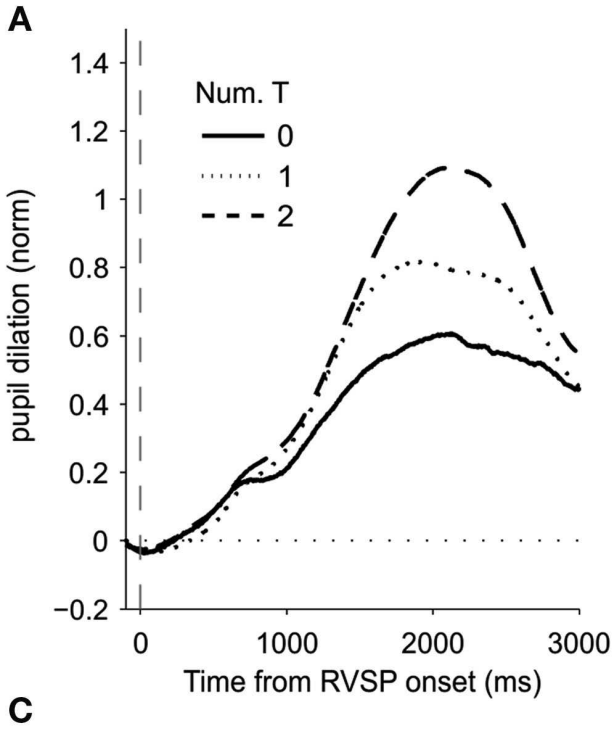


Sympathetic Innervation

https://en.wikipedia.org/wiki/Norepinephrine

Pupil dilation: a fingerprint of temporal selection during the "Attentional Blink"

Ariel Zylberberg, Manuel Oliva and Mariano Sigman



2 targets Vs 1 target (No T2)

Pupil dilation Vs cognitive load

Pupil dilation: a fingerprint of temporal selection during the "Attentional Blink"

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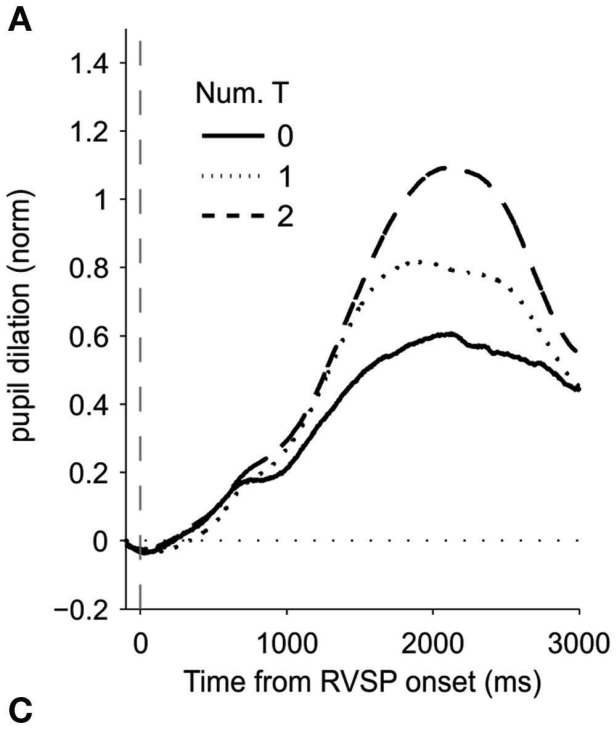
2 targets Vs 1 target (No T2)



OUR Data??

1 target (NoT2)

Vs

2 targets

Pupil dilation Vs cognitive load

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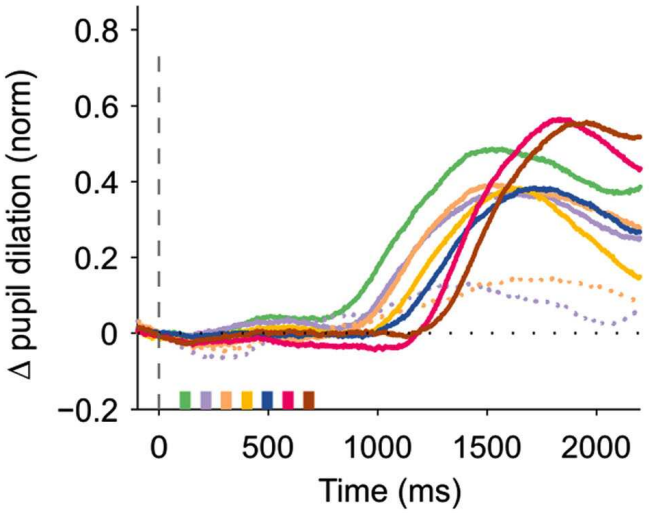

	Same	**Opposite**	**Perpendicular**
S1	C>I	C>I	C>I
S2	C<I	C<I	C<I
S3	C<I	C<I	C<I

Pupil dilation: Correct Vs Incorrect

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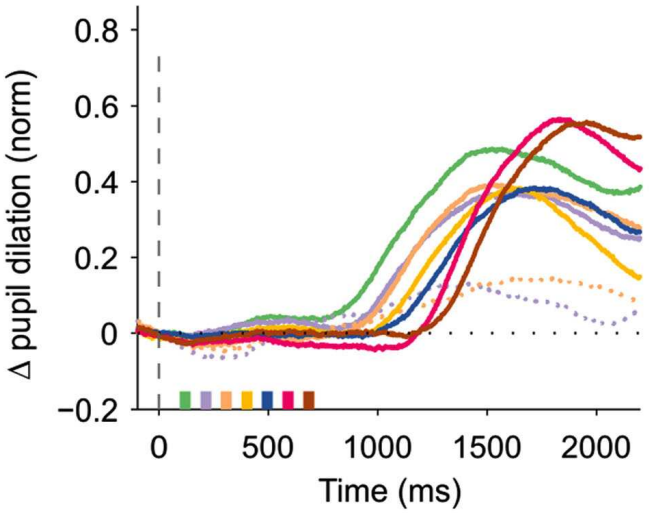

Same figure for our data:
Average Same/opposite & per conditions across SOA
???

Pupil dilation: Correct Vs Incorrect

Pupil dilation: a fingerprint of temporal selection during the "Attentional Blink"

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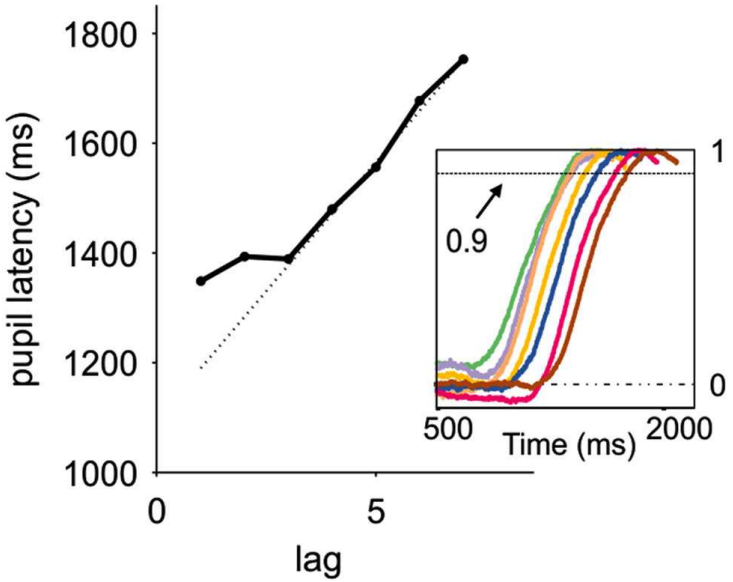

In our Data
Latency rising and falling

Pupil dilation: a fingerprint of temporal selection during the "Attentional Blink"

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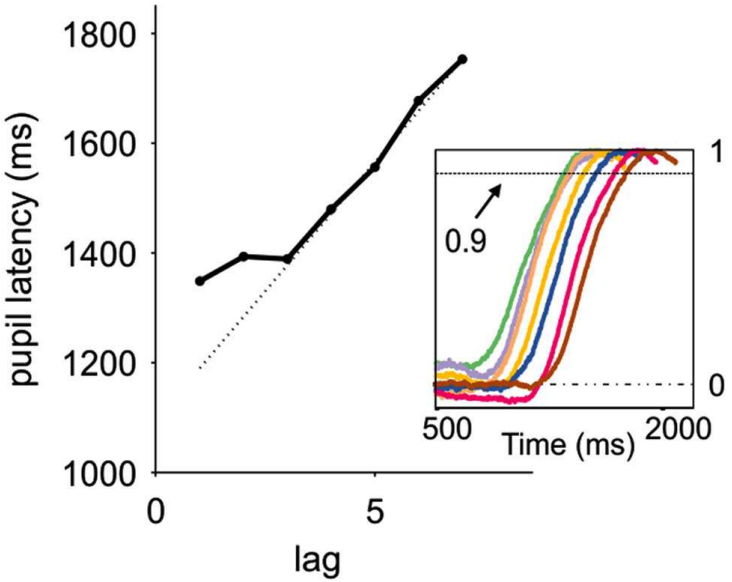
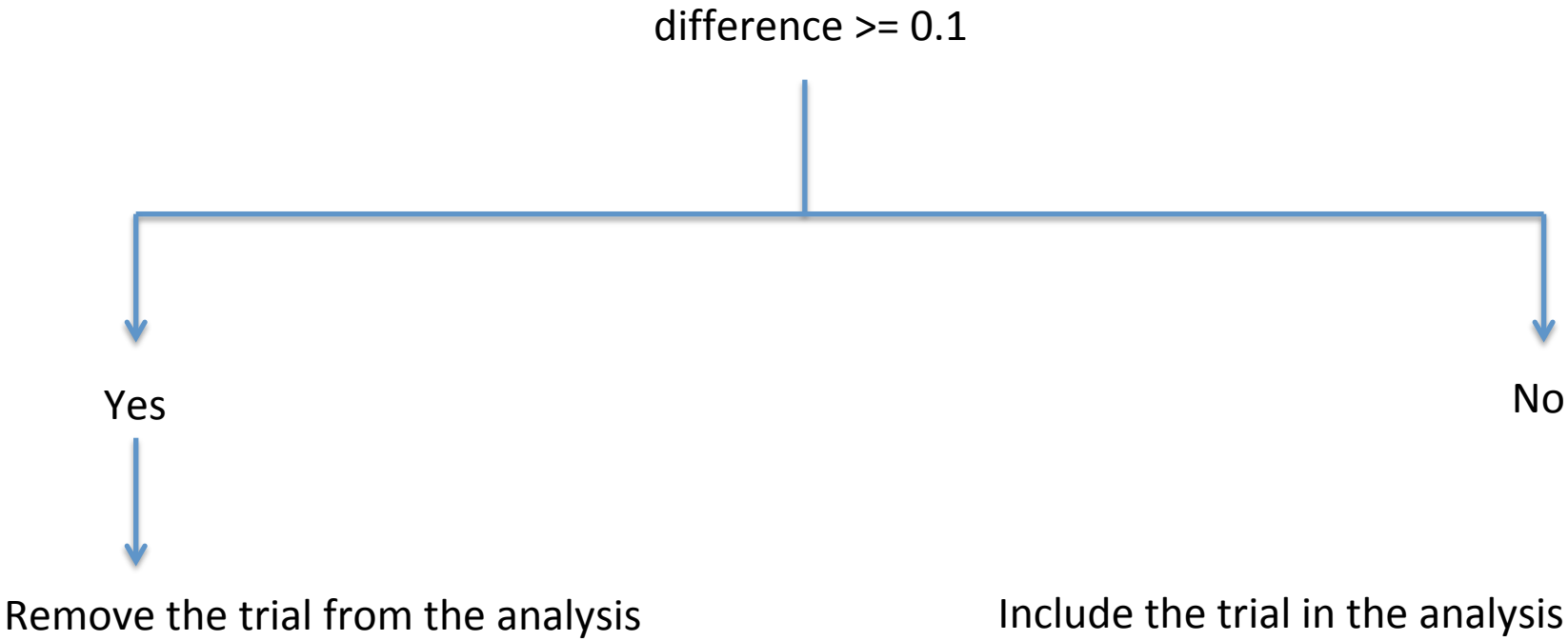


Same figure for our data:
Average Same/opposite & per conditions across SOA
???

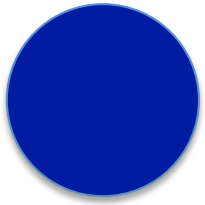
Given that we have only 12 participants out of 19 left we will try to recover some participants which have been removed previously from the analysis due to noisy data.

Assumption: there are only 1 or 2 trials which are noisy, so will remove only those trials

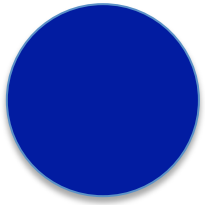
For each trial find difference between min and max value after normalization



Direction of the dot?



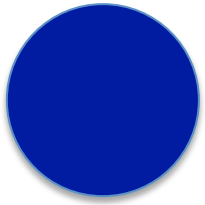
Direction of the dot?



Right

Direction of the dot?

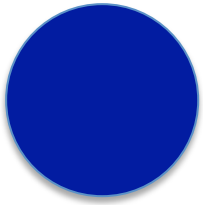
Integration within space and time



Down

Direction of the dot?

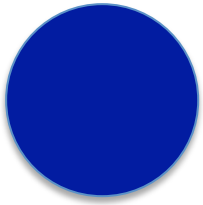
Integration within space and time

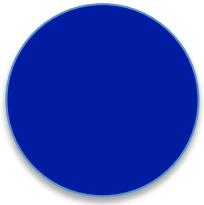


Down

Direction of the dot?

Integration within space and time





Same

Direction of the dot?

Integration within space and time

Perpendicular

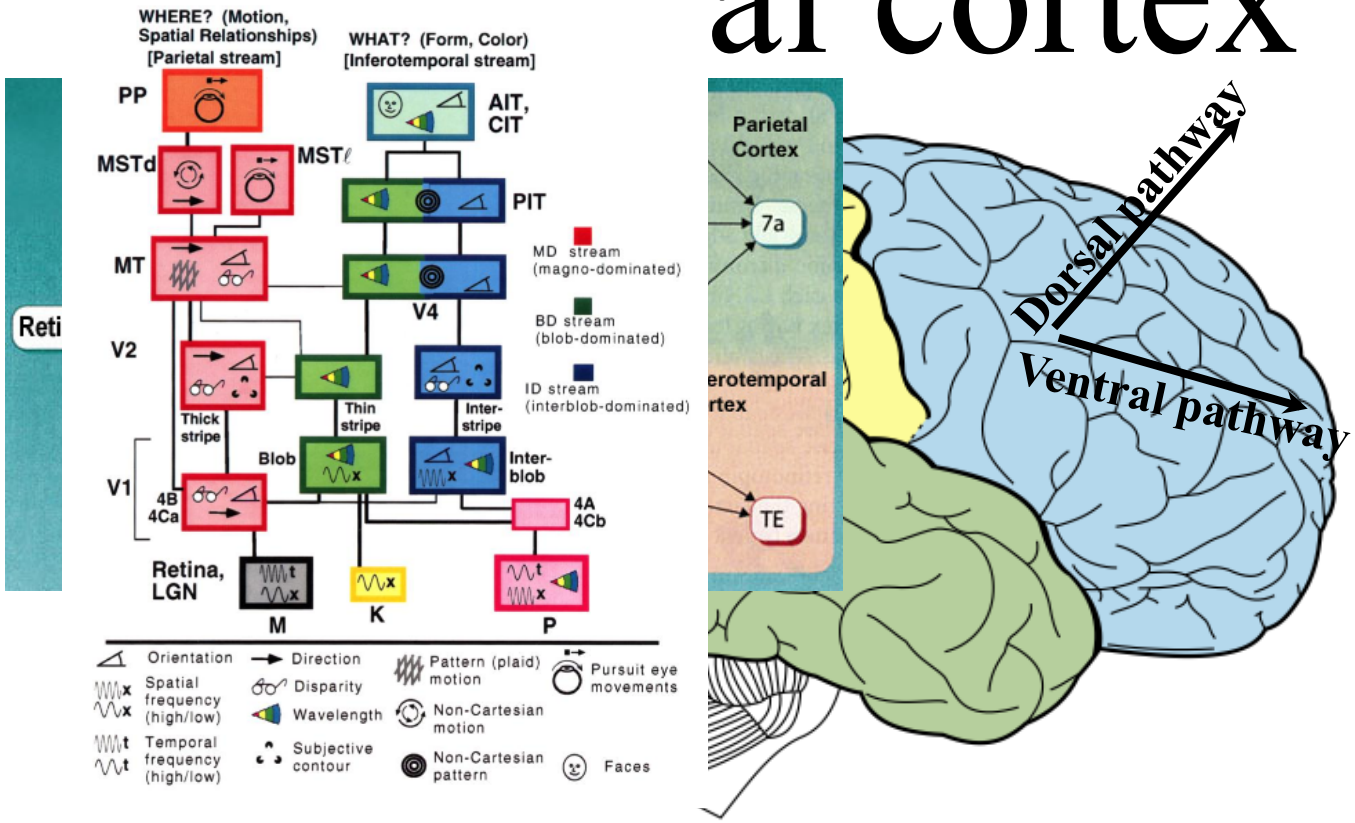
Direction of the dot?

Integration within space and time

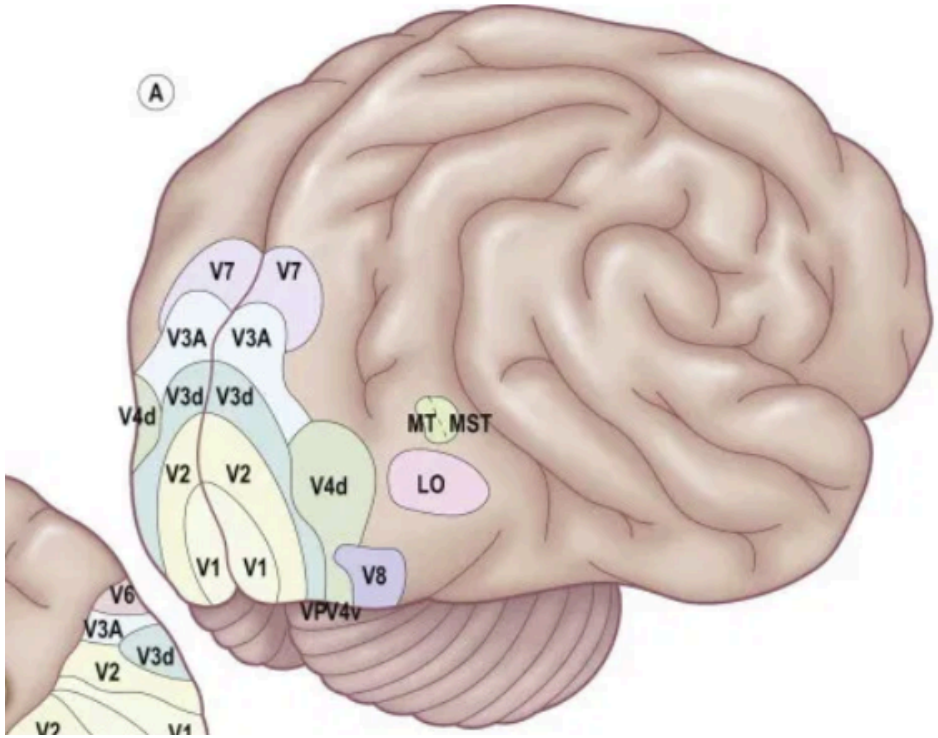
Perpendicular

Same

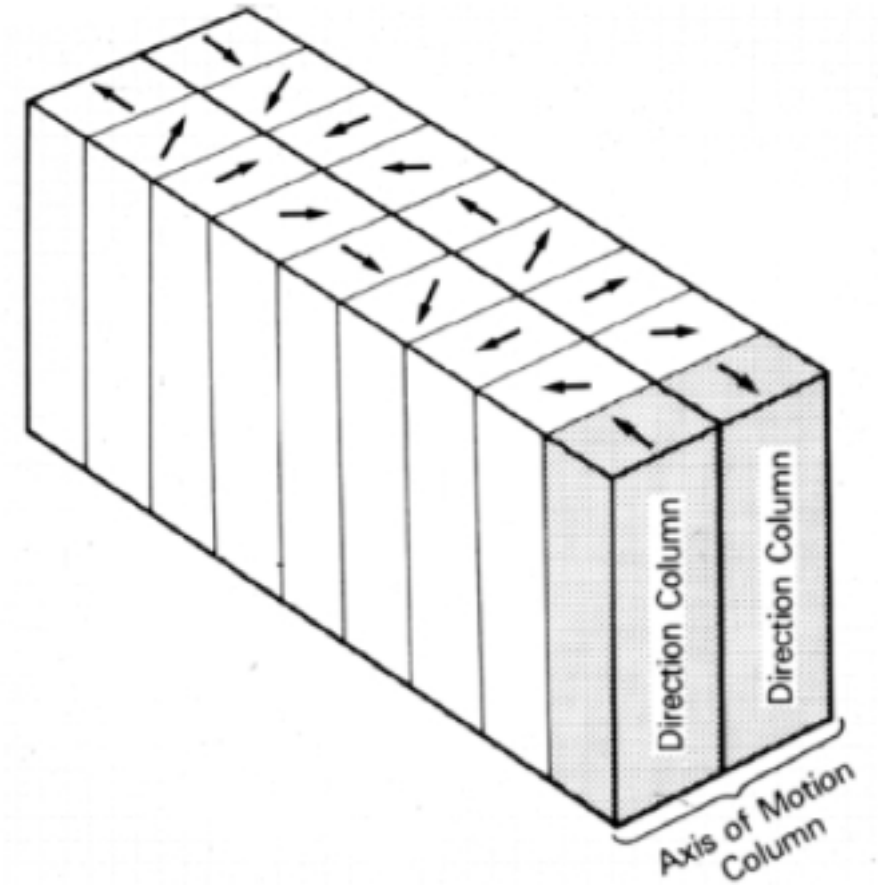
Visual Brain cortex



Motion processing



https://entokey.com/extrastriate-visual-cortex/



http://fourier.eng.hmc.edu/e161/lectures/nn/node14.html

Columnar organization

Direction of the dot?

Integration within space and time

Low SNR

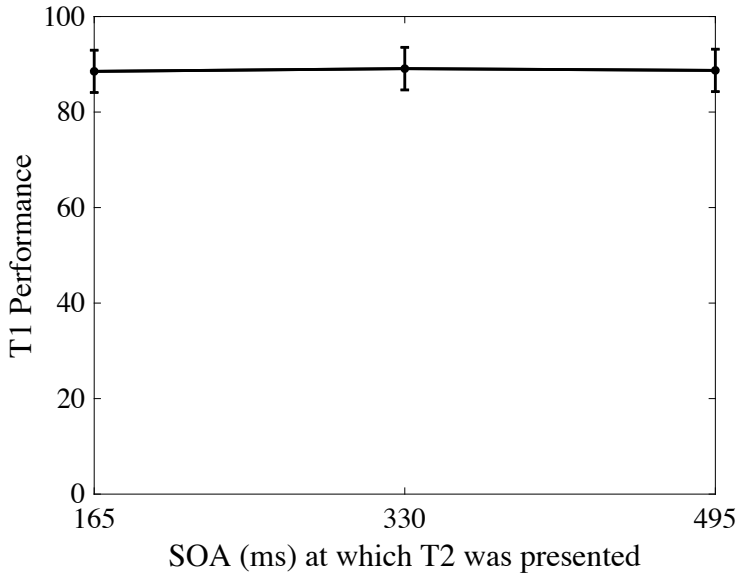
Perpendicular

High SNR

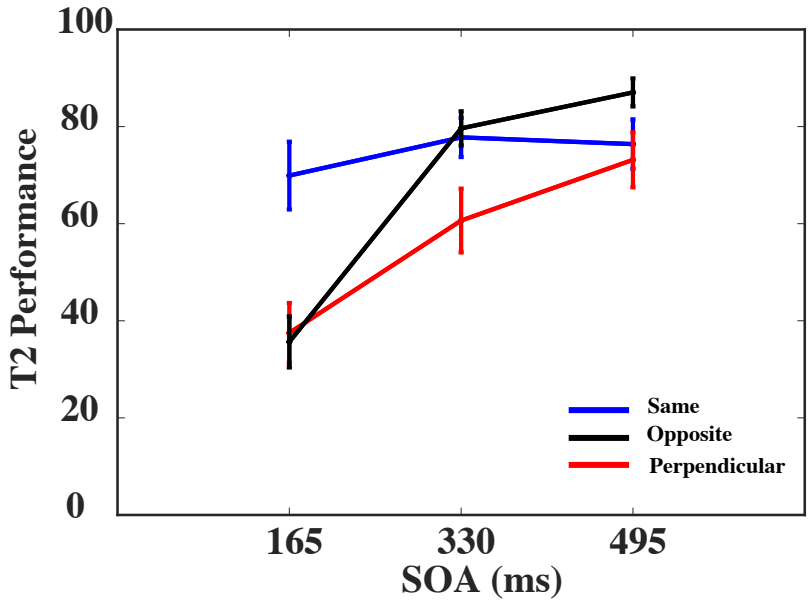
Same

Behavioural Data

T1 Performance



T2 Performance



Same

Correct

24 16 11
18 21 14
16 20 13
16 22 3
17 14 11
18 20 9
5 5 7
19 7 10
18 10 14
16 19 21
14 19 18
7 21 15

InCorrect

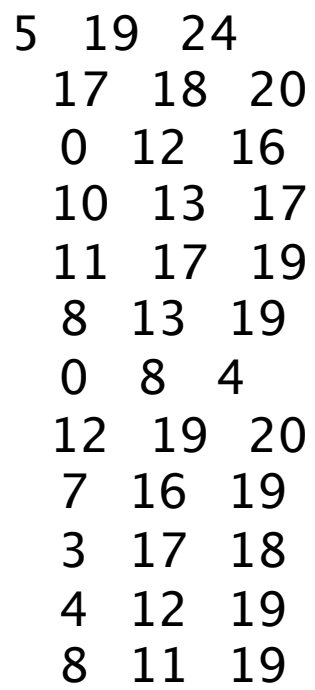
0 1 1
0 0 0
17 1 0
3 1 0
2 1 0
0 0 0
9 1 1
4 0 0
7 0 0
19 0 0
13 3 0
3 0 1

Opposite

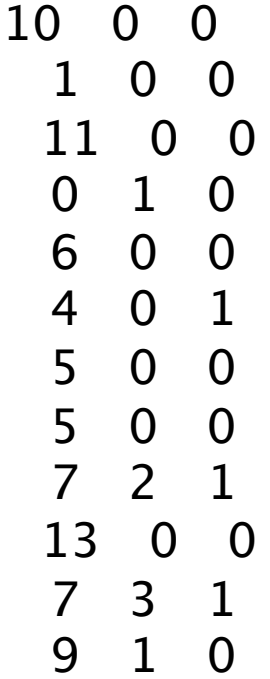
Correct	InCorrect
9 16 21	10 0 0
17 16 15	2 0 0
1 2 4	20 1 1
16 15 16	1 0 0
13 19 20	10 0 0
6 12 13	5 0 1
8 12 12	1 1 1
11 17 20	6 1 0
7 17 11	10 1 0
2 14 18	14 0 0
2 12 16	11 2 0
2 5 10	6 1 0

Perpendicular

Correct



InCorrect



NoT2

Correct

43 43 38 5 46 35 14 35 42 37 30 31

InCorrect

4 1 4 42 2 5 23 12 4 3 13 11

Next Step

- Change normalization method and period
  - Old: Signal - mean (First 250 points)
  - New: $\frac{\text{Signal - mean (From first point until T1Onset)}}{\text{mean (From first point until T1Onset)}}$

- Mean method
  - Old: mean of trials (participant) → mean across participants
  - New: Append all trials (after normalization) for a condition across participant and then make the mean

  e.g collect all correct trials for the Same condition SOA1 from all participant in one array and then take the average.
- Plot both condition as well as SOA wise like in slide #69 & 70 of shared google presentation.
- Evaluate standard deviation of each condition and plot as an area across each curve as shown in next slide std

P1 = [0.1 0.3 0.4 0.5 0.6
0.4 0.4 0.5 0.3 0.3
0.5 0.3 0.5 0.5 0.2]

M1 = 0.5 0.3 0.5 0.5 0.2

P2 = [0.1 0.3 0.4 0.5 0.6
0.4 0.4 0.5 0.3 0.3
0.5 0.3 0.5 0.5 0.2]

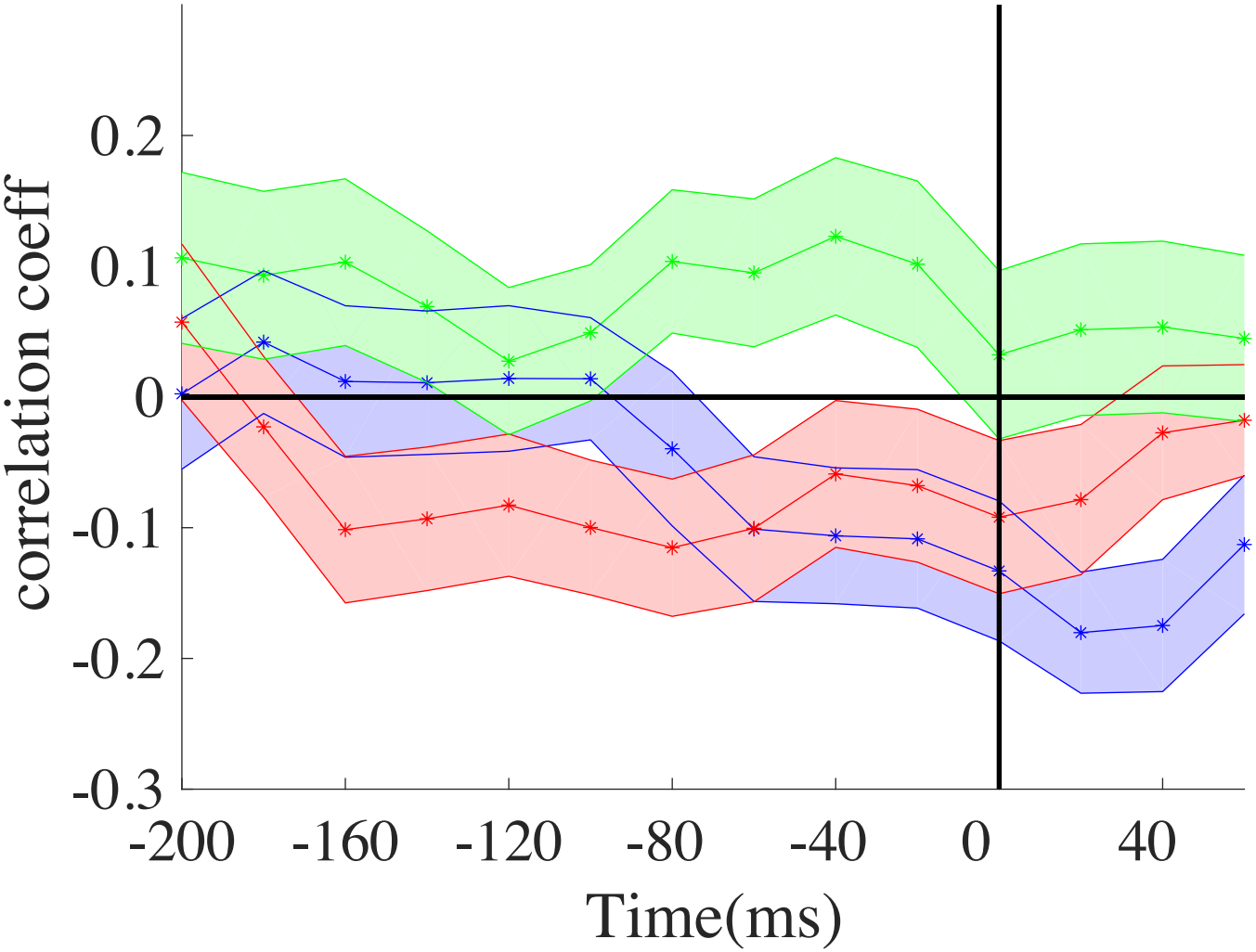
M2 = 0.5 0.3 0.5 0.5 0.2

P3 = [0.1 0.3 0.4 0.5 0.6
0.4 0.4 0.5 0.3 0.3
0.5 0.3 0.5 0.5 0.2]

M3 = 0.5 0.3 0.5 0.5 0.2

SOA1Same= 0.1 0.3 0.4 0.5 0.6
0.4 0.4 0.5 0.3 0.3
0.5 0.3 0.5 0.5 0.2
0.1 0.3 0.4 0.5 0.6
0.4 0.4 0.5 0.3 0.3
0.5 0.3 0.5 0.5 0.2
0.1 0.3 0.4 0.5 0.6
0.4 0.4 0.5 0.3 0.3
0.5 0.3 0.5 0.5 0.2

std(SOA1Same)



ciPlot: Shared in google folder

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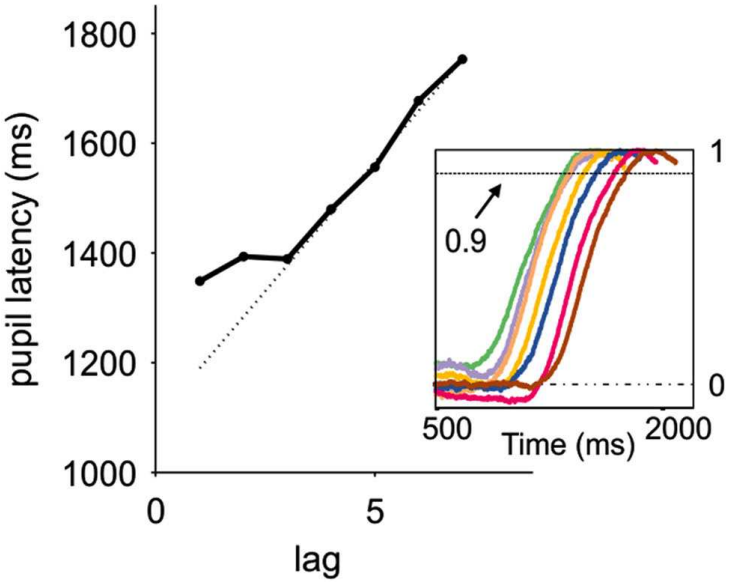

Same figure for our data:
Average Same/opposite & per conditions across SOA
???

Next Step

Latency Calculation:

- Constrict latency: Time @ which we see constriction in pupil diameter.
- Dilate latency: Time @ which pupil starts dilating again.

Constrict latency claculation

- Collate data across participants for different conditions, e.g. for same soa1 there are S = 165 X 1400 elements, representing T1-200 to T1+ 1200 ms
- Take data from T1 onset
- Compare each adjacent column elements through this statistical test
  - For I = 1:1400-1
  - [h,p] = ttest(S(:,i),S(:,i+1))
  - If h == 1; break: This will given you first point in time where pupil starts constricting.

Next Step

Dilate latency claculation

- Collate data across participants for different conditions, e.g. for same soa1 there are S = 165 X 1400 elements, representing T1-200 to T1+ 1200 ms
- Take data from minimum point after T1 onset
- Compare each adjacent column elements through this statistical test
  - For i = min(S): (end-1)
  - [h,p] = ttest(S(:,i),S(:,i+1))
  - If h == 1; break: This will given you first point in time where pupil starts dilating .

- Replicate figure 2A & 2D of Zylberberg et al, 2012.
- Replicate slides 72 & 75 with errors in response 3 (misclassification into wrong direction)
- Compile the trends in the data.
- Also share the figure files as PDF in our shared folder.
- A plot from first point until T1 onset.

Observations

- Difference between correct and incorrect trials @SOA1
- This difference disappears for SOA2 & 3 close to zero.
- Latency different for different SOA for all directions: same, opposite and perpendicular
- @SOA1 max constriction for same followed by opposite and perpendicular