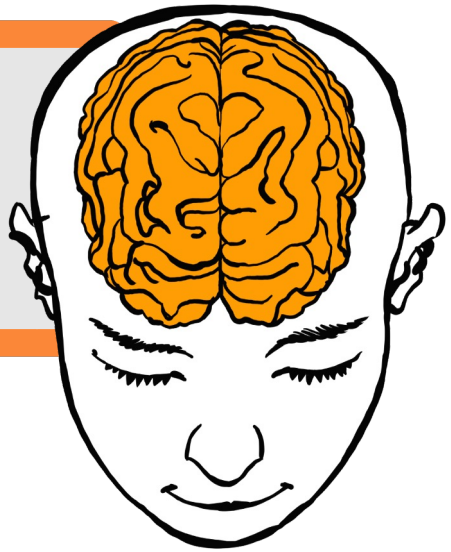
PreCont:
Continuous Prediction Error



March, 9th, 2023

Lifespan Cognitive and Brain Development (LISCO) Lab
Goethe University Frankfurt

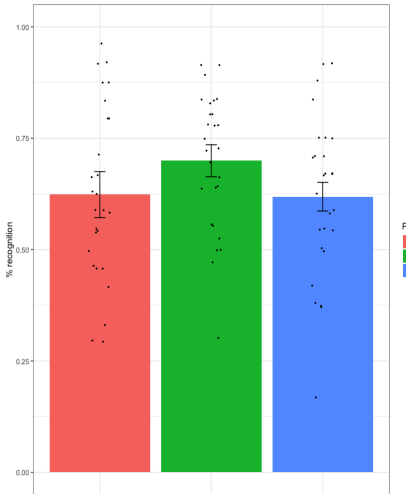
Pupillo, Ortiz-Tudela, & Shing

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

LISCO

THEORETICAL BACKGROUND

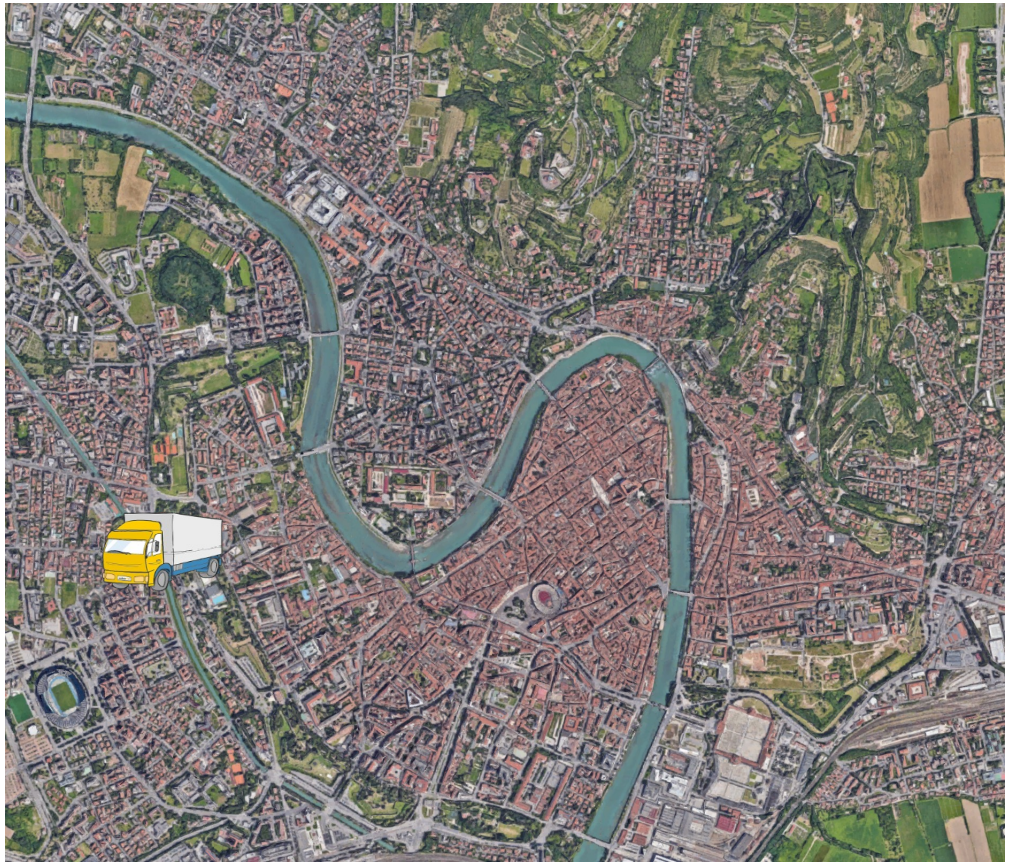
So far we have considered PE as a categorical variables, depending on the condition



Low PE Med PE High PE

In the current setup, we aim to derive a continuous PE variable

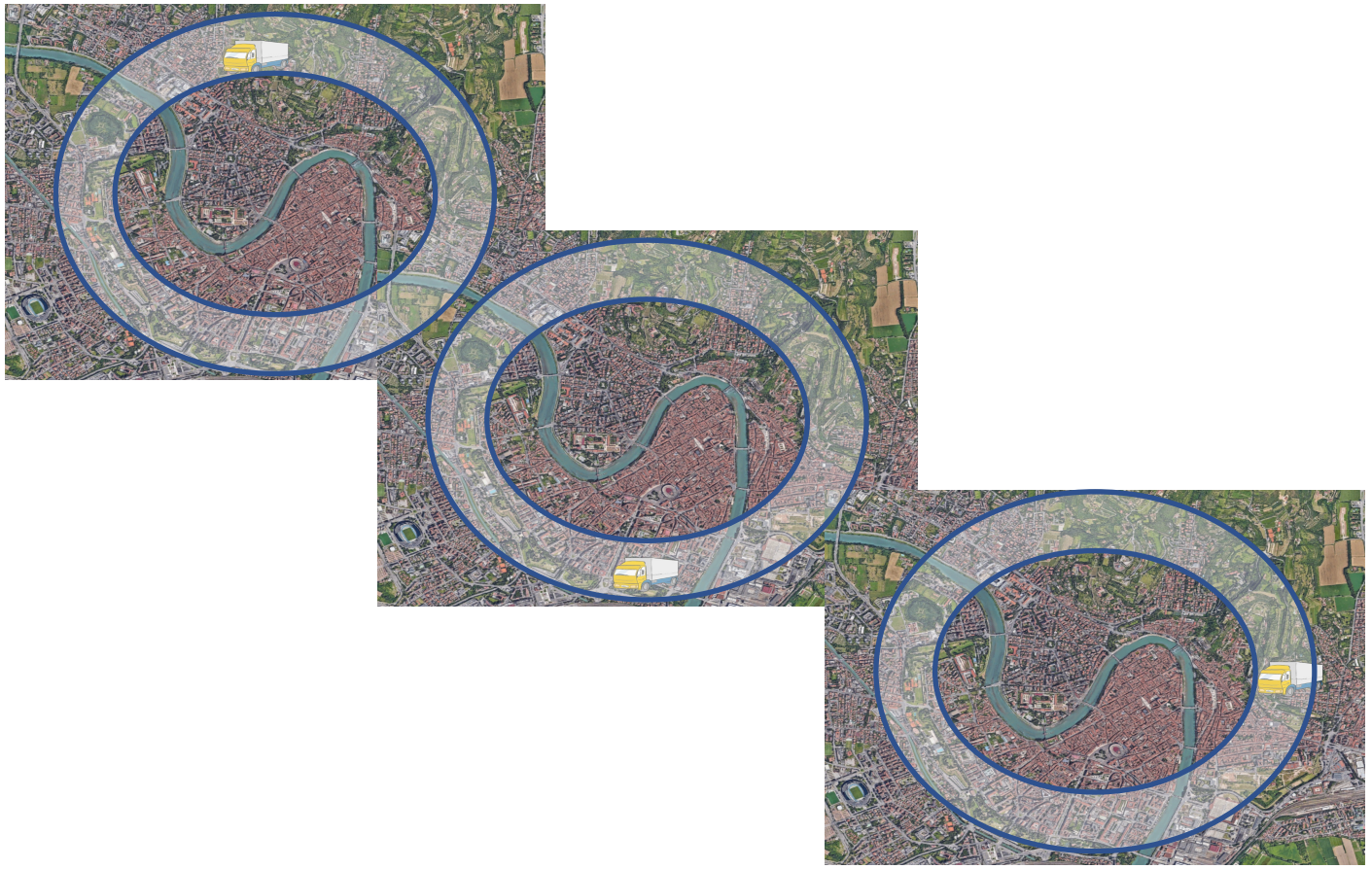
METHODS



“In each city, the truck has to stop at certain warehouses to drop off the goods”

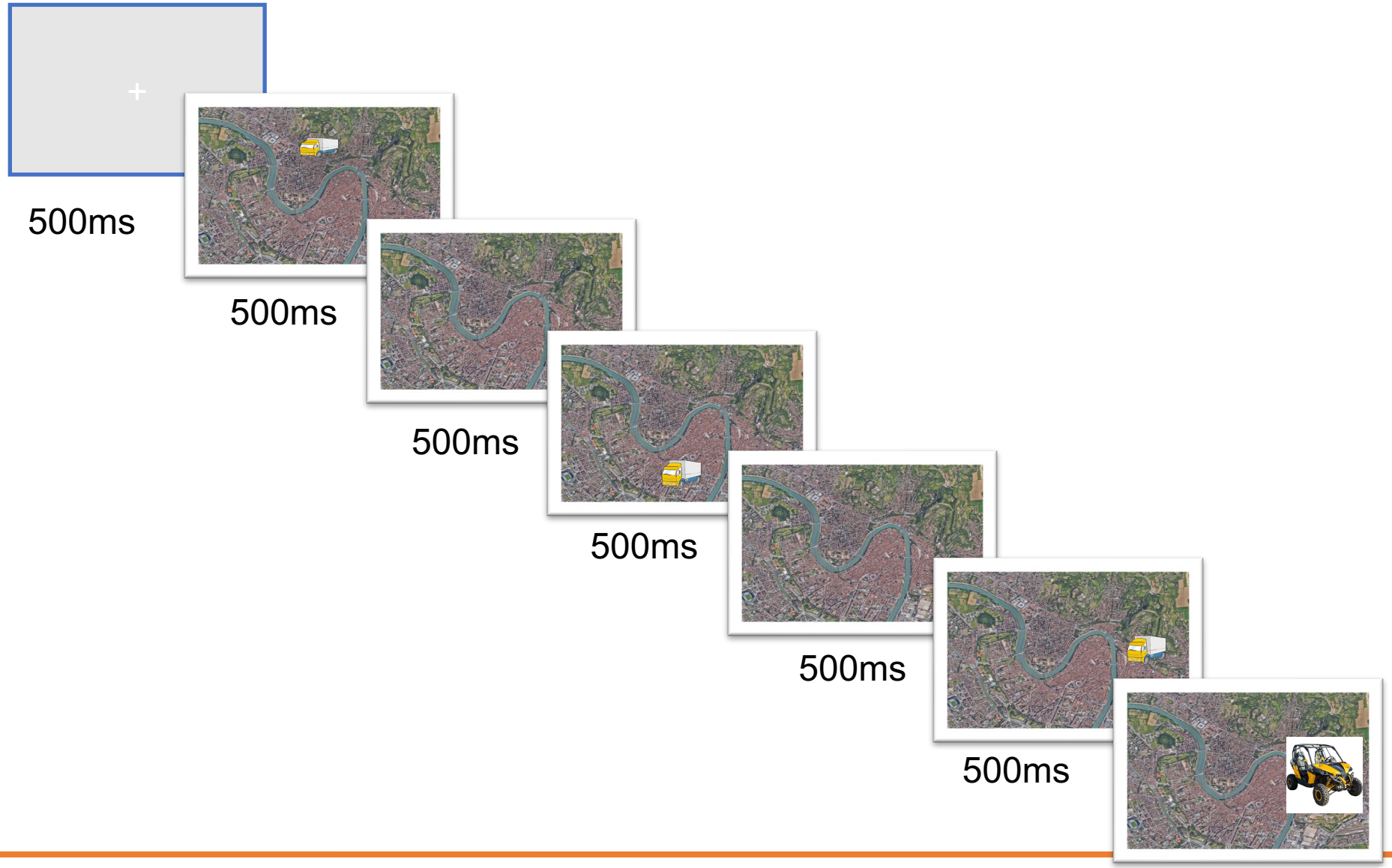
METHODS

METHODS



“The truck will travel through a ring that surrounds the city”

METHODS

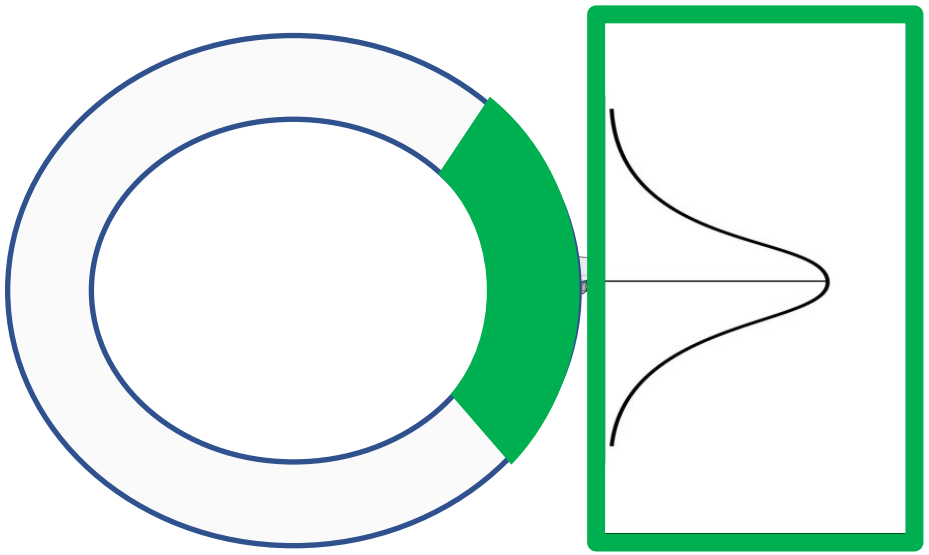


METHODS

Is the object that you have just seen typically found indoor or outdoor?

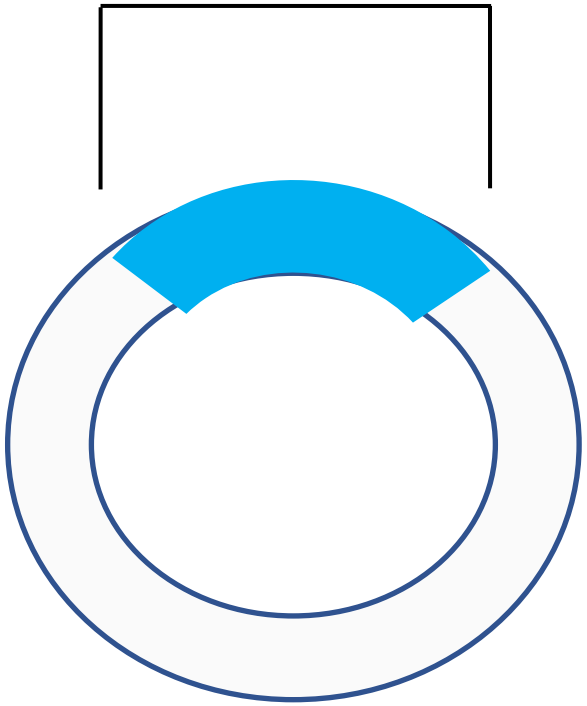
METHODS

N trials =170



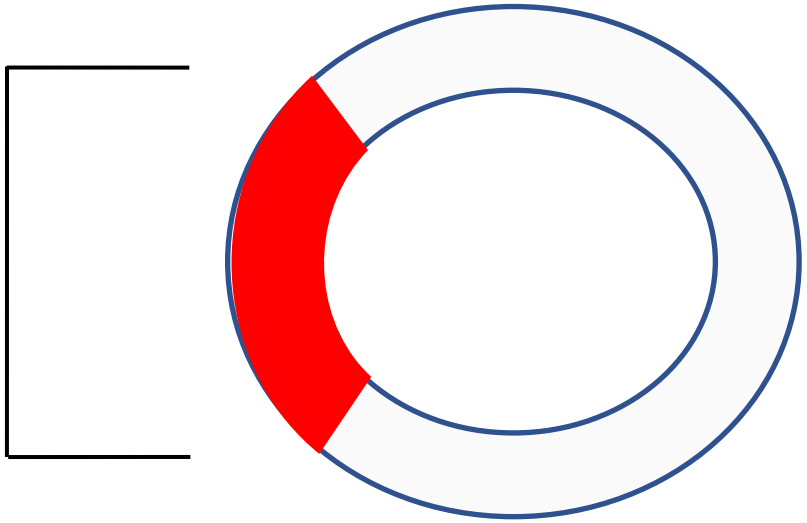
65% of the times
Von Mises distribution, κ = 10.
N = 110

METHODS



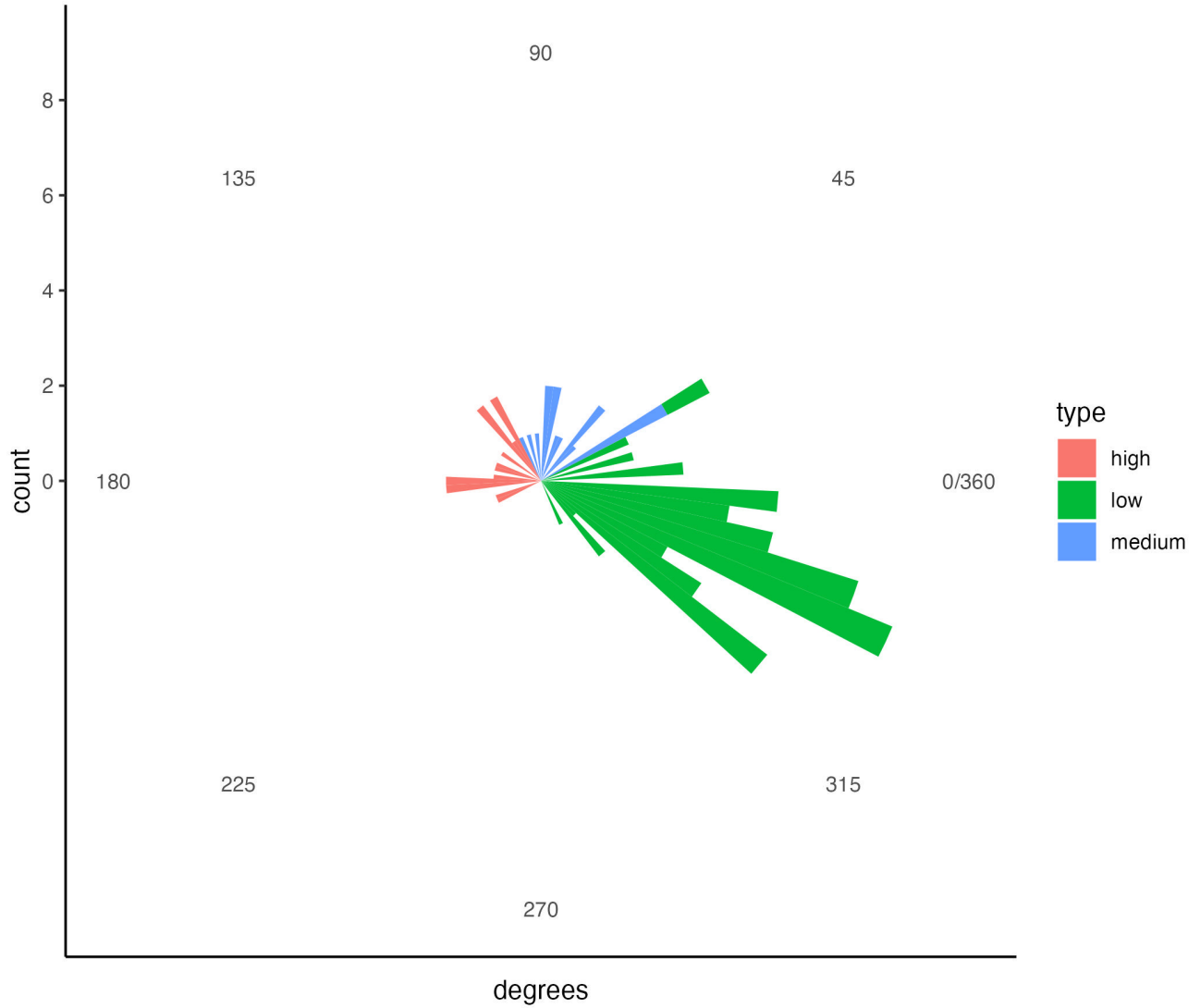
~17.5% of the times
Uniform distribution.
N = 30

METHODS

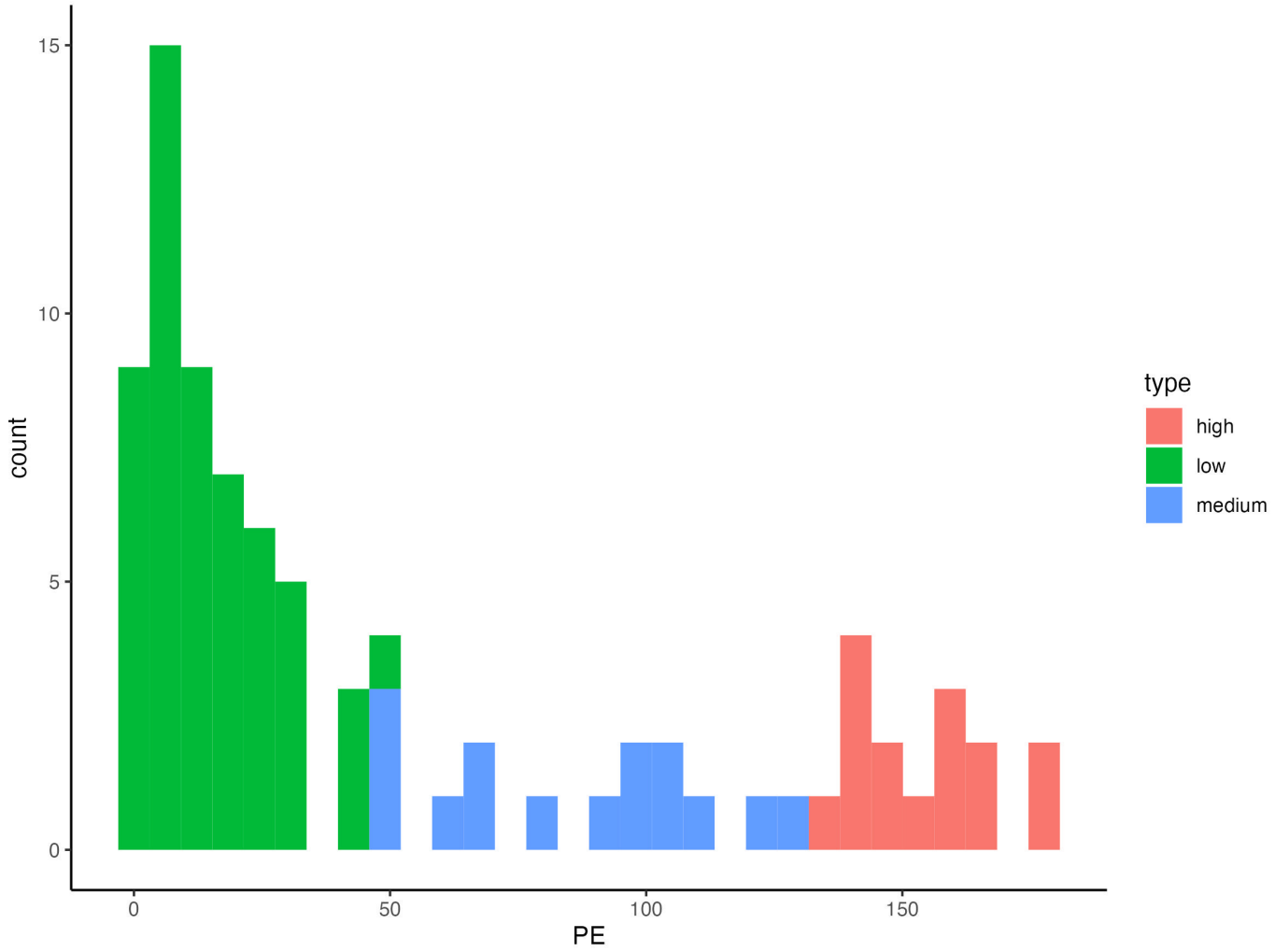


~17.5% of the times
Uniform distribution
N = 30

METHODS


90
135
45
180
0/360
225
315
270
8
6
4
2
0
count
degrees
type
high
low
medium

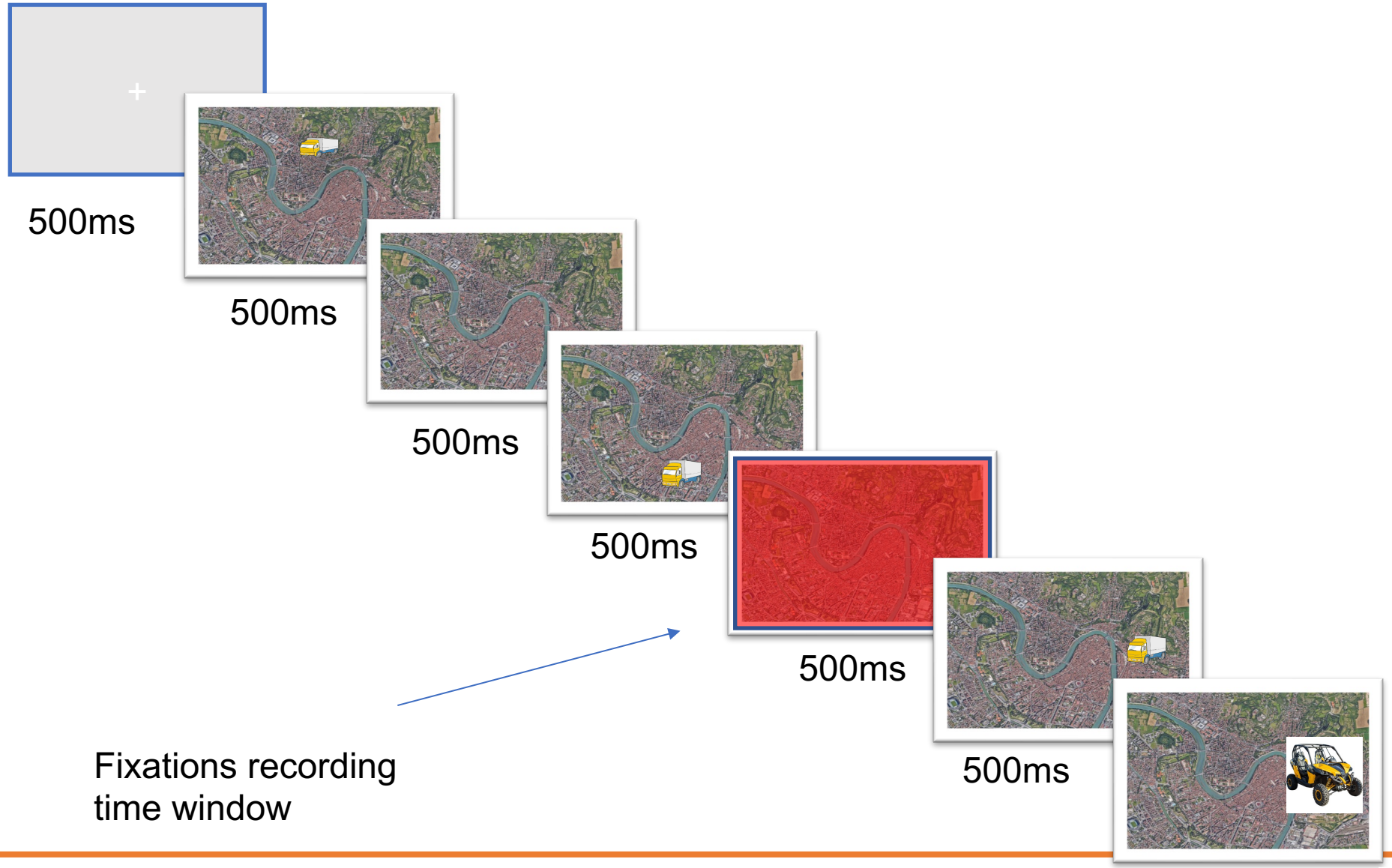
METHODS



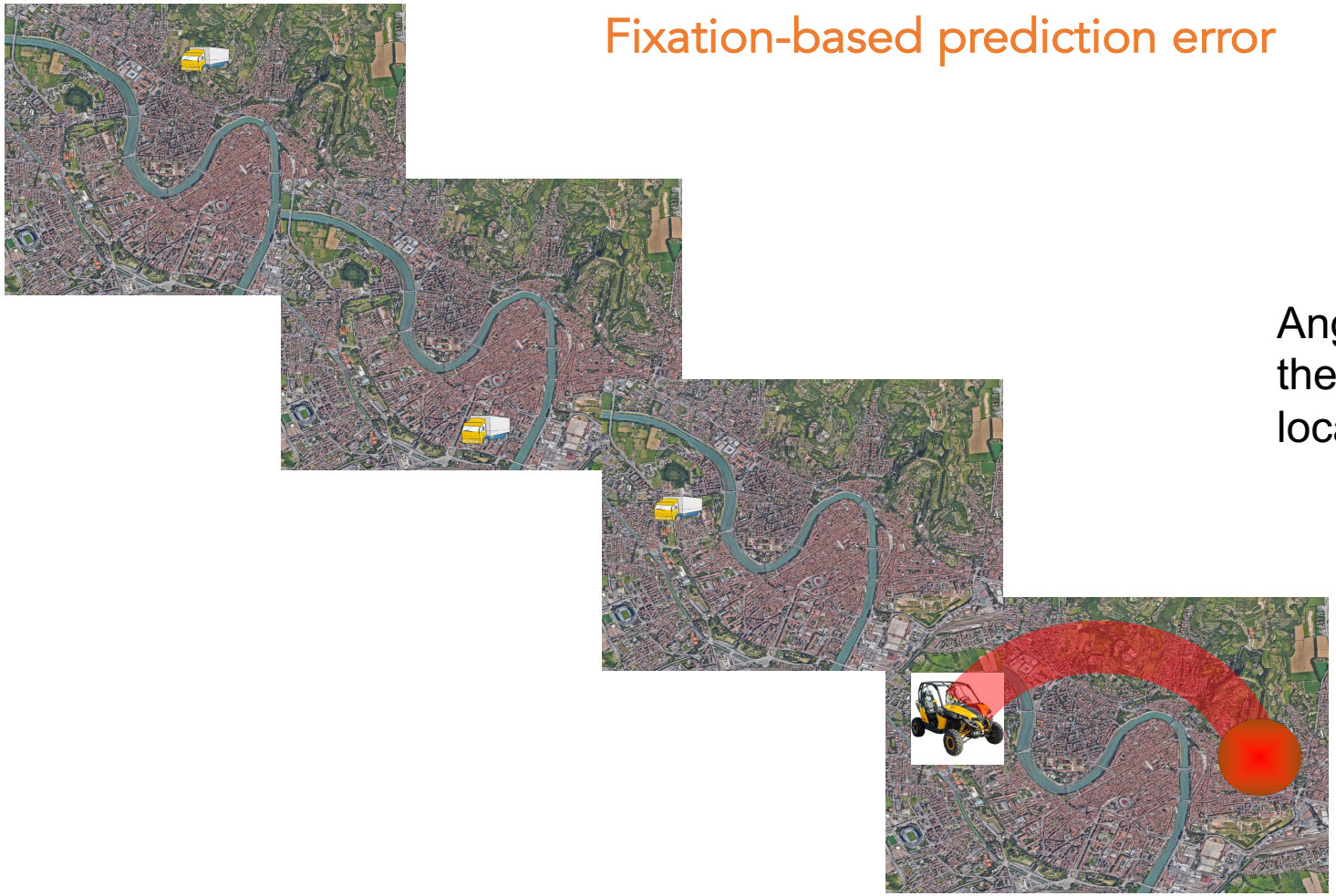
Experimentally-manipulated prediction error

Angular distance between the center of the low PE distribution and presented location

METHODS – EYE TRACKING



Fixation-based prediction error



Angular distance between the fixation and presented location

Recognition Task

Old/New judgements + Confidence ratings

Location Memory

Where was the item delivered?

Recognition Task

Location error = distance between location at encoding and reported location at retrieval

METHODS

In order to reduce the bias towards the most frequent location in the low PE trials, and make them more comparable with the high PE ones, we have two blocks with two different sequences

Block 1

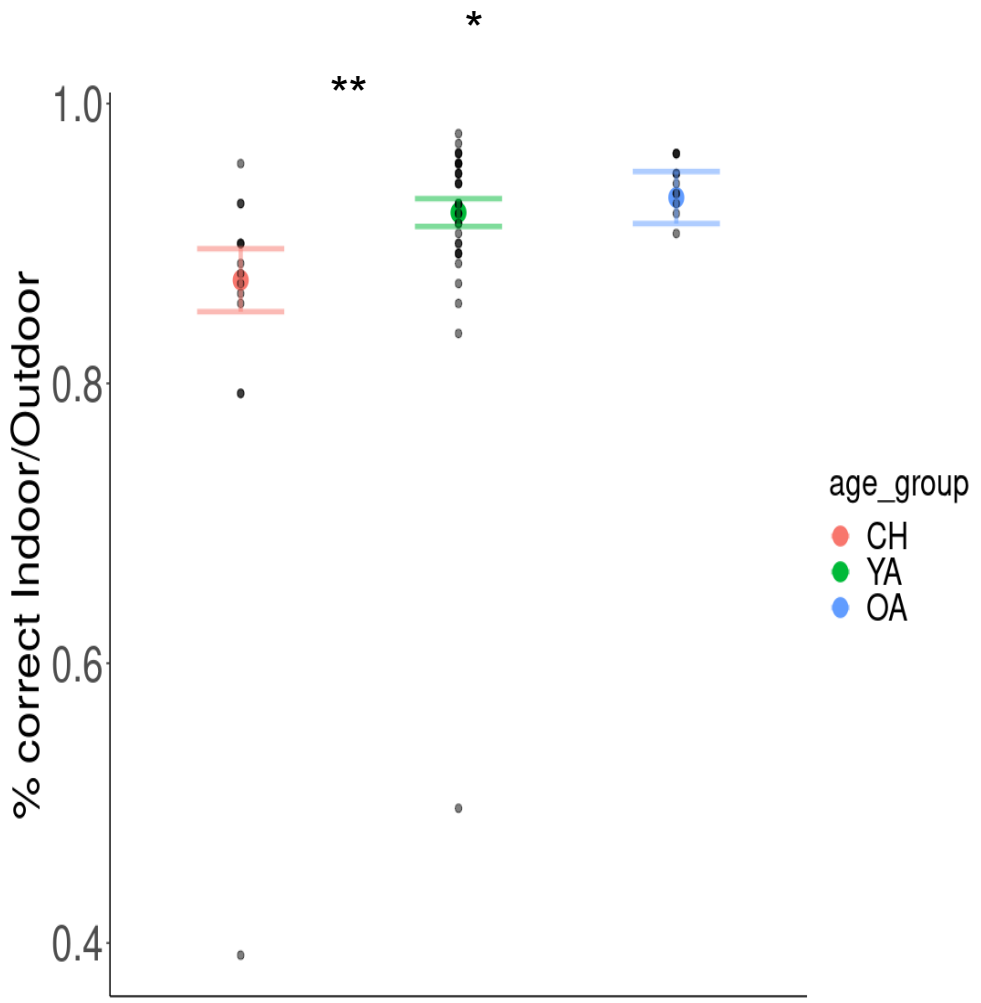
Block 2

METHODS

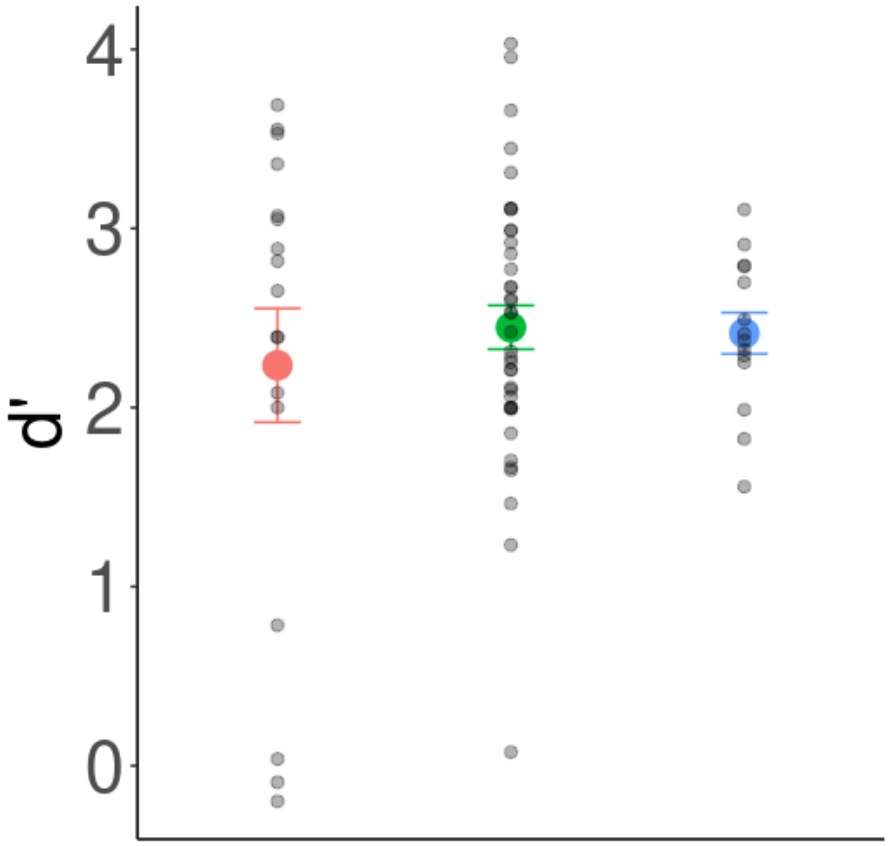
We also added singletons: trials in which the trajectory of the truck is not predictable. In these trials, the truck starts its journey from a quadrant that is different from the predictable trials. These trials occur randomly and constitute ~1/3rd of the total sample.

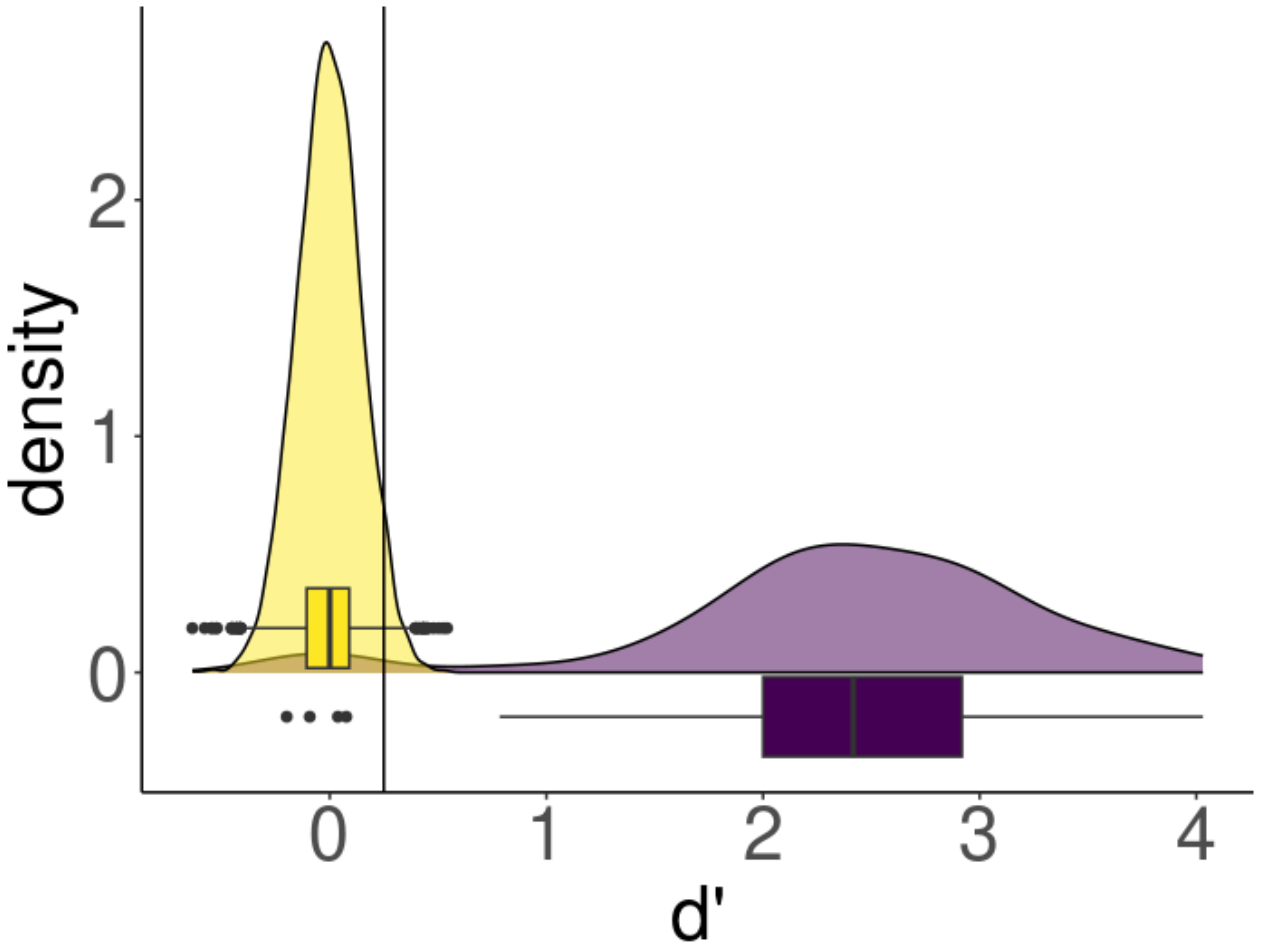
RESULTS-recognition memory

Sample: 14 CH (9-13 years old)
36 YA (18-30 years old)
14 OA (62-75 years old)

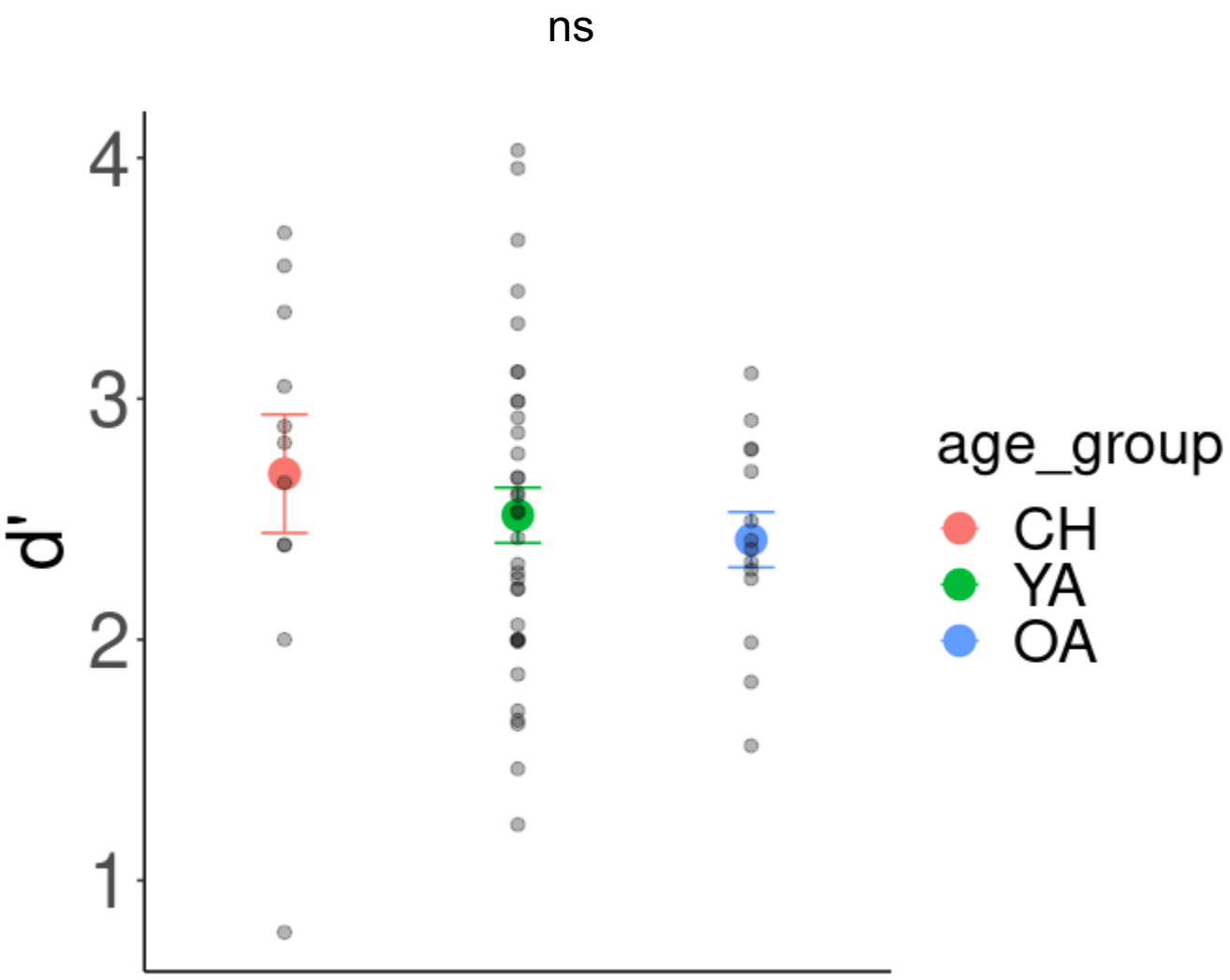


RESULTS-recognition memory

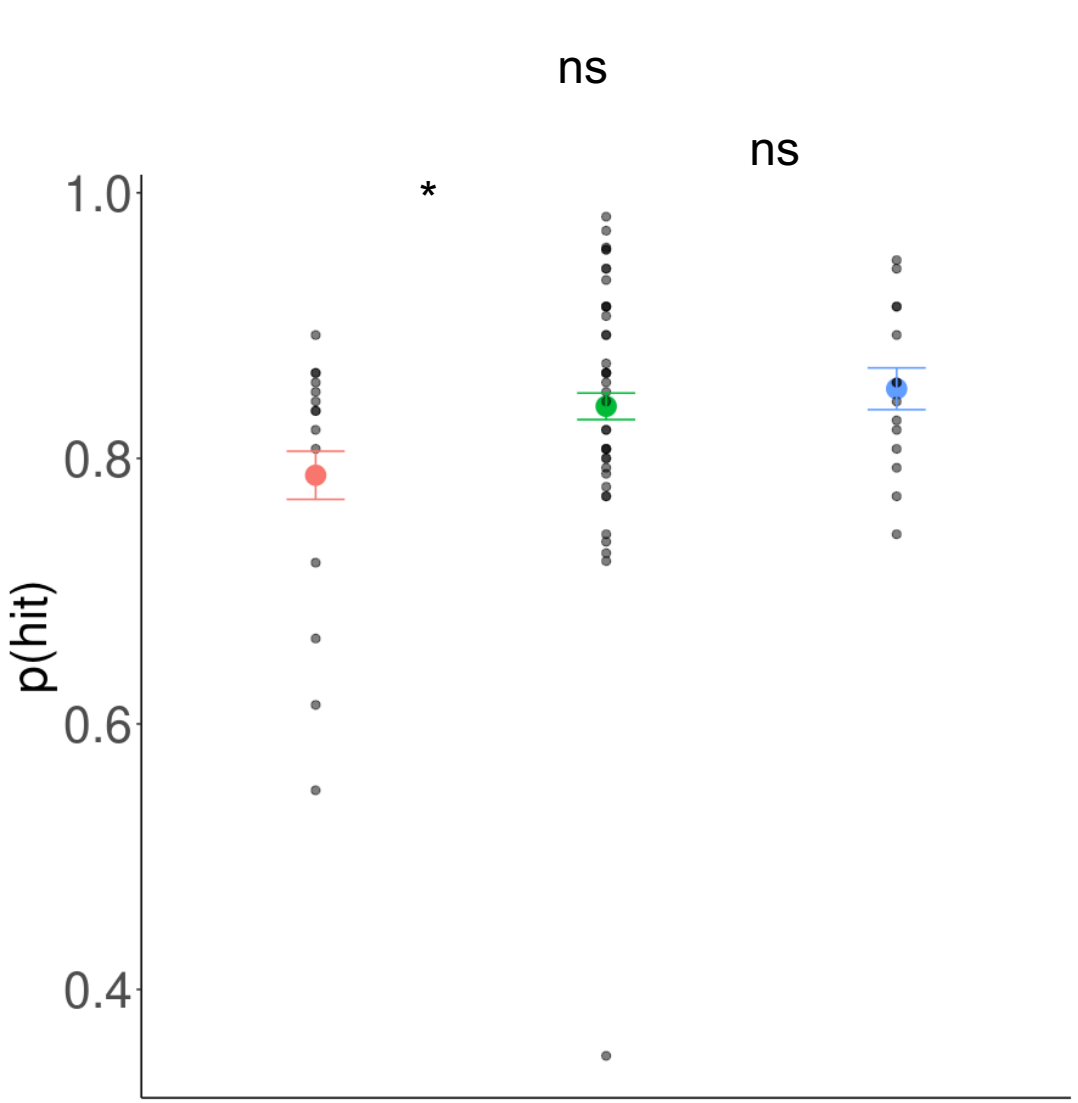


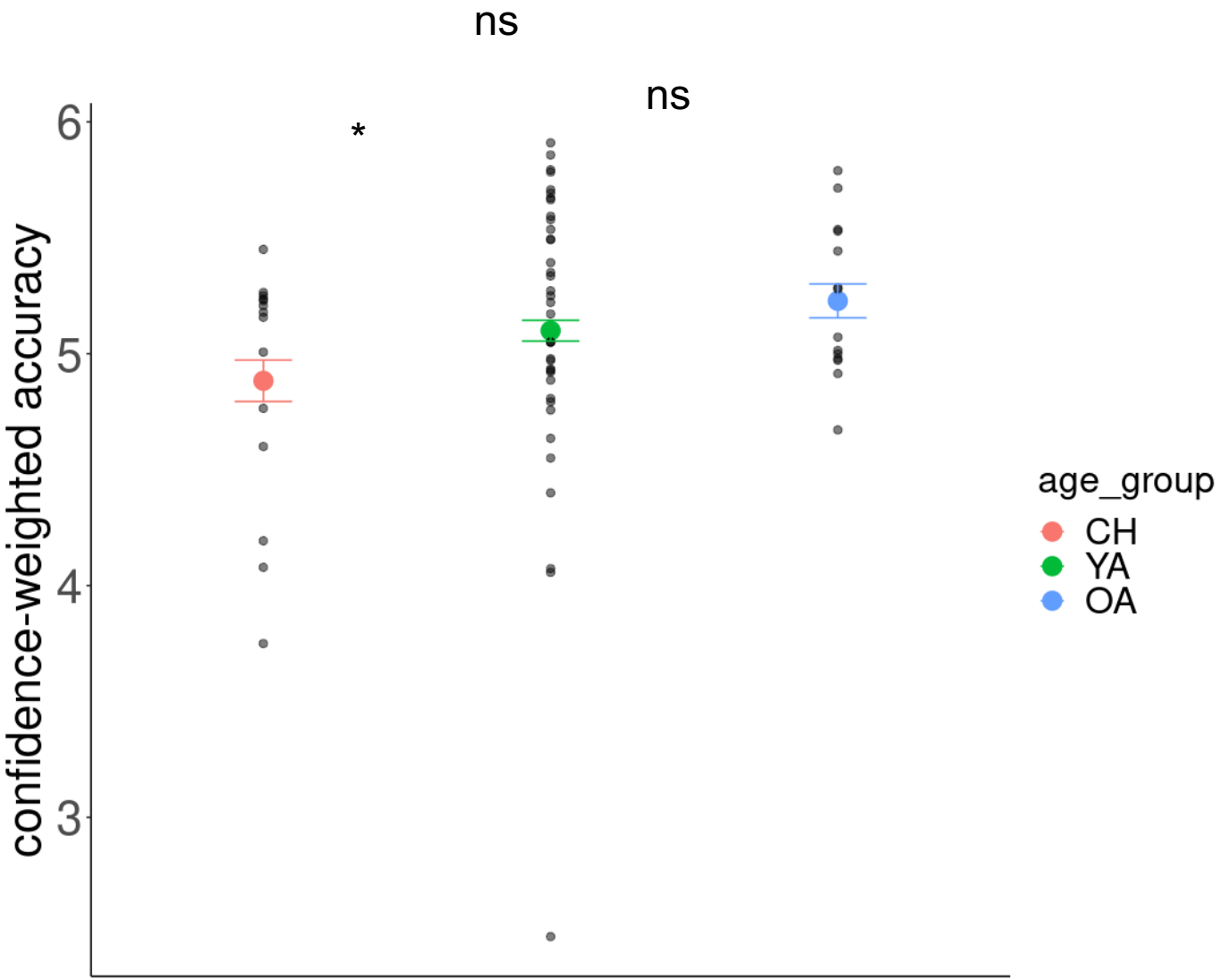


RESULTS-recognition memory

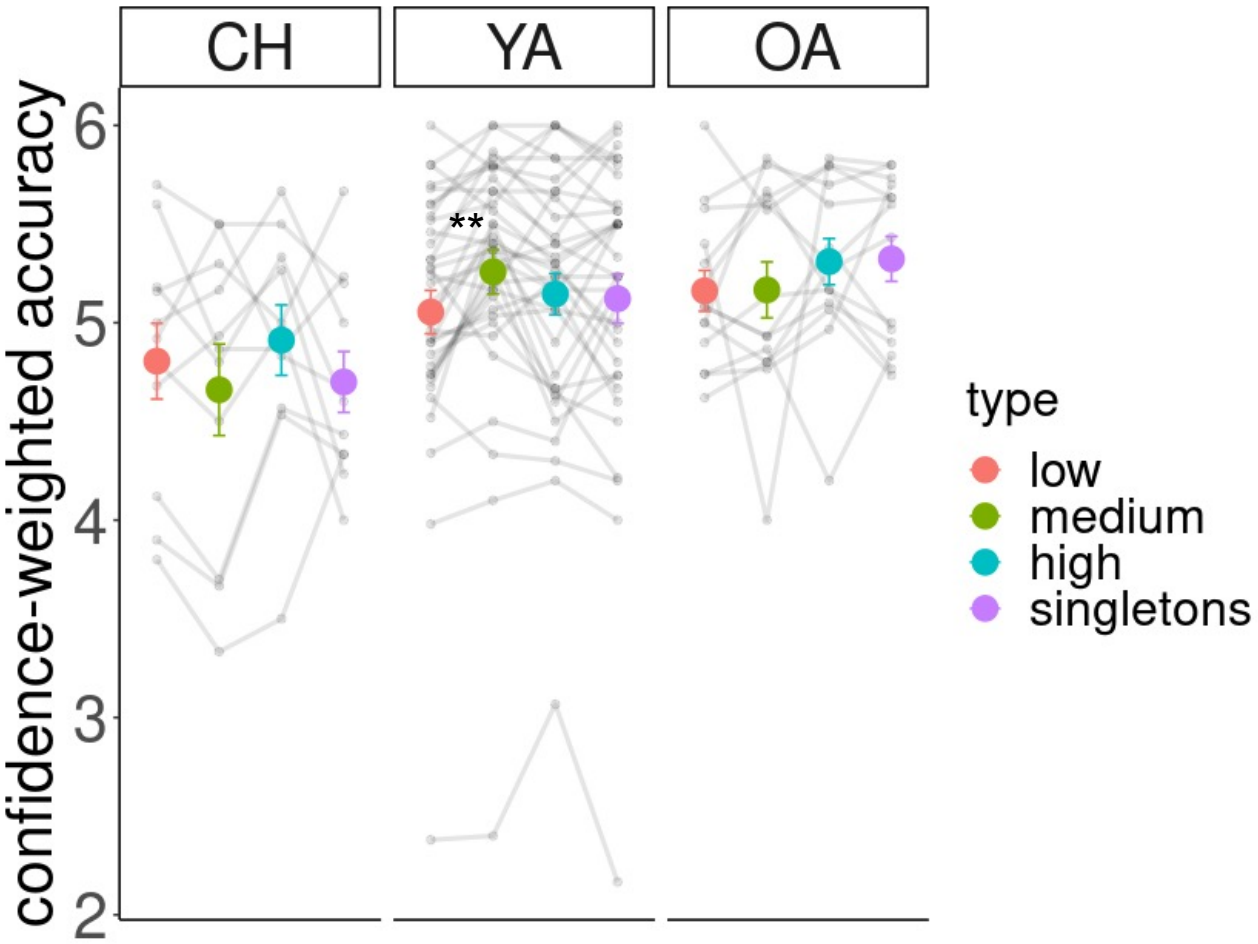


RESULTS


ns
ns
*
1.0
0.8
0.6
0.4
p(hit)


ns
ns
*
6
5
4
3
confidence-weighted accuracy
age_group
CH
YA
OA

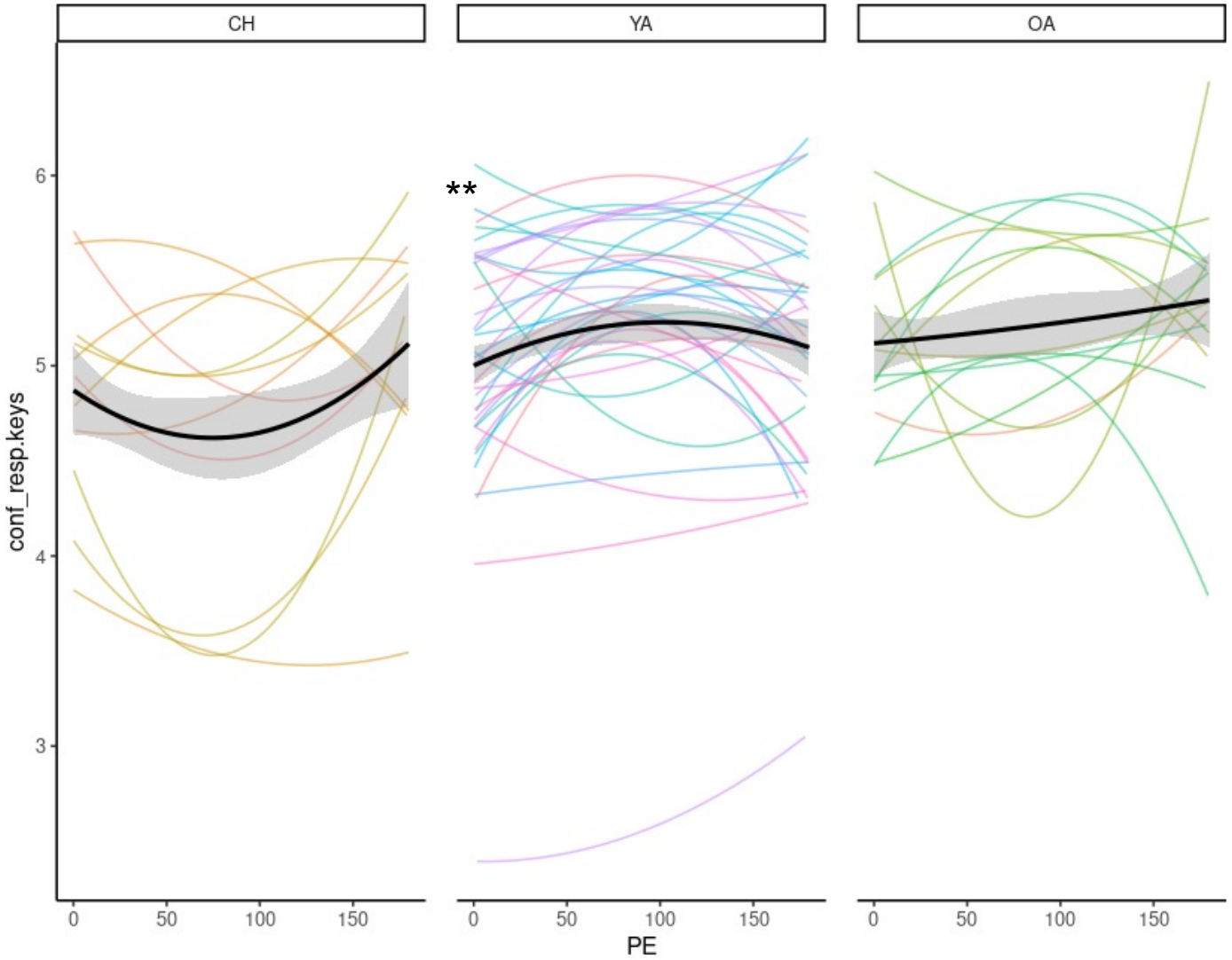
RESULTS-recognition memory



Response: conf_resp.keys

	Chisq	Df	Pr(>Chisq)	
age_group	2.8589	2	0.23943	
type	6.4852	2	0.03906	*
age_group:type	9.1151	4	0.05829	.

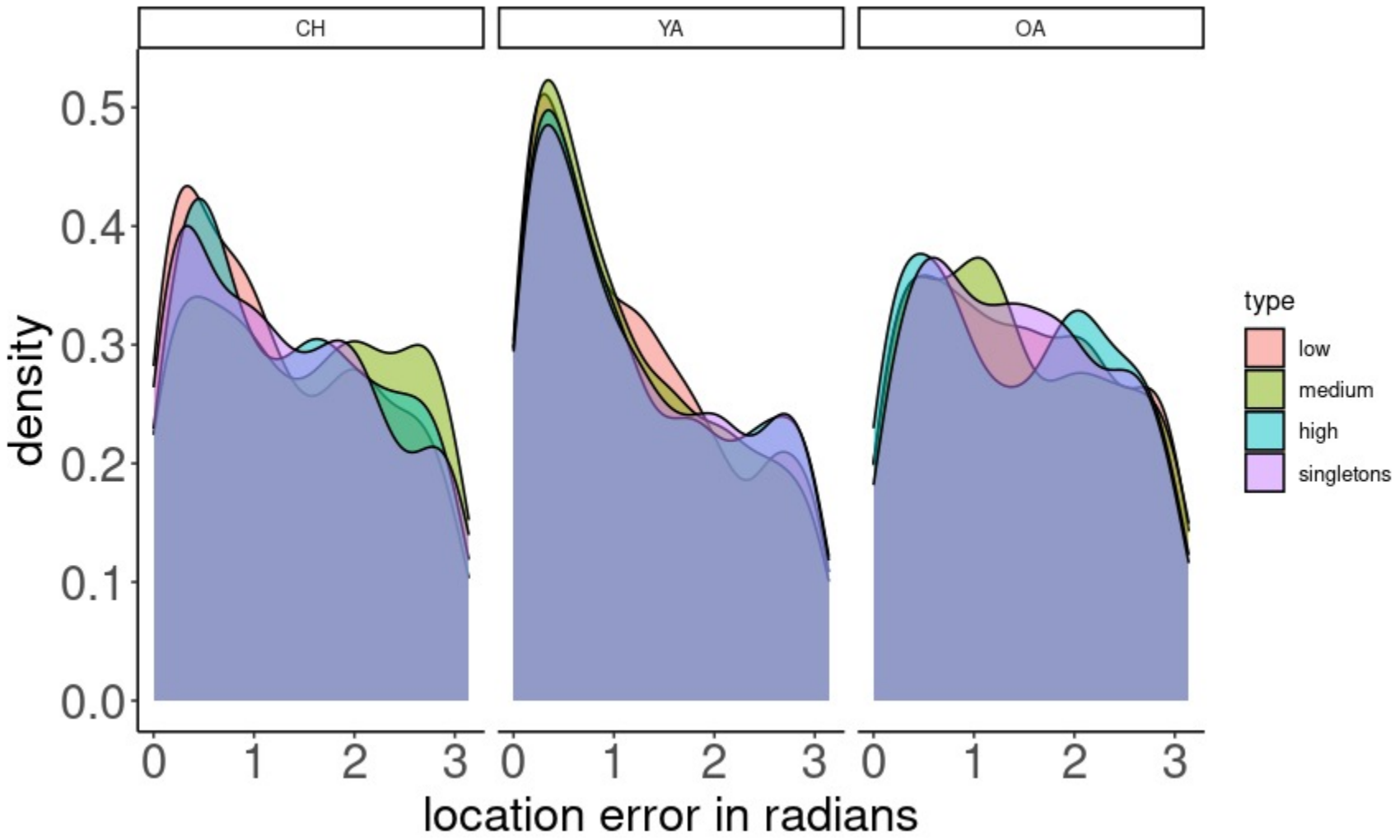
RESULTS-recognition memory: PE



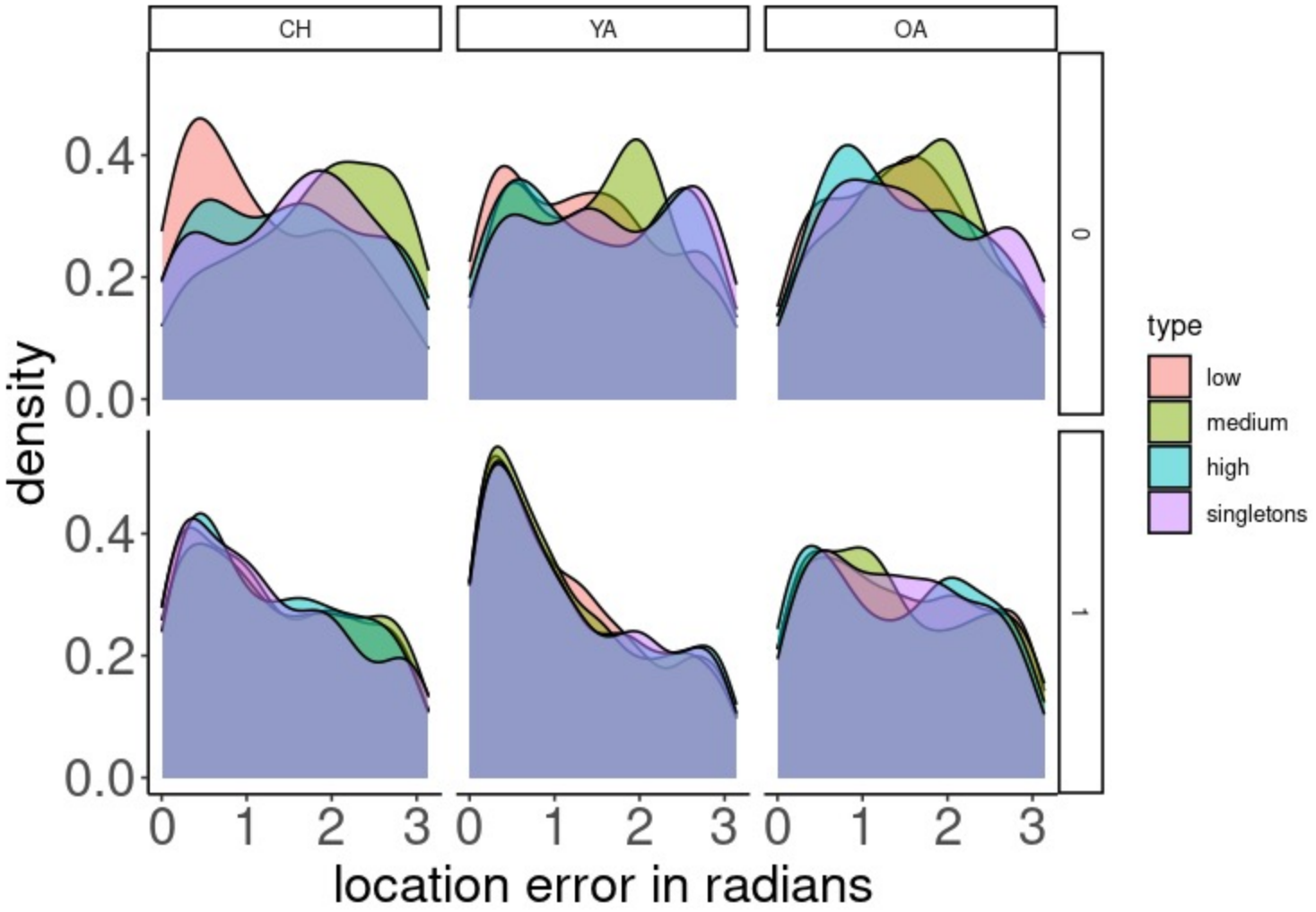
Response: conf_resp.keys

	Chisq	Df	Pr(>Chisq)
poly(PE_sc, 2)	7.6273	2	0.02207 *
age_group	3.7273	2	0.15510
poly(PE_sc, 2):age_group	10.2564	4	0.03632 *

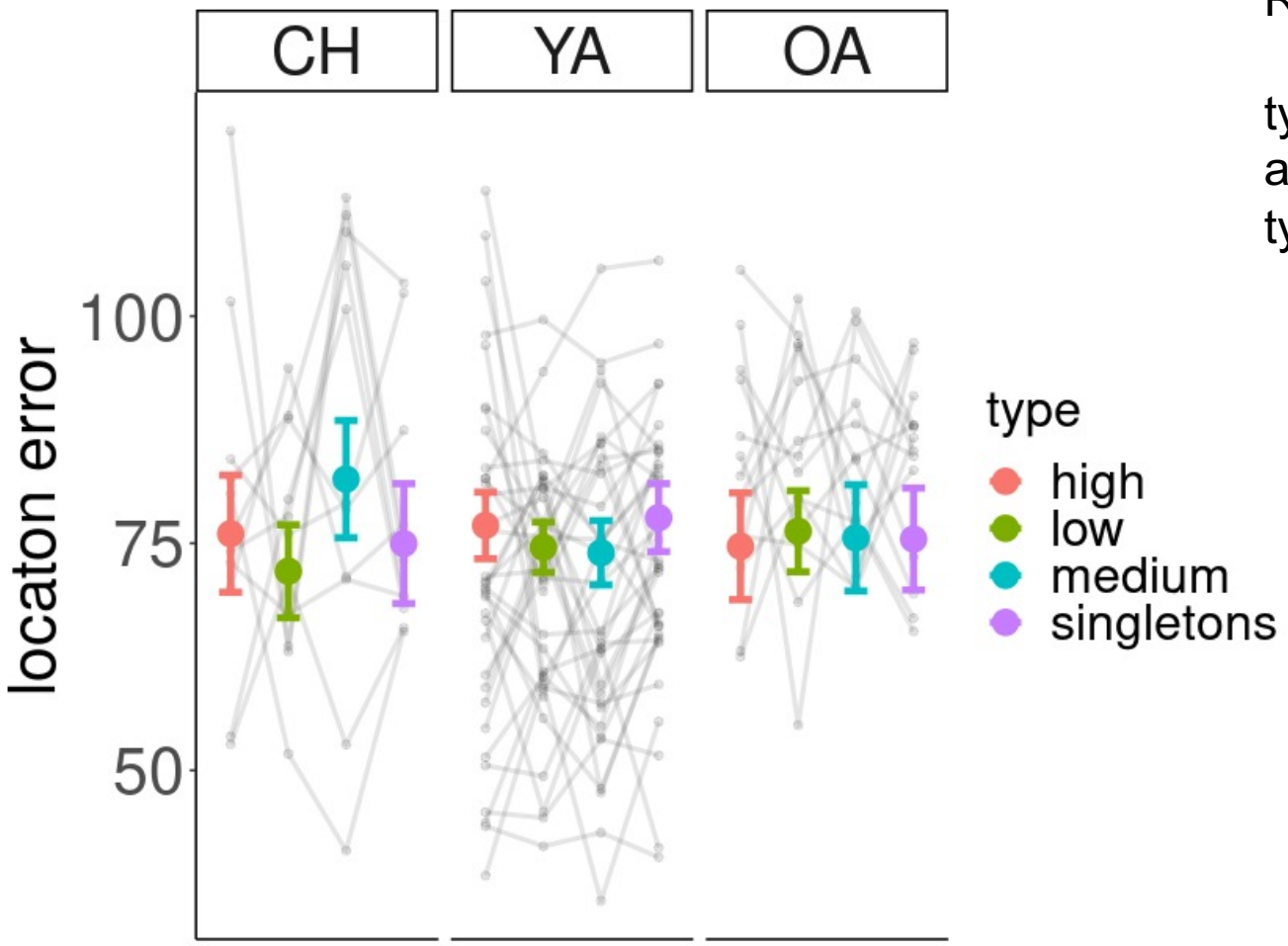
RESULTS - Location error



RESULTS - Location error: Misses vs Hits

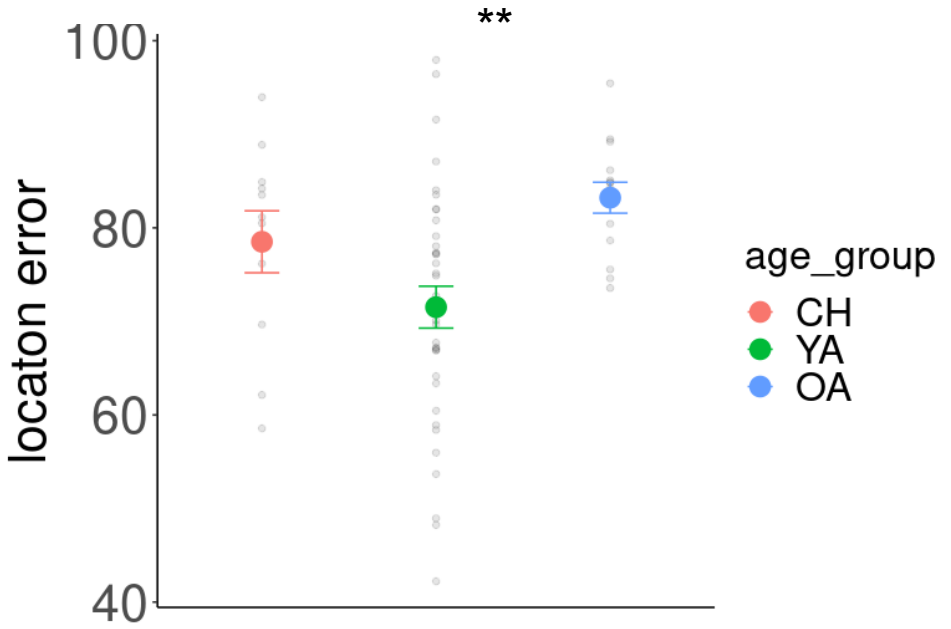


RESULTS - Location error

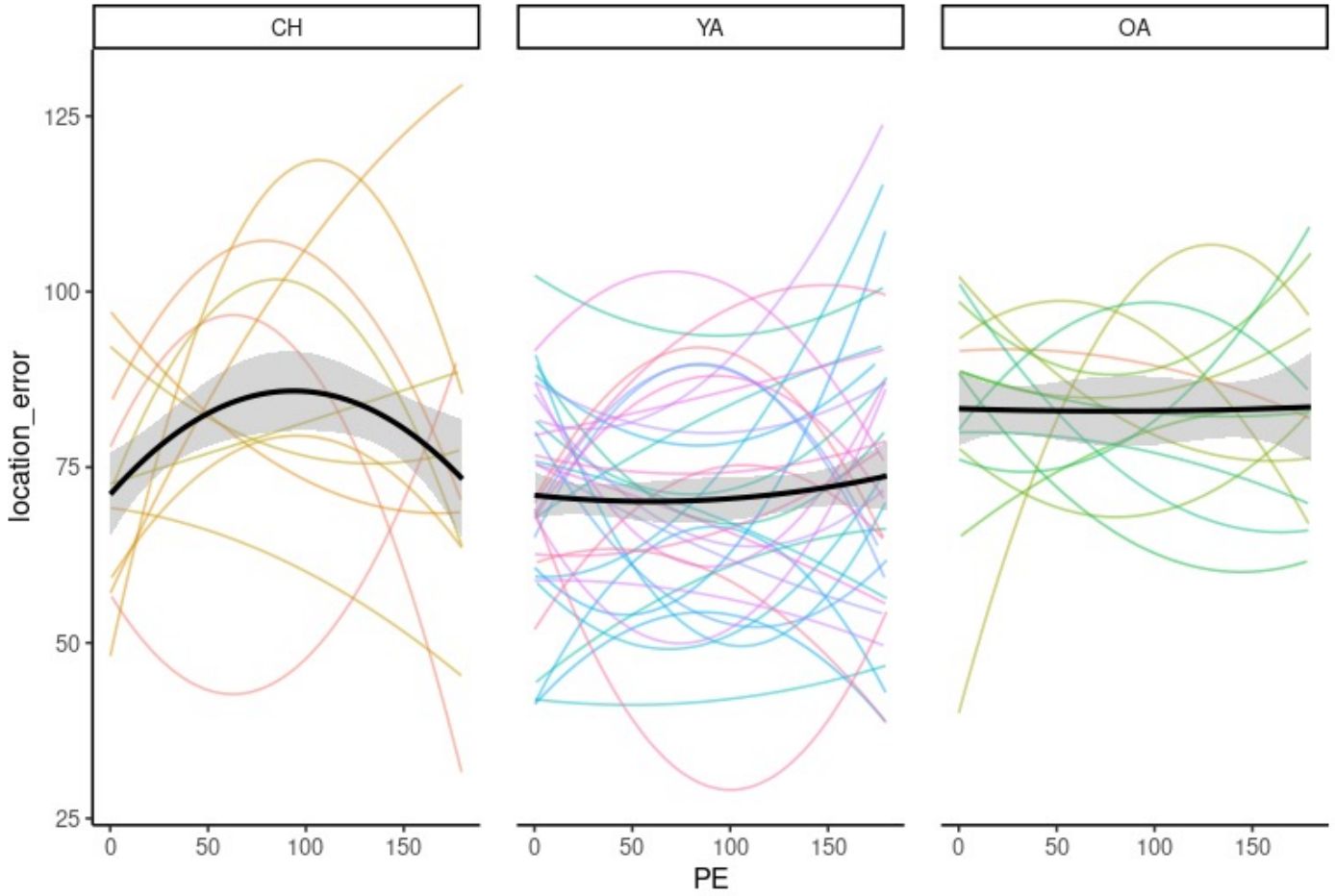


Response: location_error

	Chisq	Df	Pr(>Chisq)	
type	0.2877	2	0.866007	
age_group	13.7775	2	0.001019	**
type:age_group	2.1456	4	0.709001	



RESULTS - Location error



Response: location_error

	Chisq	Df	Pr(>Chisq)	
poly(PE, 2)	0.7006	2	0.704477	
age_group	11.3998	2	0.003346	**
poly(PE, 2):age_group	6.4337	4	0.169019	

Fixations

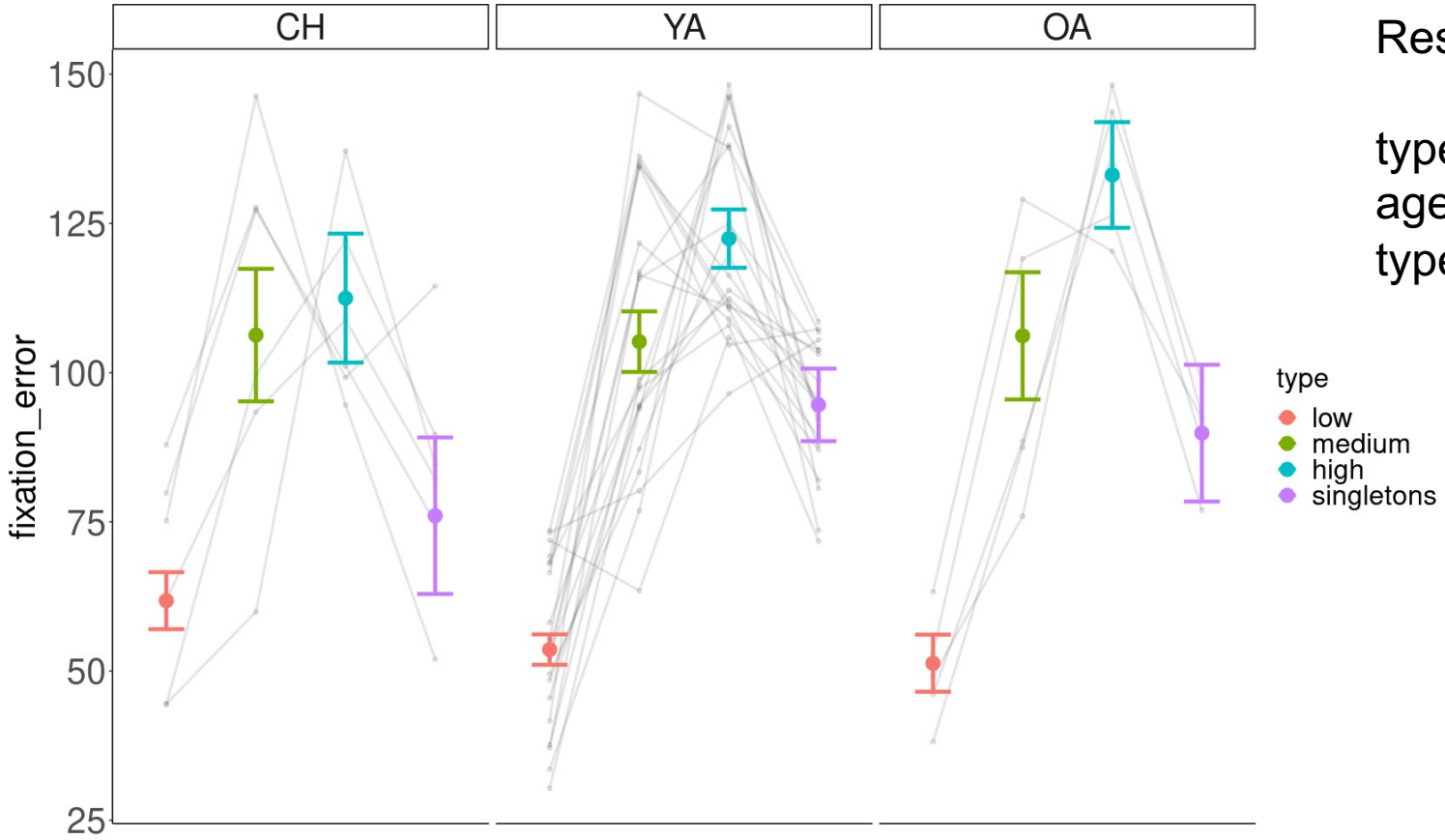
Sample: 6 CH (9-13 years old)
20 YA (18-30 years old)
5 OA (62-75 years old)

The standard parser setting uses velocity and acceleration thresholds of 30°/s and 8000°/s^2, respectively.
Samples above threshold are determined to be in saccade, and samples below threshold are determined to be in fixation
So the onset of a fixation is determined by the offset of the previous saccade, and the offset of a fixation is determined by the onset of the subsequent saccade.

We took the last fixation within the time window and extracted the angle in relation to the circle

RESULTS - FIXATIONS

Fixation error = angular distance between the location of the third truck and the last fixation before the truck appears



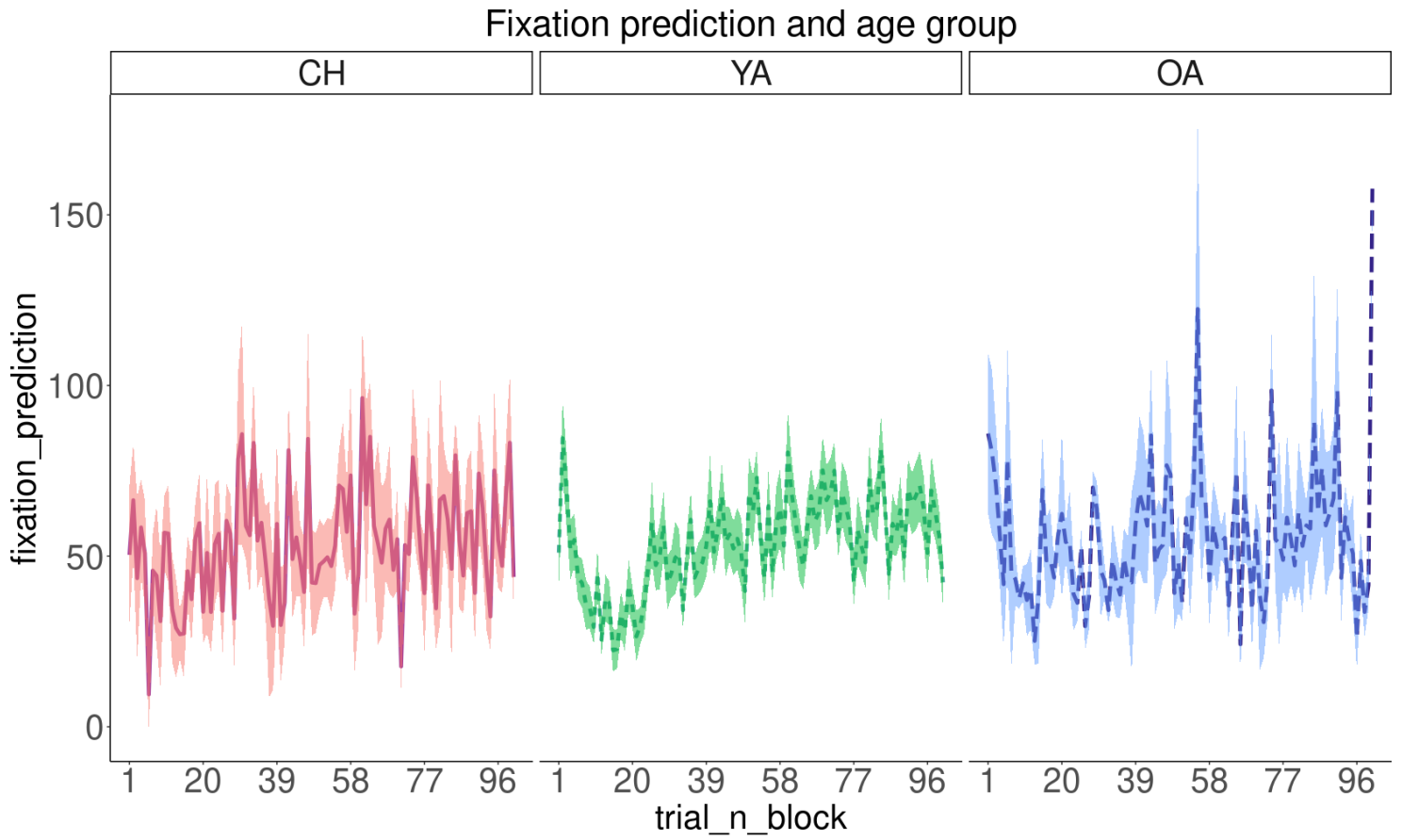
Response: fixation_error

	Chisq	Df	Pr(>Chisq)
type	264.2416	3	< 2e-16 ***
age_group	1.6959	2	0.42829
type:age_group	11.9090	6	0.06403 .

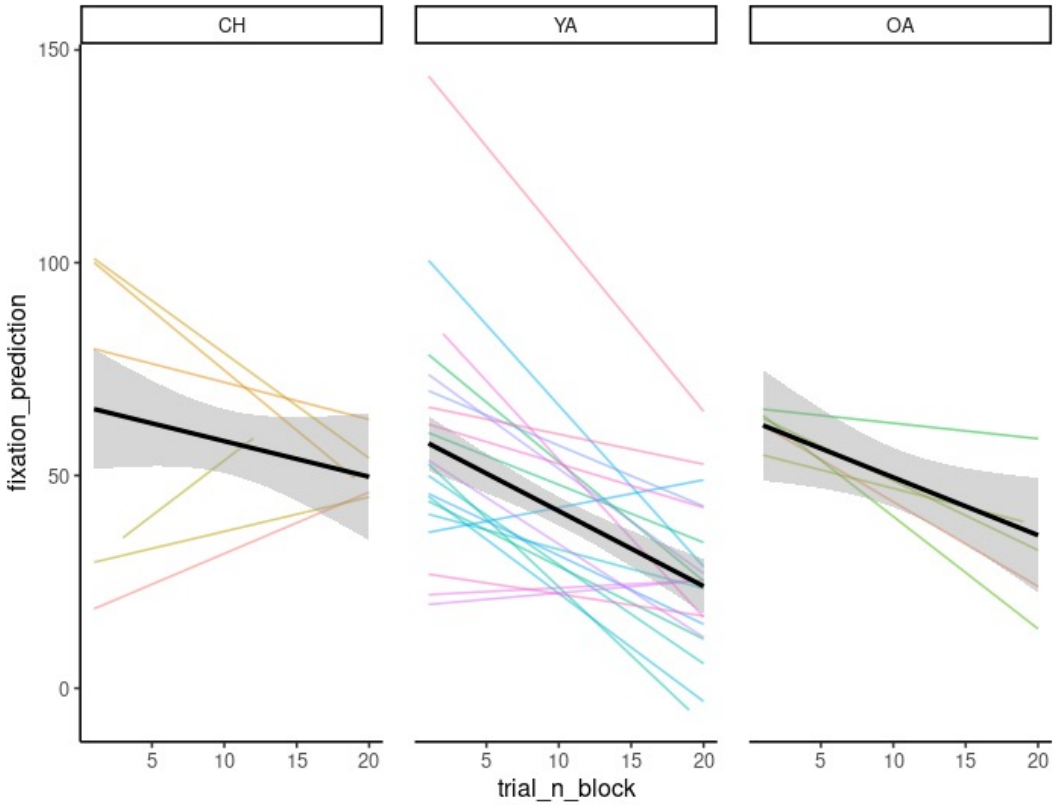
Many NAs!

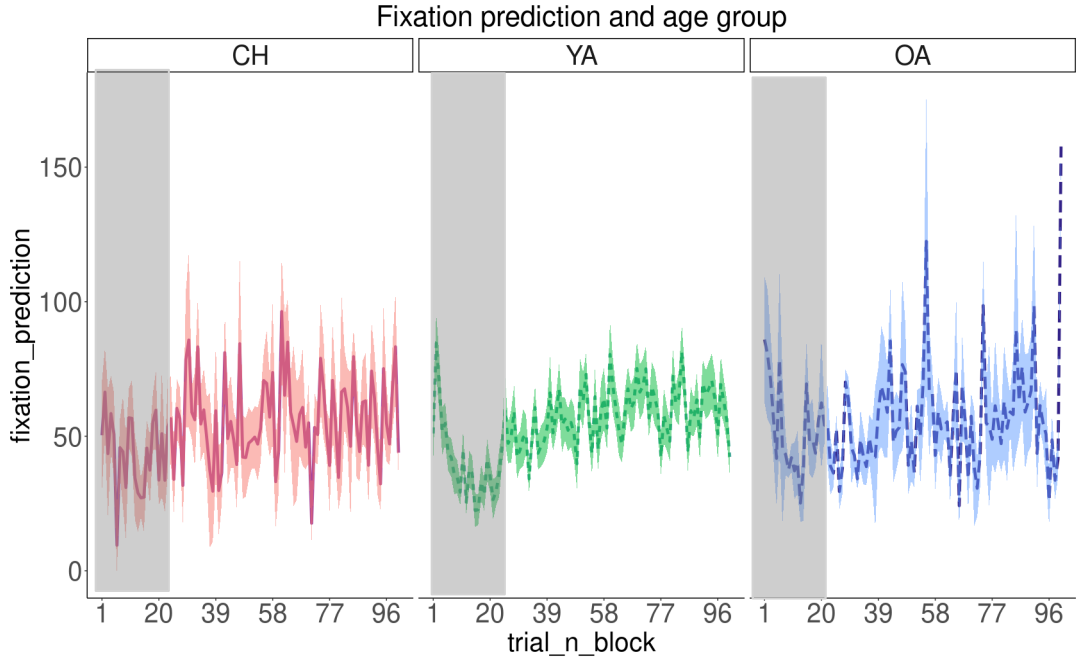
RESULTS - FIXATIONS

Fixation Prediction: angular distance between the center of distribution of the most frequent location and the last fixation before the truck appears



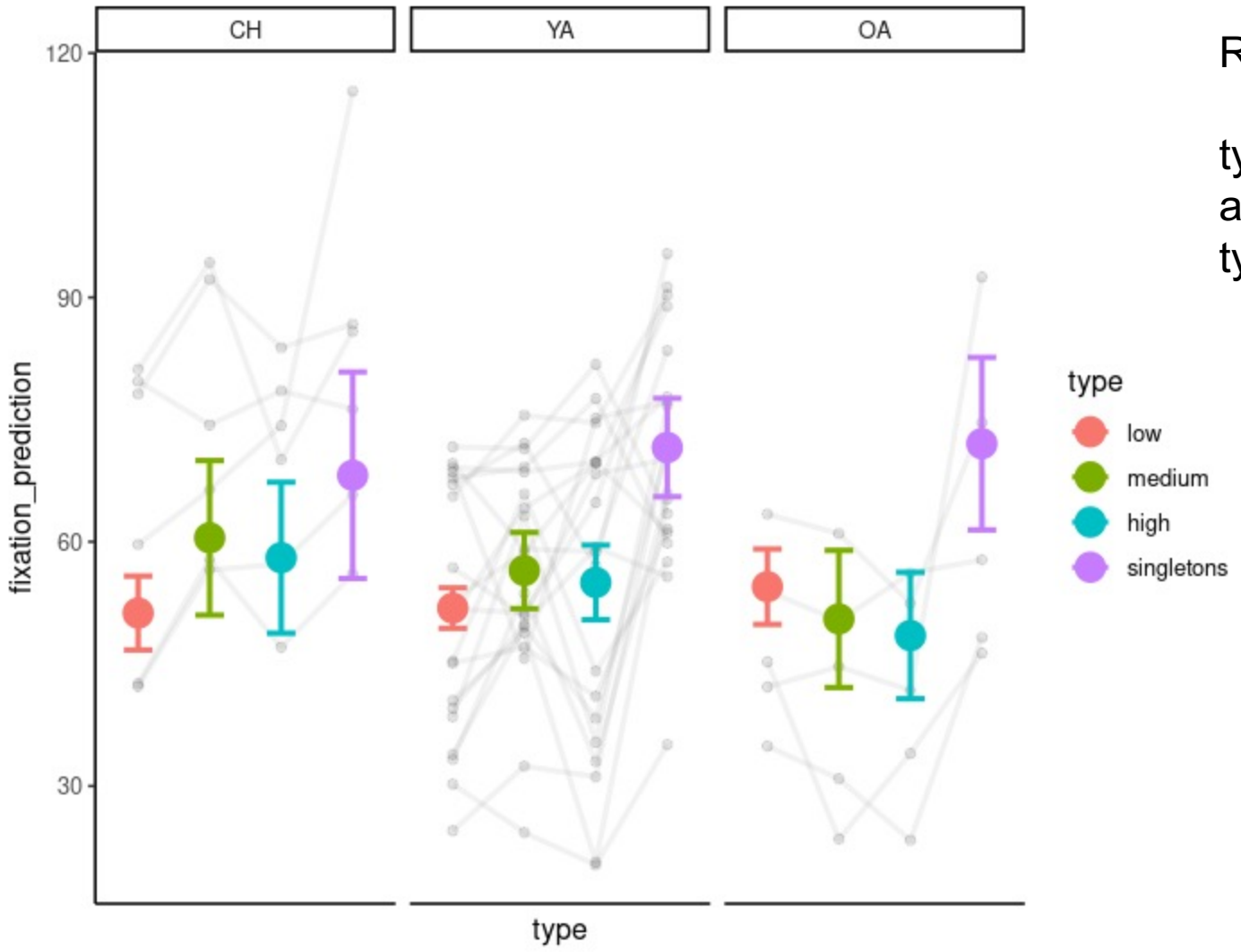
RESULTS - FIXATIONS





trial_n_block -1.241 0.253 160.478 -4.903 2.30e-06 ***

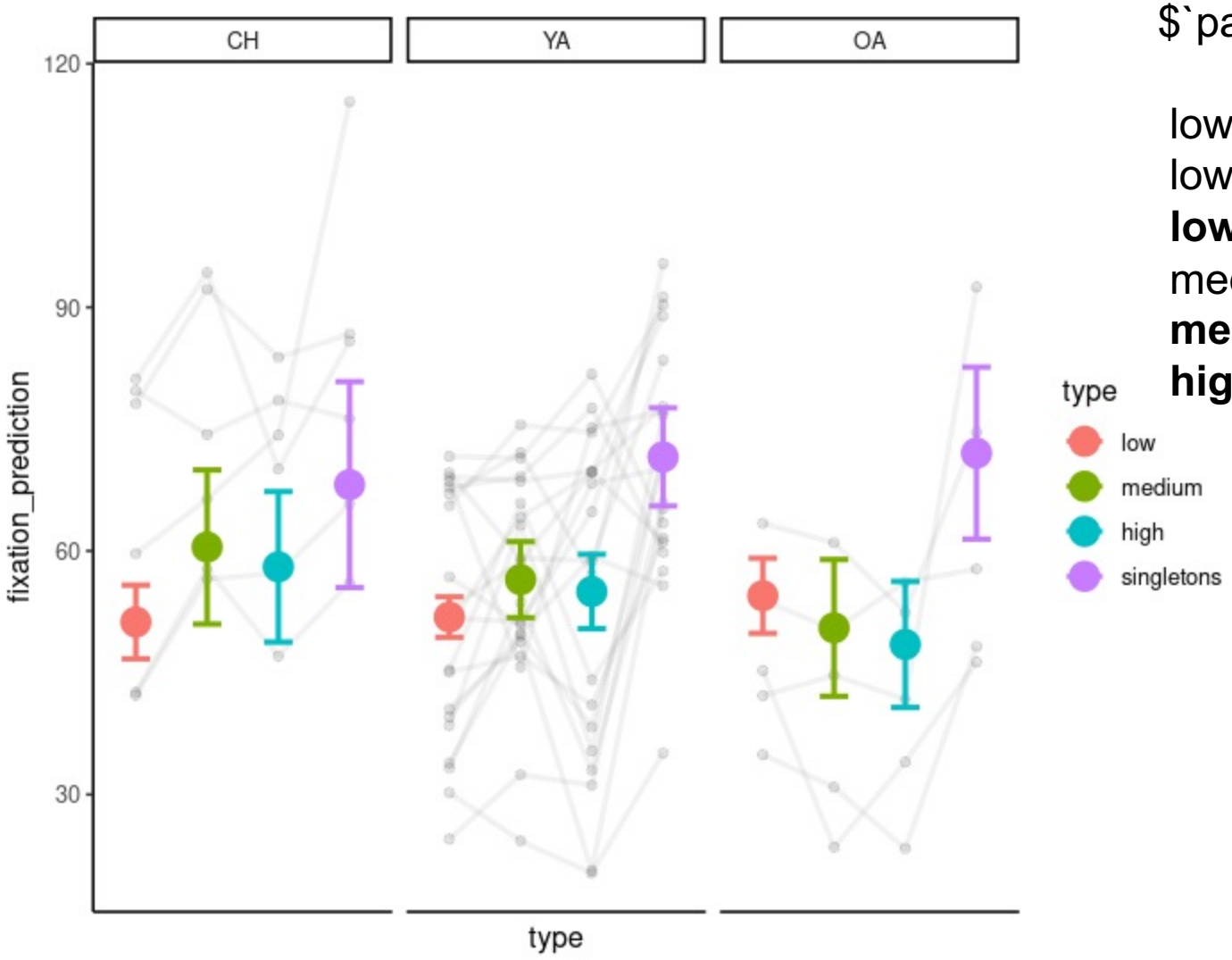
RESULTS - FIXATIONS



Response: fixation_prediction

	Chisq	Df	Pr(>Chisq)	
type	34.7855	3	1.352e-07	***
age_group	5.9997	2	0.04979	*
type:age_group	6.6115	6	0.35827	

RESULTS - FIXATIONS



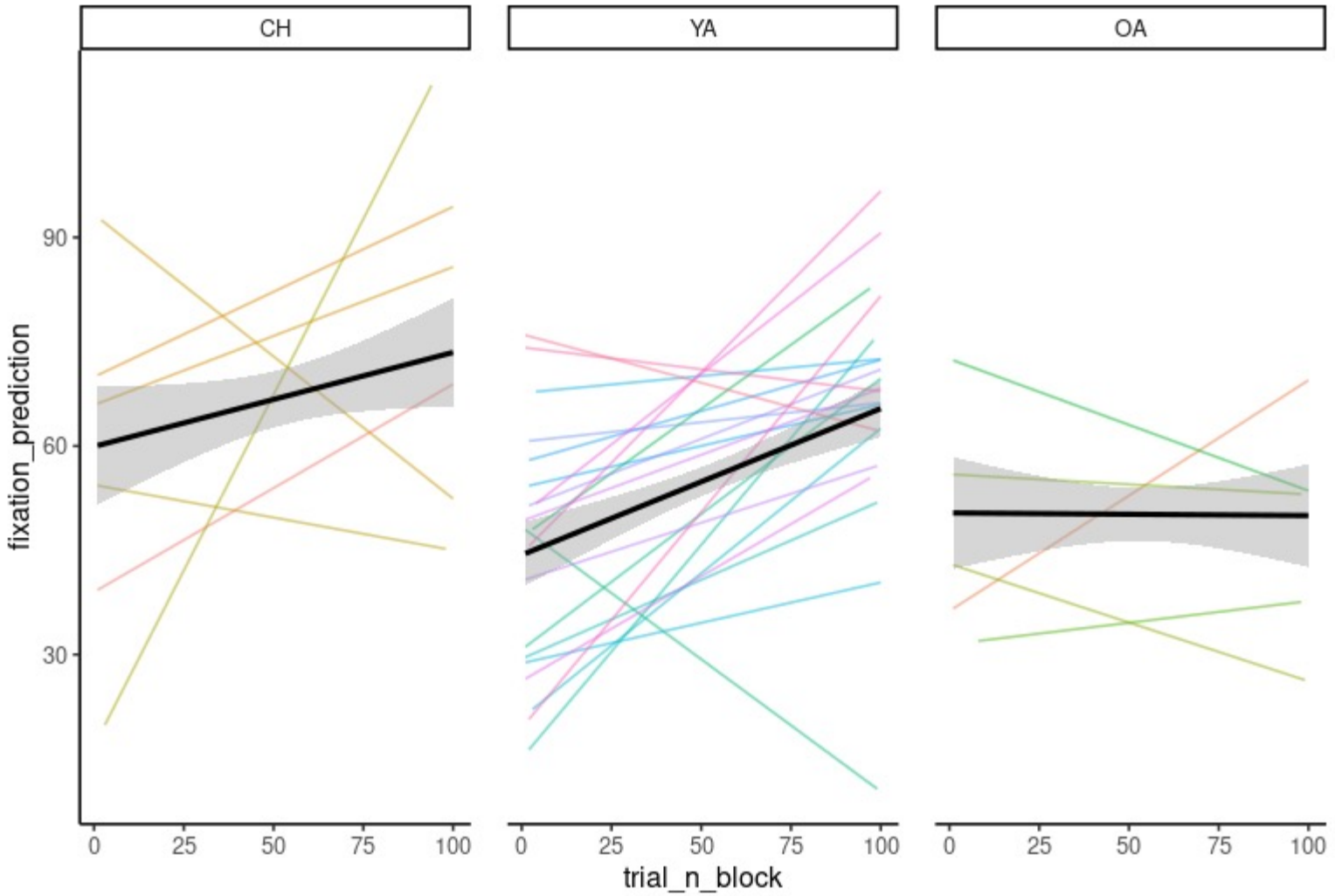
$`pairwise differences of type`

	estimate	SE	df	z.ratio	p.value
low - medium	-4.17	2.03	Inf	-2.053	0.2406
low - high	-2.64	2.00	Inf	-1.320	1.0000
low - singletons	-18.84	3.12	Inf	-6.033	<.0001
medium - high	1.53	2.53	Inf	0.604	1.0000
medium – singletons	-14.66	3.07	Inf	-4.770	<.0001
high - singletons	-16.19	3.41	Inf	-4.755	<.0001

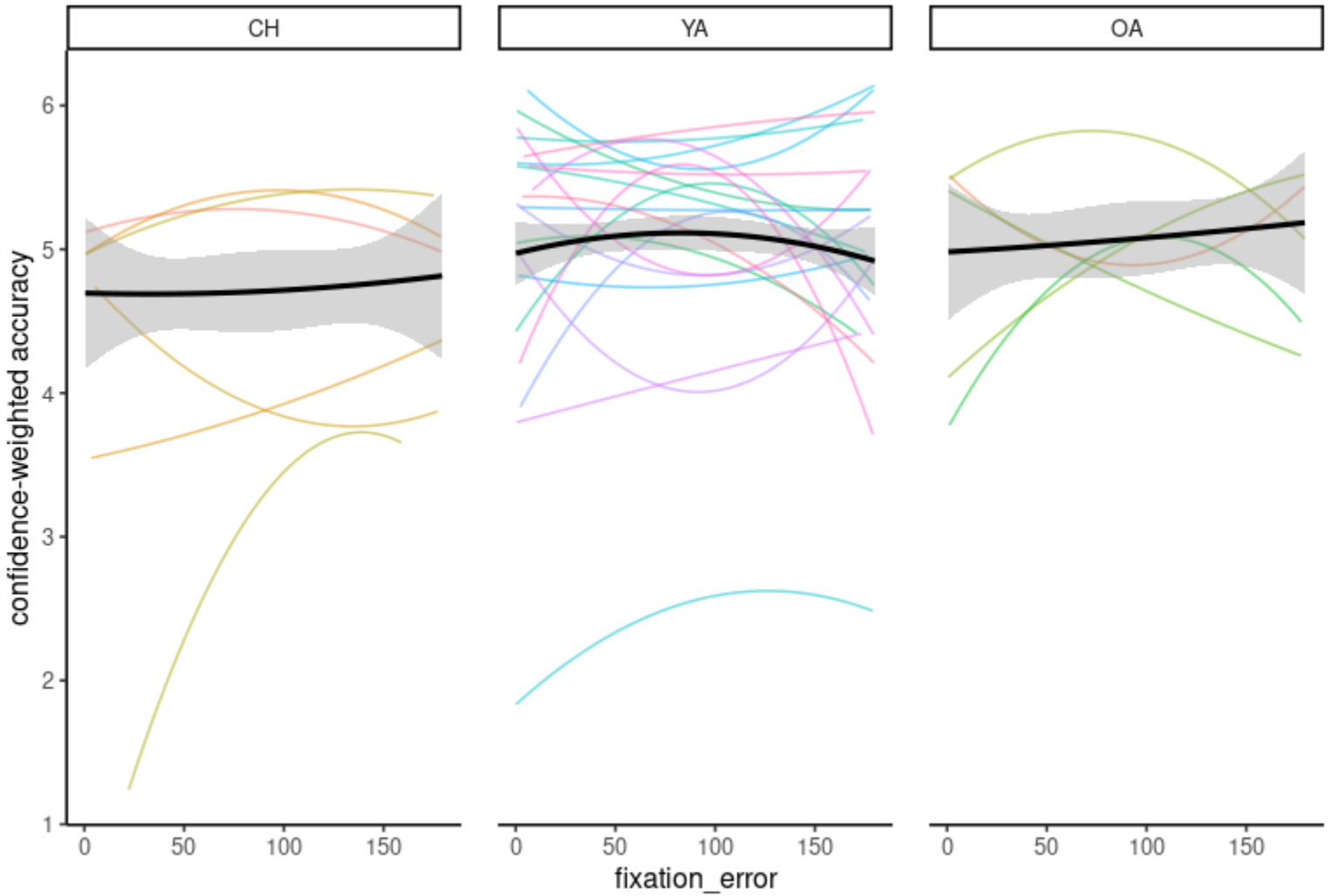
$`pairwise differences of age_group`

	estimate	SE	df	z.ratio	p.value
CH - YA	14.41	6.58	Inf	2.189	0.0731
CH - OA	22.12	8.56	Inf	2.582	0.0265
YA - OA	7.71	7.03	Inf	1.097	0.5161

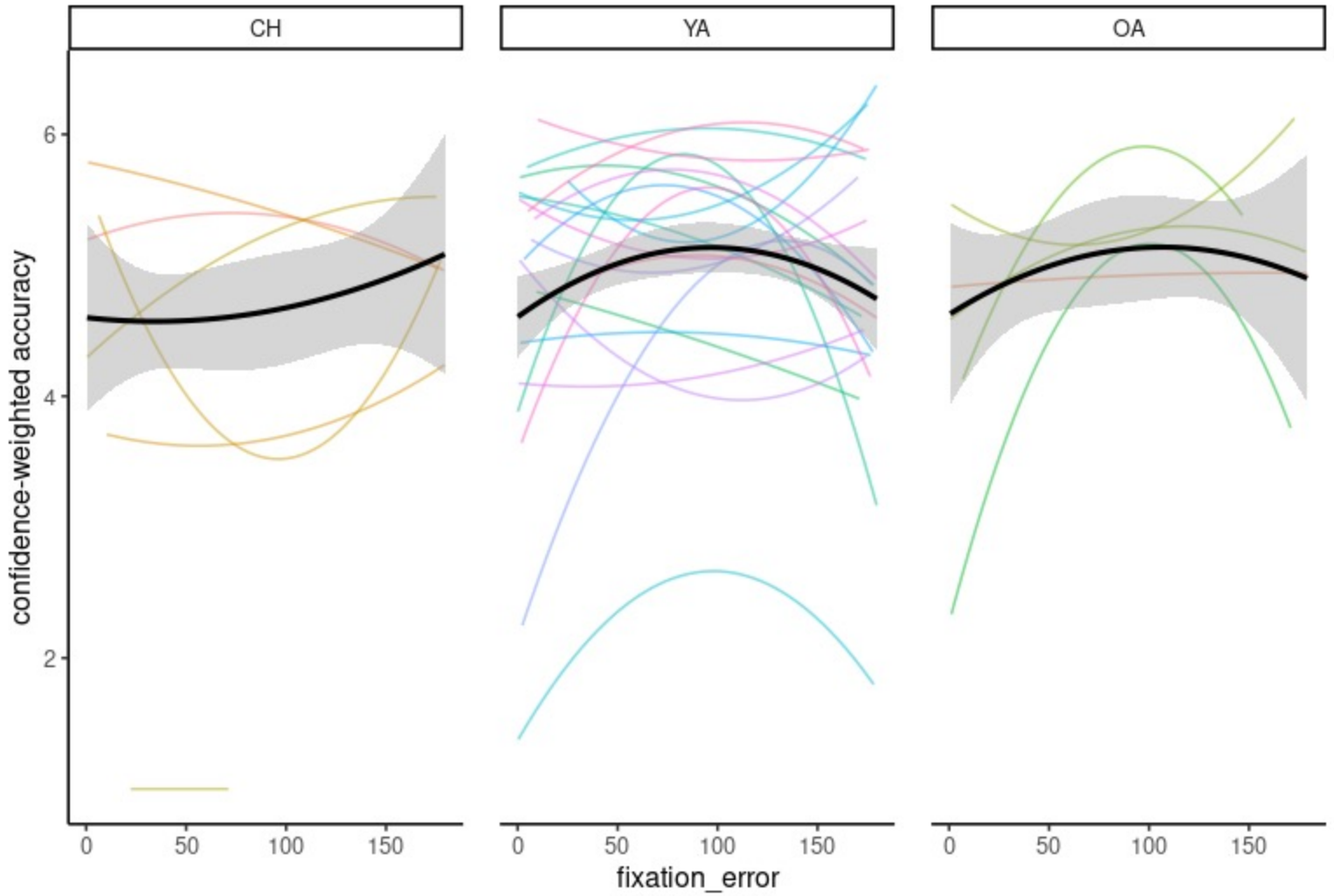
RESULTS - FIXATIONS



RESULTS – FIXATIONS: memory

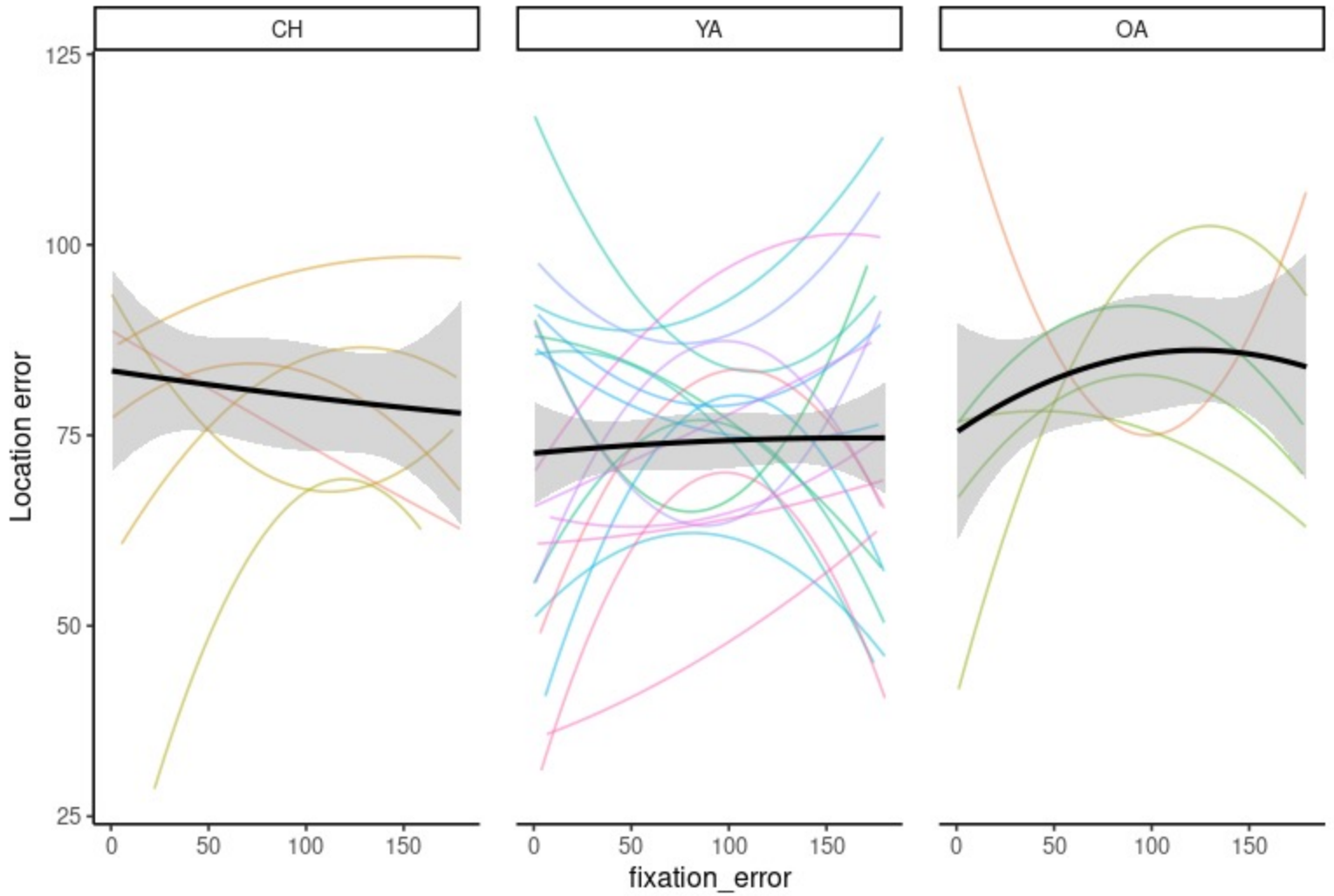


RESULTS – FIXATIONS: memory

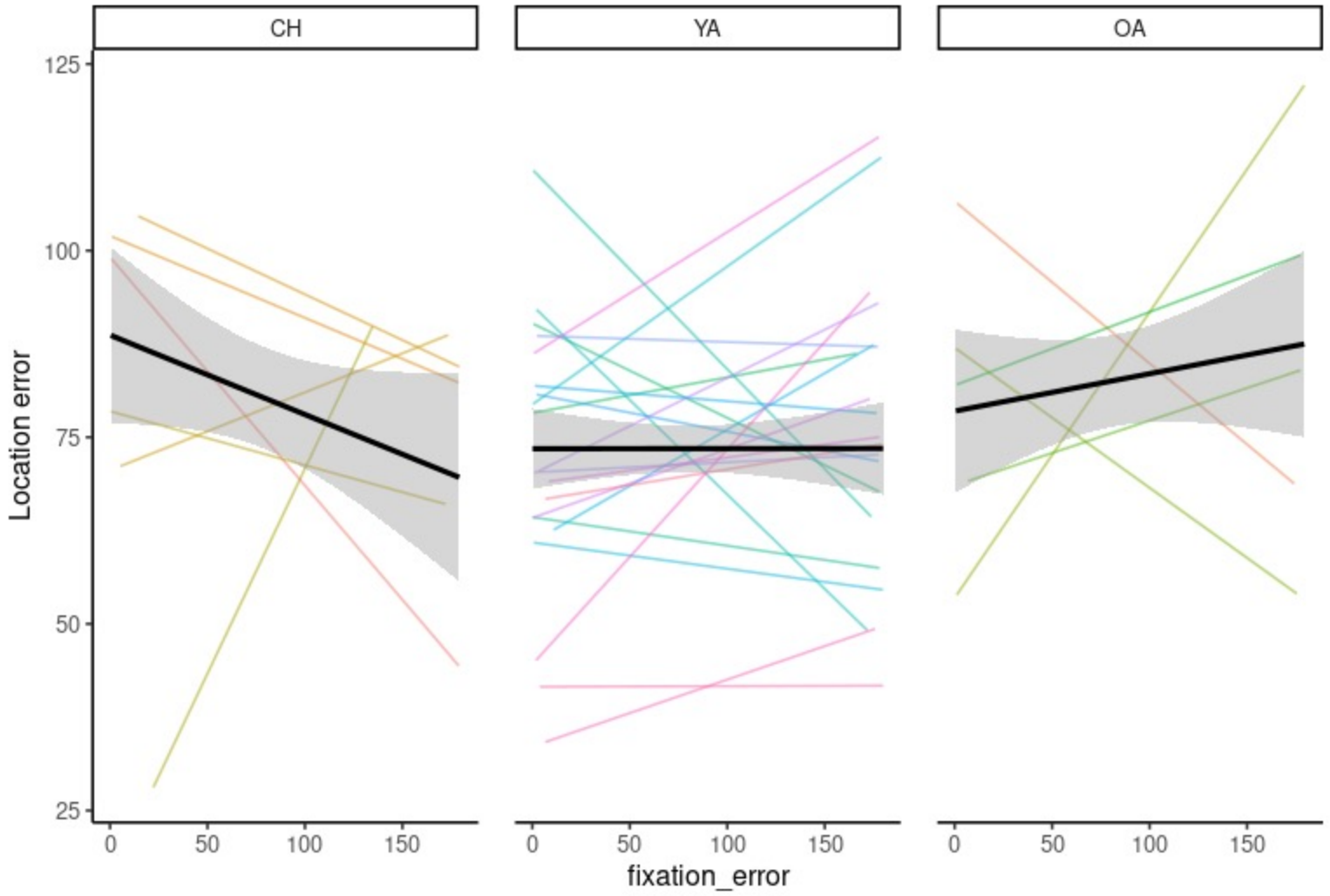


First 50 trials

RESULTS – FIXATIONS: memory



RESULTS – FIXATIONS: memory



fixation_prediction< 60

Suggestions?

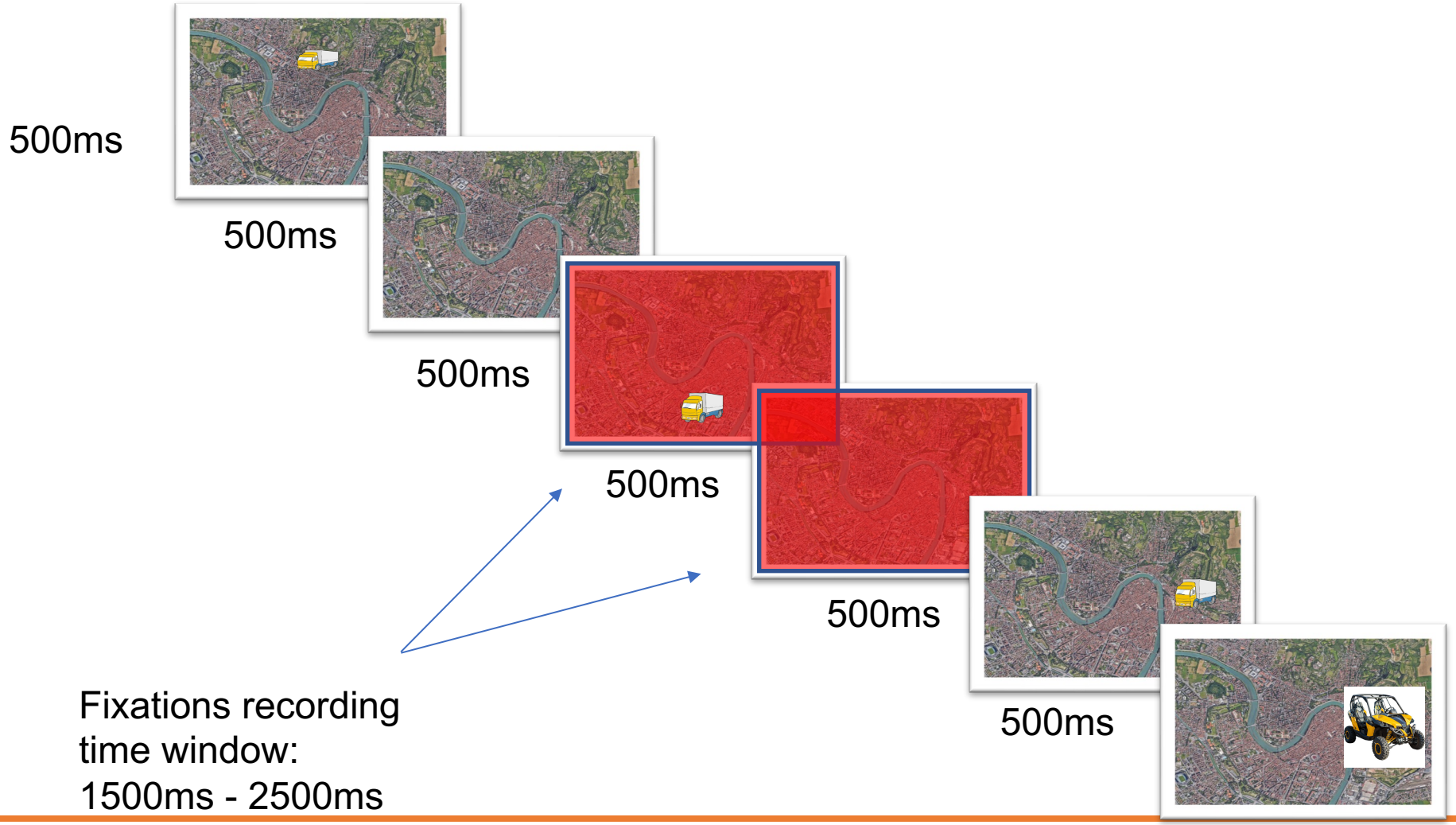
Hello! I'm here to help. It sounds like you're conducting an experiment where you're trying to manipulate participants' expectations and measure their response to unexpected events. If I understand correctly, you're saying that initially participants look at the expected location, but after being exposed to some trials where the truck appears in different locations, they stop looking at the most likely location.

One approach to encourage participants to continue looking at the expected location is to use a technique called "attentional cueing." This involves using a cue, such as a brief flash of light or a sound, to direct participants' attention to the expected location before the truck appears. This can help to reinforce their expectation and increase the likelihood that they will look at the expected location.

Another approach could be to gradually introduce the prediction error trials, starting with a low frequency and gradually increasing it over time. This would allow participants to adapt to the new information without becoming overwhelmed or confused. Additionally, you could consider providing feedback to participants after each trial to reinforce the correct response.

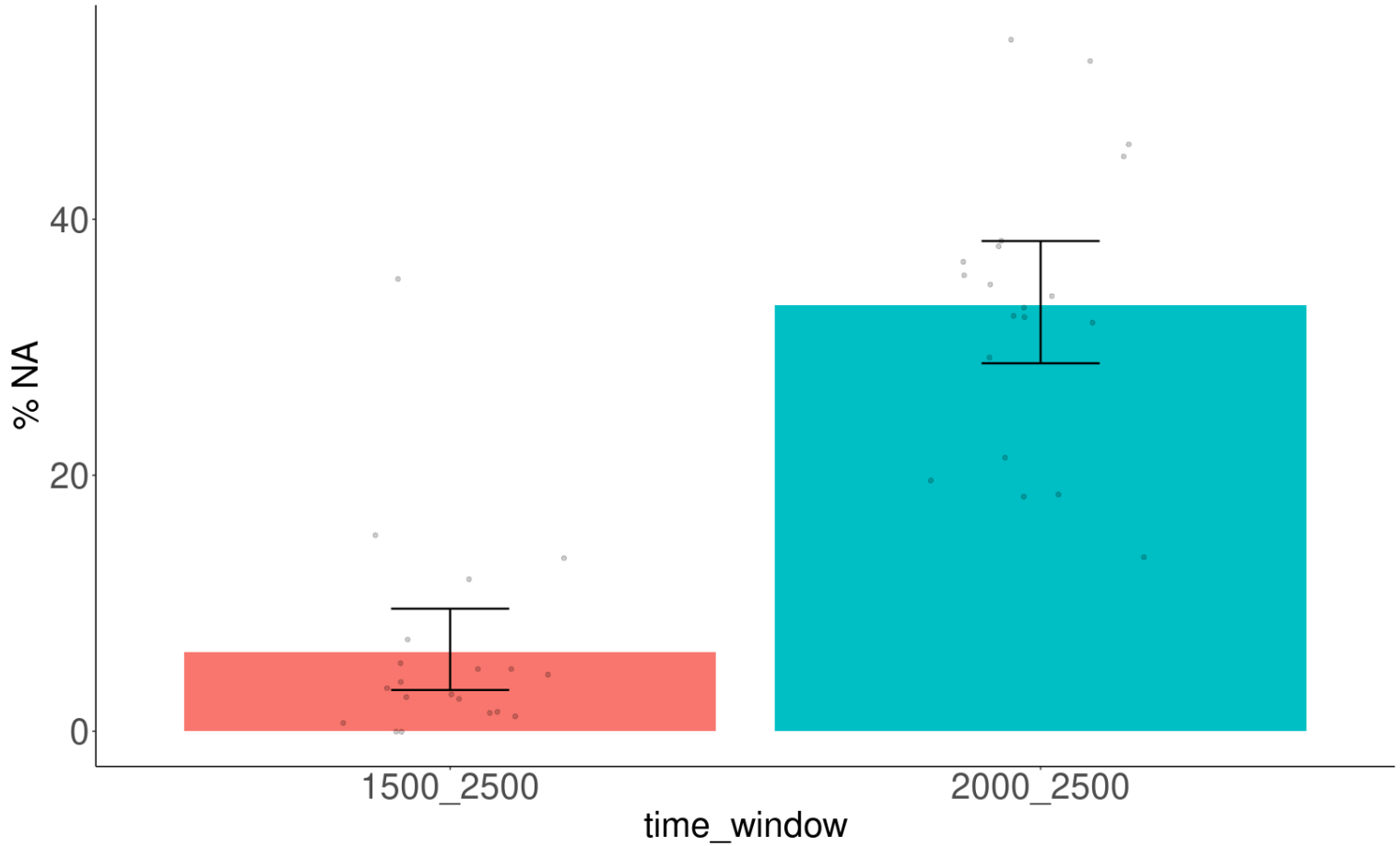
Finally, you could also consider providing an explicit instruction to participants to continue looking at the expected location, along with a rationale for why this is important. This could help to make participants more aware of their behavior and more motivated to maintain their attention on the expected location.

New Time-window: 1500-2500



Fixations recording
time window:
1500ms - 2500ms

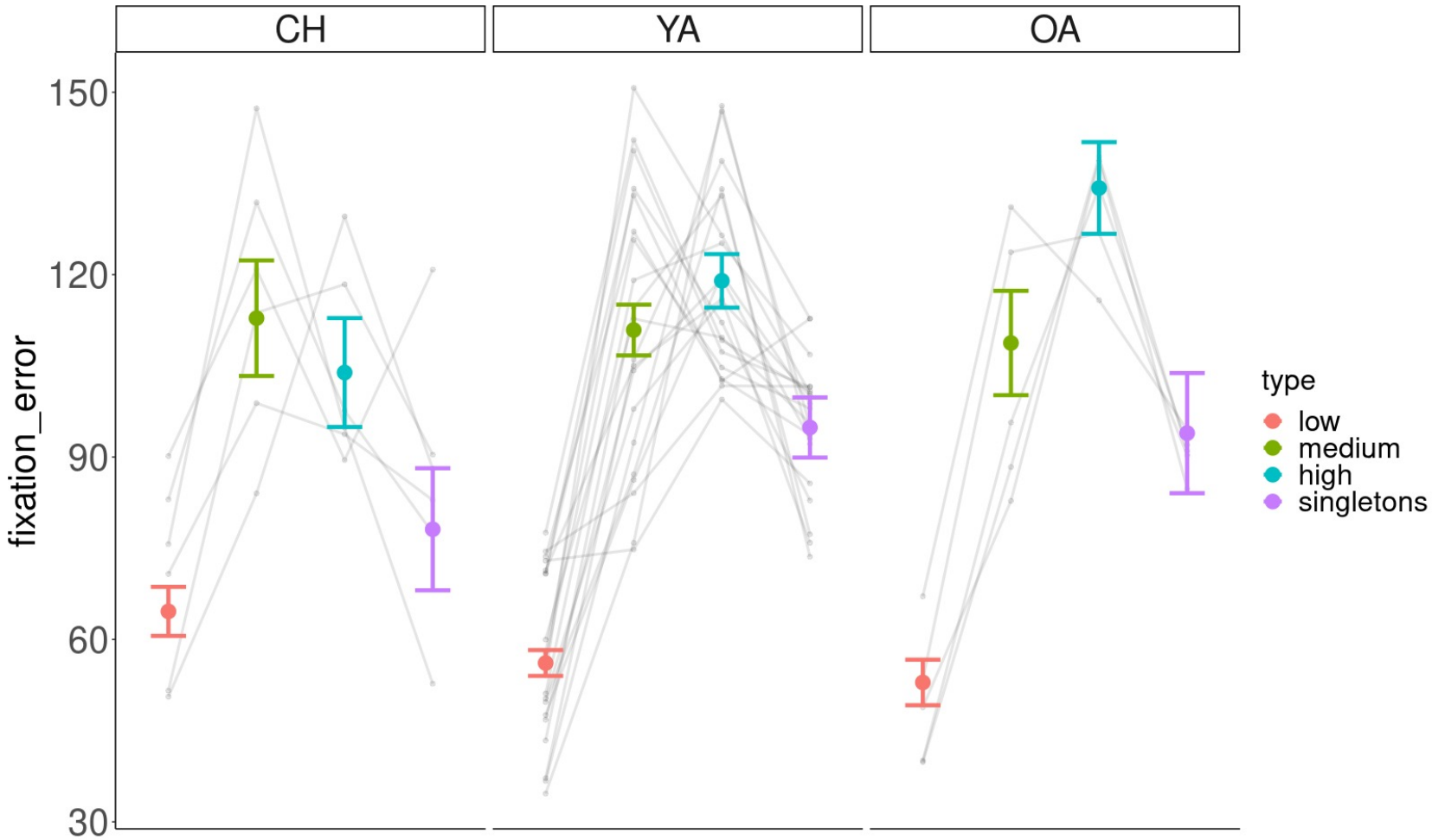
New Time-window: 1500-2500



Including the 500ms before significantly reduced the number of missing fixations

1500ms

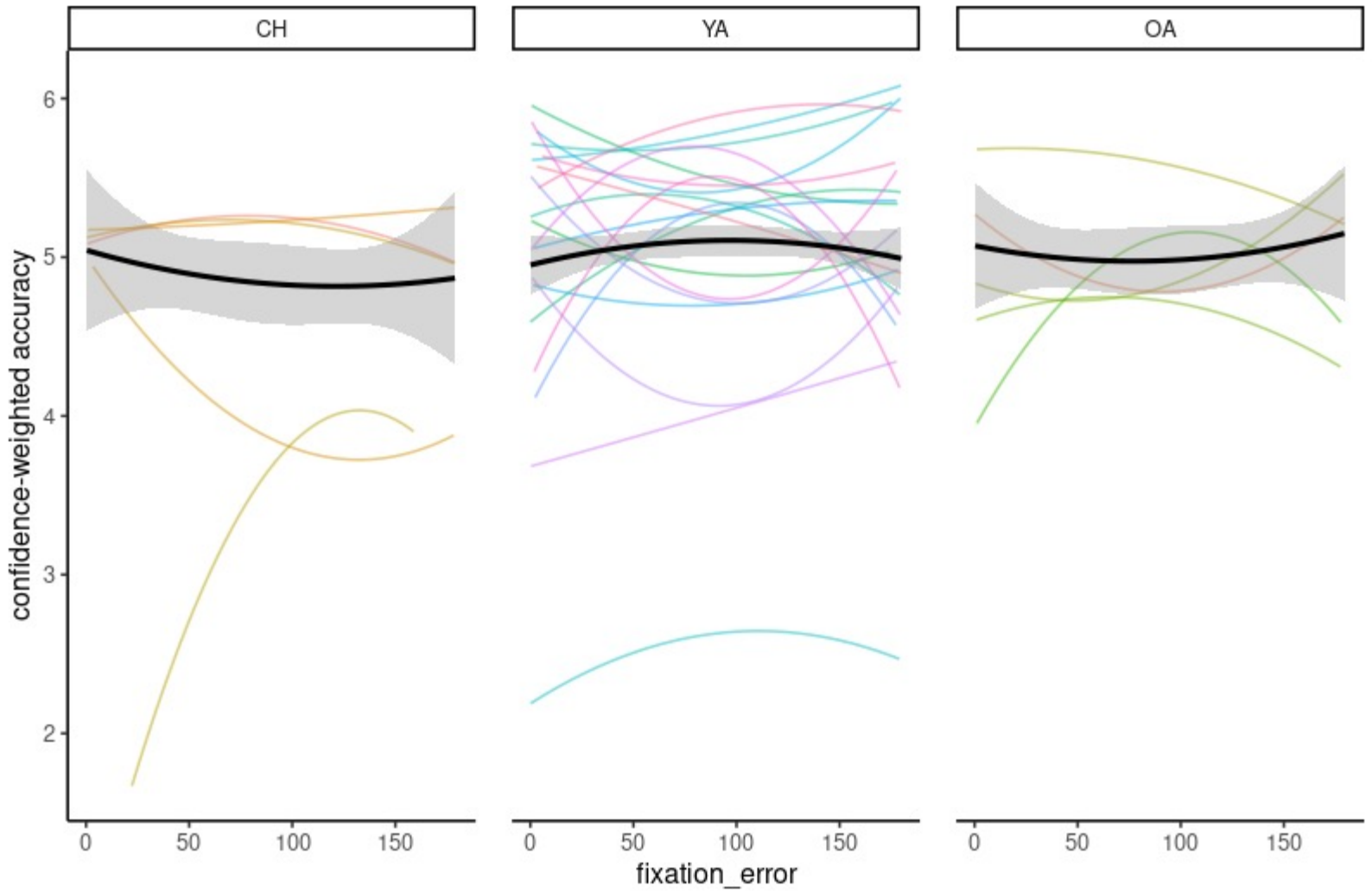
New Time-window: 1500-2500



The pattern is preserved

1500ms

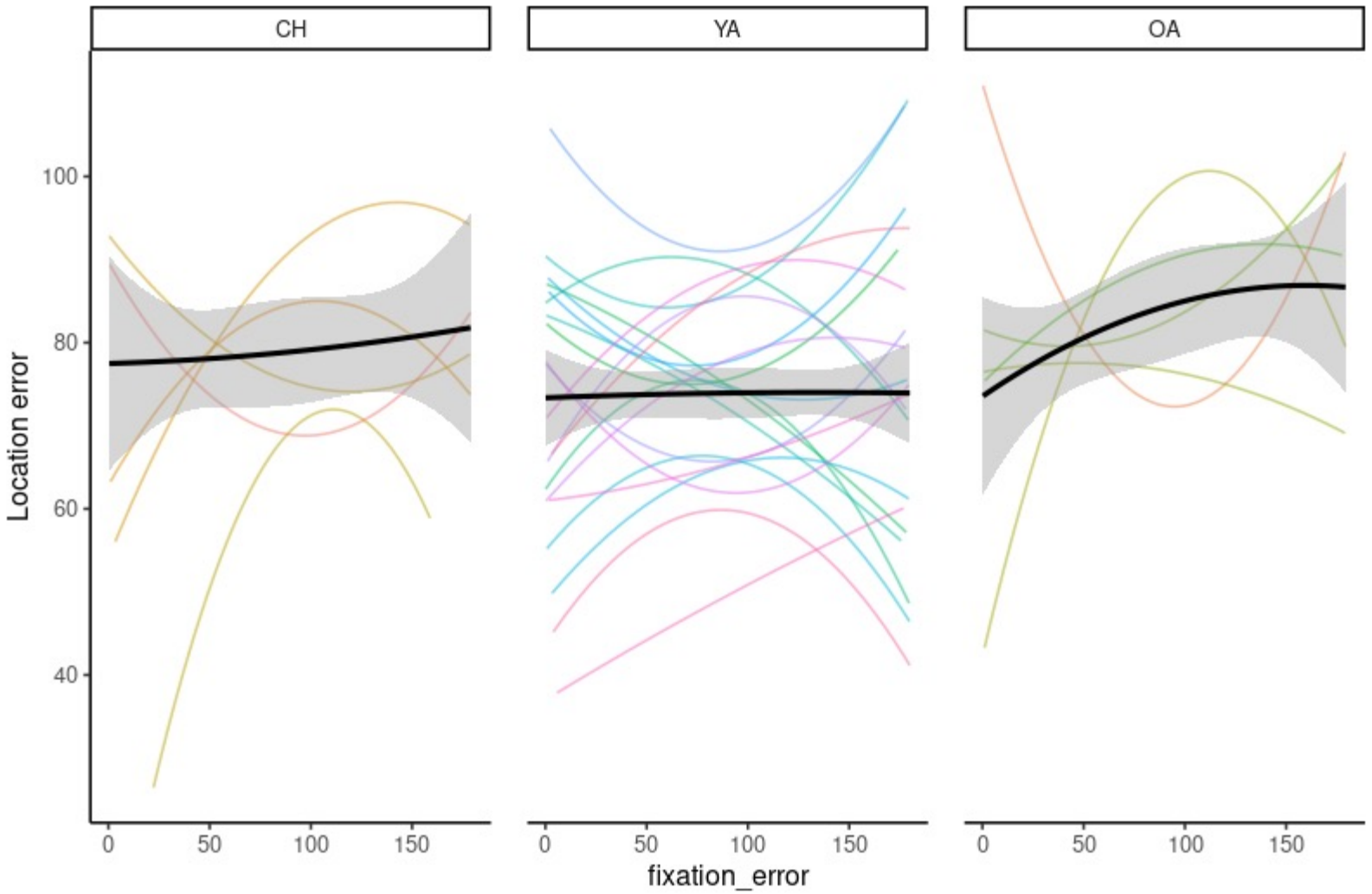
New Time-window: 1500-2500



Fixation error on item memory

1500ms

New Time-window: 1500-2500



Fixation error on location memory (only for misses)

1500ms

Computational model

$$\mu_1 = \mu_0 + (x - \mu_0)\frac{\sigma_0^2}{\sigma^2 + \sigma_0^2}$$

Murphy (2007)