

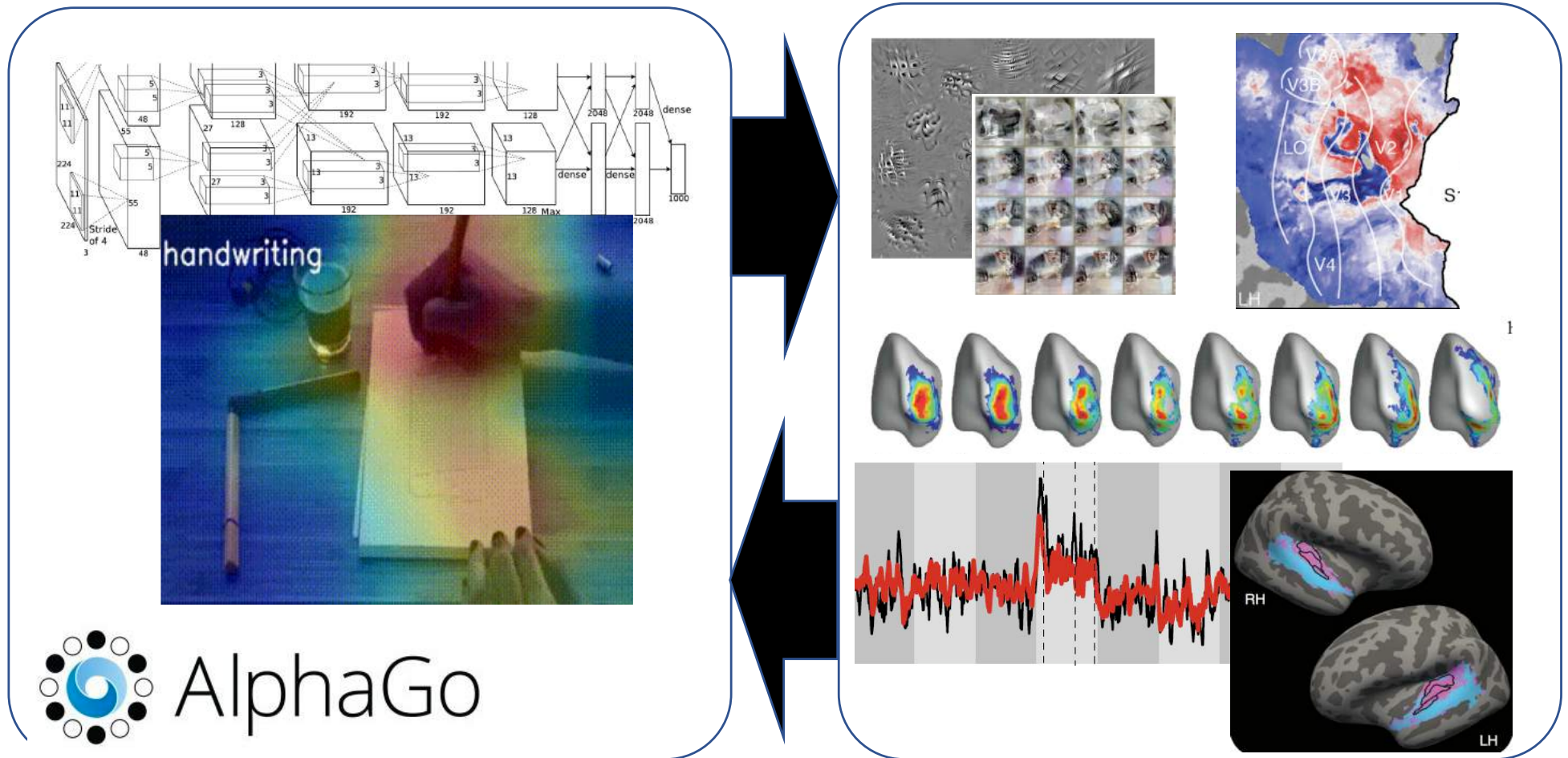


# The Algonauts Project: Challenge 2019

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Benjamin Lahner, Alex Lascelles, Yalda Mohsenzadeh, Kandan  
Ramakrishnan, Aude Oliva**

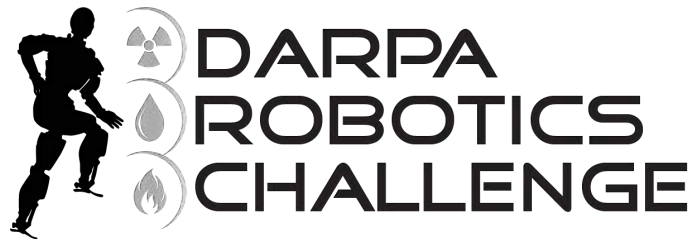


# Interaction Artificial ↔ Natural Intelligence



⇒ High potential in facilitating communication and collaboration

# Open challenges as Communication Channel



## QUA BENCHMARK

- ⇒ integration
- ⇒ comparison of results
- ⇒ collaboration

## QUA CHALLENGE

- ⇒ fast-paced
- ⇒ efficient

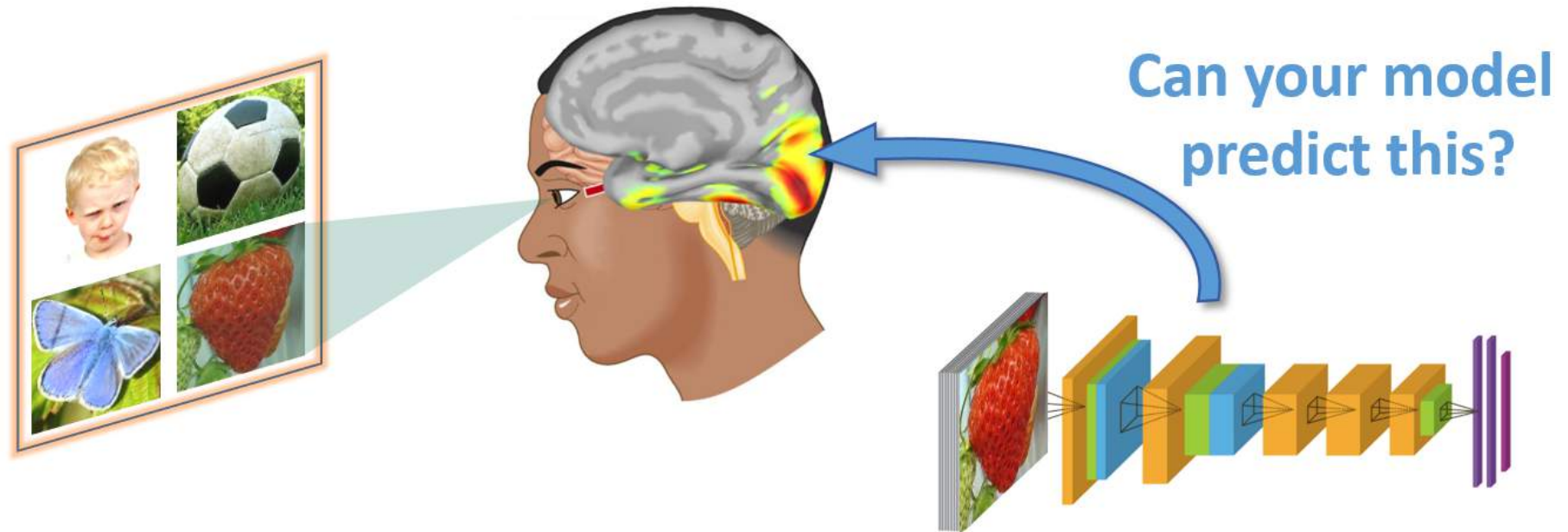
## BEST IF

- ⇒ open
- ⇒ transparent

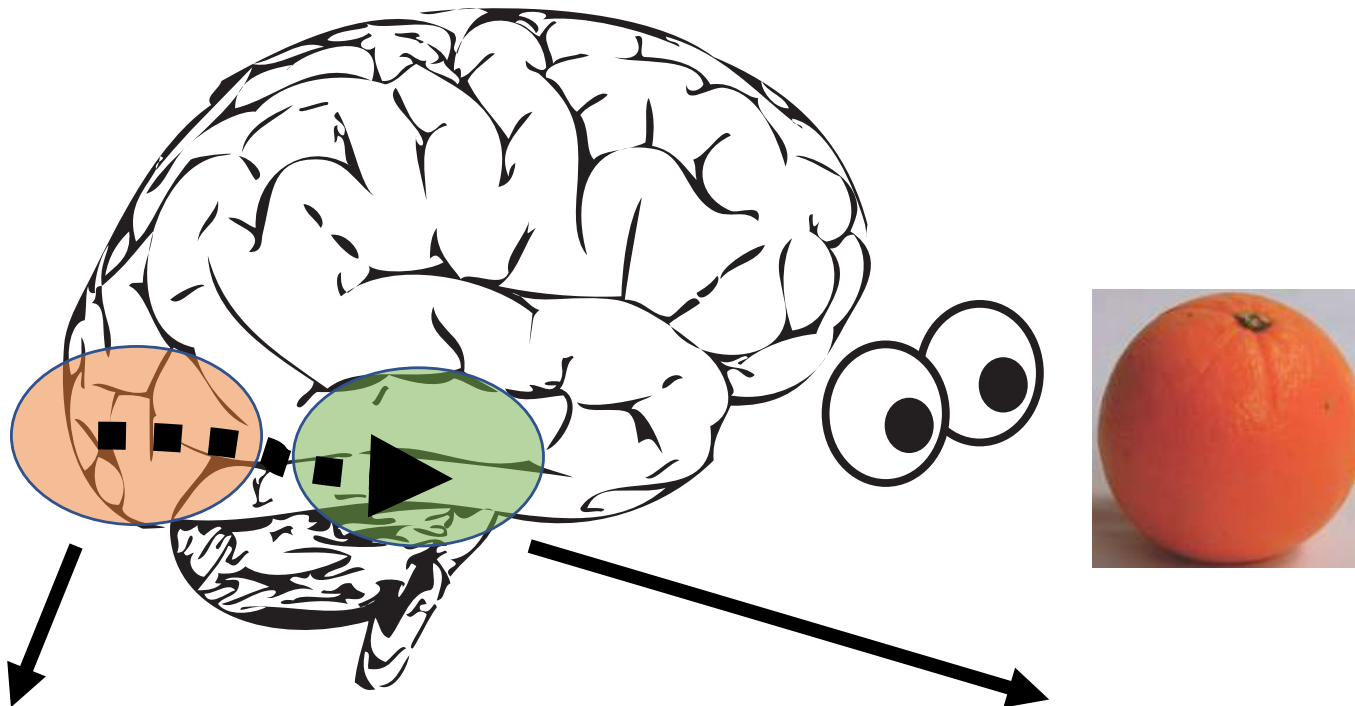
# 2019 Challenge: Explaining the visual brain

**Goal:** Explain human visual brain activity by computational models

**Focus:** Visual object recognition

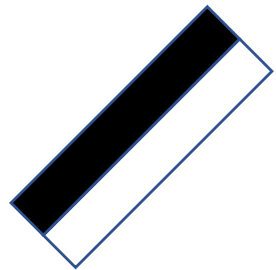


# The Ventral Visual Stream



**Early visual cortex (EVC)**

**Inferior temporal cortex (IT)**



responds **early**  
in time

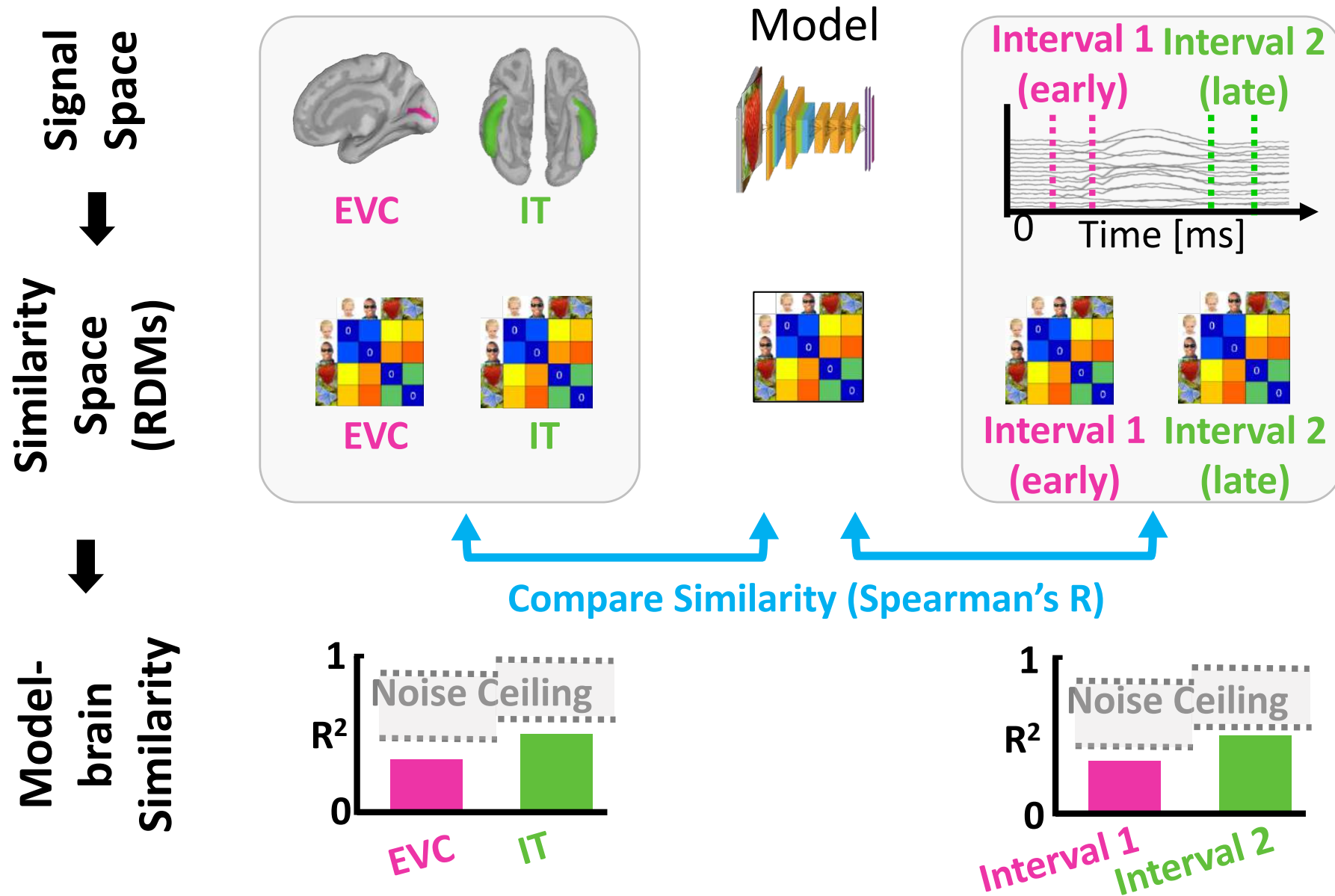


responds **late**  
in time

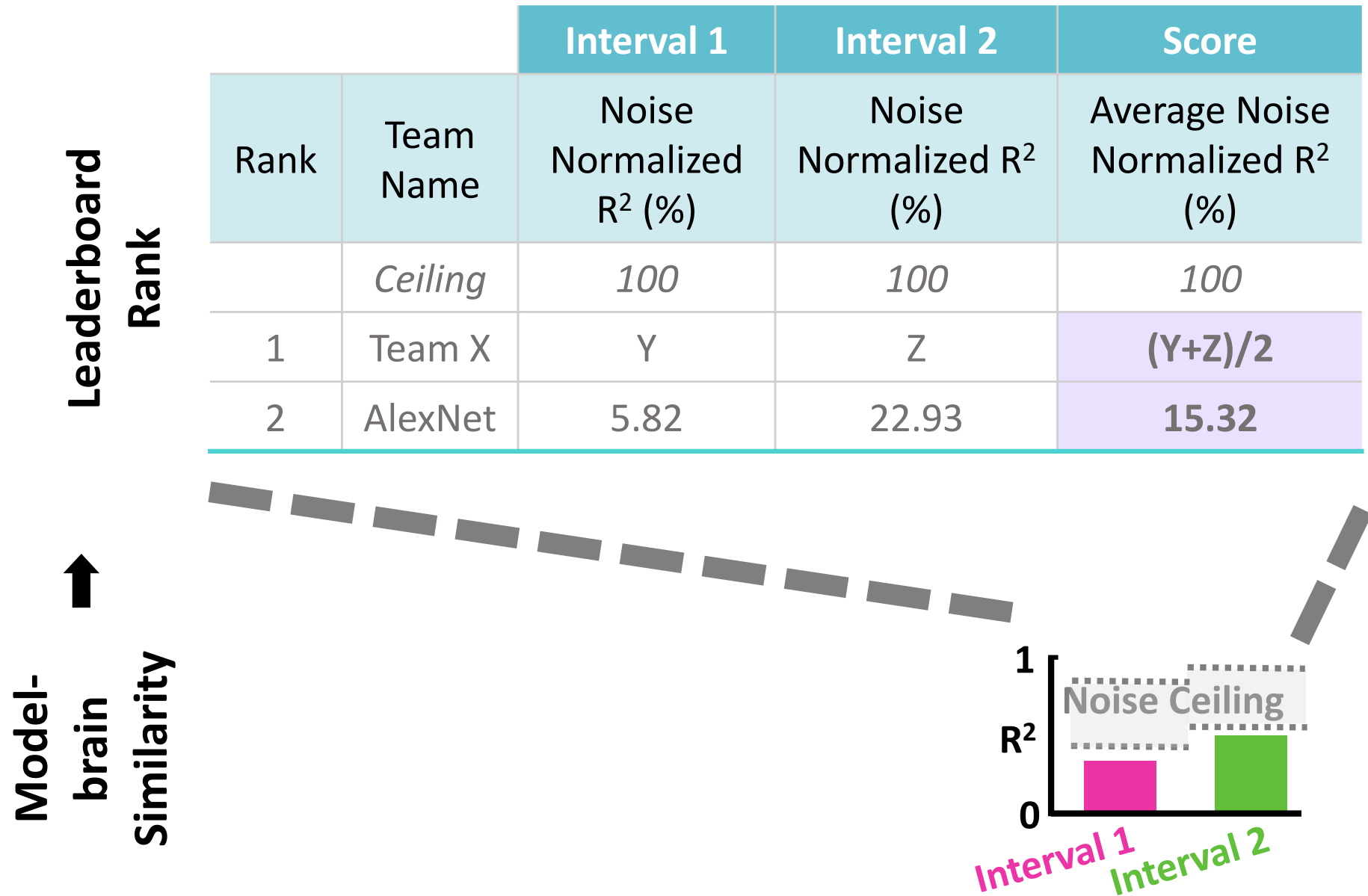
# Challenge Mechanics in a Nut Shell

## Track 1: Space (fMRI)

## Track 2: Time (MEG)



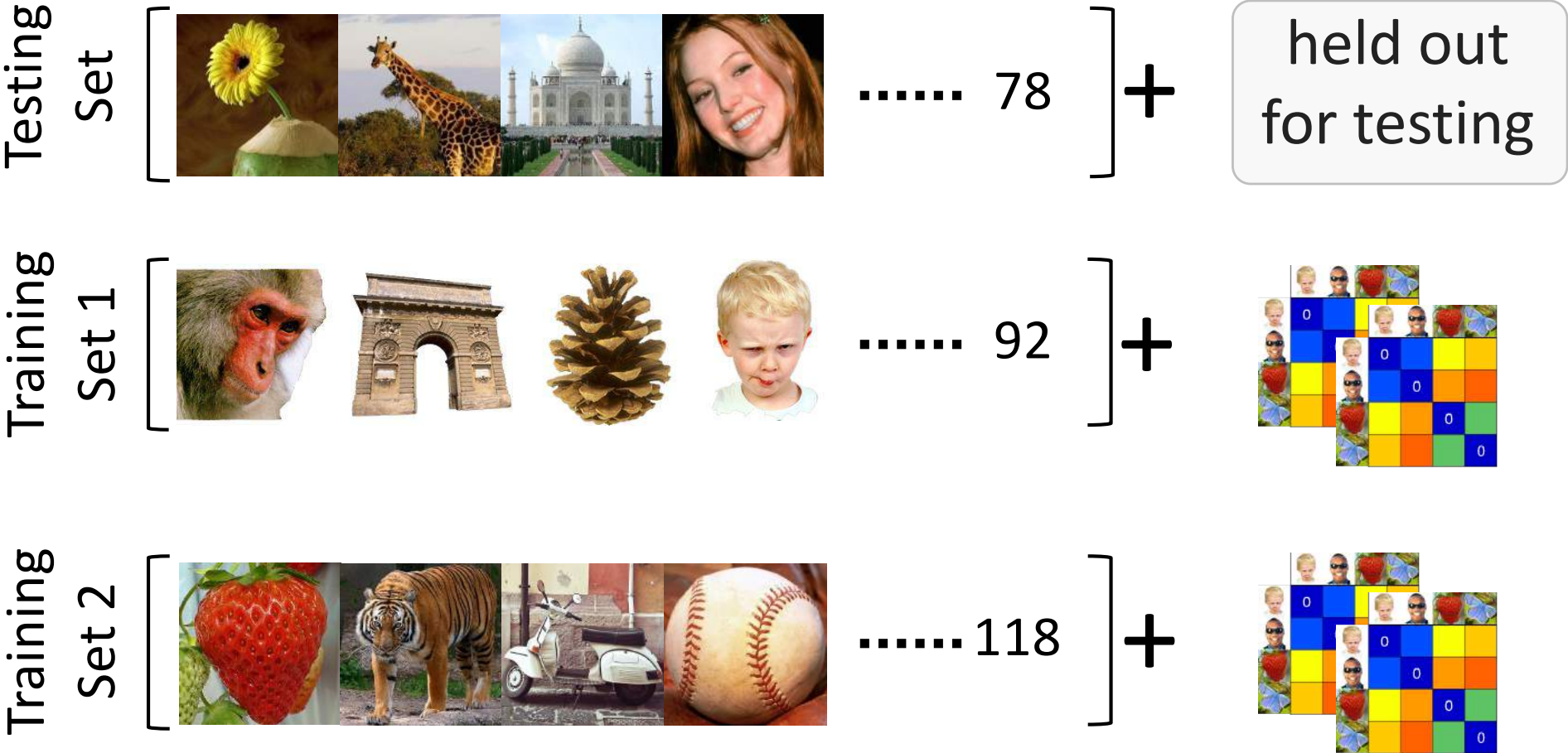
# ... to Leaderboard



# Testing & Training data

## Images (examples)

## Brain data (MEG & fMRI RDMs)





# Participation

Teams that	Track 1 (fMRI)	Track 2 (MEG)
signed up	80	53
submitted models	27	16

⇒ Excellent participation for first edition

⇒ fMRI more popular

# Leaderboard Track 1 (fMRI)

		EVC	IT	Score
Rank	Team Name	Noise Normalized $R^2$ (%)	Noise Normalized $R^2$ (%)	Average Noise Normalized $R^2$ (%)
	<i>Noise Ceiling</i>	<i>100</i>	<i>100</i>	<i>100</i>
1	agustin	32.88	20.99	26.91
2	Aakash	30.56	19.28	24.89
3	rmldj	28.40	20.77	24.56
...	...	...	...	...
24	AlexNet-Baseline	6.58	8.22	7.41

⇒ **~3.6-fold increase in explained variance**

# Leaderboard Track 2 (MEG)

		Early Interval	Late Interval	Score
Rank	Team Name	Noise Normalized R <sup>2</sup> (%)	Noise Normalized R <sup>2</sup> (%)	Average Noise Normalized R <sup>2</sup> (%)
	<i>Noise Ceiling</i>	<i>100</i>	<i>100</i>	<i>100</i>
1	Aakash	58.95	67.25	63.56
2	rml dj	46.91	57.38	52.73
3	agustin	50.95	53.59	52.42
...	...	...	...	...
10	AlexNet-Baseline	5.82	22.93	15.32

⇒ **~4.1-fold increase in explained variance**

# Checking for generalizability

Up to 250 submissions / team were allowed

PRO: encourages participation and exploration

CONTRA: danger of **overfitting** test data

⇒ Use a hidden test data set

Challenge  
Test Set



# Hidden Track 1 (fMRI)

		EVC	IT	Score
Rank	Team Name	Noise Normalized R <sup>2</sup> (%)	Noise Normalized R <sup>2</sup> (%)	Average Noise Normalized R <sup>2</sup> (%)
	<i>Noise Ceiling</i>	<i>100</i>	<i>100</i>	<i>100</i>
1	agustin	9.63	15.86	12.92
2	Wenxin_SU	10.51	15.73	13.27
3	rmldj	7.68	13.13	10.56
...	...	...	...	...
22	AlexNet-Baseline	4.60	4.42	4.50

⇒ **~2.9-fold increase in explained variance**

# Hidden Track 2 (MEG)

		Early Interval	Late Interval	Score
Rank	Team Name	Noise Normalized R <sup>2</sup> (%)	Noise Normalized R <sup>2</sup> (%)	Average Noise Normalized R <sup>2</sup> (%)
	<i>Noise Ceiling</i>	<i>100</i>	<i>100</i>	<i>100</i>
1	Aakash	11.88	56.60	35.63
2	rml dj	10.81	47.54	30.31
3	agustin	8.06	44.92	27.64
...	...	...	...	...
10	AlexNet-Baseline	0.55	18.13	9.89

⇒ **~3.6-fold increase in explained variance**

## Check B: Hidden Track 1 (fMRI)

		EVC	IT	Score
Rank	Team Name	Noise Normalized R <sup>2</sup> (%)	Noise Normalized R <sup>2</sup> (%)	Average Noise Normalized R <sup>2</sup> (%)
	<i>Noise Ceiling</i>	<i>100</i>	<i>100</i>	<i>100</i>
	rml dj	13.00	17.34	15.29
	Aakash	14.14	9.64	11.76
	ggaziv	15.26	8.49	11.68
...	...	...	...	...
	AlexNet-Baseline	5.05	4.76	4.90

⇒ **~3.1-fold increase in explained variance**

# Check B: Hidden Track 2 (MEG)

		Early Interval	Late Interval	Score
Rank	Team Name	Noise Normalized R <sup>2</sup> (%)	Noise Normalized R <sup>2</sup> (%)	Average Noise Normalized R <sup>2</sup> (%)
	<i>Noise Ceiling</i>	<i>100</i>	<i>100</i>	<i>100</i>
1	Aakash	49.79	69.44	60.28
2	rml dj	53.55	55.01	54.32
3	agustin	40.20	56.65	49.08
...	...	...	...	...
	AlexNet-Baseline	8.62	23.81	16.69

⇒ **~3.6-fold increase in explained variance**



# Summary: Jump in Variance Explained

	Track 1 (fMRI)	Track 2 (MEG)
Open leaderboard	~2.5	~4.1
Hidden leaderboard (method 1)	~2.9	~3.6
Hidden leaderboard (method 2)	~3.1	~3.6

⇒ **Overfitting risk is mitigated**

# Results in space



Alex Lascelles

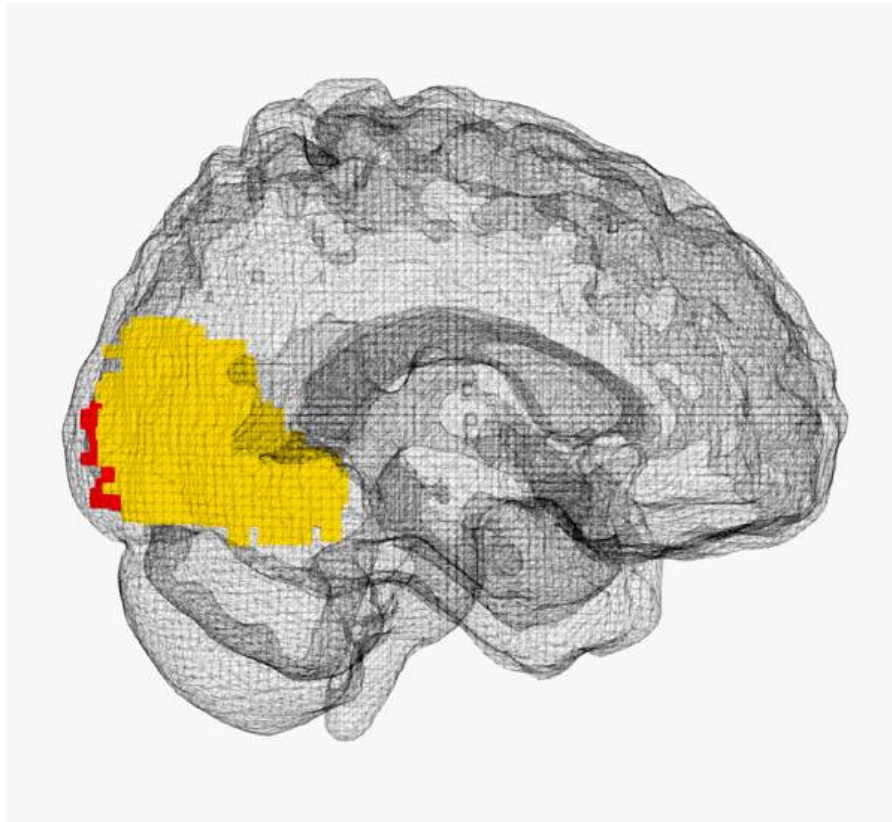


Alex Andonian

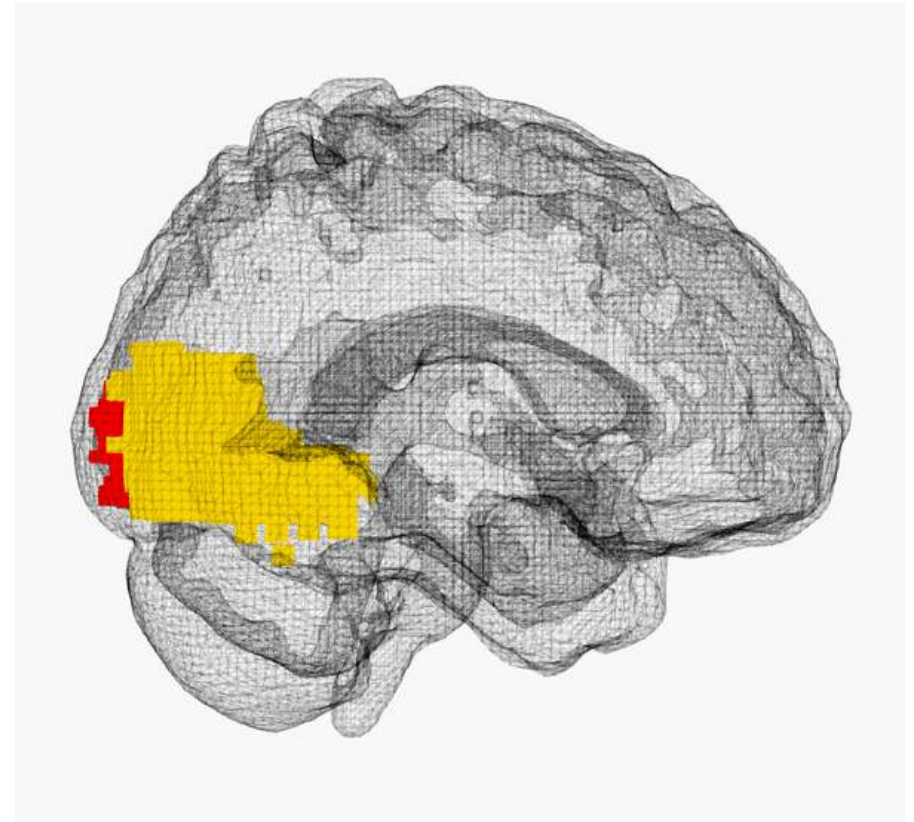


Ben Lahner

## Challenge Test Set

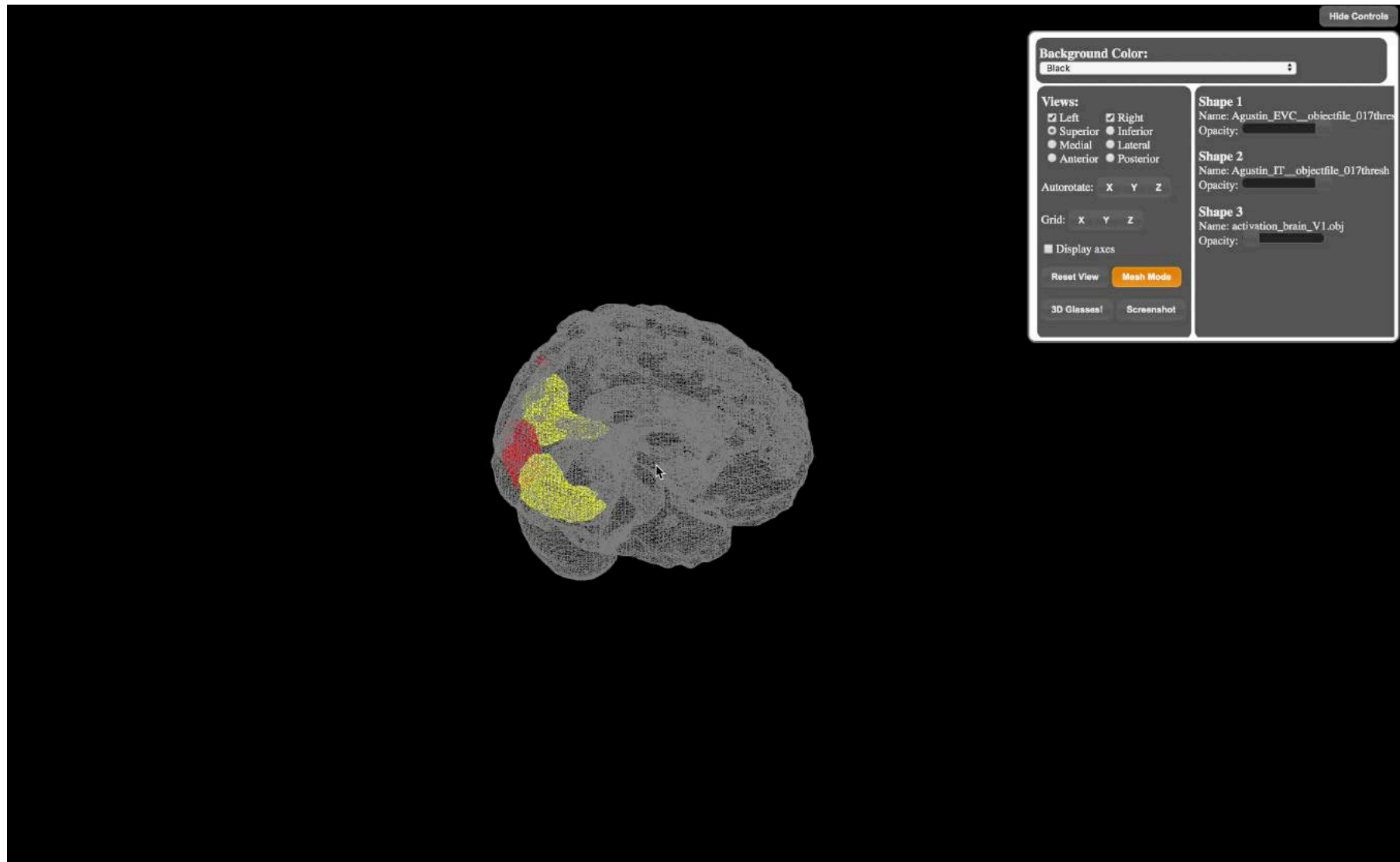


## Hidden Test Set



Available now on [Algonauts website](#)

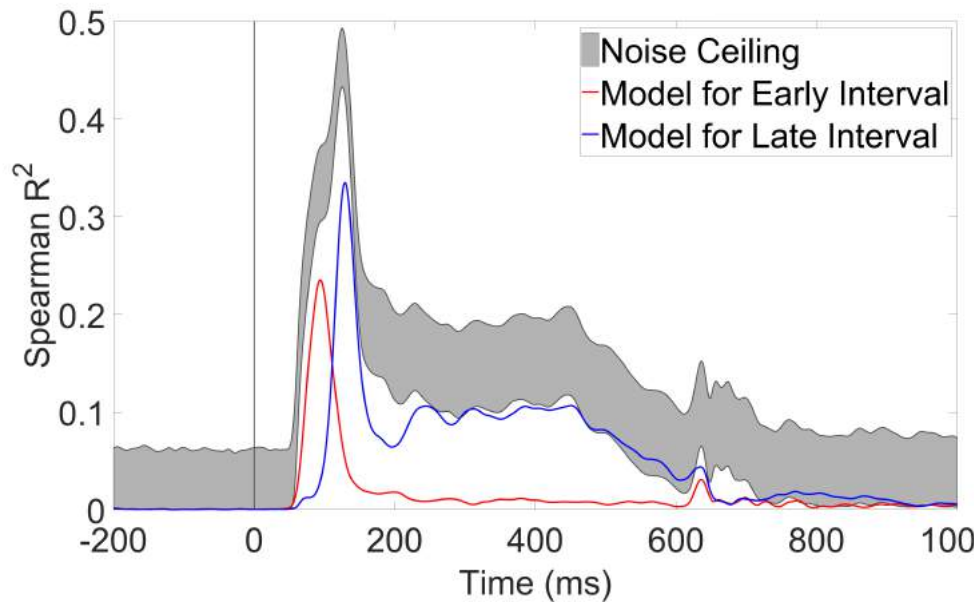
# Interactive visualization



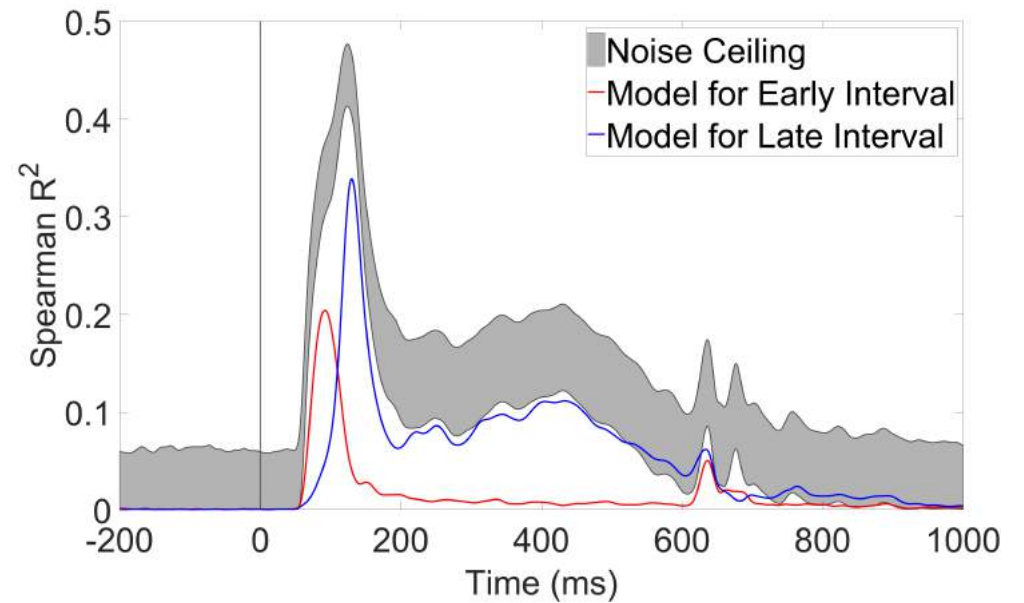
Available now on [Algonauts website](#)

# Results in time

## Challenge Test Set



## Hidden Test Set



Available now on [Algonauts website](#)

# Open questions for future challenges

## **Data**

type            *small vs large scale*

format         *summary statistic vs. raw data*

## **Analytical treatment**

representational similarity analysis, regression,  
principal component modelling, ...

## **Topics**

Diversification?

**Panel discussion:**

The future of challenges explaining the brain

# Next: The winners present



**1:50 – 2:10 pm**

**Agustin Lage-Costellanos (1st fMRI, 3rd MEG)**

*Maastricht University, NL*



**2:10 – 2:30 pm**

**Romuald Janik (3rd fMRI, 2nd MEG)**

*Jagiellonian University, PL*



**2:30 – 2:50 pm**

**Aakash Agrawal (2nd fMRI, 1st MEG)**

*Indian Institute of Science, IN*