Cognitive Science and AI

NeuroAI Datasets

Datasets

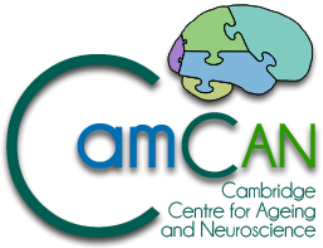
Some slides are from Oota, Gupta, Toneva, Bapi (2023) Tutorial at IJCAI 2023:

DL for Brain Encoding and Decoding

Cognitive Neuroscience is becoming data-intensive

HUMAN Connectome PROJECT

- The Human Connectome Project (adult, *N=1200*)
  - T1, DTI, resting-state fMRI, task-fMRI
- Cambridge Centre for Ageing Neuroscience (healthy aging, *N=700*)
  - T1, DTI, resting-state & task-fMRI and MEG
- Alzheimer's Disease Neuroimaging Initiative (aging, *N=1600*)
  - T1, DTI, resting-state fMRI
- The UK Biobank (early aging, *N=100,000*)
  - T1, DTI, resting-state fMRI, task-fMRI

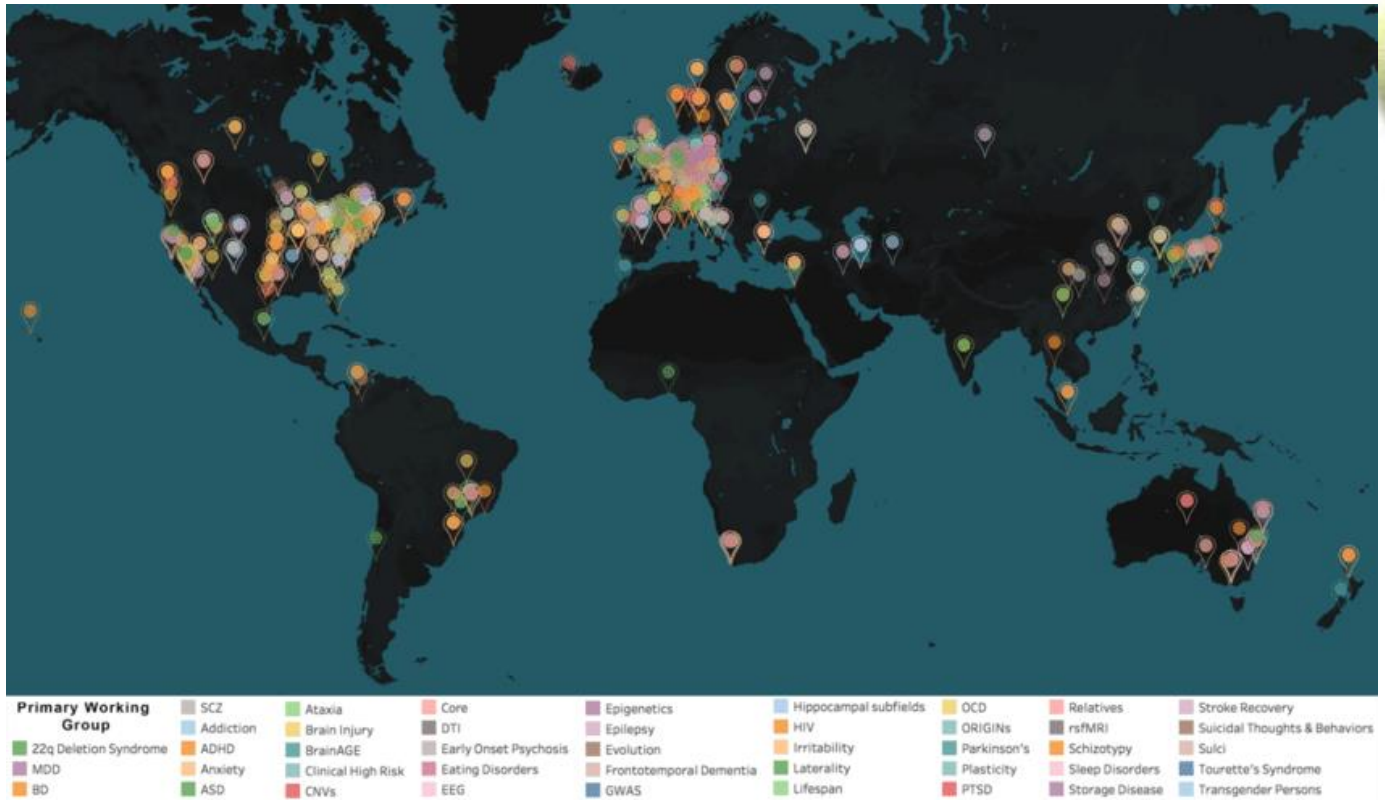


biobank uk

Cognitive Neuroscience is becoming data-intensive: Data consortium

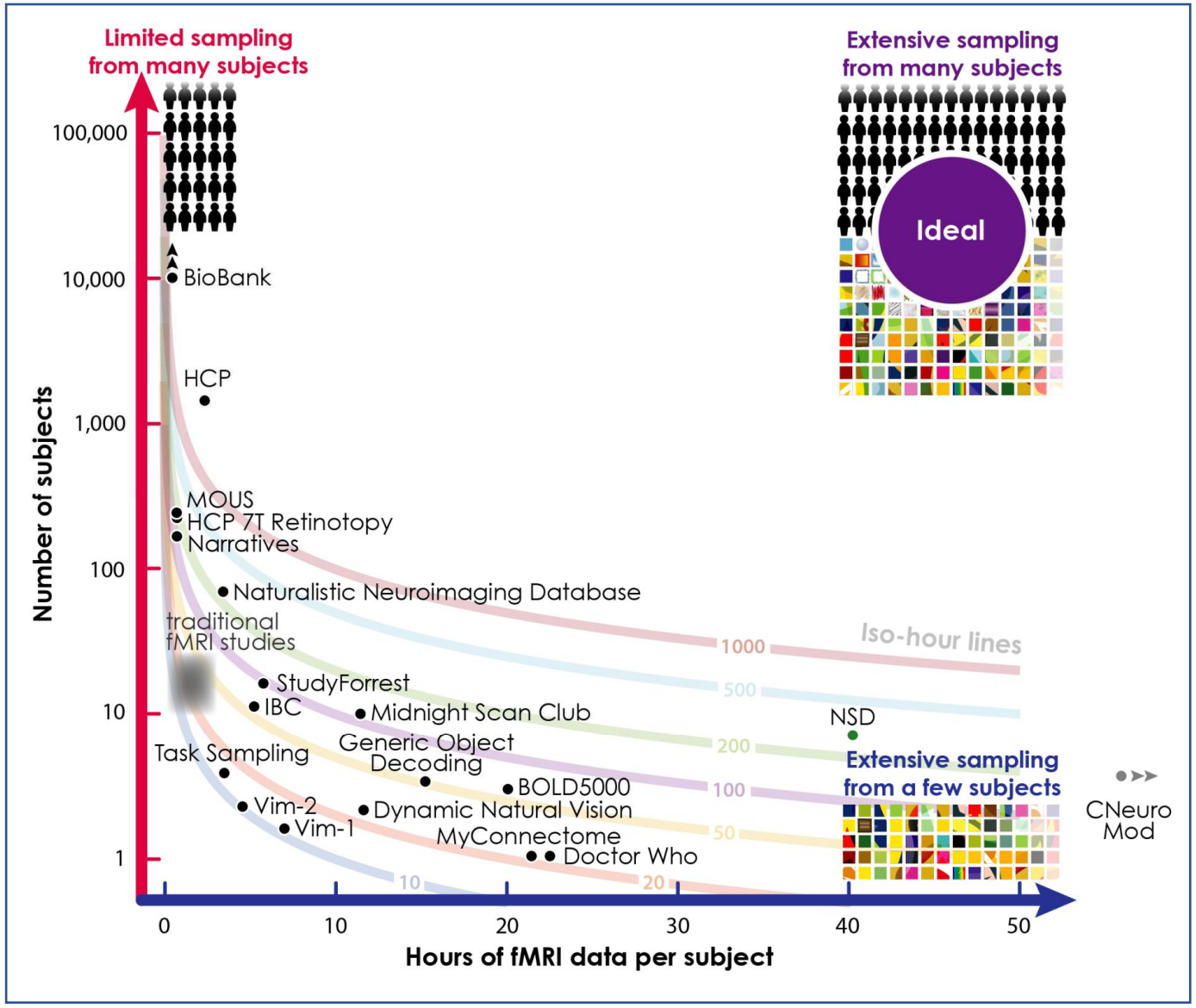
ENIGMA is organized as a set of 50 WGs, studying 26 major brain diseases

- Disease working groups
- Genomics
- Healthy variation
- Methods & Development



Thompson, P.M., *et al.* ENIGMA and global neuroscience: A decade of large-scale studies of the brain in health and disease across more than 40 countries. *Transl Psychiatry* (2020)

Trade-off between number of subjects versus amount of data per subject



Thomas Naselaris, et al. Extensive sampling for complete models of individual brains, Current Opinion in Behavioral Sciences, August 2021.

Types of stimuli and popular datasets

- Text (Words, Sentences, Paragraphs): Harry Potter Story, ZUCO EEG, Question-Answering MEG.
- Visual: Binary visual patterns, Natural Images (Vim-1), BOLD5000, Algonauts and SS-fMRI.
- Audio: Alice's Adventures in Wonderland, Narratives, The Moth Radio Hour, Audio stories.
- Video: BBC's Doctor Who, Japanese Ads, Pippi Langkous, Algonauts.
- Other Multimodal Stimuli: Words + line drawing of concept named by each word, Pereira.

Forms of stimulus presentation and data collection

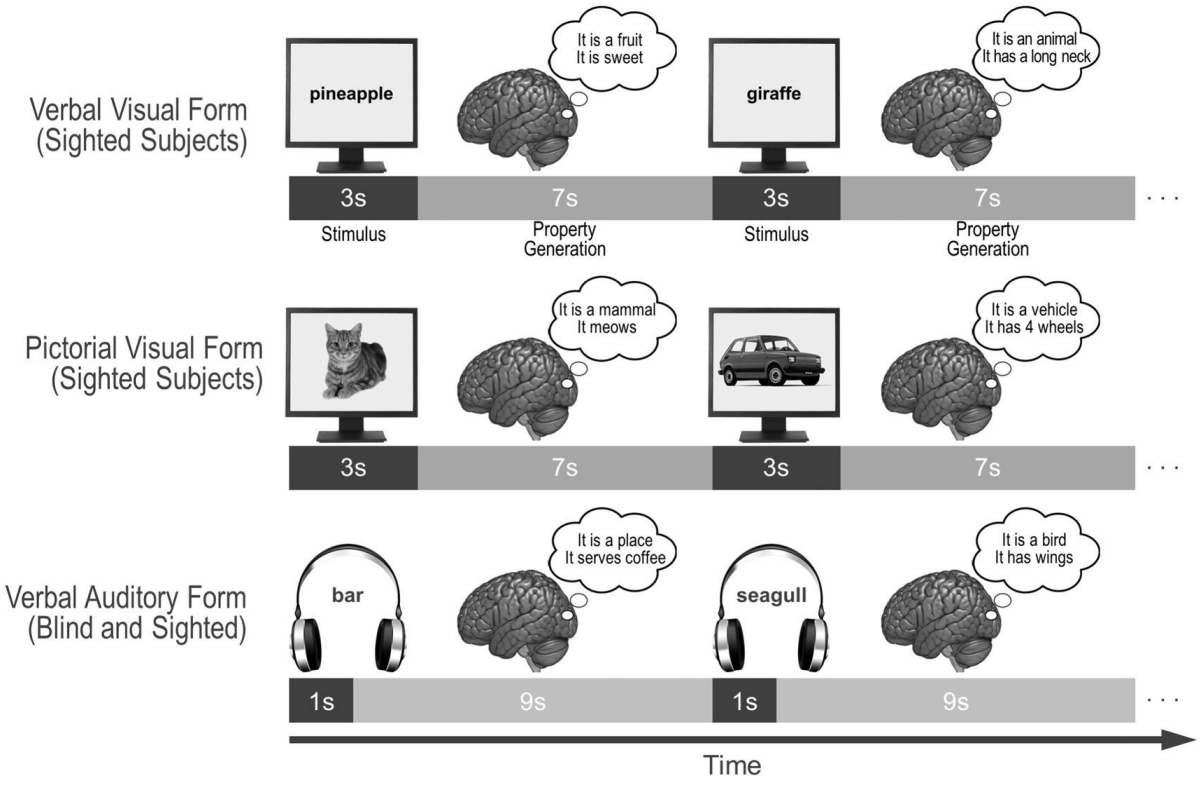
- Type: fMRI, EEG, MEG, …
- TR (Repetition Time): Sampling time.
- Fixation points: location, color, shape.
- Form of stimulus presentation: text, video, audio, images.
- Task: question answering, property generation, understanding, …
- Time given to participants: 1 minute to list properties, …
- Type of participants: males/females, sighted/blind, …
- Response Frequency: Number of times the response to stimuli was recorded.
- Language: English, Italian, Japanese, …

Text Stimulus Datasets

Dataset	Type	Language	Stimulus	#Subjects	Paradigm	Size	Task
Wehbe et al., 2014	fMRI	English	Chapter 9 of *Harry Potter and the Sorcerer's Stone*	9	Reading stories	5000 word chapter was presented in 45 minutes.	Story understanding
Handjaras et al., 2016	fMRI	Italian	Verbal, pictorial or auditory presentation of 40 concrete nouns	20	Reading, viewing or listening	40 nouns * 4 times.	Property Generation
Anderson et al., 2017	fMRI	Italian	70 concrete and abstract nouns from law/music.	7	Reading	70 nouns * 5 times.	Imagine a situation that they personally associate with the noun
Zurich Cognitive Language Processing Corpus (ZuCo): Hollenstein et al., 2018	EEG and eye-tracking	English	Sentences from movie reviews or Wikipedia	12	Reading natural sentences	21,629 words in 1107 sentences and 154,173 fixations	Rate movie quality, answer control questions, check for existence of a relation
Anderson et al., 2019	fMRI	English	240 active voice sentences describing everyday situations	14	Reading	240 sentences seen 12 times (by 10 subjects) and 6 times (by 4 subjects)	Passive reading
BCCWJ-EEG: Oseki and Asahara, 2020	EEG	Japanese	20 newspaper articles	40	Reading	1 time reading for ~30-40 minutes	Passive reading
Deniz et al., 2019	fMRI	English	Subset of Moth Radio Hour. 11 stories	9	Reading	11 10- to 15 min stories presented twice word by word	Passive reading and Listening

Data for concrete nouns from sighted/blind subjects

- Participants were asked to verbally enumerate in one minute the properties (features) that describe the entities the words refer to.
- 4 groups of participants
  - 5 sighted individuals were presented with a pictorial form of the nouns
  - 5 sighted individuals with a verbal visual (i.e., written Italian words) form
  - 5 sighted individuals with a verbal auditory (i.e., spoken Italian words) form
  - 5 congenitally blind with a verbal auditory form.



Handjaras, Giacomo, Emiliano Ricciardi, Andrea Leo, Alessandro Lenci, Luca Cecchetti, Mirco Cosottini, Giovanna Marotta, and Pietro Pietrini. "How concepts are encoded in the human brain: a modality independent, category-based cortical organization of semantic knowledge." *Neuroimage* 135 (2016): 232-242.

70 - Italian word stimuli fMRI data

- Taxonomic categories in law and music domain
  - Ur-abstract: that are classified as abstract in WordNet
  - Attribute: A construct whereby objects or individuals can be distinguished
  - Communication: Something that is communicated by, to or between groups
  - Event/action: Something that happens at a given place and time
  - Person/Social role: Individual, someone, somebody, mortal
  - Location: Points or extents in space
  - Object/Tool: A class of unambiguously concrete nouns

	LAW		MUSIC	
Ur-abstracts	giustizia	justice	musica	music
	liberta'	liberty	blues	blues
	legge	law	jazz	jazz
	corruzione	corruption	canto	singing
	refurtiva	**loot**	punk	punk
Attribute	giurisdizione	jurisdiction	sonorita'	sonority
	cittadinanza	citizenship	ritmo	rhythm
	impunita'	impunity	~~melodia~~	~~melody~~
	legalita'	legality	tonality'	tonality
	illegalita	illegality	intonazione	pitch
Communication	divieto	prohibition	canzone	song
	verdetto	verdict	**pentagramma**	**stave**
	ordinanza	decree	ballata	ballad
	addebito	accusation	ritornello	refrain
	ingiunzione	injunction	sinfonia	symphony
Event/action	arresto	arrest	**concerto**	**concert**
	processo	trial	recital	recital
	reato	crime	assolo	solo
	furto	theft	**festival**	**festival**
	assoluzione	acquital	**spettacolo**	**show**
Person/Social-role	**giudice**	**judge**	**musicista**	**musician**
	ladro	**thief**	**cantante**	**singer**
	imputato	**defendant**	**compositore**	**composer**
	testimone	**witness**	**chitarrista**	**guitarist**
	avvocato	**lawyer**	**tenore**	**tenor**
Location	**tribunale**	**court/tribunal**	**palco**	**stage**
	carcere	**prison**	**auditorium**	**auditorium**
	~~**questura**~~	~~**police-station**~~	**discoteca**	**disco**
	penitenziario	**penitentiary**	**conservatorio**	**conservatory**
	patibolo	**gallows**	**teatro**	**theatre**
Object/Tool	**manette**	**handcuffs**	**violino**	**violin**
	toga	**robe**	**tamburo**	**drum**
	manganello	**truncheon**	**tromba**	**trumpet**
	cappio	**noose**	**metronomo**	**metronome**
	~~**grimaldello**~~	~~**skeleton-key**~~	**radio**	**radio**

Anderson, Andrew J., Douwe Kiela, Stephen Clark, and Massimo Poesio. "Visually grounded and textual semantic models differentially decode brain activity associated with concrete and abstract nouns." *Transactions of the Association for Computational Linguistics* 5 (2017): 17-30.

Zurich Cognitive Language Processing Corpus (ZuCo)

	Task 1 Normal reading (Sentiment)	Task 2 Normal reading (Wikipedia)	Task 3 Task-specific reading (Wikipedia)
Material	Positive, negative or neutral sentences from movie reviews	Wikipedia sentences containing specific relations	Wikipedia sentences containing specific relations
Example	*"The film often achieves a mesmerizing poetry."* (positive)	*"Talia Shire (born April 25, 1946) is an American actress of Italian descent."* (relations: *nationality, job title*)	*"Lincoln was the first Republican president."* (relation: *political affiliation*)
Task	Read the sentences, rating the quality of the movie based on the sentence read	Read the sentences, answer control questions	Mark whether a specific relation occurs in the given sentence or not
Control question	*"Based on the previous sentence, how would you rate this movie from 1 (very bad) to 5 (very good)?"*	*"Talia Shire was a ...1) singer 2) actress 3) director"*	*"Does this sentence contain the* political affiliation *relation? 1) Yes 2) No"*

- Personal reading speed.
  - Sentences were presented to the subjects in a naturalistic reading scenario
  - Complete sentence is presented on the screen
  - Subjects read each sentence at their own speed, i.e., the reader determines for how long each word is fixated and which word to fixate next.

Hollenstein, Nora, Jonathan Rotsztejn, Marius Troendle, Andreas Pedroni, Ce Zhang, and Nicolas Langer. "ZuCo, a simultaneous EEG and eye-tracking resource for natural sentence reading." *Scientific data* 5, no. 1 (2018): 1-13.

Visual Stimulus Datasets

Dataset	Type	Stimulus	#S	Paradigm	Size	Task
Thirion et al., 2006	fMRI	Rotating wedges, expanding/contracting rings, rotating Gabor filters, grid	9	Viewing visual patterns	Wedges/rings for 8 times, 36 Gabor filters for 4 times, grid 36 times	Passive viewing, imagine one of the 6 domino stimuli when prompted to.
Vim-1: Kay et al., 2008	fMRI	Sequences of natural photos	2	Viewing natural images	Each subject viewed 1750 (Stage 1)+ 120 (Stage 2) novel natural images	Passive viewing
Horikawa et al., 2017	fMRI	Object images	5	Viewing and Reading	Each subject: (1) Image presentation: 1,200 images from 150 object categories and 50 images from 50 object categories; (2) Imagery: 10 times.	One-back repetition detection task, imagine object images pertaining to the category
BOLD5000: Chang et al., 2019	fMRI	5254 images depicting real-world scenes	4	Viewing natural images	~20 hours of MRI scans per each of four participants	Passive viewing
Algonauts: Cichy et al., 2019	fMRI (EVC and IT)/MEG (early and late in time)	Object images	15	Viewing object images	92 silhouette object images and 118 images of objects on natural background	Passive viewing
Natural Scenes Dataset: Allen et al., 2022	fMRI	73000 natural scenes	8	Viewing natural scenes	~73000 distinct natural scene images from MSCOCO.	Passive viewing
THINGS: Hebart et al., 2023	fMRI/EEG	31188 natural images across 1,854 object concepts.	8	Viewing natural images	fMRI: 3 Participants. 8,740 unique images. 720 objects. MEG: 4 Participants. 22,448 unique images. 1,854 objects	oddball detection task (synthetic image).

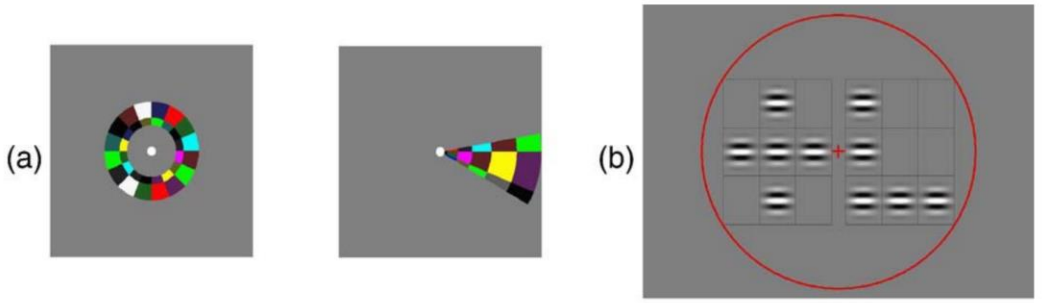
Visual Binary Patterns

a) Retinotopic mapping experiment: flickering rotating wedges and expanding/contracting rings.

b) Domino experiment: groups of quickly rotating Gabor filters in an event-related design. Disks appeared simultaneously on the left and right side of the visual field.

c) 6 different patterns in each hemifield.

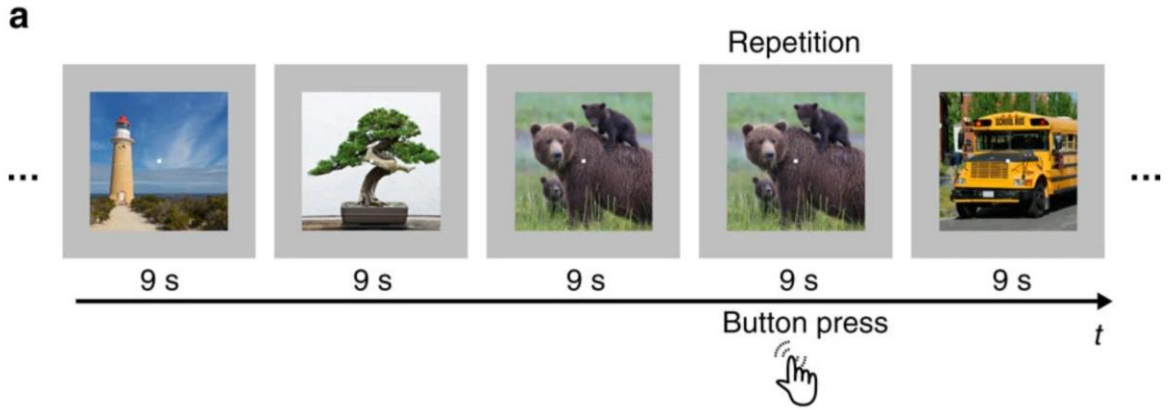
d) Subject was presented with the same grid. When the central fixation cross (left) became a left arrow (middle) or a right arrow (right), the subject had to imagine one of the 6 patterns presented previously, either in the left or right hemifield.



Thirion, Bertrand, Edouard Duchesnay, Edward Hubbard, Jessica Dubois, Jean-Baptiste Poline, Denis Lebihan, and Stanislas Dehaene. "Inverse retinotopy: inferring the visual content of images from brain activation patterns." *Neuroimage* 33, no. 4 (2006): 1104-1116.

Seen and imagined objects

- Two fMRI experiments: An image presentation experiment, and an imagery experiment.
- Image presentation experiment (a)
  - Subjects performed a one-back repetition detection task on the images, responding with a button press for each repetition.
- Imagery experiment (b)
  - Cue stimuli composed of an array of object names that were visually presented.
  - The onset and the end of the imagery periods were signalled by auditory beeps.
  - After the first beep, the subjects were instructed to imagine as many object images as possible pertaining to the category indicated by red letters.
  - They continued imagining with their eyes closed (15 s) until the second beep.
  - Subjects were then instructed to evaluate the vividness of their mental imagery (3 s).



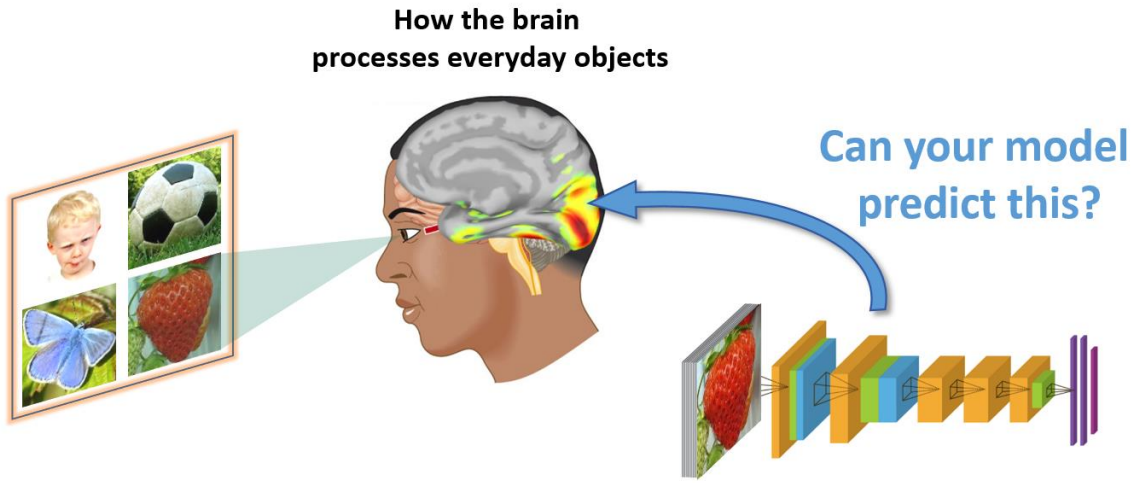
Horikawa, Tomoyasu, and Yukiyasu Kamitani. "Generic decoding of seen and imagined objects using hierarchical visual features." *Nature communications* 8, no. 1 (2017): 1-15.

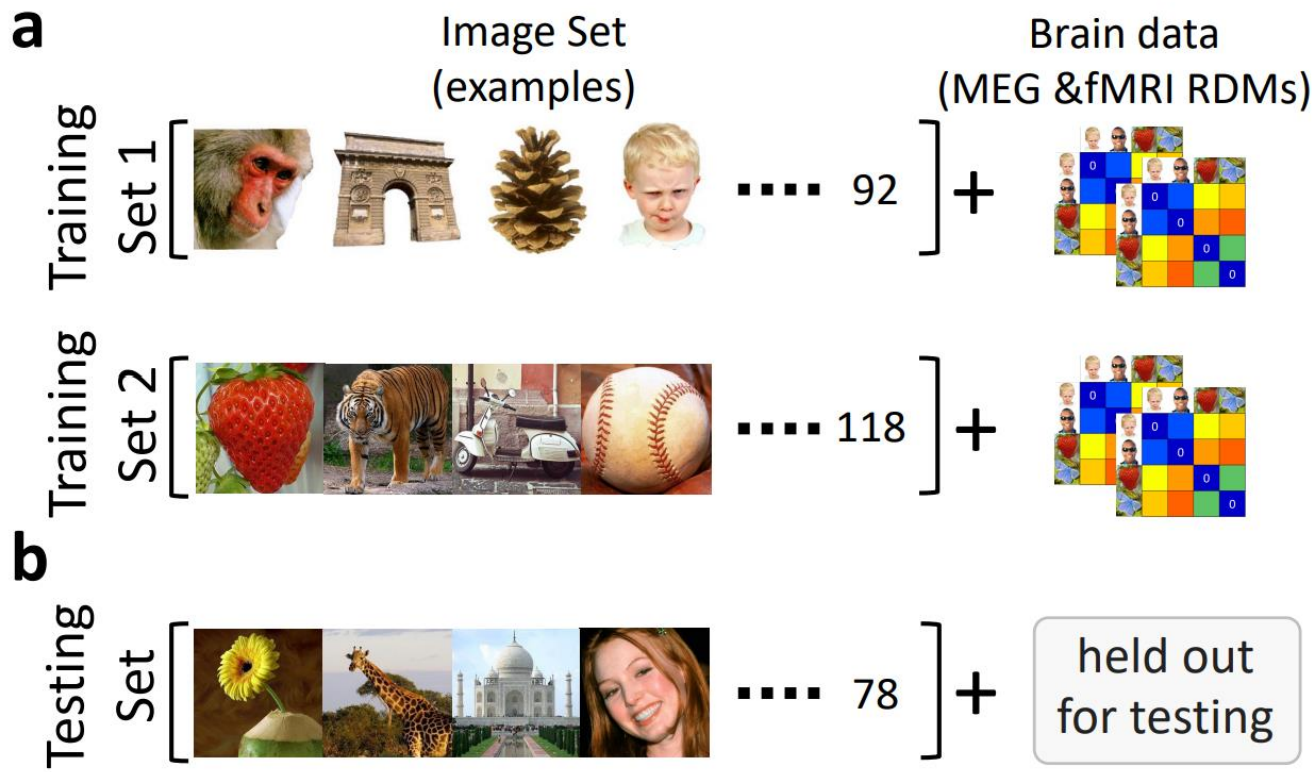
BOLD5000

- ~20 hours of MRI scans per each of the four participants.
- 4,916 unique images were used as stimuli from 3 image sources

Chang, Nadine, John A. Pyles, Austin Marcus, Abhinav Gupta, Michael J. Tarr, and Elissa M. Aminoff. "BOLD5000, a public fMRI dataset while viewing 5000 visual images." *Scientific data* 6, no. 1 (2019): 1-18.

Algonauts-2019





Training and Testing Material.

a) **There are two sets of training data, each consisting of an image set and brain activity in RDM format (for fMRI and MEG). Training set 1 has 92 silhouette object images, and training set 2 has 118 object images with natural backgrounds.**

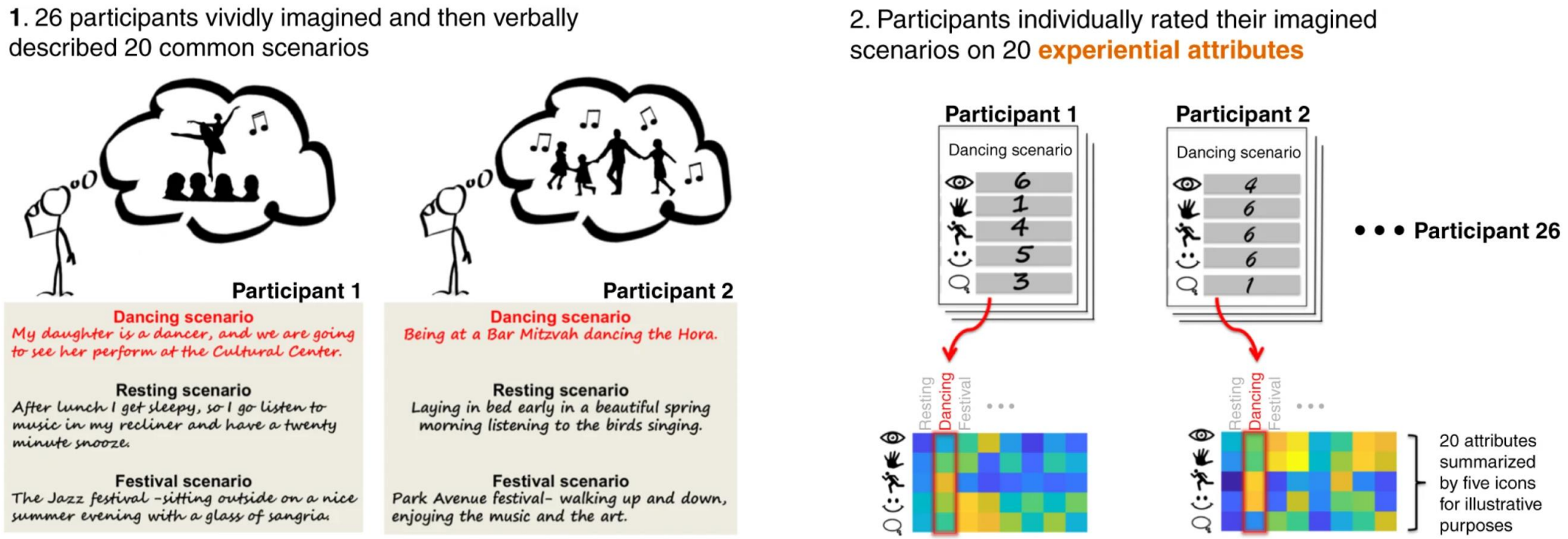
b) **Testing data consists of 78 images of objects on natural backgrounds.**

Cichy, Radoslaw Martin, Gemma Roig, Alex Andonian, Kshitij Dwivedi, Benjamin Lahner, Alex Lascelles, Yalda Mohsenzadeh, Kandan Ramakrishnan, and Aude Oliva. "The algonauts project: A platform for communication between the sciences of biological and artificial intelligence." *arXiv preprint arXiv:1905.05675* (2019).

Audio Stimulus Datasets

Dataset	Type	Language	Stimulus	#S	Paradigm	Size	Task
Handjaras et al., 2016	fMRI	Italian	Verbal, pictorial or auditory presentation of 40 concrete nouns	20	Reading, viewing or listening	40 nouns * 4 times.	Property Generation
Huth et al., 2016	fMRI	English	Eleven 10-minute stories	7	Listening	2 hours of stories from The Moth Radio Hour	Passive Listening
Brennan and Hale, 2019	EEG	English	Chapter one of Alice's Adventures in Wonderland as read by Kristen McQuillan	33	Listening	2,129 words in 84 sentences. The entire experimental session lasted 1–1.5 h (including QA).	8 MCQ Question answering concerning the contents of the story
Anderson et al., 2020	fMRI	English	One of 20 scenario names	26	Listening scenario name	20 scenario prompts displayed 5 times.	Imagine themselves personally experiencing common scenarios
Narratives: Nastase et al., 2021	fMRI	English	27 diverse naturalistic spoken stories	345	Listening	891 functional scans, totaling ~4.6 hours of unique stimuli (~43,000 words)	Passive Listening
Natural Stories: Zhang et al., 2020	fMRI	English	Moth-Radio-Hour naturalistic spoken stories	19	Listening	5 h 33 m (repeated twice). Each story is 6 m 48 s avg or 2492 words.	Passive Listening
The Little Prince: Li et al., 2021	fMRI	English, Chinese, French	Audiobook	112	Listening	English audiobook is 94 minutes long. Chinese: 99min. French: 97 min.	Passive Listening. 4 quiz questions.
MEG-MASC: Gwilliams et al., 2022	MEG	English	4 English fictional stories: Cable spool boy, LW1, Black willow, Easy money.	27	Listening	Two hours of naturalistic stories. 208 MEG sensors.	Passive Listening

Imagining common scenarios



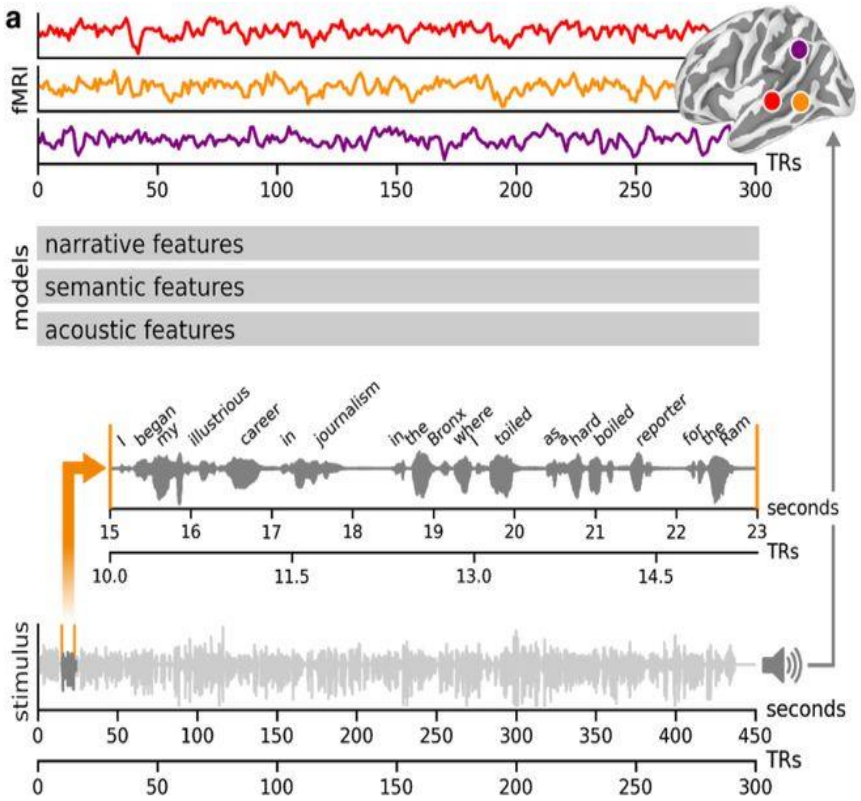
- Participants underwent fMRI as they reimagined the scenarios when prompted by standardized cues.
- 20 Scenarios: resting, reading, writing, bathing, cooking, housework, exercising, internet, telephoning, driving, shopping, movie, museum, restaurant, barbecue, party, dancing, wedding, funeral, festival.
- 20 attributes: bright, color, motion, touch, audition, music, speech, taste, head, upperlimb, lowerlimb, body, path, landmark, time, social, communication, cognition, pleasant, unpleasant.

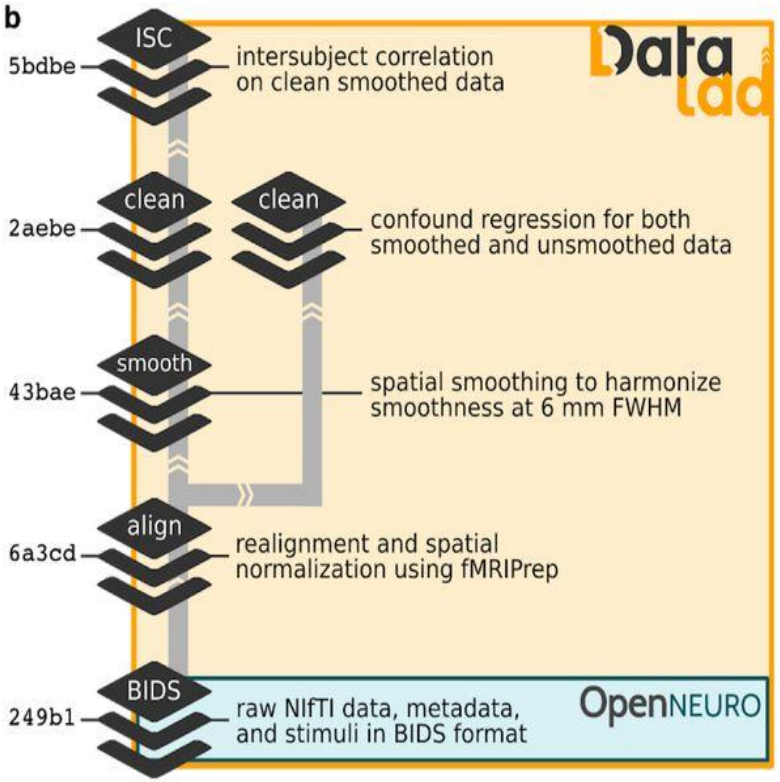
Anderson, Andrew James, Kelsey McDermott, Brian Rooks, Kathi L. Heffner, David Dodell-Feder, and Feng V. Lin. "Decoding individual identity from brain activity elicited in imagining common experiences." *Nature communications* 11, no. 1 (2020): 1-14.

Listening data set

- PieMan story listening:
  - 82 subjects
  - 282 TRs (repetition time)
  - TR is 1.5 sec.

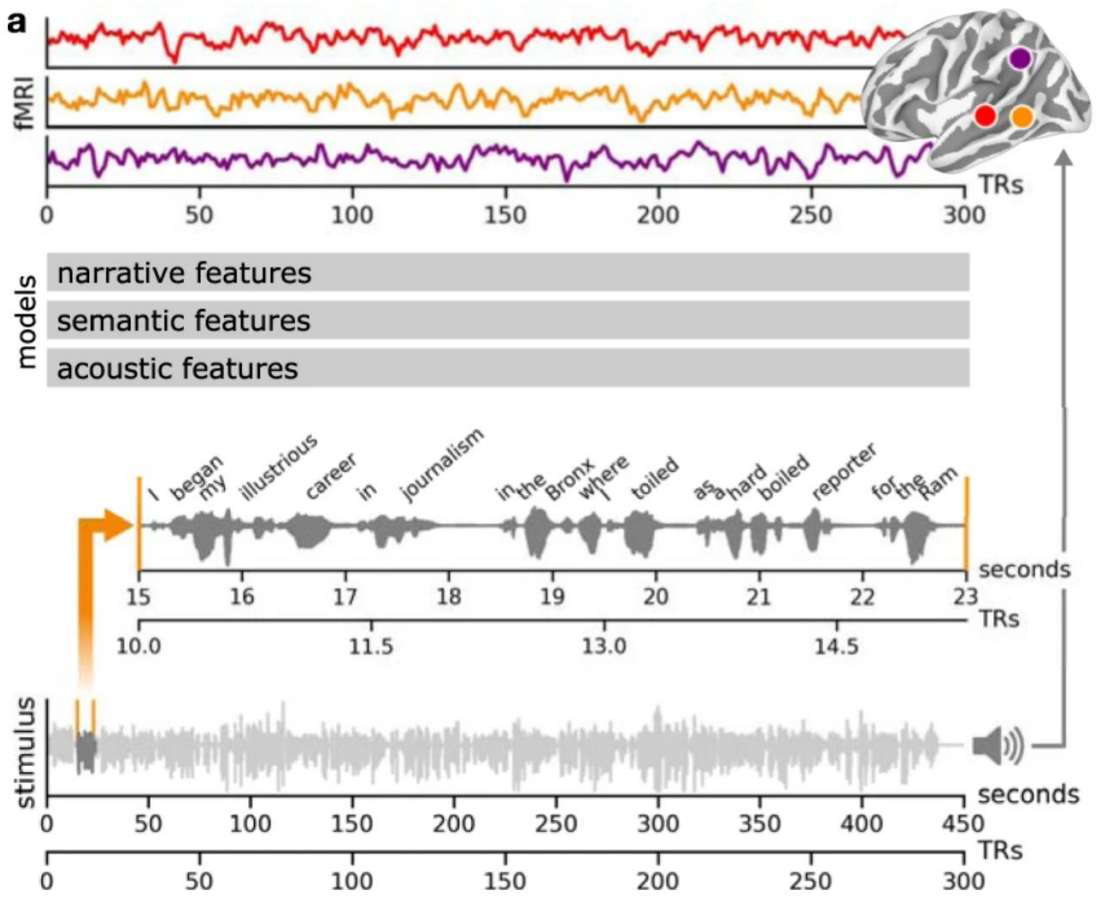
Example: "I began my illustrious carrier in journalism…"





Nastase et al., *Scientific Data*, 2021

Narratives



Story	Duration	TRs	Words	Subjects
"Pie Man"	07:02	282	957	82
"Tunnel Under the World"	25:34	1,023	3,435	23
"Lucy"	09:02	362	1,607	16
"Pretty Mouth and Green My Eyes"	11:16	451	1,970	40
"Milky Way"	06:44	270	1,058	53
"Slumlord"	15:03	602	2,715	18
"Reach for the Stars One Small Step at a Time"	13:45	550	2,629	18
"It's Not the Fall That Gets You"	09:07	365	1,601	56
"Merlin"	14:46	591	2,245	36
"Sherlock"	17:32	702	2,681	36
"Schema"	23:12	928	3,788	31
"Shapes"	06:45	270	910	59
"The 21st Year"	55:38	2,226	8,267	25
"Pie Man (PNI)"	06:40	267	992	40
"Running from the Bronx (PNI)"	08:56	358	1,379	40
"I Knew You Were Black"	13:20	534	1,544	40
"The Man Who Forgot Ray Bradbury"	13:57	558	2,135	40
Total:	4.6 hours	11,149 TRs	42,989 words	
Total across subjects:	6.4 days	369,496 TRs	1,399,655 words	

Nastase, Samuel A., Yun-Fei Liu, Hanna Hillman, Asieh Zadbood, Liat Hasenfratz, Neggin Keshavarzian, Janice Chen et al. "The "Narratives" fMRI dataset for evaluating models of naturalistic language comprehension." *Scientific data* 8, no. 1 (2021): 1-22.

Video Stimulus Datasets

Dataset	Type	Language	Stimulus	#Subjects	Paradigm	Size	Task
BBC's Doctor Who: Seeliger et al., 2019	fMRI	English	Spatiotemporal visual and auditory naturalistic stimuli (30 episodes of BBC's Doctor Who)	1	Viewing episode videos	120.830 whole-brain volumes (approx. 23 h) of single-presentation data, and 1.178 volumes (11 min) of repeated narrative short episodes (22 repetitions)	Passive viewing
Japanese Ads: Nishida et al., 2020	fMRI	Japanese	368 web and 2452 TV Japanese ad movies (15-30s)	40 and 28 for web and TV ads. 16 were overlapped	Viewing Ads	7200 train and 1200 test fMRIs for web; fMRIs from 420 ads.	Passive viewing
Pippi Langkous: Berezutskaya et al., 2020	ECoG	The movie was originally in Swedish but dubbed in Dutch	30 s excerpts of a feature film (in total, 6.5 min long), edited together for a coherent story	37 patients	Viewing	6.5 min movie.	Passive viewing
Algonauts: Cichy et al., 2021	fMRI	English	1000 short video clips	10	Viewing video clips	1000 short video clips (3 sec each)	Passive viewing
Natural Short Clips: Huth et al., 2022	fMRI	English	Natural short movie clips	5	Watching natural short movie clips	3870 responses per subject.	Passive viewing

Japanese Ads

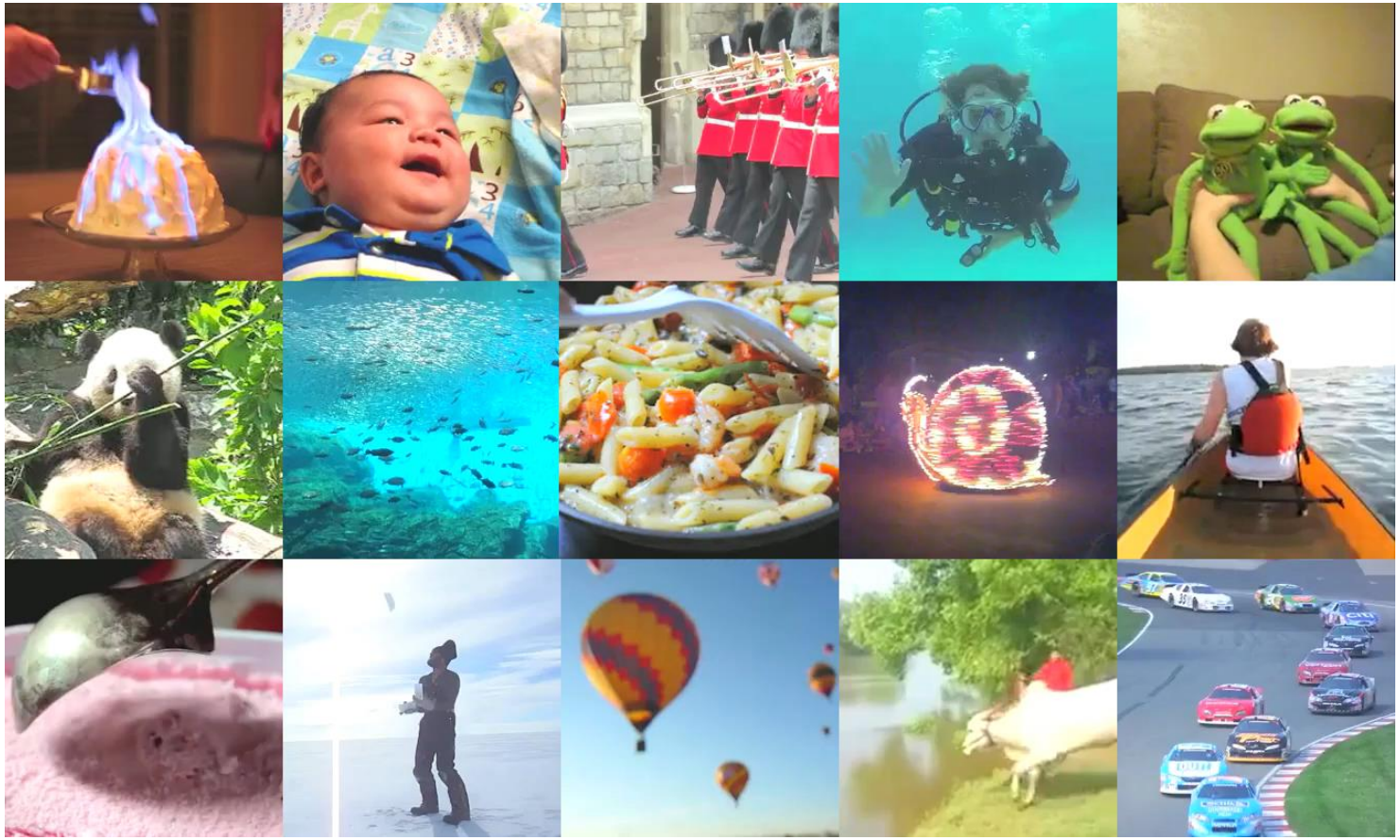
- Two sets of movies were provided by NTT DATA Corp: web and TV ads.
- Four types of cognitive labels associated with the movie datasets
  - Scene descriptions
    - Human judges create scene descriptions with 50+ words per 1s scene.
  - Impression ratings
    - Human rating on 30 factors for every 2s clip on a scale of 0-4.
  - Ad effectiveness indices
    - Click rate: fraction of viewers who clicked the frame of a movie and jumped to a linked web page
    - View completion rate: fraction of viewers who continued to watch an ad movie until the end without choosing a skip option.
  - Ad preference votes
    - Each tester was asked to freely recall a small number of favorite TV ads from among the ads recently broadcasted.
    - The total number of recalls of an ad was regarded as its preference value.

Categories	Web ad movies	TV ad movies
Electronic & Precision	4	50
Audiovisual	5	6
Appliance	16	23
Car	31	145
Food & Confectionery	7	369
Beverage & Alcoholic drink	20	236
Medical & Health	35	156
Cosmetics	49	85
Sundries & Home equipment	10	254
Garment/apparel	9	43
Entertainment	42	237
Media & Education	41	82
Distribution & Retailer	12	112
Communication & Service	35	328
House & Construction	9	90
Finance	9	145
Enterprise, Public service, & Others	34	91

Nishida, Satoshi, Yusuke Nakano, Antoine Blanc, Naoya Maeda, Masataka Kado, and Shinji Nishimoto. "Brain-mediated transfer learning of convolutional neural networks." In *Proceedings of the AAAI Conference on Artificial Intelligence*, vol. 34, no. 04, pp. 5281-5288. 2020.

Algonauts 2021

- fMRI from 10 human subjects that watched over 1,000 short (3 sec) video clips.



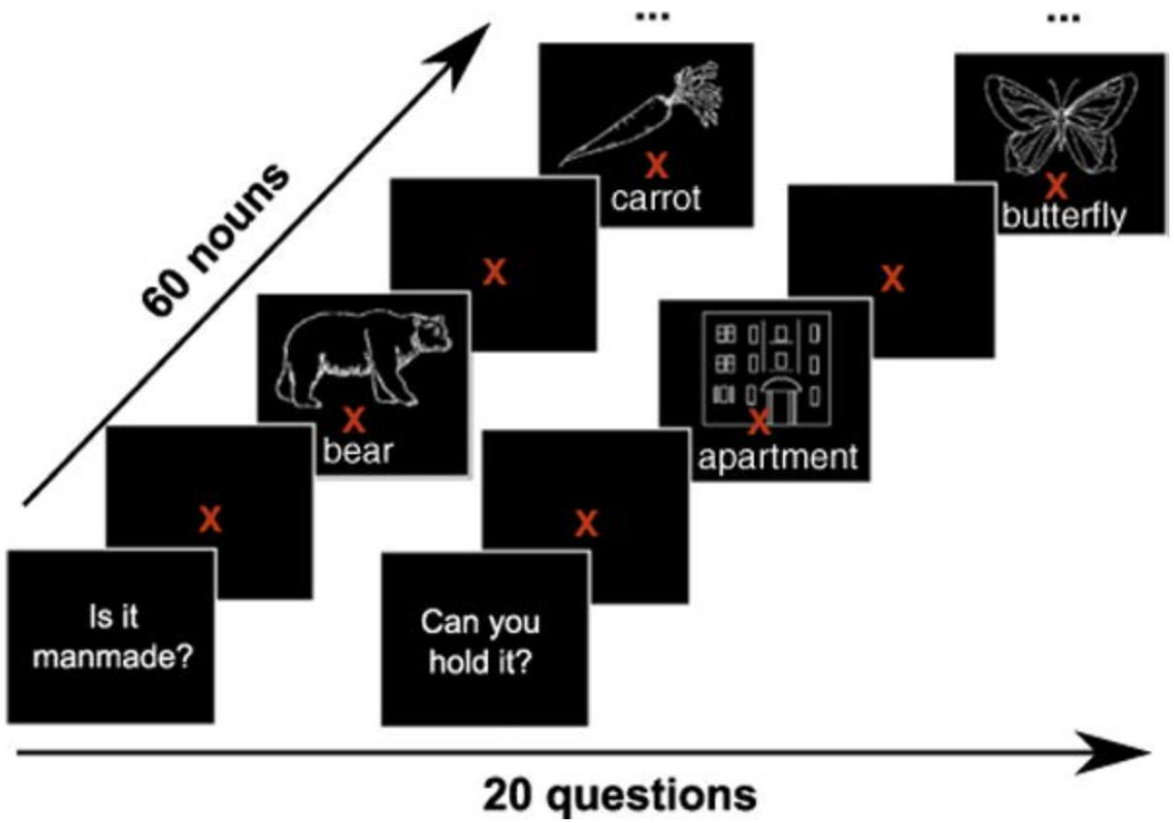
Cichy, Radoslaw Martin, Kshitij Dwivedi, Benjamin Lahner, Alex Lascelles, Polina Iamshchinina, M. Graumann, A. Andonian et al. "The Algonauts Project 2021 Challenge: How the Human Brain Makes Sense of a World in Motion." *arXiv preprint arXiv:2104.13714* (2021).

Other Multimodal Stimulus Datasets

Dataset	Type	Language	Stimulus	#Subjects	Paradigm	Size	Task
Mitchell et al., 2008	fMRI	English	60 different word-picture pairs from 12 categories.	9	Viewing word-picture pairs	60 different word-picture pairs presented six times each	Passive viewing
Sudre et al., 2012	MEG	English	60 concrete nouns along with line drawings	9	Reading	60 stimuli × 20 questions = 1200 examples	Question answering
Zinszer et al., 2017	fNIRS	English	8 concrete nouns (audiovisual word and picture stimuli): bunny, bear, kitty, dog, mouth, foot, hand, and nose	24	Viewing and listening	12 blocks with the 8 stimuli per subject.	Passive viewing and listening
Pereira et al., 2018	fMRI	English	180 Words with Picture, Sentences, word clouds; 96 text passages; 72 passages	16	Viewing WP, sentences or word clouds	180 WP, S and WC per subject; 96+72 passages shown 3 times	Passive viewing
Cao et al., 2021	fNIRS	Chinese	50 concrete nouns from 10 semantic categories	7	Viewing and listening	Each stimulus is presented 7 times.	Passive viewing and listening
Courtois Neuromod	fMRI	full-length movies and TV show	6	Viewing and Listening	~100 hours of data per participant	Passive viewing	

Concrete nouns with line drawings

- Subjects were asked to perform a QA task, while their brain activity was recorded using MEG.
- Subjects were first presented with a question (e.g., “Is it manmade?”), followed by 60 concrete nouns, along with their line drawings, in a random order.
- Each stimulus was presented until the subject pressed a button to respond “yes” or “no” to the initial question.
- Once all 60 stimuli are presented, a new question is shown for a total of 20 questions.



Sudre, Gustavo, Dean Pomerleau, Mark Palatucci, Leila Wehbe, Alona Fyshe, Riitta Salmelin, and Tom Mitchell. "Tracking neural coding of perceptual and semantic features of concrete nouns." NeuroImage 62, no. 1 (2012): 451-463.

Dataset Details (Experiment-1)

- 180 Concepts
  - 128 nouns
  - 22 verbs
  - 29 adjectives
  - 1 function word
- 16 subjects
- AAL atlas (180 regions)
- Gordon atlas (333 regions)

Periera et al. 2018

Dataset Details (Experiment-1)

Concept
Word

Bird

1. The bird flew around the cage.
2. The nest was just big enough for the bird.
3. The only bird she can see is the parrot.
4. The bird poked its head out of the hatch.
5. The bird holds the worm in its beak.
6. The bird preened itself for mating.

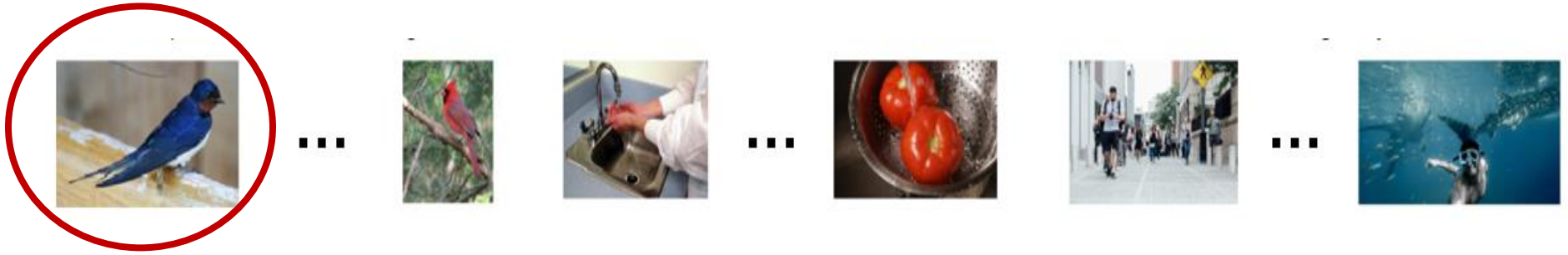
Wash

1. To make the counter sterile, wash it.
2. The dishwasher can wash all the dishes.
3. He likes to wash himself with bar soap.
4. She felt clean after she could wash herself.
5. You have to wash your laundry beforehand.
6. The maid was asked to wash the floor.

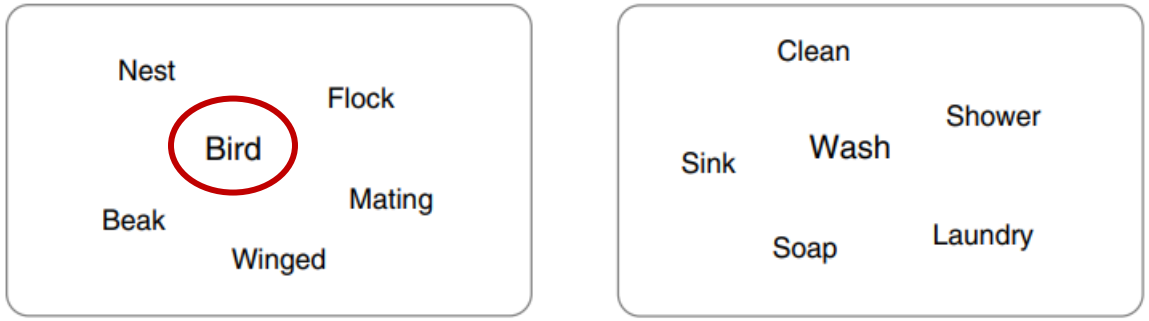
Unaware

1. She was unaware of how oblivious he really was.
2. She was unaware of her status.
3. Unprejudiced and unaware, she went full throttle.
4. Unaware of current issues, he is a terrible candidate.
5. He was unaware of how uninterested she was.
6. He was unaware of the gravity of the situation.

⇨ Concept + Sentence View



⇨ Concept + Picture View



⇨ Concept + Wordcloud View

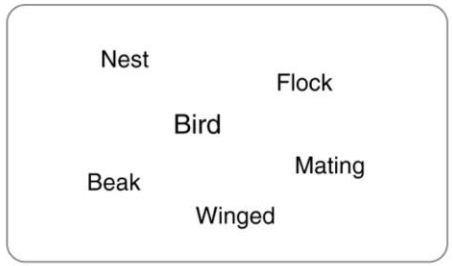
Periera et al. 2018

Word+Picture, Sentences, Word Clouds, Passages

Experiment 1:

Bird

1. The bird flew around the cage.
2. The nest was just big enough for the bird.
3. The only bird she can see is the parrot.
4. The bird poked its head out of the hatch.
5. The bird holds the worm in its beak.
6. The bird preened itself for mating.



Wash

1. To make the counter sterile, wash it.
2. The dishwasher can wash all the dishes.
3. He likes to wash himself with bar soap.
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5. You have to wash your laundry beforehand.
6. The maid was asked to wash the floor.


Experiment 2:

Musical instruments (clarinet)

A clarinet is a woodwind musical instrument. It is a long black tube with a flare at the bottom. The player chooses notes by pressing keys and holes. The clarinet is used both in jazz and classical music.

Musical instruments (accordion)

An accordion is a portable musical instrument with two keyboards. One keyboard is used for individual notes, the other for chords. Accordions produce sound with bellow that blow air through reeds. An accordionist plays both keyboards while opening and closing the bellows.

Musical instruments (piano)

The piano is a popular musical instrument played by means of a keyboard. Pressing a piano key causes a felt-tipped hammer to hit a vibrating steel string. The piano has an enormous note range, and pedals to change the sound quality. The piano repertoire is large, and famous pianists can give solo concerts.

Experiment 3:

Skiing (passage 1)

I hesitantly skied down the steep trail that my buddies convinced me to try. I made a bad turn, and I found myself tumbling down. I finally came to a stop at a flat part of the slope. My skis were nowhere to be found, and my poles were lodged in a snow drift up the hill.

Skiing (passage 2)

A major strength of professional skiers is how they use ski poles. Proper use of ski poles improves their balance and adds flair to their skiing. It minimizes the need for upper body movements to regain lost balance while skiiing.

Skiing (passage 3)

New ski designs and stiffer boots let skiers turn more quickly. But faster and tighter turns increase the twisting force on the legs. This has led to more injuries, particularly to ligaments in the skier's knee

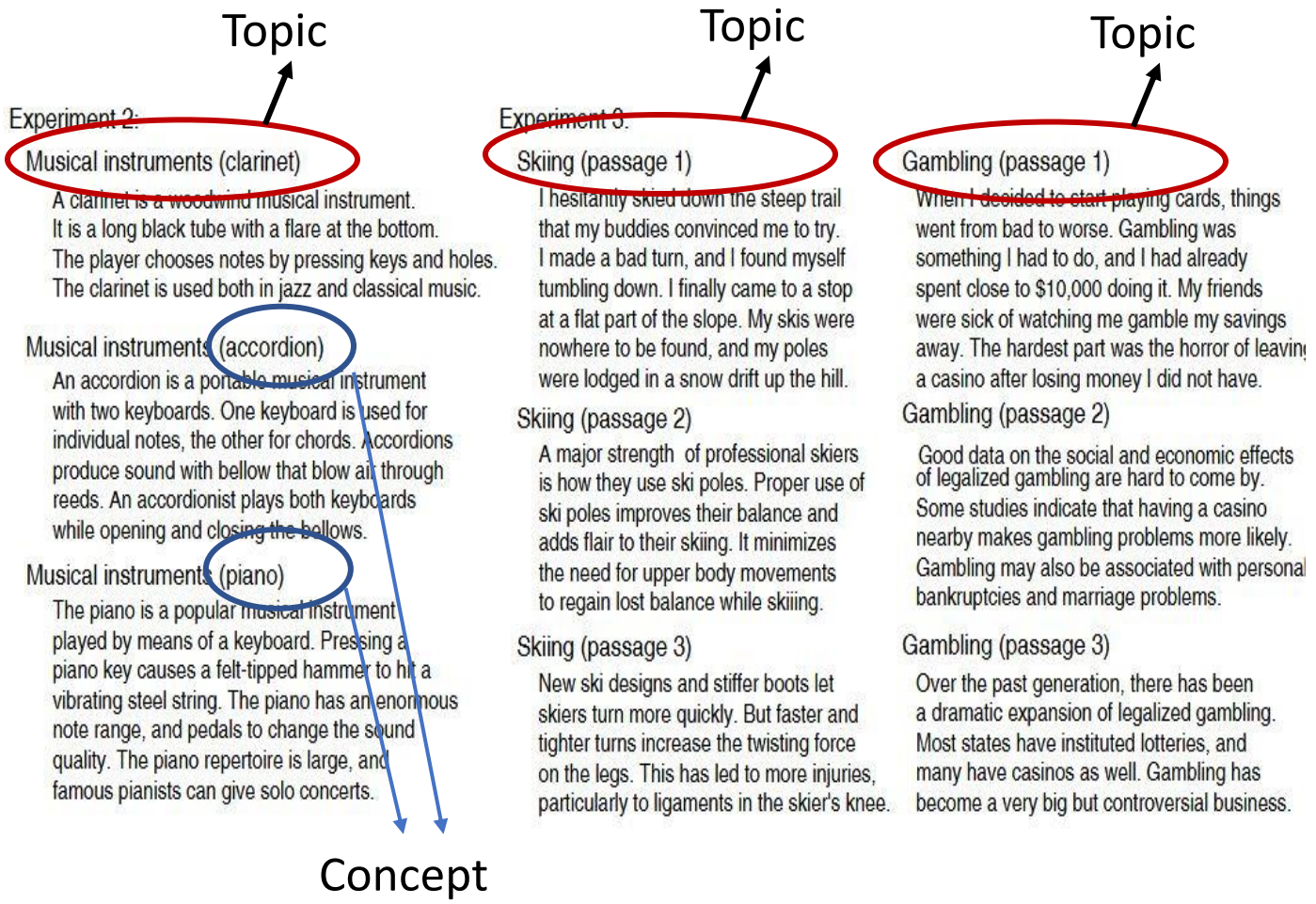
- Experiment 1: 180 words (128 nouns, 22 verbs, 29 adjectives and adverbs, and 1 function word). 3 paradigms.
- Experiment 2: 96 text passages, each with 4 sentences from 24 broad topics (e.g., professions, clothing, birds, musical instruments, natural disasters, crimes, etc.)
- Experiment 3: 72 passages, each with 3-4 sentences from another 24 topics.

Pereira, Francisco, Bin Lou, Brianna Pritchett, Samuel Ritter, Samuel J. Gershman, Nancy Kanwisher, Matthew Botvinick, and Evelina Fedorenko. "Toward a universal decoder of linguistic meaning from brain activation." *Nature communications* 9, no. 1 (2018): 1-13.

Reading data set

- Periera dataset
  - reading sentences
  - 5 subjects
  - 627 sentences (experiment 2 + 3)

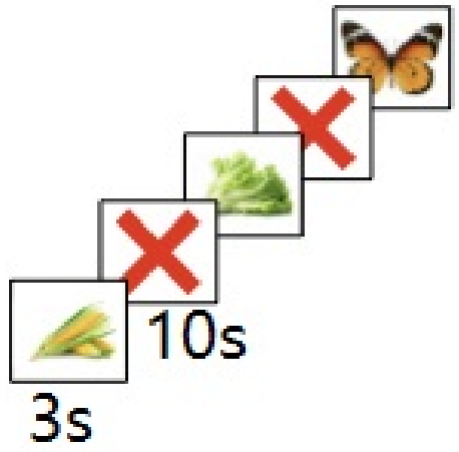
Example: ''A clarinet is a woodwind musical instrument.''



Periera et al., *Nature Communications*, 2018

fNIRS with audio-visual stimuli

- Stimuli are pictures and audios of 50 objects from 10 categories.
- Visual presentation lasts for 3s, with audio presented immediately at the onset, followed by a 10s rest period.
- During rest period, participants are instructed to fixate on an X displayed in the center of the screen.
- The task for participants is to passively view and listen, simply focusing on each stimulus and thinking about properties of the object freely when it is presented.



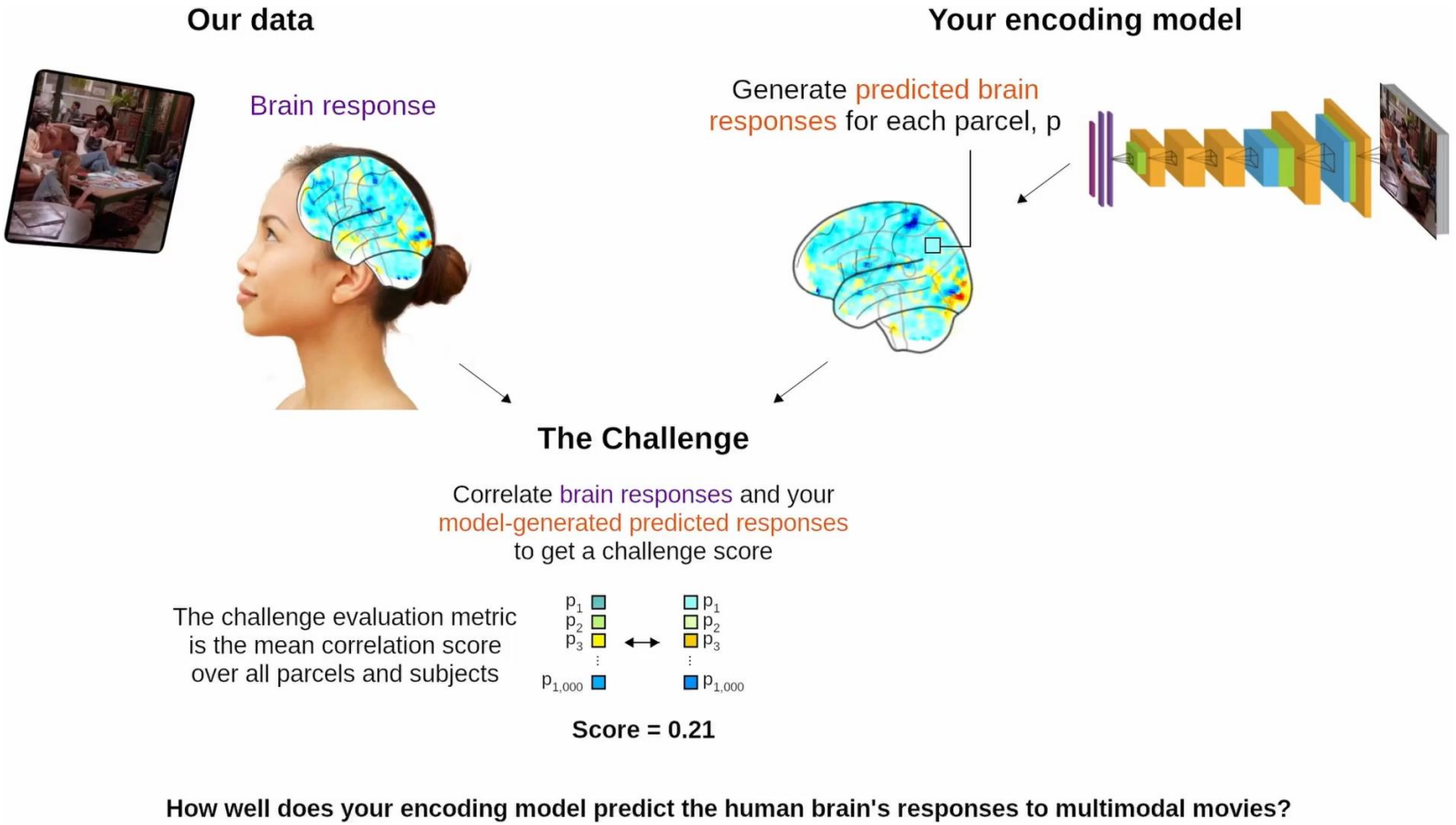
Category	Exemplar
tool	pliers, saw, screwdriver, scissor, hammer
vegetable	celery, corn, carrot, tomato, lettuce
building	bird's nest, tiananmen, oriental pearl TV tower, pyramid, water cube
insect	bee, butterfly, dragonfly, ant, fly
transportation	car, train, truck, airplane, bicycle
furniture	sofa, chair, desk, bed, bookshelf
cloth	sweater, jeans, shirt, skirt, dress
animal	panda, cat, dog, horse, cow
body-part	arm, eye, foot, palm, leg
kitchen	knife, pan, spoon, glass, chopsticks

Cao, Lu, Dandan Huang, Yue Zhang, Xiaowei Jiang, and Yanan Chen. "Brain decoding using fnirs." In Proceedings of the AAAI Conference on Artificial Intelligence, vol. 35, no. 14, pp. 12602-12611. 2021.

Algonauts-2025 (Multimodal)

- The Algonauts Project 2025 challenge invites best model predictions to the competition **until July 13th, 2025**.
- The Algonauts Project 2025 challenge focuses on predicting responses in the human brain as participants perceive complex multimodal movies.
- Through collaboration with the Courtois Project on Neuronal Modelling (CNeuroMod) team, the challenge runs on the largest human brain dataset available, opening new venues for accurate models of neural responses to multimodal naturalistic stimulation.
- To promote more robust models of the brain, the 2025 challenge features a selection process based on out-of-distribution generalization.
- The challenge is organized in partnership with the **Conference on Cognitive Computational Neuroscience (CCN)**.

Algonauts-2025 (Multimodal)



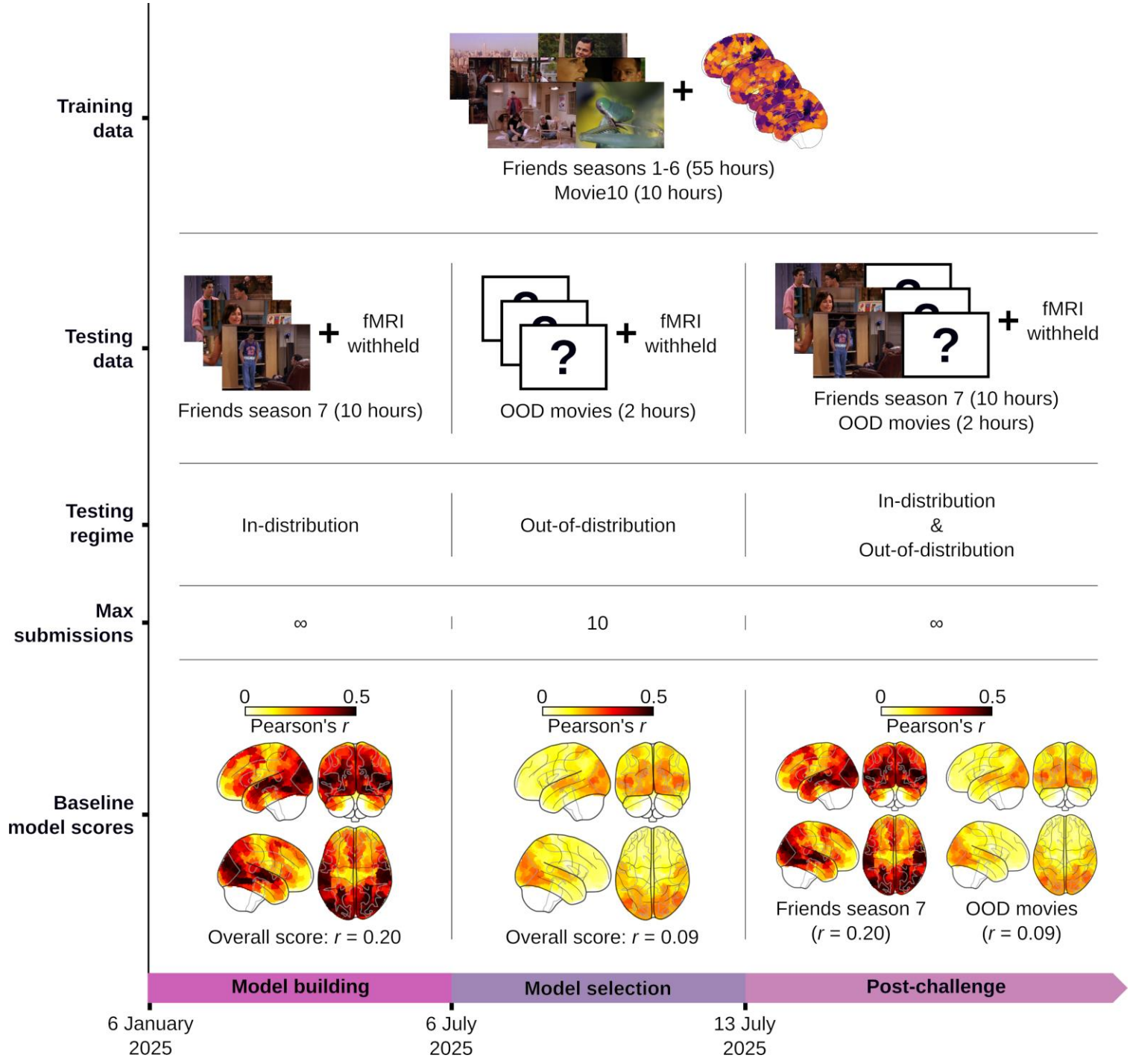
https://algonautsproject.com/challenge.html

Algonauts-2025 (Multimodal)

Figure 1 | **Challenge phases**. During the model building phase, models are trained using stimuli and corresponding fMRI responses for seasons 1 to 6 of the sitcom Friends and Movie10 (a set of four movies), and tested in-distribution (ID) on Friends season 7 (for which the fMRI responses are withheld) with unlimited submissions. During the model selection phase, the winning models are selected based on the accuracy of their predicted fMRI responses for out-of-distribution (OOD) movie stimuli (for which the fMRI responses are withheld) with up to ten submissions. The challenge will be followed by an indefinite post-challenge phase with unlimited submissions, which will serve as a public benchmark for both ID and OOD model validation.

6-months model building phase, followed by 1-week model selection phase.

https://algonautsproject.com/challenge.html



CSAI Course Project Datasets (12)

Dataset	Authors	Imaging Modality	Stimulus	Task
Audio				
The Little Prince	Li et al,. 2021	fMRI	Listening audio book for about 100 minutes	Passive Listening (English) Passive Listening (Chinese) Passive Listening (French)
Music Genre	Nakai et al., 2022	fMRI	Listening 540 music pieces from 10 music genres	Passive Listening (English)
Giovanni2023	Liberto et al., 2023	EEG	Listening an audio book: “The Old Man and the Sea”	
Vision (Text)				
ZuCo	Hollenstein et al., 2018	EEG	Reading 1107 sentences with 21,629 words from movie reviews	Rate Movie Quality (English)
Harry Potter	Wehbe et al., 2014	MEG	Reading Chapter 9 of Harry Potter and the Sorcerer’s Stone	Story Understanding (English)
Vision (Static Images)				
NOD	Gong et al., 2023	fMRI	Viewing 57,120 natural images	Passive Viewing
Gifford2022	Gifford et al., 2022	EEG	Viewing 82160 natural images	
Vision (Videos without audio)				
Mind Captioning	Horikawa, 2024	fMRI		Passive Viewing
Multimodal				
Game of Thrones	Watson & Andrews, 2024	fMRI	Watching short audiovisual clips	Passive Viewing and Listening (English)
AVID	Sava-Segal et al., 2023			

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