

Drawing data, protocols & concepts

Martin Krzywinski

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<http://mkweb.bcgsc.ca>

@MKrzywinski

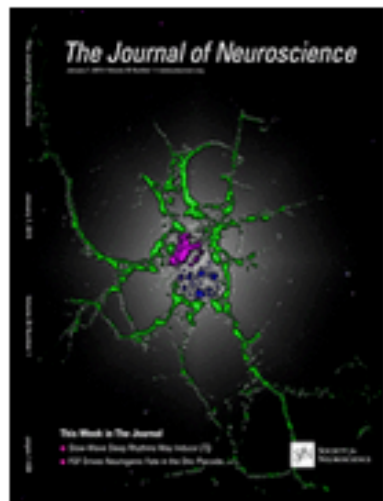
Canada's Michael Smith Genome Sciences Center
Vancouver, Canada

with short commentary
(like this one)

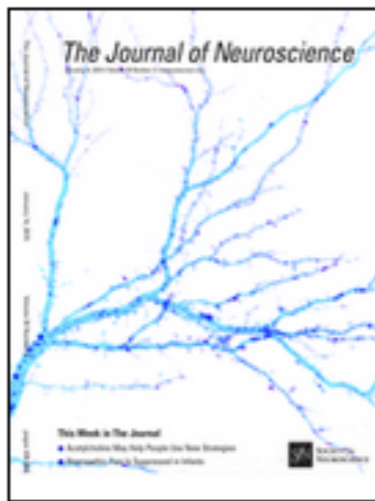


Gordon Andrews (designer)
Gazelle chair (c. 1950) designed, 1957 manufactured
plywood, aluminium, wool
74.0 x 48.0 x 55.0 cm
Museum of Applied Arts and Sciences, Sydney
Purchased, 1989 (89/499)

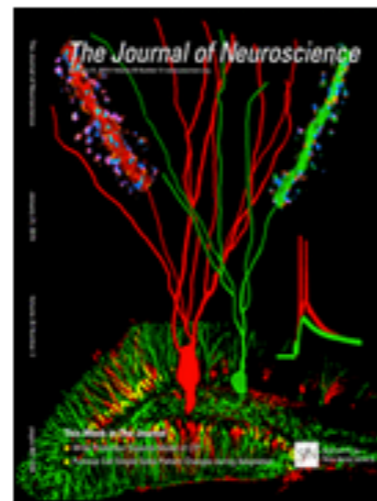
JOURNAL OF NEUROSCIENCE 2014–2018



January 7, 2015
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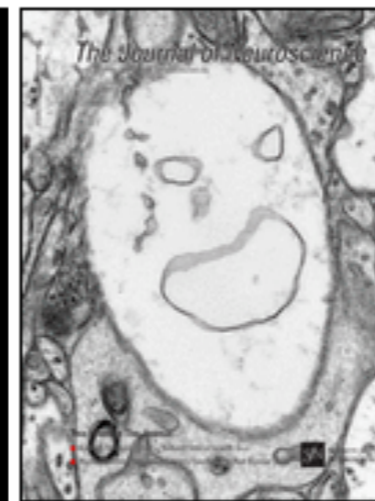
January 14, 2015
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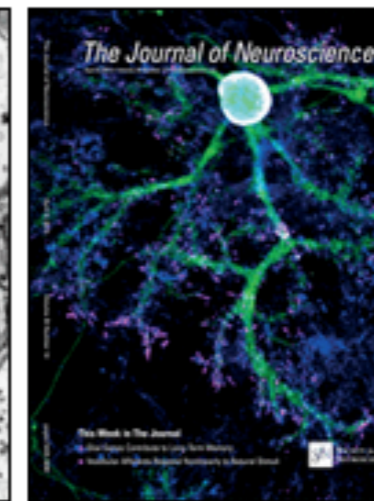
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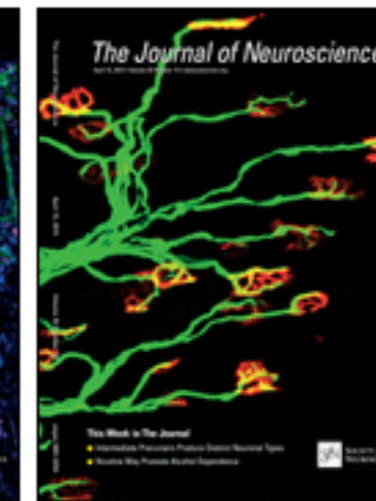
January 28, 2015
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April 1, 2015
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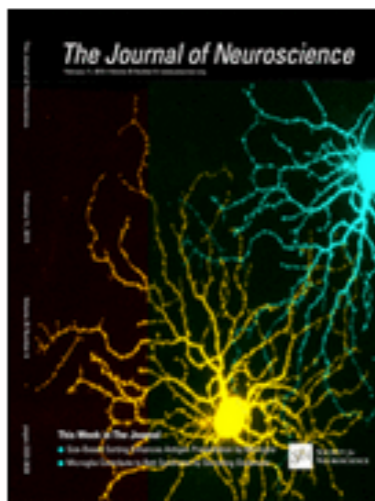
April 8, 2015
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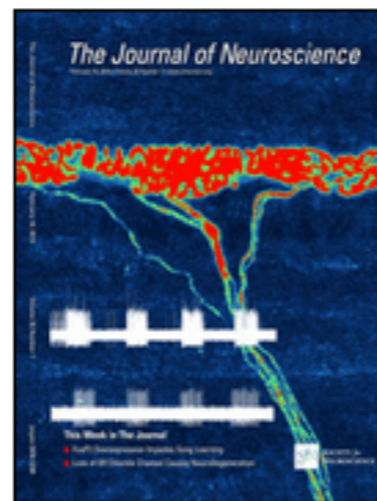
April 15, 2015
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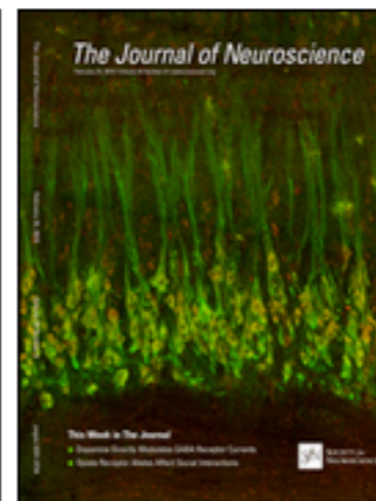
February 4, 2015
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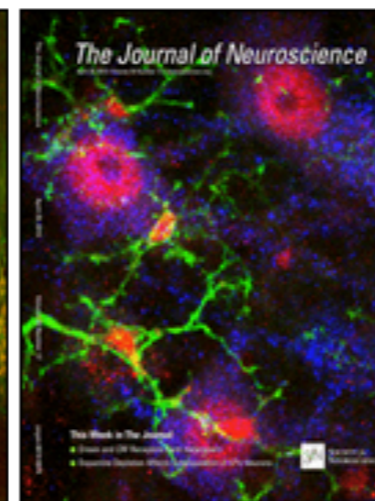
February 11, 2015
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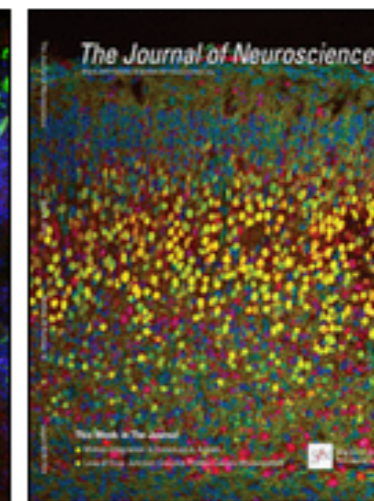
February 18, 2015
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February 25, 2015
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April 29, 2015
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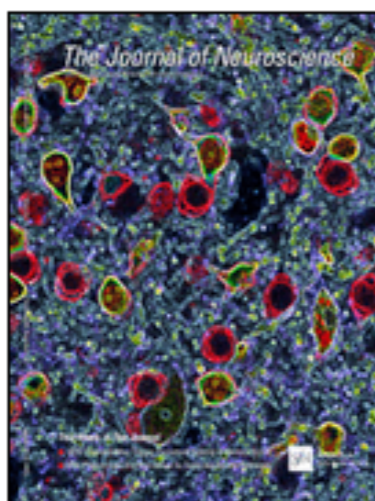
May 6, 2015
Vol. 35, Num. 18



May 13, 2015
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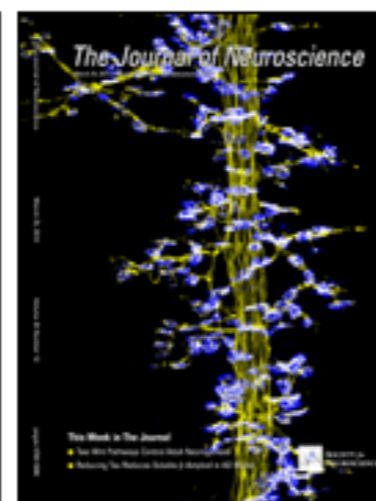
March 4, 2015
Vol. 35, Num. 9



March 11, 2015
Vol. 35, Num. 10



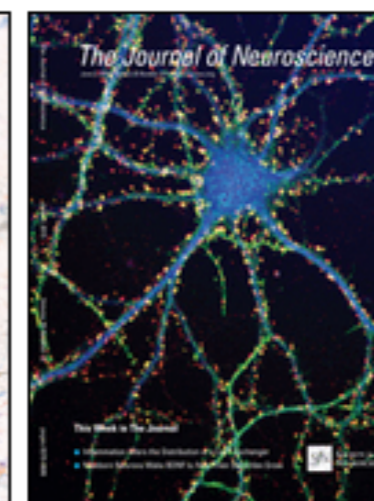
March 18, 2015
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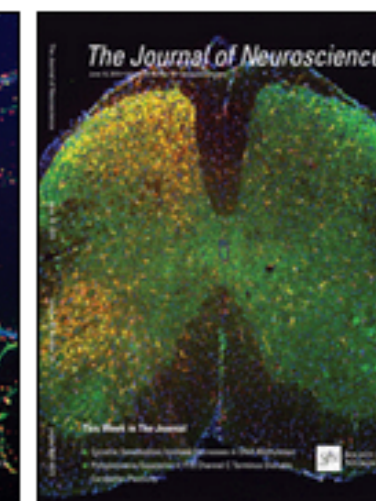
March 25, 2015
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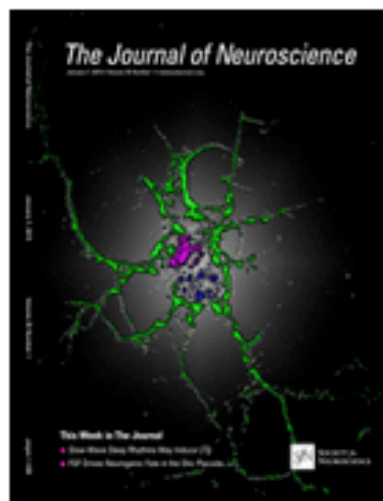
May 27, 2015
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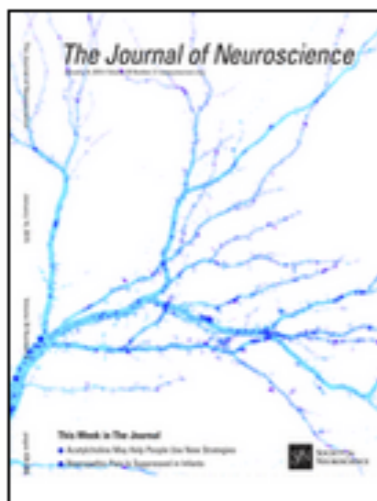
June 3, 2015
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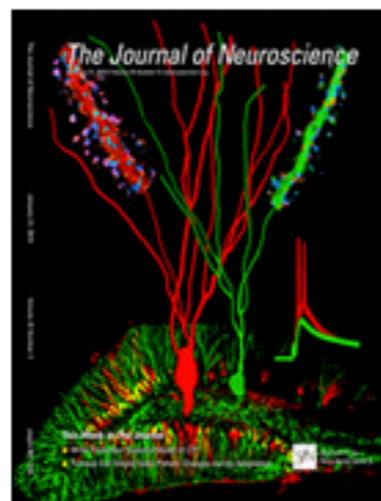
June 10, 2015
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January 7, 2015
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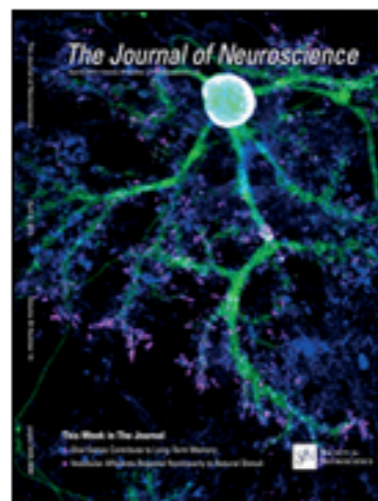
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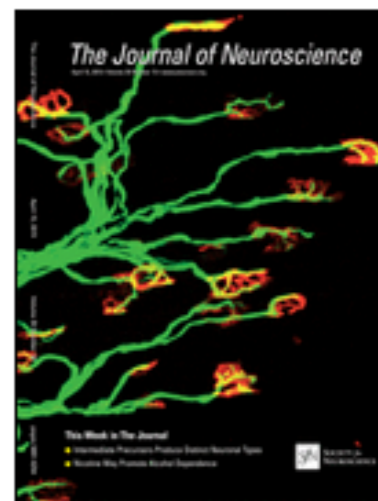
January 28, 2015
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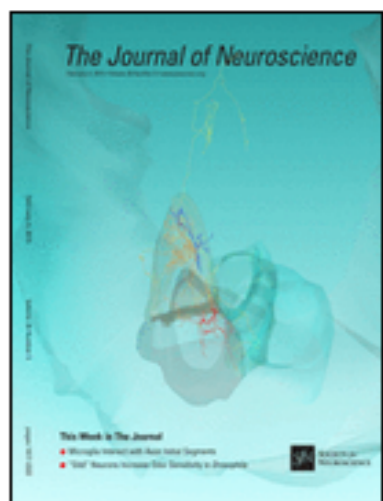
April 1, 2015
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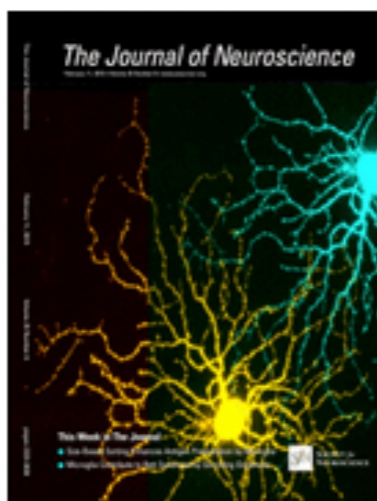
April 8, 2015
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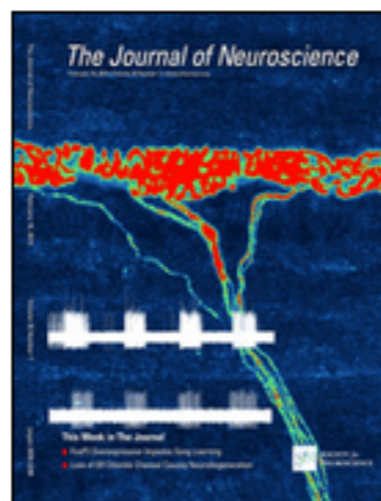
April 15, 2015
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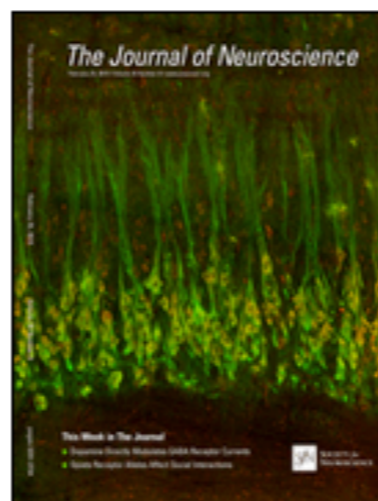
February 4, 2015
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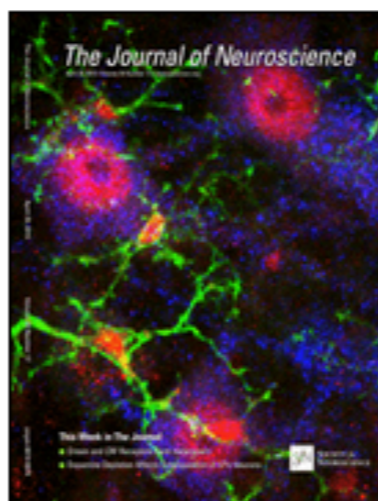
February 11, 2015
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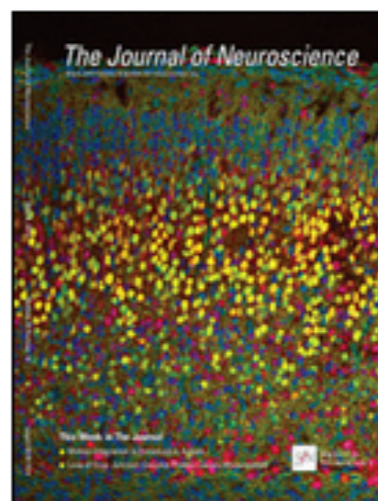
February 18, 2015
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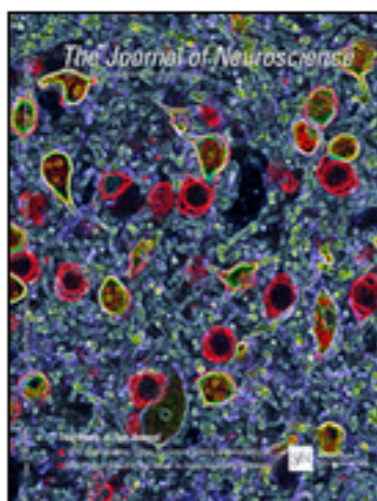
May 6, 2015
Vol. 35, Num. 18



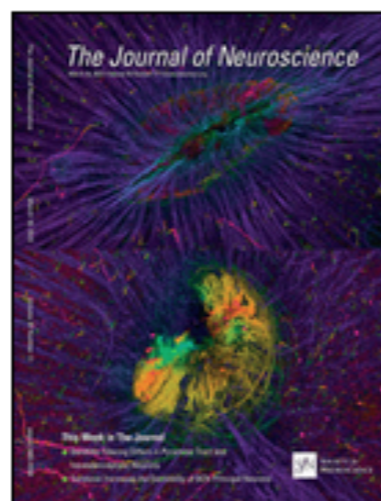
May 13, 2015
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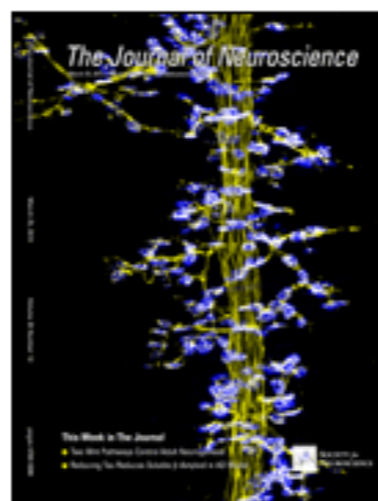
March 4, 2015
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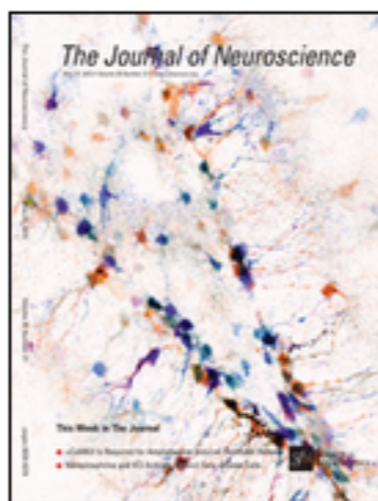
March 11, 2015
Vol. 35, Num. 10



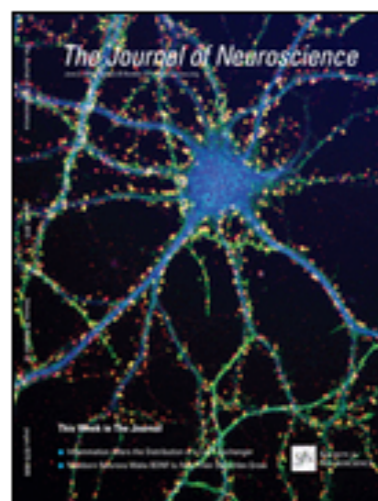
March 18, 2015
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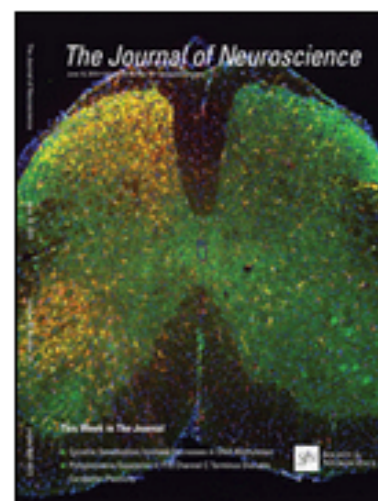
March 25, 2015
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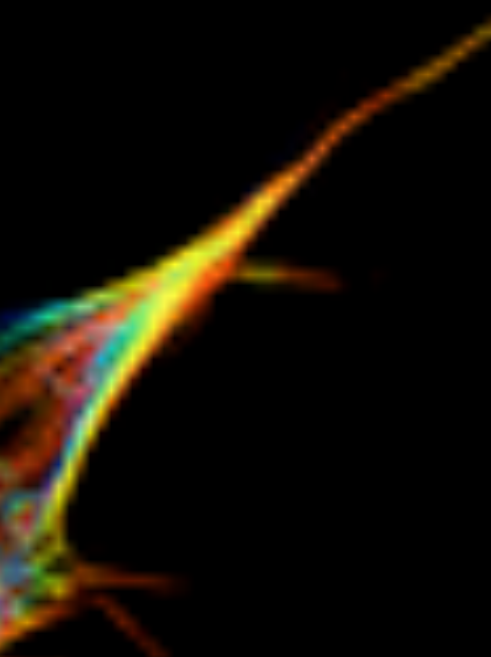


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Journal of Neuroscience



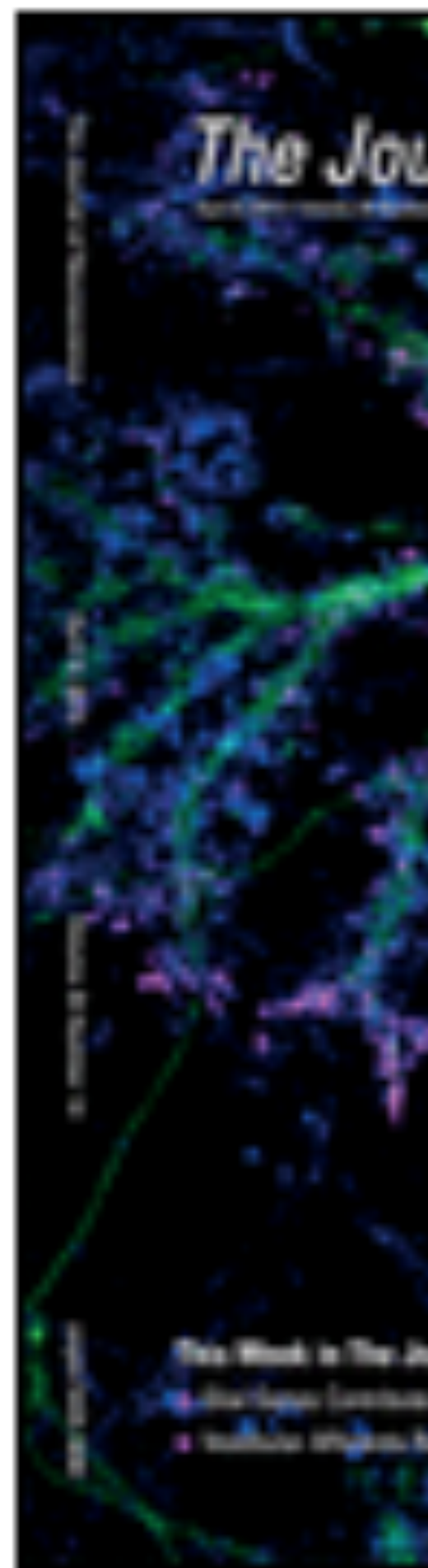
Neuron function in the
Cerebral Cortex

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April 1, 2015

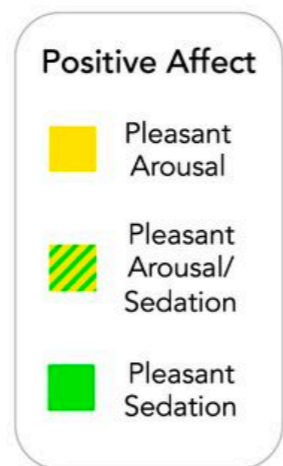
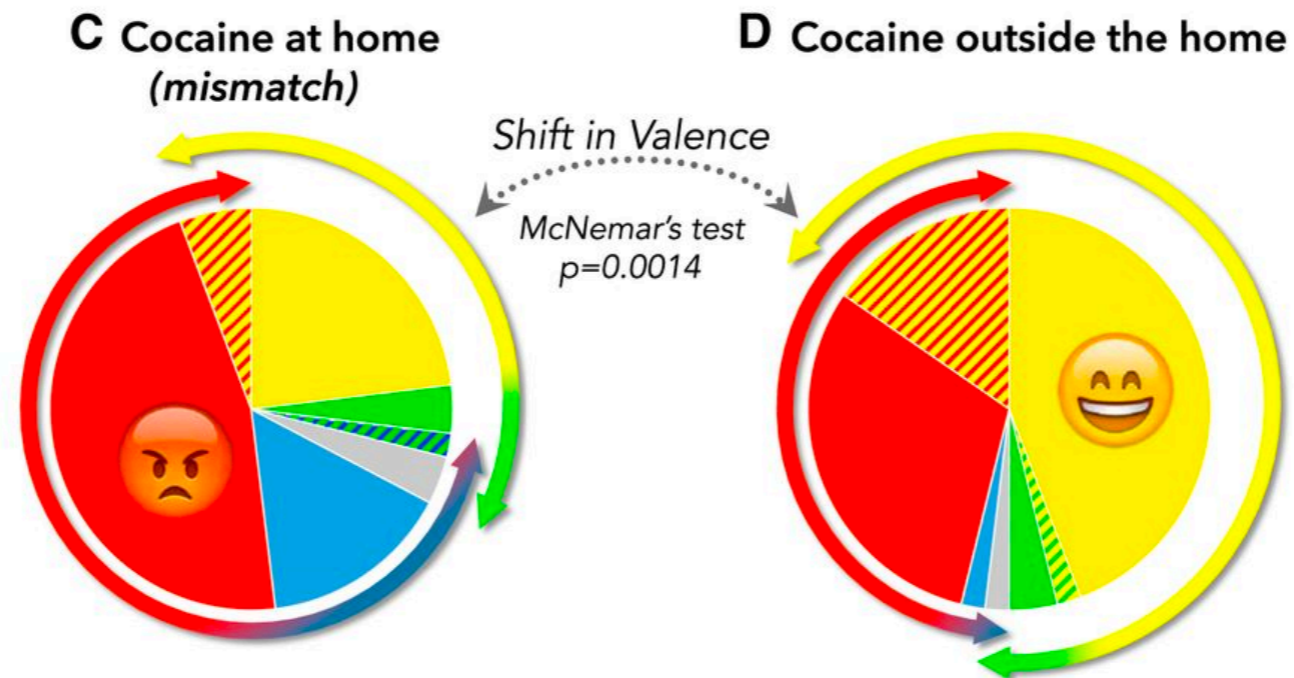
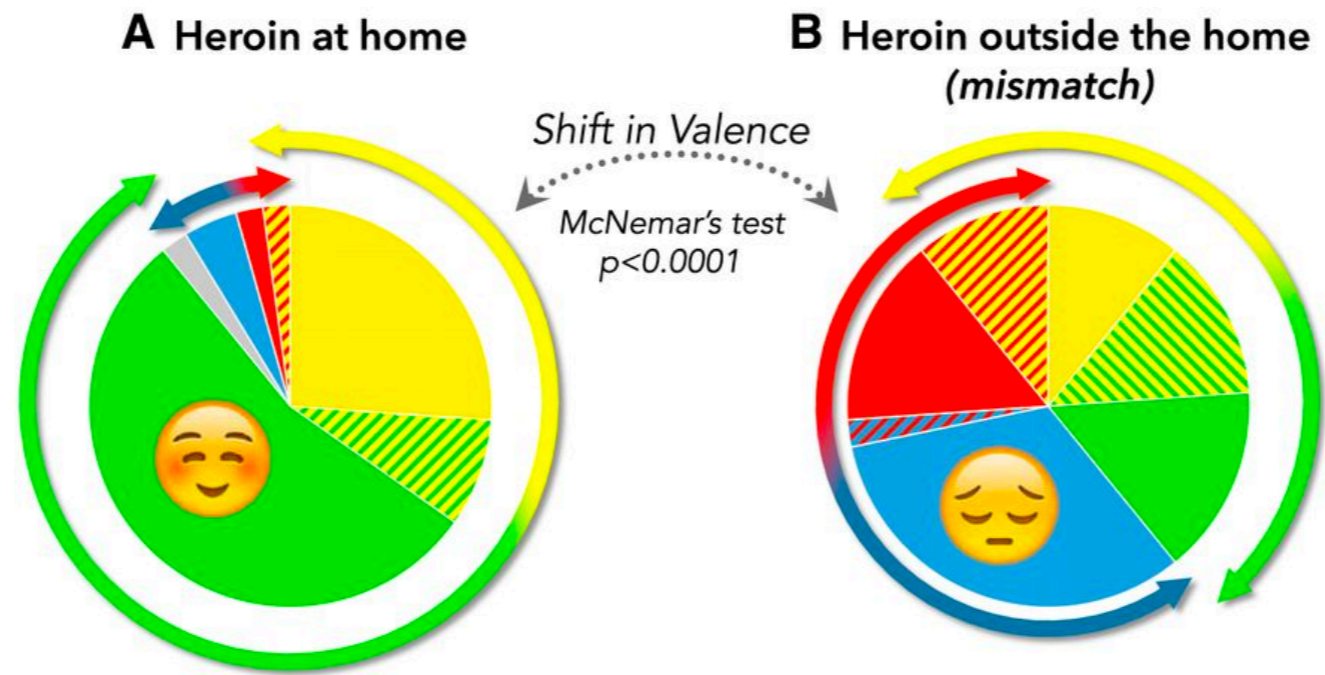


A

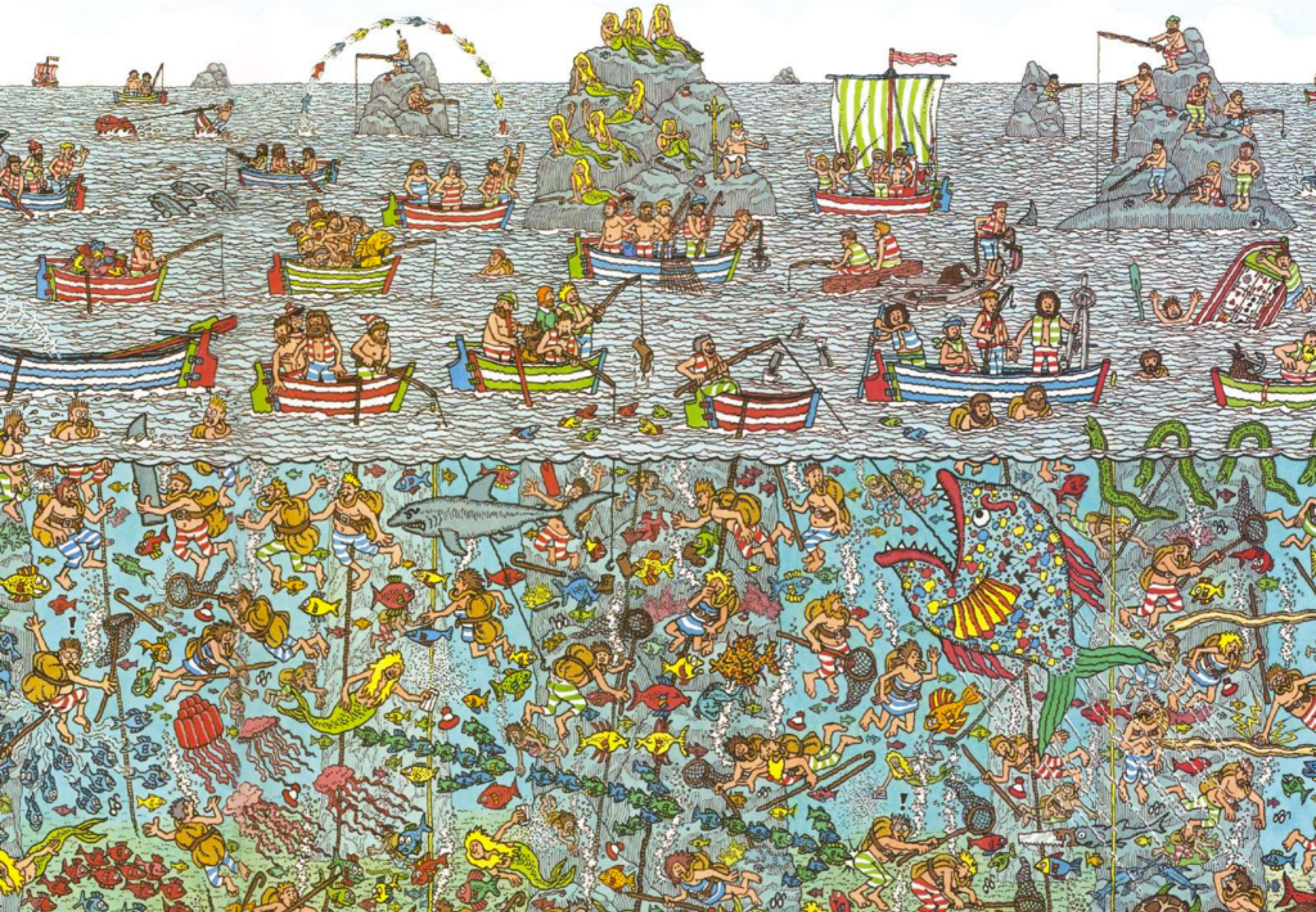
pareidolia—boon in the bush, bane in dataviz





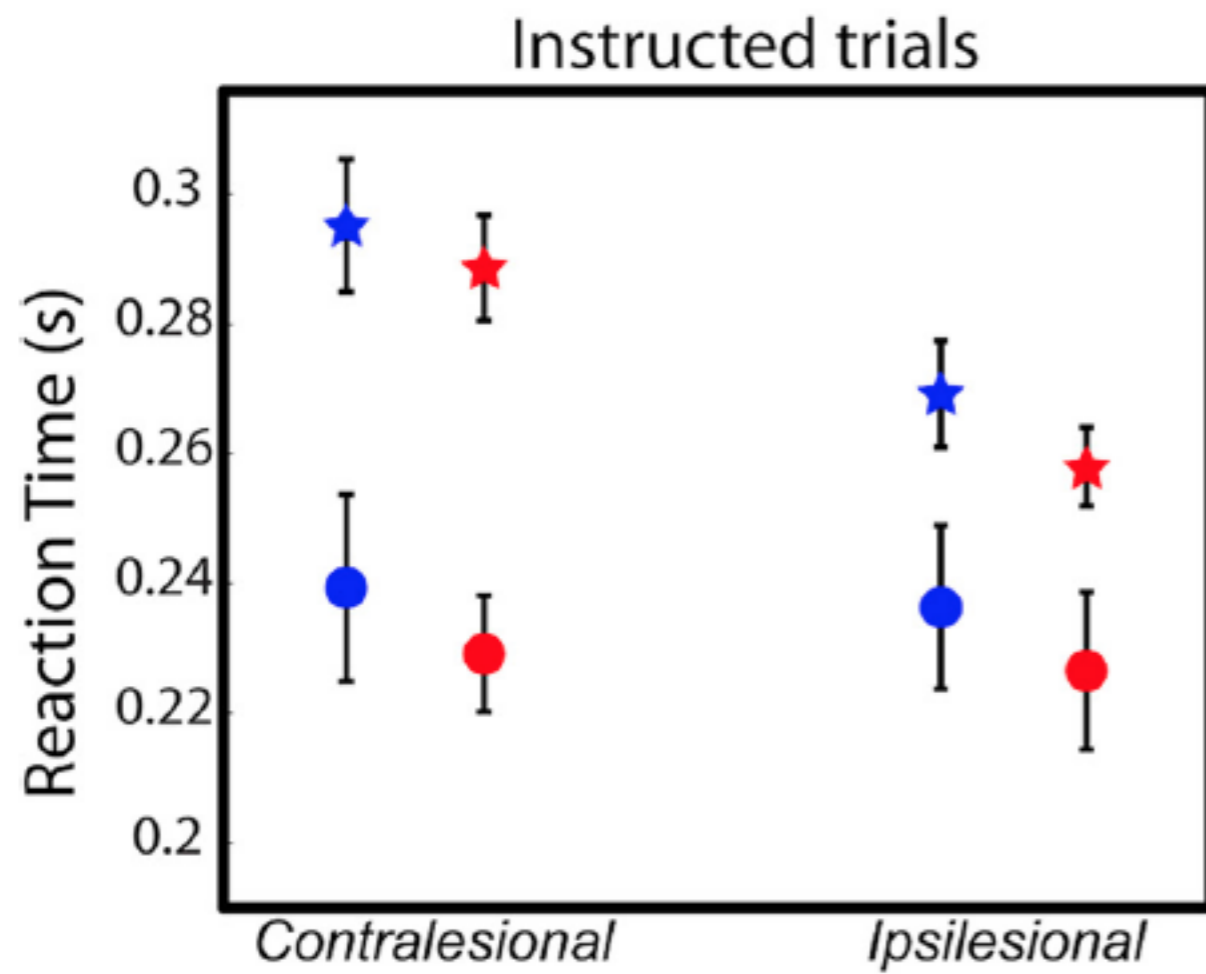
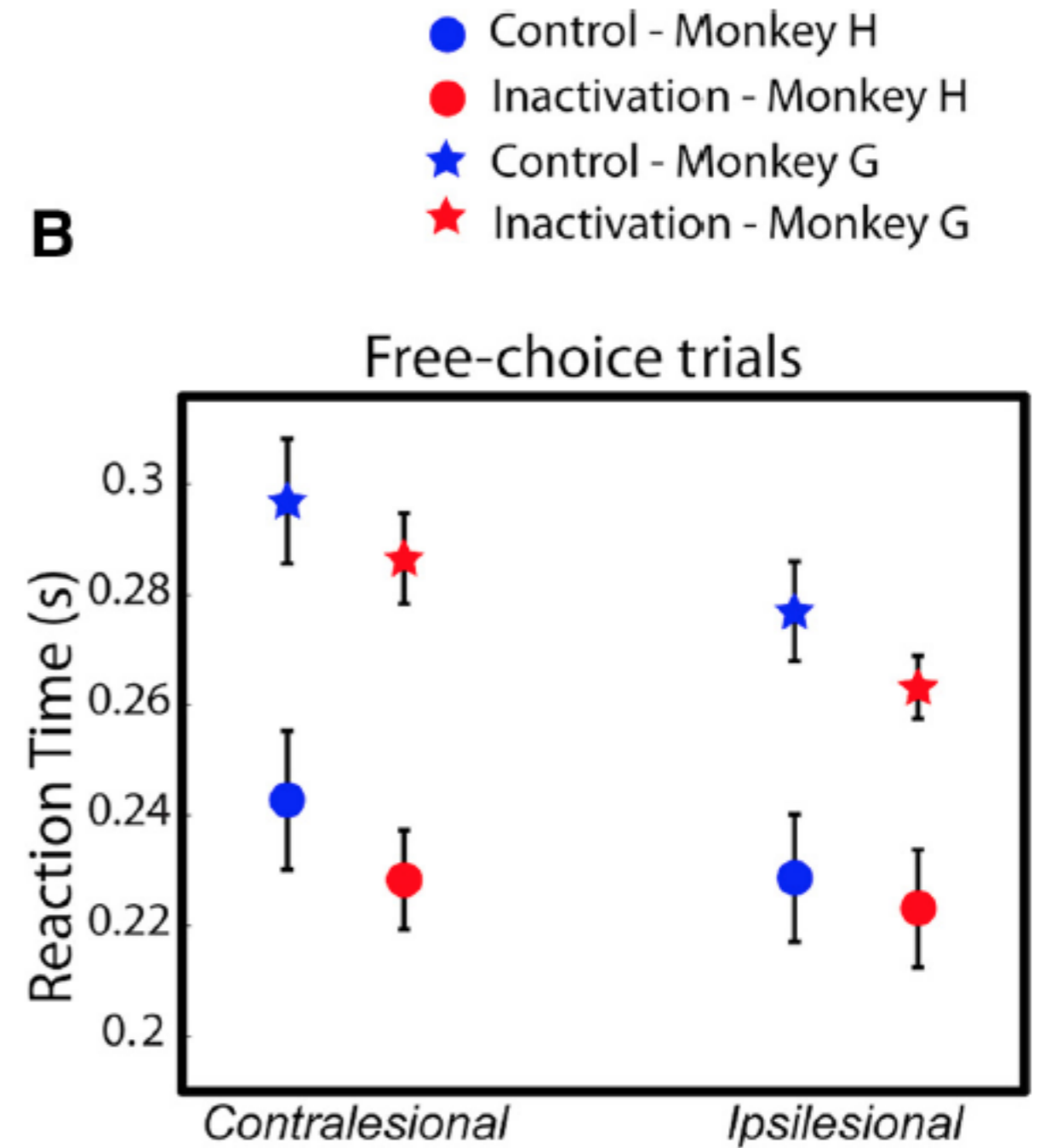


Missä Vallu?

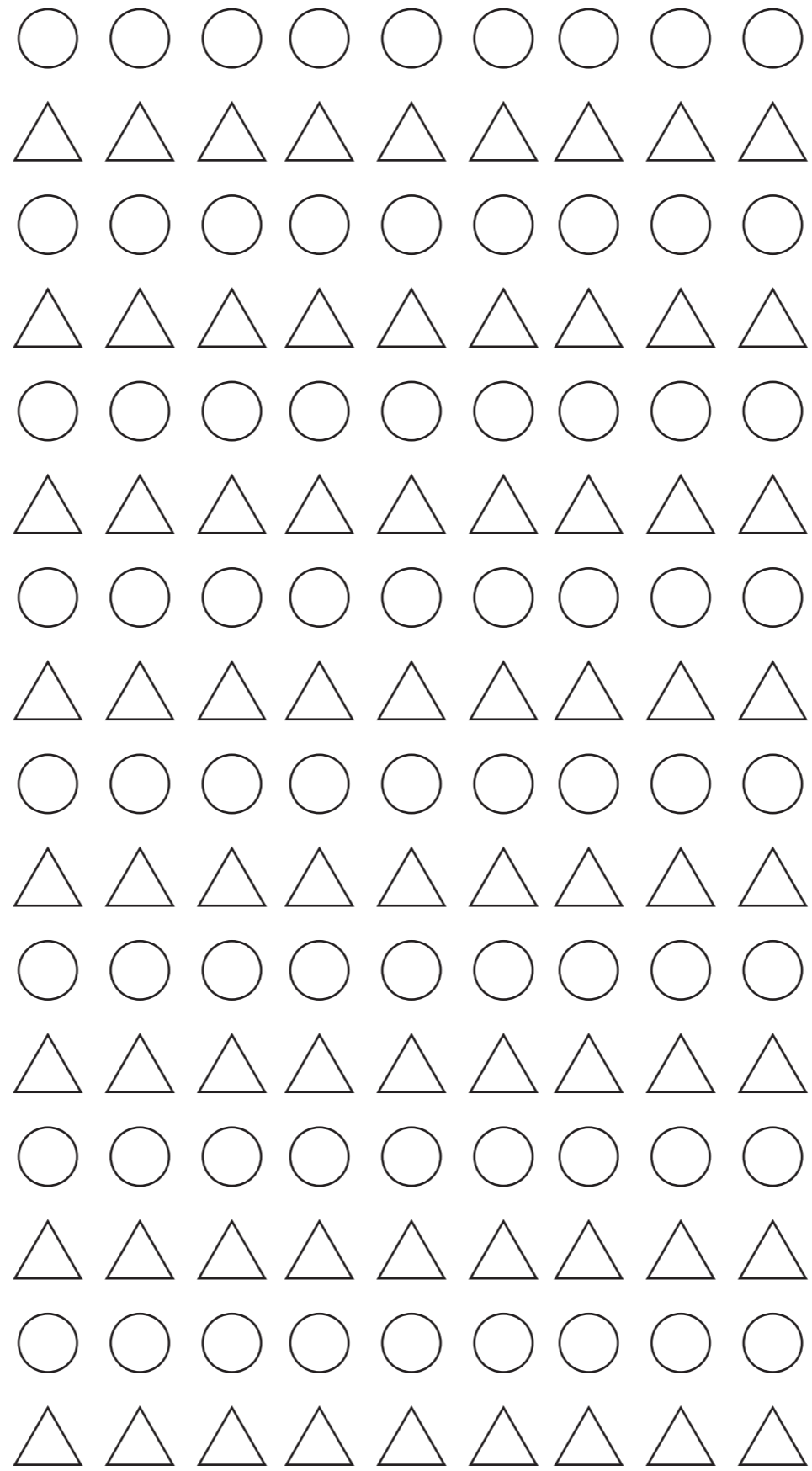


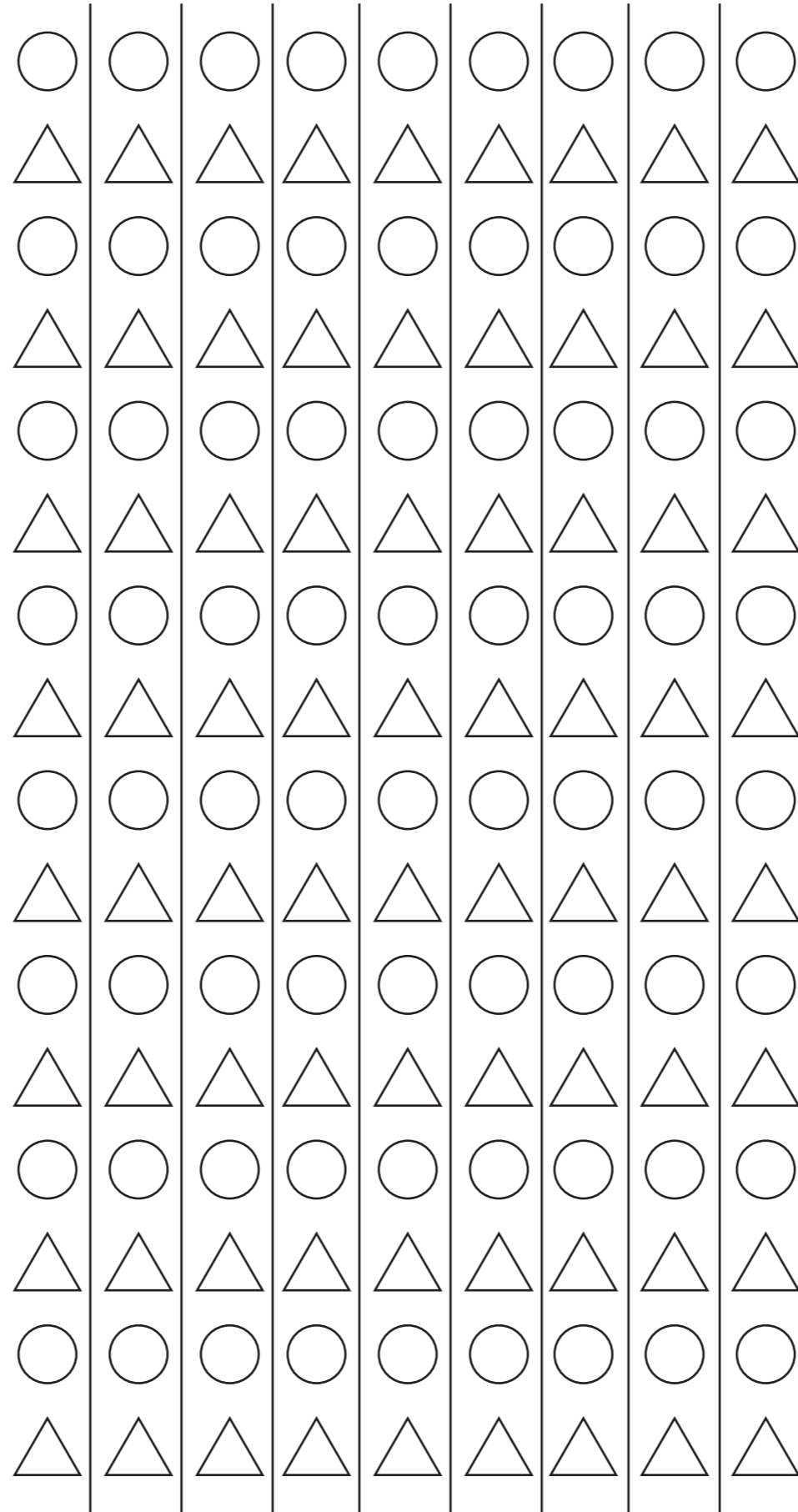
only group the things that are meant to be compared

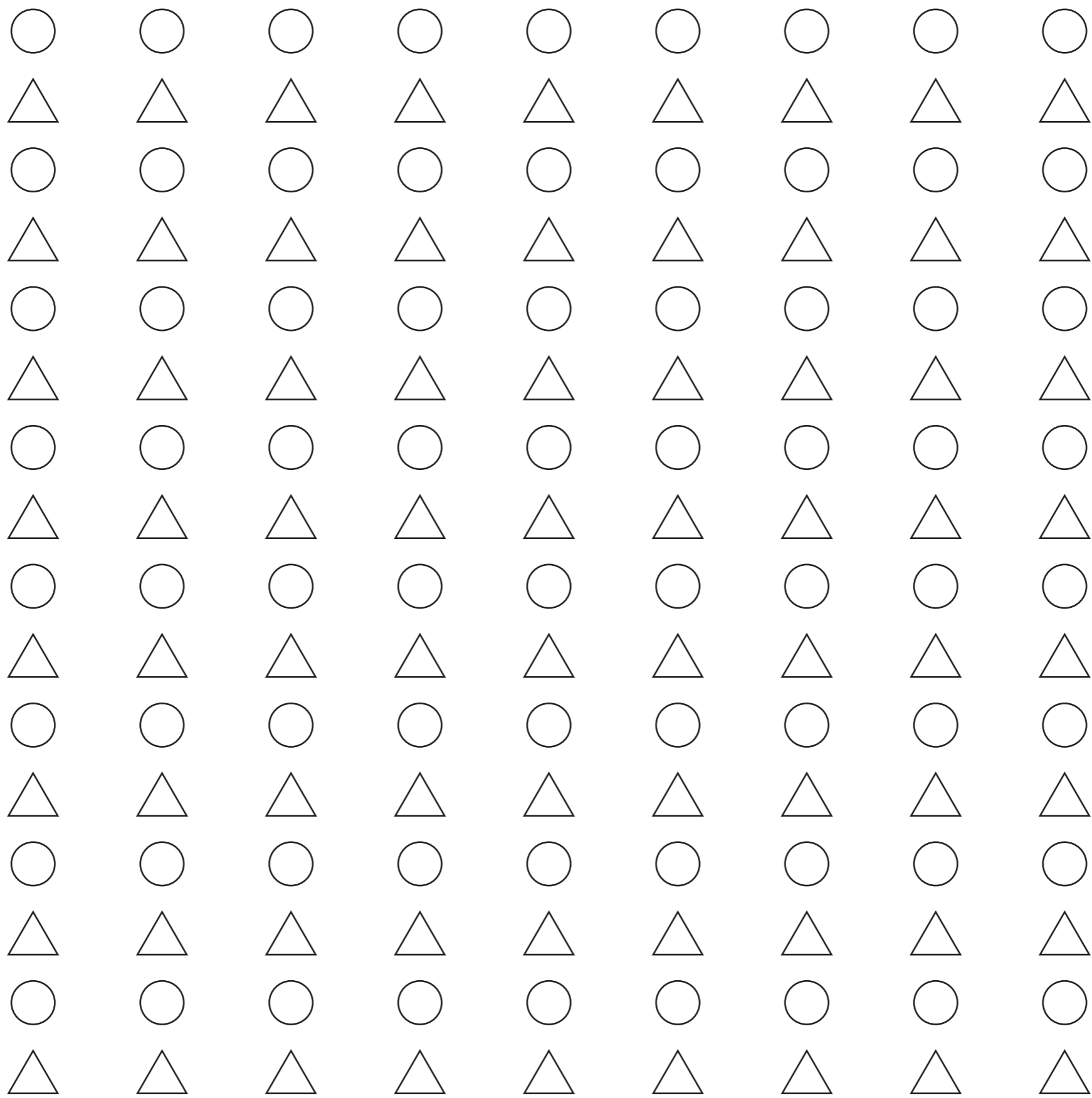
be wary of accidentally grouping other things

A**B**

Spa ce mak es gro ups.

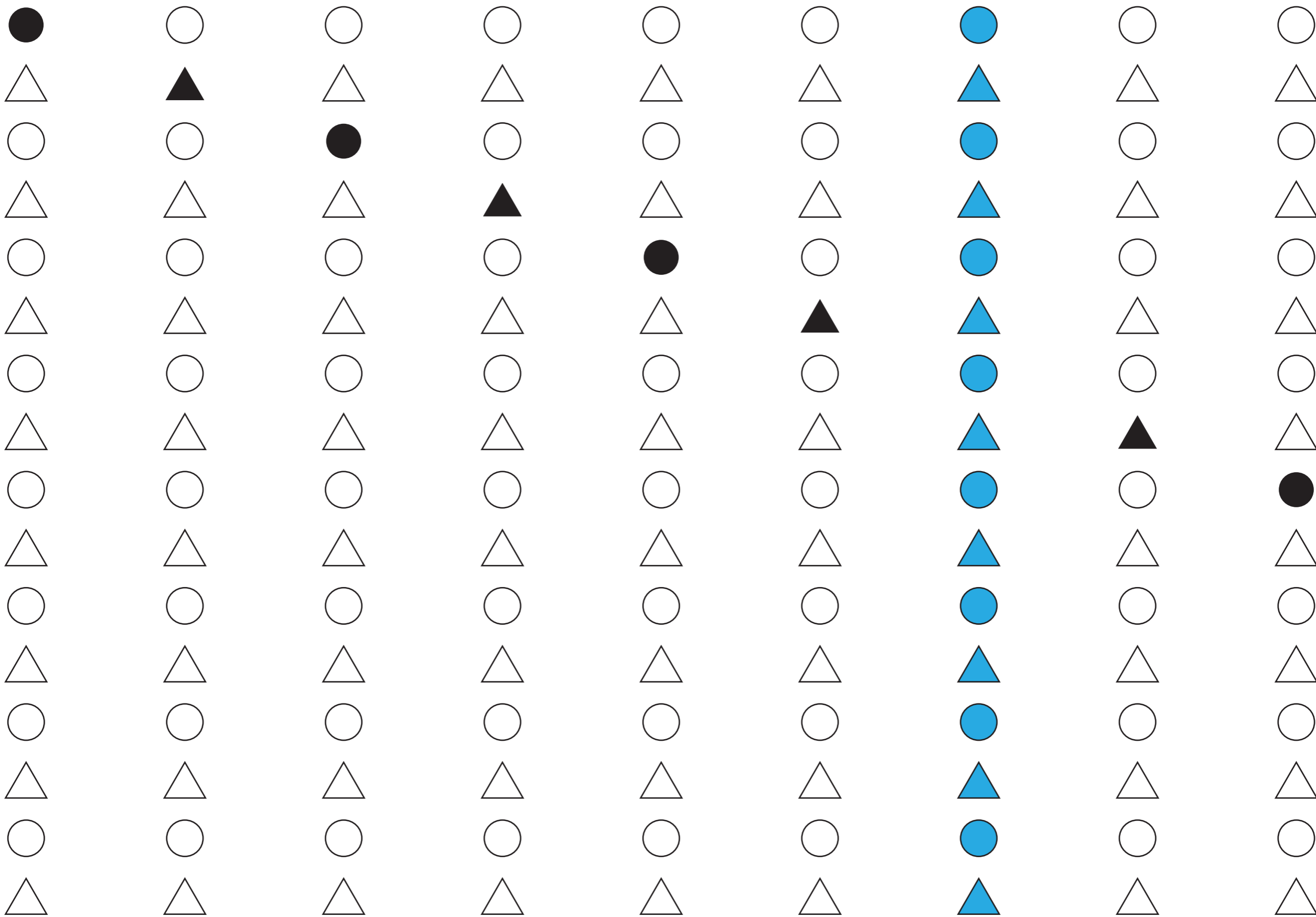


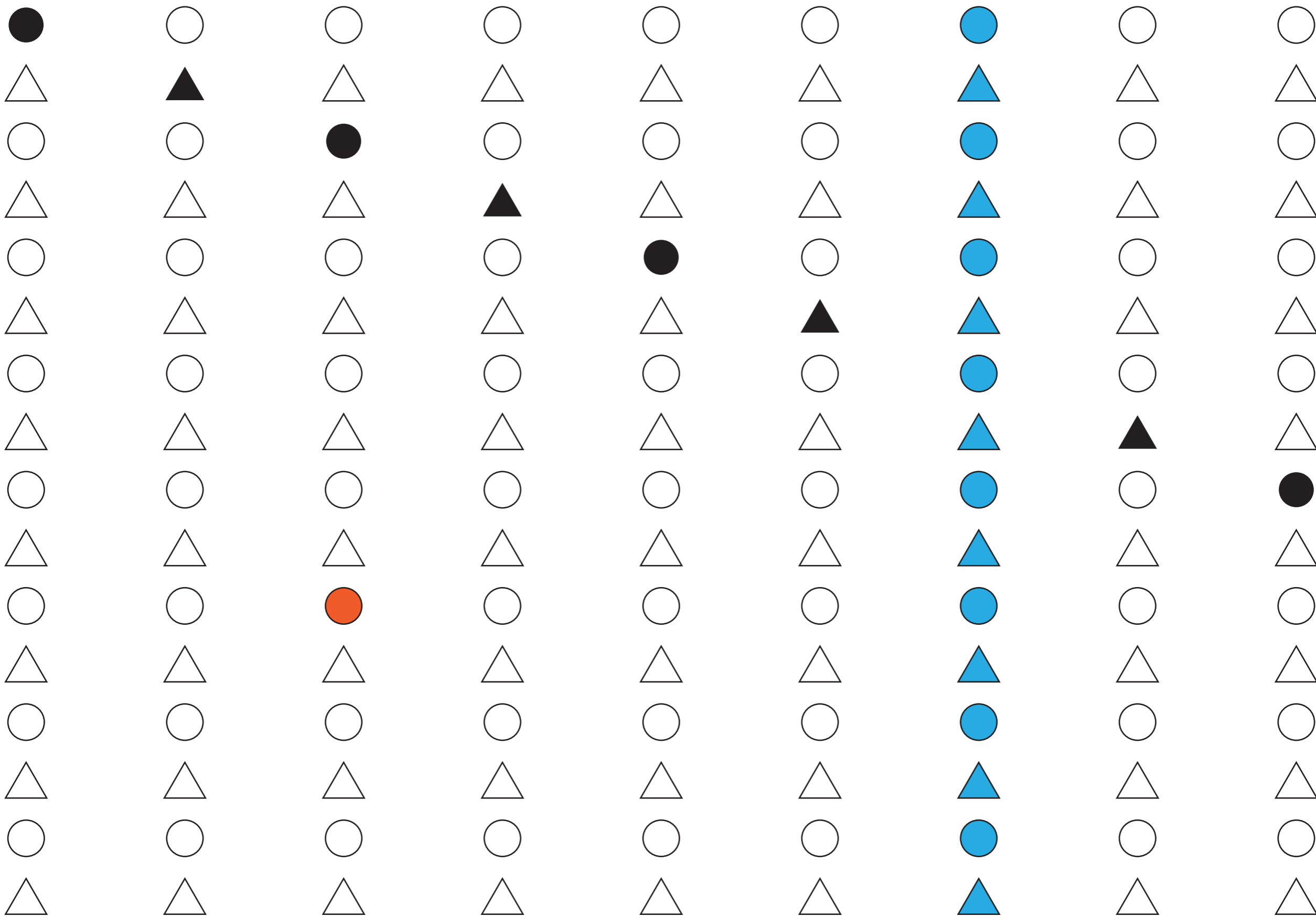


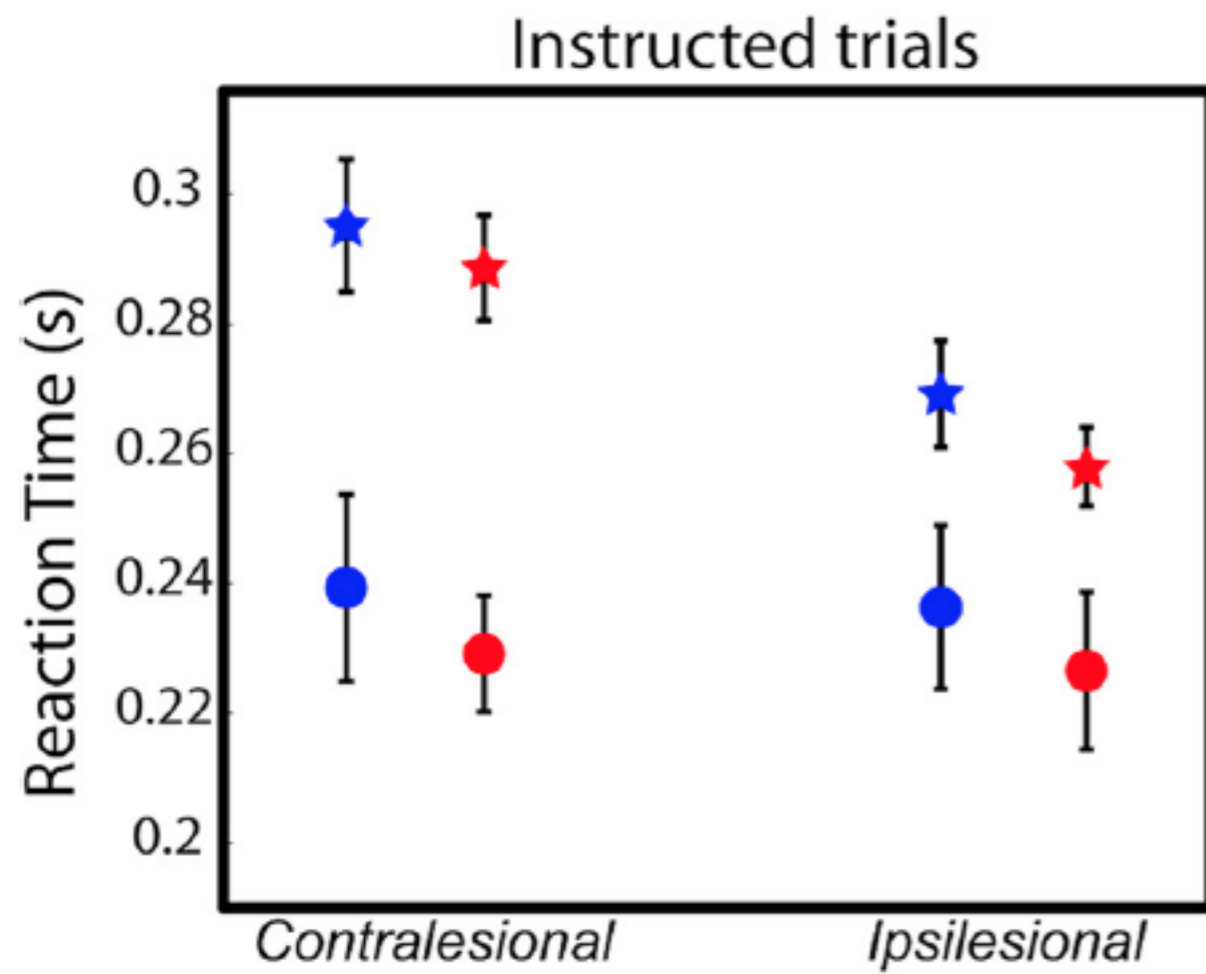
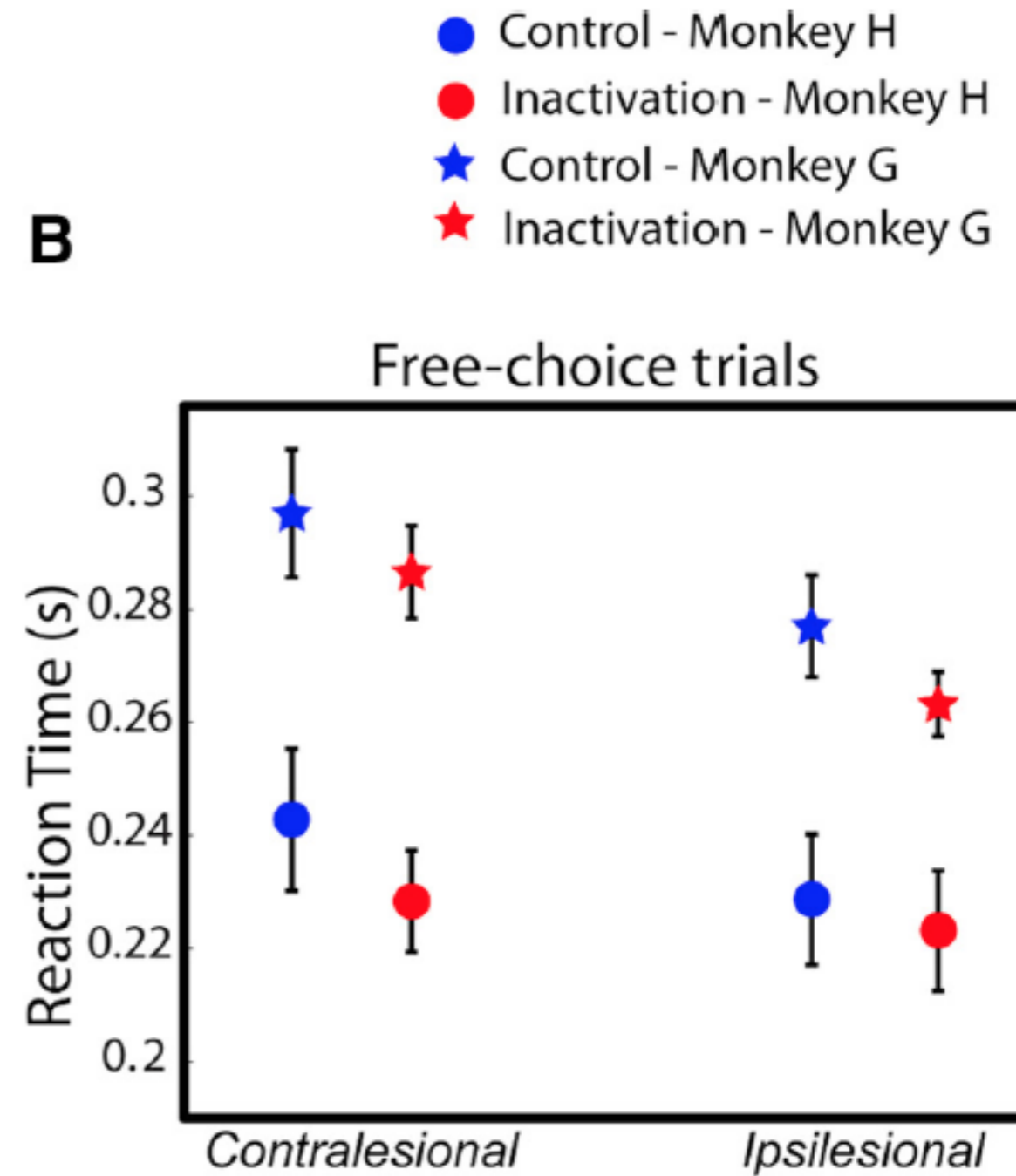


Spa ce mak es gro ups.

Spa ce mak es gro ups.

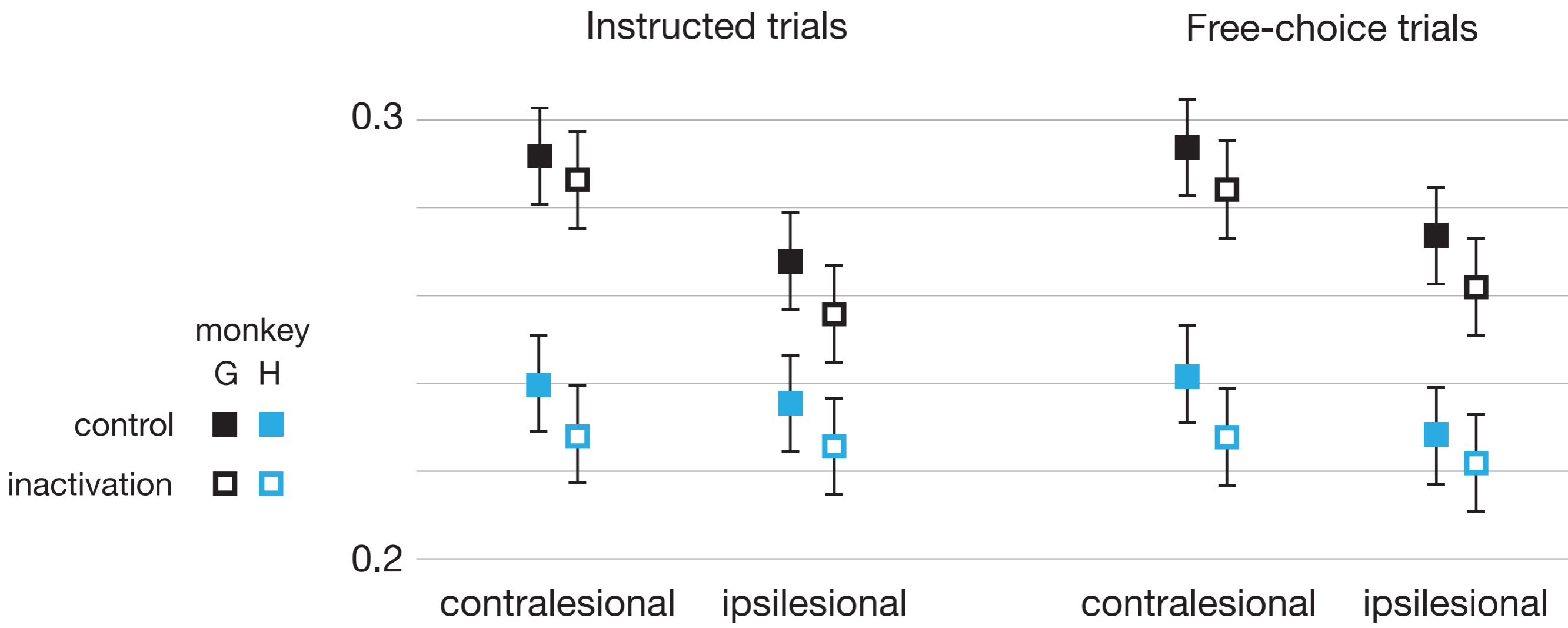




A**B**

- control, monkey H
- inactivation, monkey H
- ★ control, monkey G
- ★ inactivation, monkey G

	monkey	
	G	H
control	■	■
inactivation	□	□

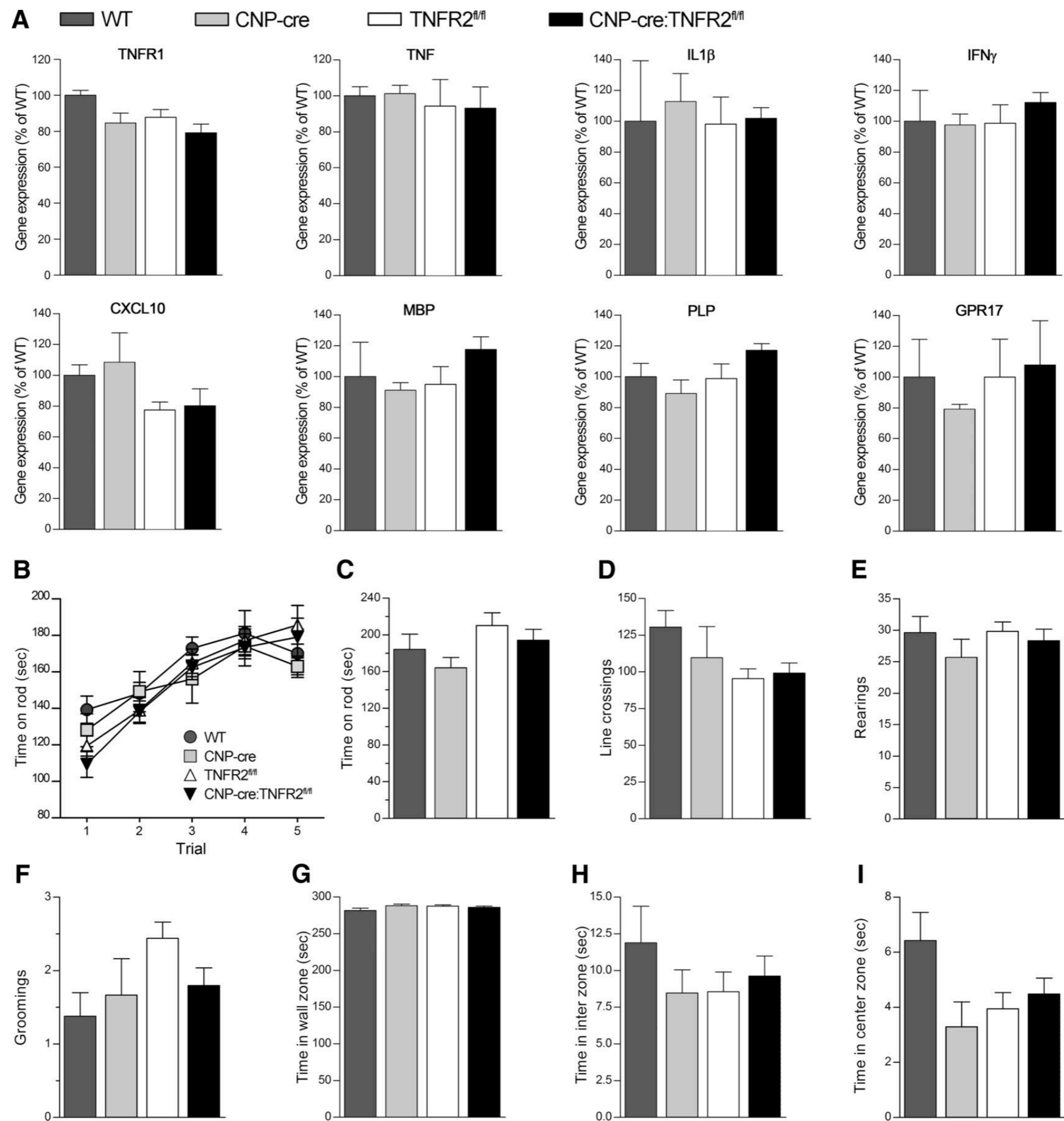


important! important! important!
important! important! important!
important! important! important!
important! important! important!
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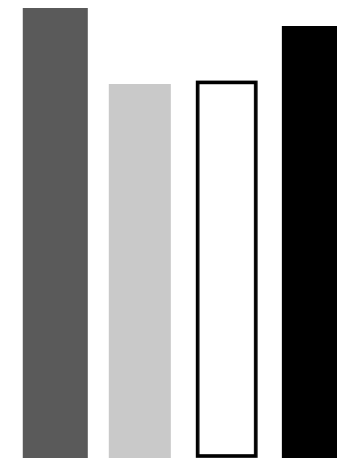
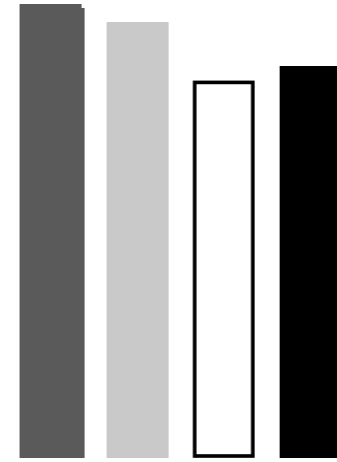
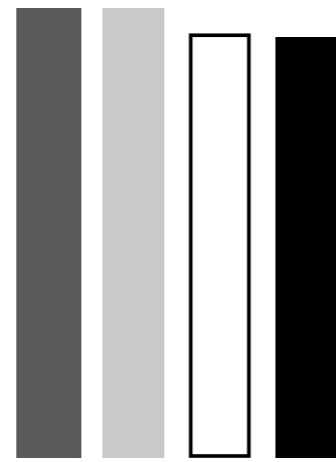
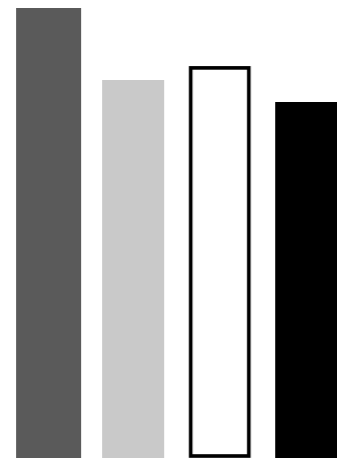
look here

where are the trends?

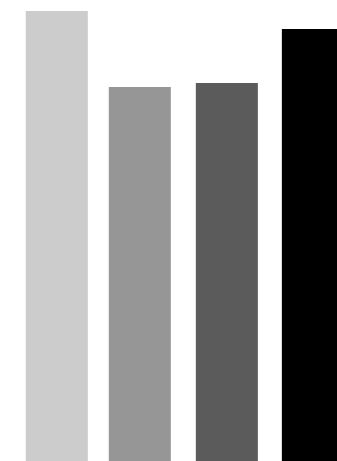
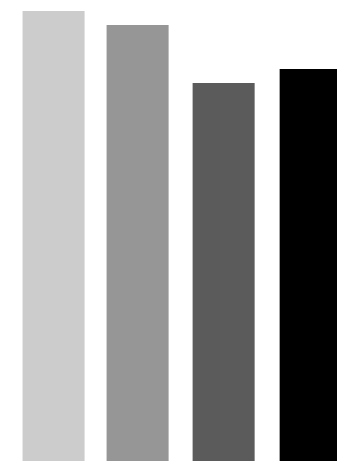
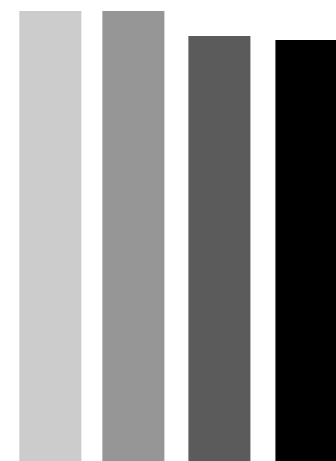
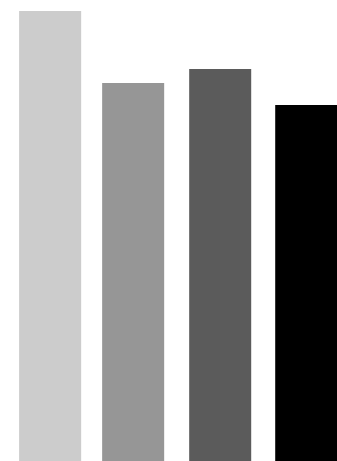
show them quickly

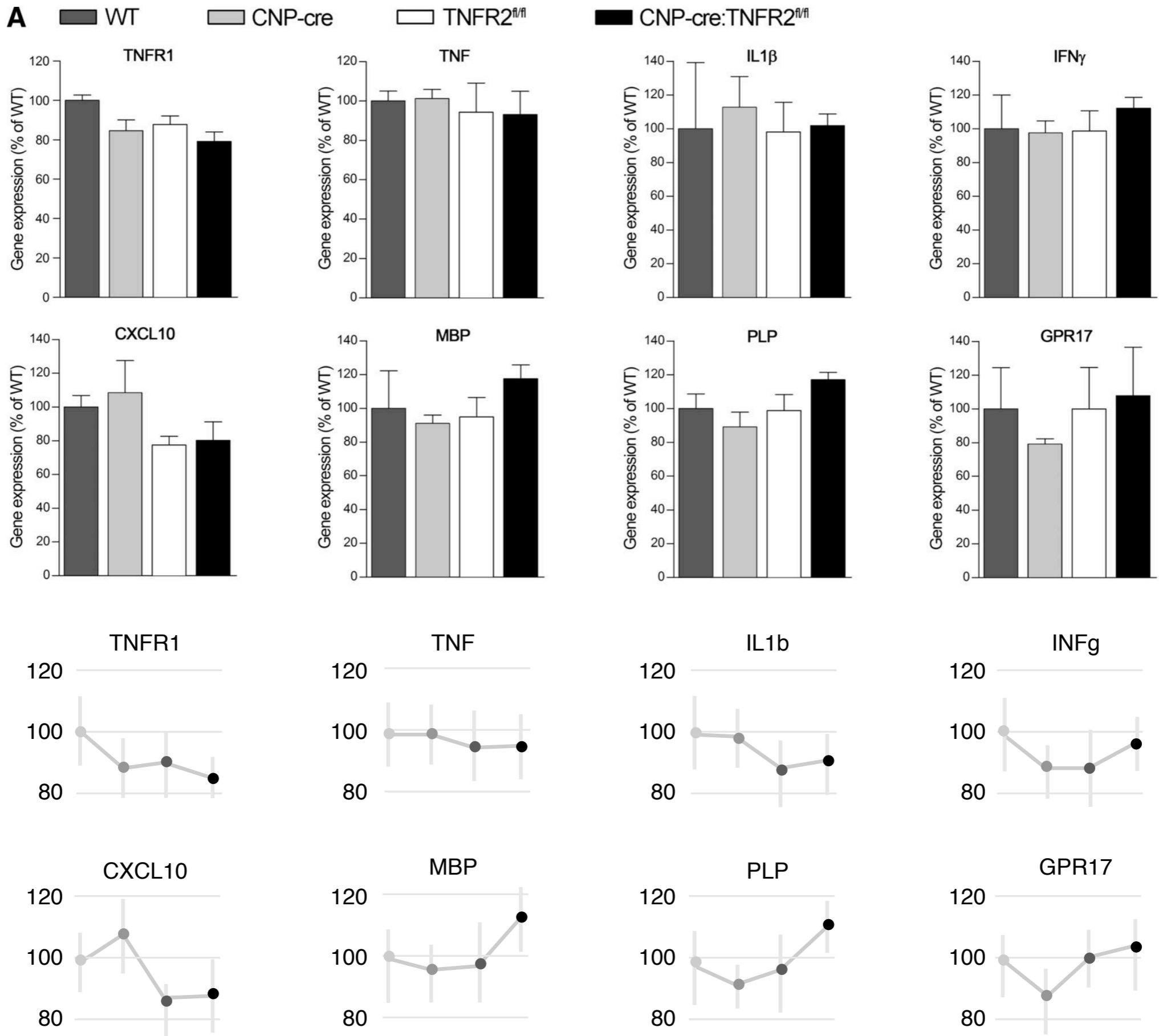


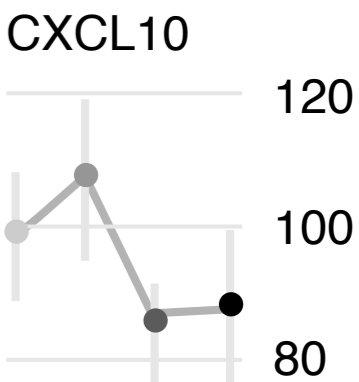
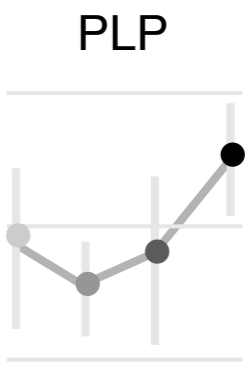
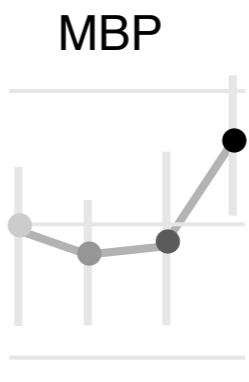
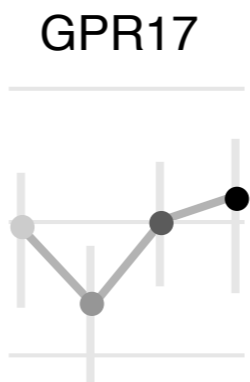
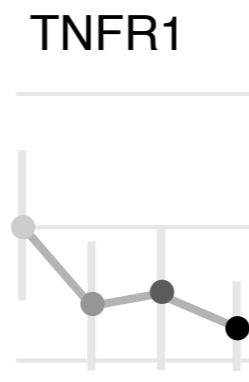
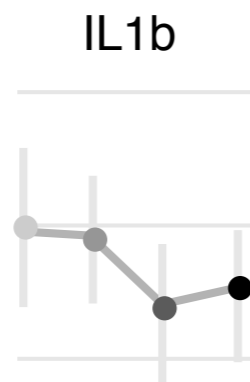
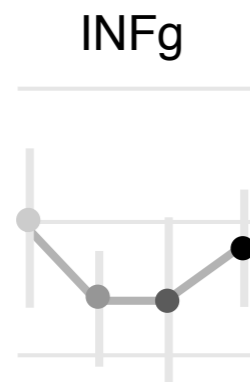
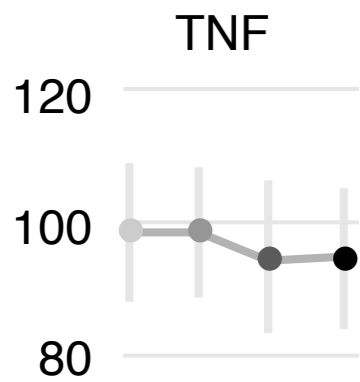
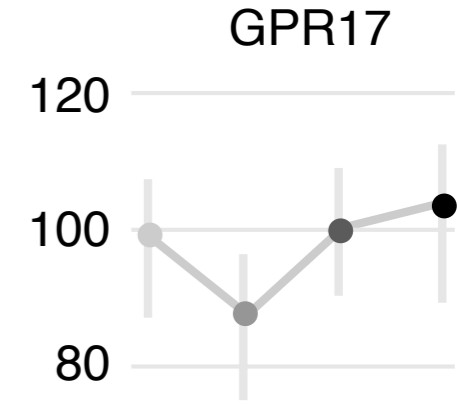
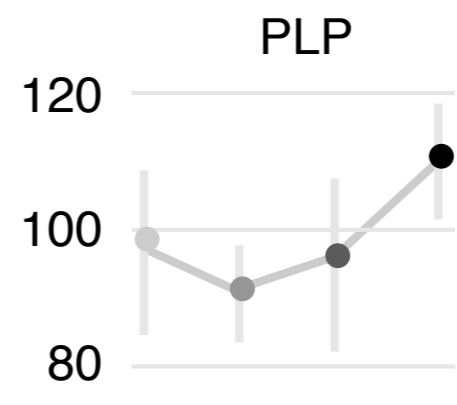
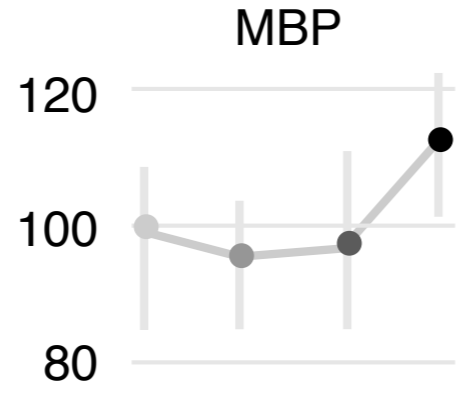
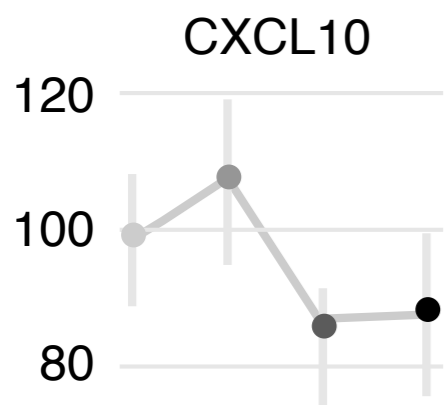
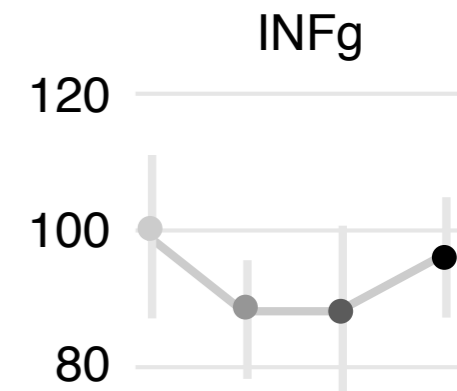
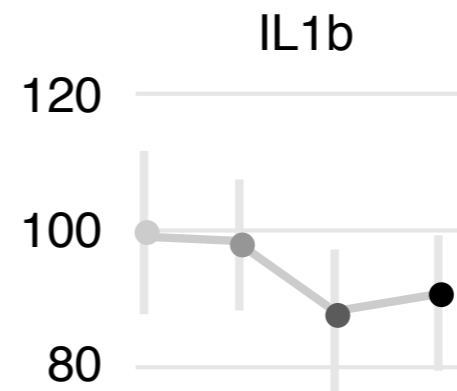
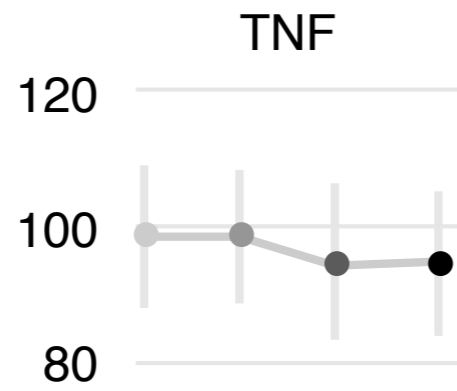
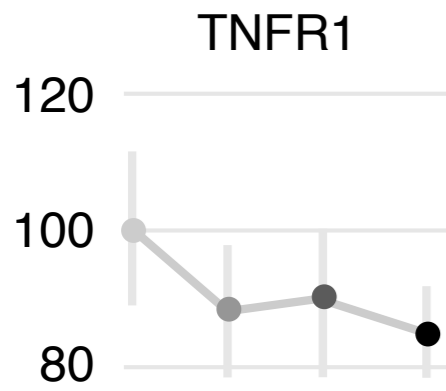
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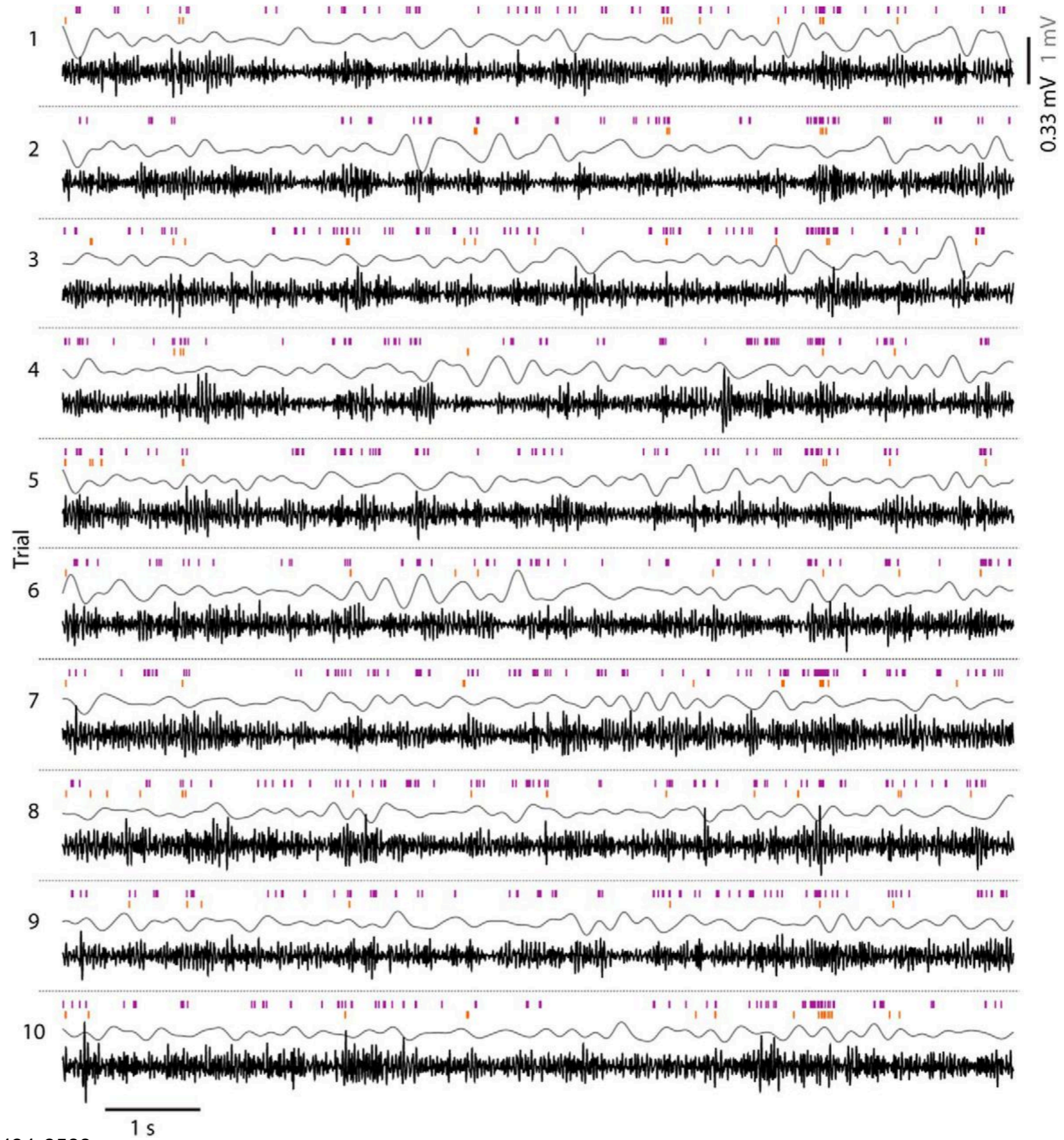


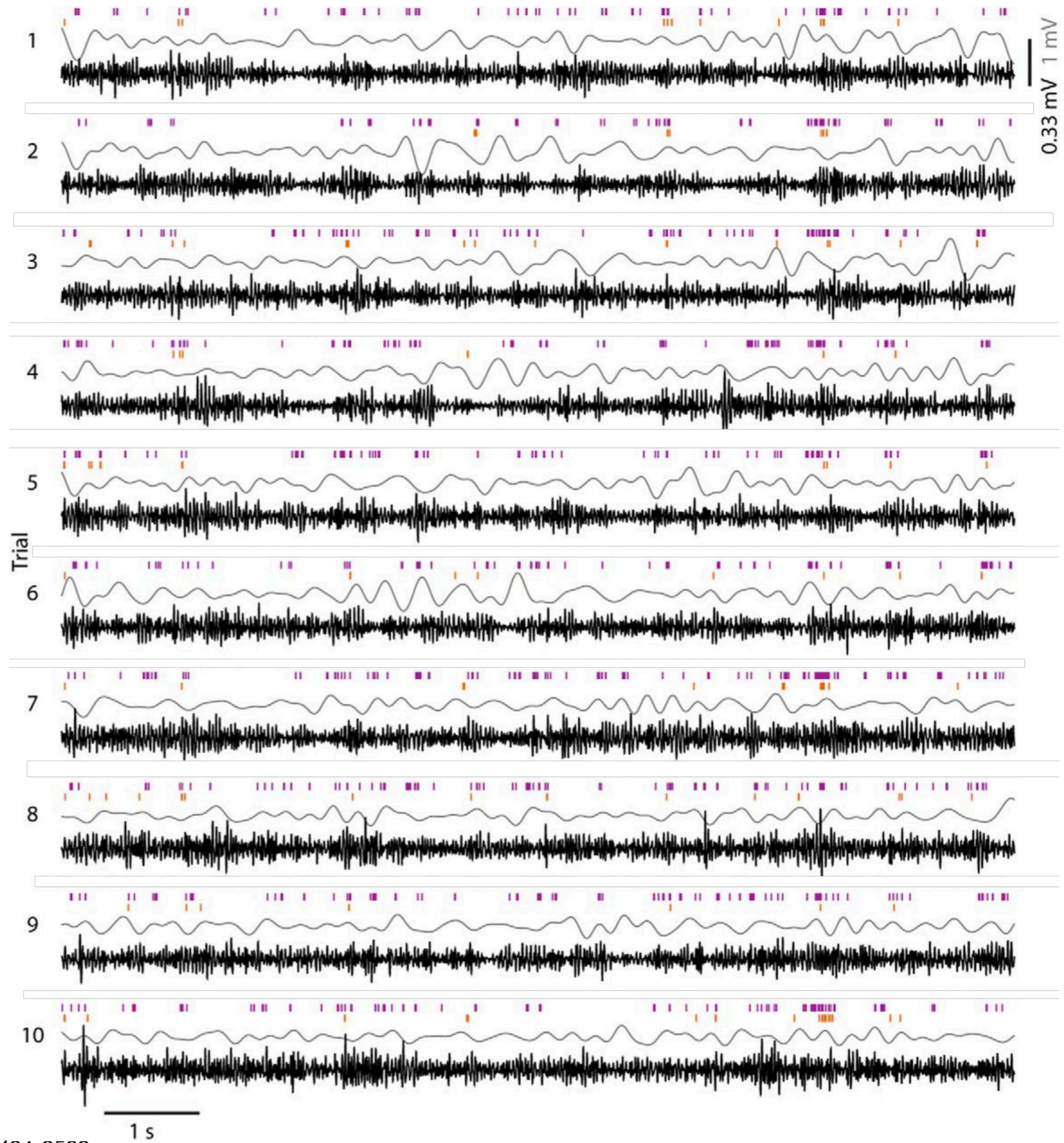


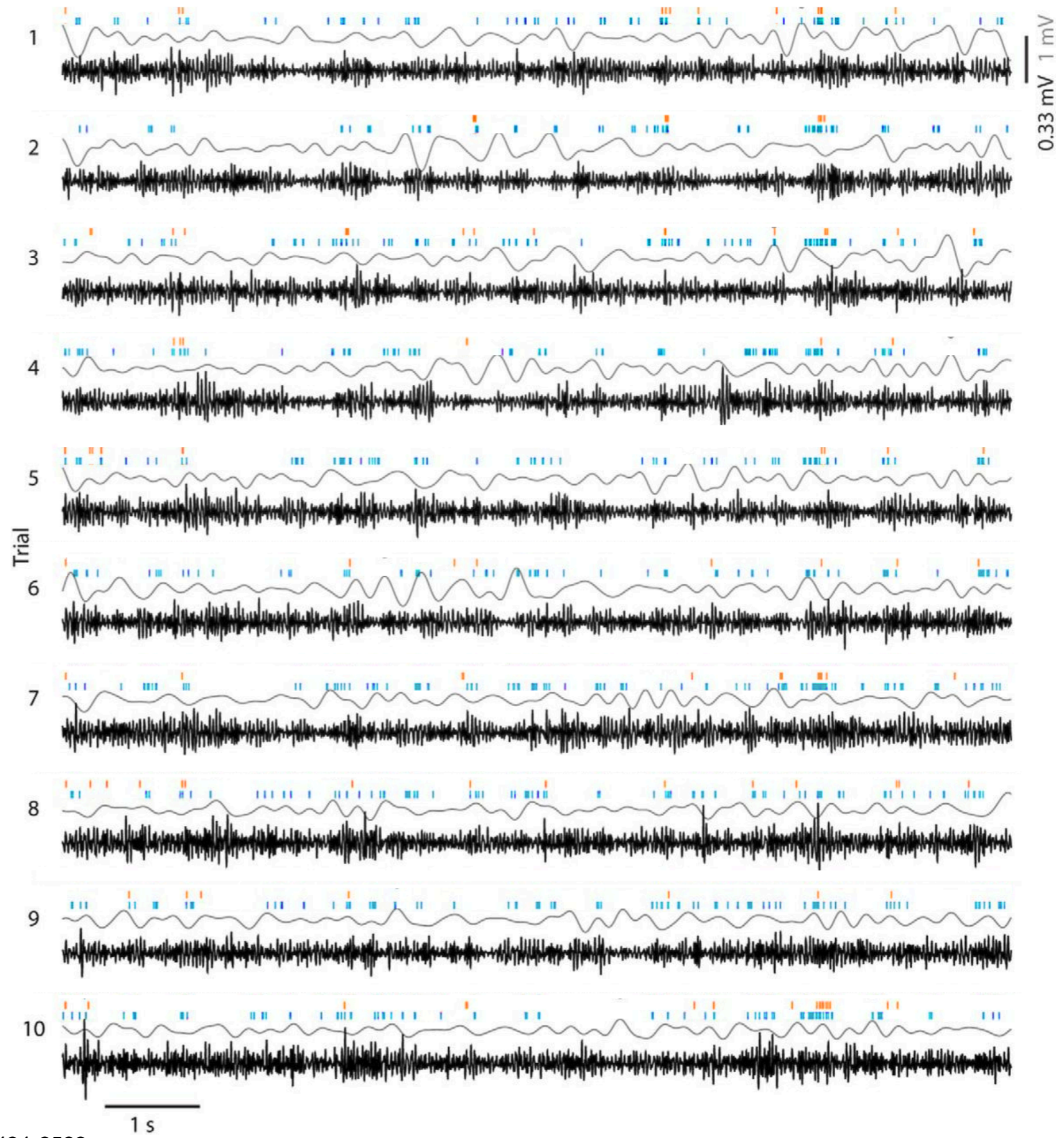


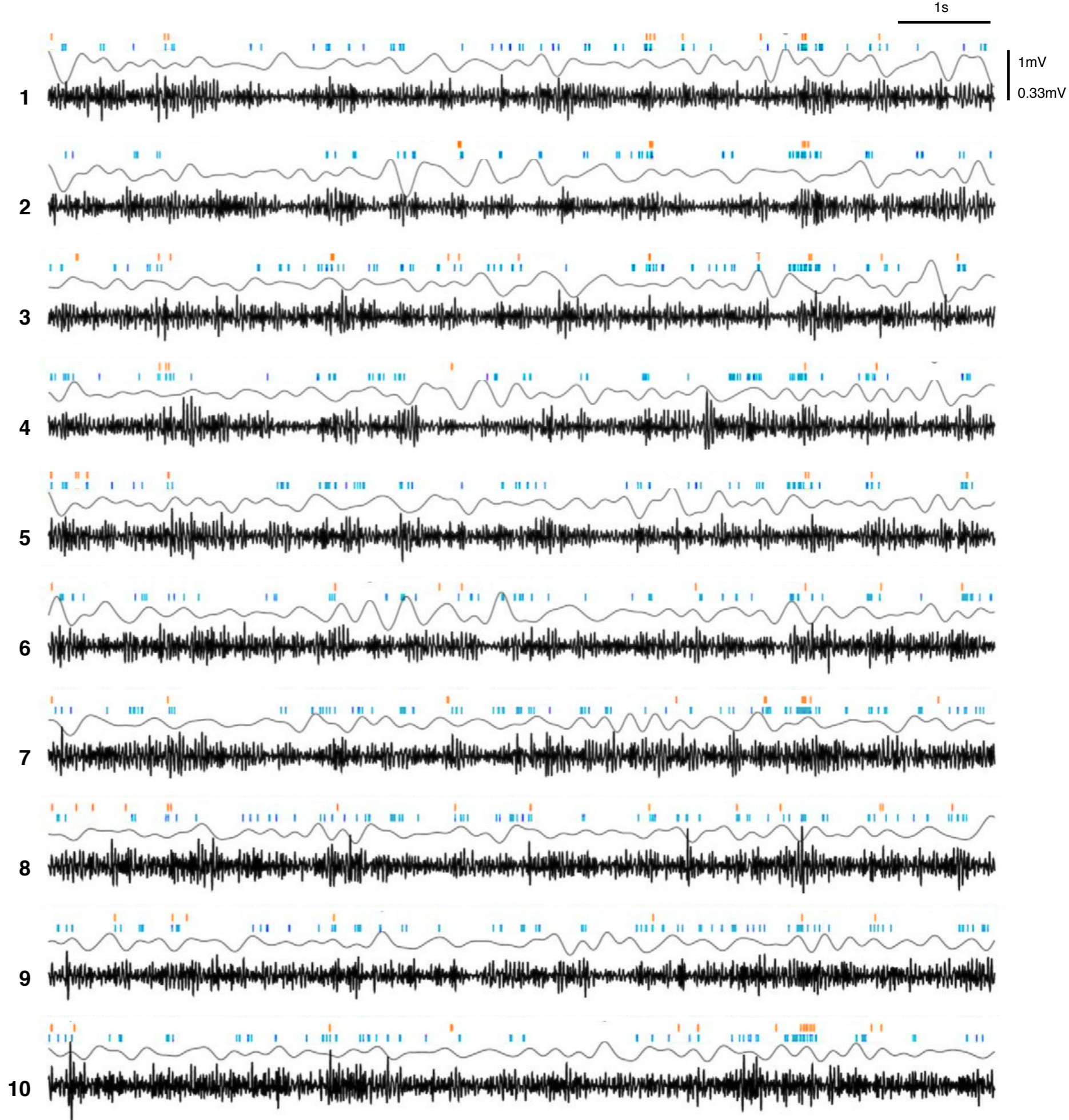
be sensitive to even the smallest spaces

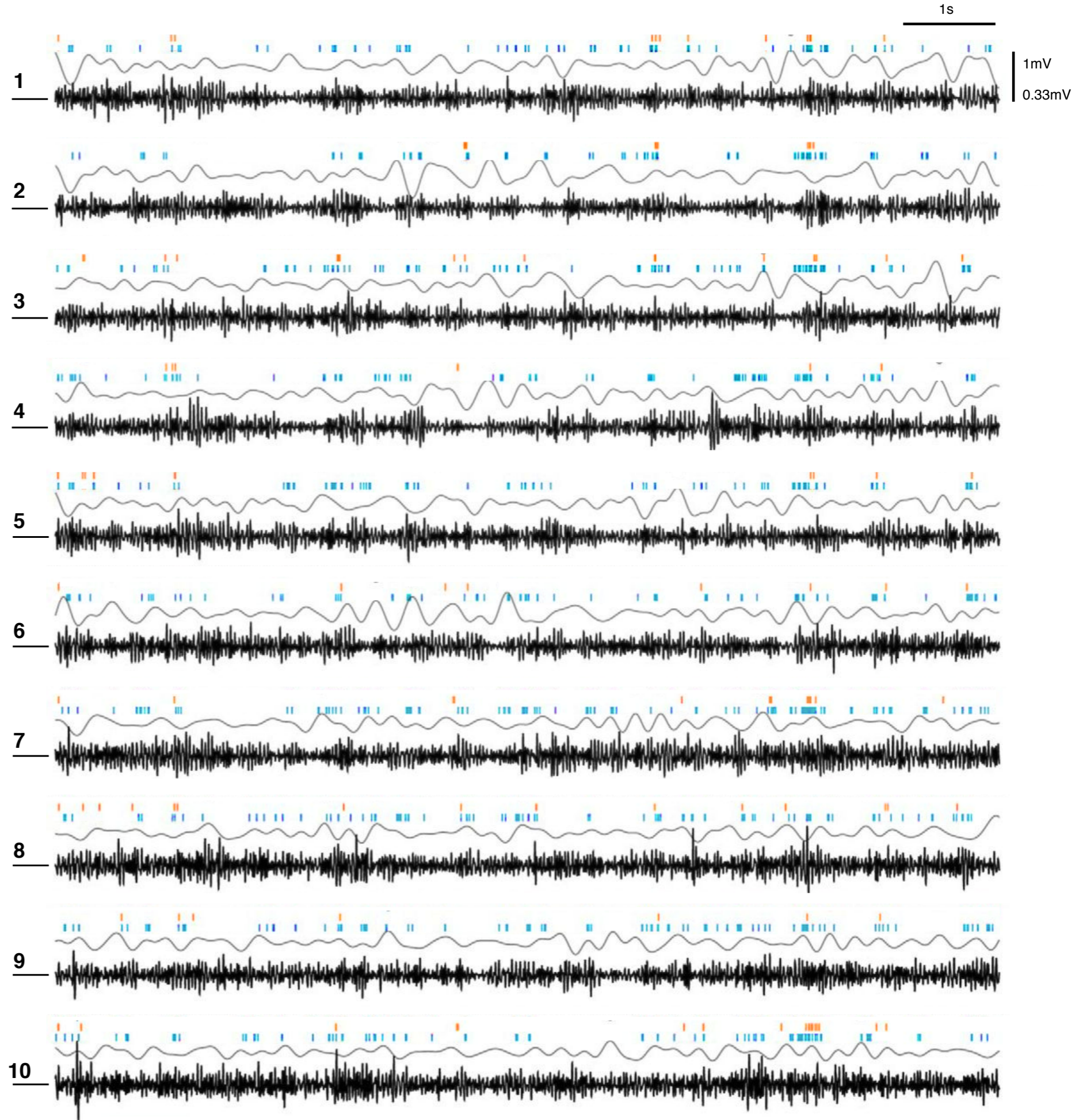
sometimes, that's all you need to separate objects





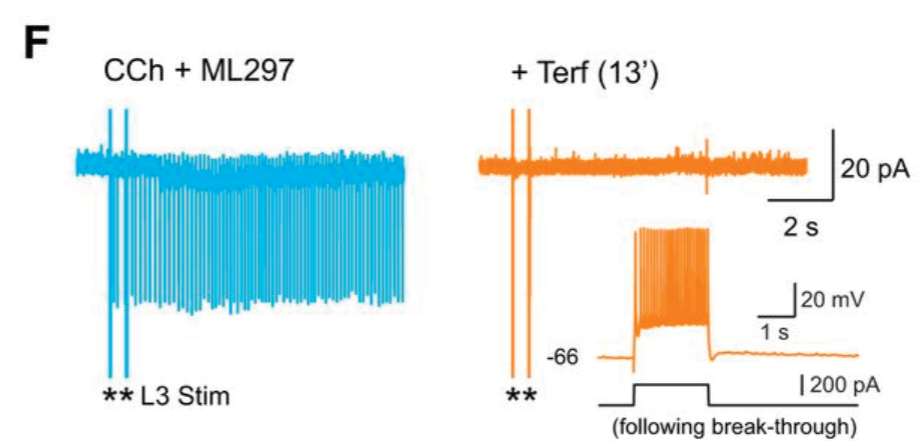
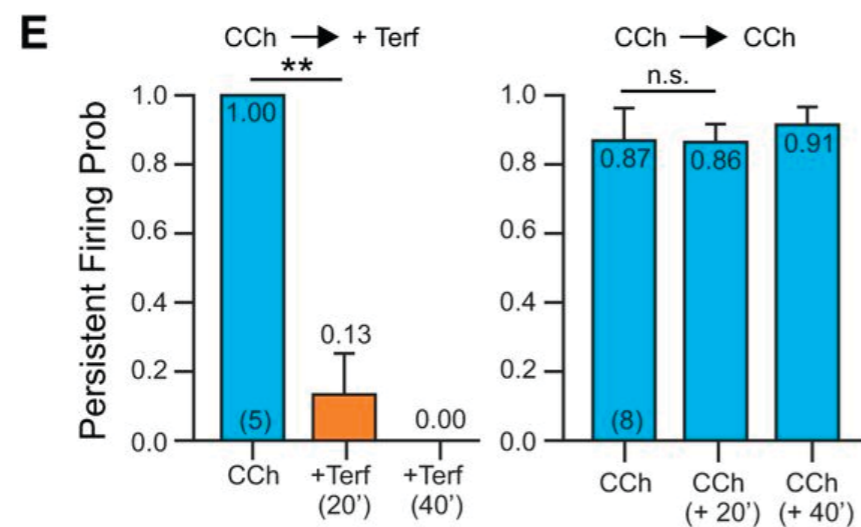
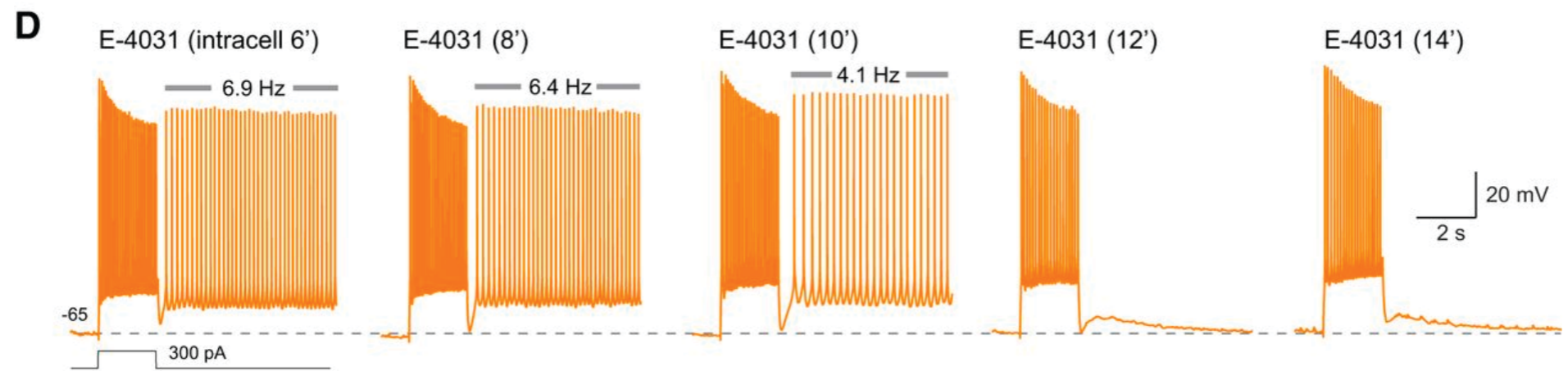
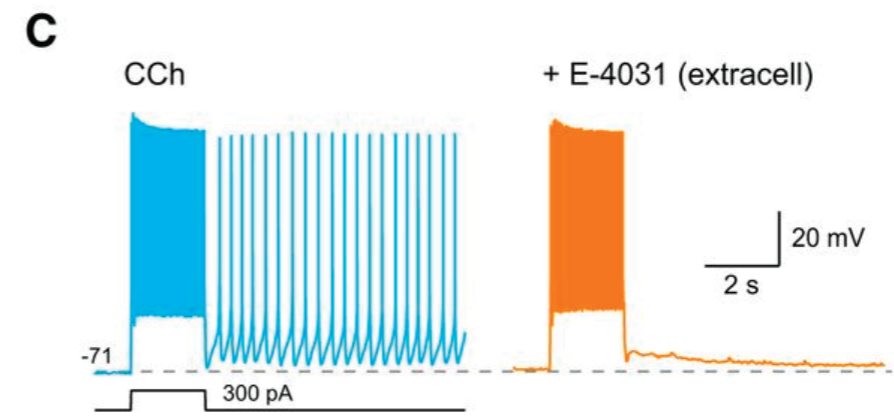
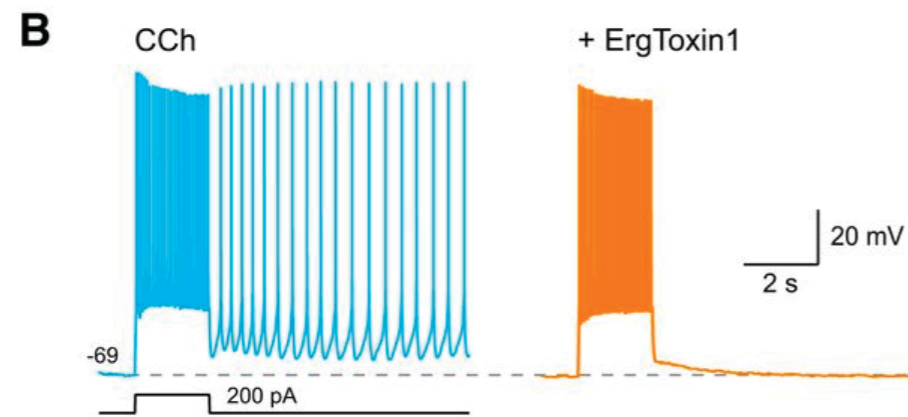
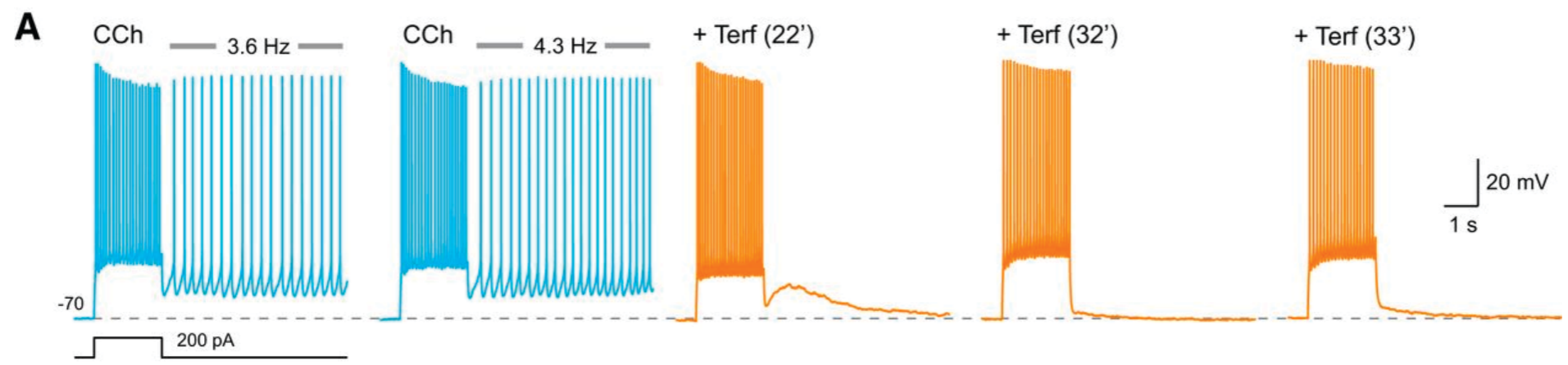


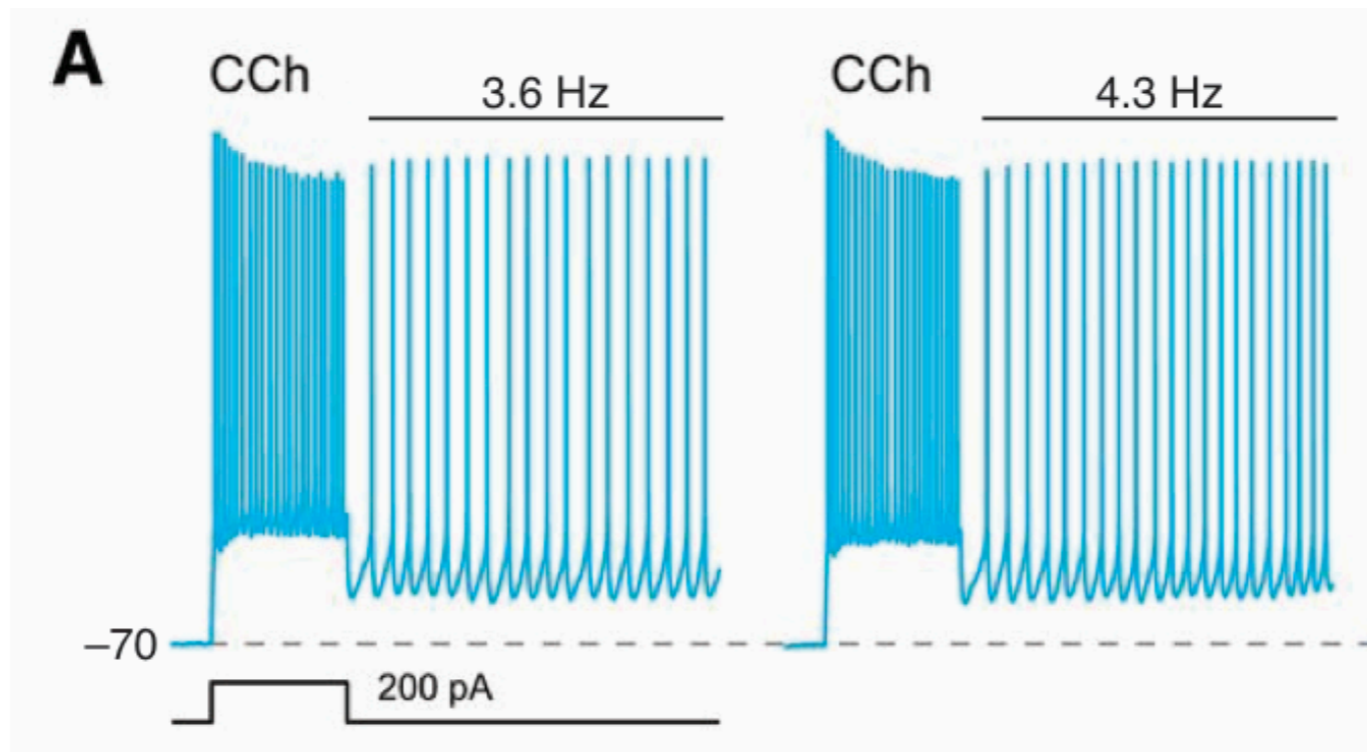
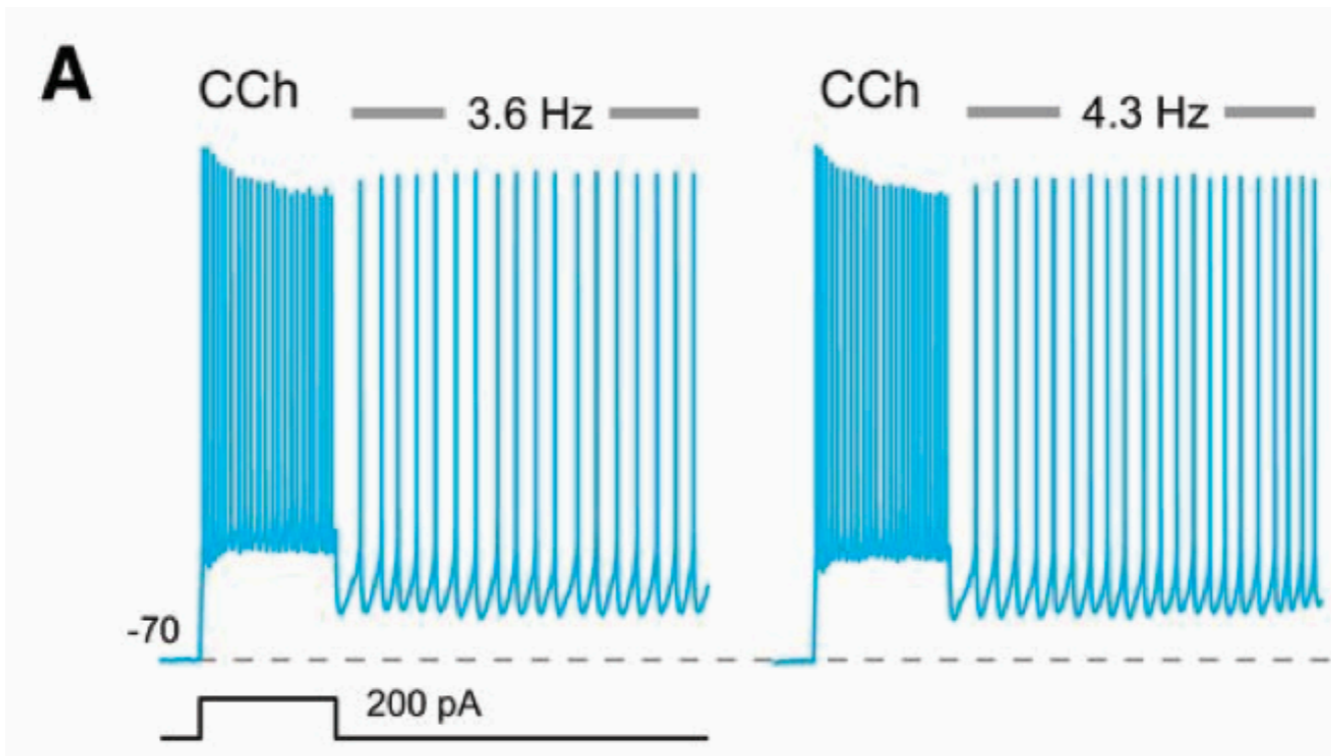


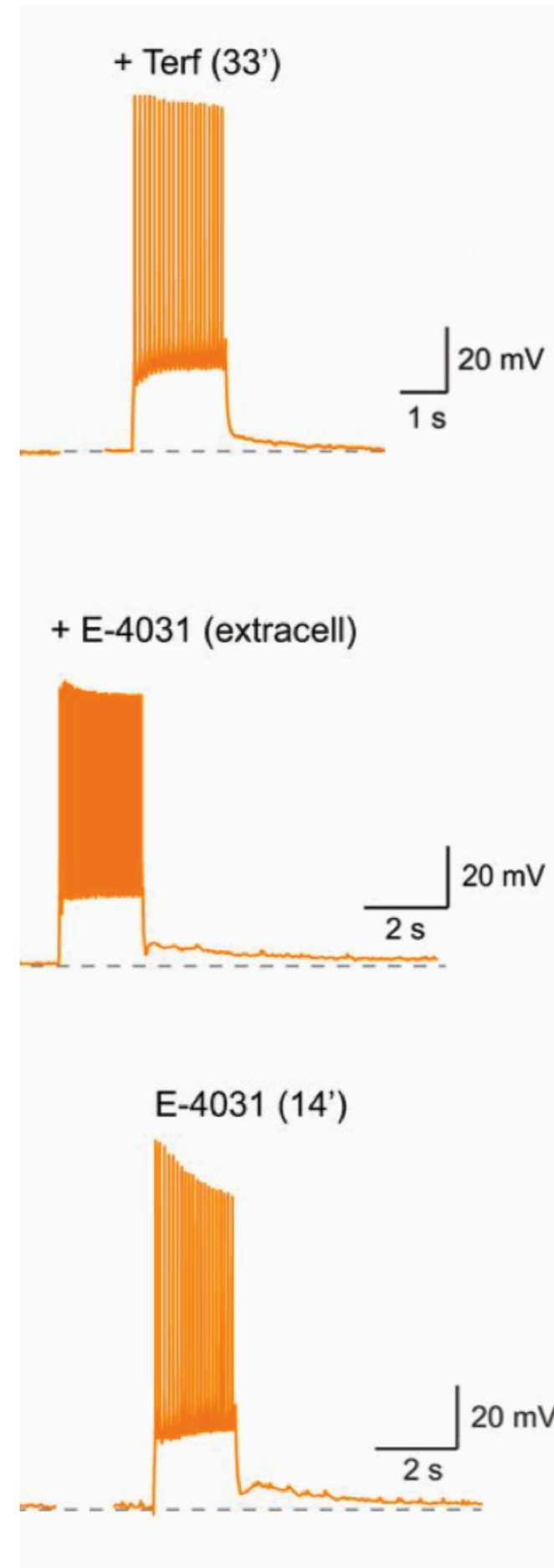
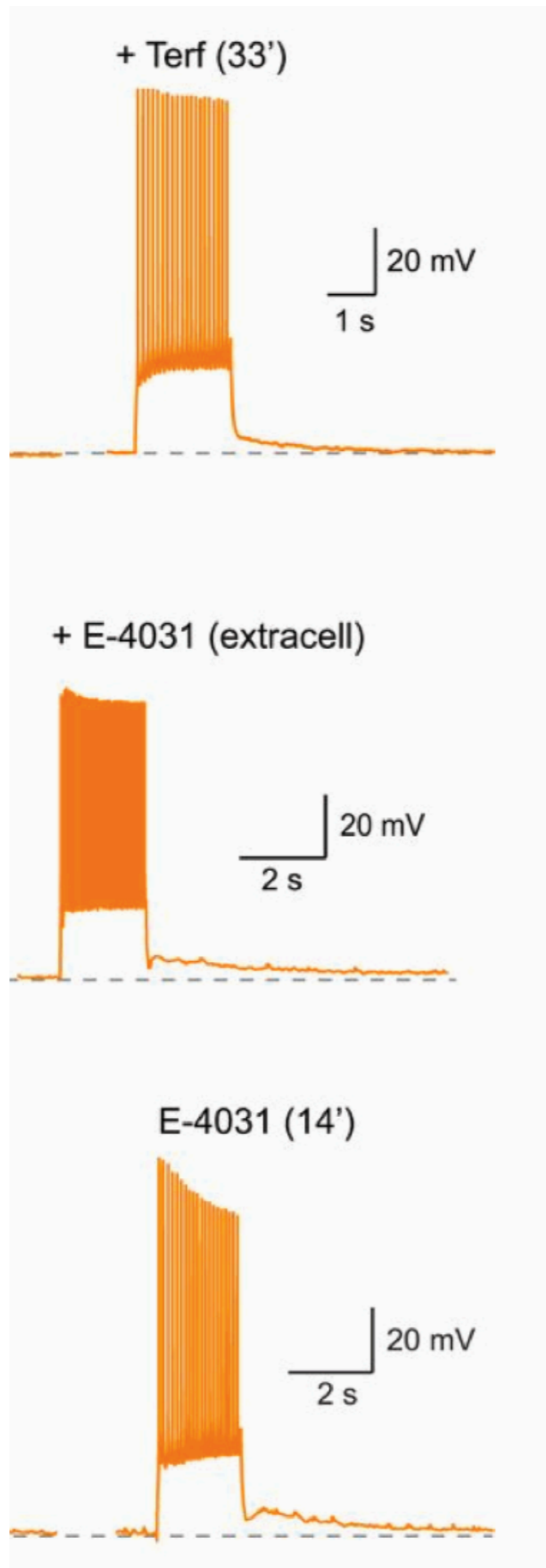


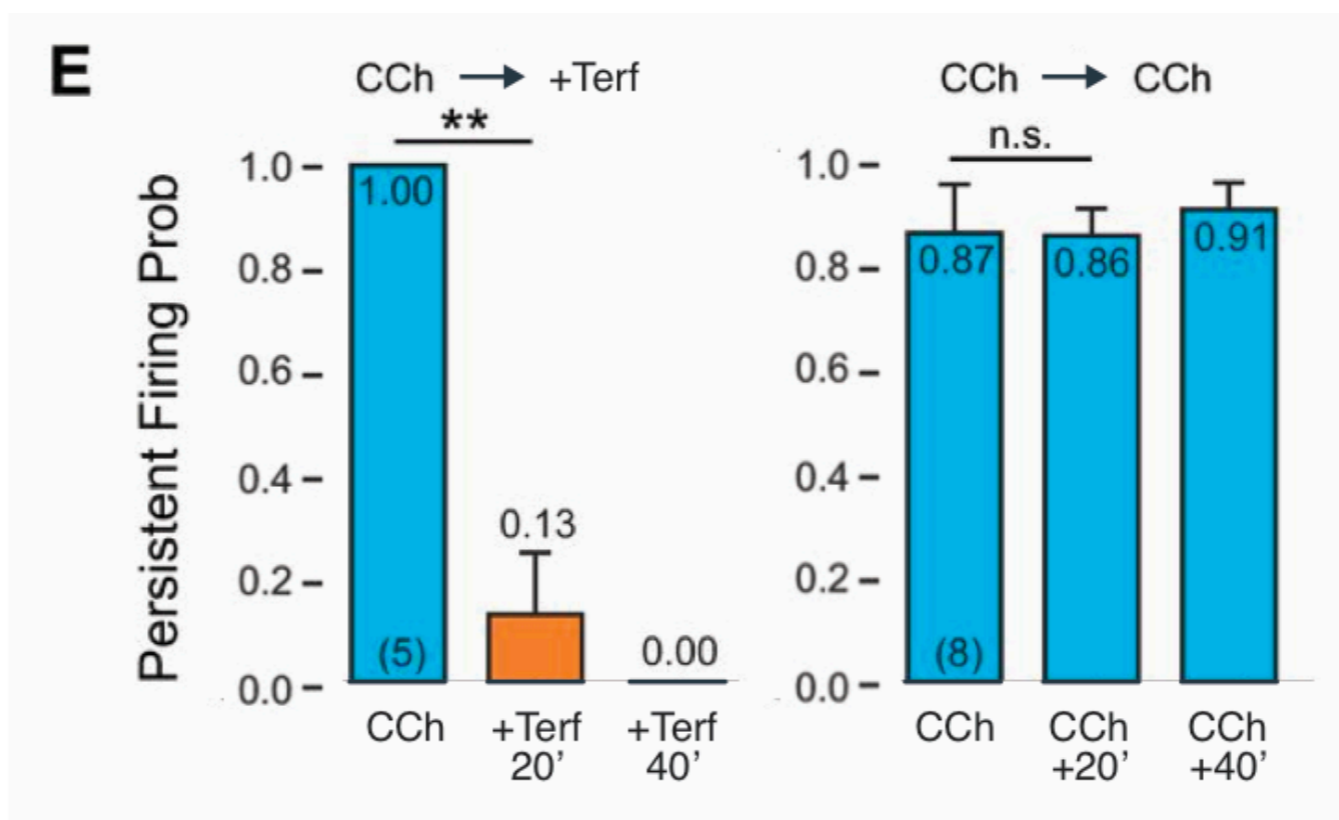
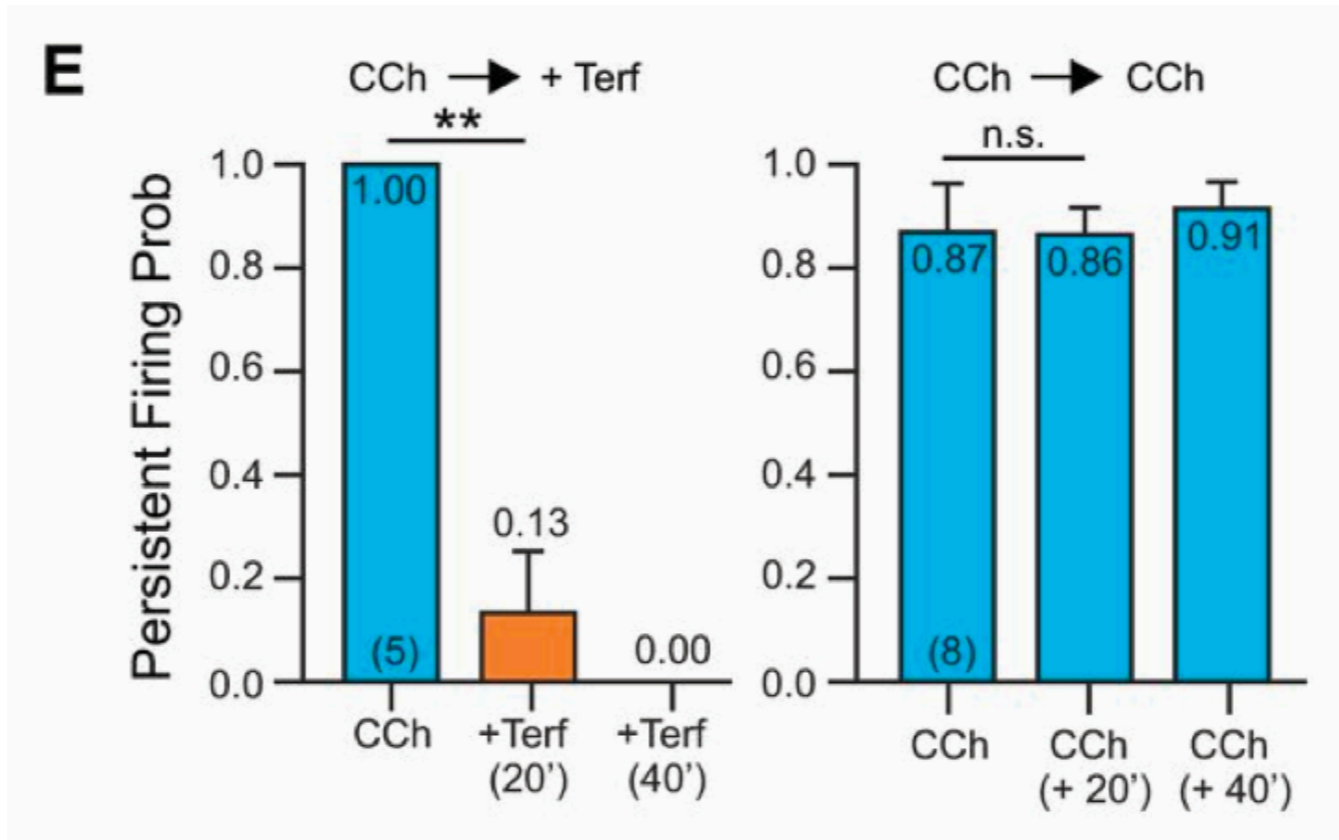
the work is never done

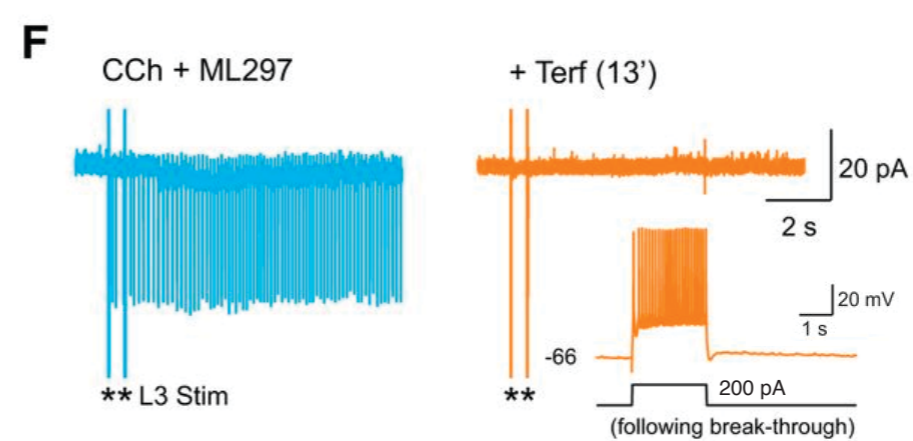
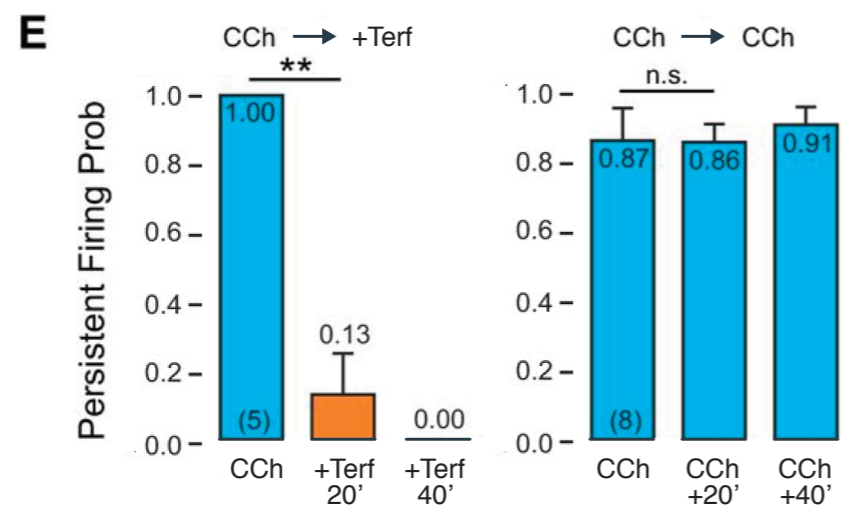
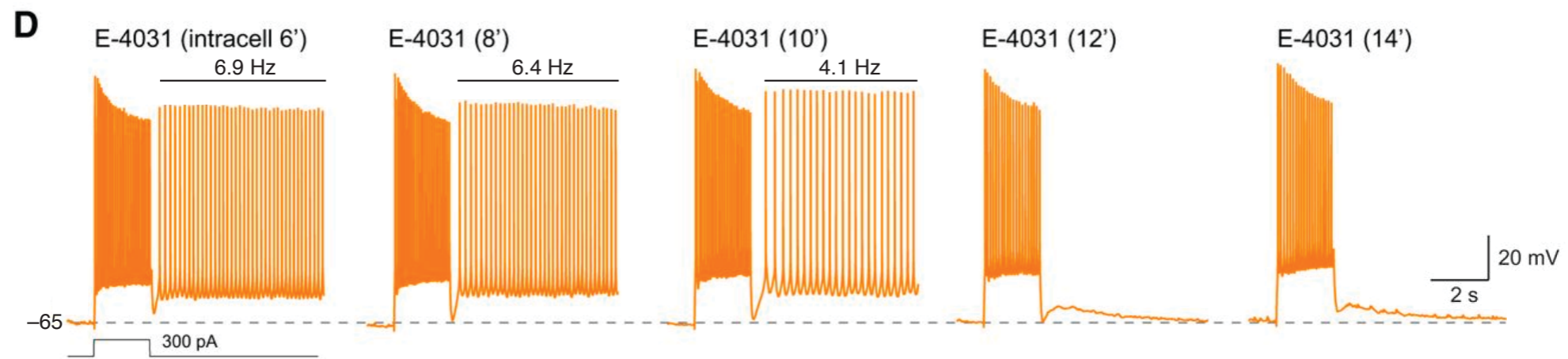
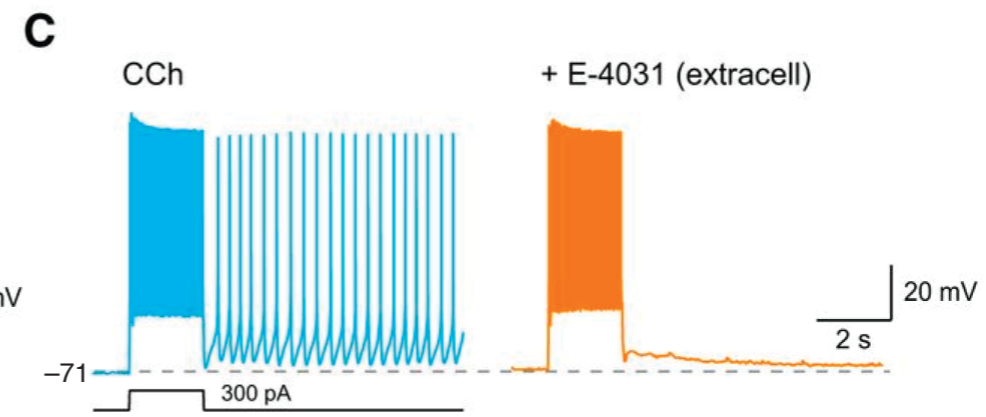
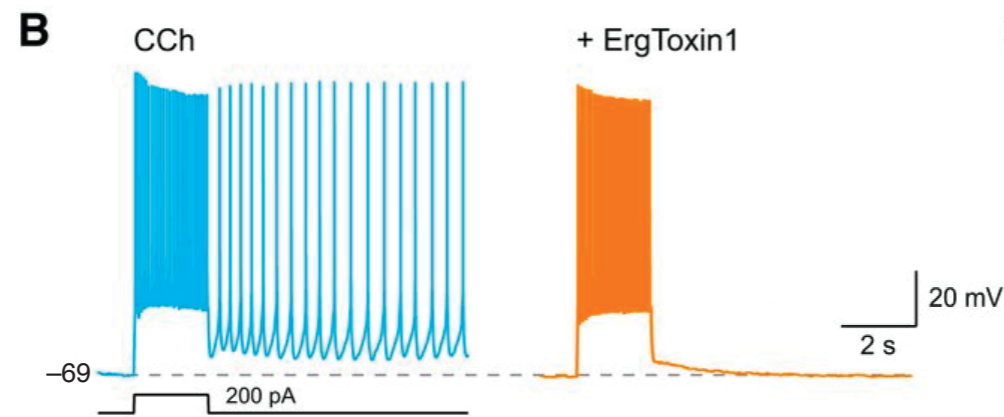
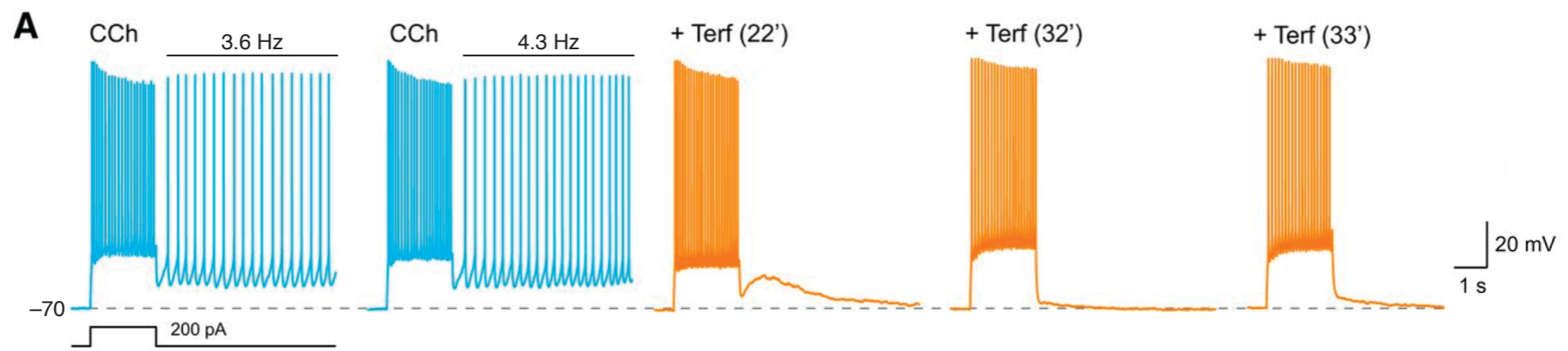
even great things can be improved



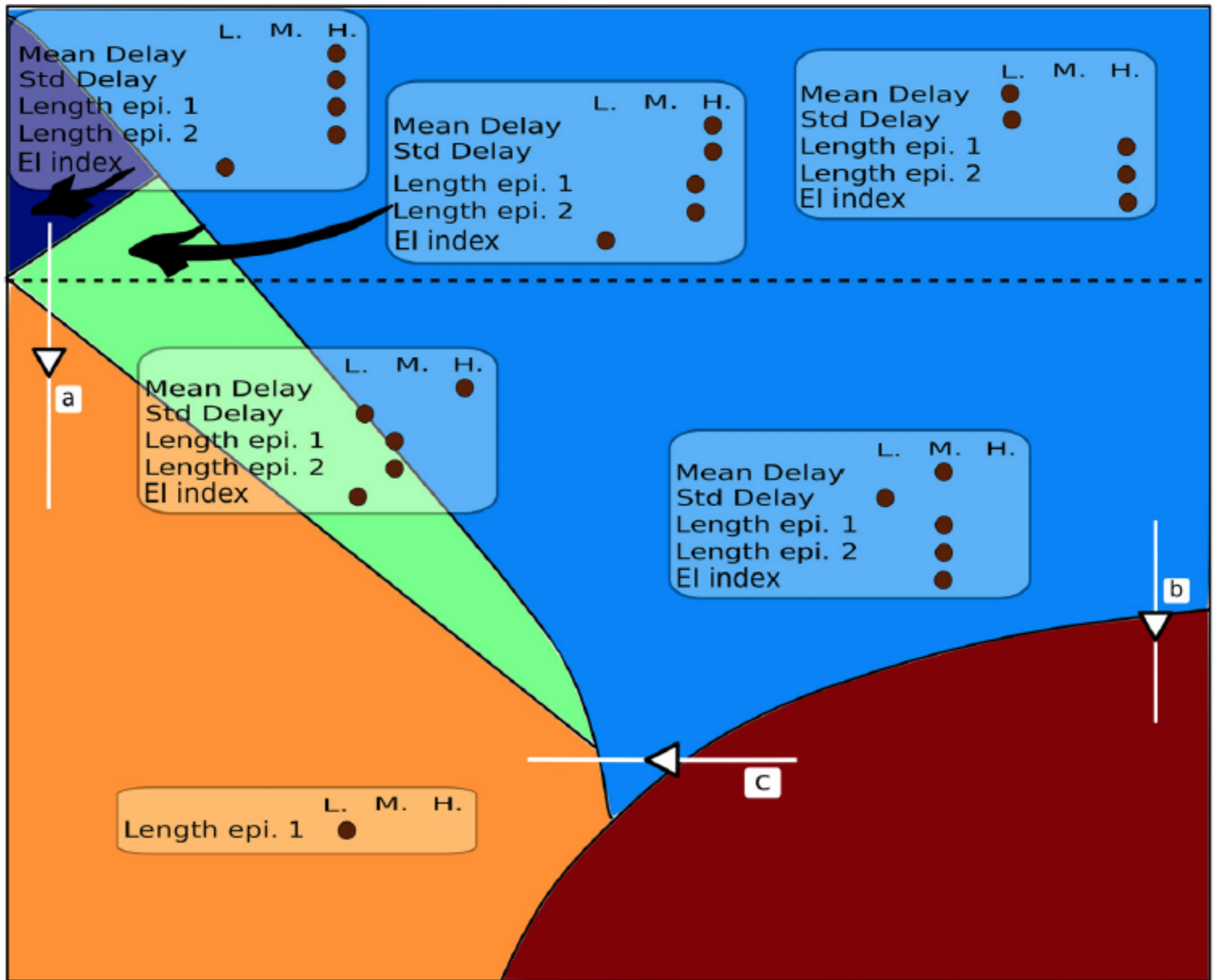




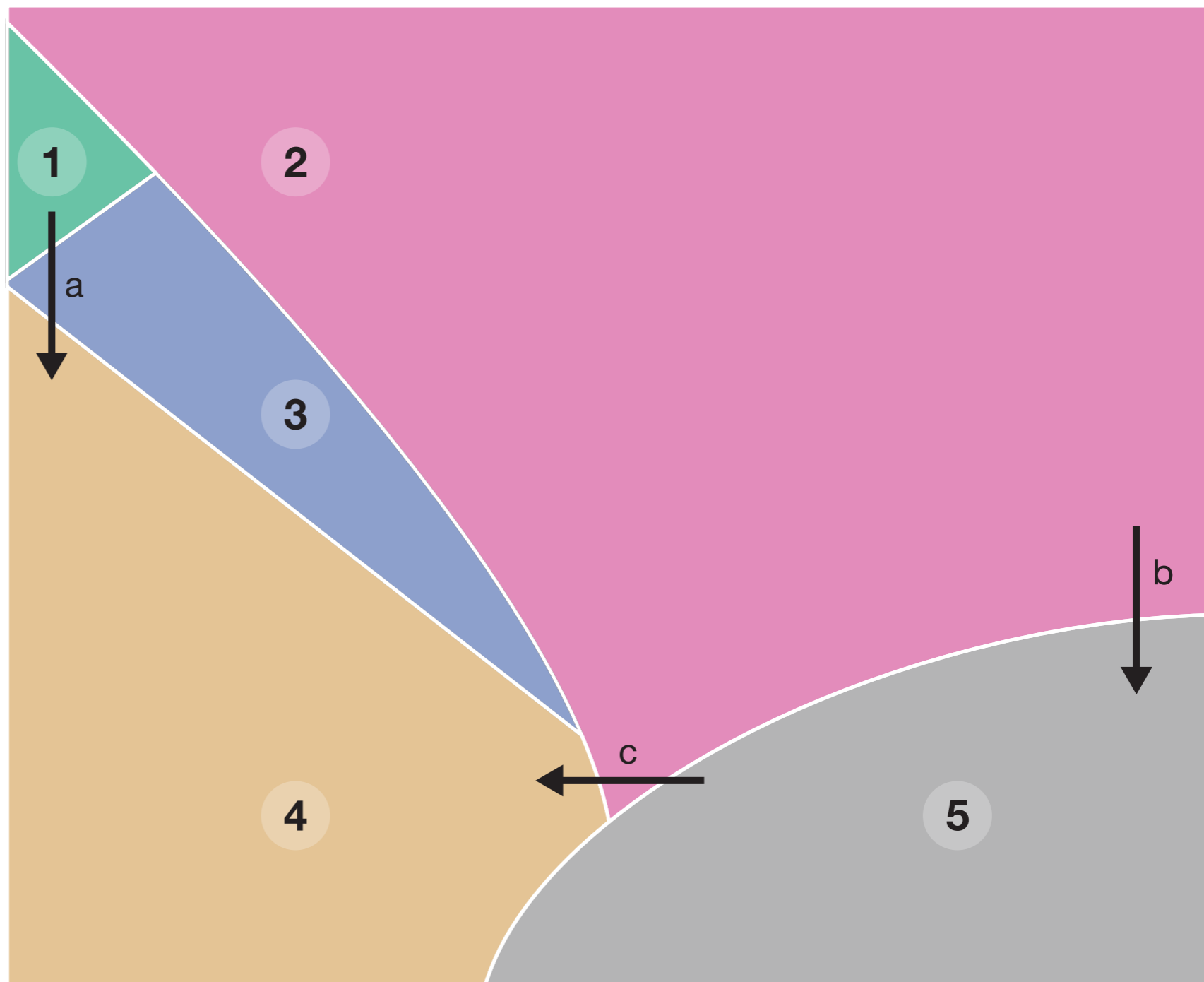




explore Brewer palettes and
perceptually-uniform color spaces (Lab, LCH)



	1	2	3	4
mean delay	•	•	●	
std delay	●	•	•	
length epi 1	●	●	•	
length epi 2	●	●	•	•
EI index	●	●	•	



set2



BREWER PALETTES

QUALITATIVE

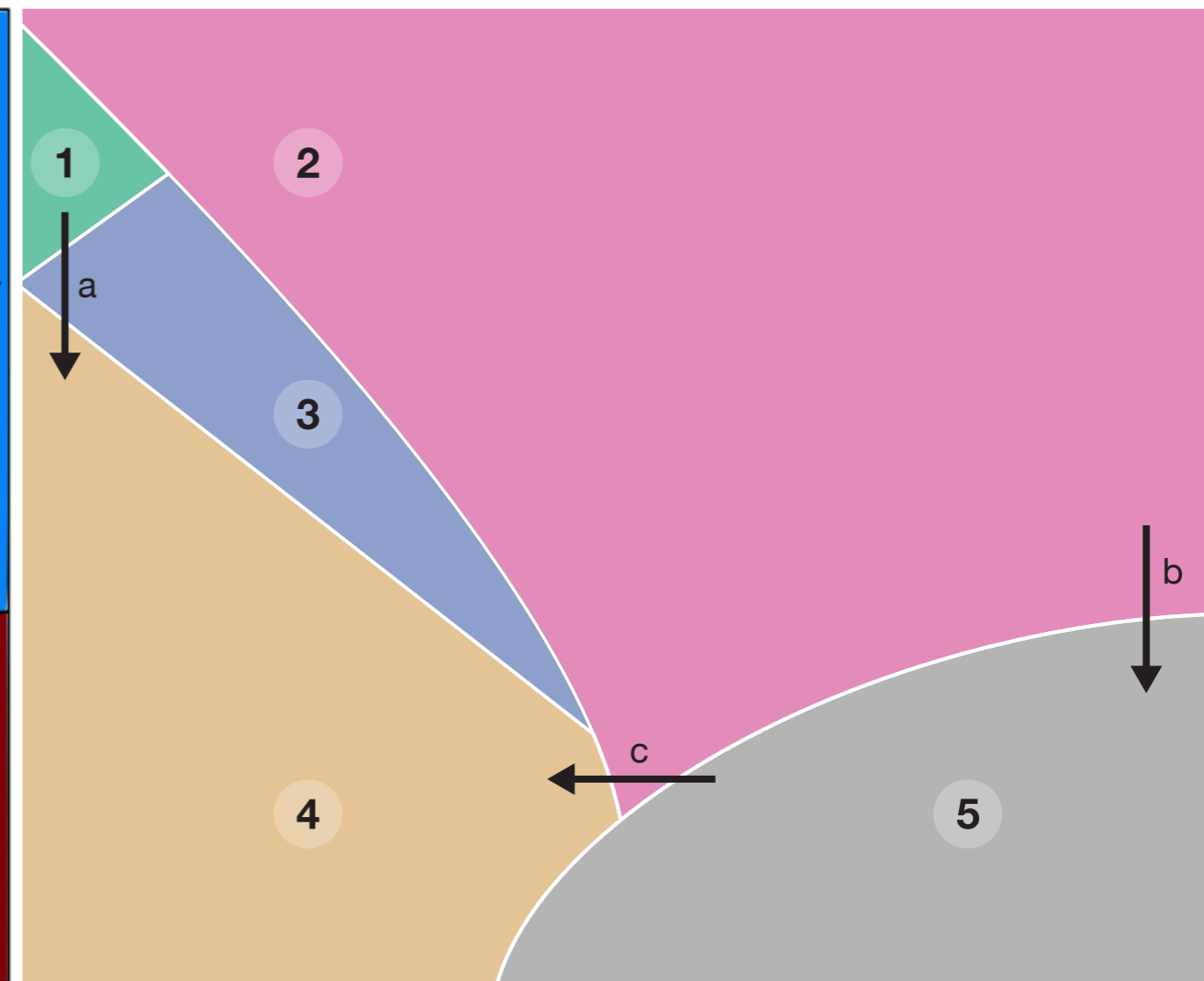
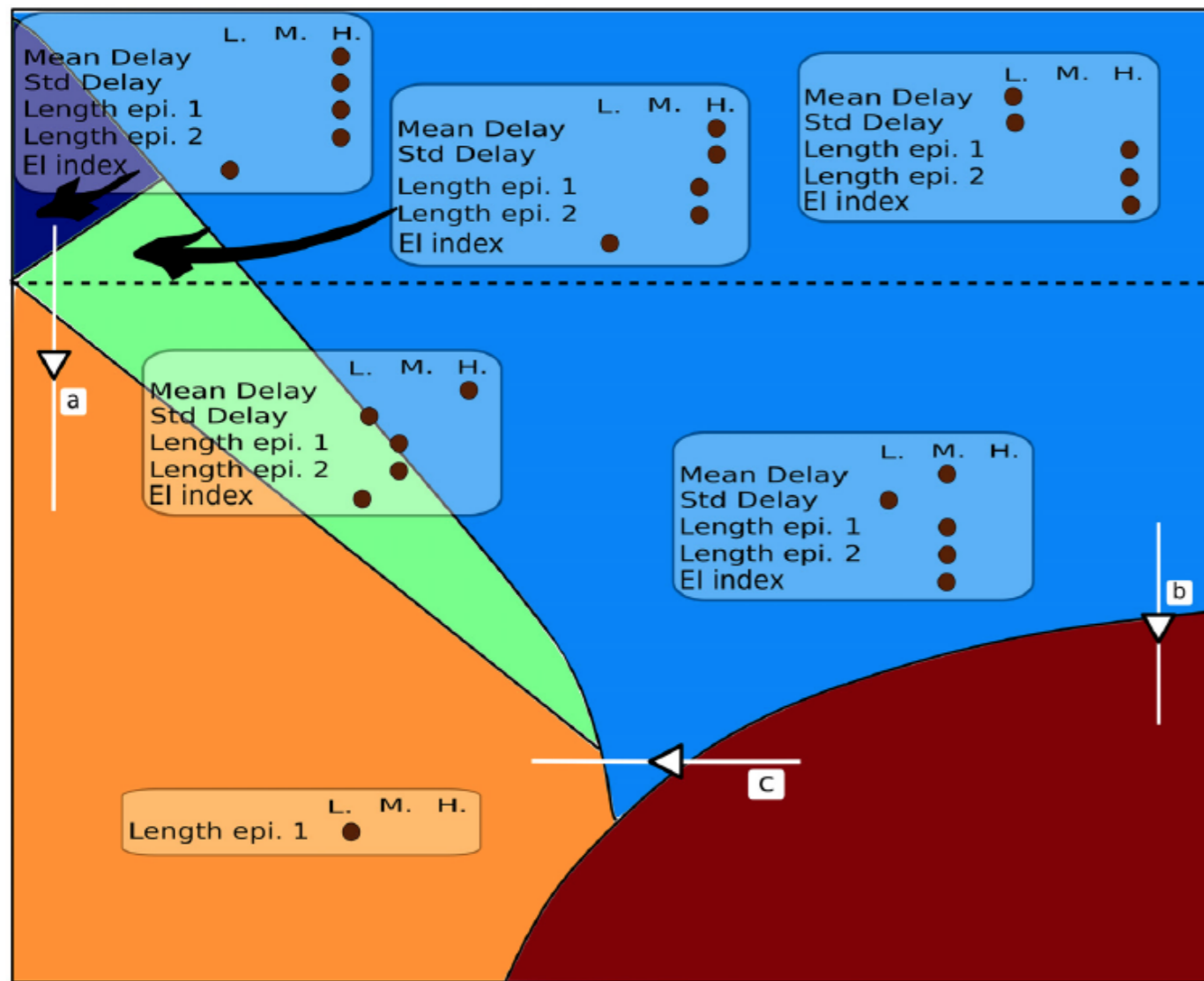


SEQUENTIAL

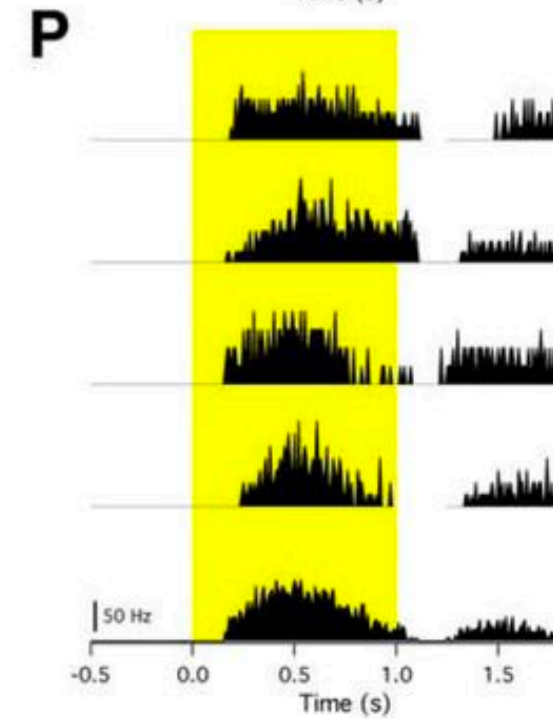
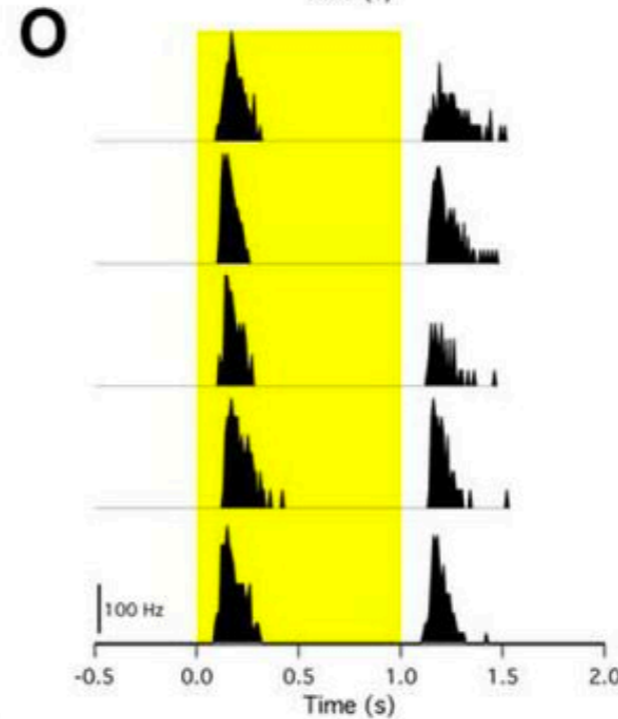
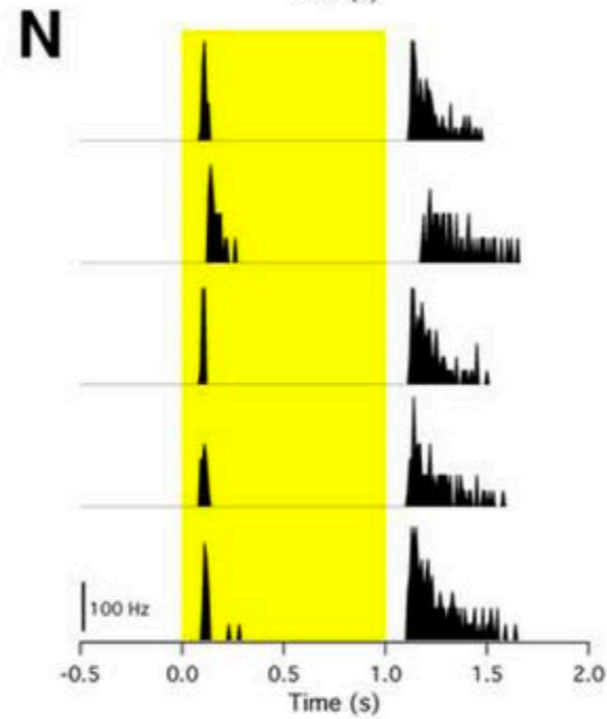
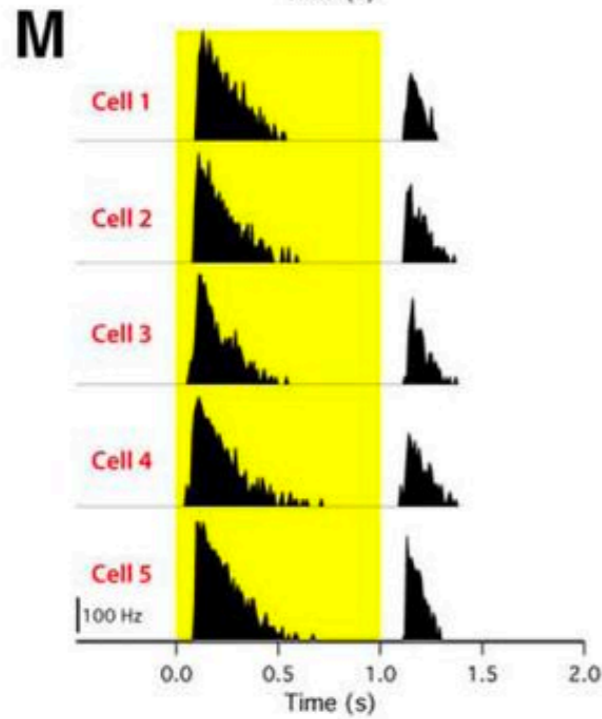
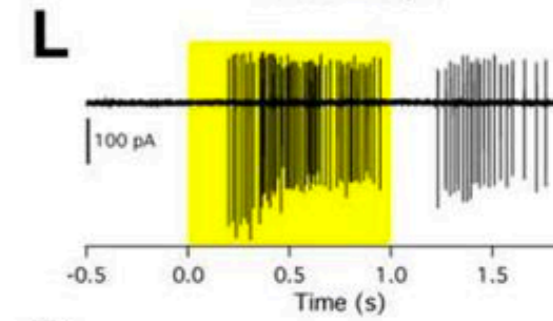
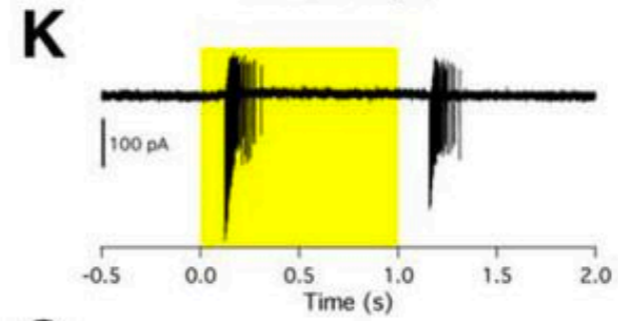
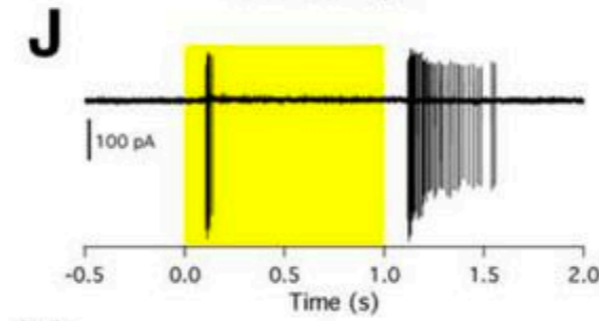
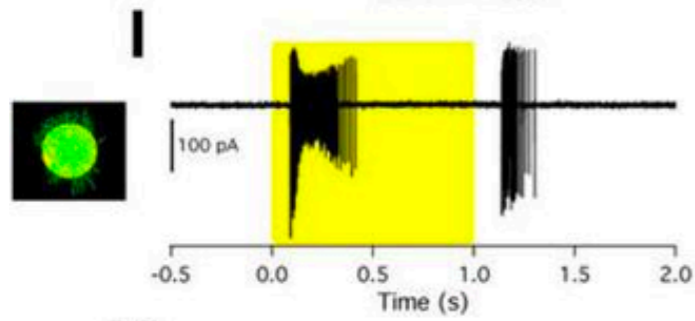
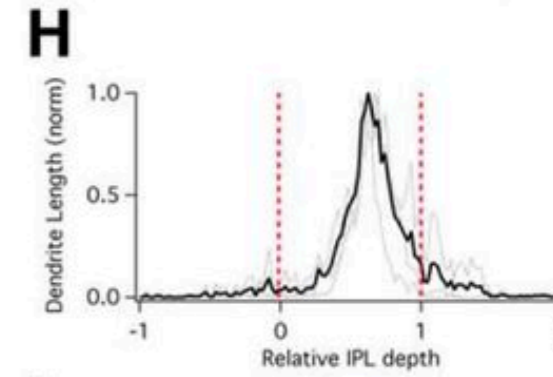
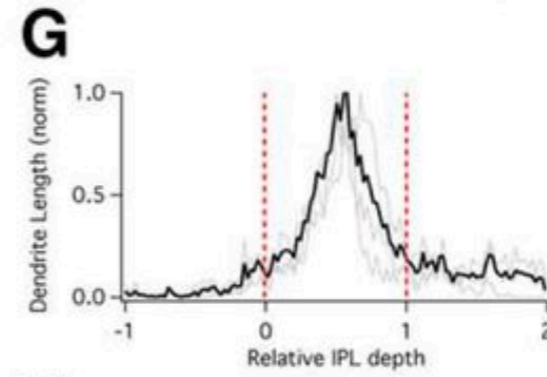
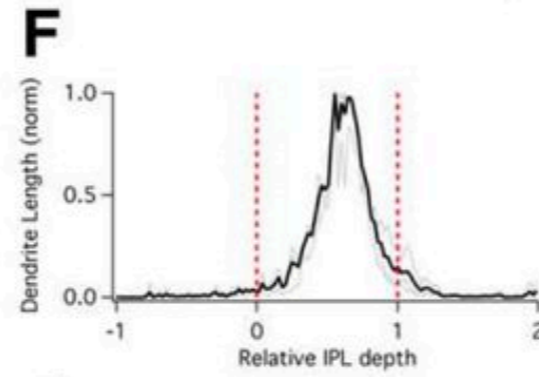
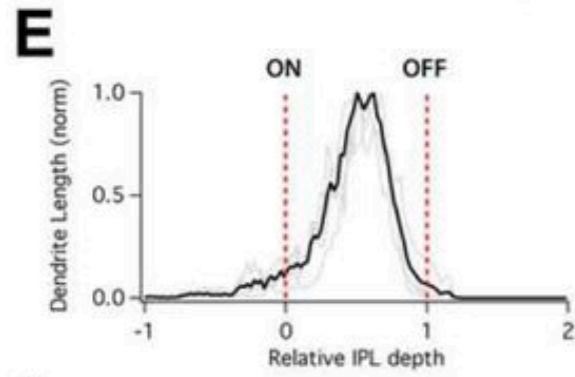
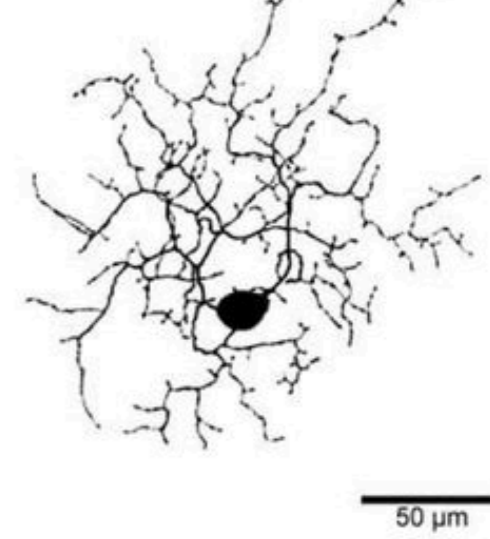
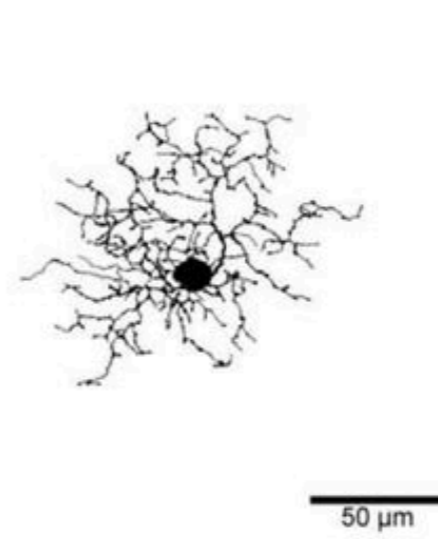
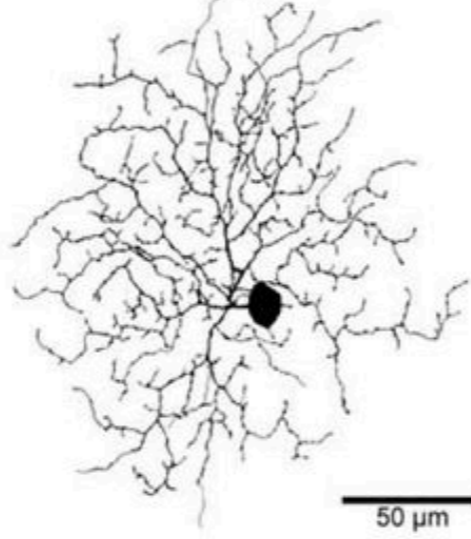
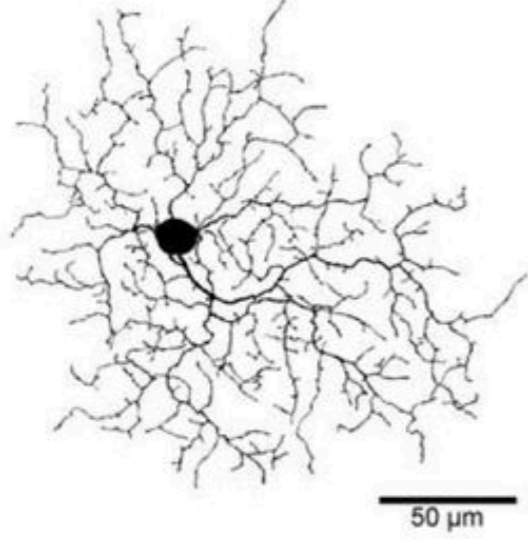


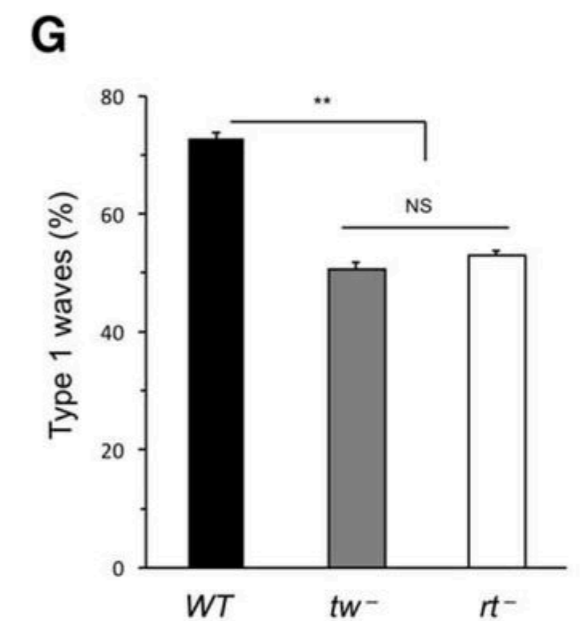
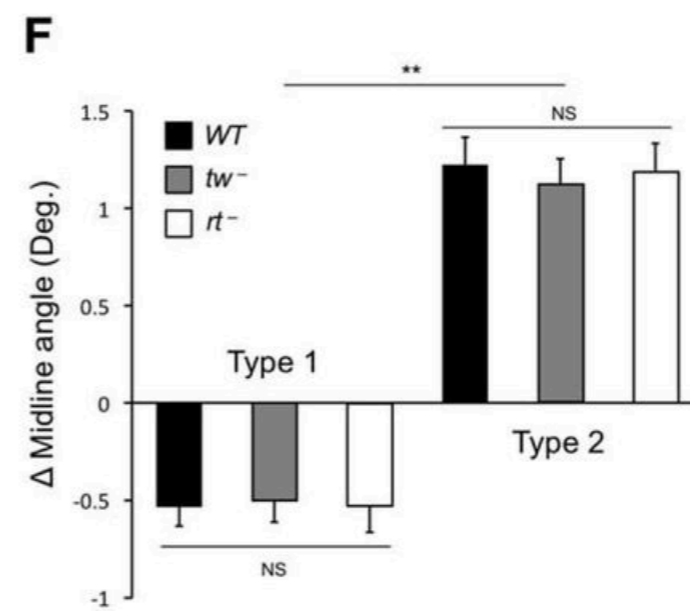
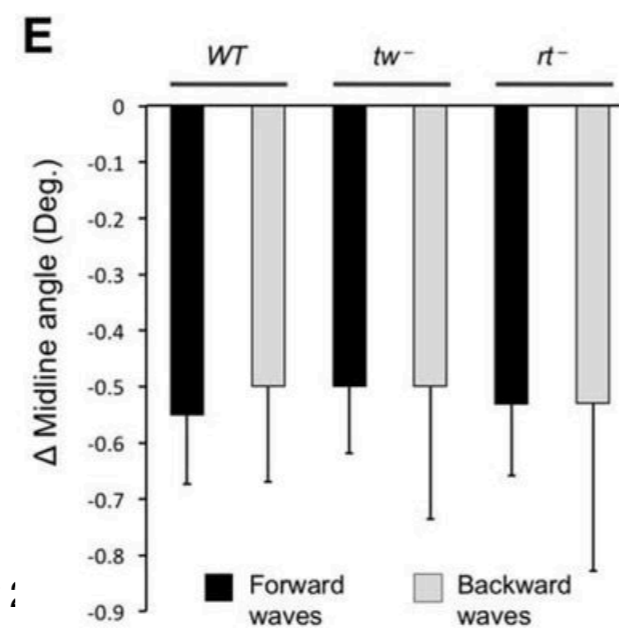
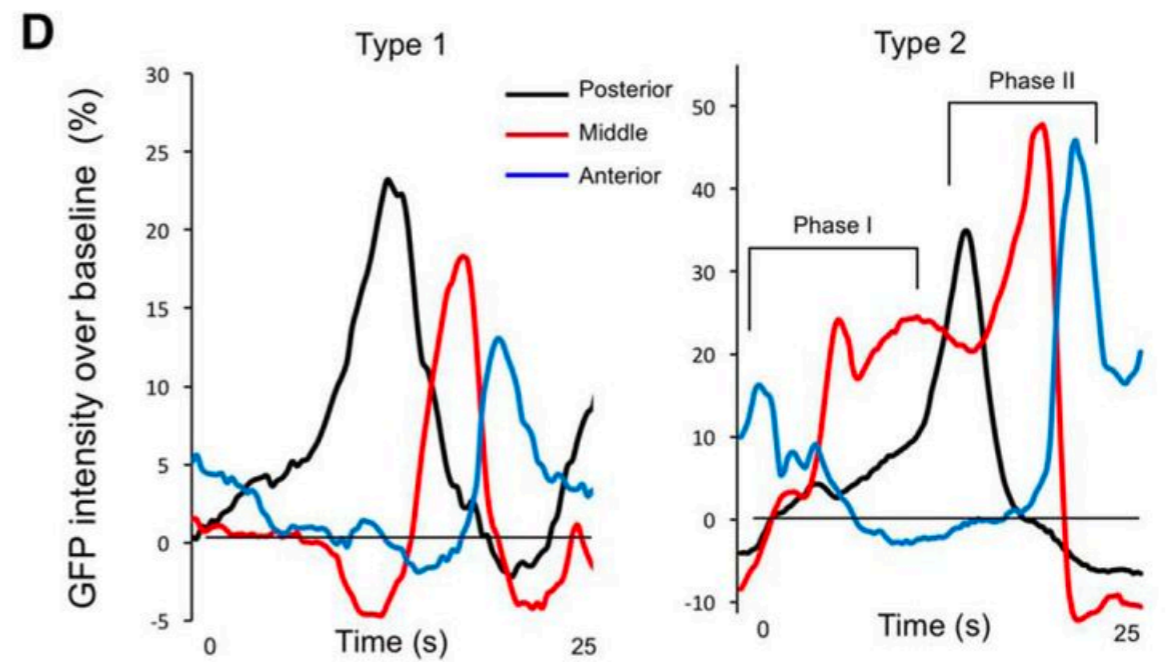
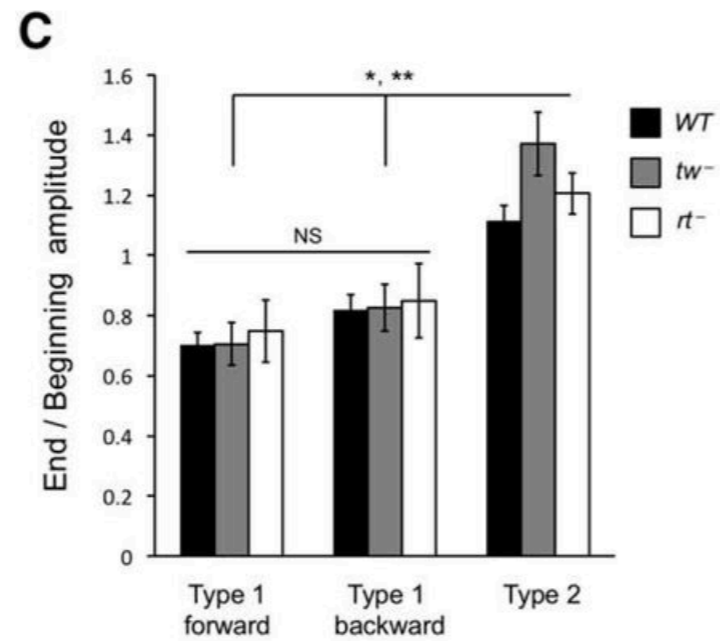
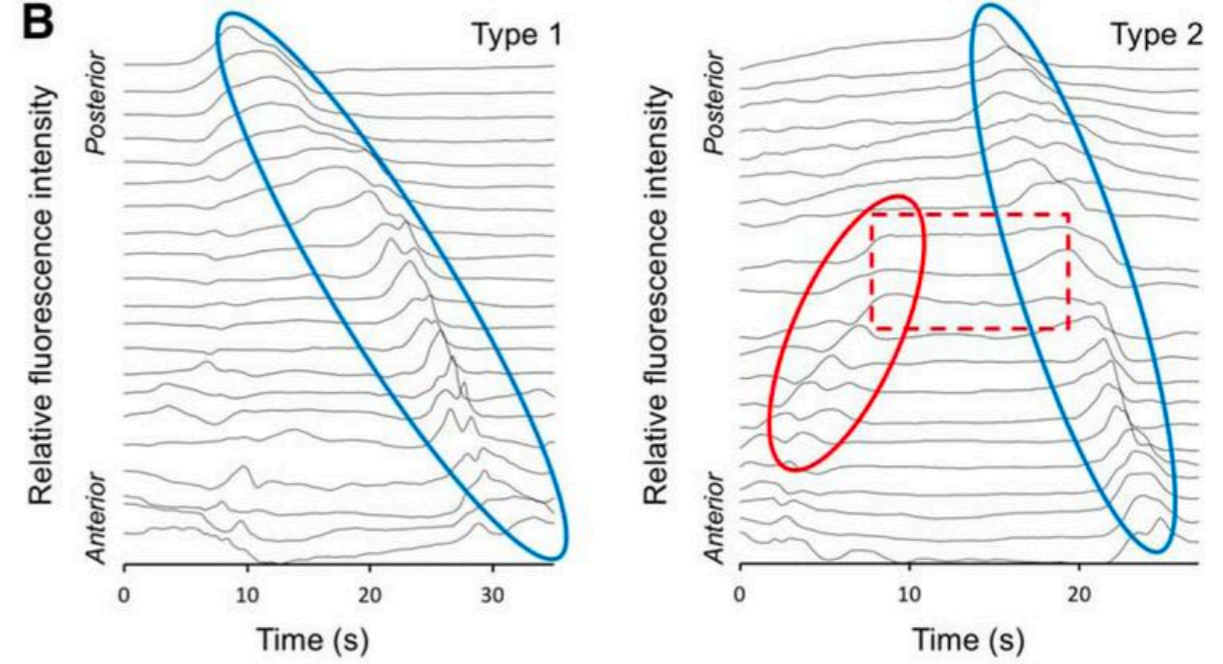
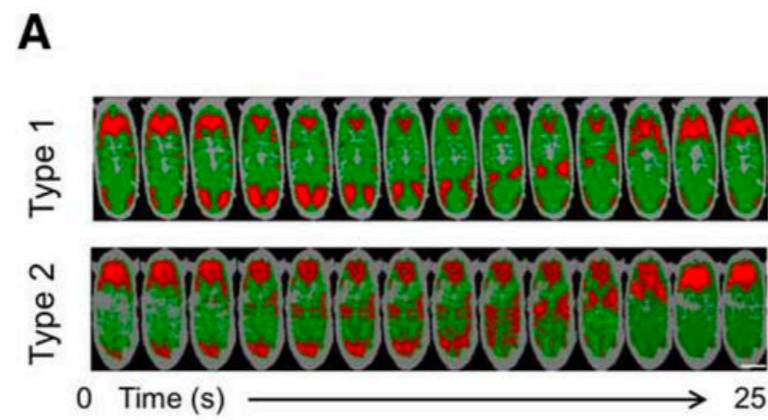
DIVERGING

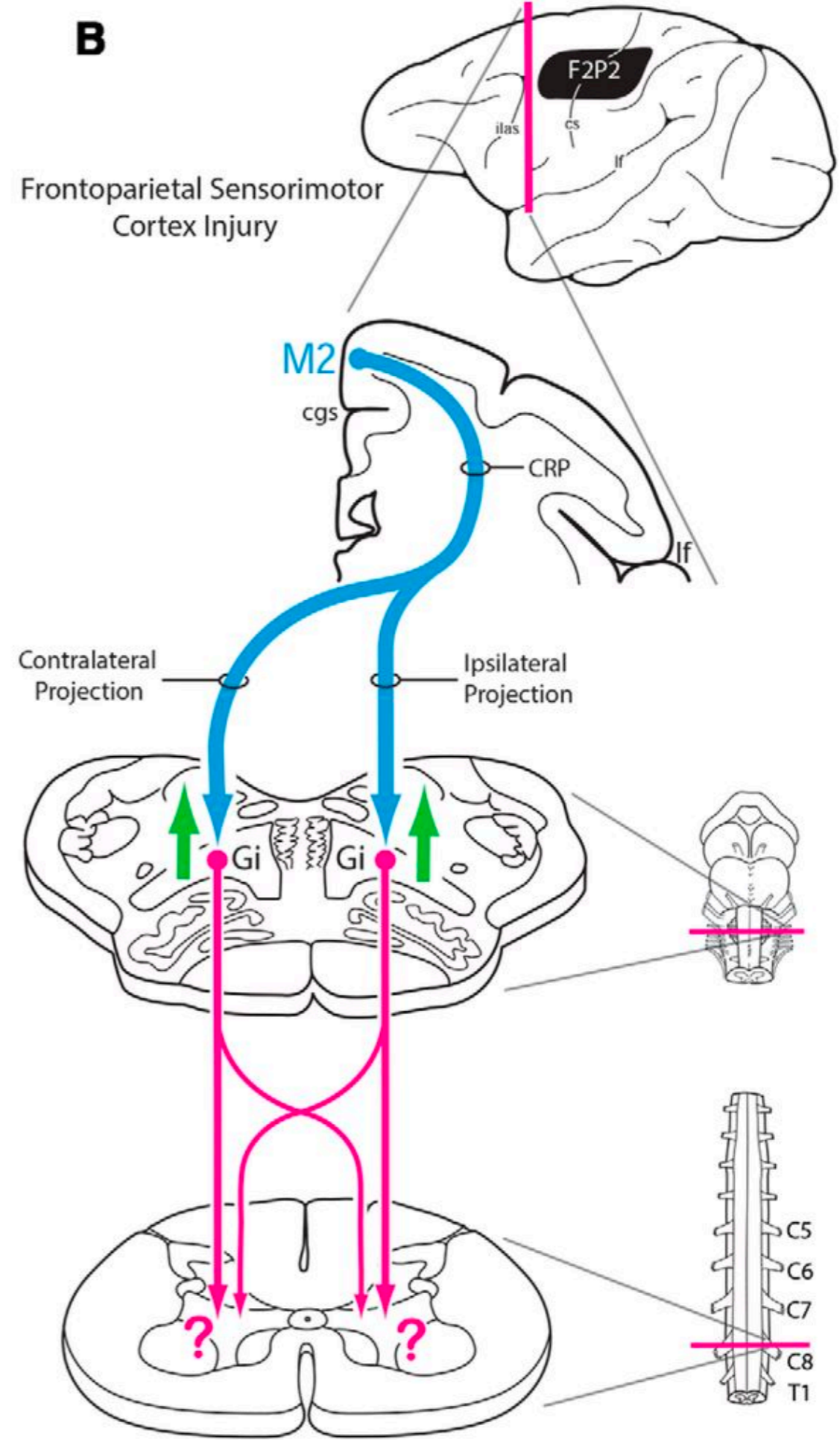
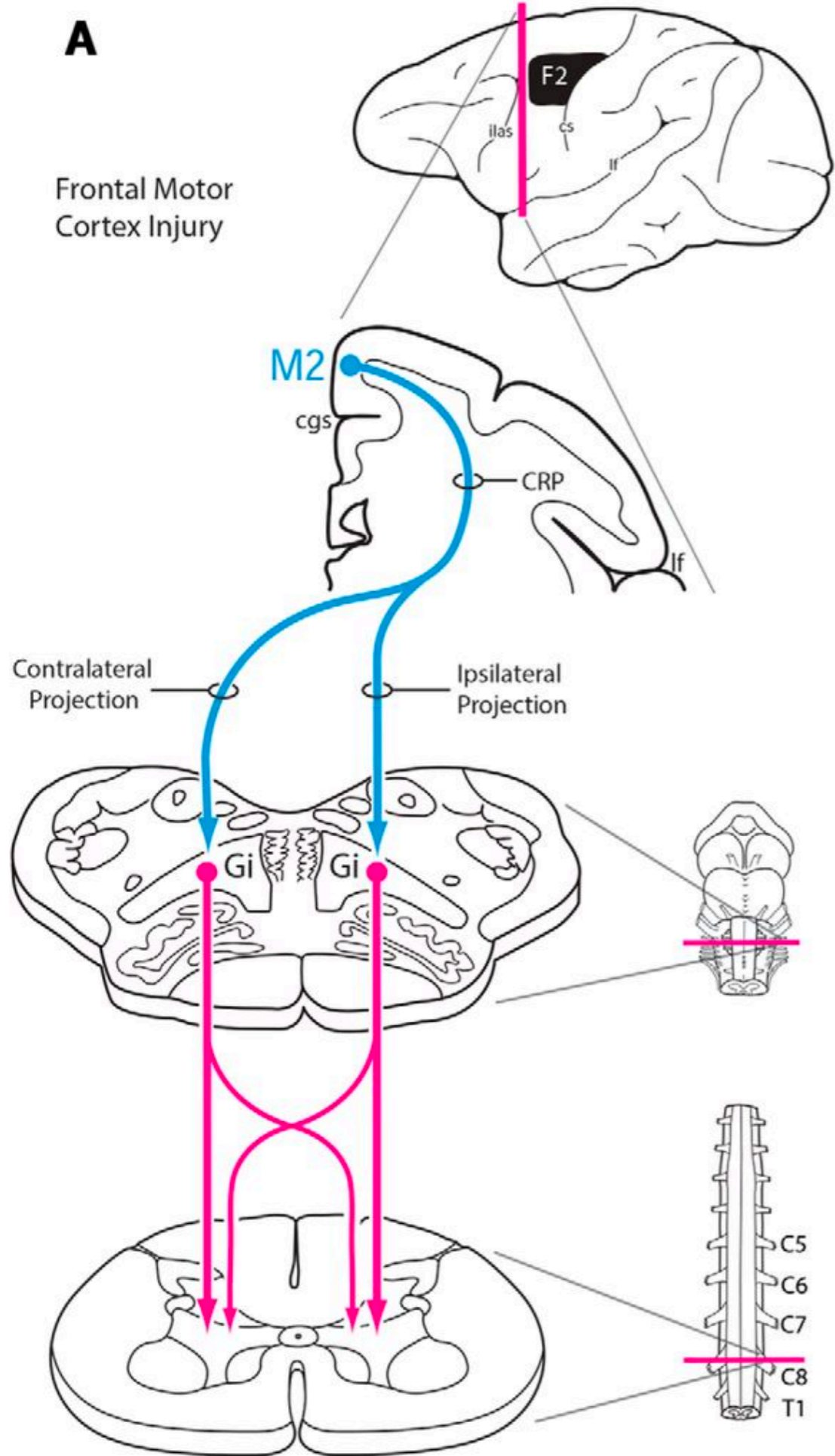




	1	2	3	4
mean delay	•	•	•	•
std delay	•	•	•	•
length epi 1	•	•	•	•
length epi 2	•	•	•	•
EI index	•	•	•	•





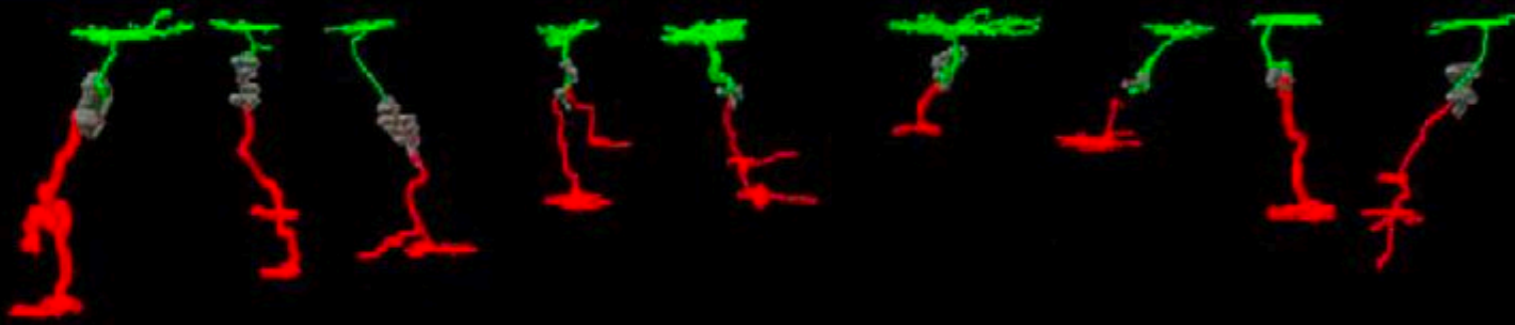


think about perception

think about color blindness

use Color Oracle to simulate it
<https://colororacle.org/>

A Control Neurons | Side View



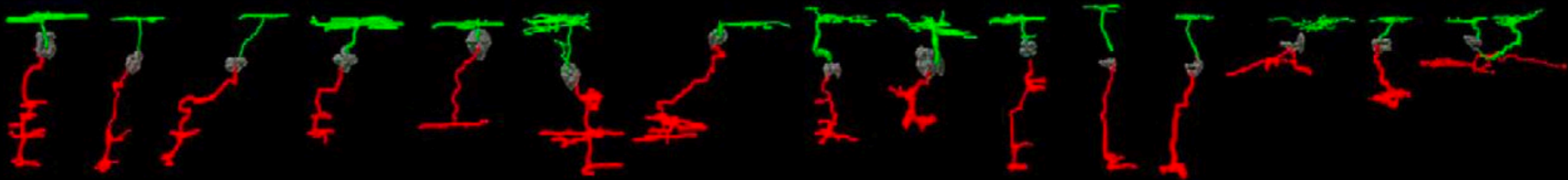
Dendritic trees
Somata
Axons

Control Neurons | Top Down View

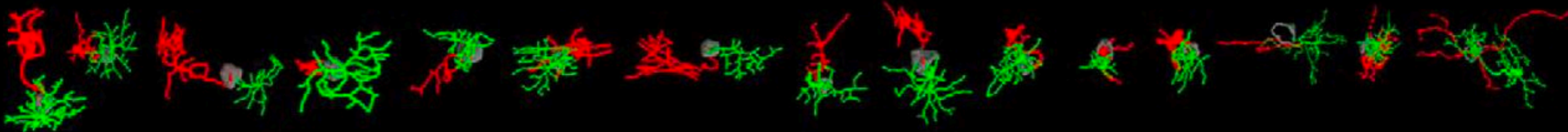


25μm

B 60 DPI Neurons | Side View



60 DPI Neurons | Top Down View



A Control Neurons | Side View



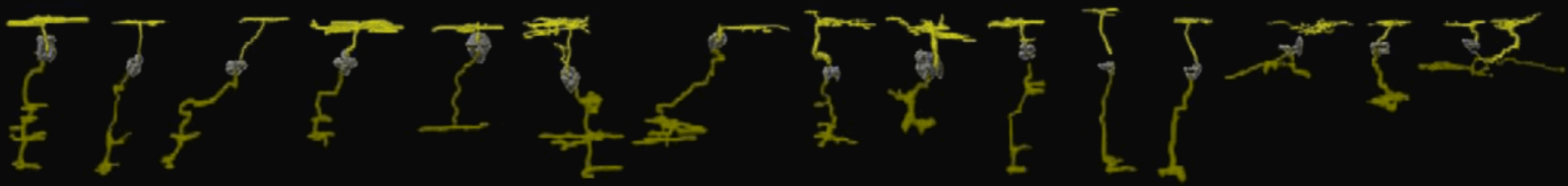
Dendritic trees
Somata
Axons

Control Neurons | Top Down View



25µm

B 60 DPI Neurons | Side View



60 DPI Neurons | Top Down View





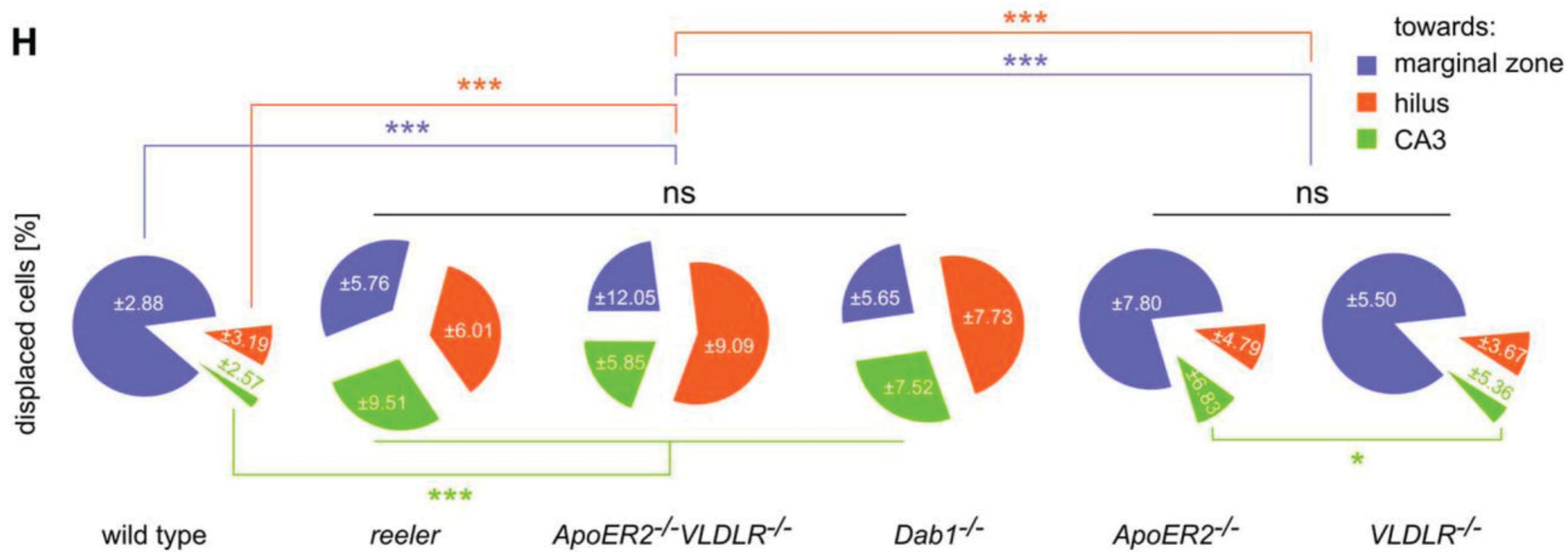
deuteranopia

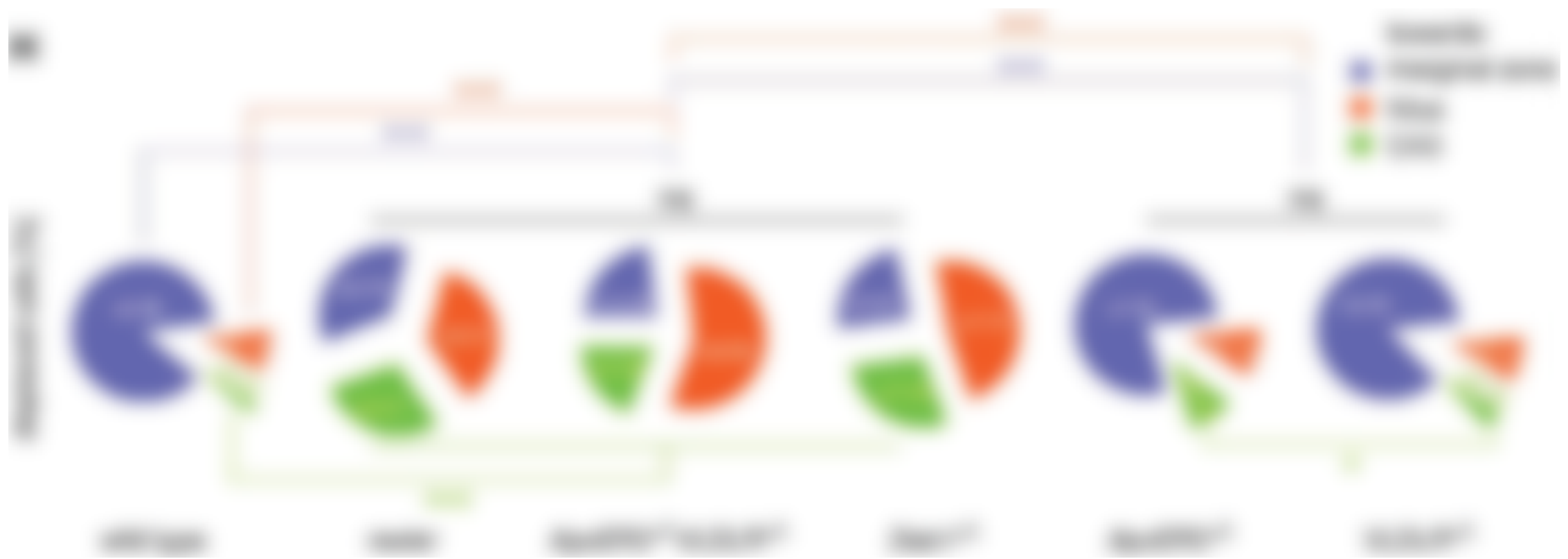


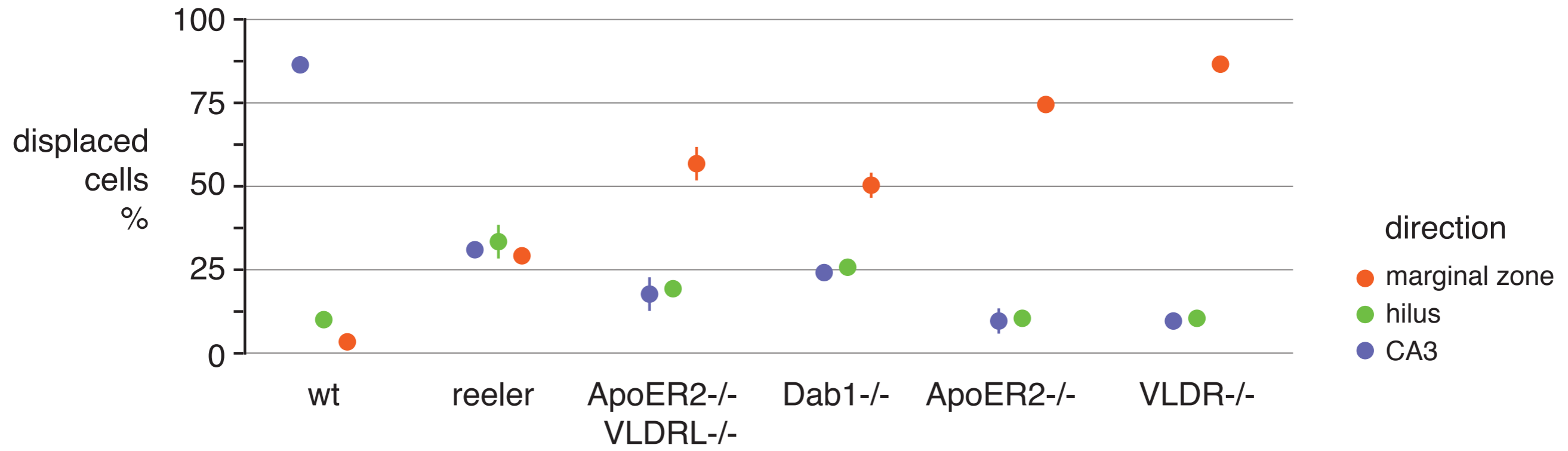
protanopia

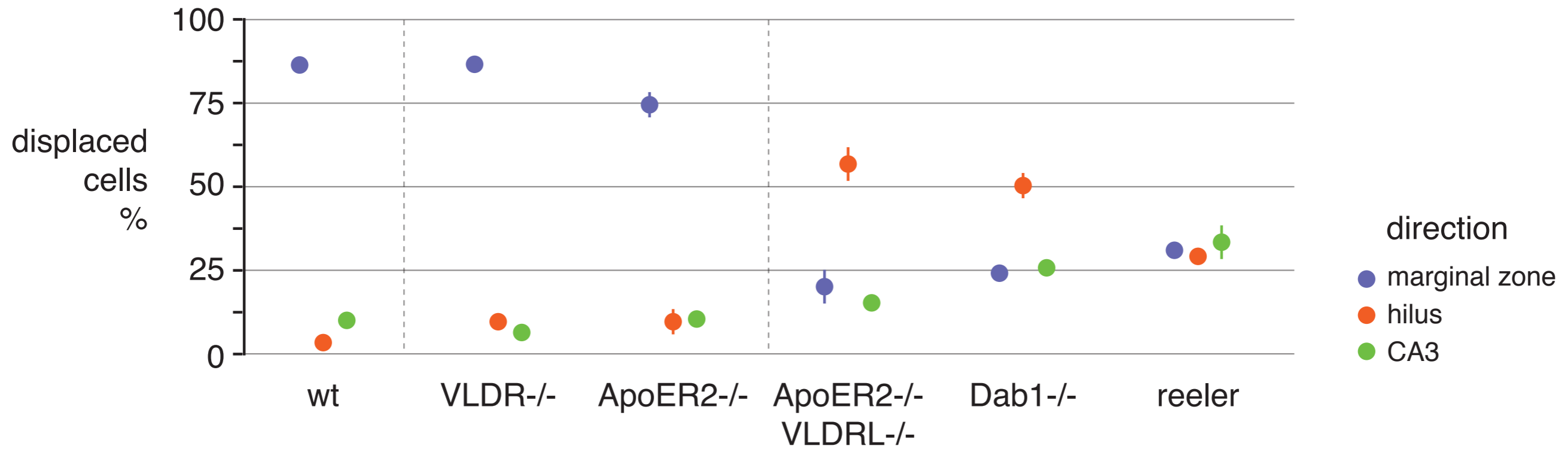


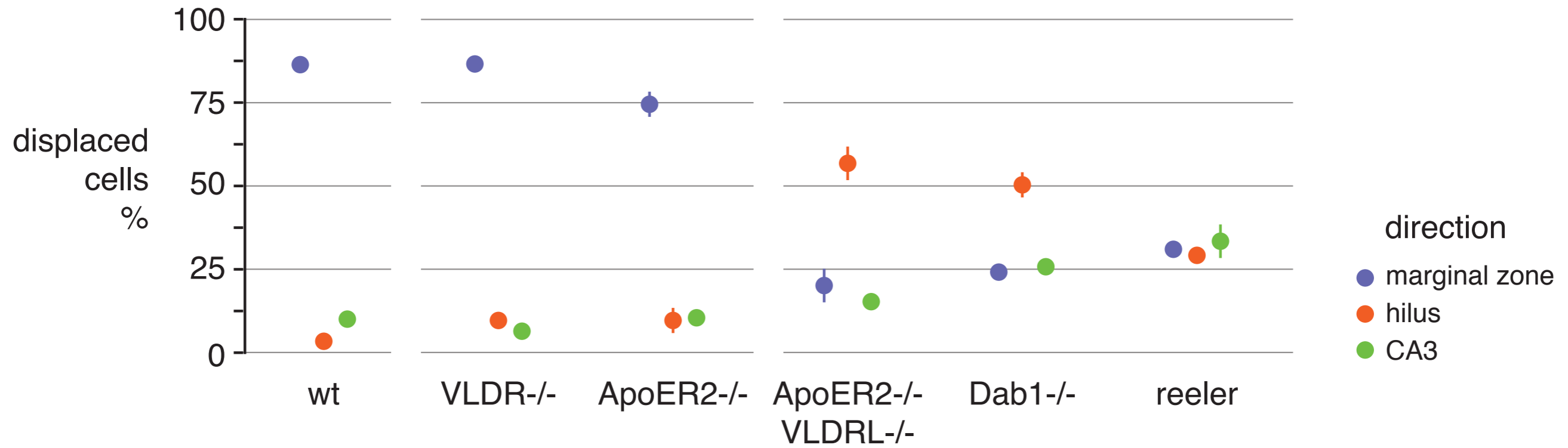
tritanopia

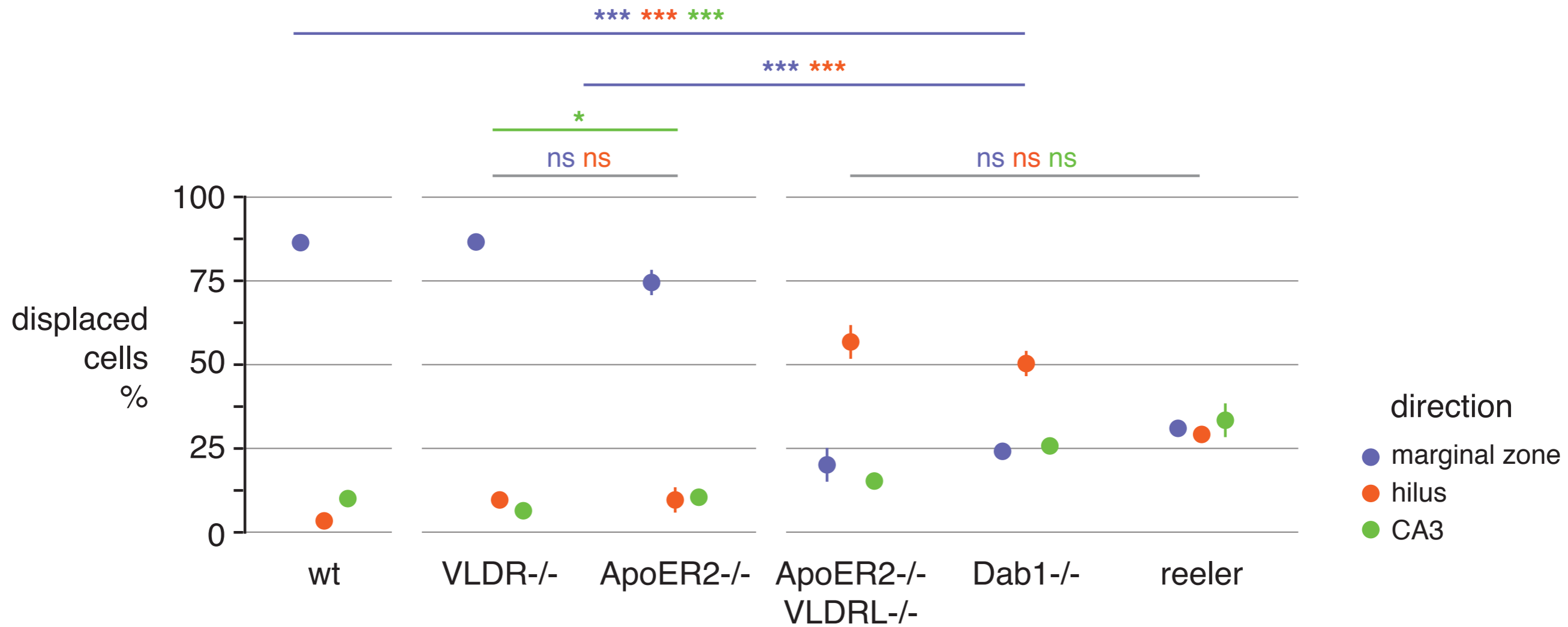


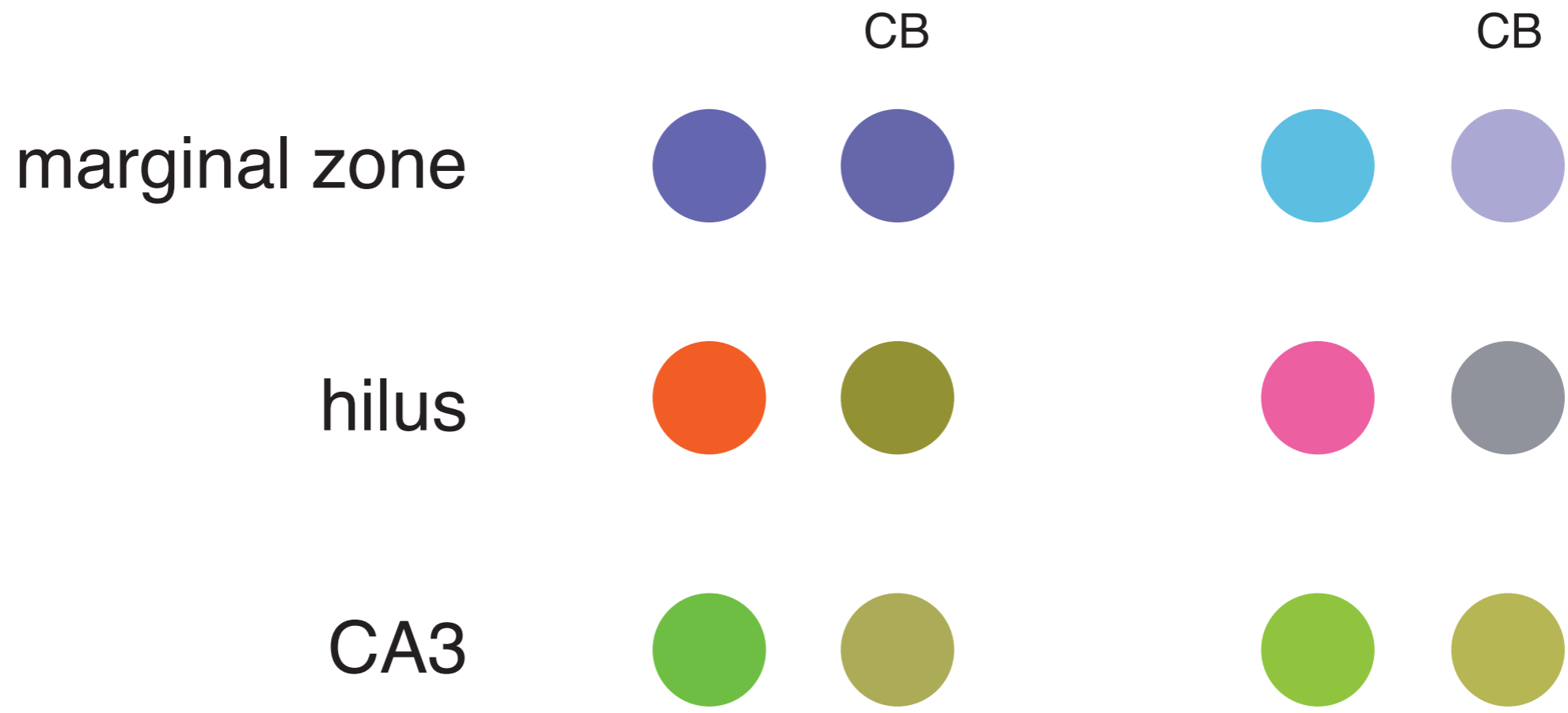


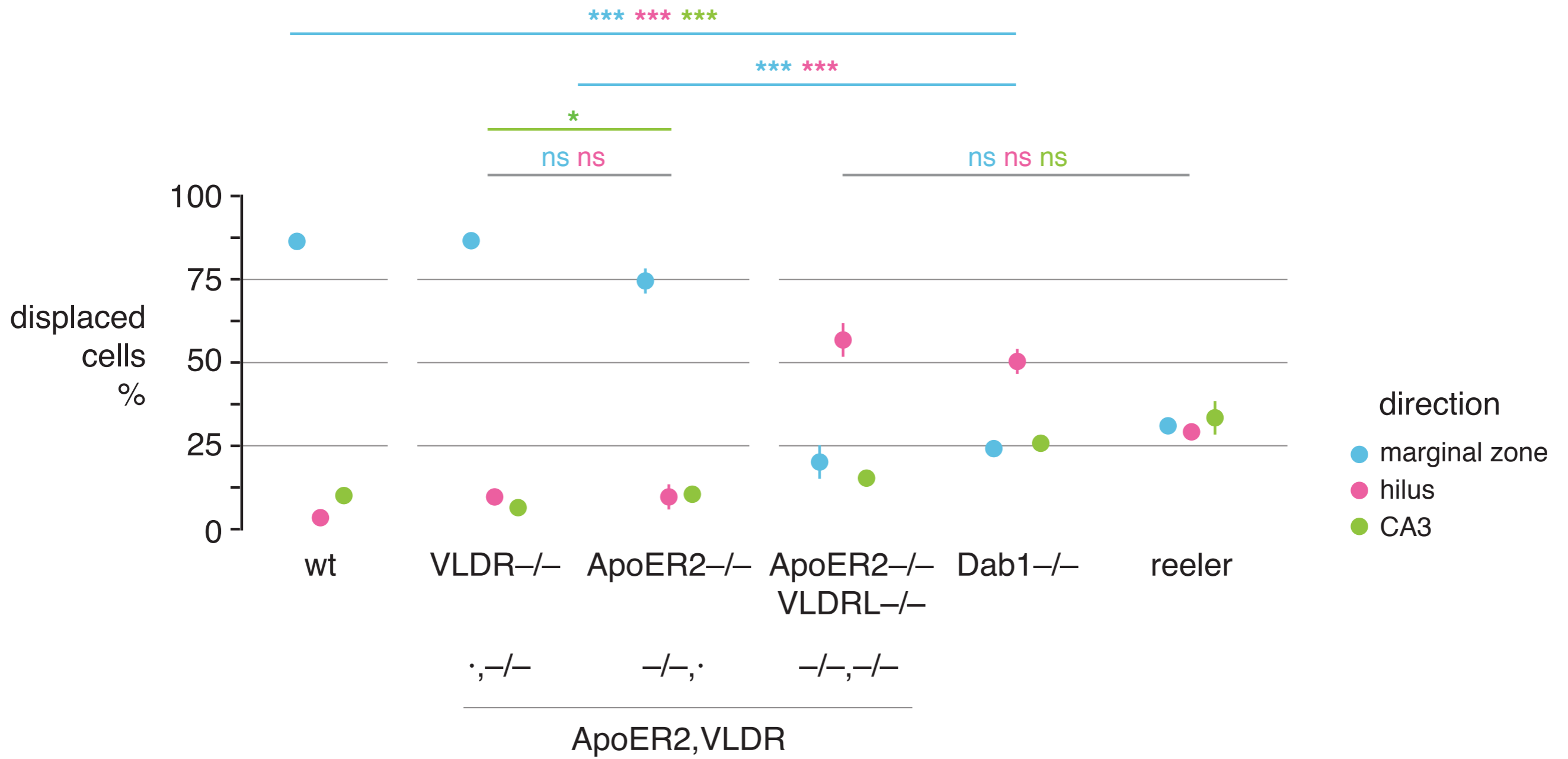


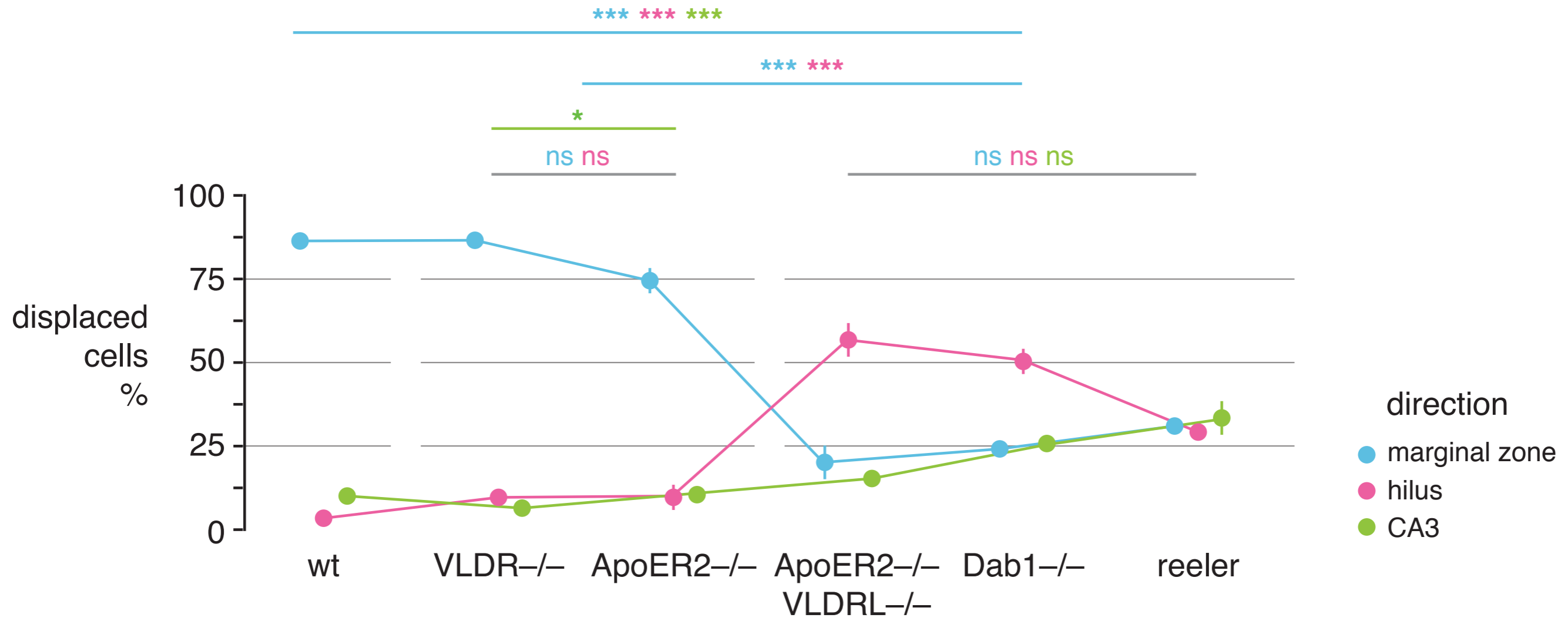




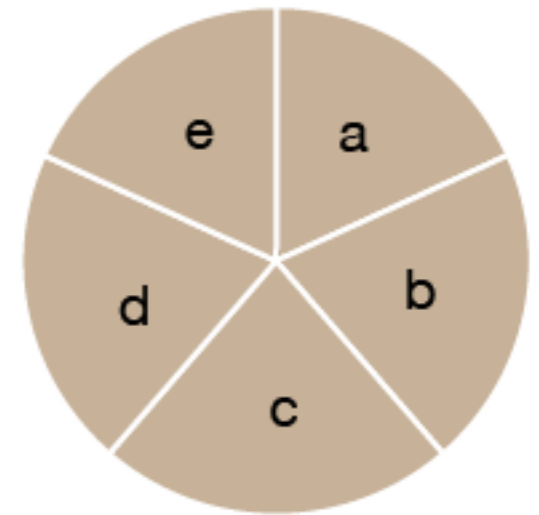
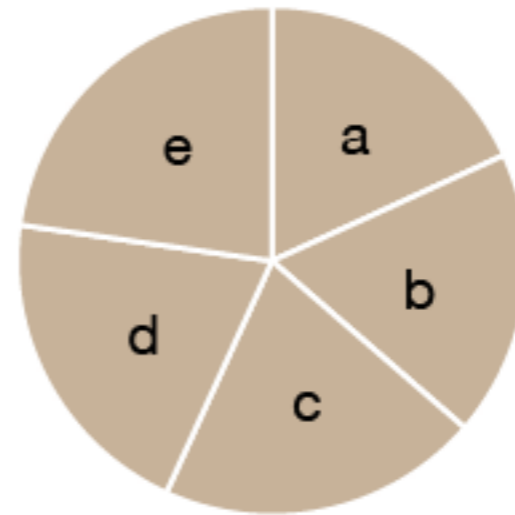
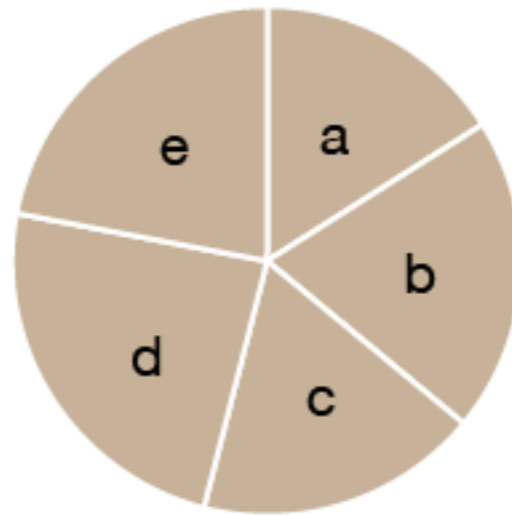
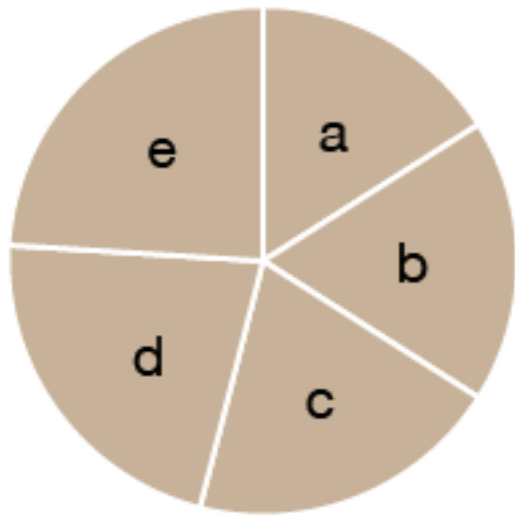
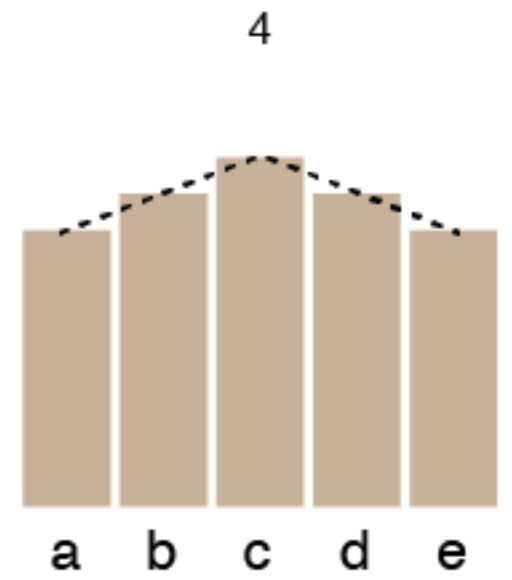
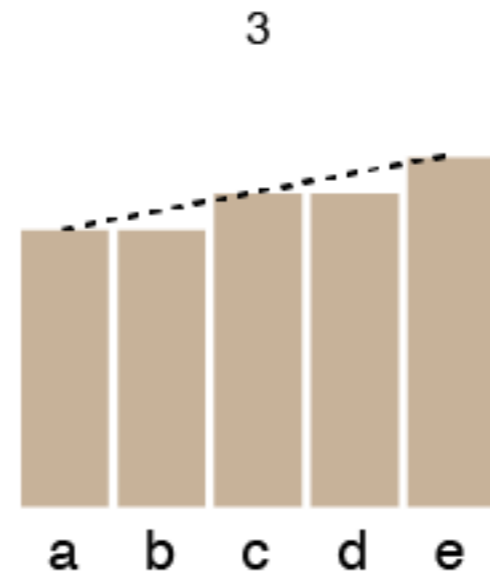
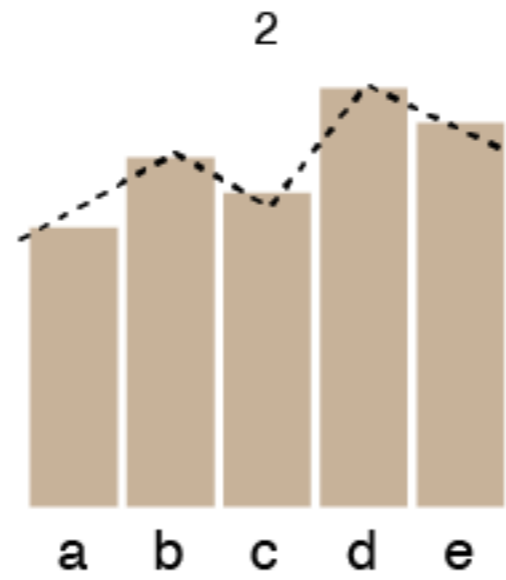
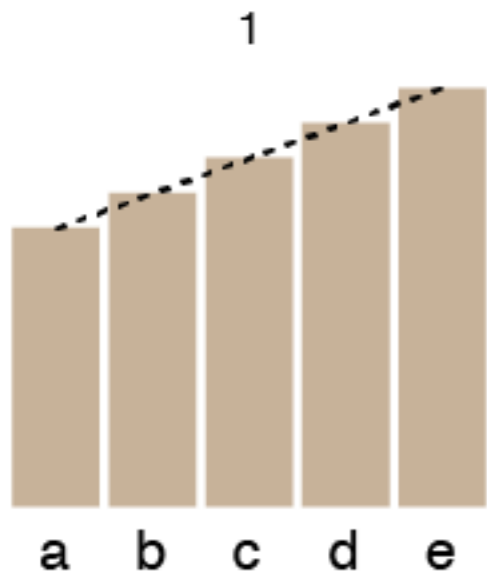




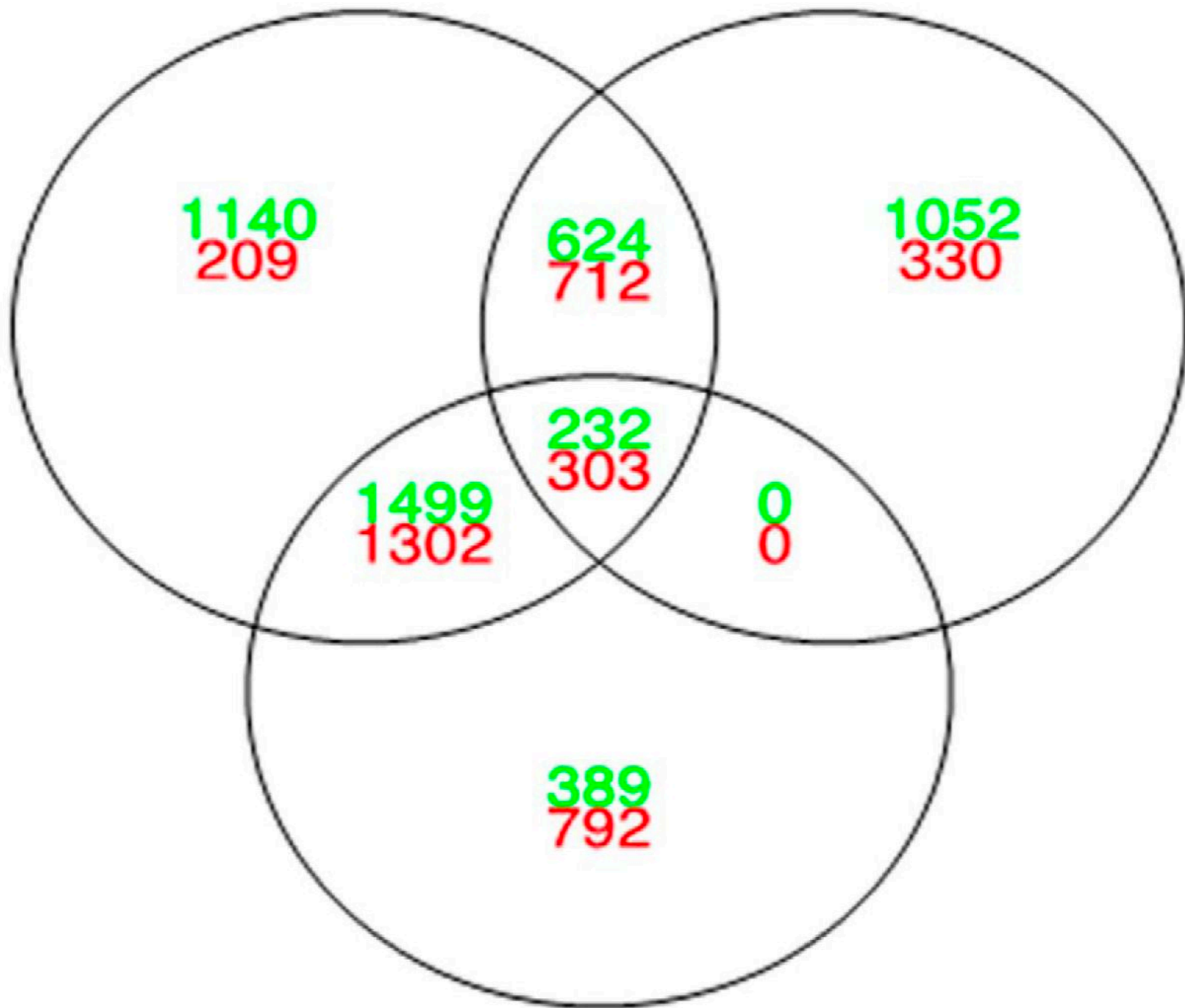








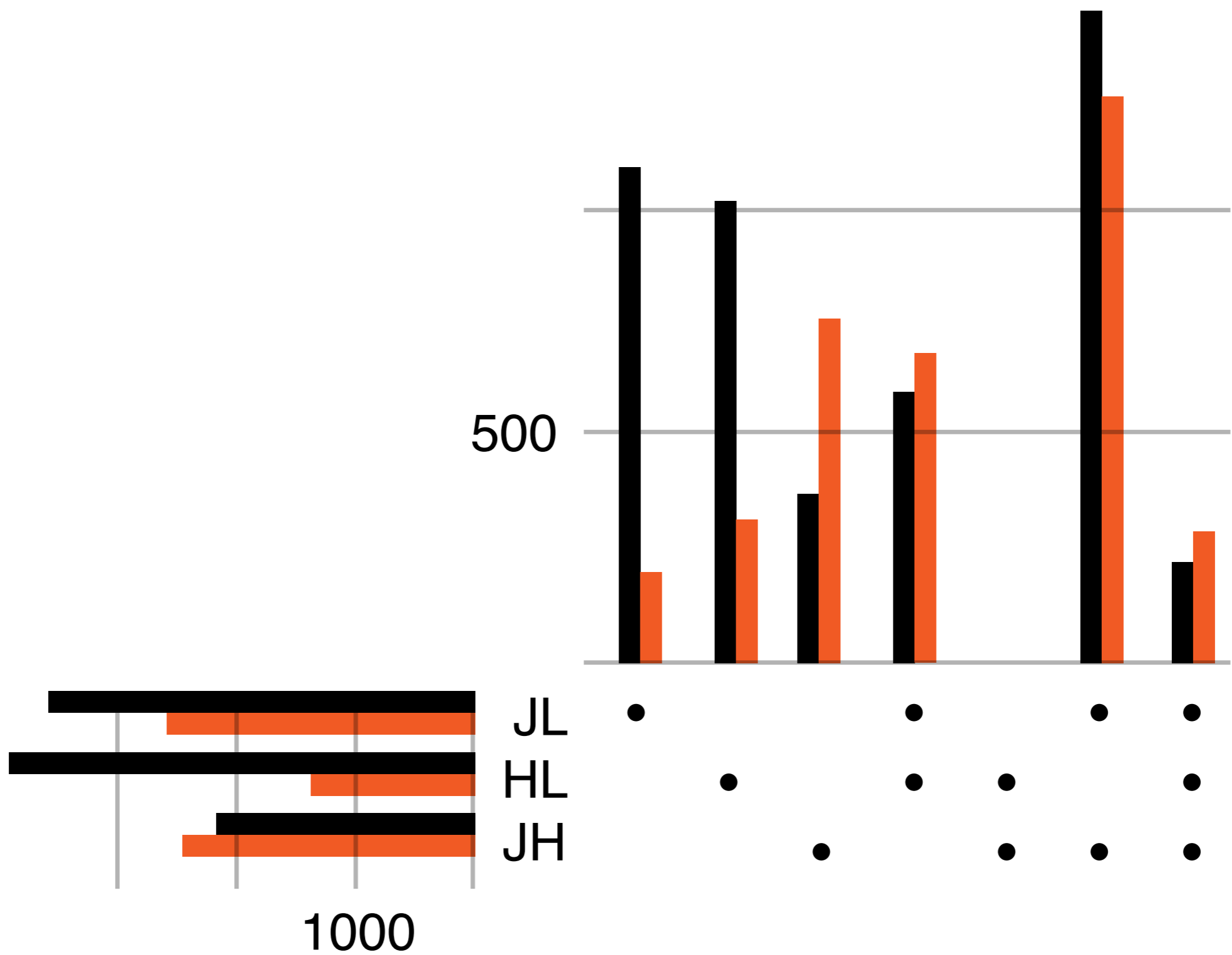
Trends are impossible to draw on a pie chart



up
down

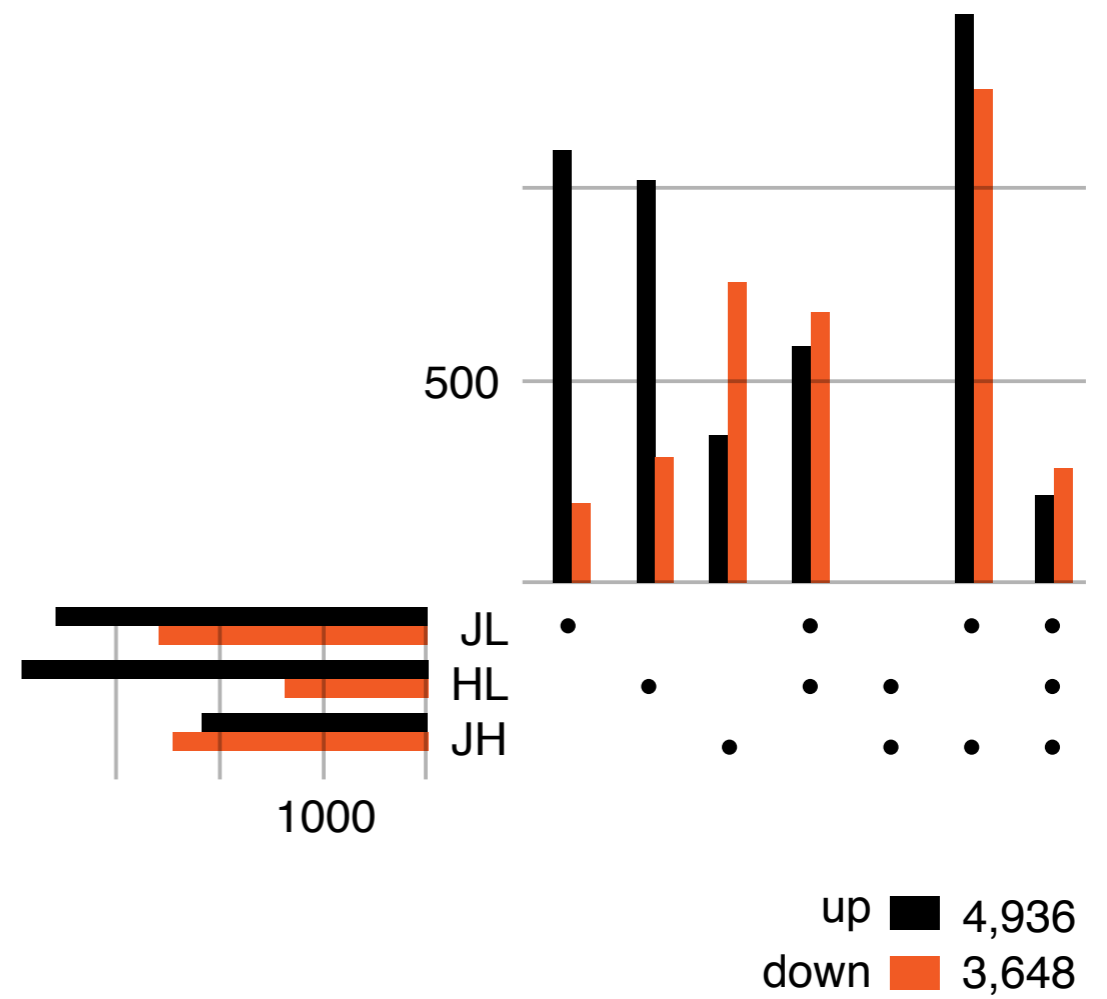
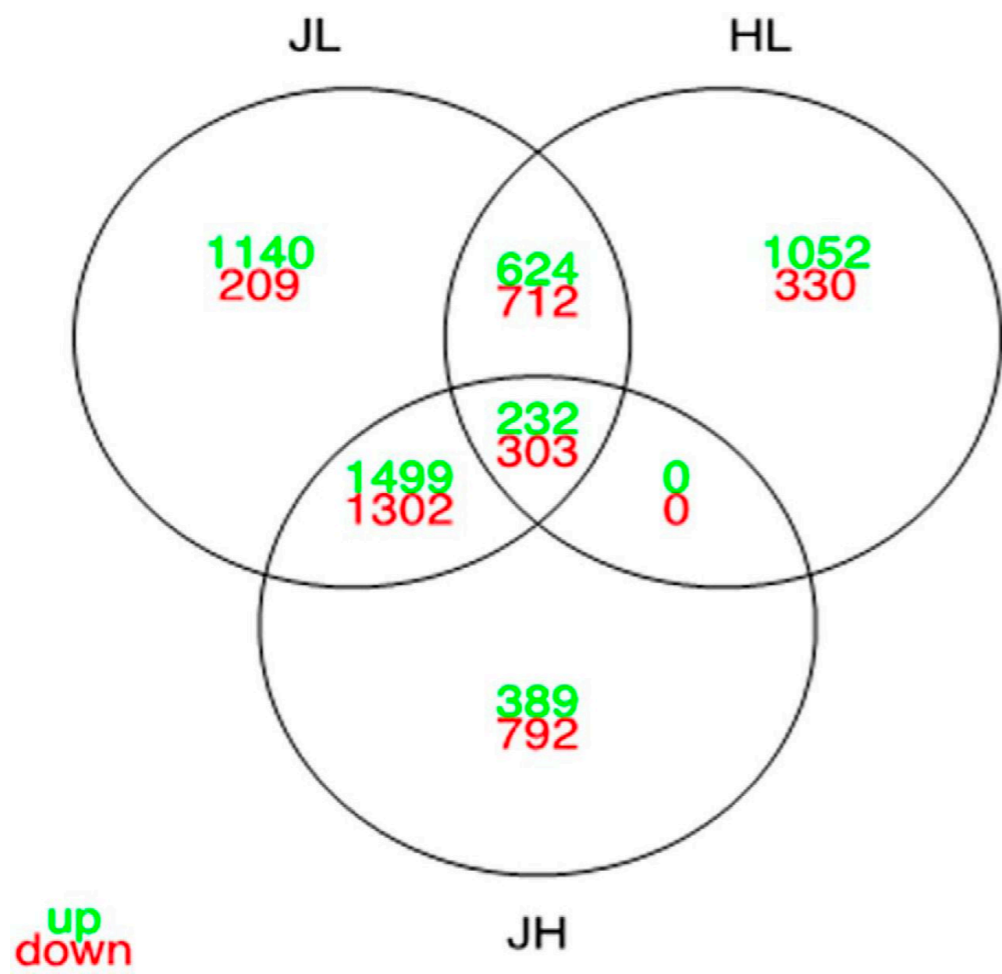
JH

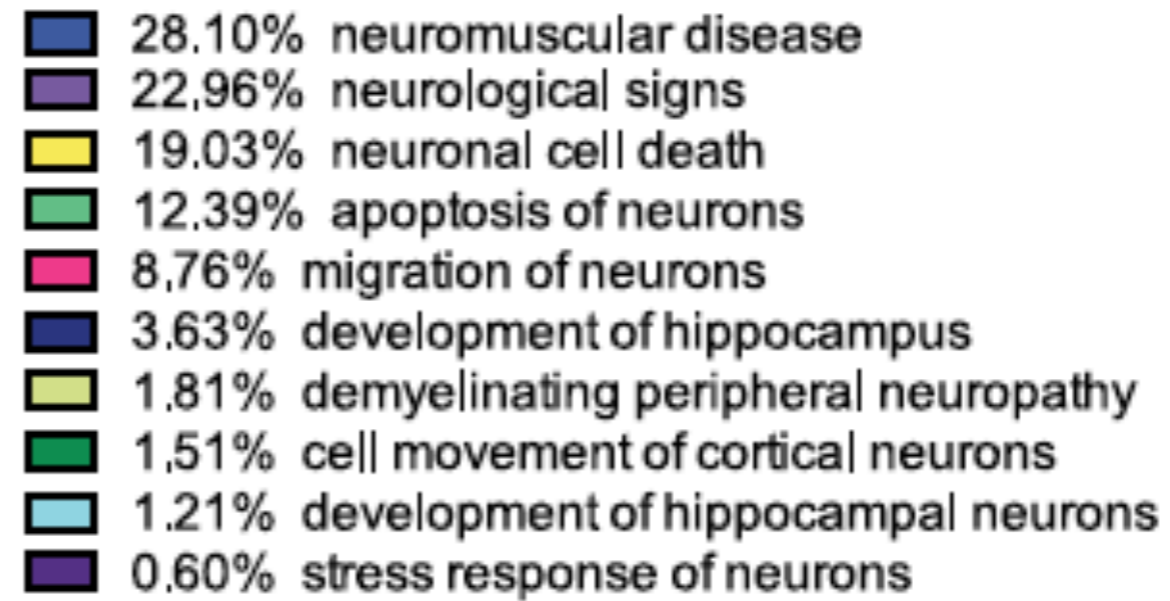
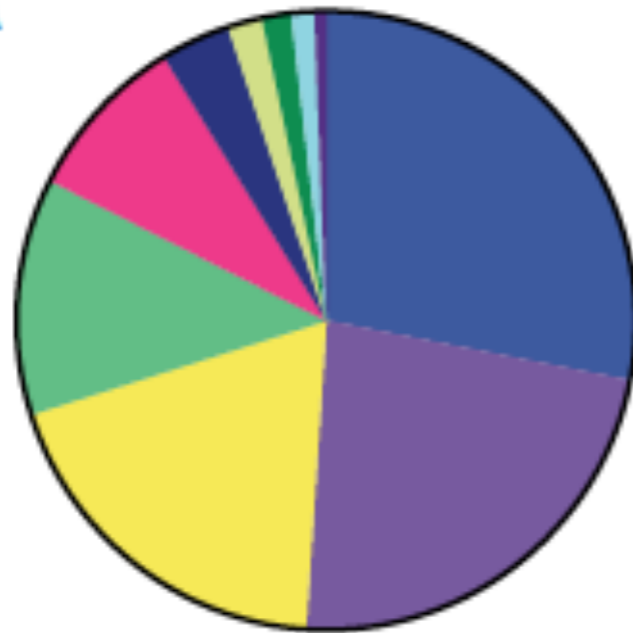
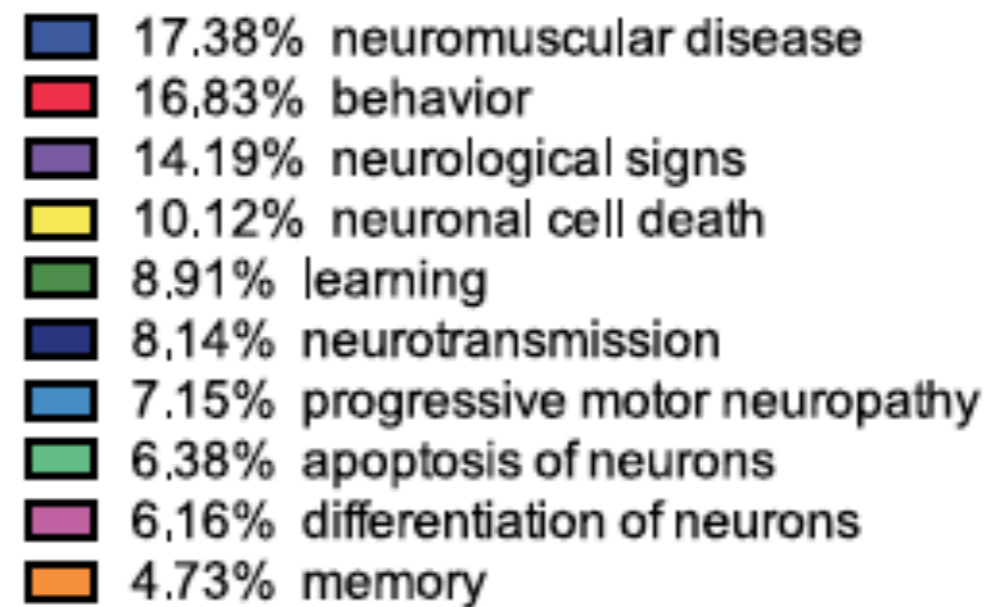
UpSet encoding

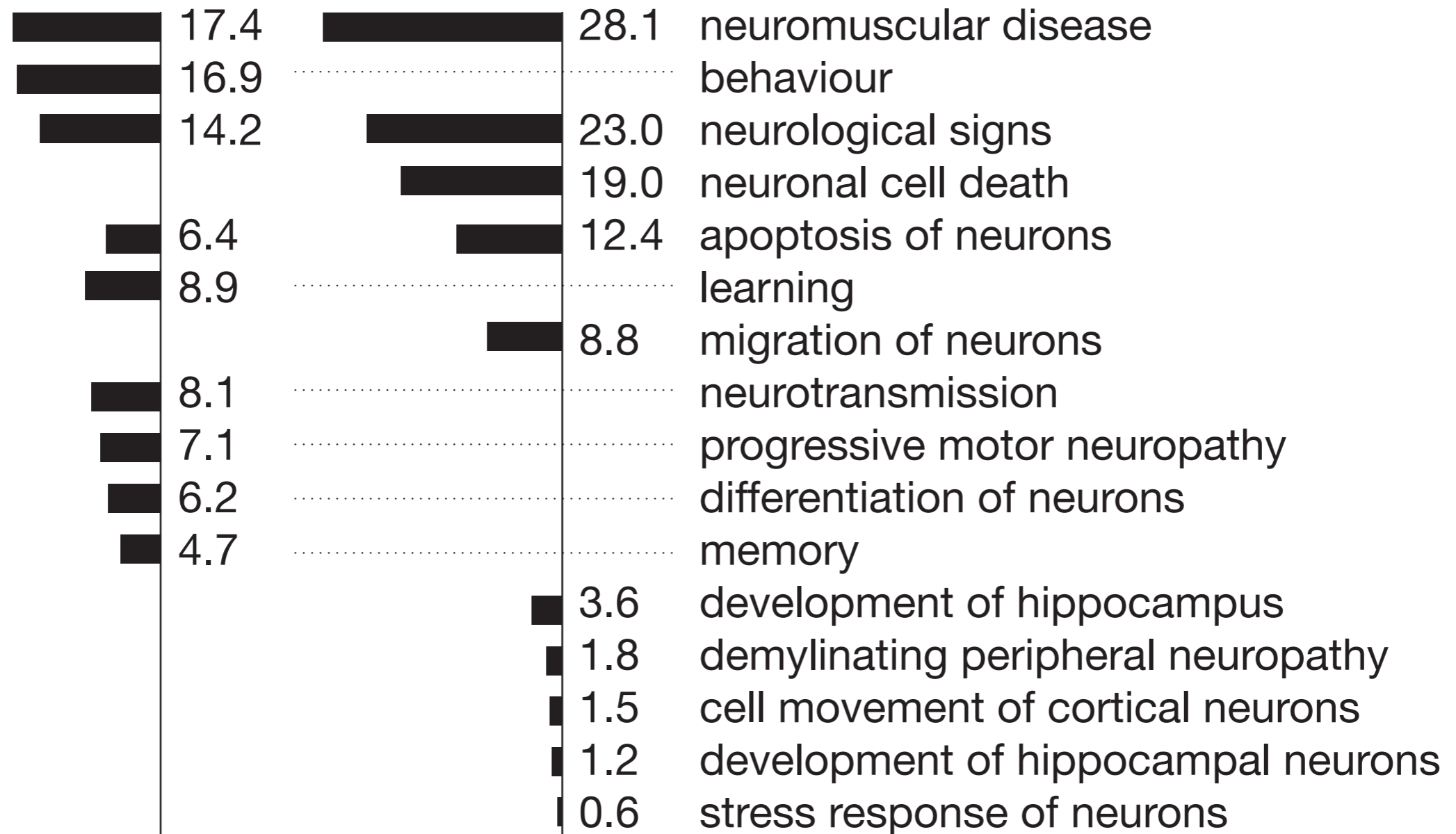


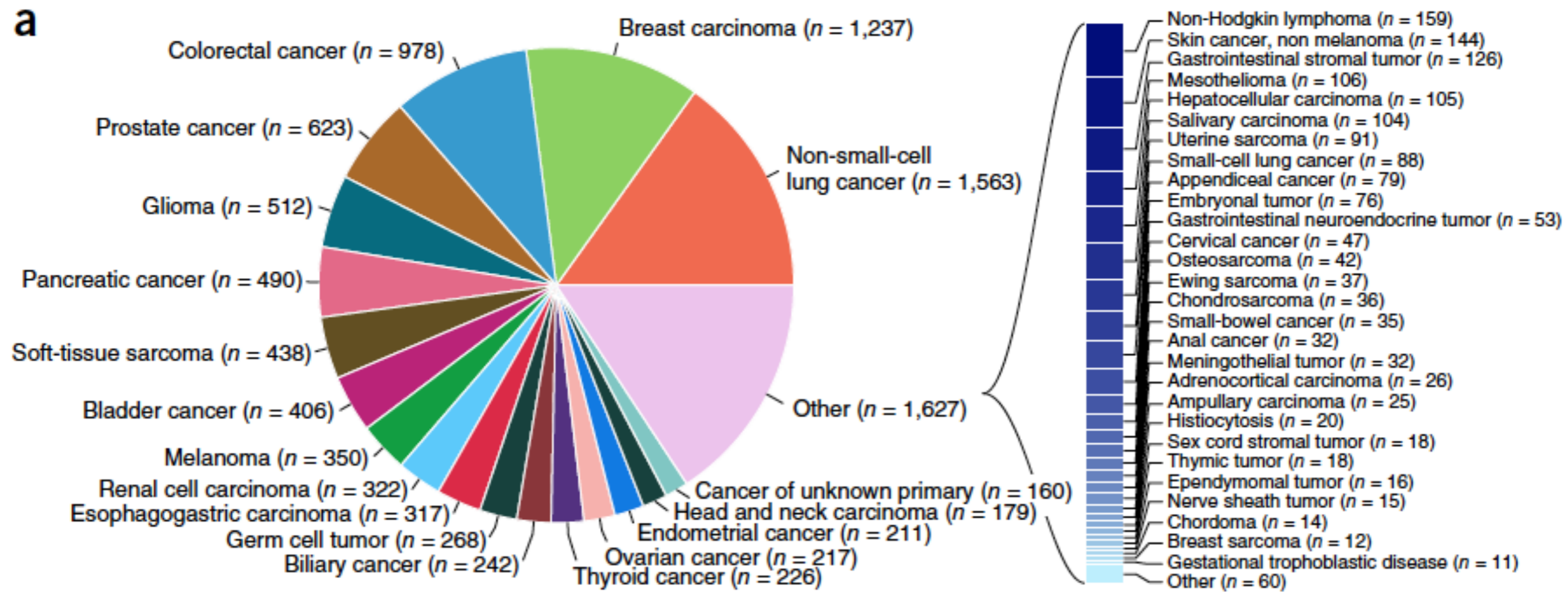
up 4,936

down 3,648



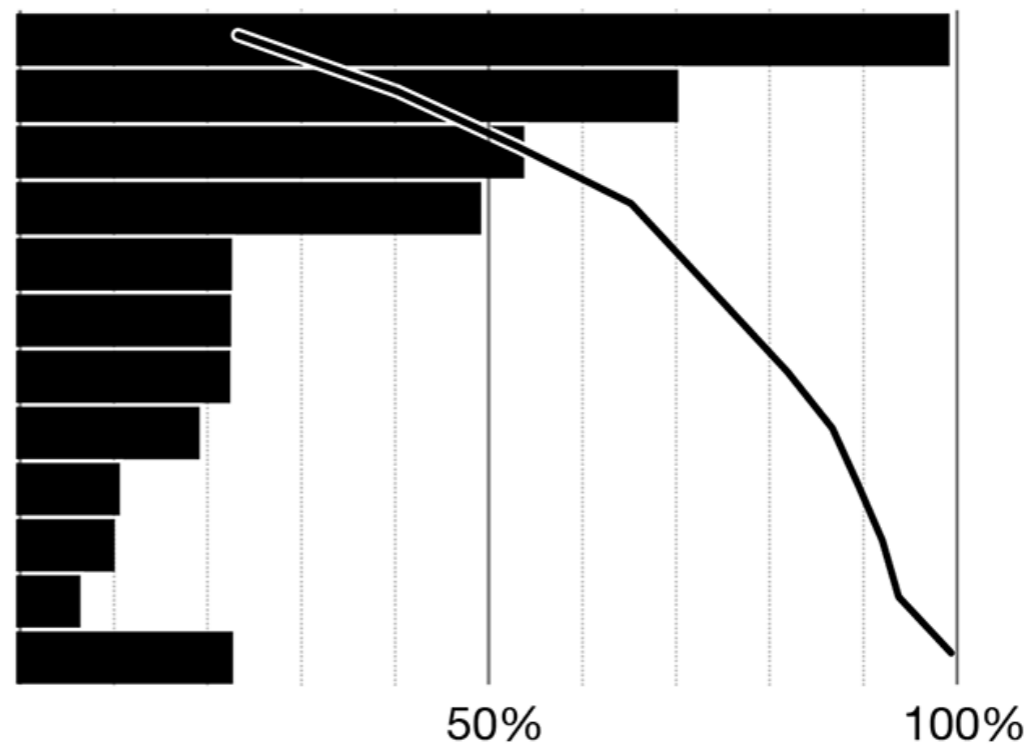
A**Experience****B****Experience + HDAC Inhibition**



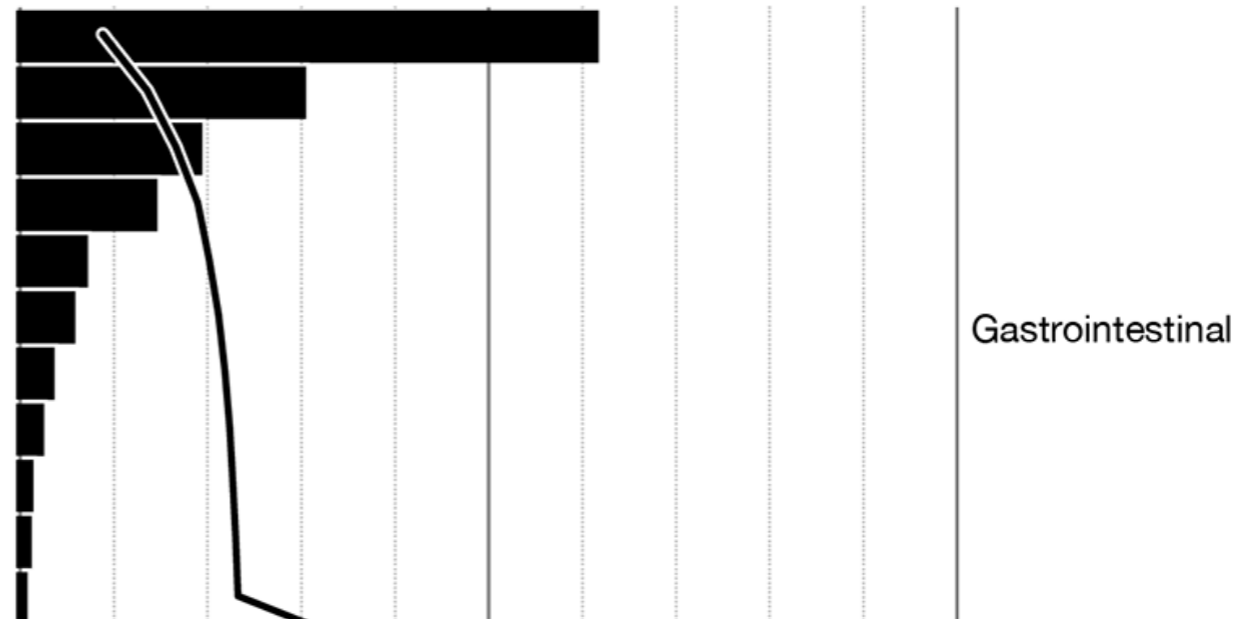
a

CATEGORY
CASES
n %

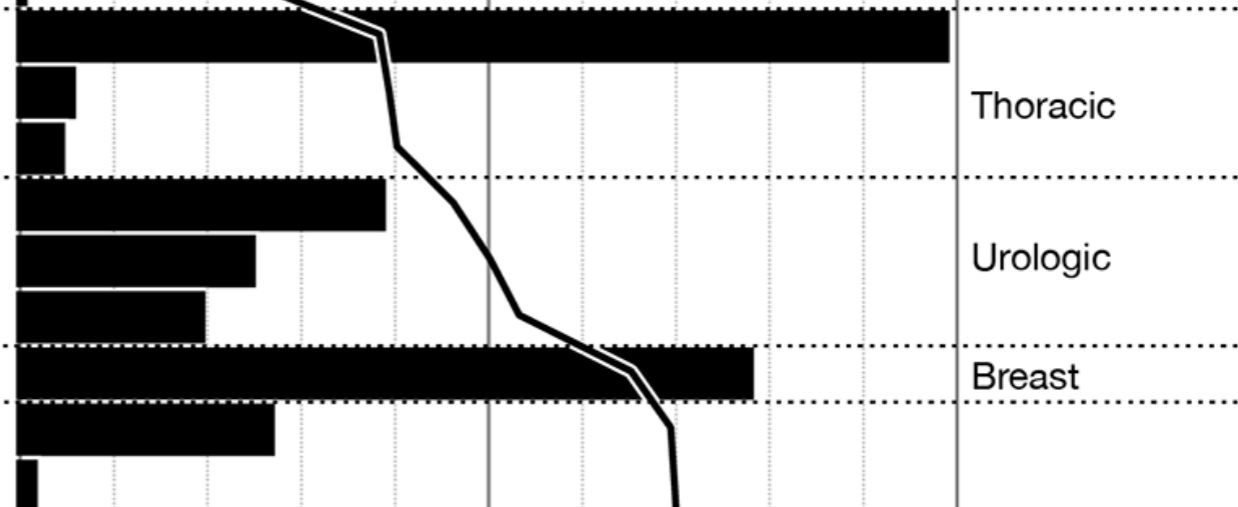
Gastrointestinal	2,473	23.9
Thoracic	1,757	17.0
Urologic	1,351	13.0
Breast	1,237	11.9
Soft Tissue	579	5.6
Gynecologic	577	5.6
CNS	575	5.6
Skin	494	4.8
Head and Neck	283	2.7
Endocrine	270	2.6
Hematologic	179	1.7
Other	582	5.6



Colorectal cancer	978	39.5
Pancreatic cancer	490	19.8
Esophagogastric carcinoma	317	12.8
Biliary cancer	242	9.8
Gastrointestinal stromal tumor	126	5.1
Hepatocellular carcinoma	105	4.2
Appendiceal cancer	70	2.8
Gastrointestinal neuroendocrine tumor	53	2.1
Small-bowel cancer	35	1.4
Anal cancer	32	1.3
Ampullary carcinoma	25	1.0



Non-small-cell lung cancer	1,563	89.0
Mesothelioma	106	6.0
Small-cell lung cancer	88	5.0
Prostate cancer	623	46.1
Bladder cancer	406	30.1
Renal cell carcinoma	322	23.8
Breast carcinoma	1,237	100.0
Soft-tissue sarcoma	438	75.6
Osteosarcoma	42	7.3

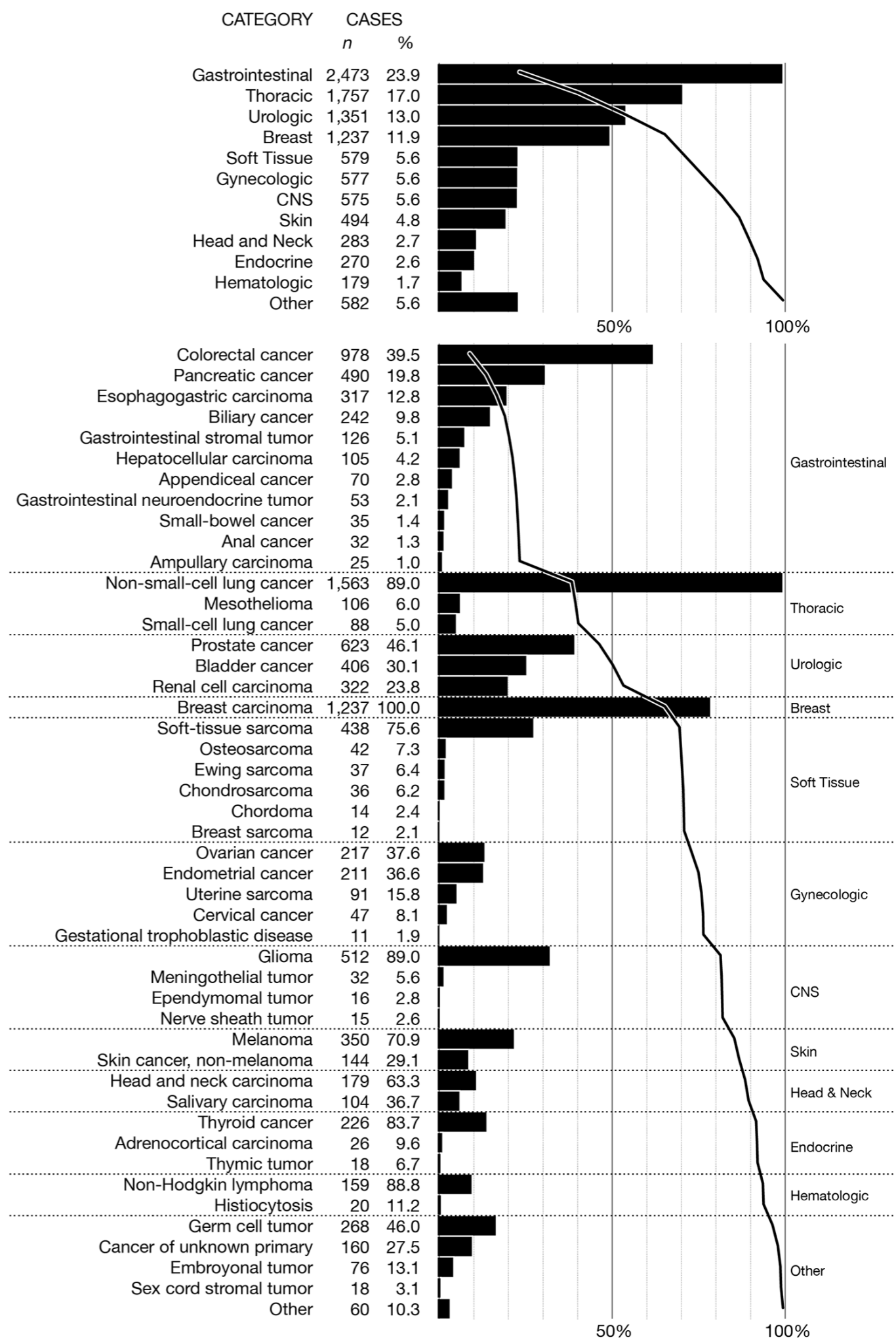


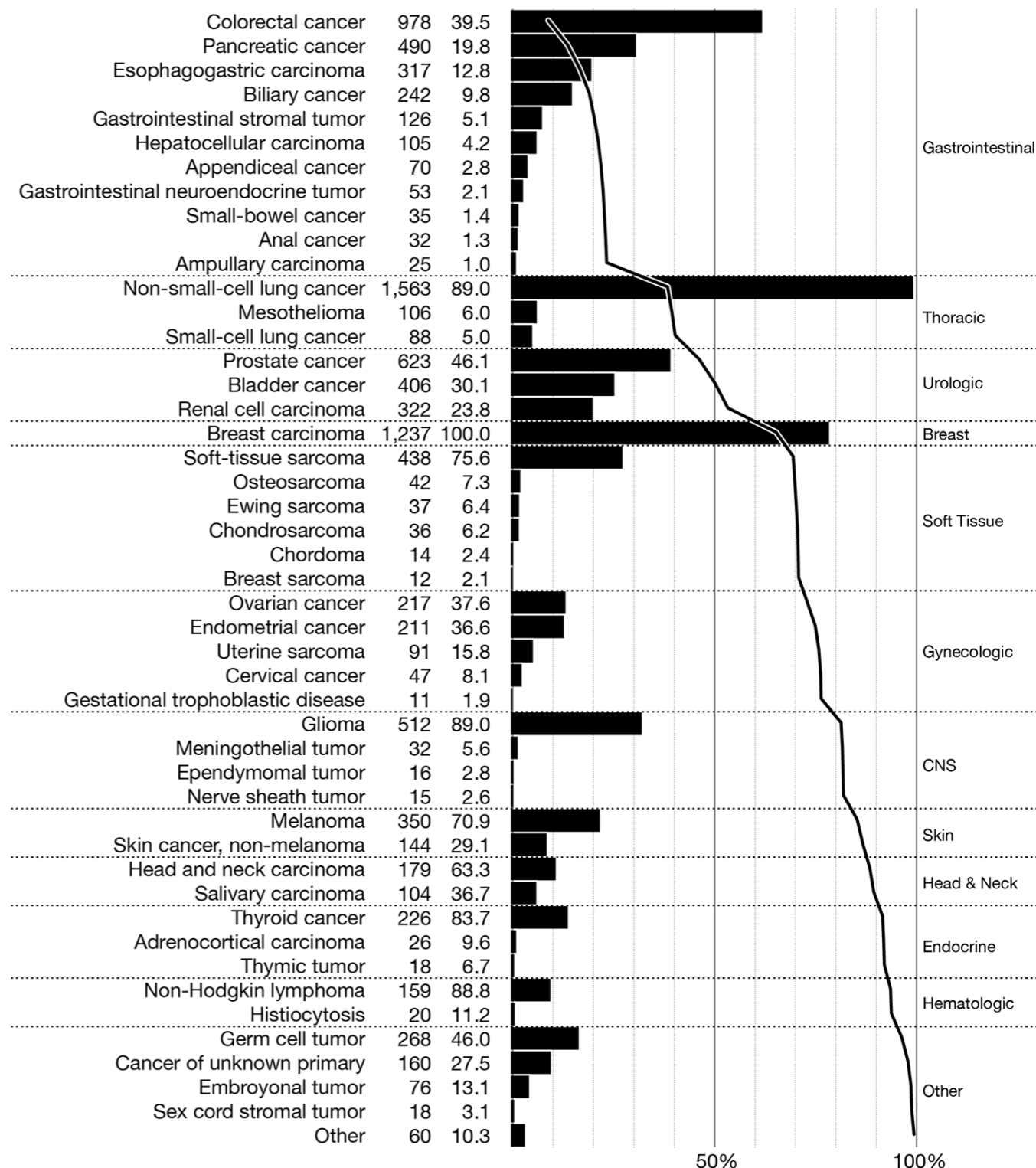
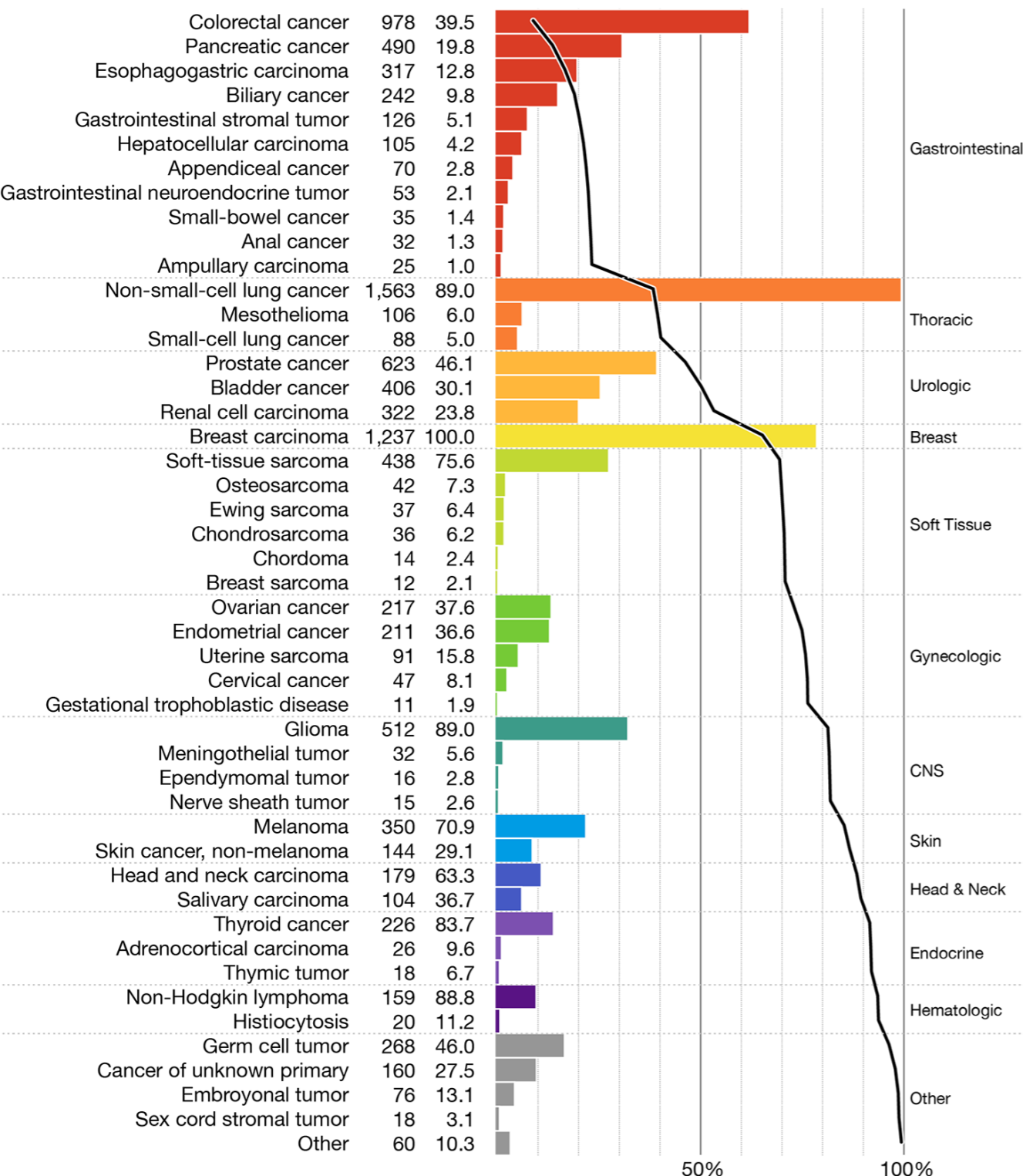
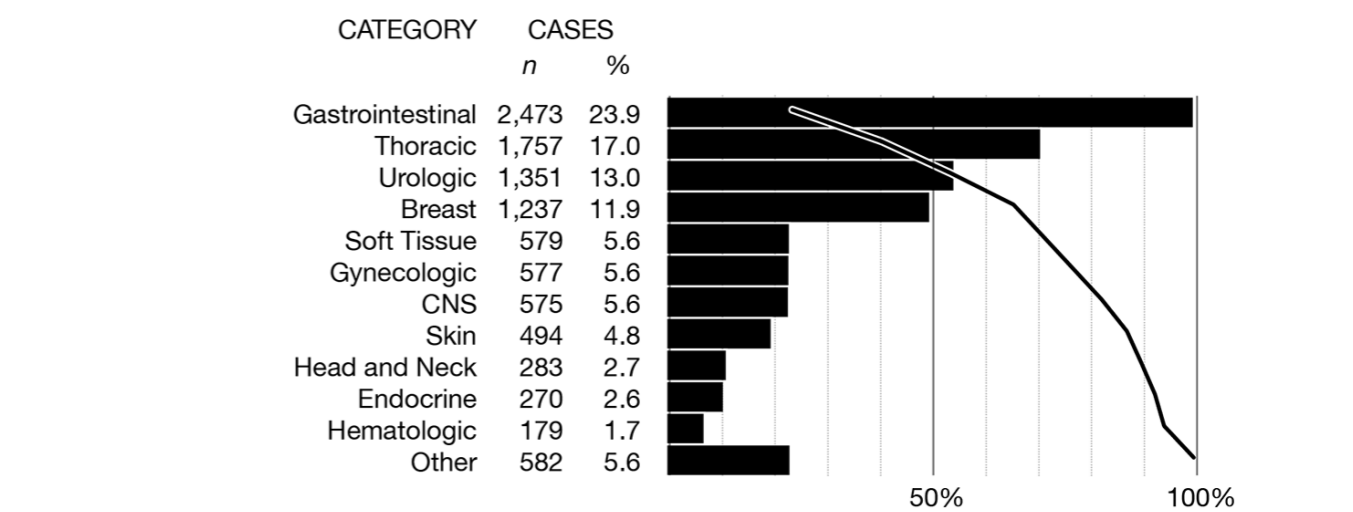
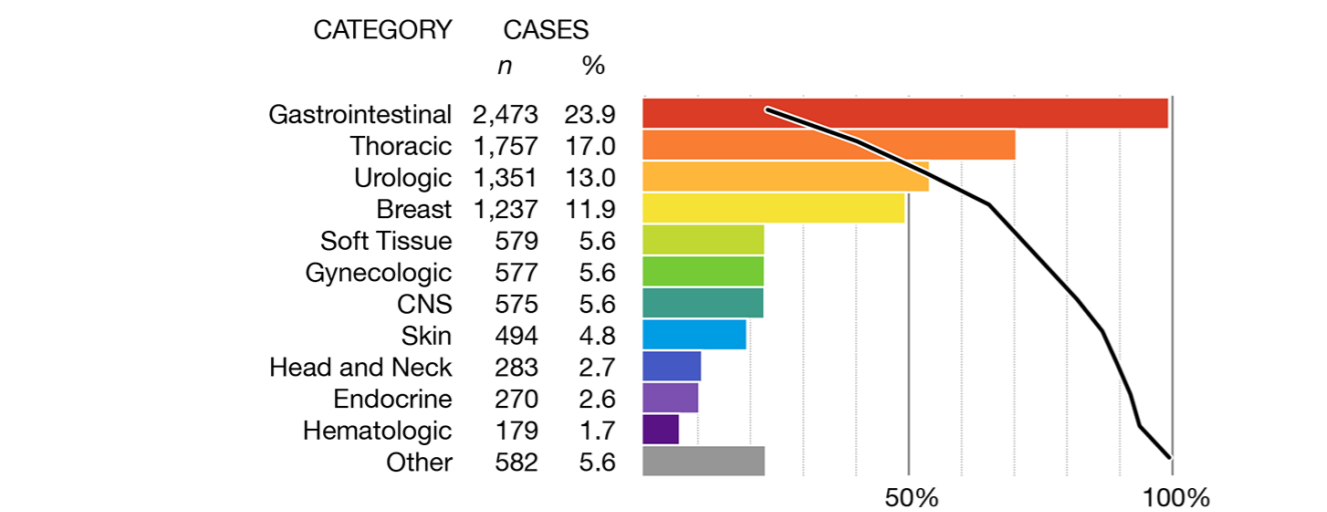
Gastrointestinal

Thoracic

Urologic

Breast





A1: 25 year old male medical student



K1: 14 year old female high school student



A2: 22 year old female psychology student



K2: 15 year old male high school student



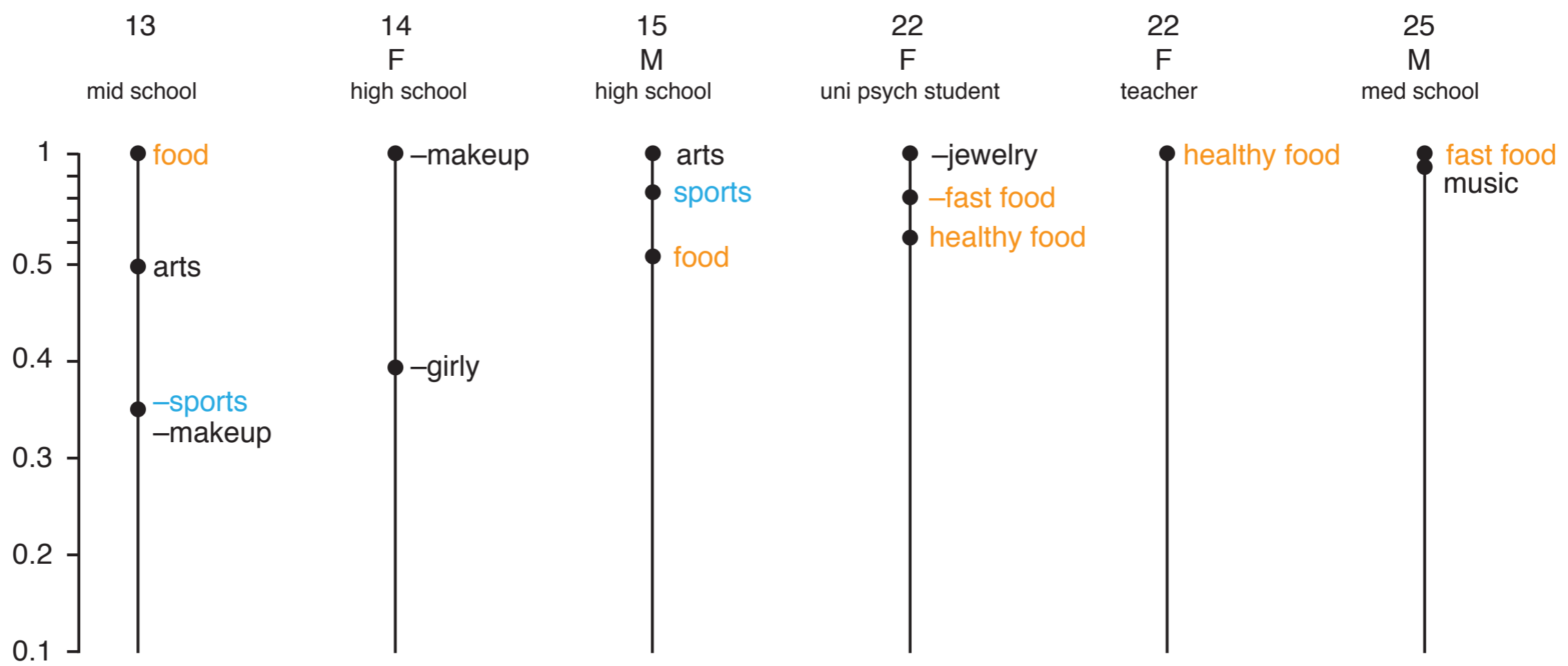
A3: 22 year old female school teacher



K3: 13 year old middle school student

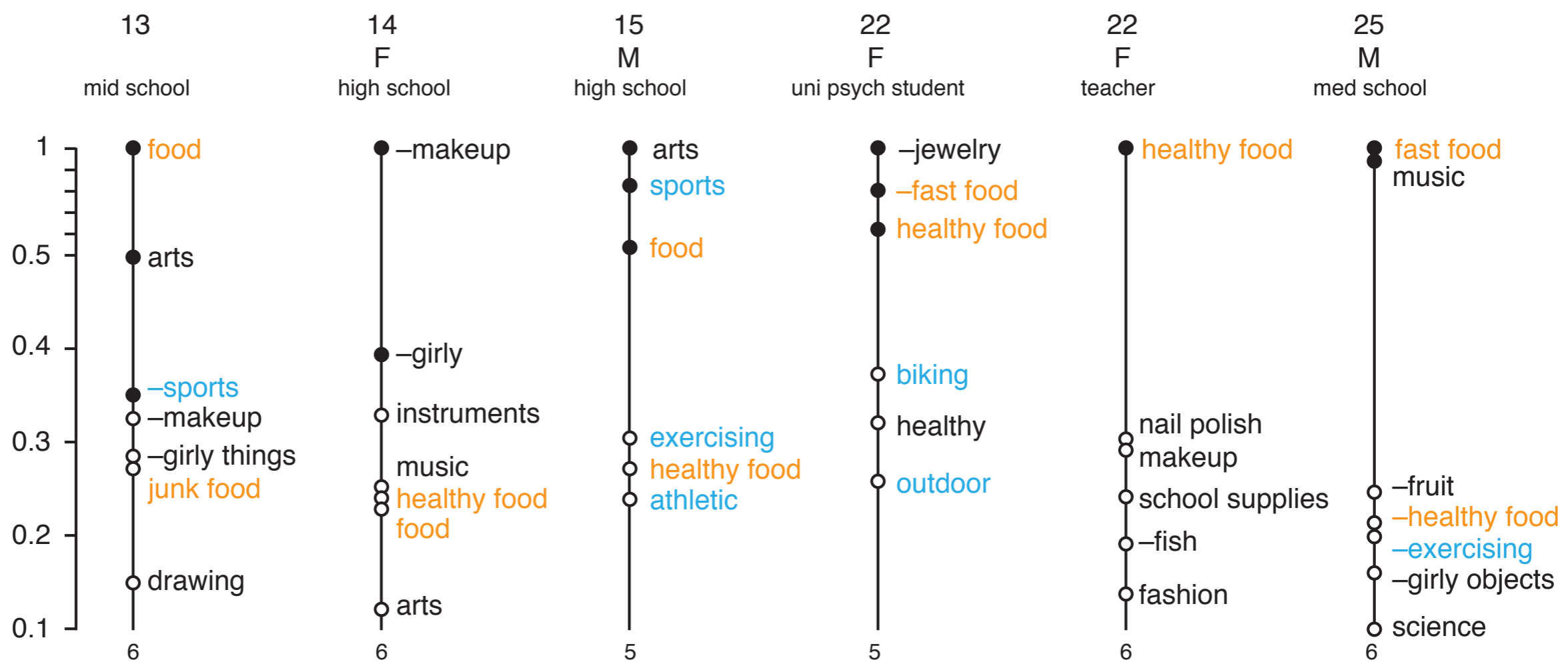


subject age,
gender, status



● in top 50% of terms
-term negation

subject age,
gender, status

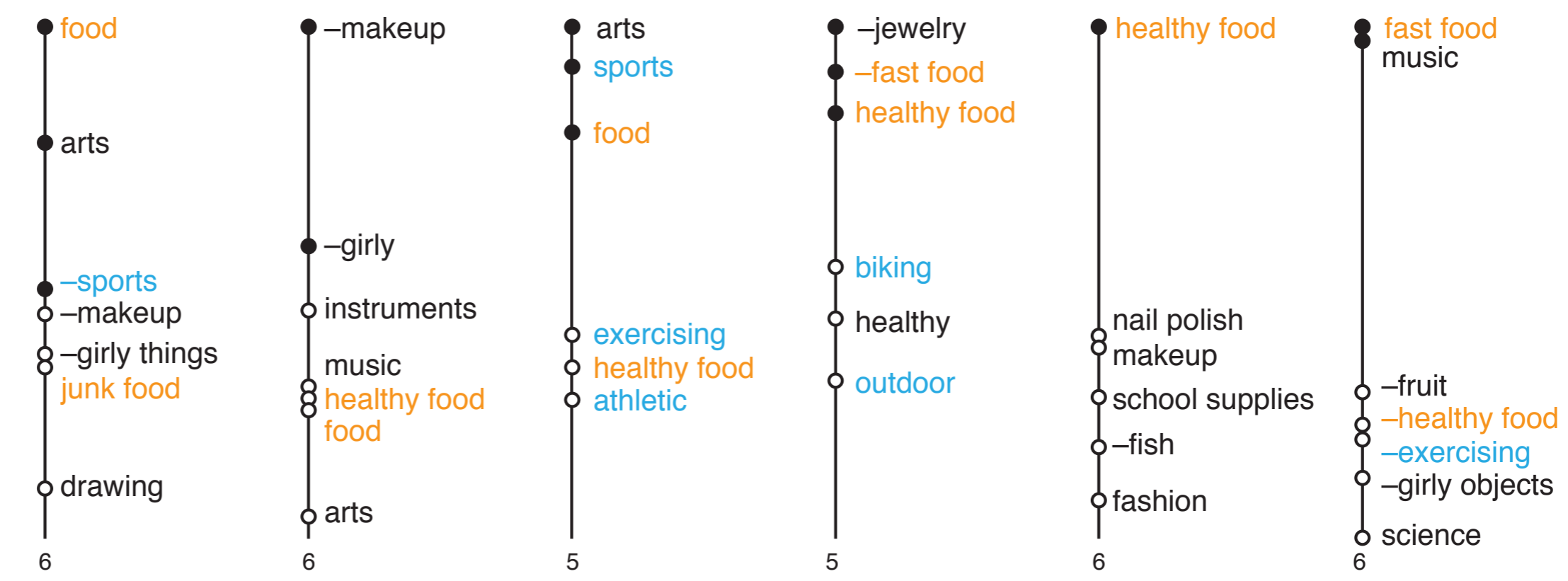
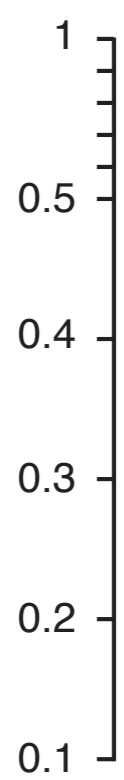


● in top 50% of terms
-term negation

subject age,
gender, status

13 mid school
14 F high school
15 M high school
22 F uni psych student
22 F teacher
25 M med school

normalized
relative
frequency

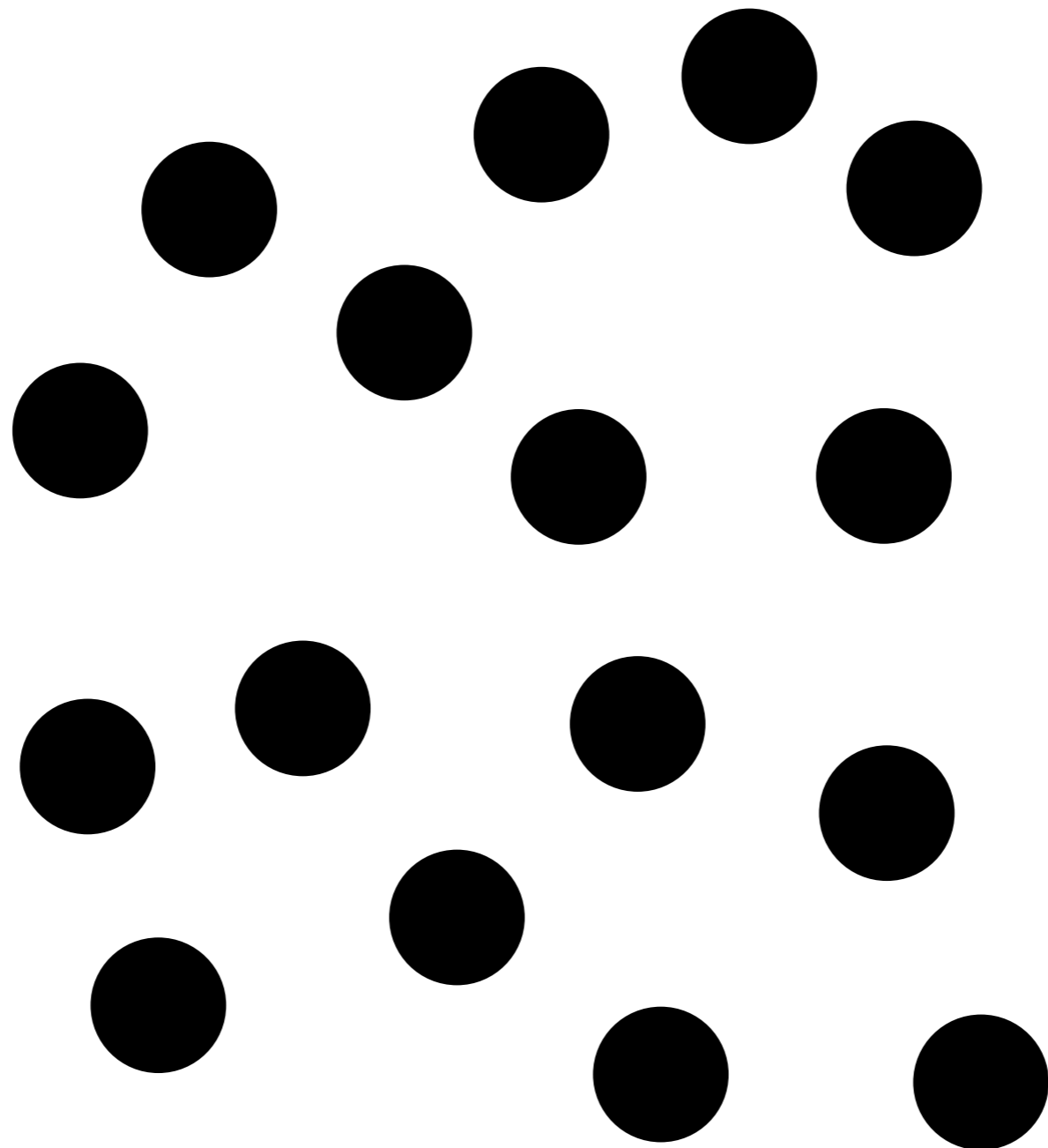


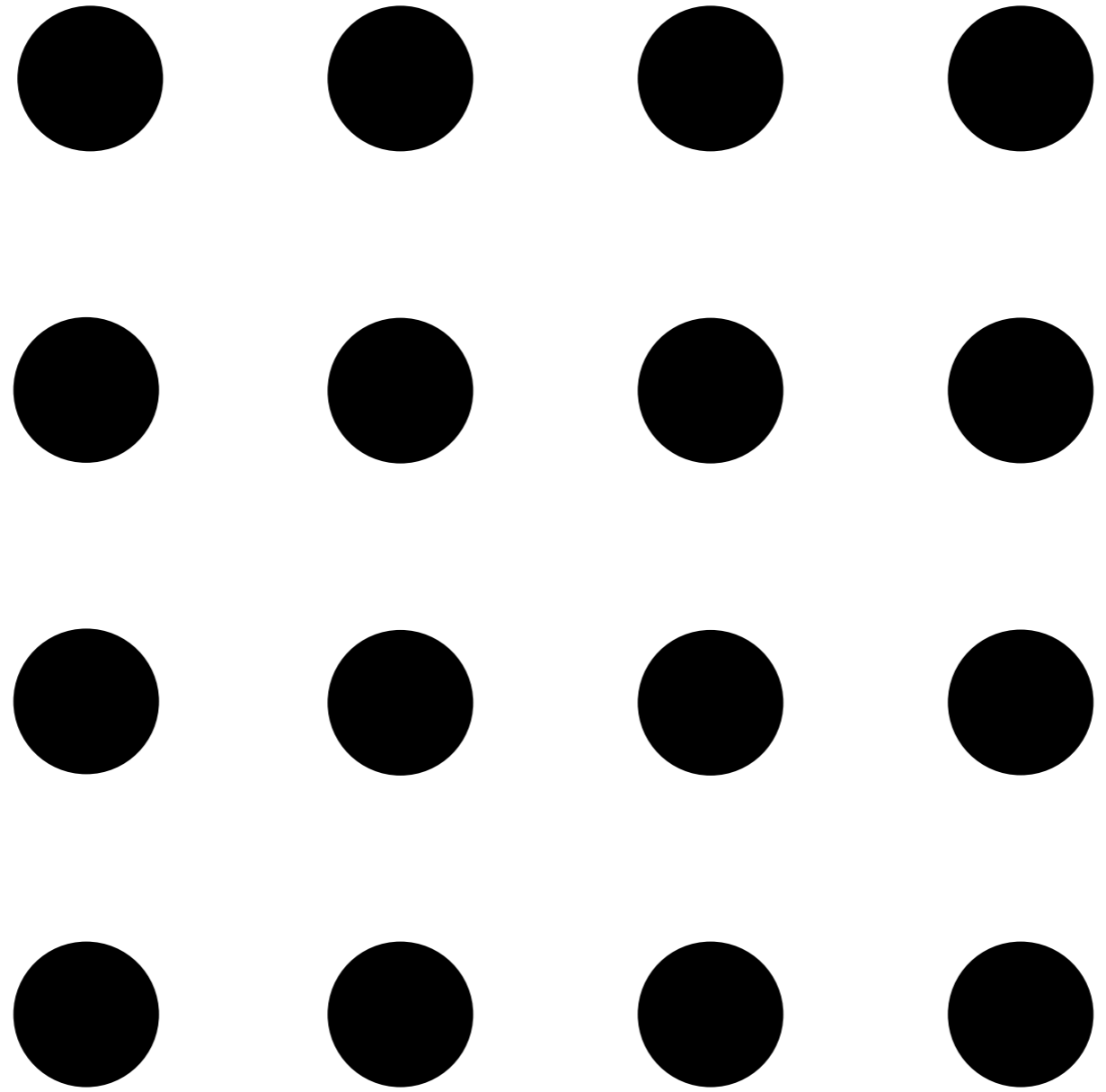
**RARE
TERMS
(<10%)**

COMMON
UNIQUE

Subject	Count	Terms
13	22	-sushi, -athletic, film, games
13	2	nerdy, picky
14	15	sweets, smart, science, tomboy
14	3	clothes, sandwiches
15	11	games, music, outdoors, jewelry
15	4	bikes, chess
22	8	crafts, bikesa, sweets, arts
22	2	technology, quirky
22	6	kiwi, sweets, creative food, accessories
22	1	guilty pleasures
25	2	sports, unhealthy, instruments, outdoor
25	1	sunglasses

● in top 50% of terms
-term negation





abcd

abcd

abcd

align

and

space

ruthlessly

abcd

abcd **or else**

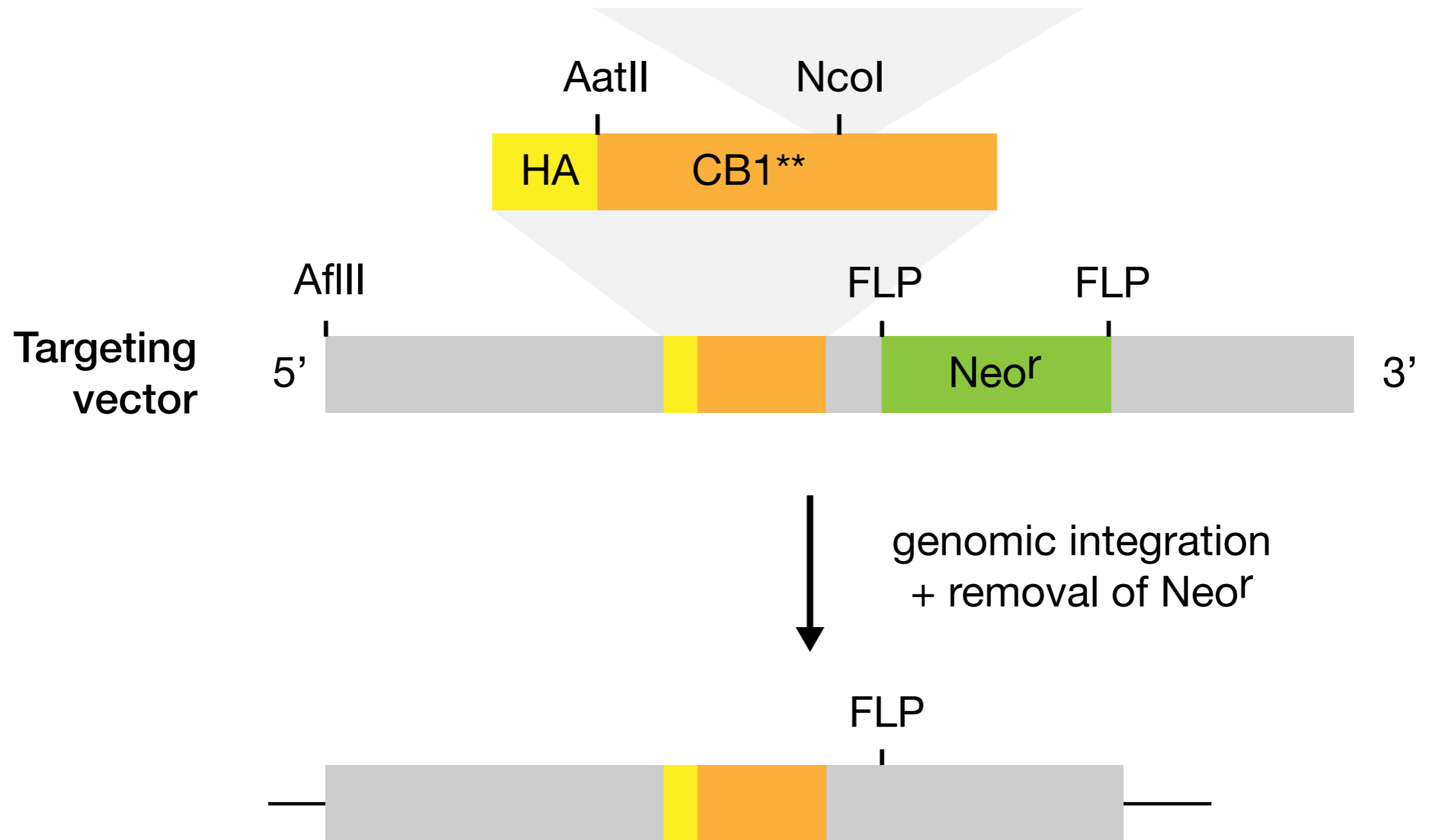
abcd

abcd

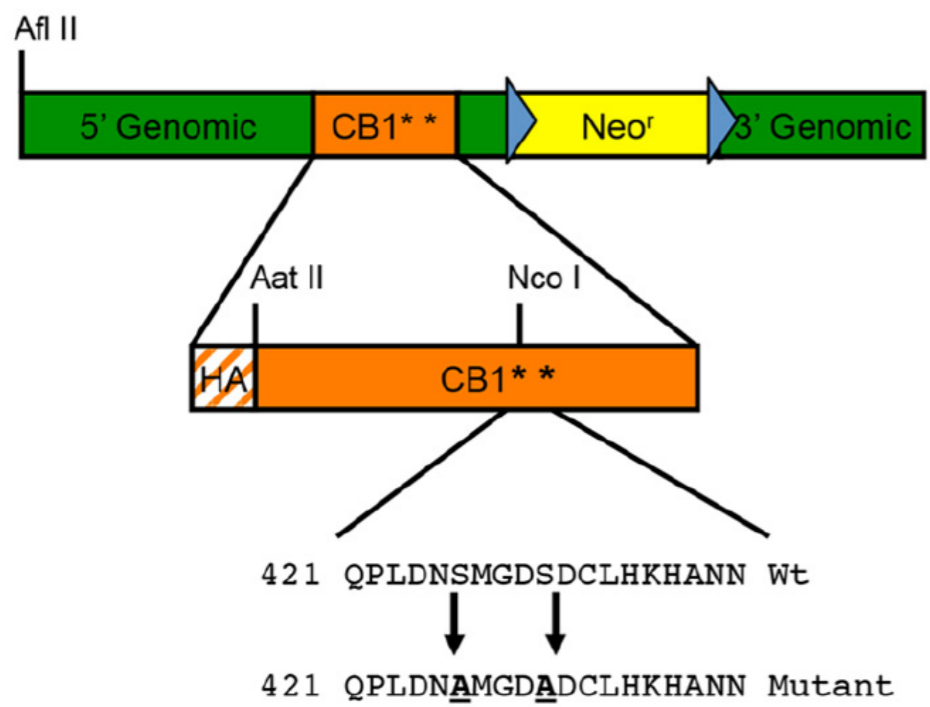
abcd

abcd

421 QPLDNSMGDSDCLHKHANN Wt
QPLDNAMGDADCLHKHANN Mutant



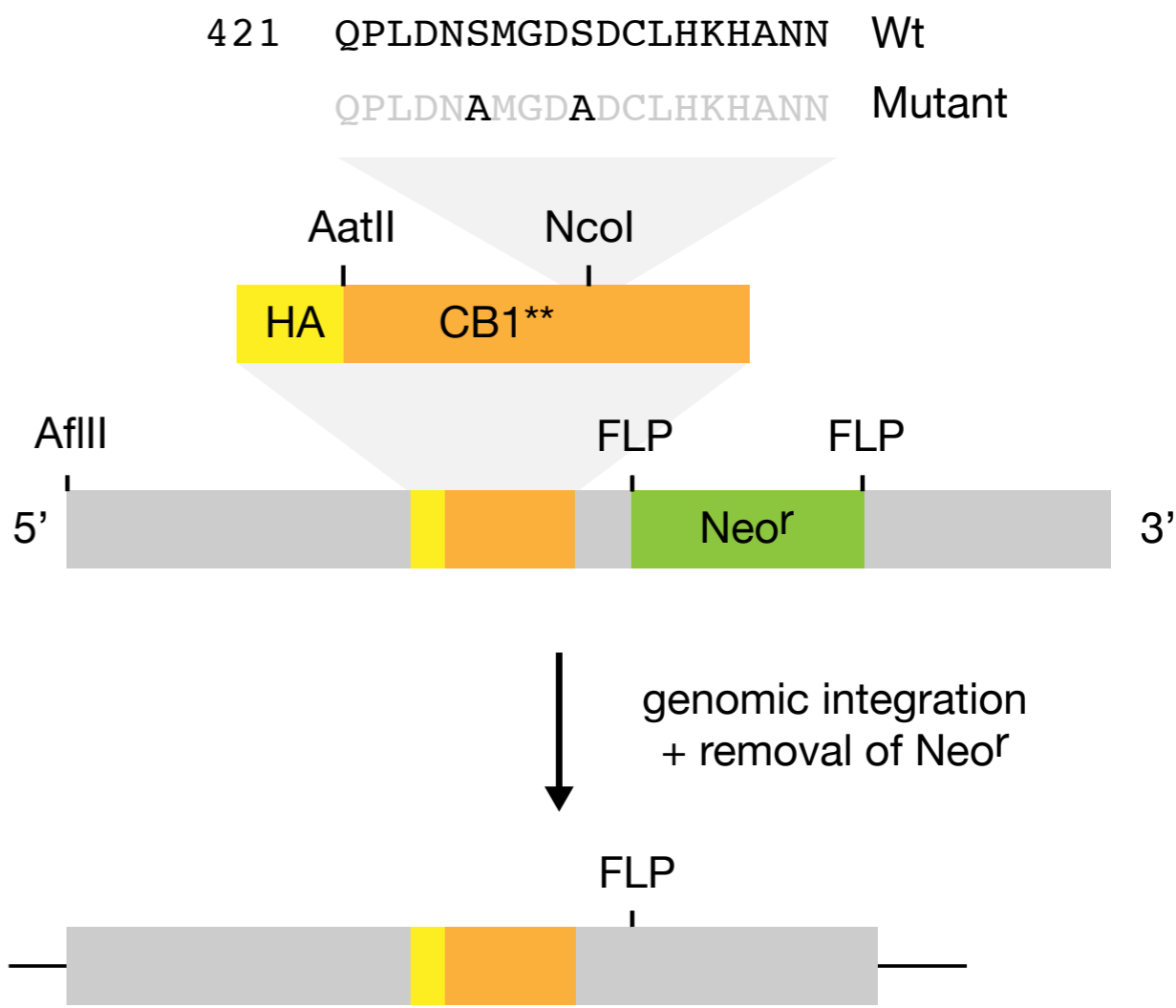
A Targeting vector



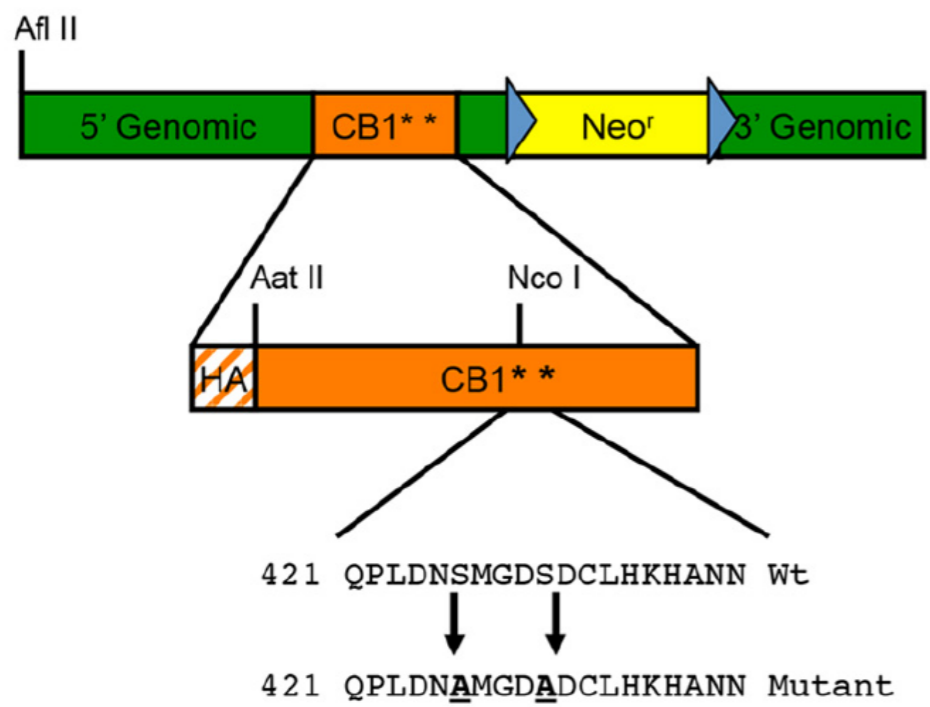
Genomic integration after removal of neo^r



Targeting vector



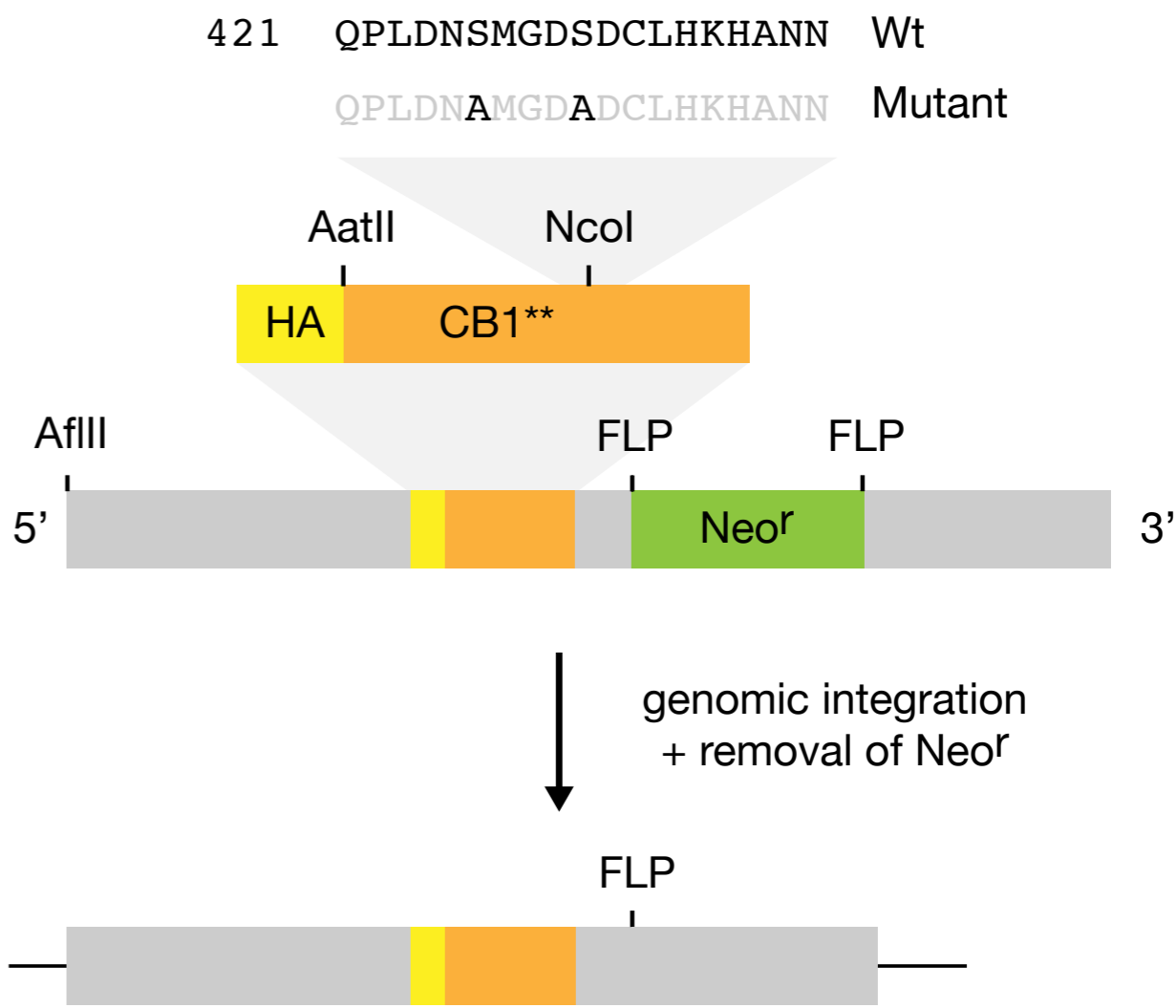
A Targeting vector



Genomic integration after removal of neo^r



Targeting vector



10

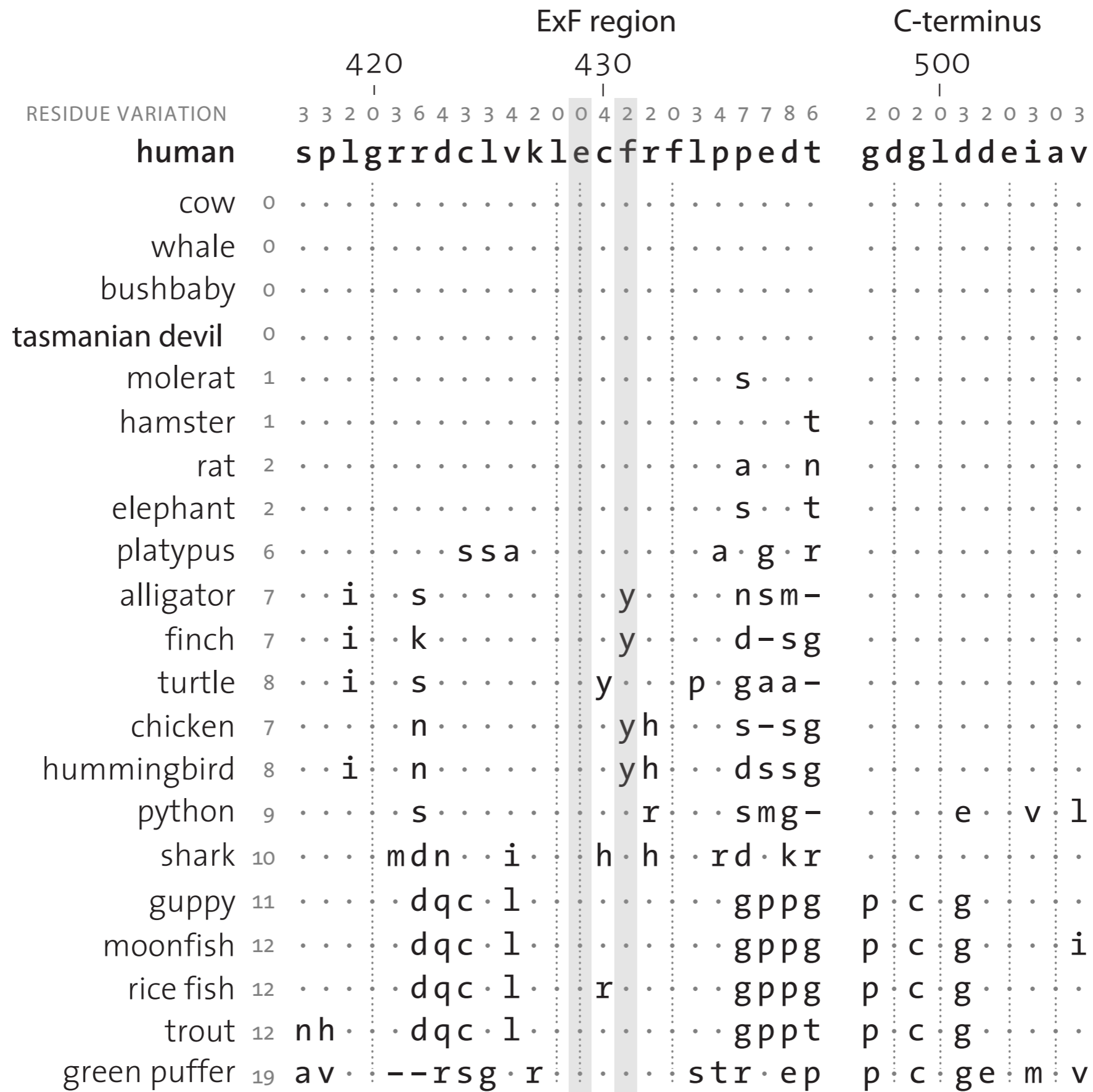
34

H. Sapiens	RQRSL S TSGES	DDIKK S YRKLA
M. Musculus	RQRSL S TSGES	DDIKK S YRKLA
R. Norvegicus	RQRSL S TSGES	DDIKK S YRKLA
G. Gallus	RQRSL S TSGES	DDIKK S YRKLA
X. Laevis	RQRSL S TSGES	DDIKK C YRKLA
D. Rerio	RQRSL S TSGES	DDIKK S YRKLA
D. melanogaster	DKRKL S TSGDS	DDIKK T YRKLA

	10	34
H. Sapiens	RQRSL S TSGES	DDIKK S YRKLA
M. Musculus	RQRSL S TSGES	DDIKK S YRKLA
R. Norvegicus	RQRSL S TSGES	DDIKK S YRKLA
G. Gallus	RQRSL S TSGES	DDIKK S YRKLA
X. Laevis	RQRSL S TSGES	DDIKK C YRKLA
D. Rerio	RQRSL S TSGES	DDIKK S YRKLA
D. melanogaster	DKRKL S TSGDS	DDIKK T YRKLA

	RQRSL S TSGES	DDIKK S YRKLA
<i>H. sapiens</i>	· · · · ·	· · · · ·
<i>M. musculus</i>	· · · · ·	· · · · ·
<i>R. norvegicus</i>	· · · · ·	· · · · ·
<i>G. gallus</i>	· · · · ·	· · · · ·
<i>D. rerio</i>	· · · · ·	· · · · ·
<i>X. laevis</i>	· · · · ·	· · · · C · · · · ·
<i>D. melanogaster</i>	DK · K · · · · · D ·	· · · · · T · · · · ·

<u>Species</u> (human numbering)	420	<u>ExF region</u> 430	<u>C-terminus</u> 500
GreenPuffer	avlg--rsgvrlecfrfstreep		pdclgeemav
Python	splgrsdclvklecfhflpsmg-		gdsledeval
Platypus	splgrrdssaklecfrflapgdr		gdslddeiaav
Shark	splgmdncliklehfhlrdekr		gdcllddeiaav
Tasmanian Devil	splgrrdclvklecfrrflppgdt		gdslddeiaav
Molerat	splgrrdclvklecfrrflpsedt		gdslddeiaav
BushBaby	splgrrdclvklecfrrflppedt		gdglddeiaav
Human	splgrrdclvklecfrrflppedt		gdglddeiaav
Cow	splgrrdclvklecfrrflppedt		gdslddeiaav
Whale	splgrrdclvklecfrrflppedt		gdslddeiaav
Rat	splgrrdclvklecfrrflpaedn		gdslddeiaav
Hamster	splgrrdclvklecfrrflppedt		gdslddeiaav
Elephant	splgrrdclvklecfrrflpsedt		gdslddeiaav
Turtle	spigrsdclvkleyfrfppgaa-		gdslddeiaav
Alligator	spigrsdclvklecyrrflpsm-		gdsledeiaav
Finch	spigrkdclvklecyrrflpd-sg		gdsledeiaav
Hummingbird	spigrndclvklecyhflpdssg		gdslddeiaav
Chicken	spigrndclvklecyhflps-sg		gdsledeiaav
Trout	nhlgrdqcllklecfrflpgppt		pdclgdeiaav
Rice Fish	splgrdqcllklerrfrflpgppg		pdclgdeiaav
Guppy	splgrdqcllklecfrflpgppg		pdclgdeiai
Moonfish	splgrdqcllklecfrflpgppg		pdclgdeiai
	:*	:** ::*	* * :*:*:

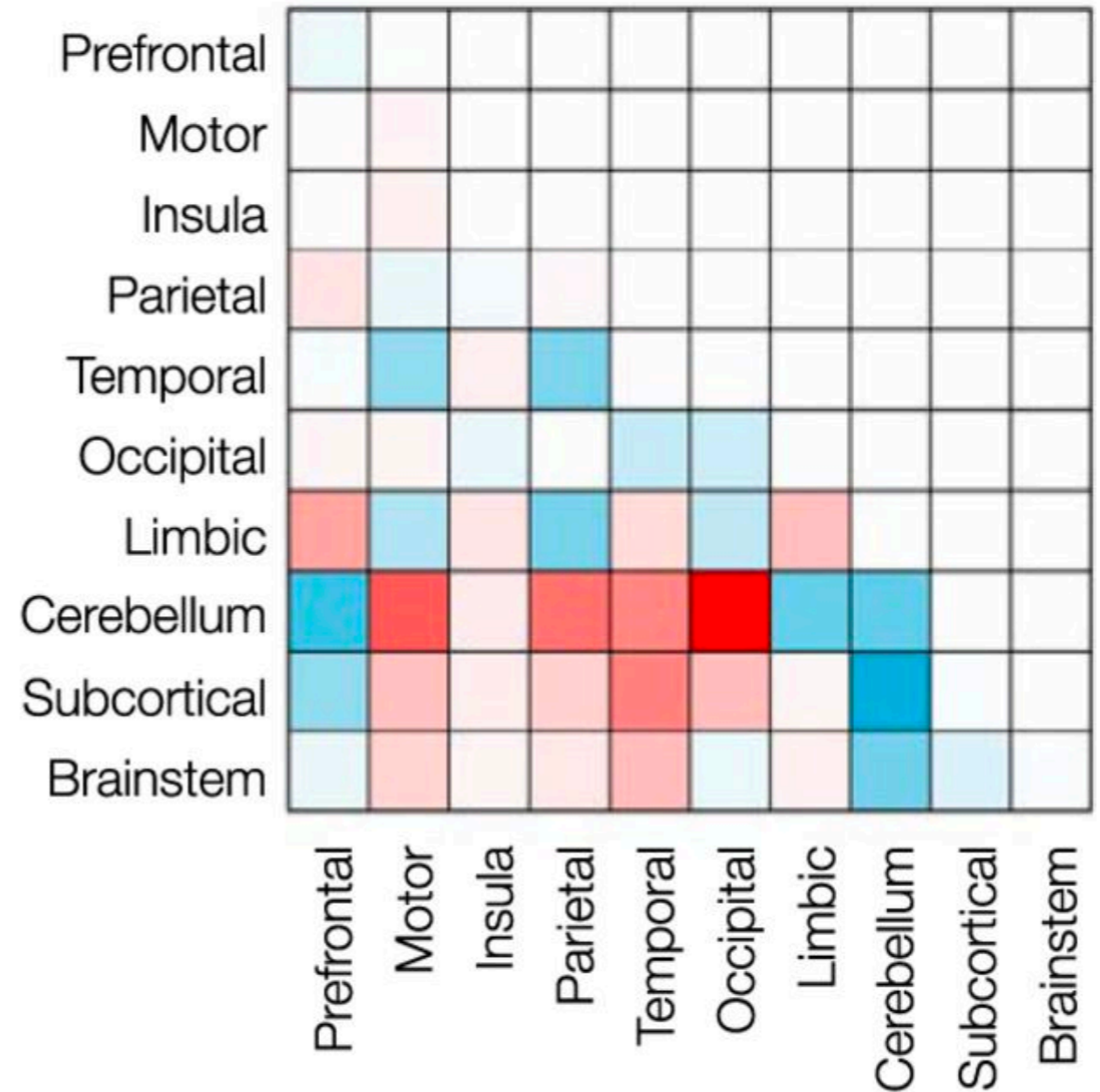
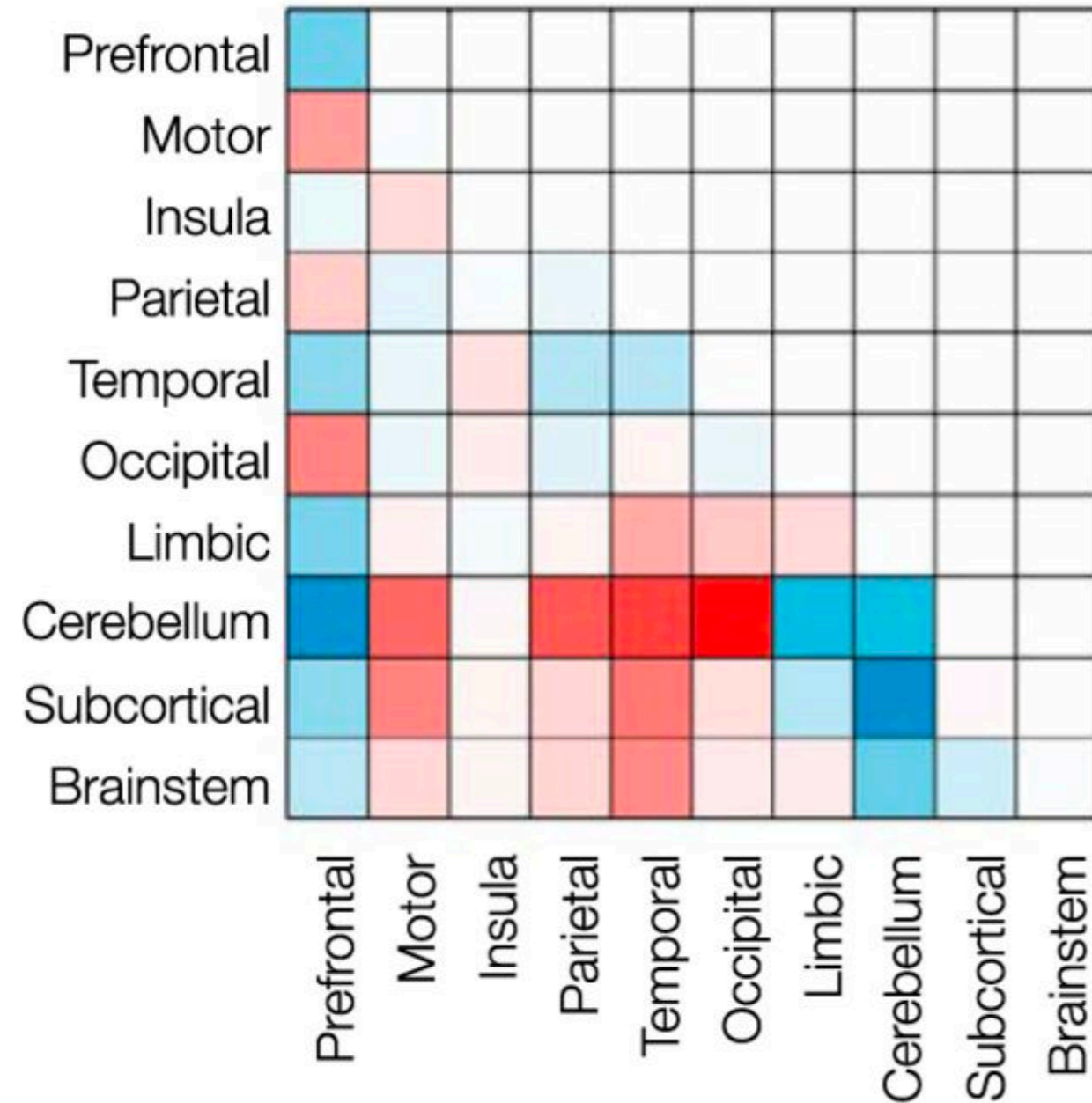


good job showing differences in the data

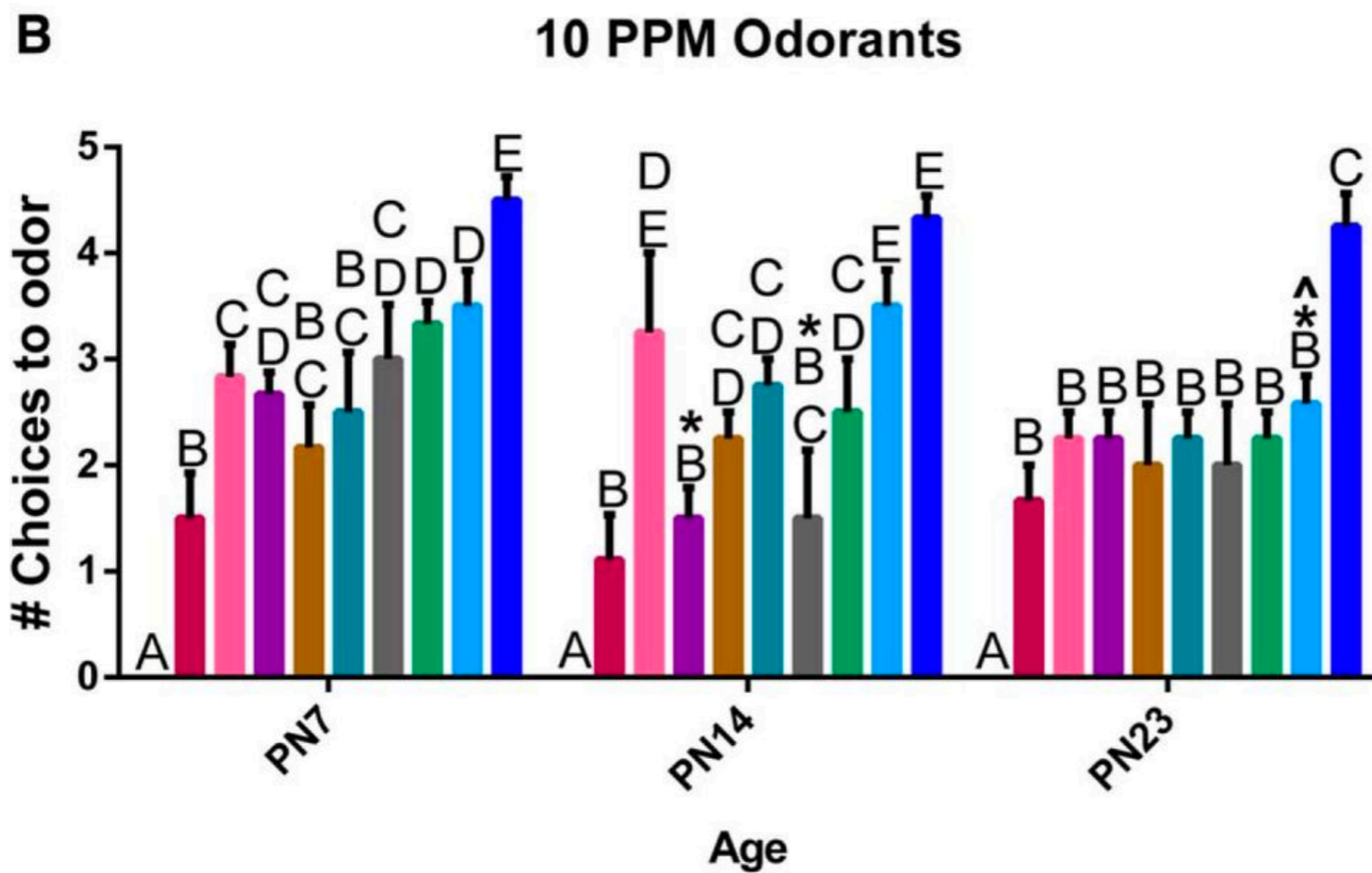
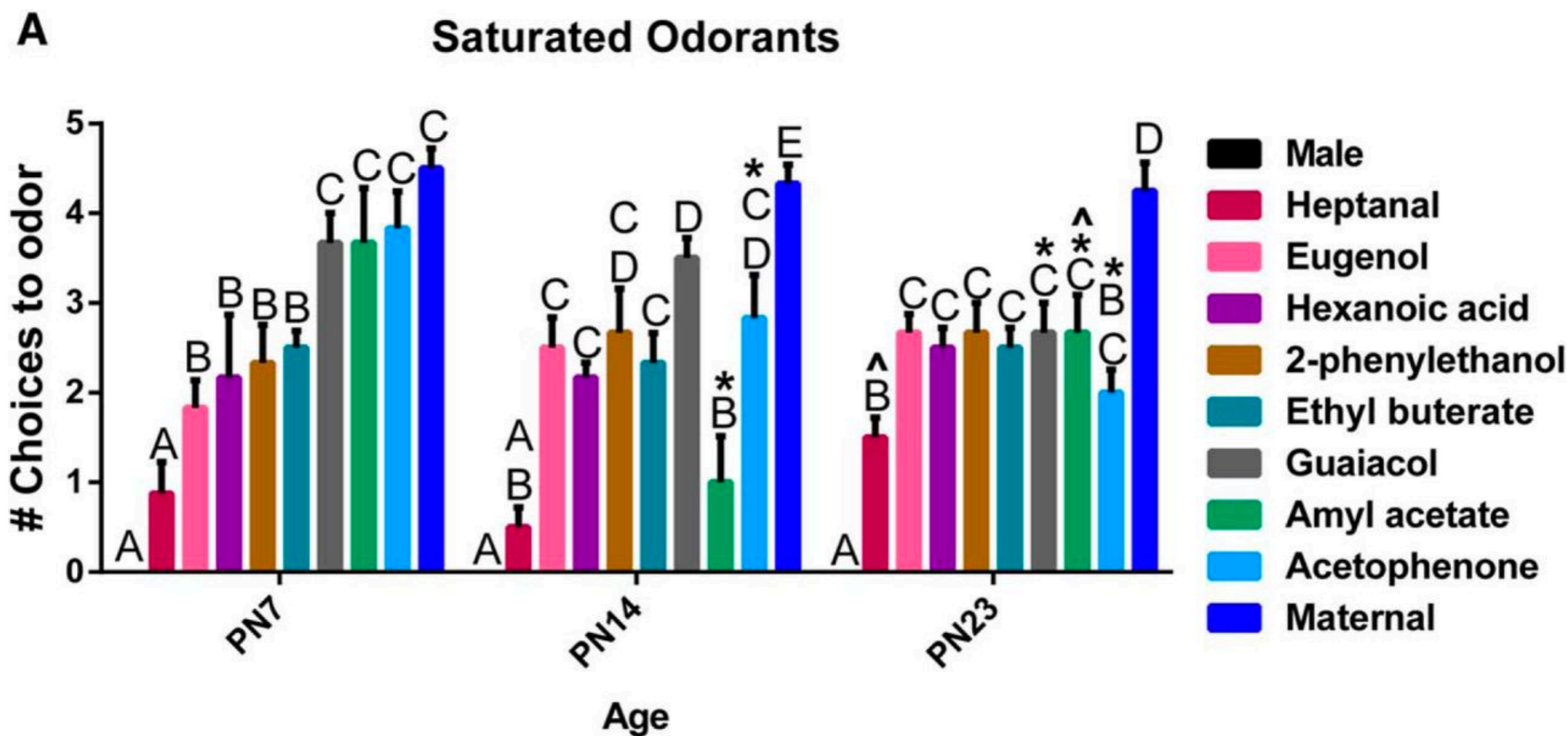
...now show difference of differences

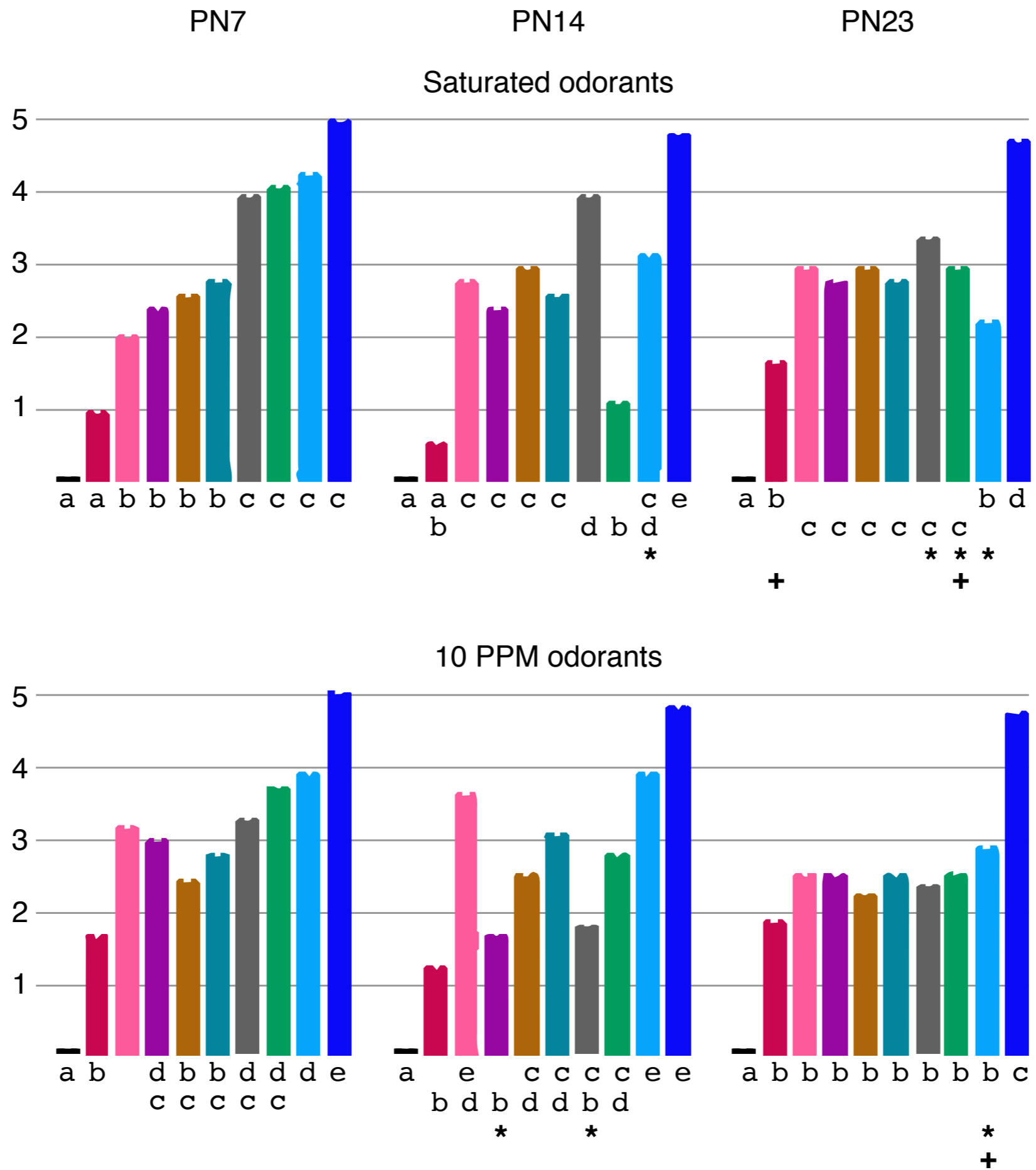
Rest

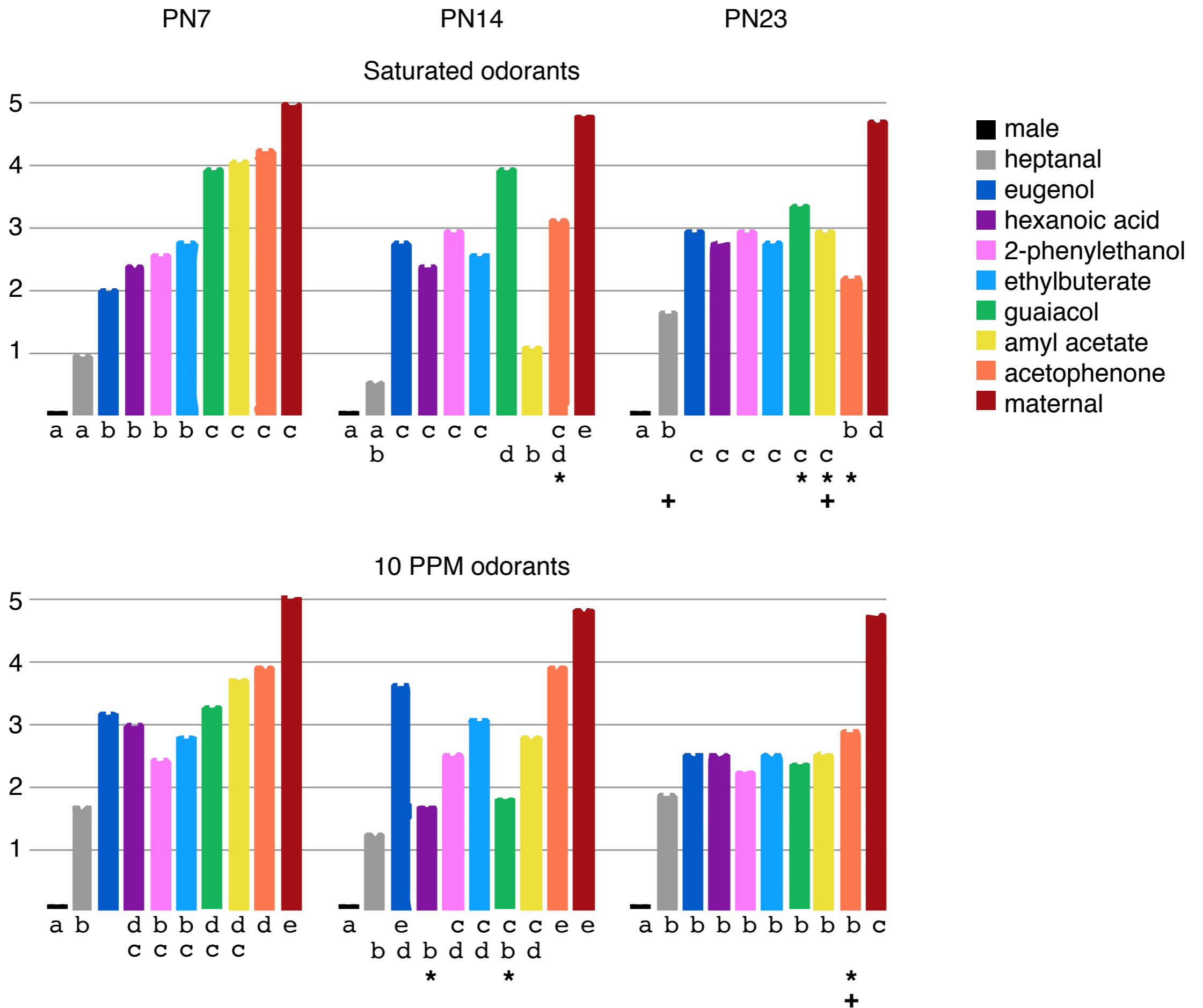
Task

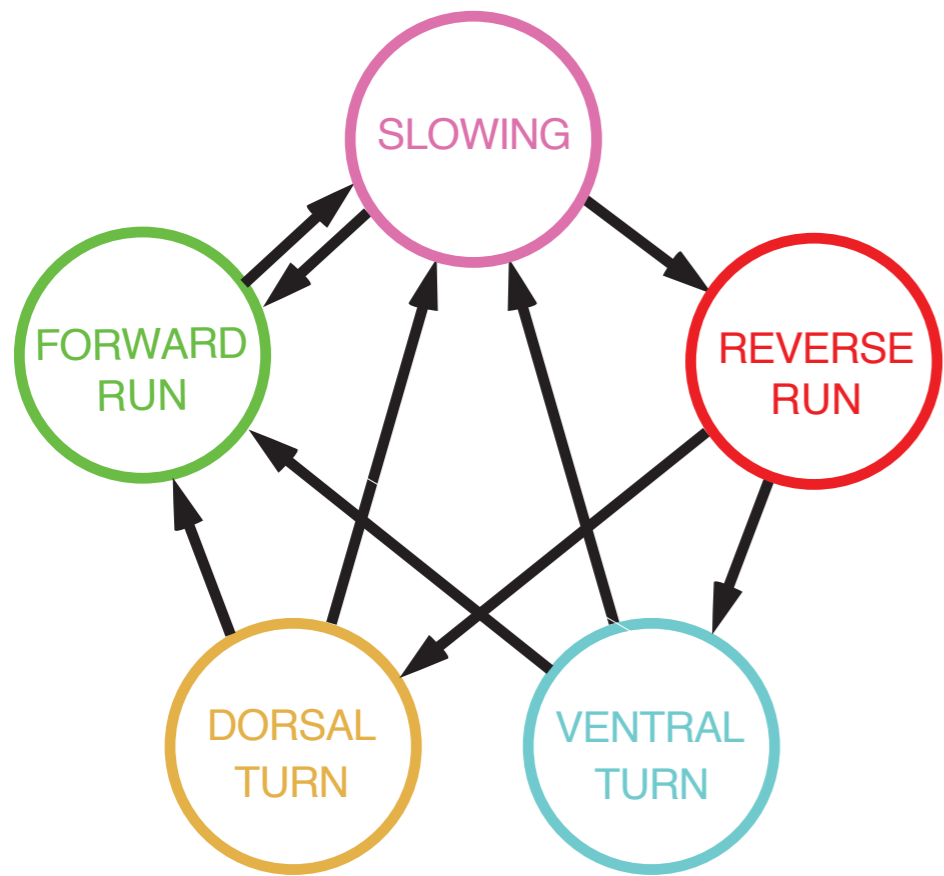


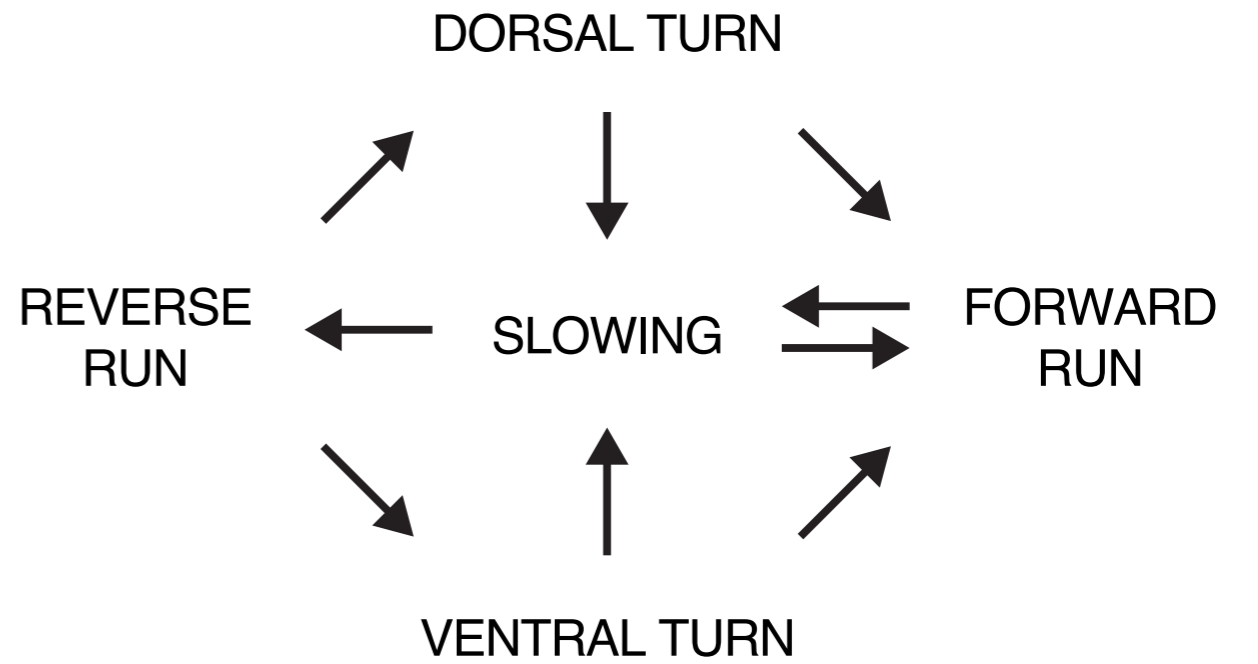
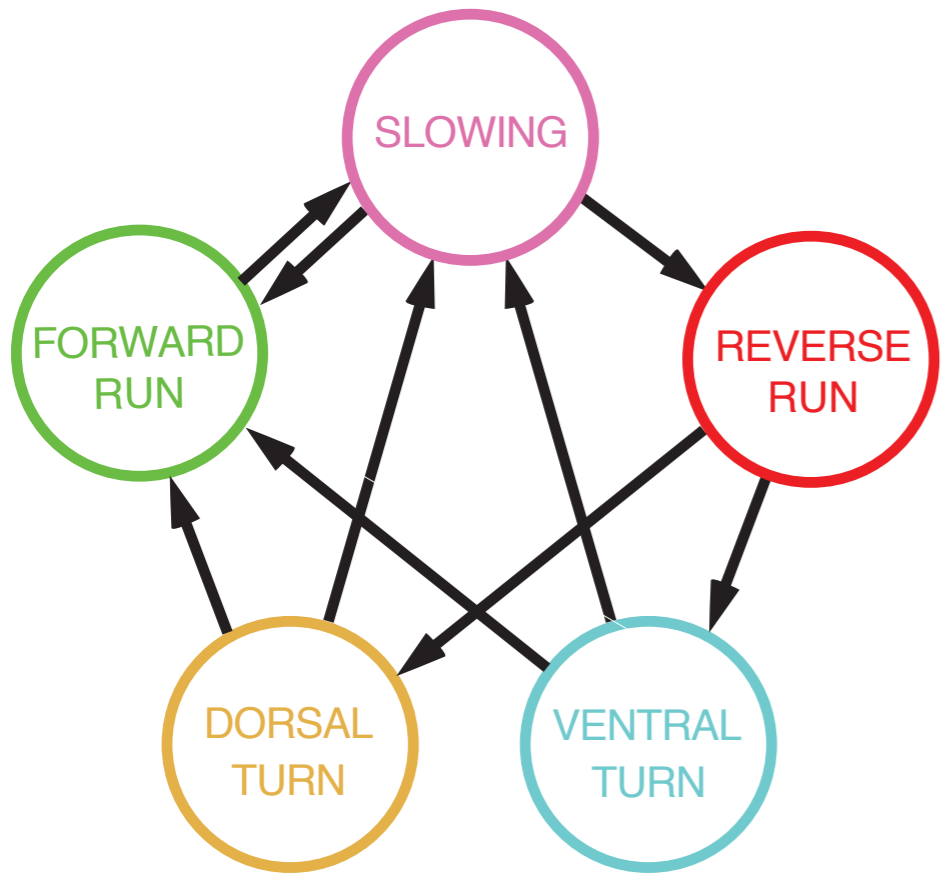
-329 edges  329 edges

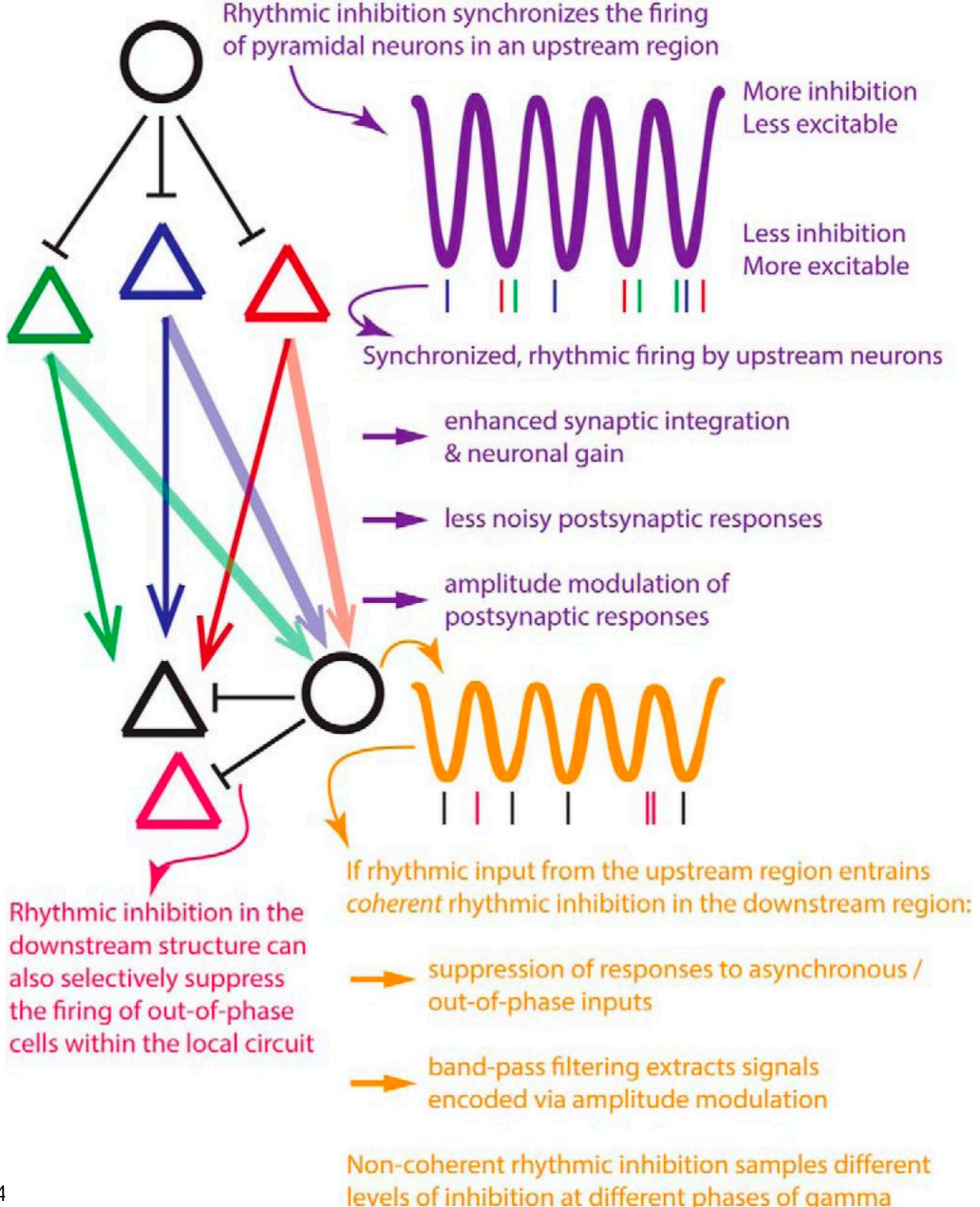






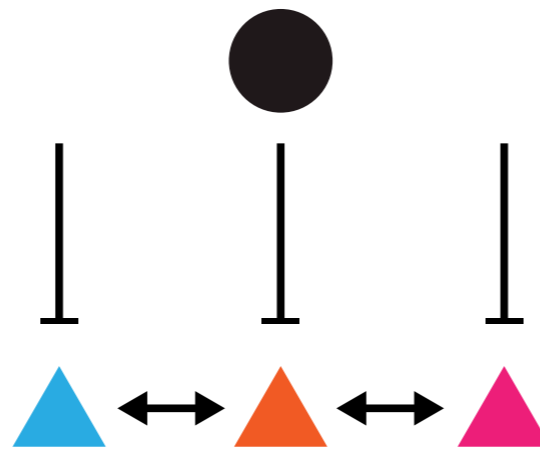
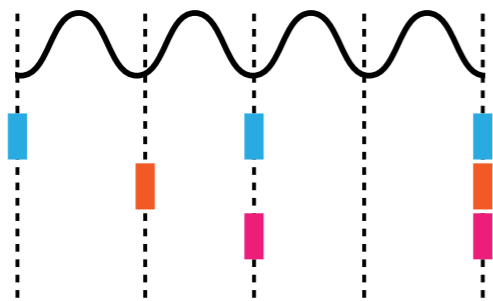






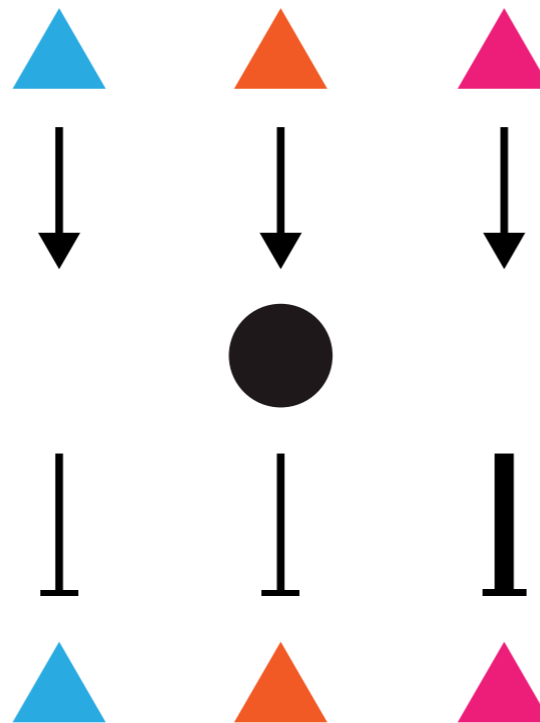
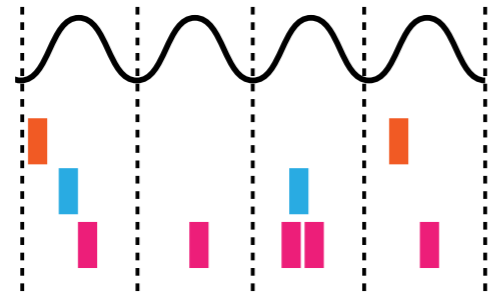
RHYTHMIC INHIBITION

Firing is synchronized in pyramidal neurons in an upstream region.



Enhanced synaptic integration and neuronal gain
Less noisy postsynaptic responses
Amplitude modulation of postsynaptic responses

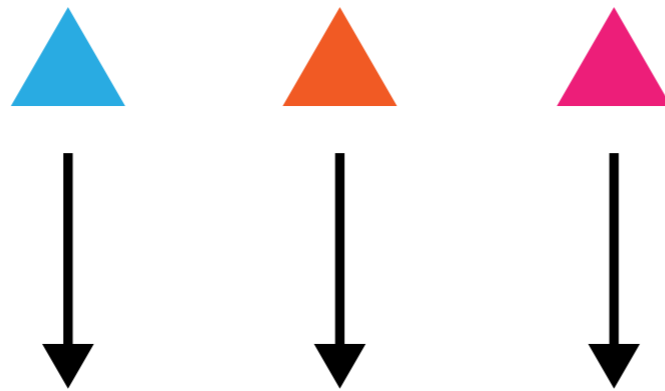
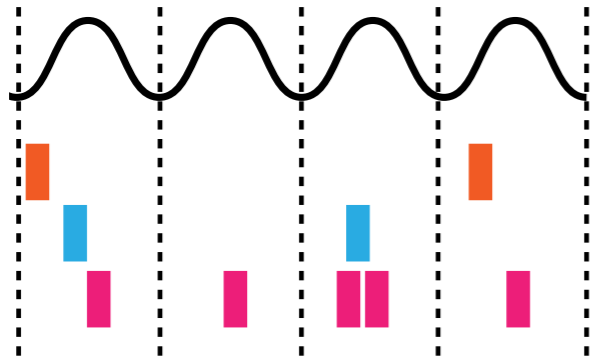
COHERENT RHYTHMIC INHIBITION



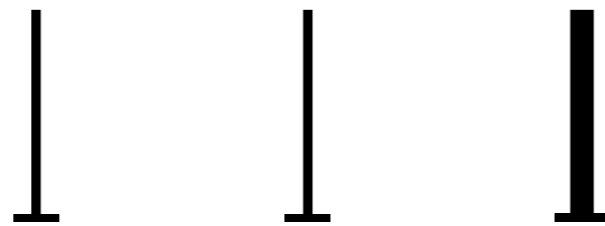
Suppresses asynchronous and out-of-phase inputs. Band-pass filtering extracts signals encoded via amplitude modulation.

Selective suppression of firing of specific out-of-phase cells within local circuit.

OUT-OF-PHASE FIRING

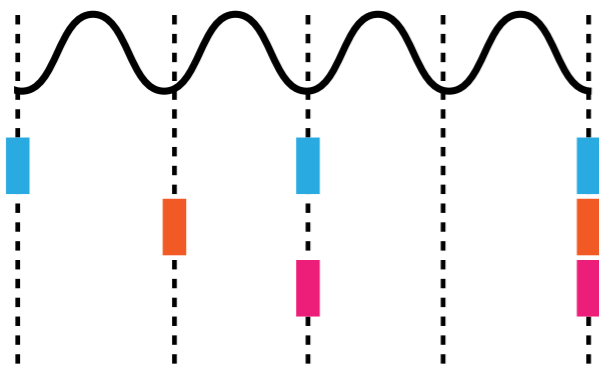


Suppresses asynchronous and out-of-phase inputs. Band-pass filtering extracts signals encoded via amplitude modulation.

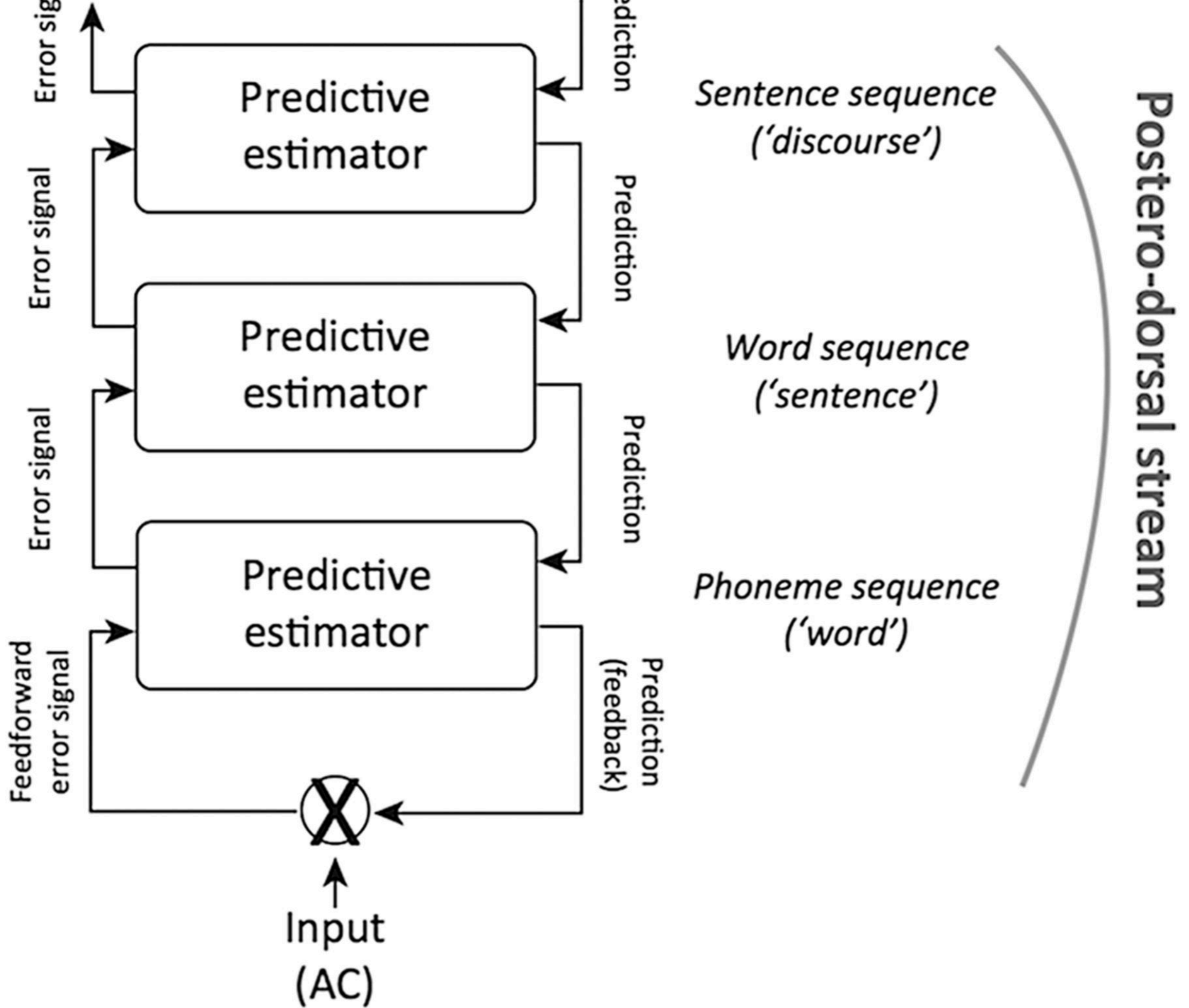


RHYTHMIC INHIBITION
Firing is synchronized in pyramidal neurons in an upstream region.

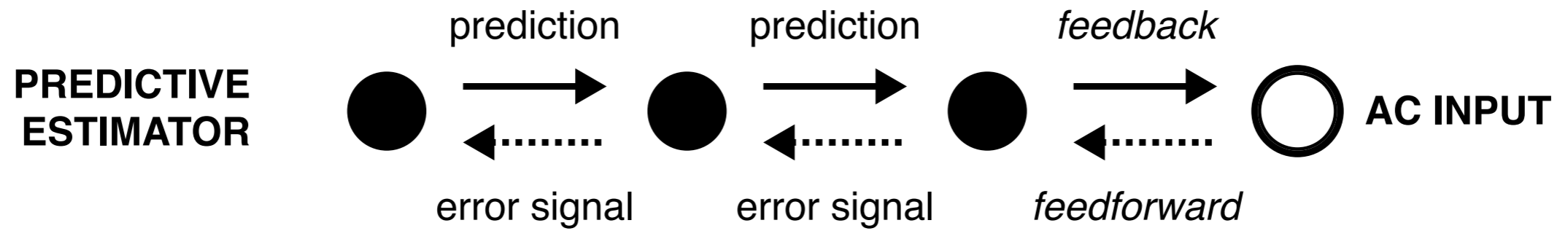
IN-PHASE FIRING



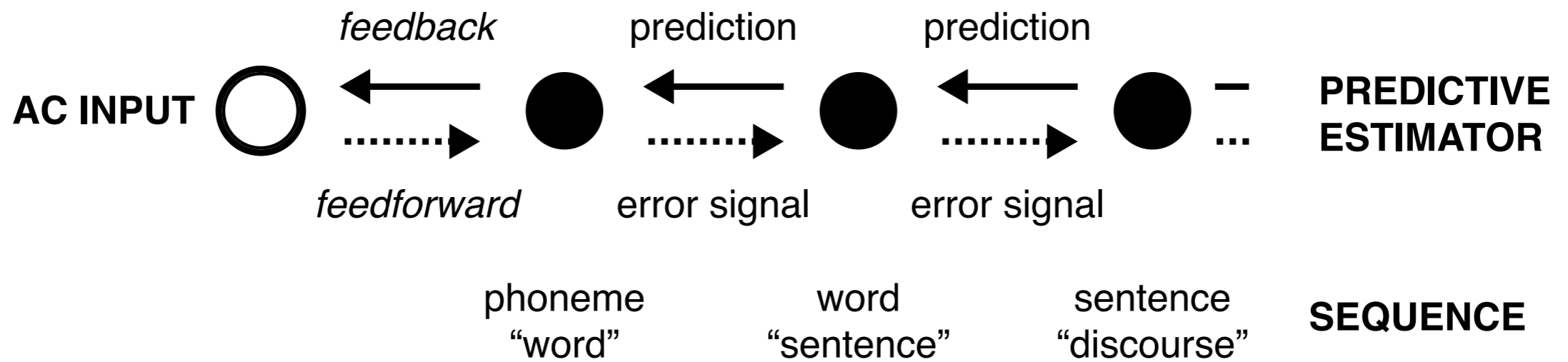
Enhanced synaptic integration and neuronal gain
Less noisy postsynaptic responses
Amplitude modulation of postsynaptic responses



POSTERIOR-DORSAL STREAM



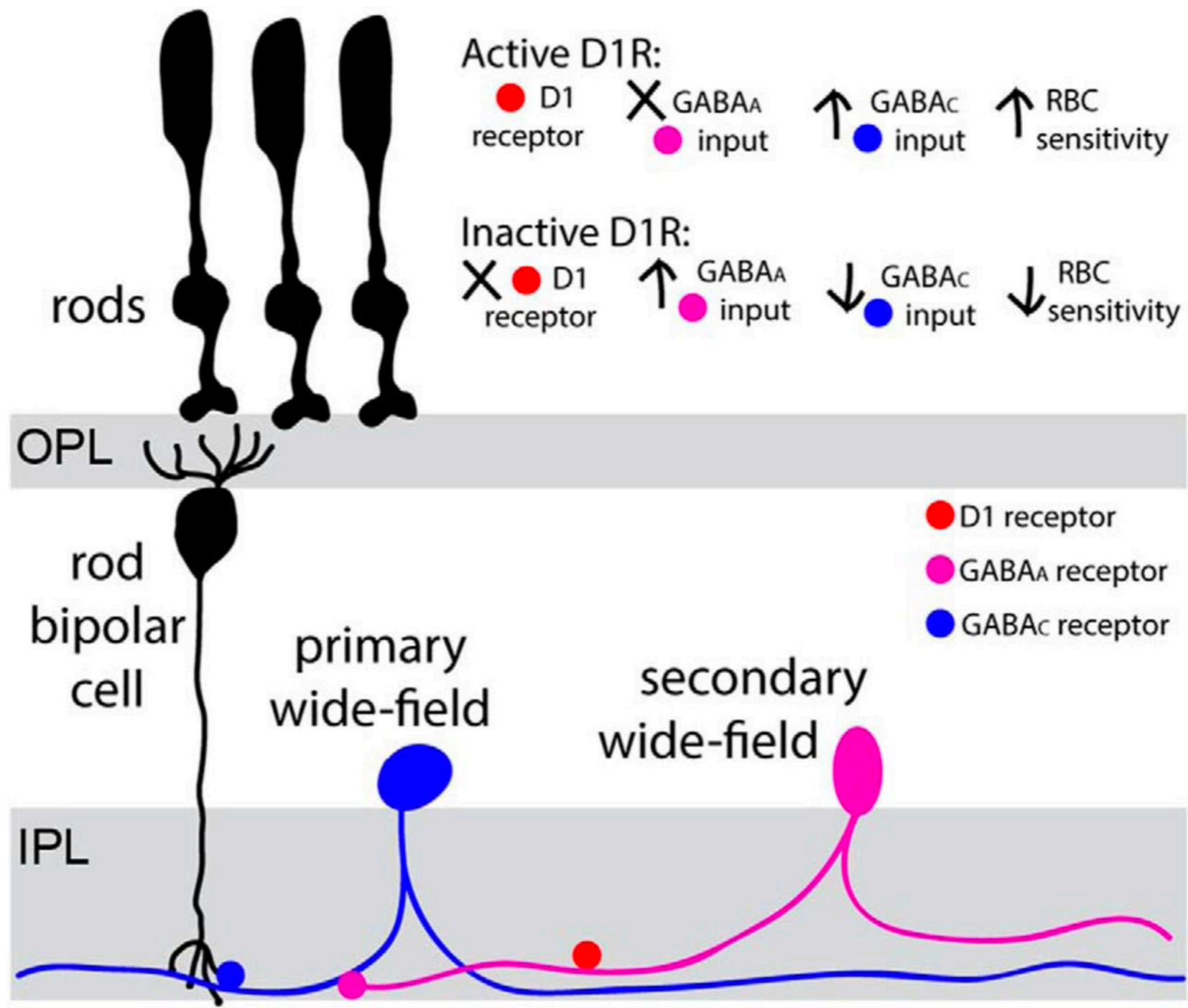
SEQUENCE sentence "discourse" word "sentence" phoneme "word"

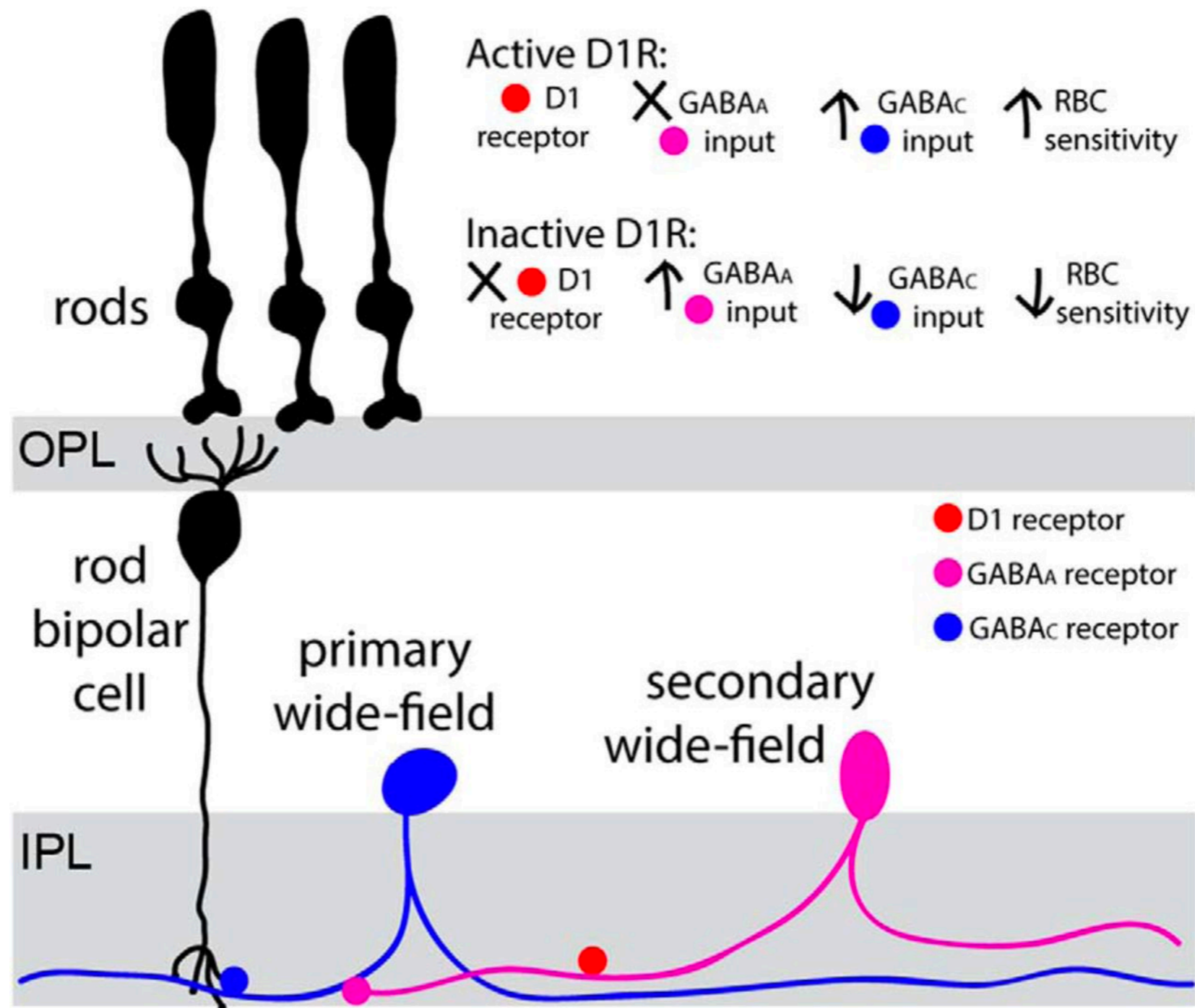


unfold circuits where possible

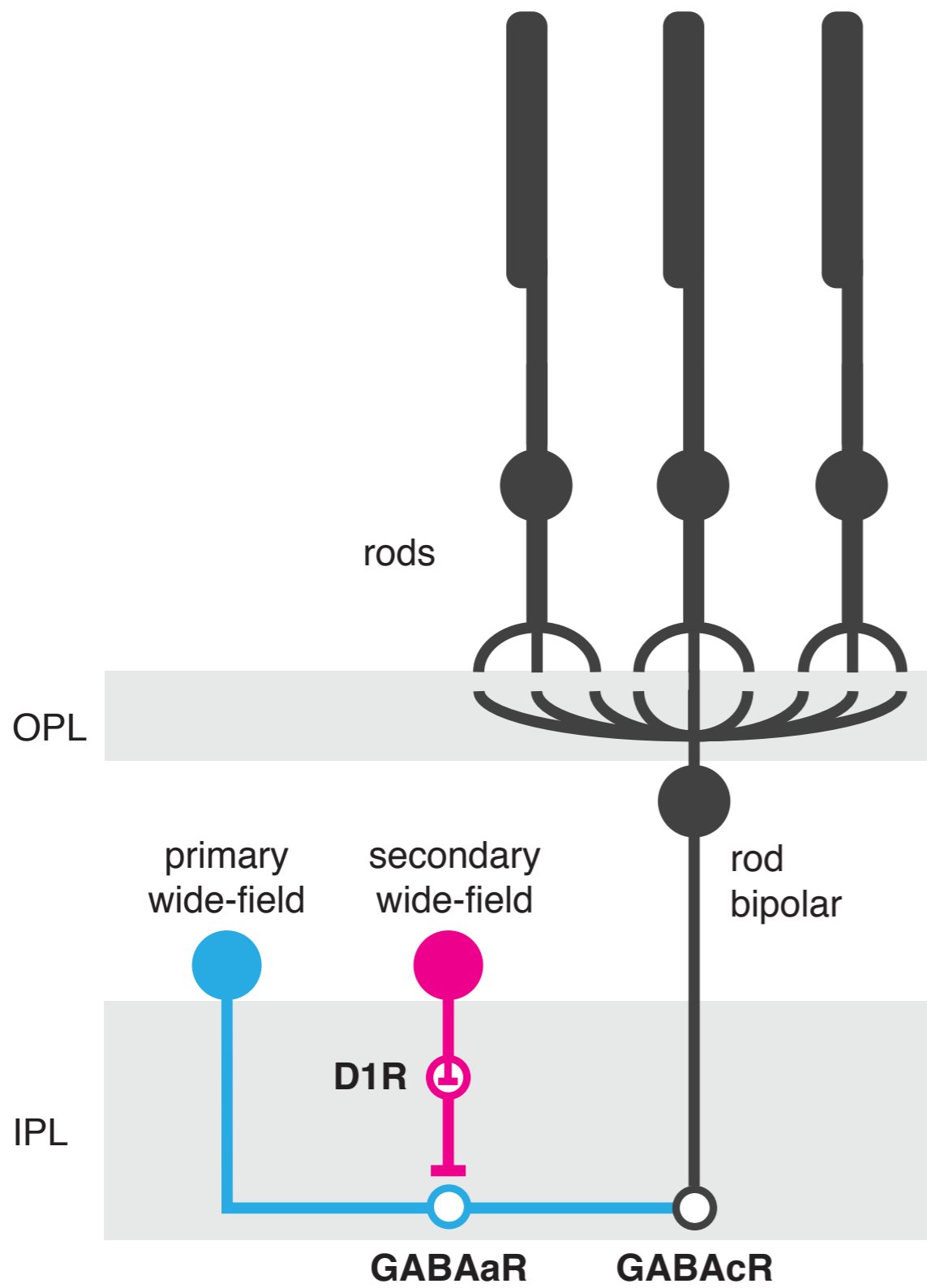
it makes annotating them with data much easier

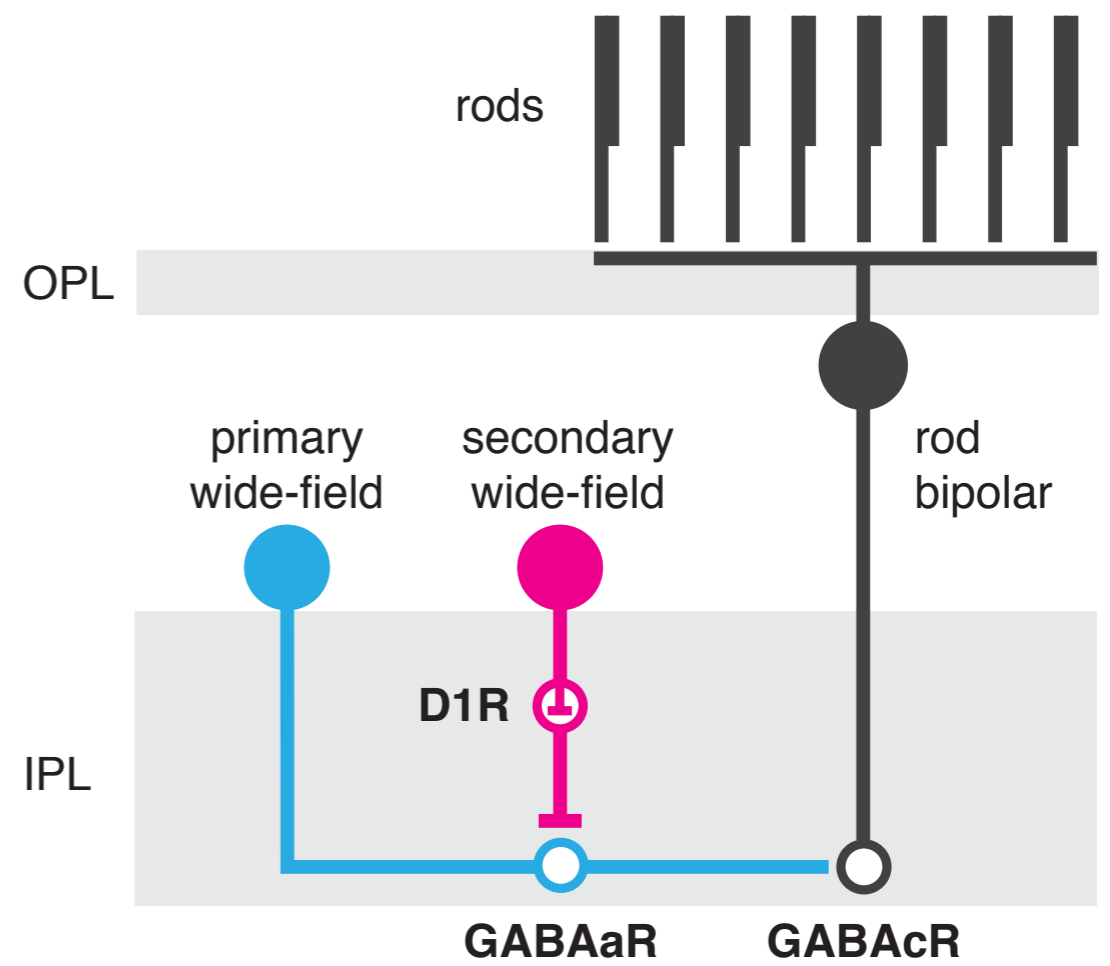
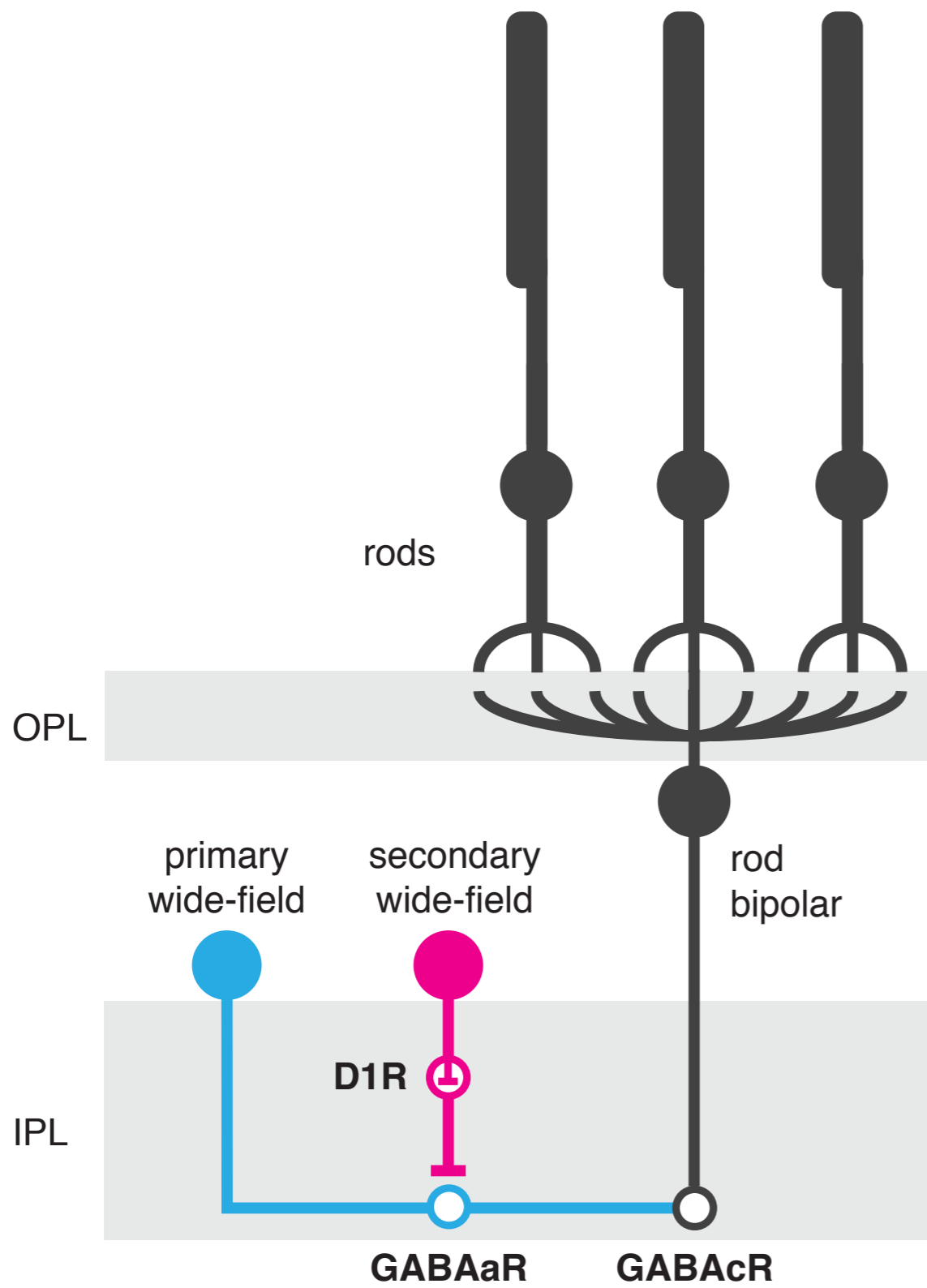
the circuit path is now a straight axis!



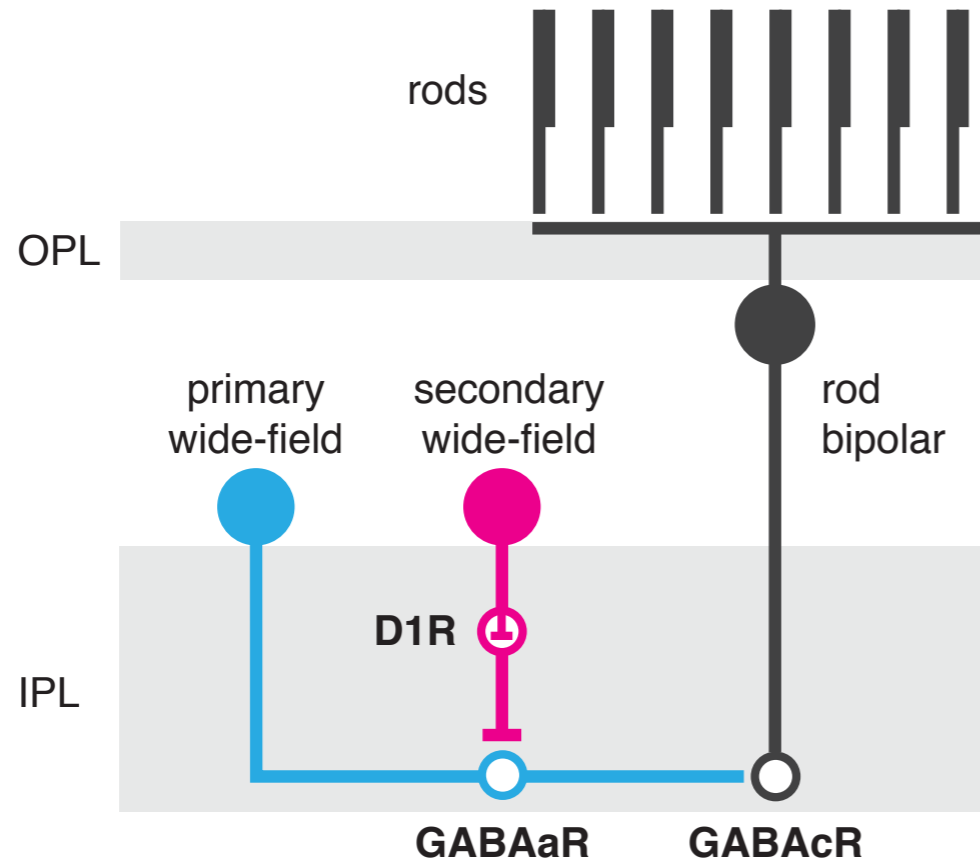


A subset of **wide-field amacrine cells (primary cell in blue)** provides sustained GABA release onto GABACRs located in the **rod bipolar cell axon**. This GABA release can be suppressed by upstream **amacrine cells (secondary cell in magenta)**, which release GABA onto GABAARs located at the **primary amacrine cell**. This serial inhibition is suppressed by dopamine acting through the **D1 receptors located on the secondary cells**.

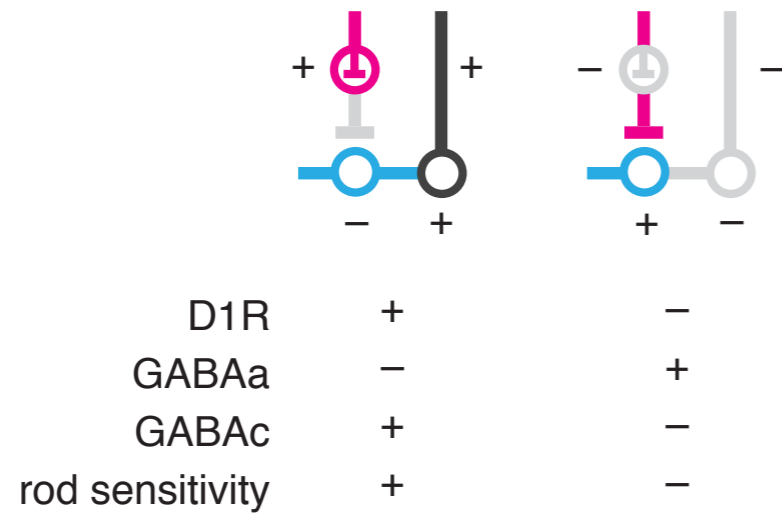


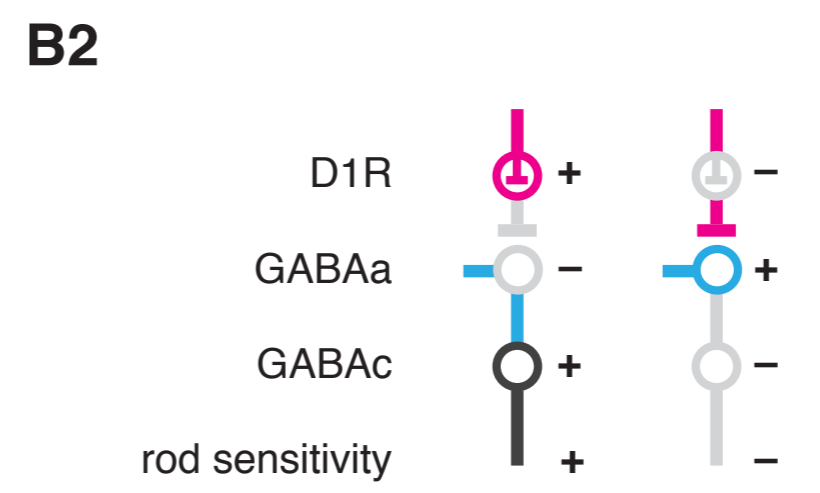
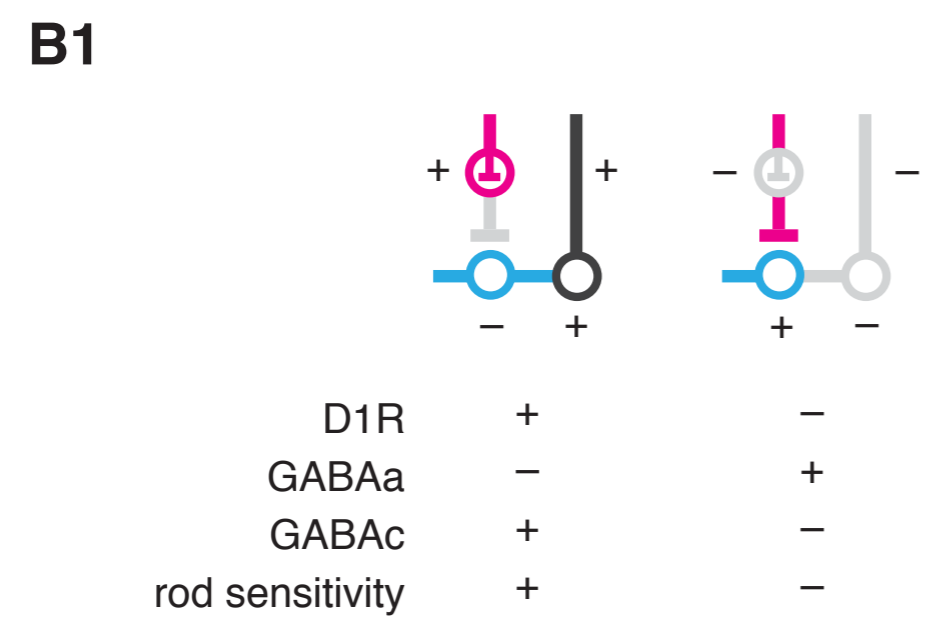
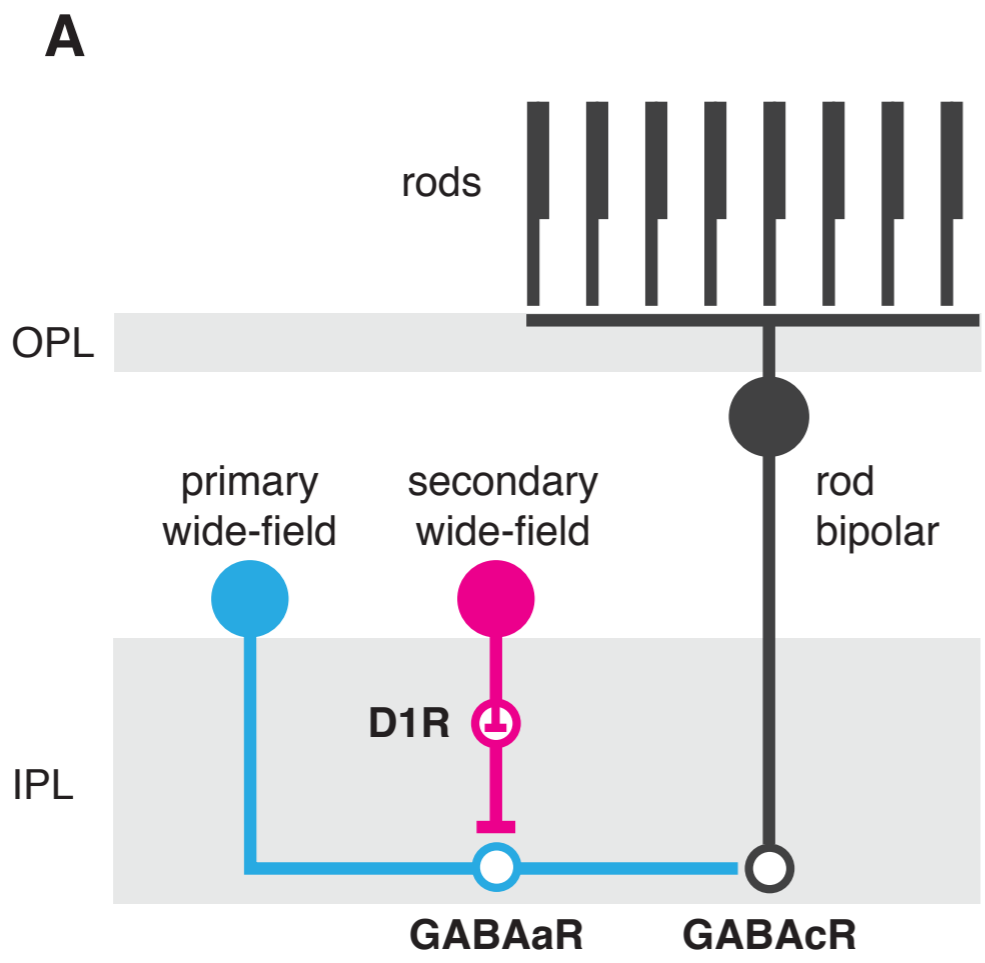


A



B1



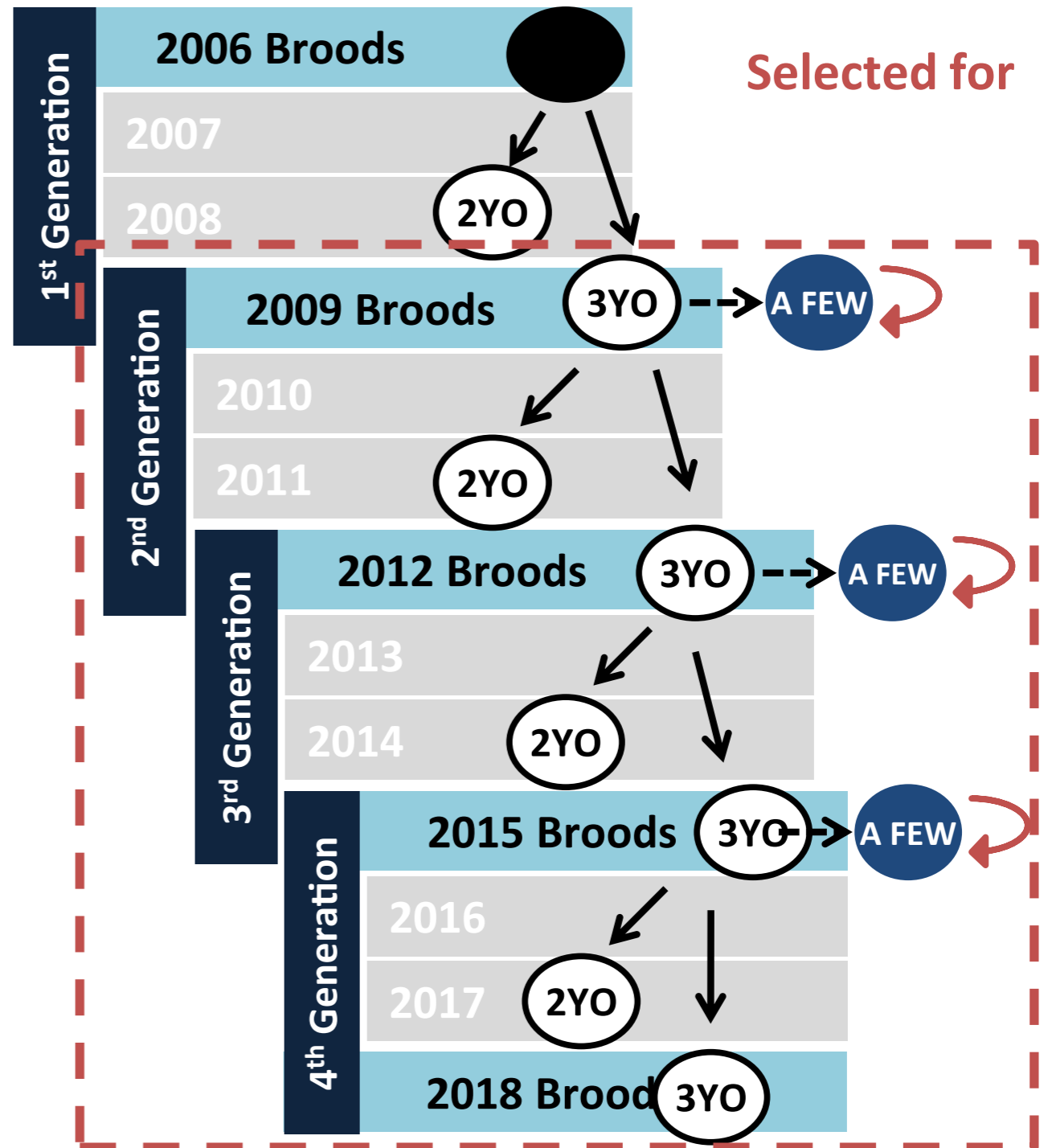
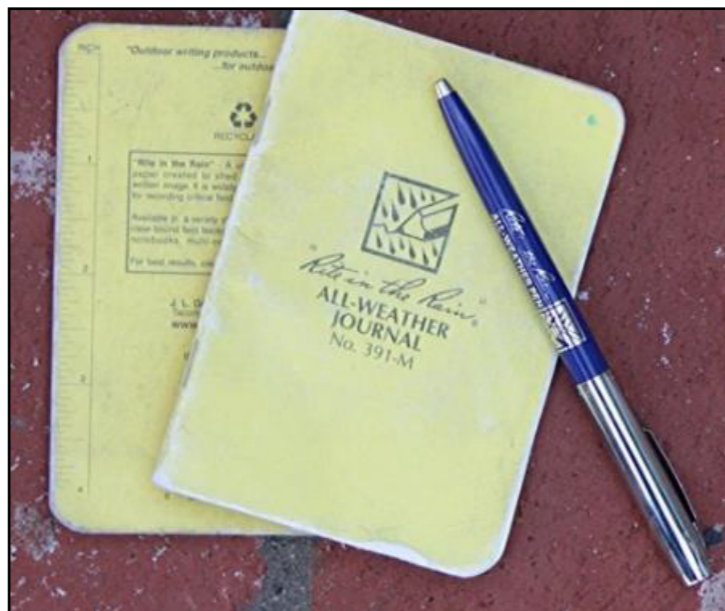


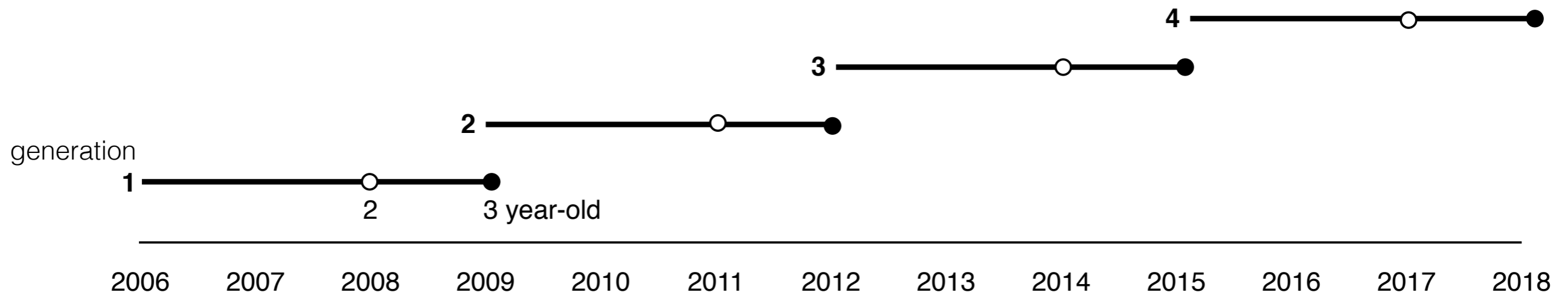
fight to find a natural axis in your data set

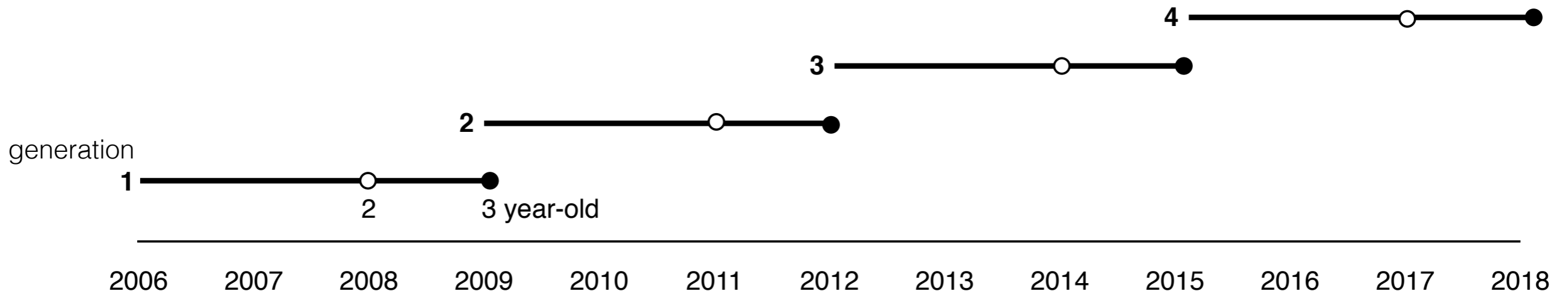
Sample and Phenotype Collection

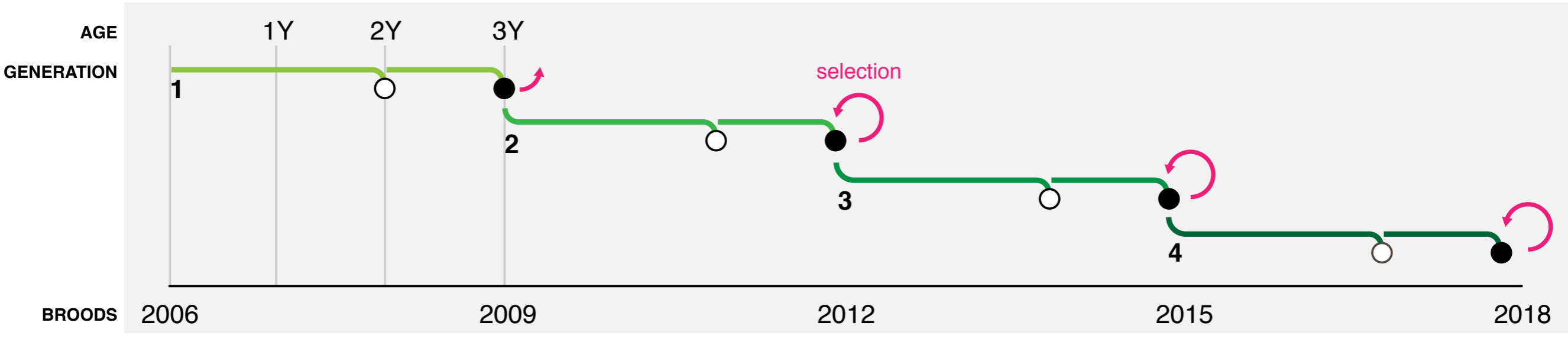
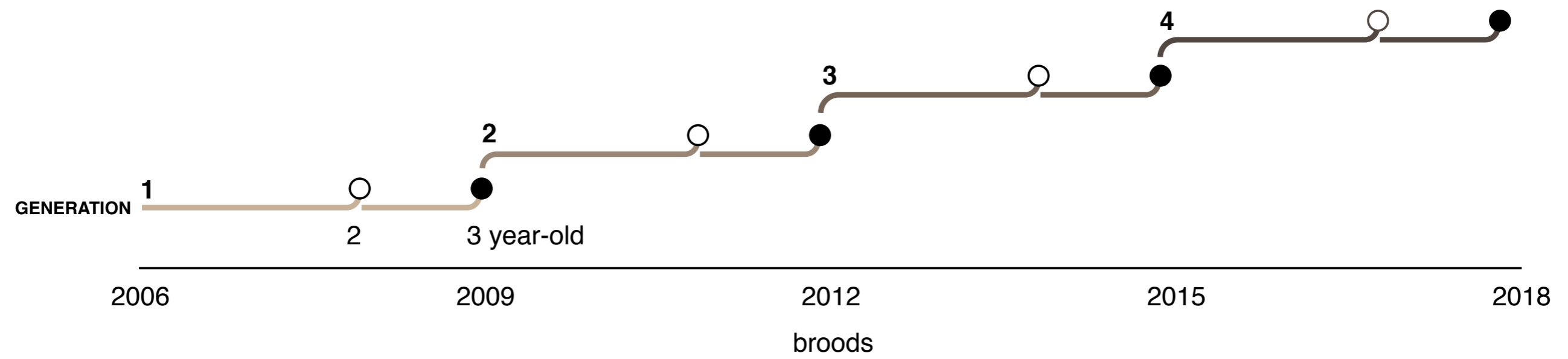


Operculum
Punches

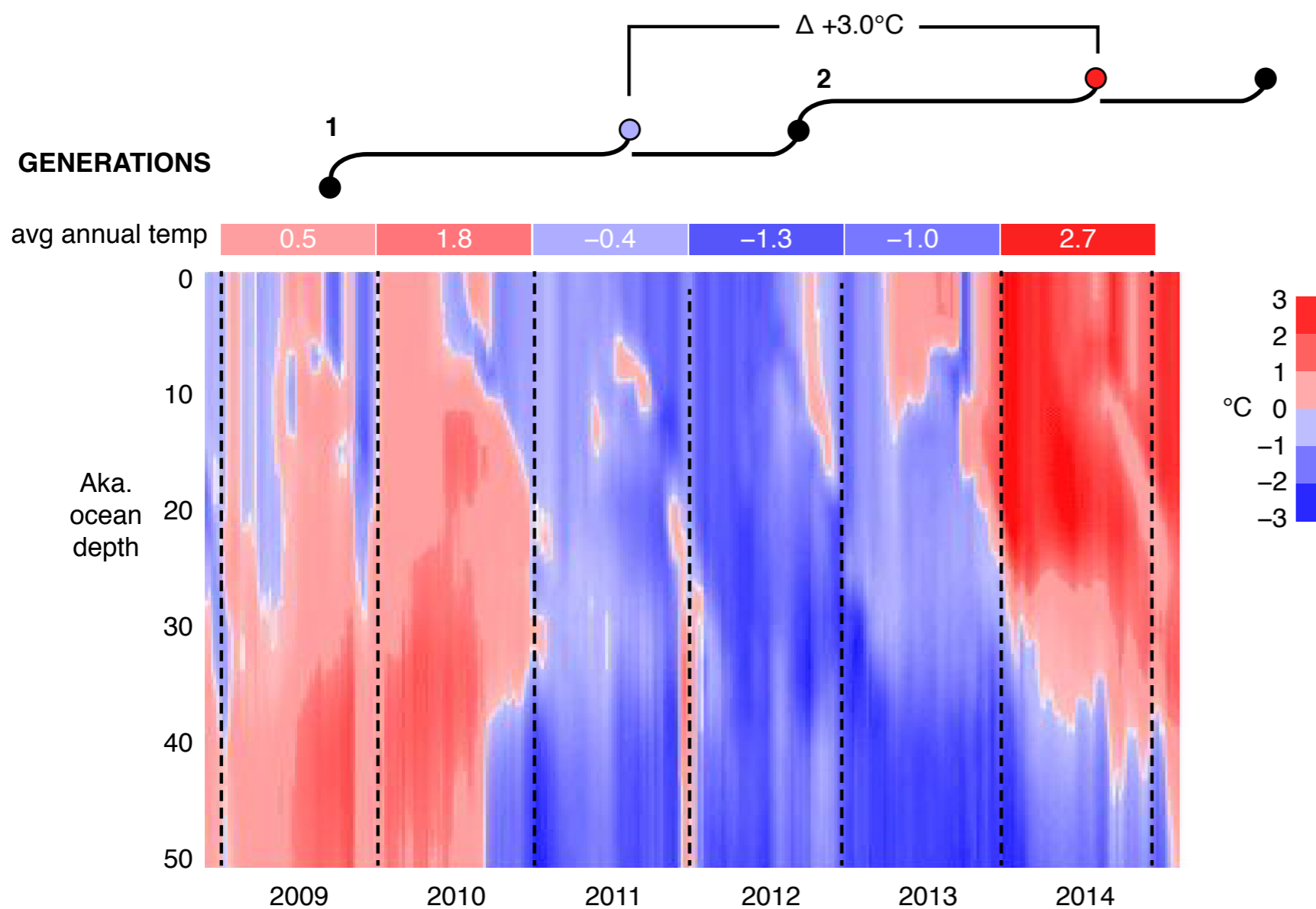








Evidence of rising temperature influence on <process> in Inch Creek Coho



$\Delta +3.0^\circ\text{C}$ between generations

impact on survival and fitness?
survivors' coping strategies?

THE ELEMENTS OF STYLE

⋮

illustrated

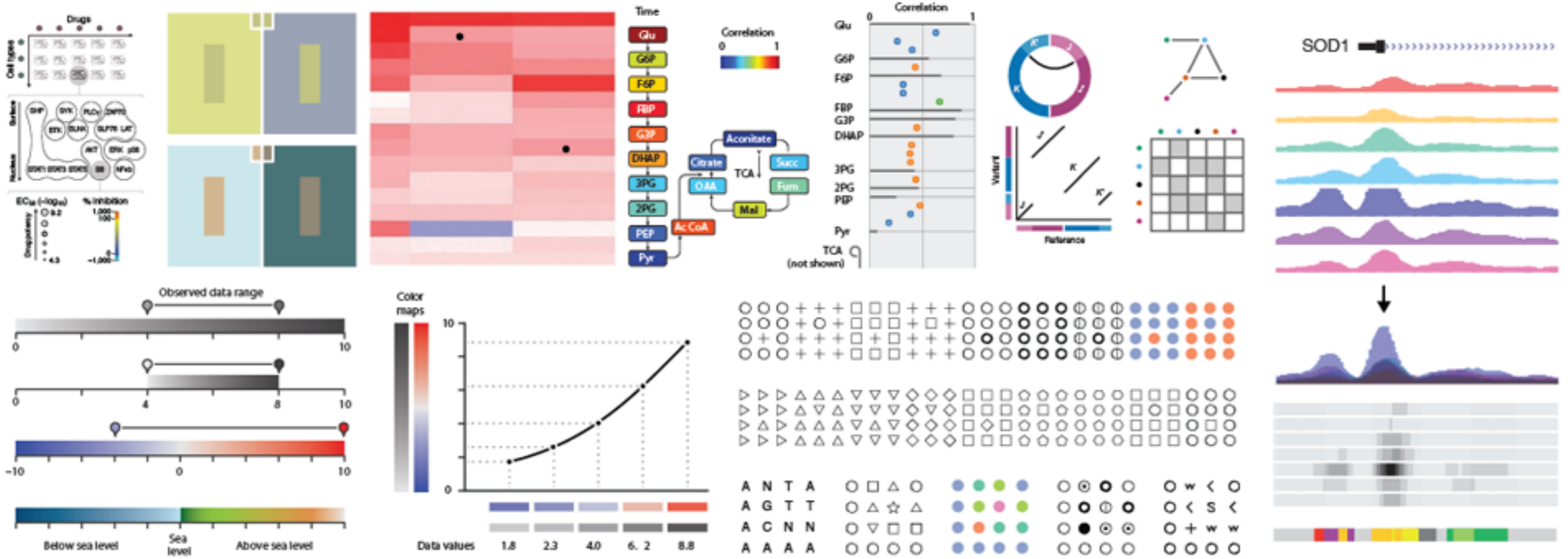
*Rich, ornate prose is hard to digest,
generally unwholesome and
sometimes nauseating.*

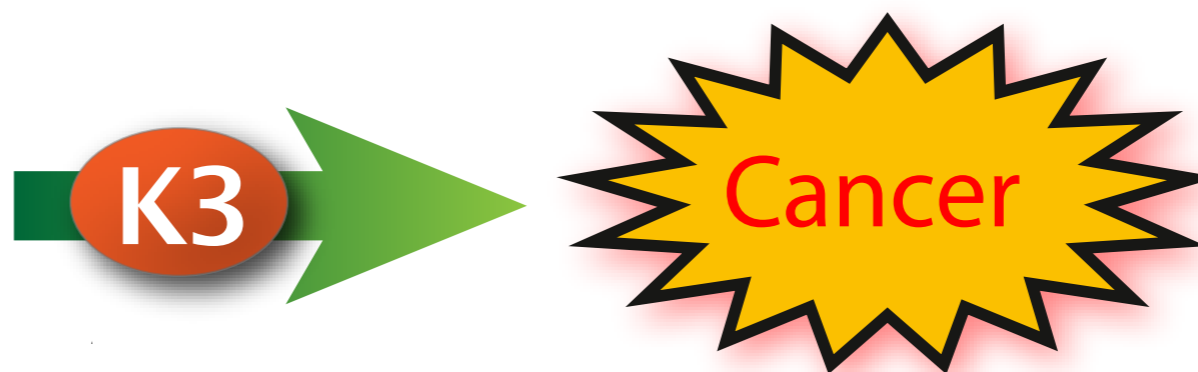
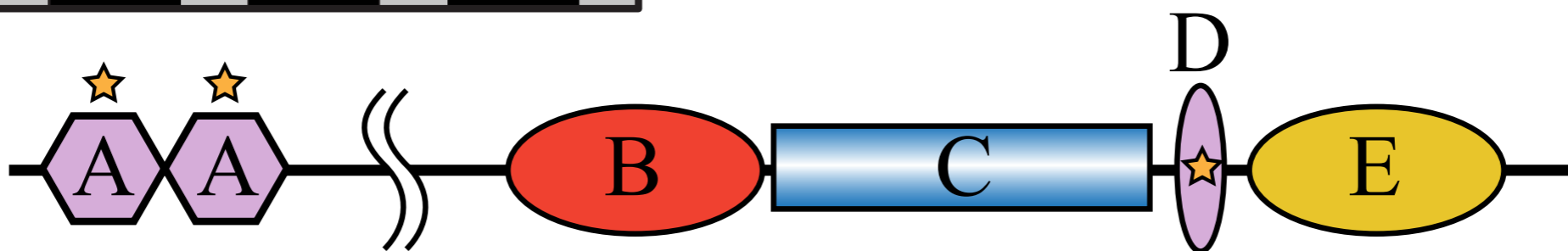
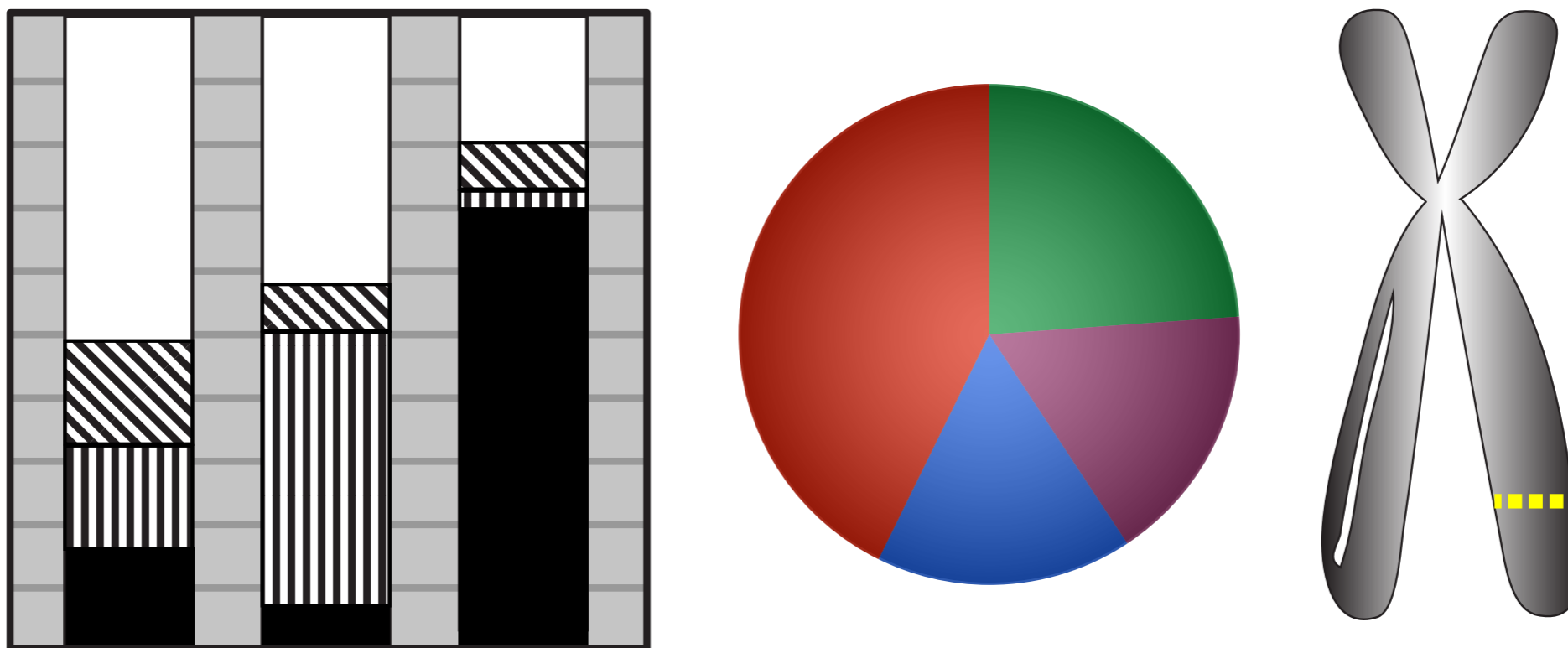
your audience is
intelligent but
easily bored

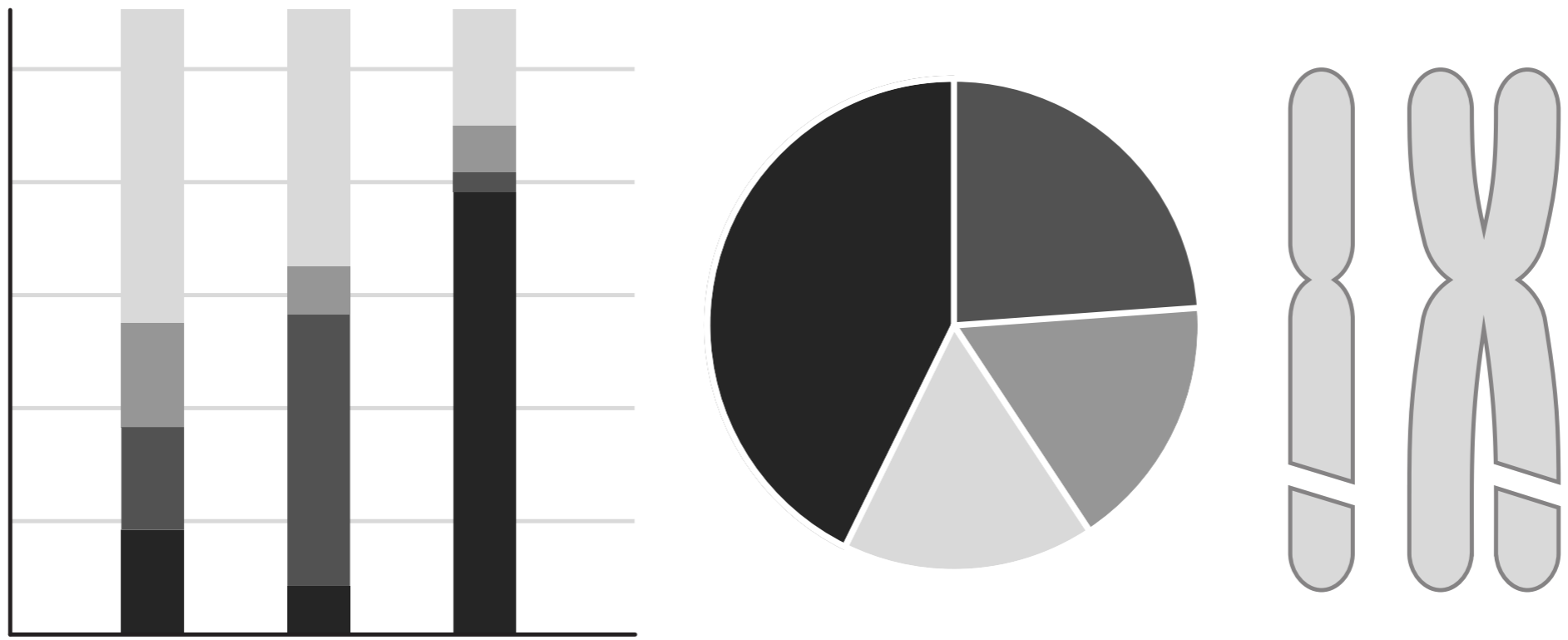
your audience is
stupid and has
lots of spare time

POINTS OF VIEW

Wong · Krzywinski · Gehlenborg · Nielsen · Soresh · Kjaegaard · Savig · Cairo







K3
→ **CANCER**

don't draw boxes ever again

PSAP/IntA Procedure (Session 15 Example)

Drug-Seeking

Drug-Taking

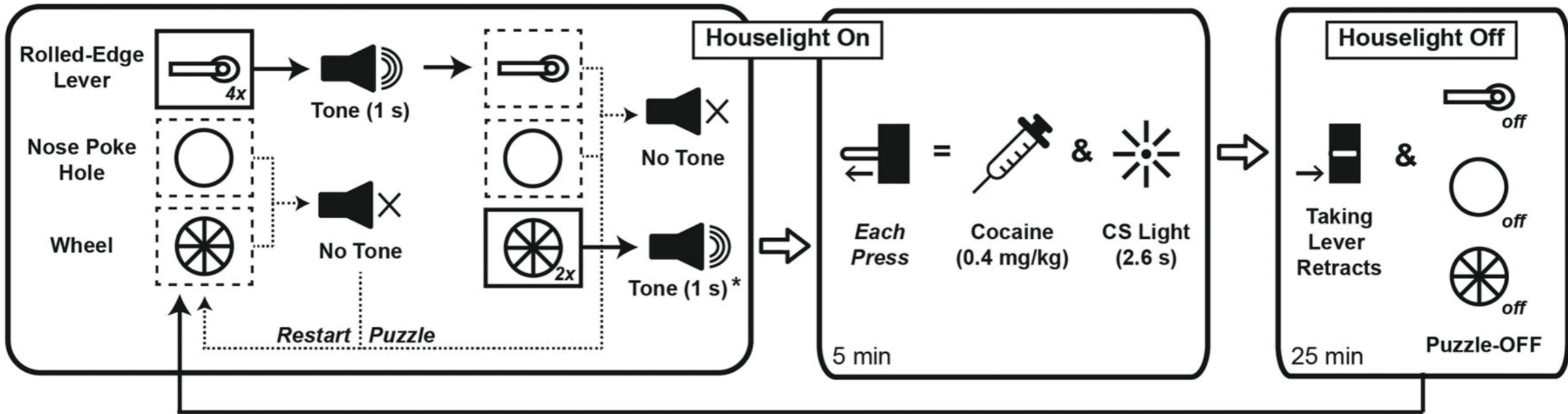
Timeout

1st Response Series

2nd Response Series

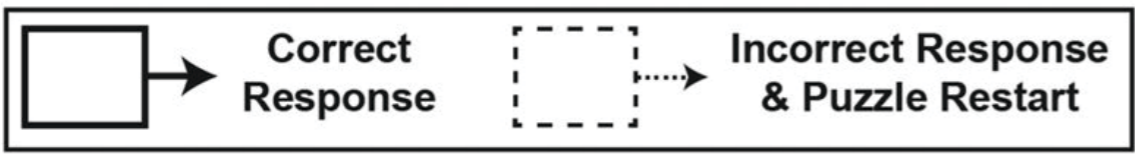
*Responding on
Lever that Extends*

*Responses w/o
Consequence*



10 trials or 7 hours per session

** To ensure equal access to cocaine across rats, if a puzzle was not solved within 10m (trial 1) or 15m (trials 2-10), then the next drug-seeking response resulted in access to the drug-taking lever.*

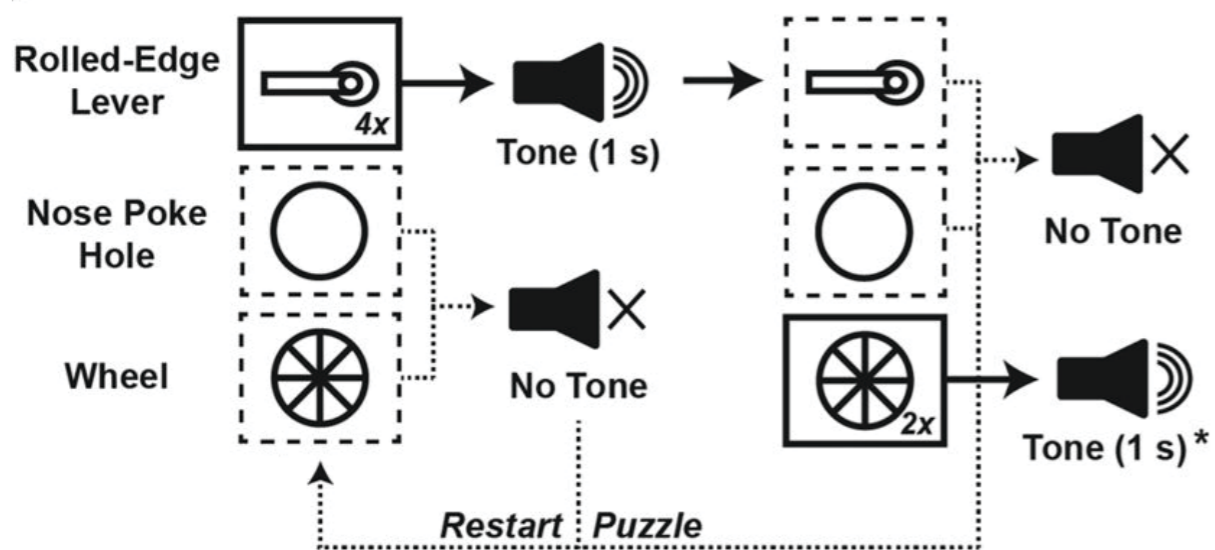


PSAP/IntA Procedure (Session 15 Example)

Drug-Seeking

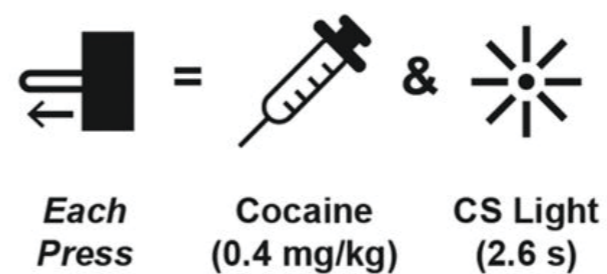
1st Response Series

2nd Response Series



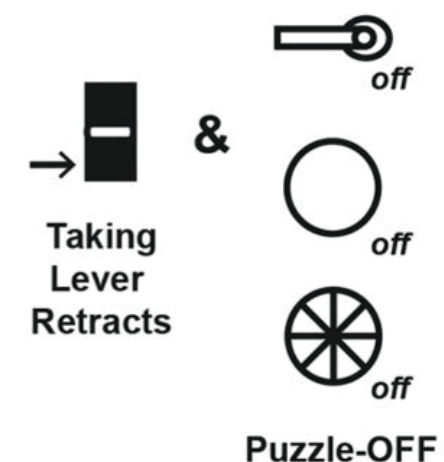
Drug-Taking

Responding on Lever that Extends

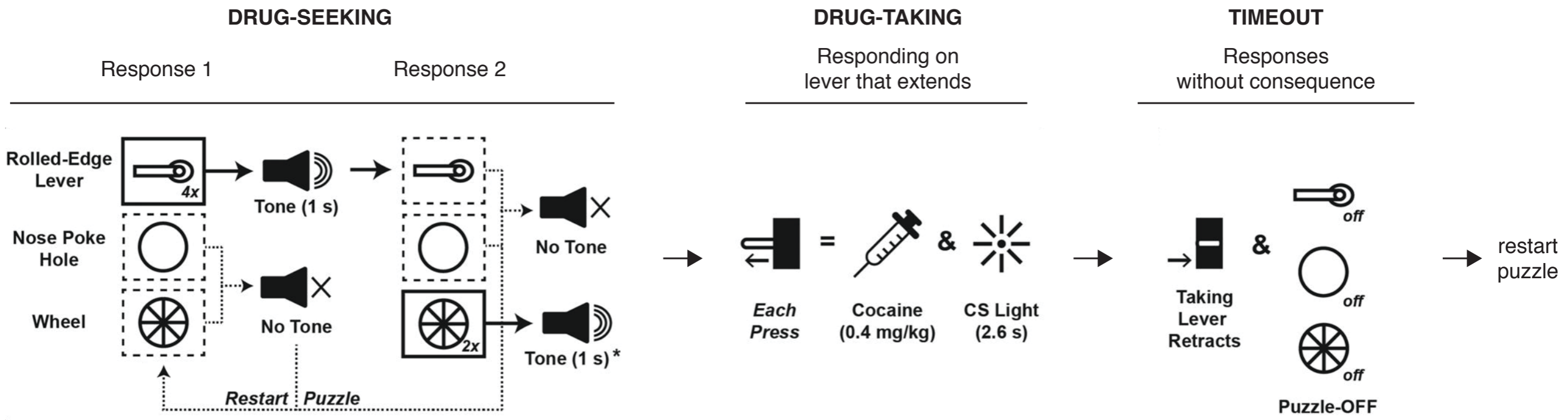


Timeout

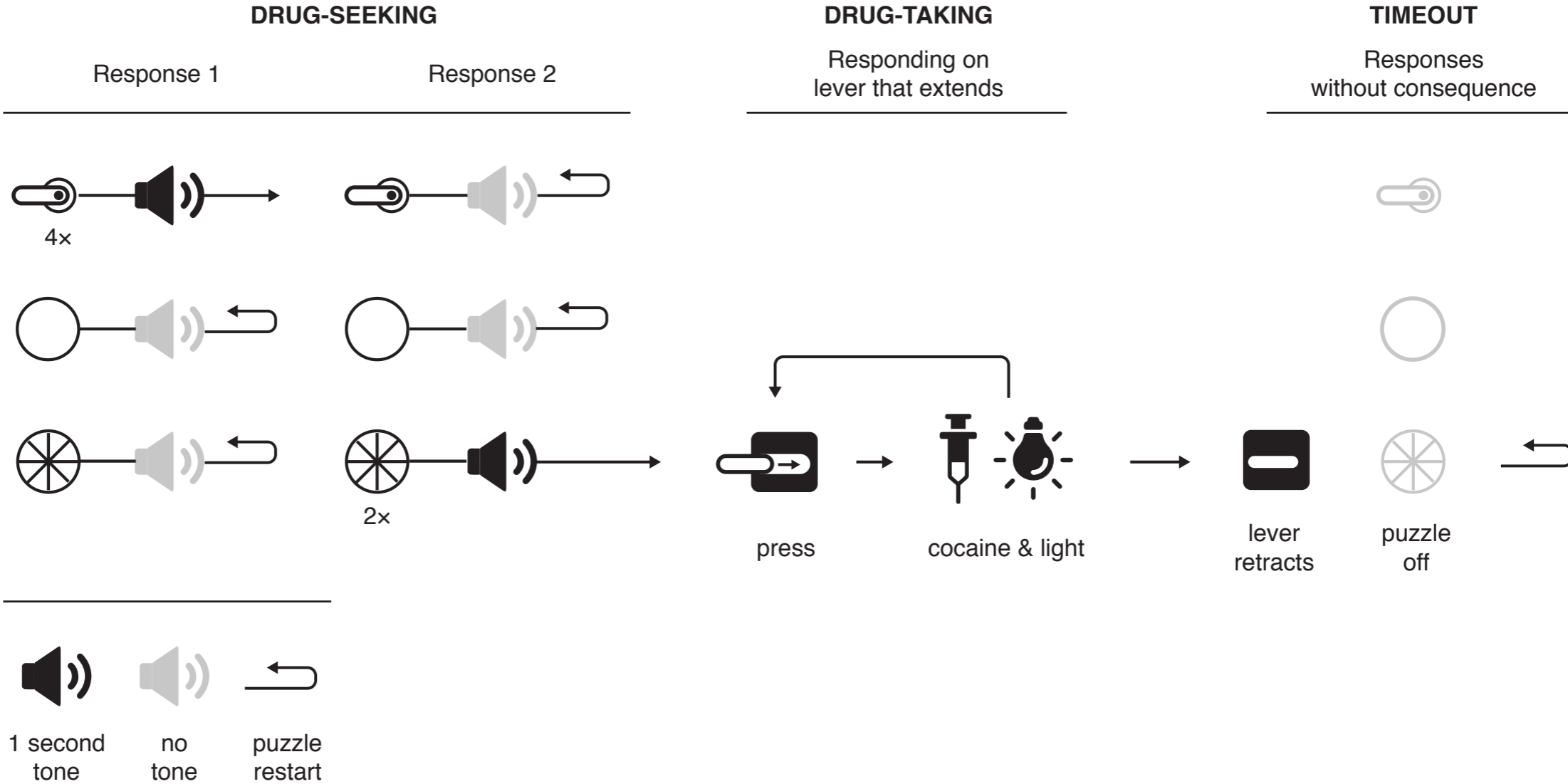
Responses w/o Consequence



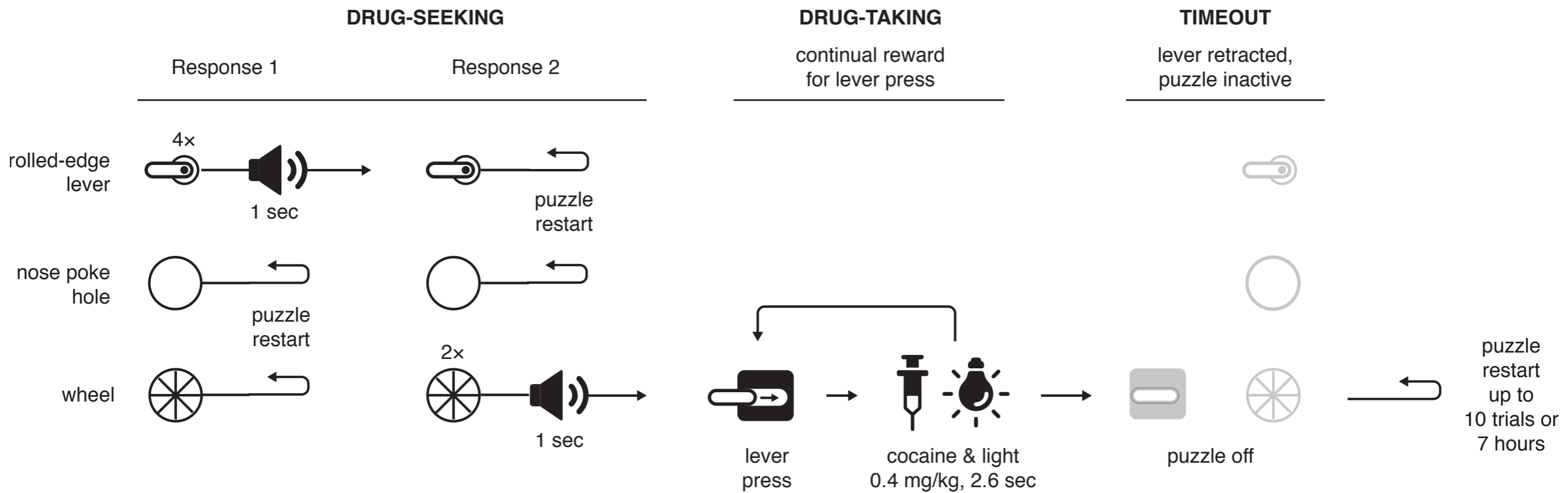
PSAP/IntA procedure
session 15 example

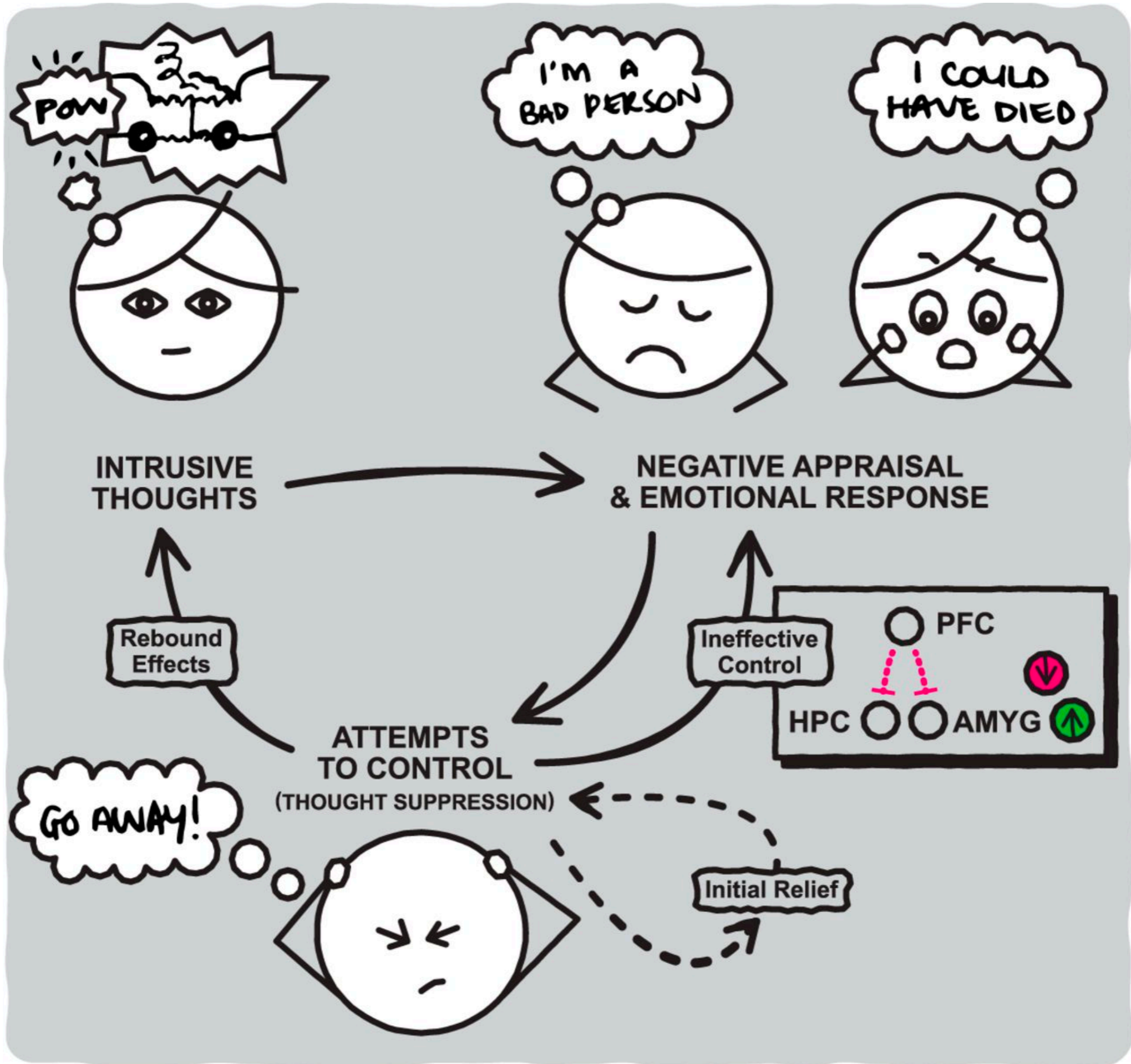


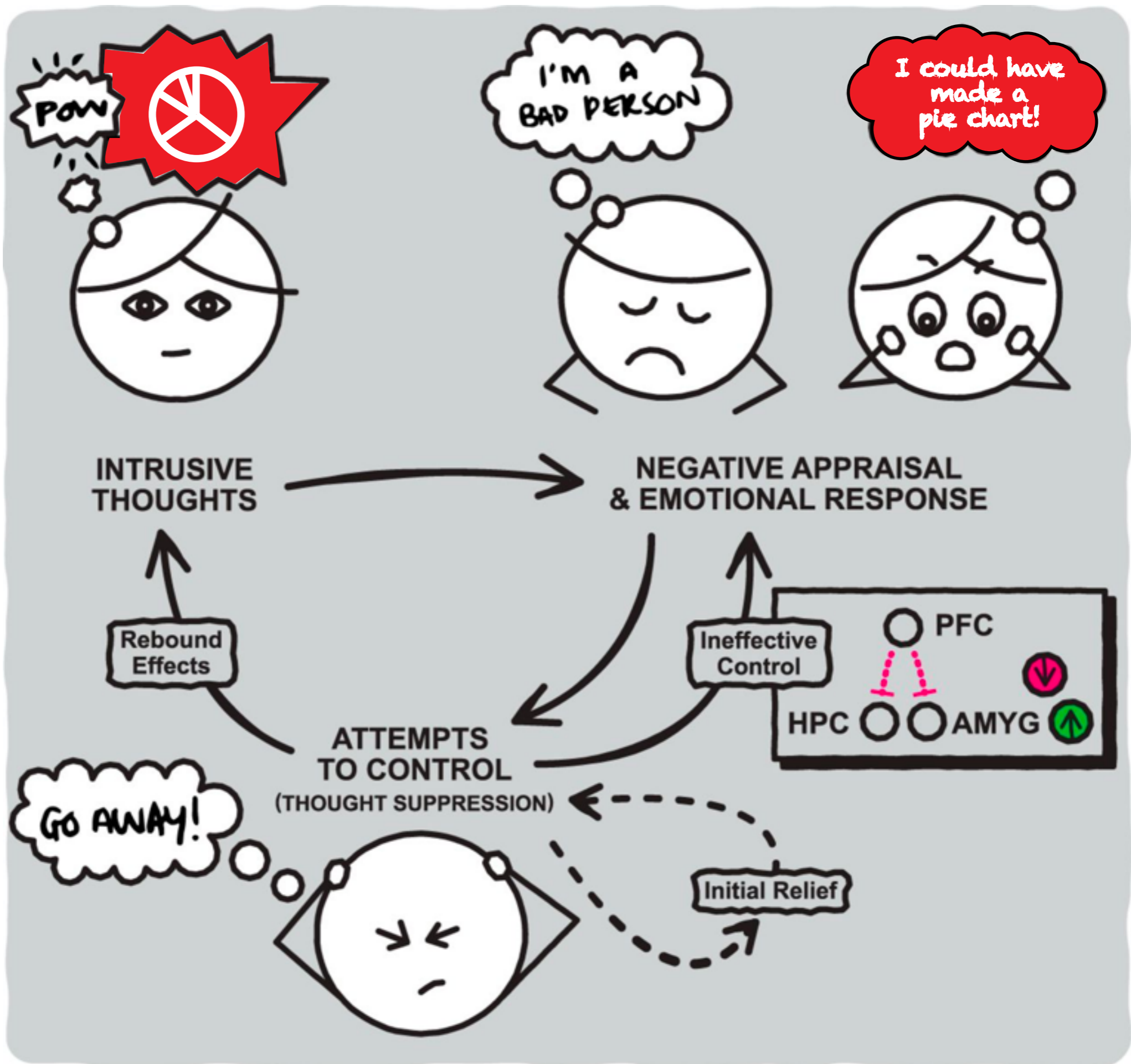
PSAP/IntA procedure
session 15 example



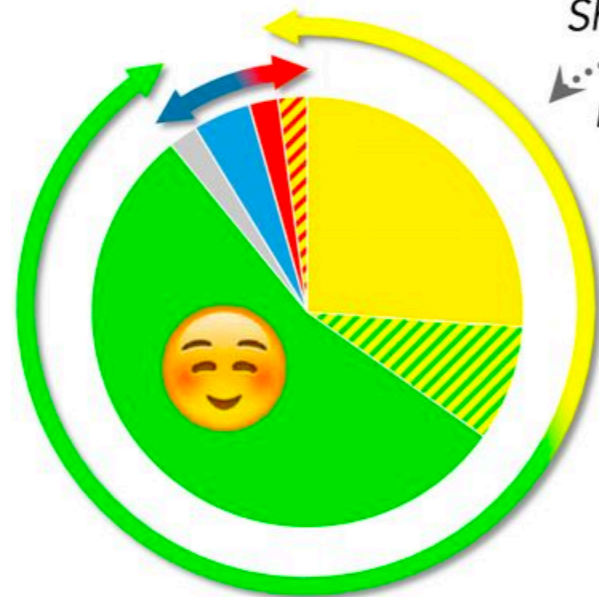
PSAP/IntA procedure
session 15 example



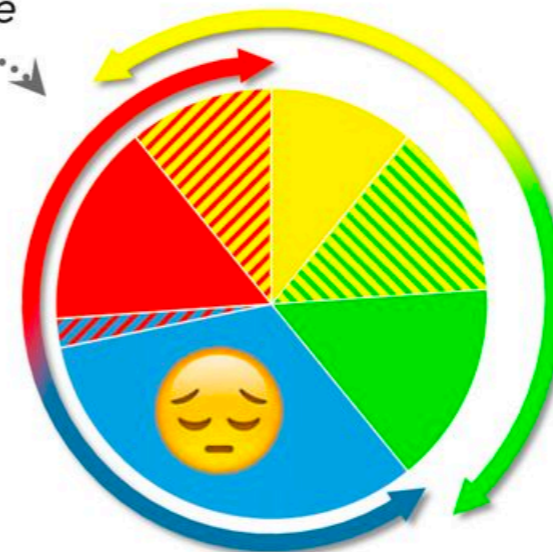




A Heroin at home

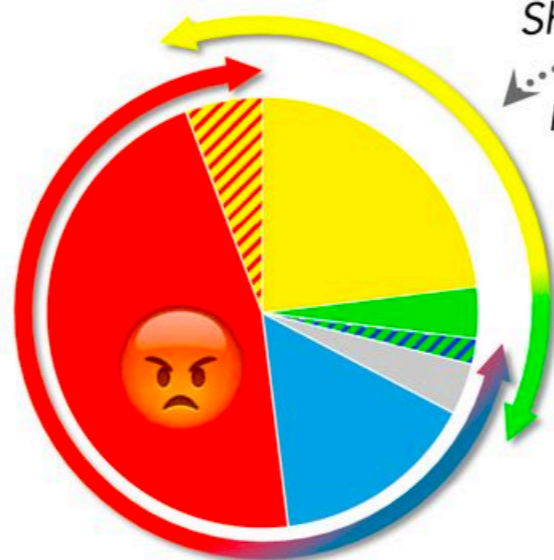


B Heroin outside the home (mismatch)

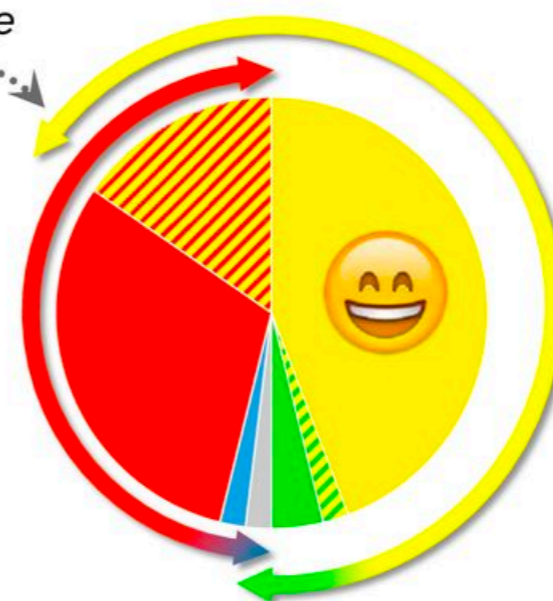


Shift in Valence
 McNemar's test
 $p < 0.0001$

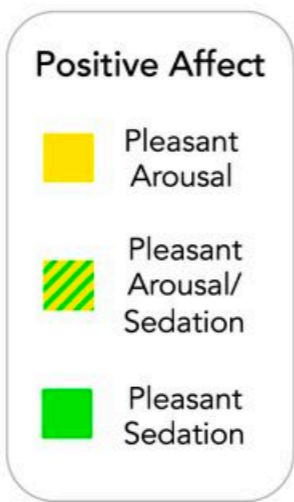
C Cocaine at home (mismatch)



D Cocaine outside the home



Shift in Valence
 McNemar's test
 $p = 0.0014$



SUPPLEMENTARY EXAMPLES

Drawing data, protocols & concepts

Martin Krzywinski

martink@bcgsc.ca

<http://mkweb.bcgsc.ca>

@MKrzywinski

Canada's Michael Smith Genome Sciences Center
Vancouver, Canada

rethink order of data panels
and emphasize trends across them

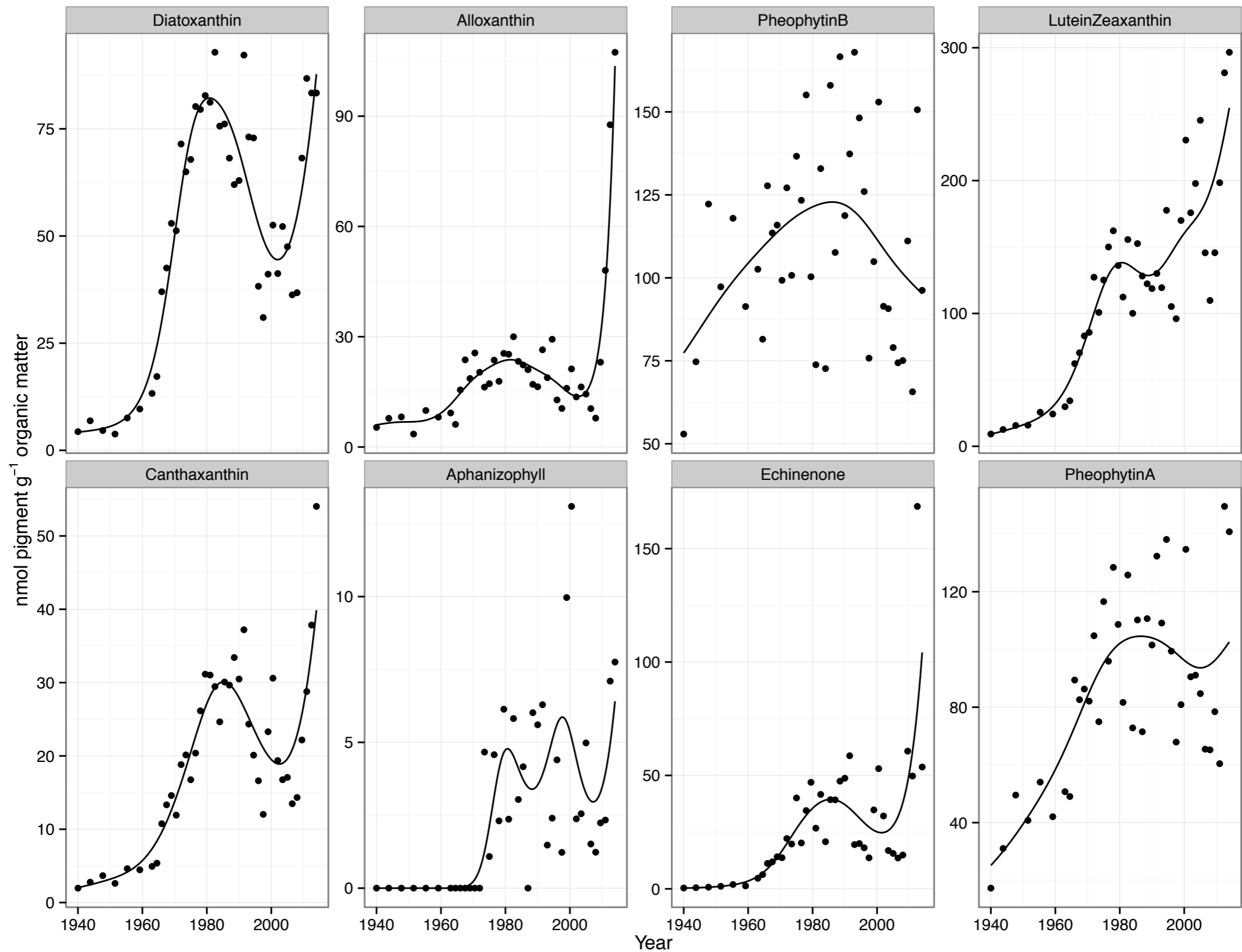
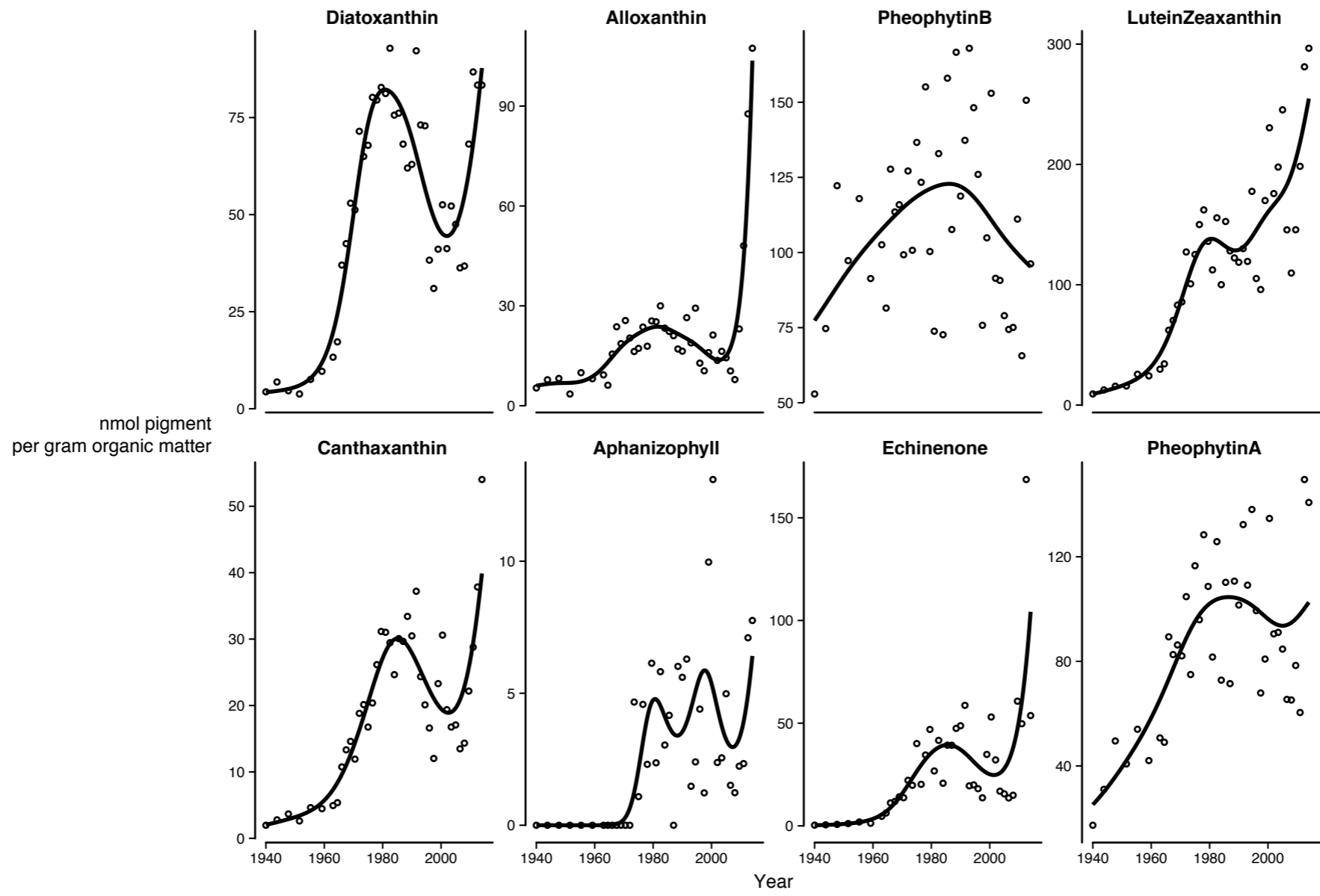
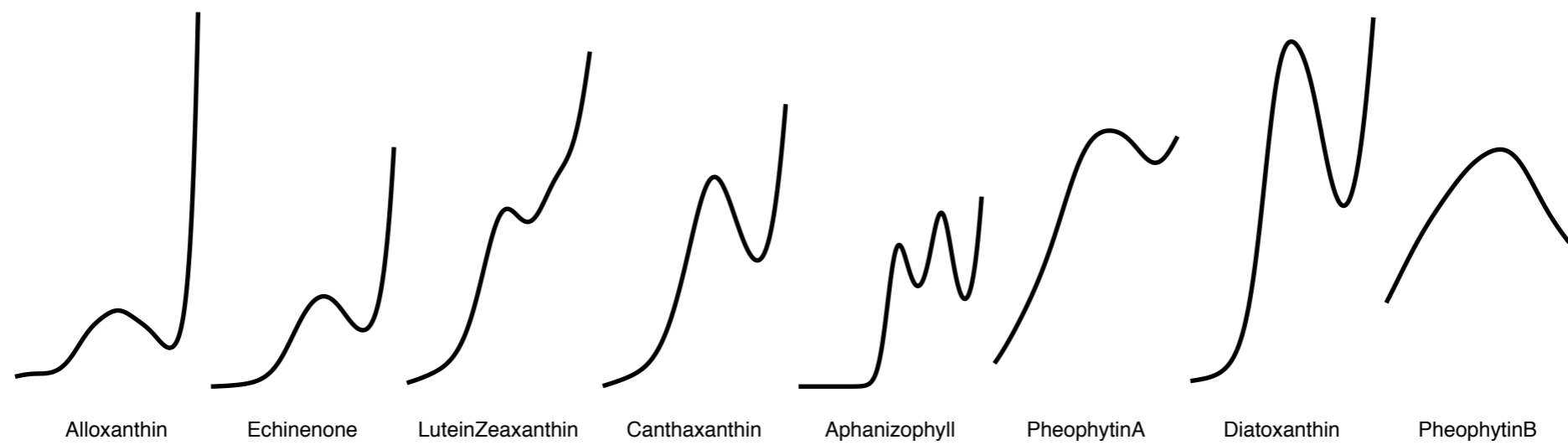
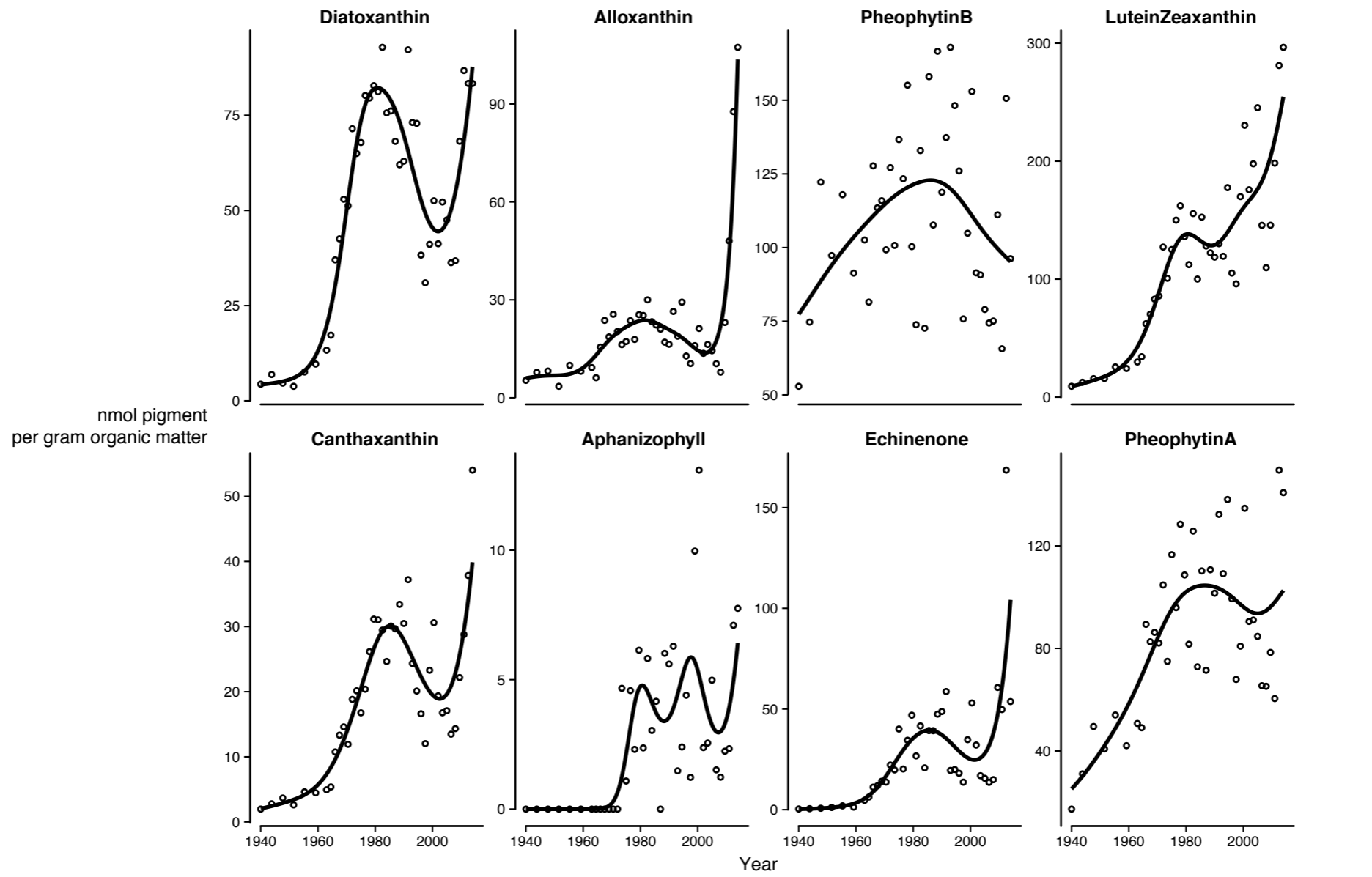
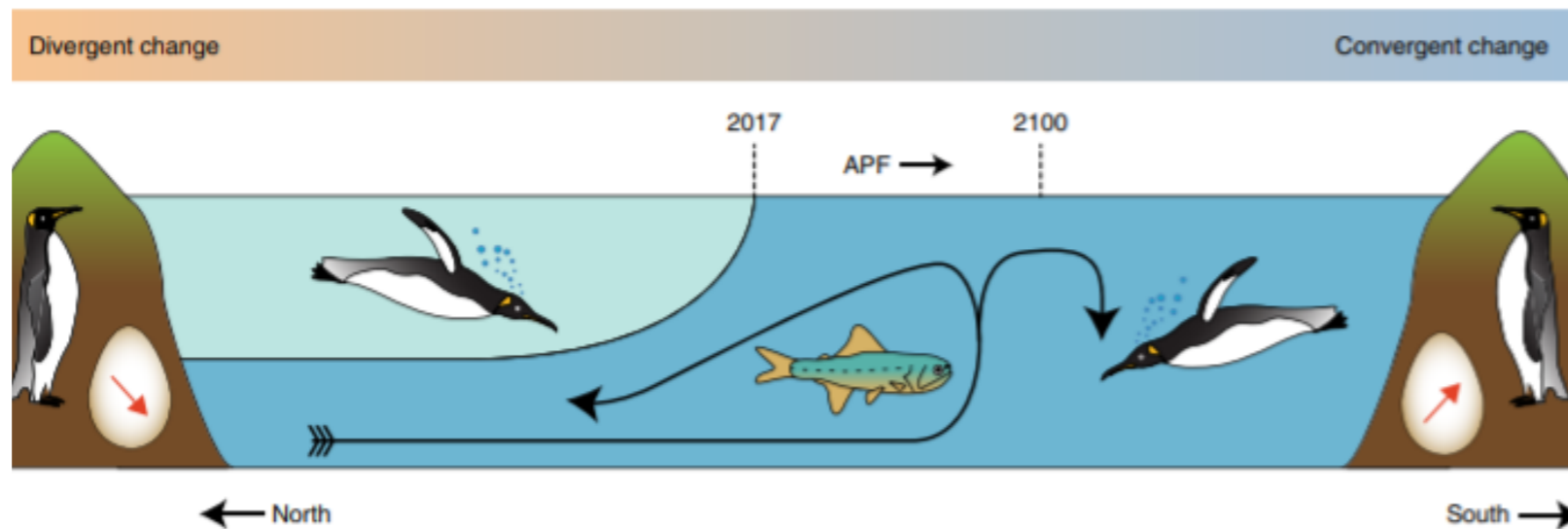
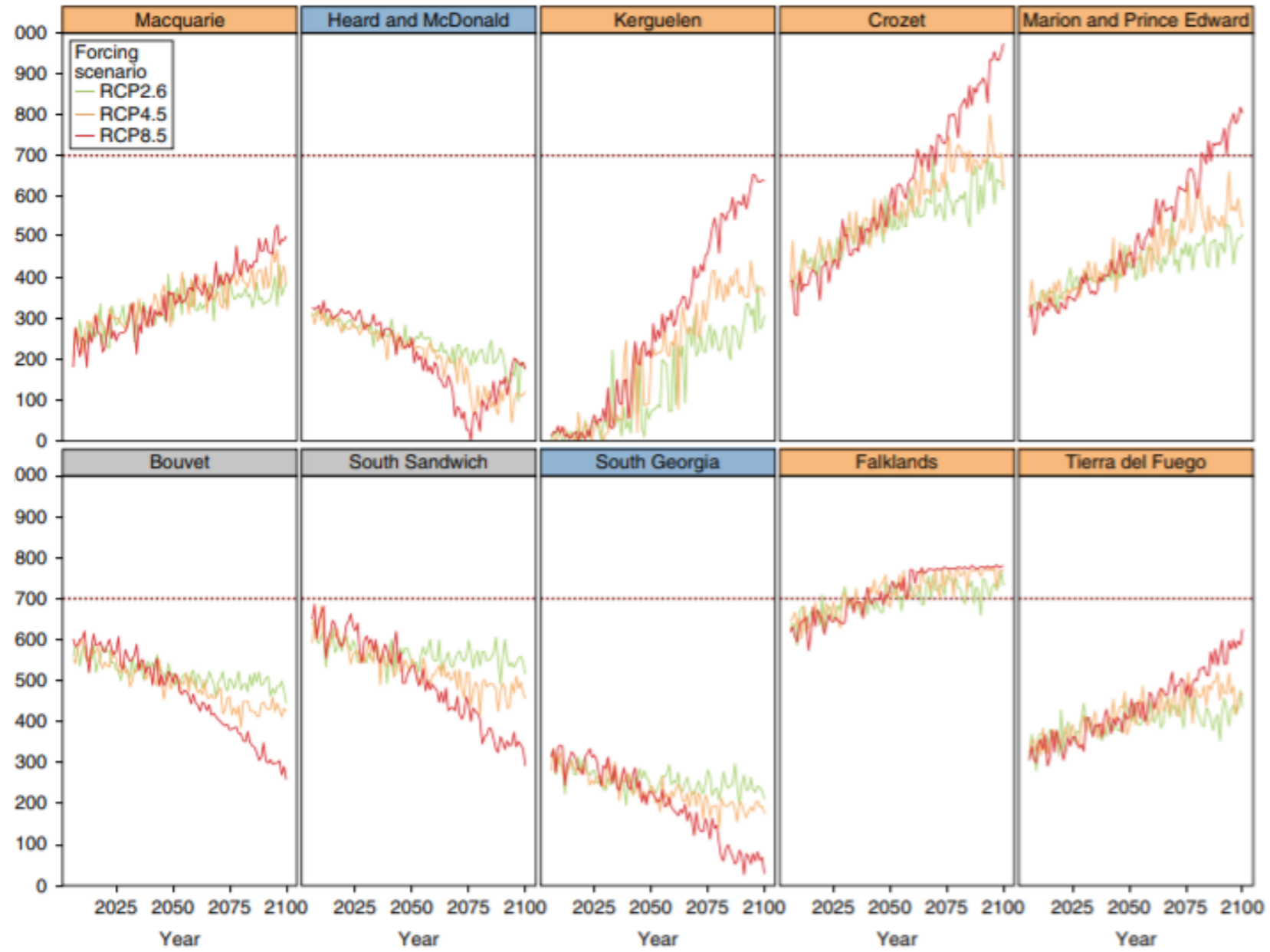
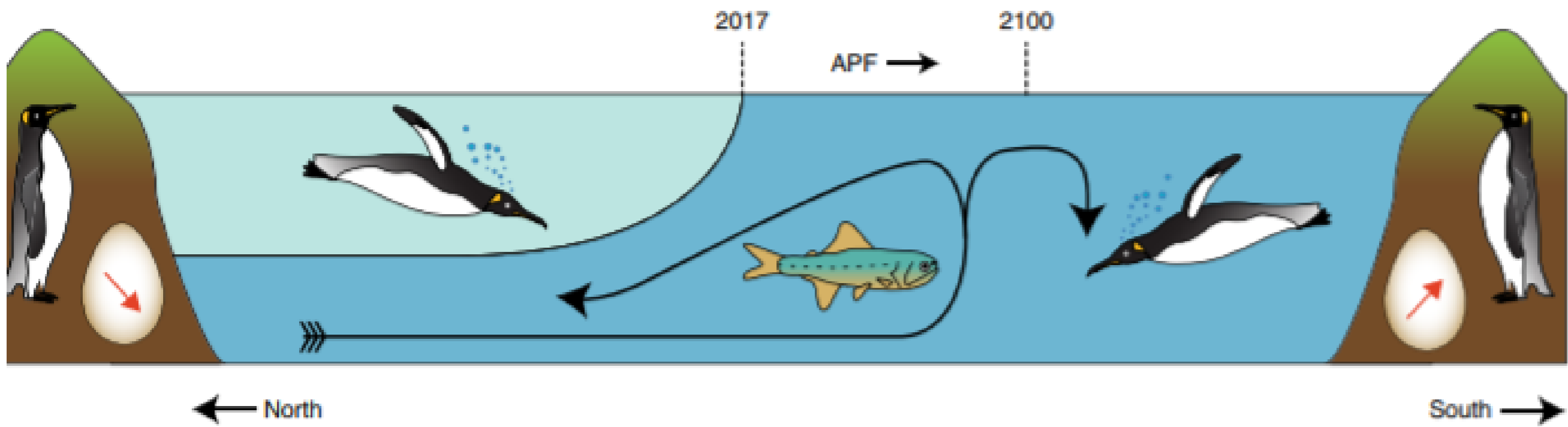
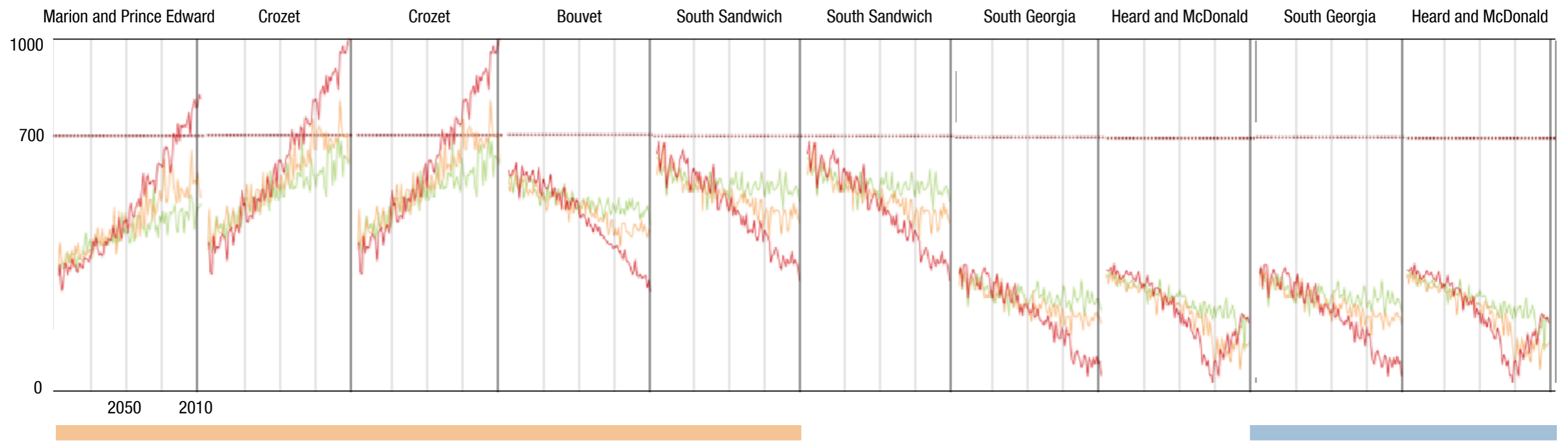


Figure 4. Concentrations of select fossil pigments throughout time in sediments from Pelican Lake. Pigment concentration was determined by HPLC analysis.





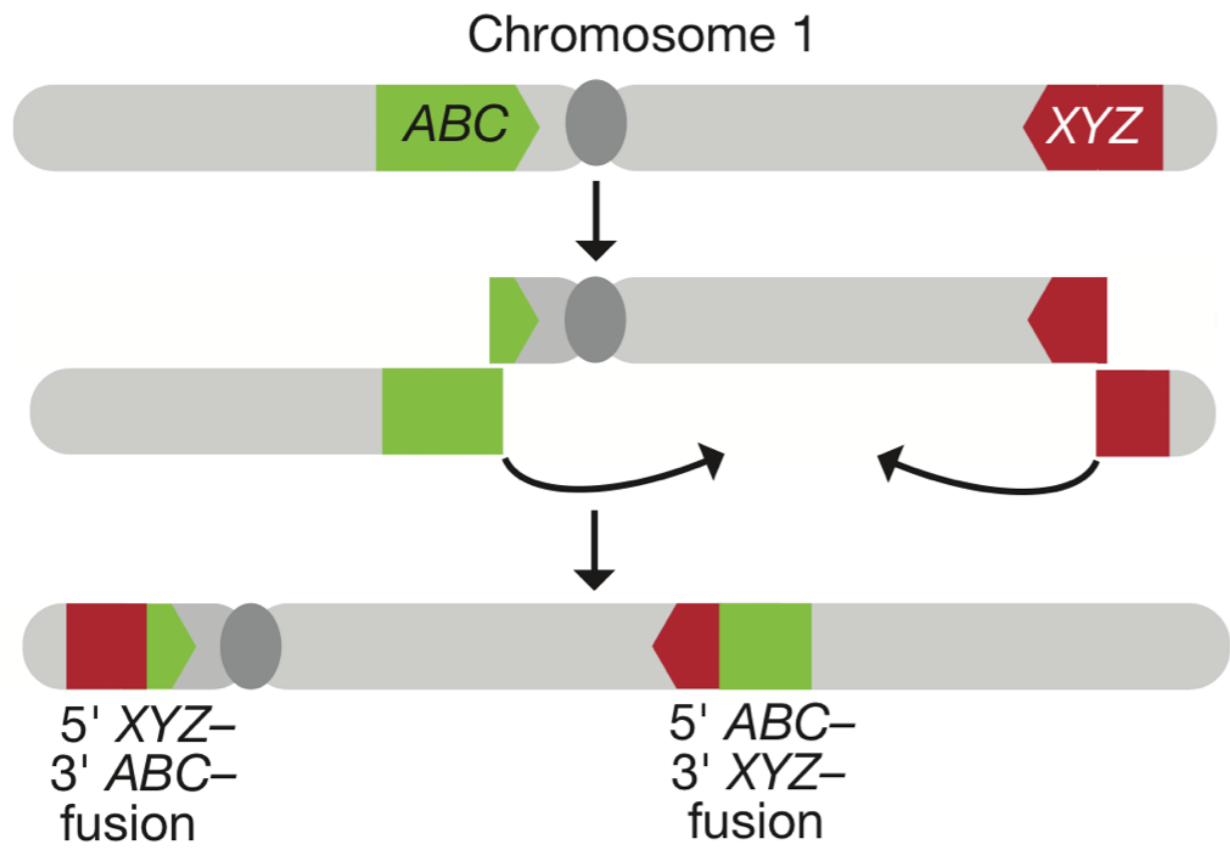


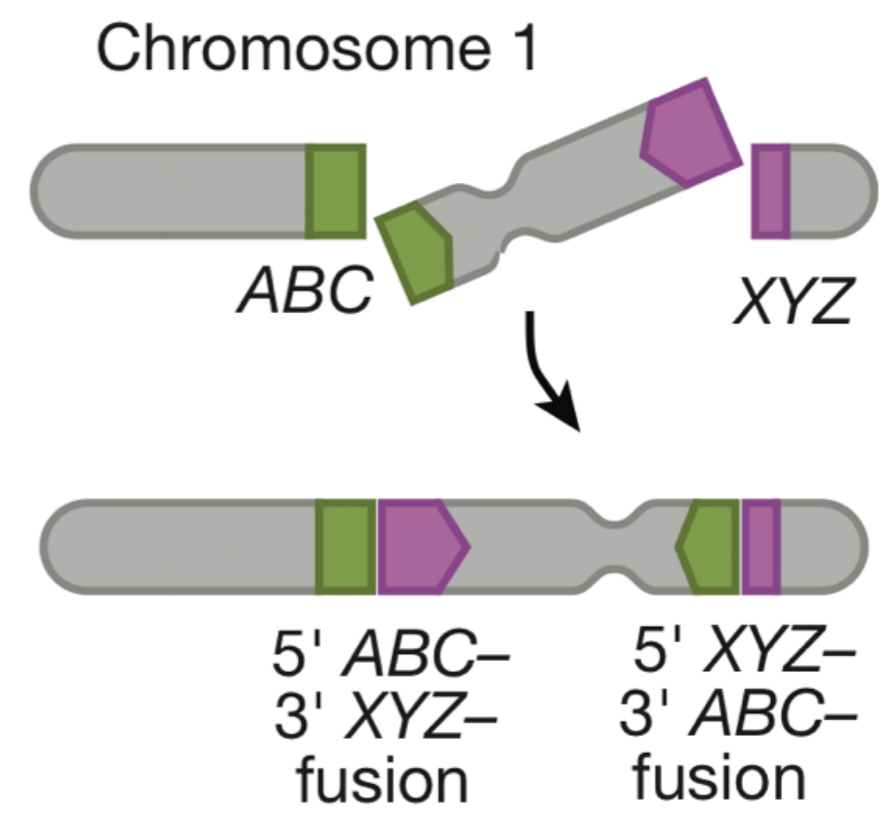
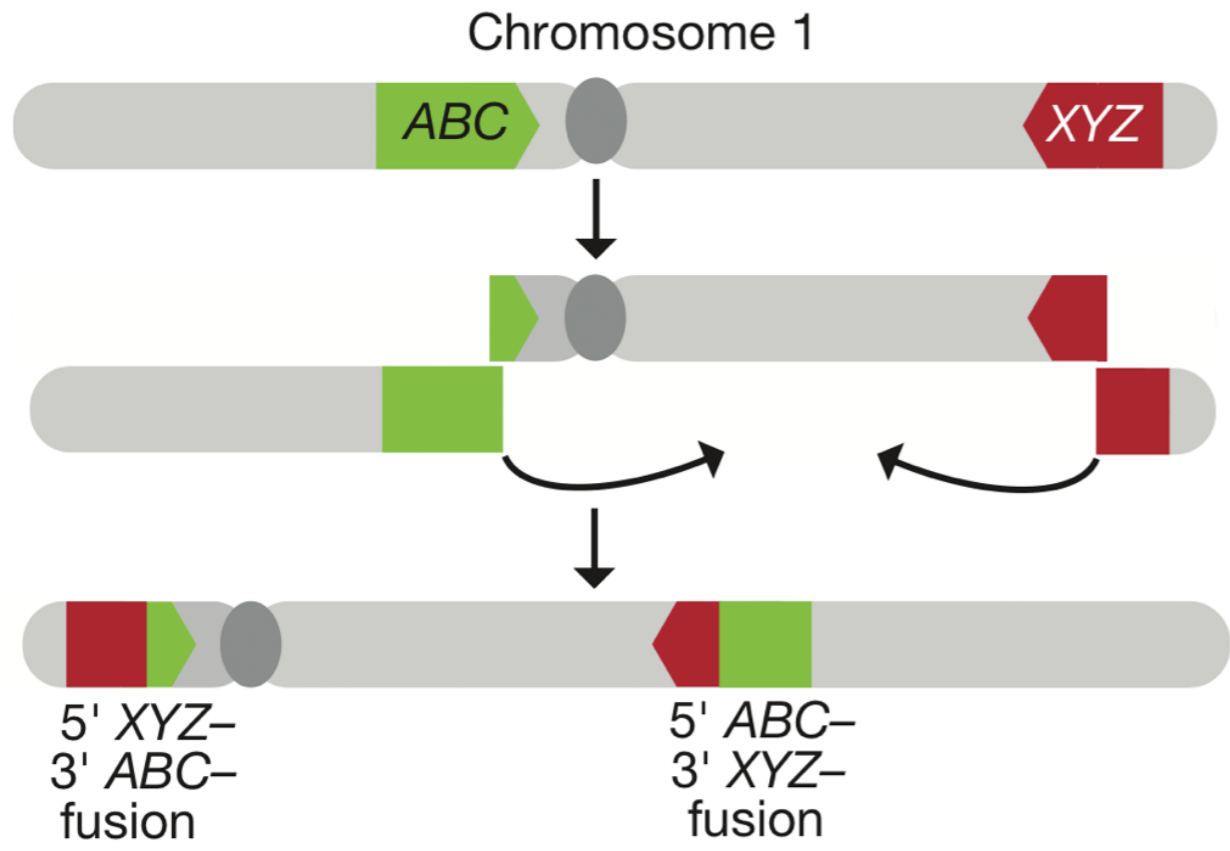


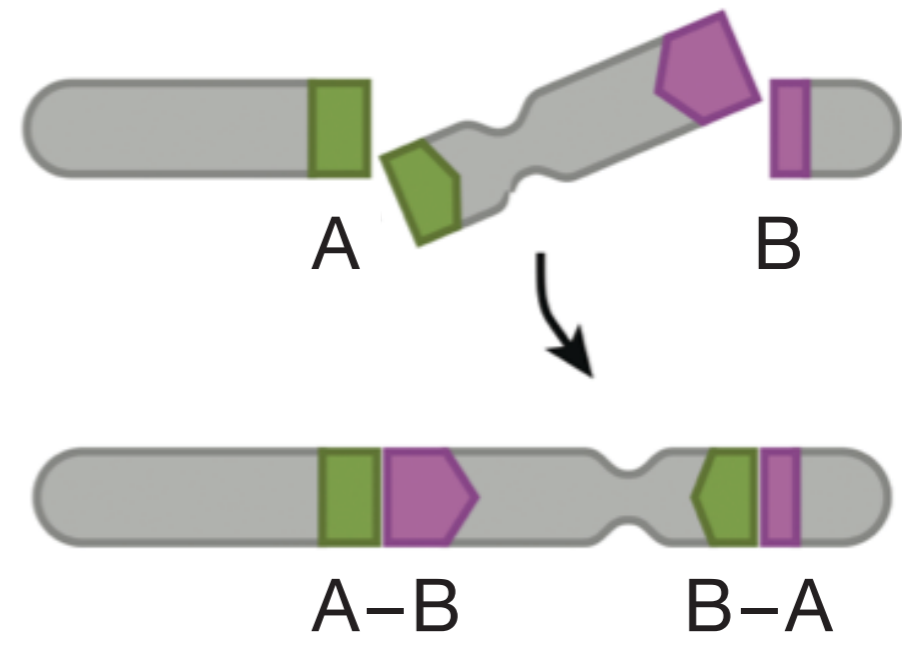
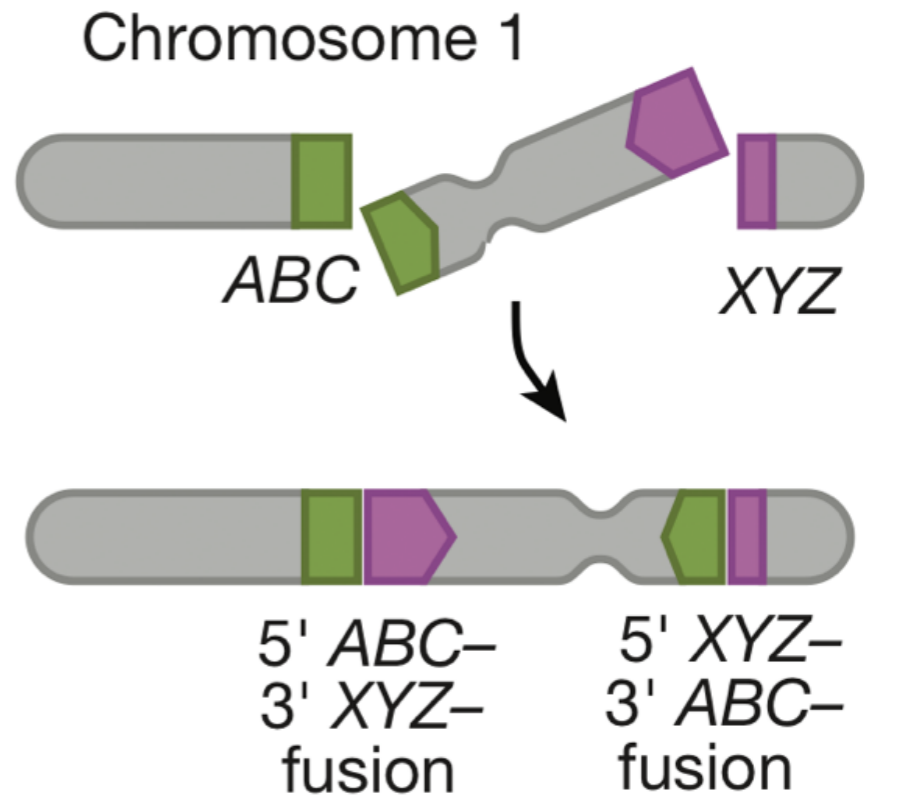
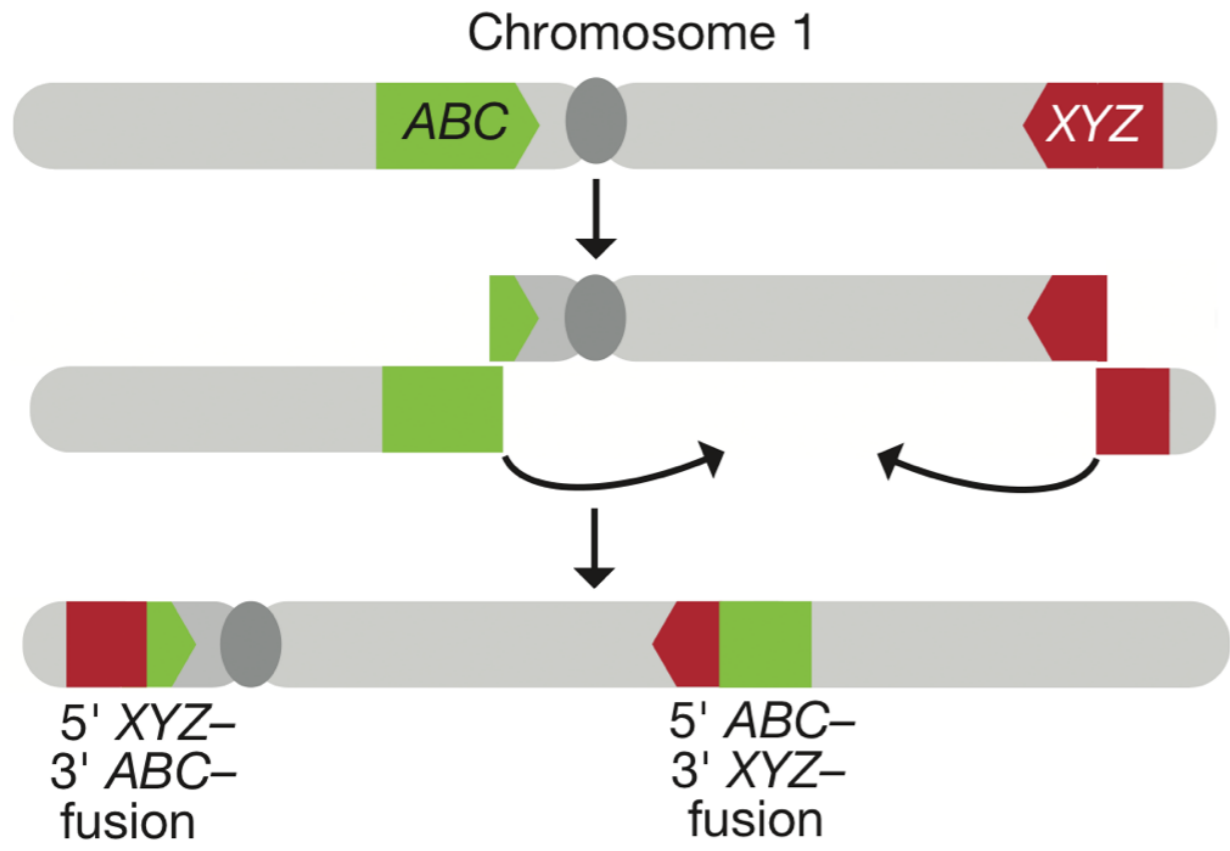
find the essence of the figure
discard all else



Consider a spherical cow
of radius R \square







fusions

thick line borders in tables add clutter

align the things that need to be compared

Stage 1: Food Self-Administration Training & Surgery

Pellet Retrieval <i>(1-2 Days)</i>	FR1 Taking <i>(2 Days)</i>	FR1-3 Seeking + FR1 Taking <i>(9 Days Total)</i>	Surgery + Recovery <i>(Jugular Catheter & Intracranial Cannula)</i>
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Stage 2: Cocaine Self-Administration Training & Tests for Addiction-Like Behavior

Infusion Criteria 10 FR1 <i>(2 Days)</i>	Infusion Criteria 20 FR1 <i>(3 Days)</i>	Infusion Criteria 40 FR1 <i>(4 Days)</i>	Behavioral Economic Threshold <i>(5 Days)</i>	Behavioral Economic Punishment <i>(3 Days)</i>
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Stage 3: Puzzle Self-Administration Procedure (PSAP) & Drug-Seeking Tests

PSAP/IntA 1-20 <i>(5 Days/Week, 4 Weeks)</i>	Seeking 1 <i>(Veh or Flu, 1 Day)</i>	PSAP/IntA 21-22 <i>(2 Days)</i>	Seeking 2 <i>(Veh or Flu, 1 Day)</i>	PSAP/IntA 23-24 <i>(2 Days)</i>	Seeking 3 <i>(Veh or Flu, 1 Day)</i>	PSAP/IntA 25-26 <i>(2 Days)</i>
--	--	---	--	---	--	---

Stage 4: Final Tests for Addiction-Like Behavior

Behavioral Economic Threshold <i>(2 Days)</i>	Behavioral Economic Punishment <i>(2 Days)</i>	PSAP/IntA 27-28 <i>(2 Days)</i>	SAL & COC Reinstatement <i>(1 Day Each)</i>	Extinction <i>(7 Days)</i>	Cue-Induced Reinstatement <i>(1 Day)</i>
---	--	---	---	--------------------------------------	--

1 FOOD SELF-ADMINISTRATION TRAINING & SURGERY

- pellet retrieval
- FR1 taking
- FR1–3 seeking & FR1 taking
- surgery & recovery (jugular catheter & intracranial cannula)

2 COCAINE SELF-ADMINISTRATION TRAINING & TESTS FOR ADDICTION-LIKE BEHAVIOUR

- infusion criteria 10 FR1
- infusion criteria 20 FR1
- infusion criteria 40 FR1
- behavioral economic threshold
- behavioral economic punishment

3 PUZZLE SELF-ADMINISTRATION PROCEDURE (PSAP) & DRUG-SEEKING TESTS

- † PSAP/IntA 1–20
- seeking 1
- PSAP/IntA 21–22
- seeking 2
- PSAP/IntA 23–24
- seeking 3
- PSAP/IntA 25–26

4 FINAL TESTS FOR ADDICTION-LIKE BEHAVIOR

- behavioral economic threshold
- behavioral economic punishment
- PSAP/IntA 27–28
- ‡ SAL & COC reinstatement
- extinction
- cue-induced reinstatement

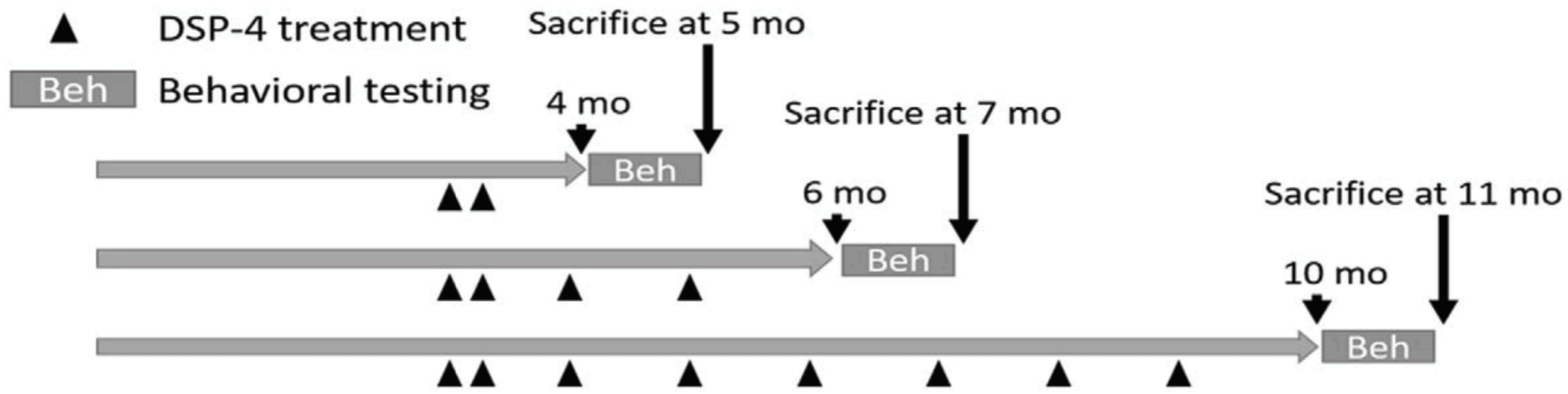
† 5 days/week, 4 weeks

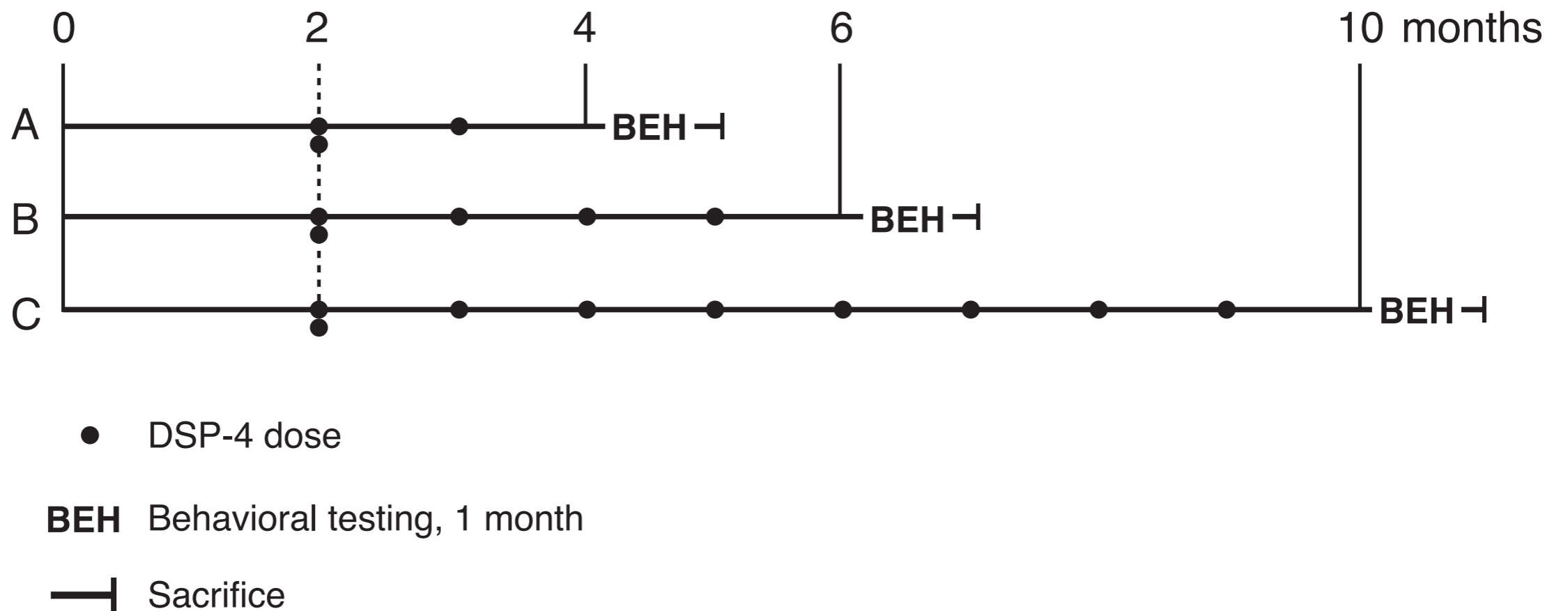
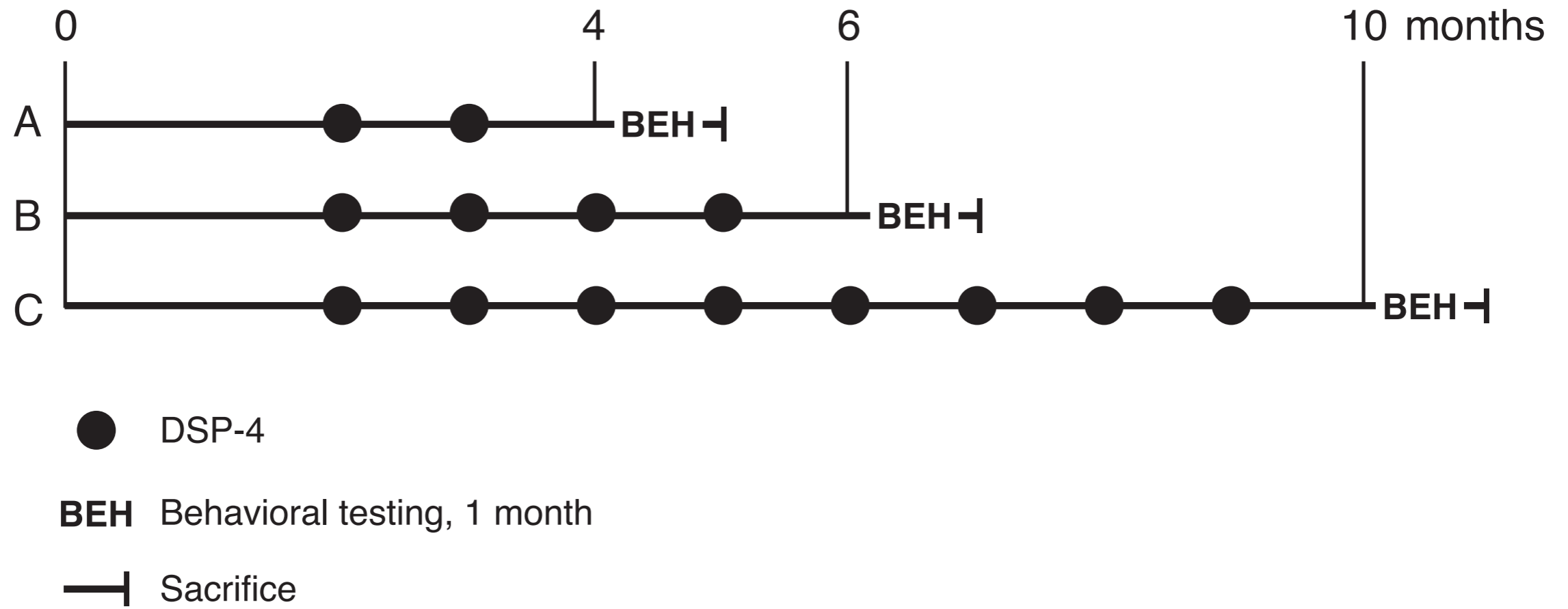
‡ 1 day for each task

- 14 days **1** **FOOD SELF-ADMINISTRATION TRAINING & SURGERY**
- pellet retrieval
 - FR1 taking
 - FR1–3 seeking & FR1 taking
 - surgery & recovery (jugular catheter & intracranial cannula)
- 17 days **2** **COCAINE SELF-ADMINISTRATION TRAINING & TESTS FOR ADDICTION-LIKE BEHAVIOUR**
- infusion criteria 10 FR1
 - infusion criteria 20 FR1
 - infusion criteria 40 FR1
 - behavioral economic threshold
 - behavioral economic punishment
- 29 days **3** **PUZZLE SELF-ADMINISTRATION PROCEDURE (PSAP) & DRUG-SEEKING TESTS**
- † PSAP/IntA 1–20
 - seeking 1
 - PSAP/IntA 21–22
 - seeking 2
 - PSAP/IntA 23–24
 - seeking 3
 - PSAP/IntA 25–26
- 16 days **4** **FINAL TESTS FOR ADDICTION-LIKE BEHAVIOR**
- behavioral economic threshold
 - behavioral economic punishment
 - PSAP/IntA 27–28
 - ‡ SAL & COC reinstatement
 - extinction
 - cue-induced reinstatement

† 5 days/week, 4 weeks

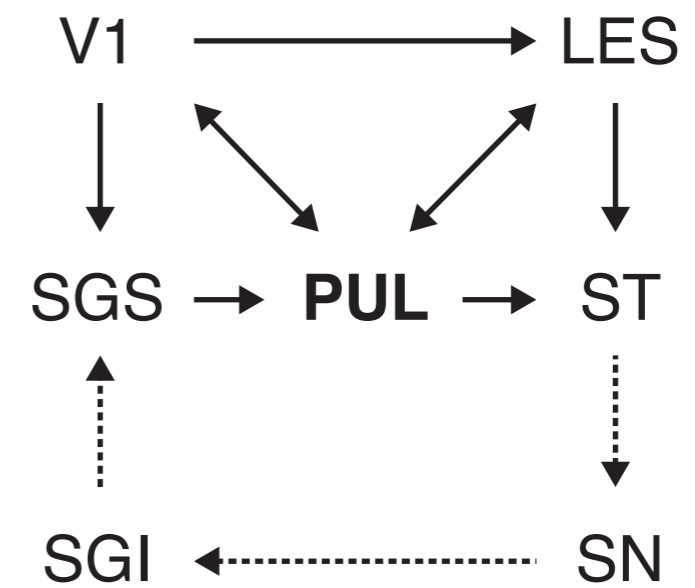
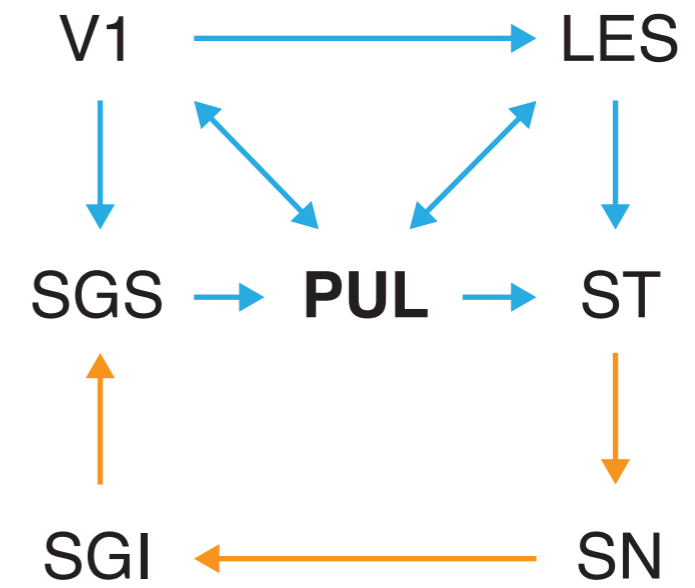
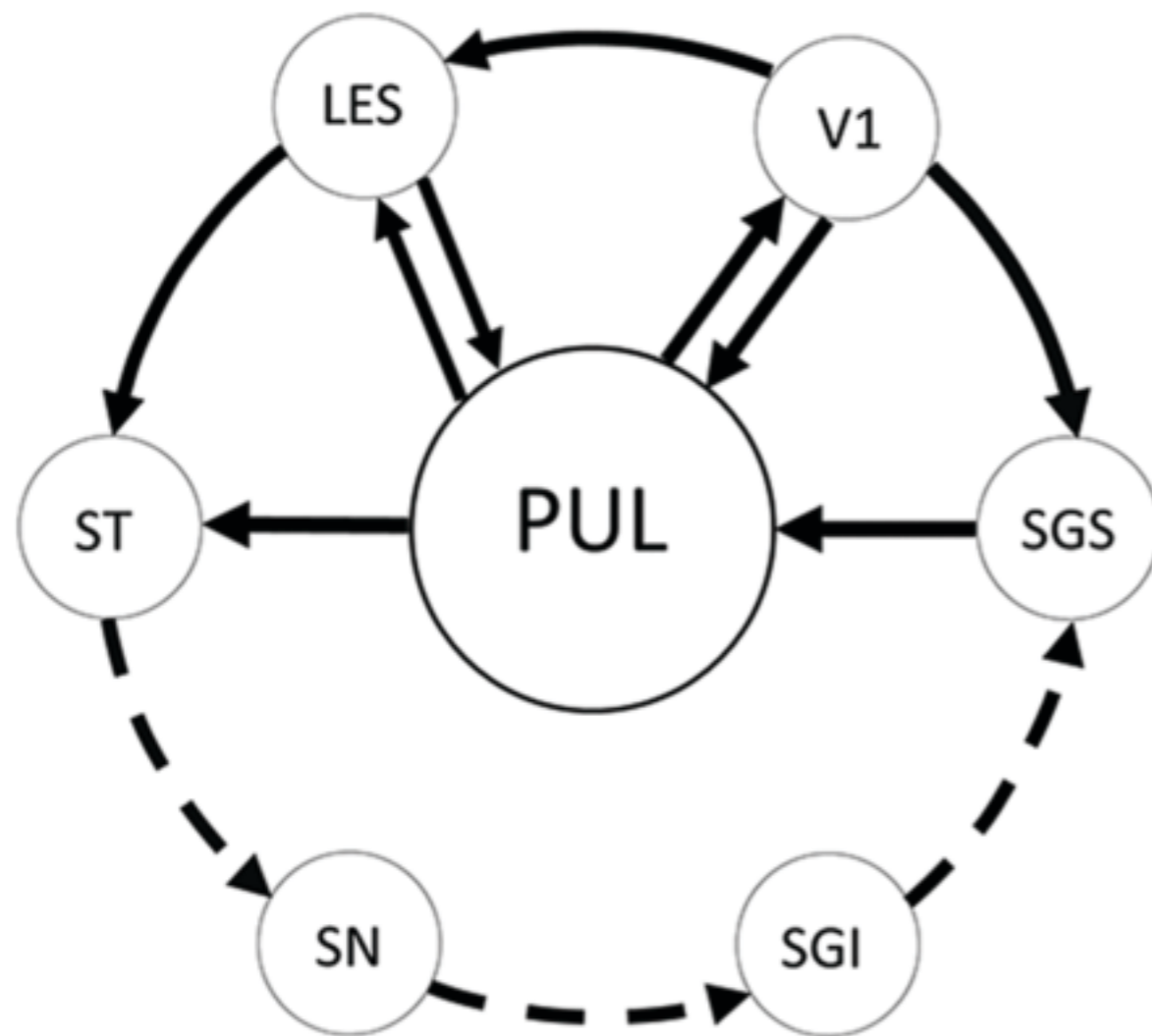
‡ 1 day for each task



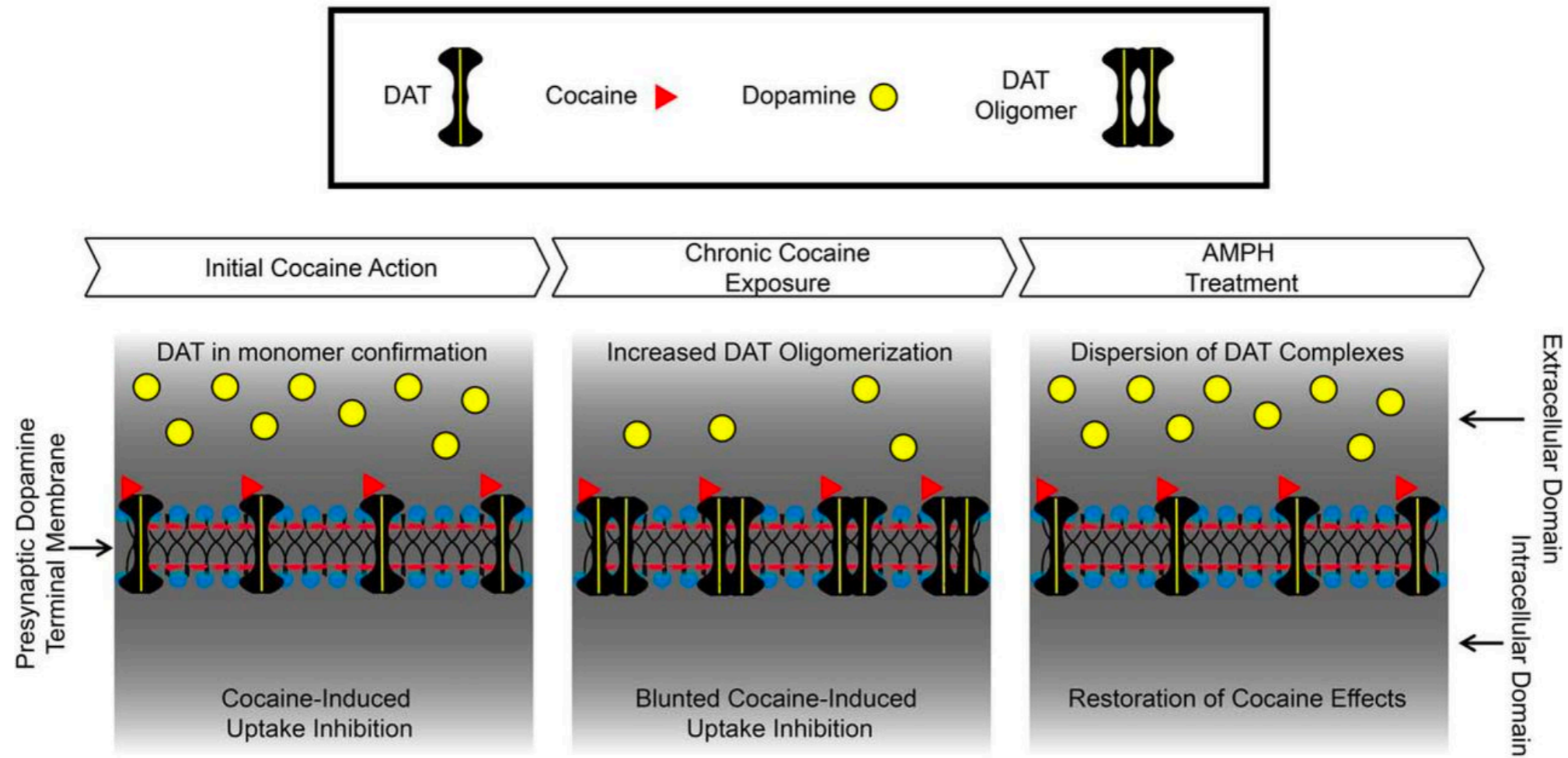


identify the point of asymmetry in the figure

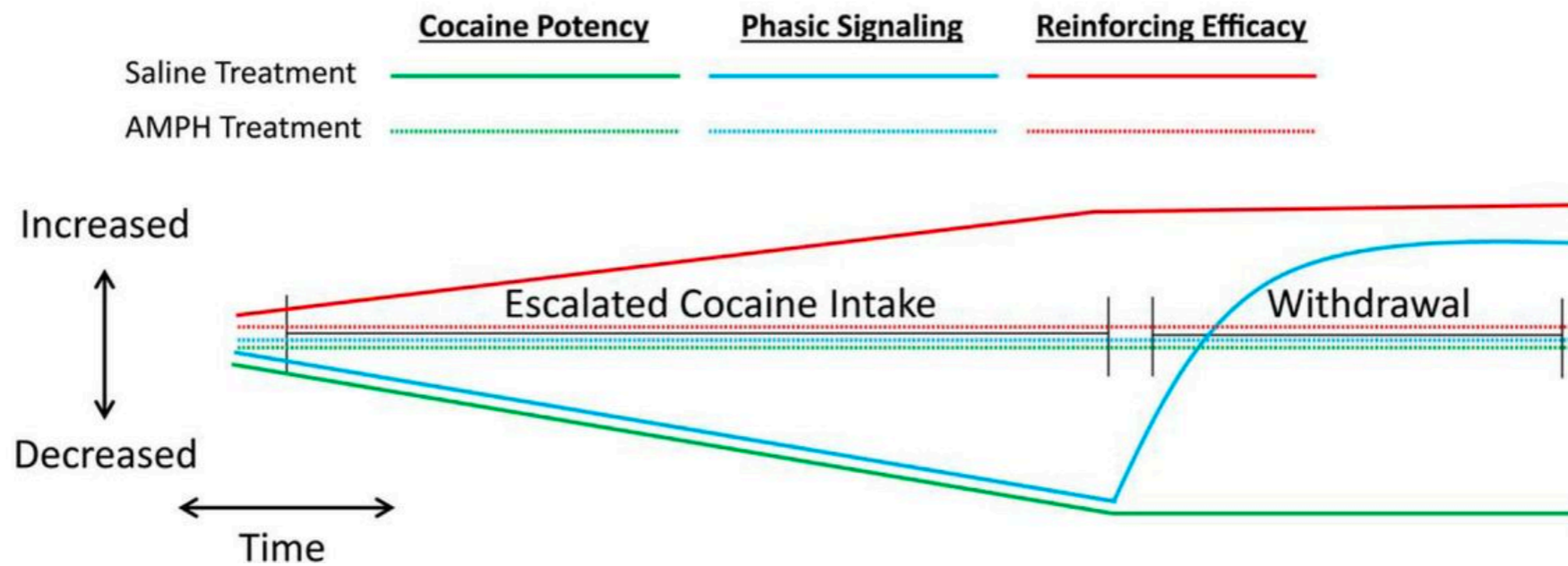
make it as obvious as possible



Mechanism of Cocaine Tolerance and AMPH Rescue



Outcomes of Cocaine Self-Administration and AMPH Treatment

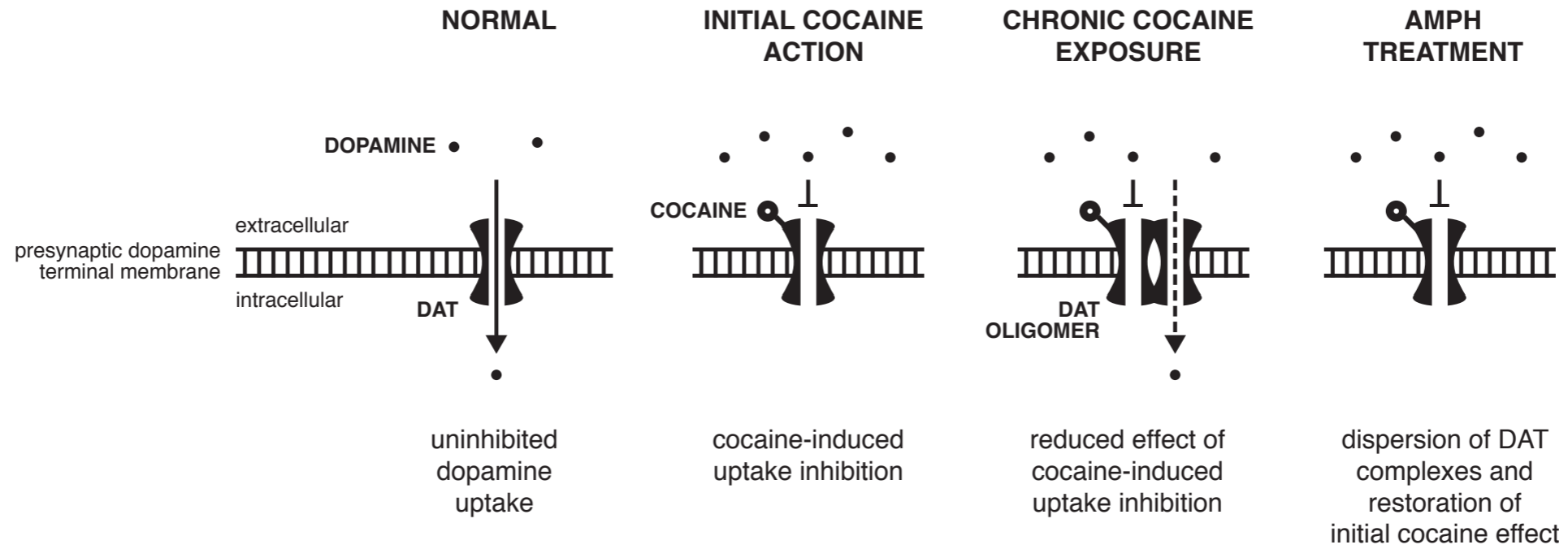


no gradients

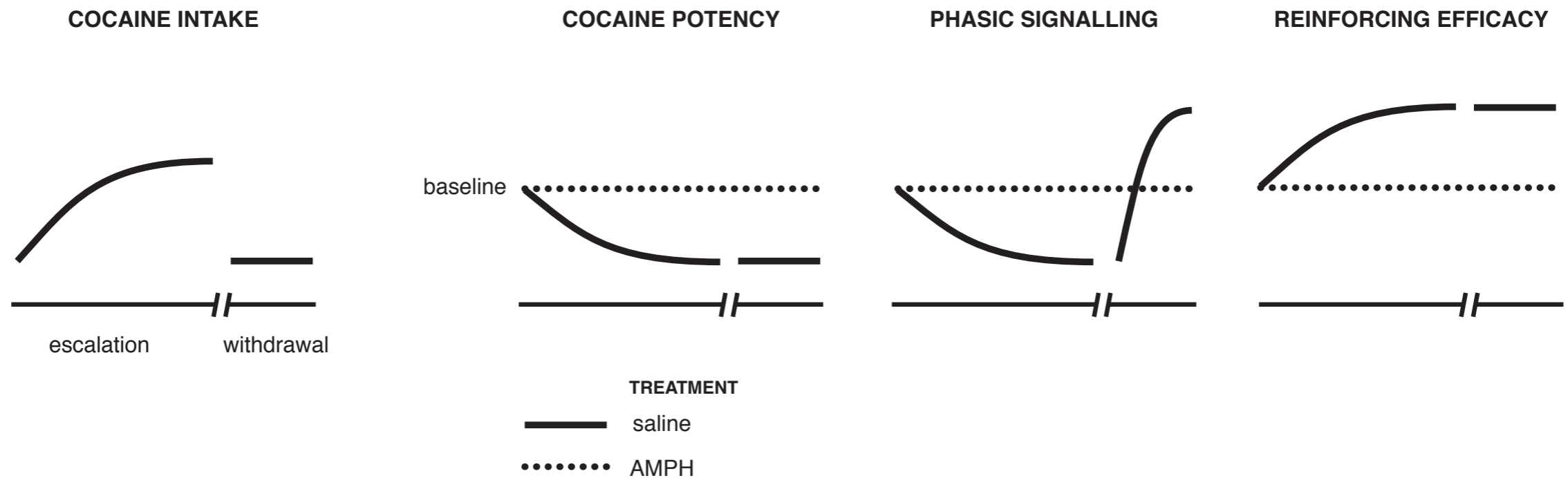
never "make it pretty"

just "make it clear"

Mechanism of cocaine tolerance and AMPH rescue

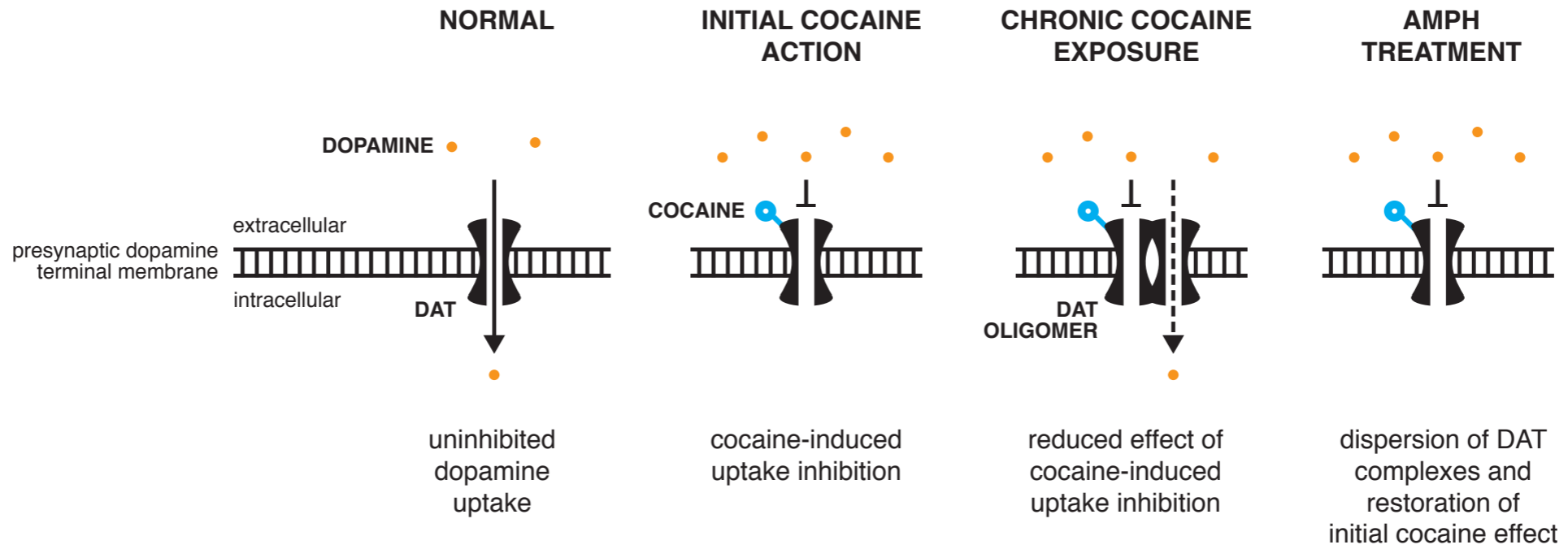


Outcome timelines of cocaine self-administration and AMPH treatment

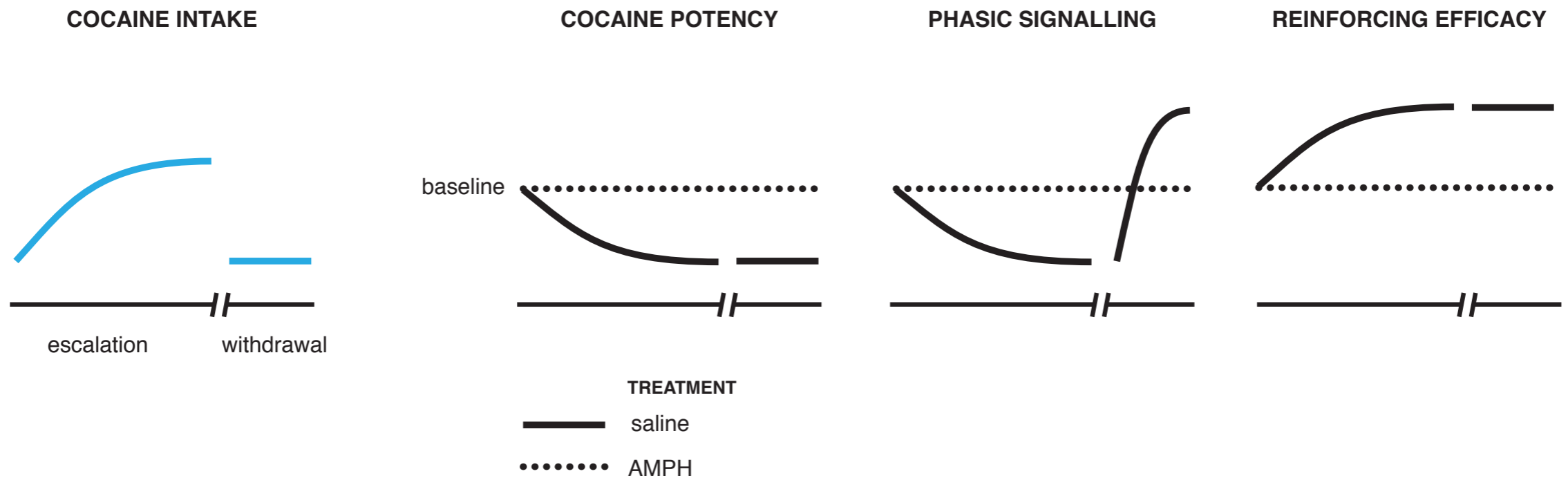


notice how the blue cocaine molecule
matches the blue cocaine intake trace
a spot use of color emphasizes the theme

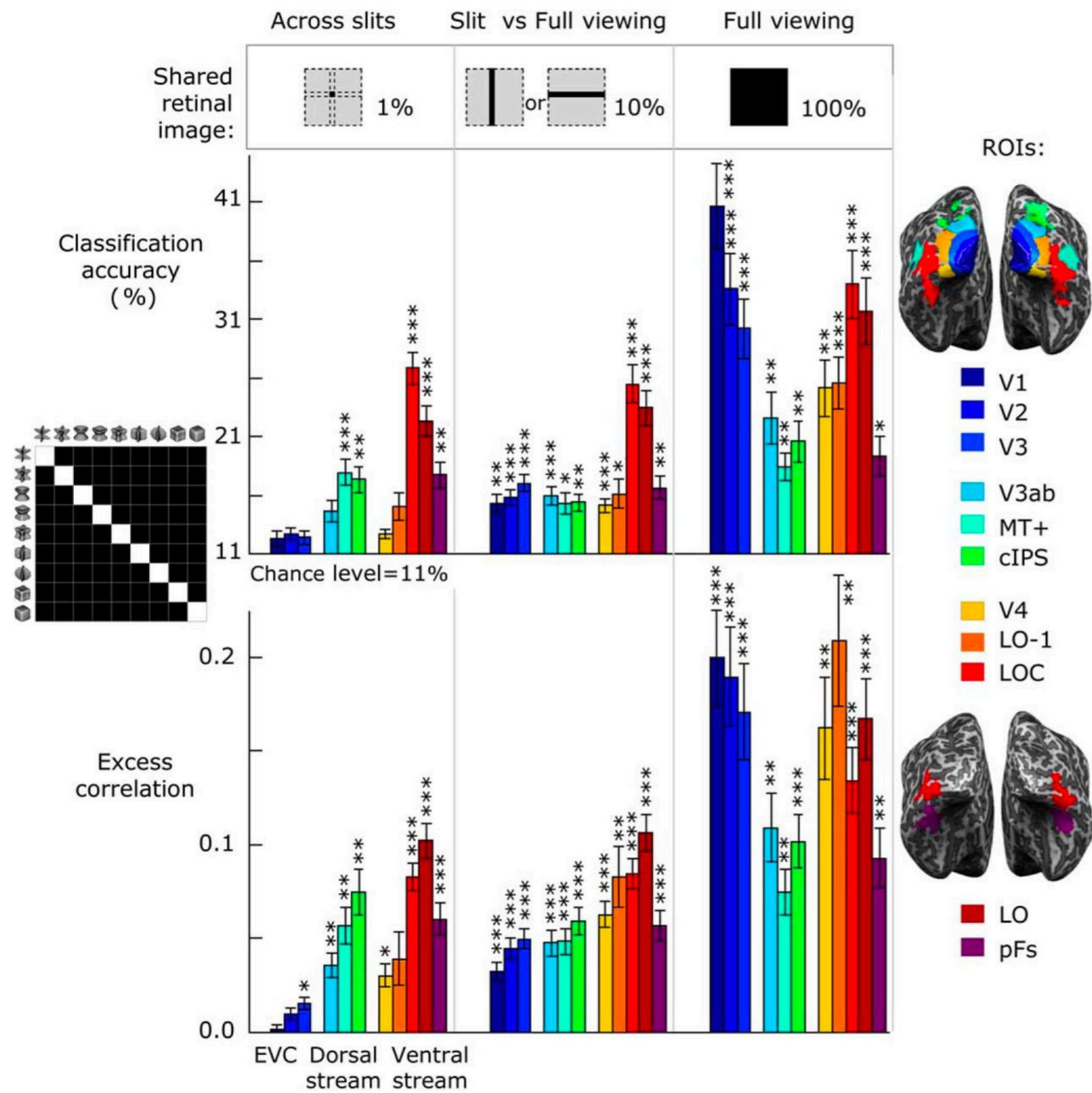
Mechanism of cocaine tolerance and AMPH rescue

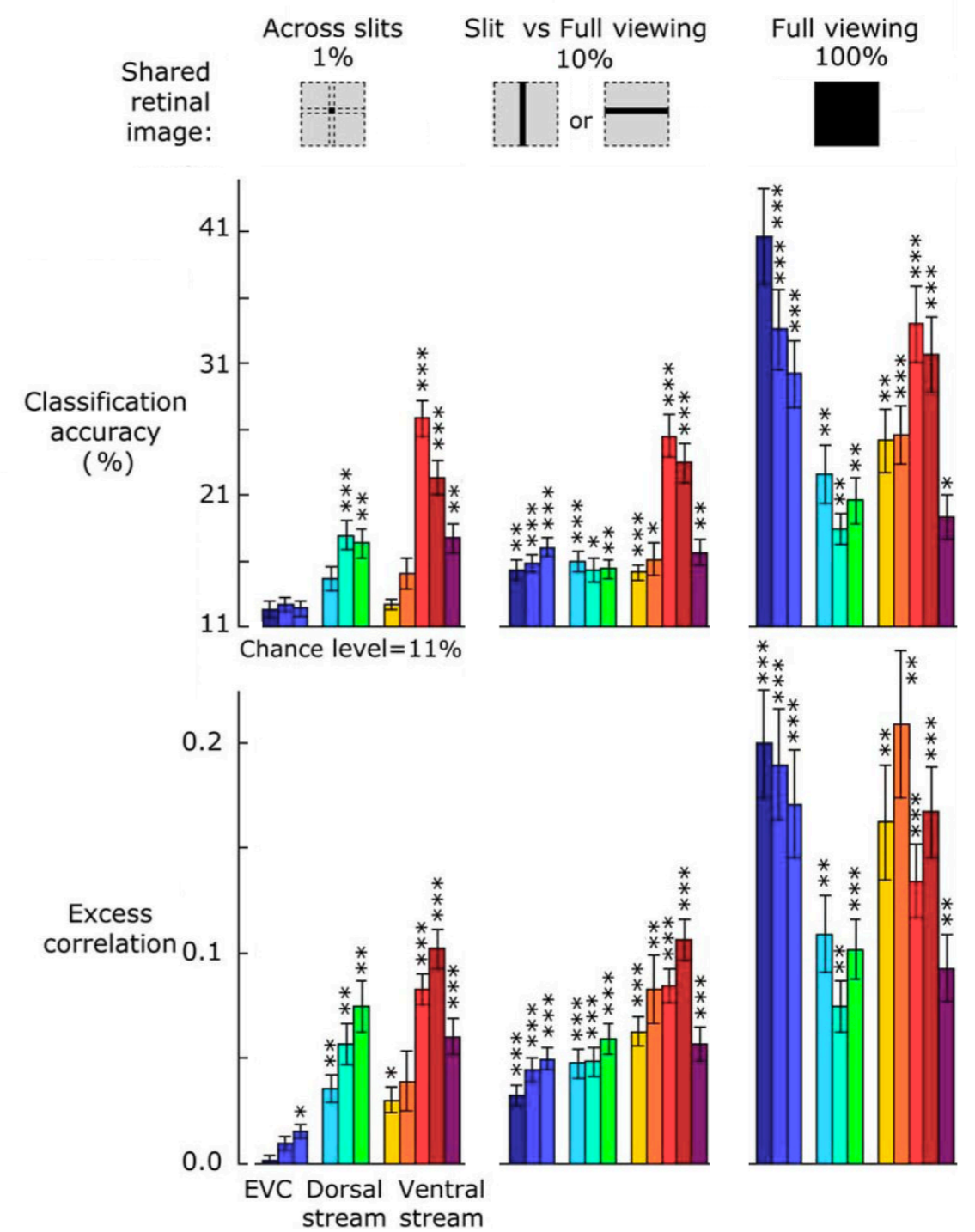
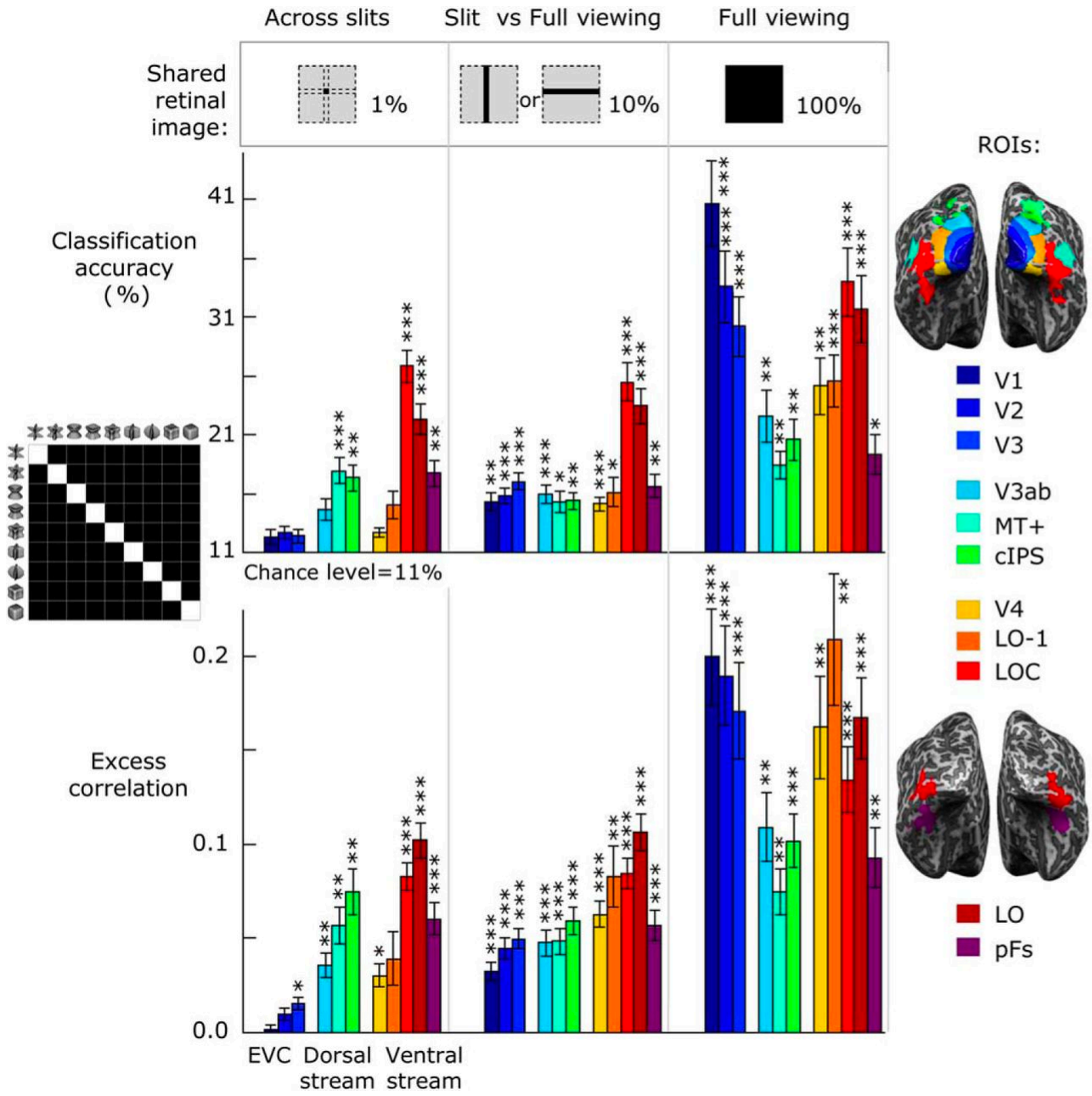
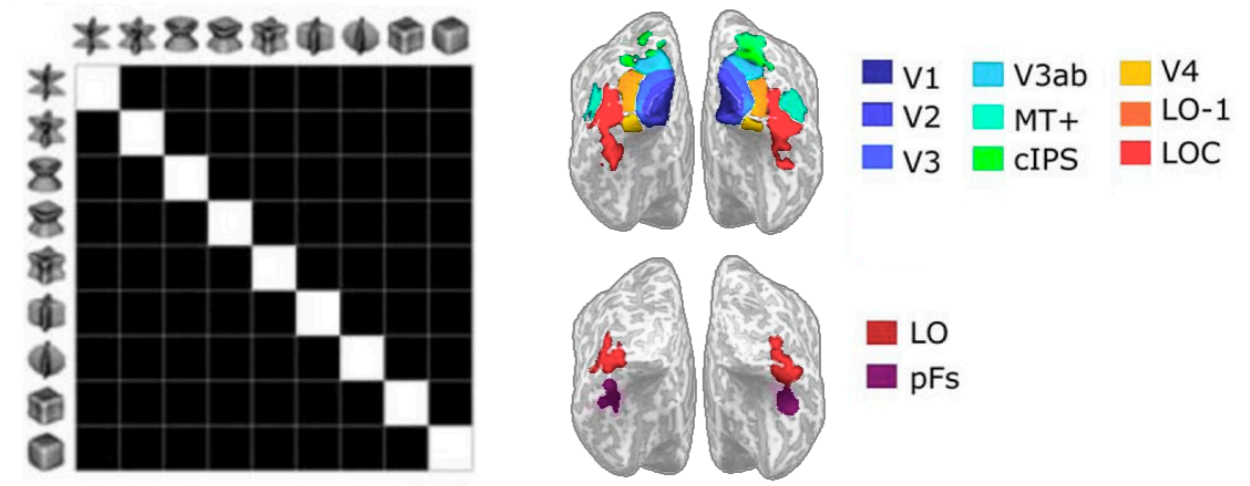


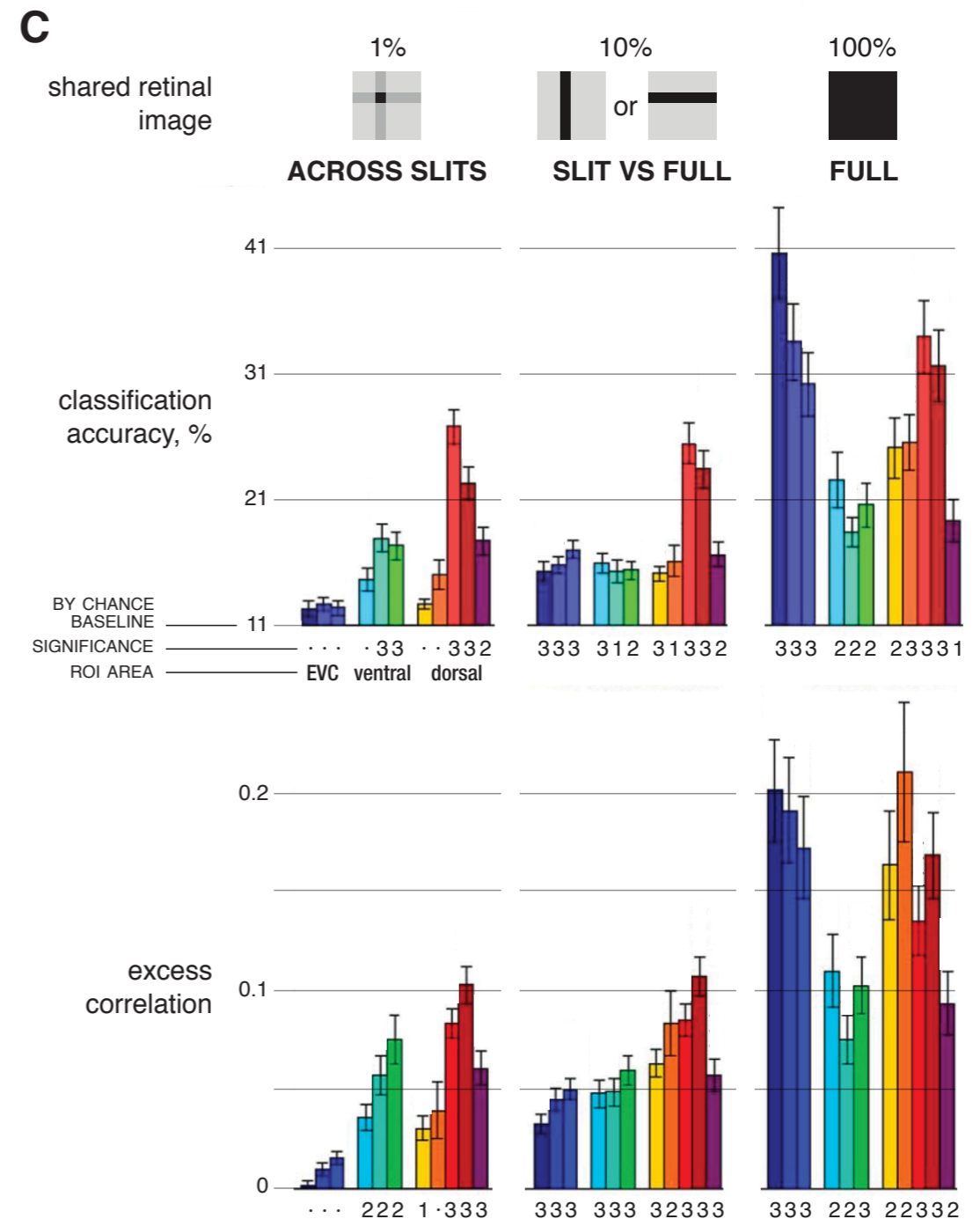
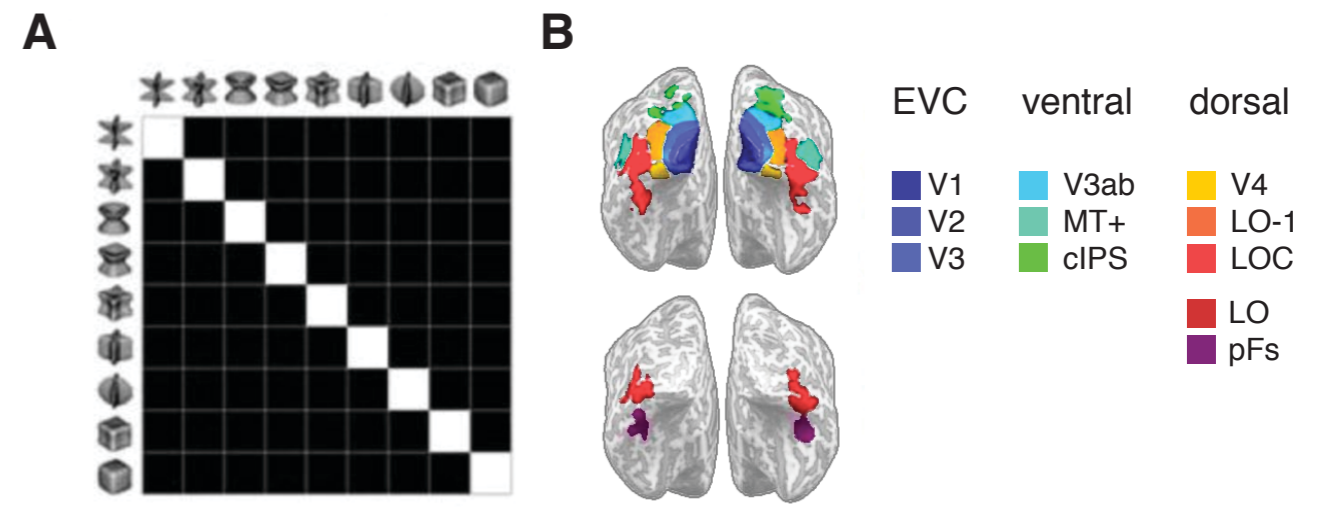
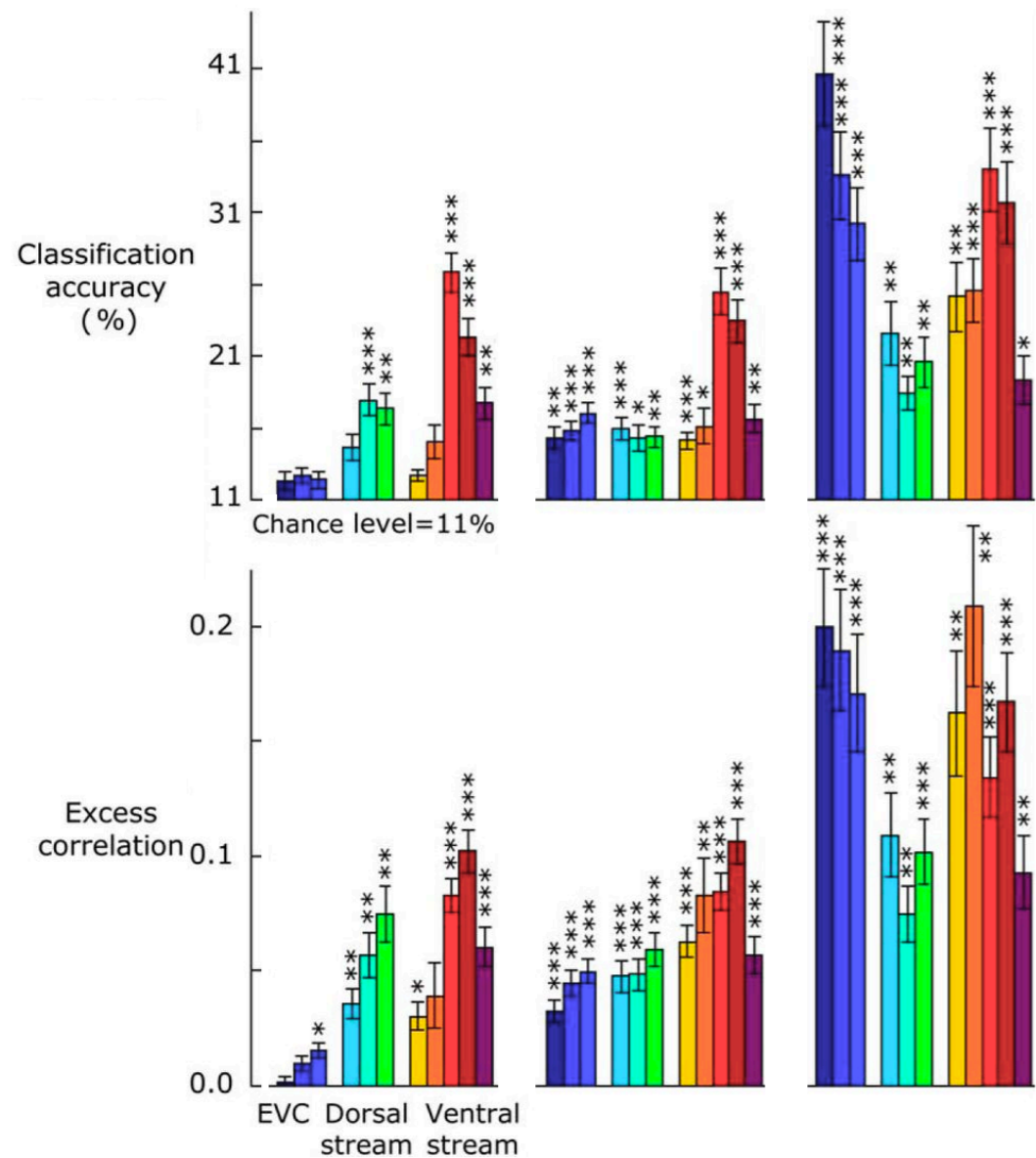
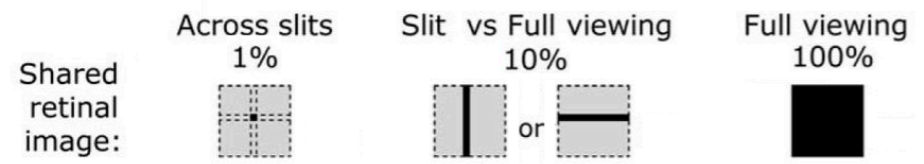
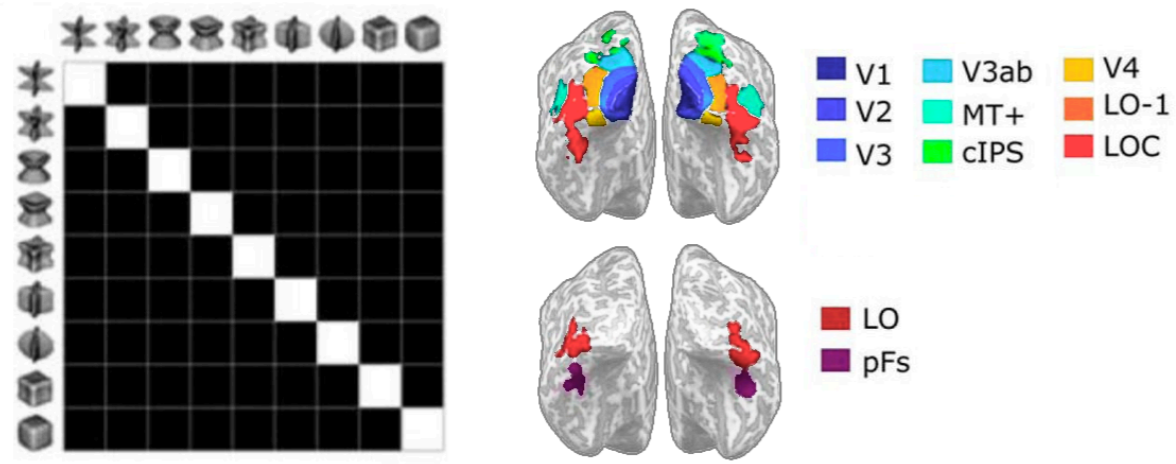
Outcome timelines of cocaine self-administration and AMPH treatment



don't crowd the graphic





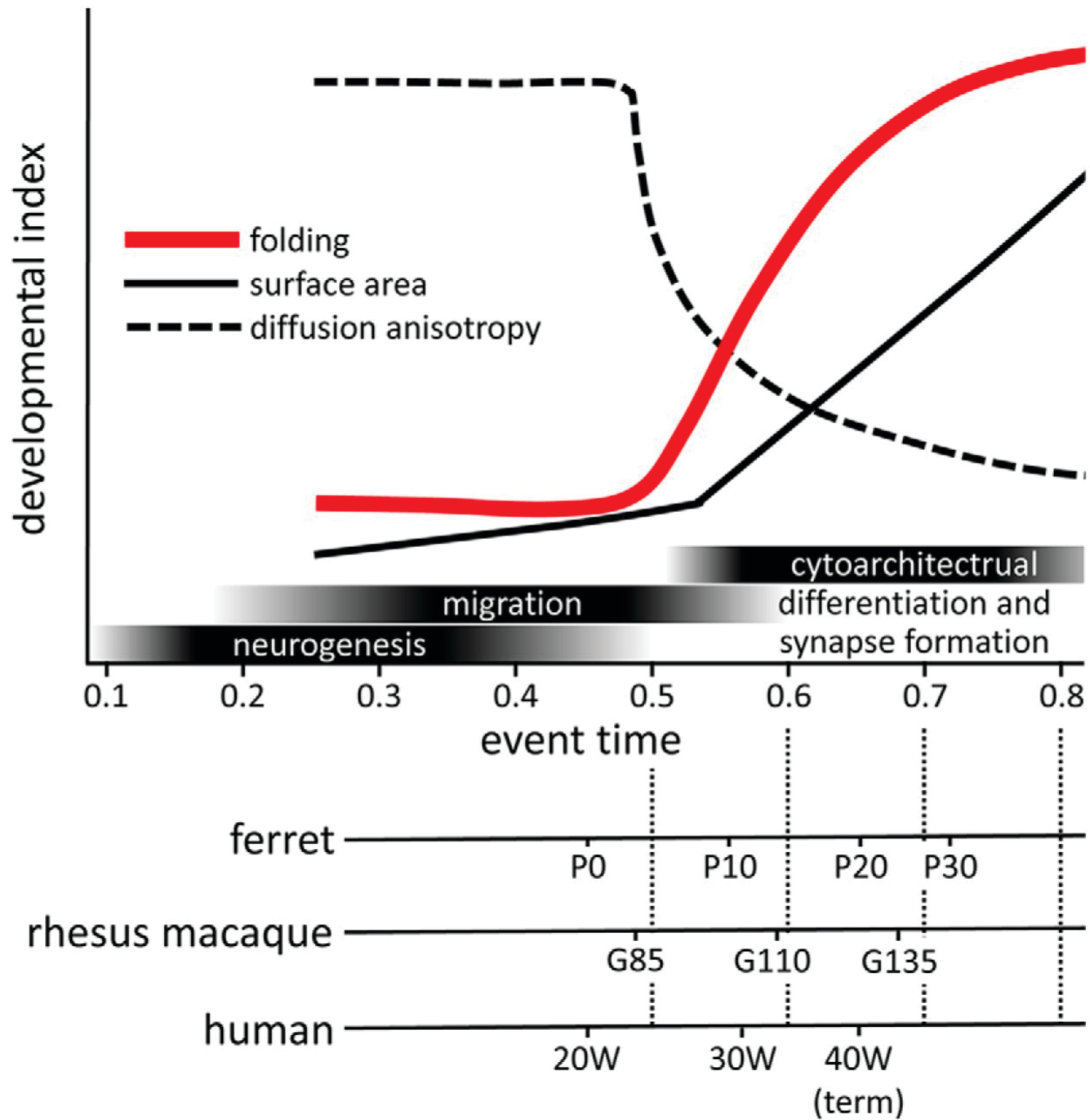


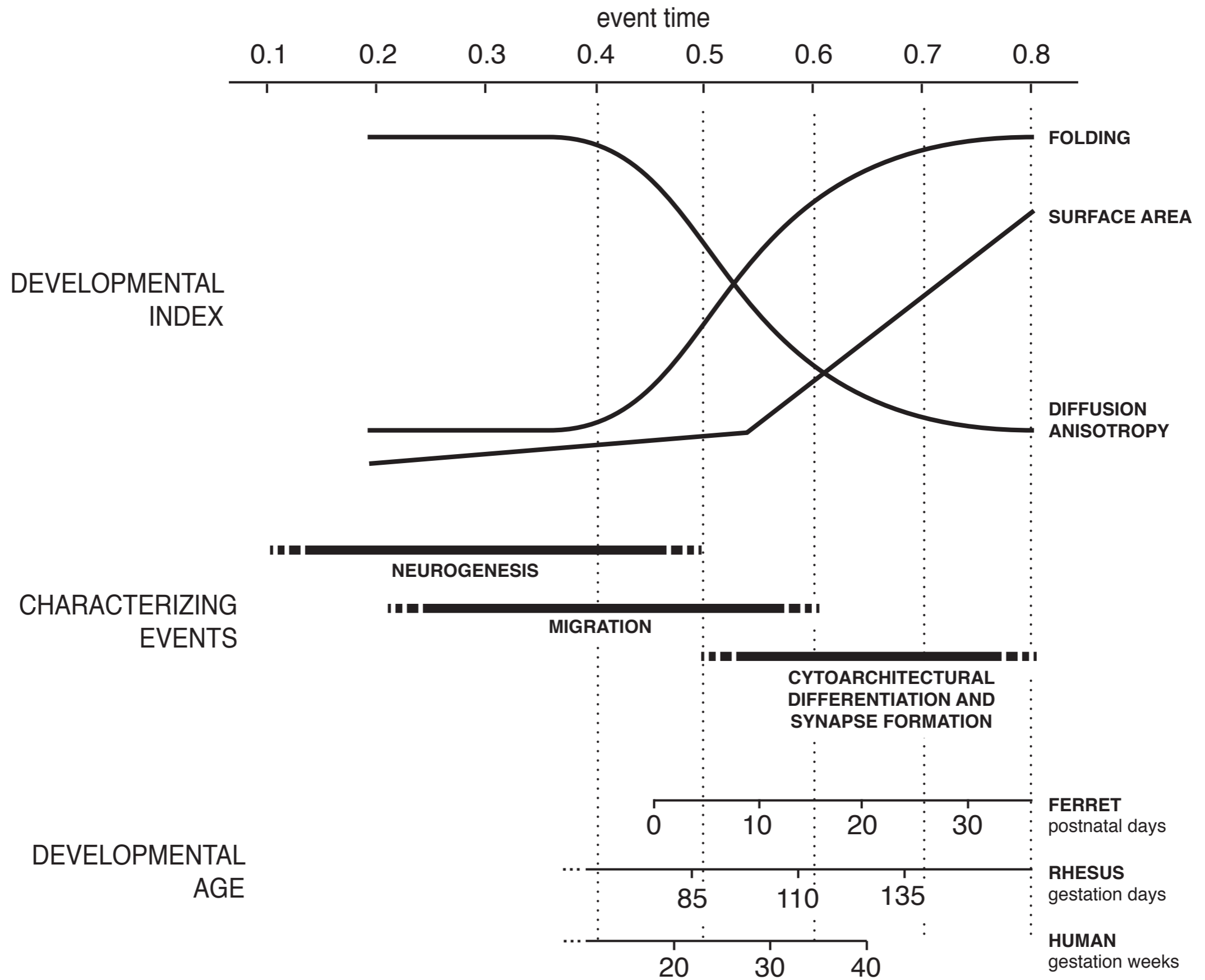
sketches of data trends, just like real data,

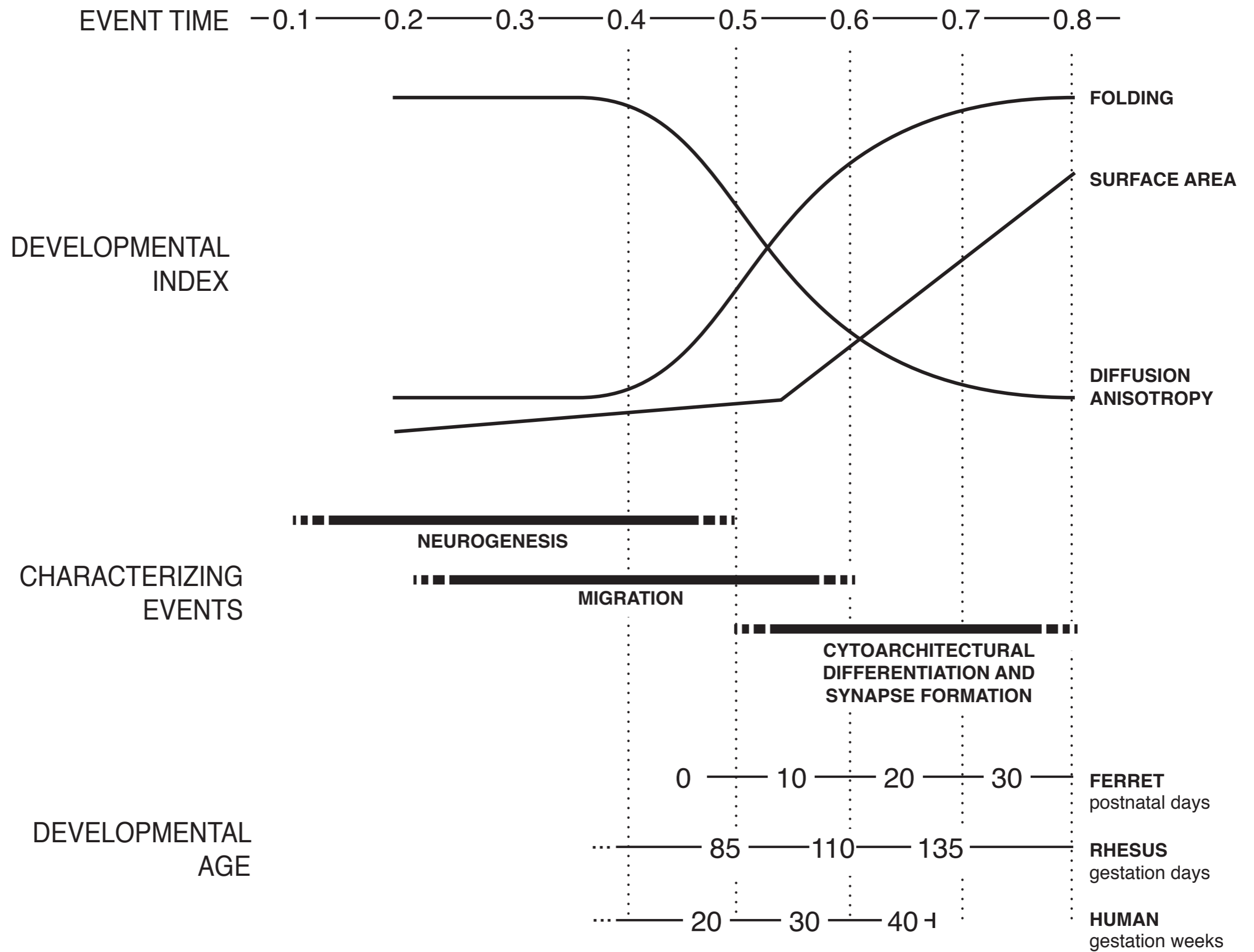
need to stand apart and above other layers

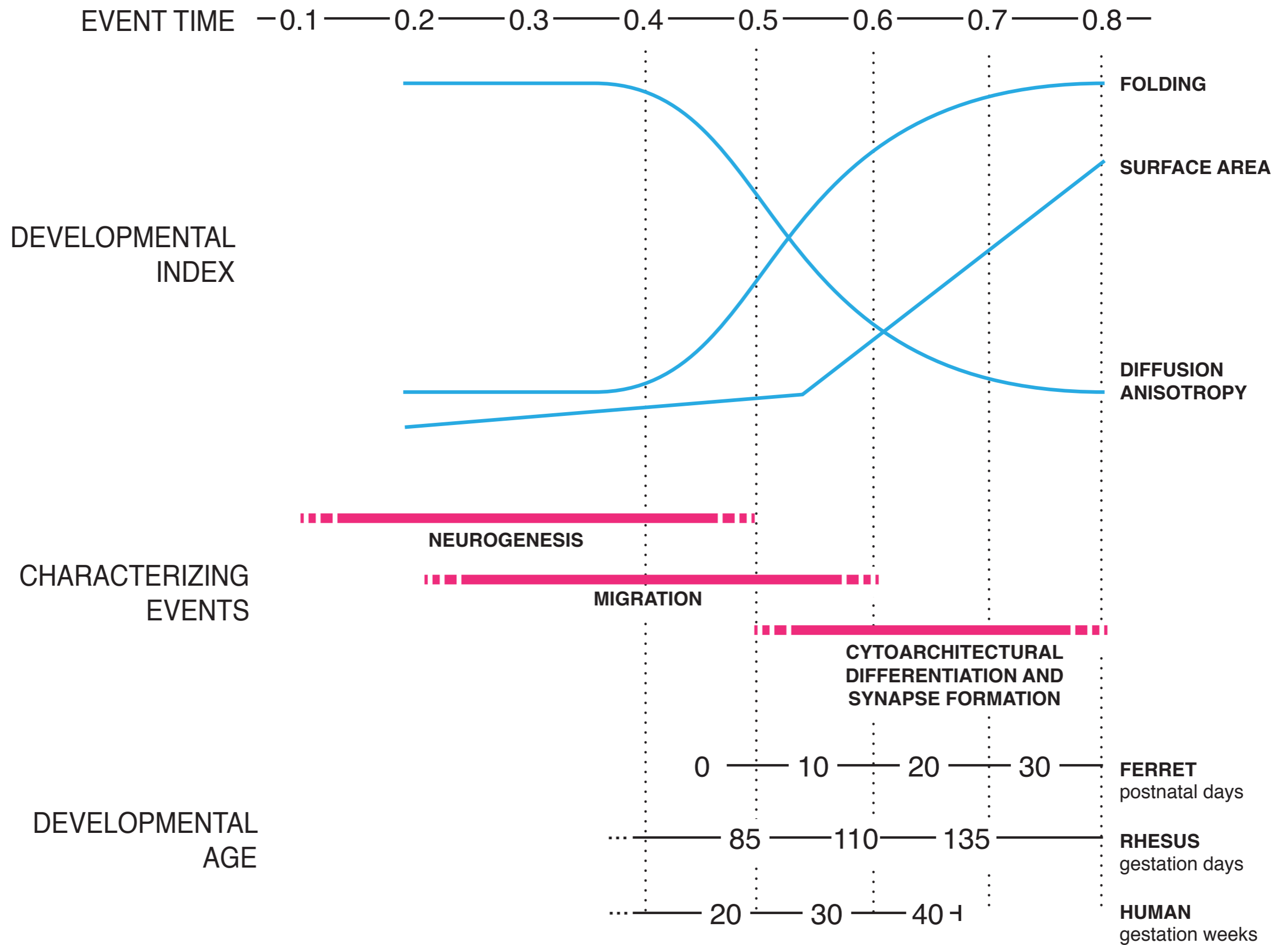
ask yourself: can my graphic support more content?

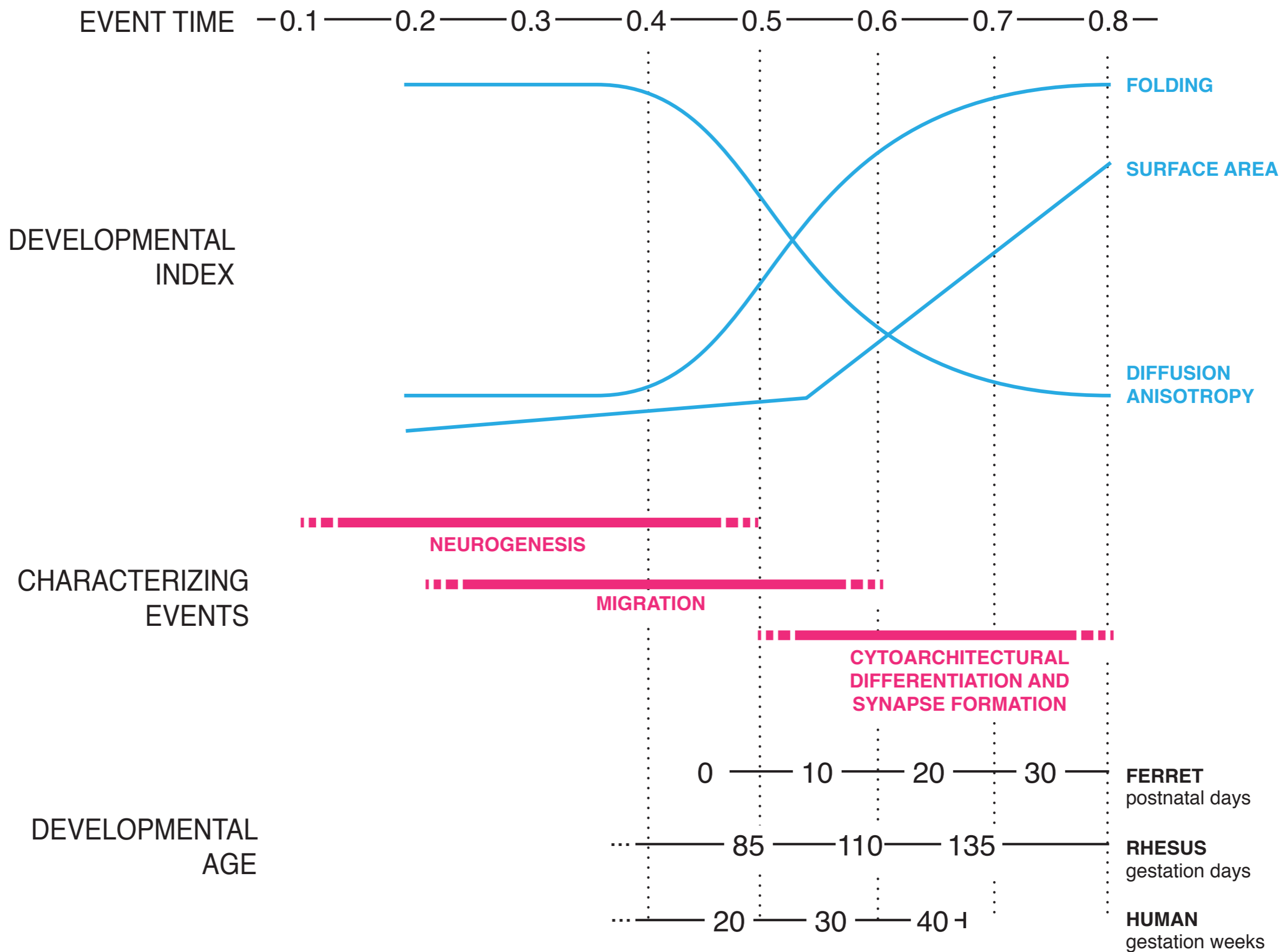
if not, give it more room

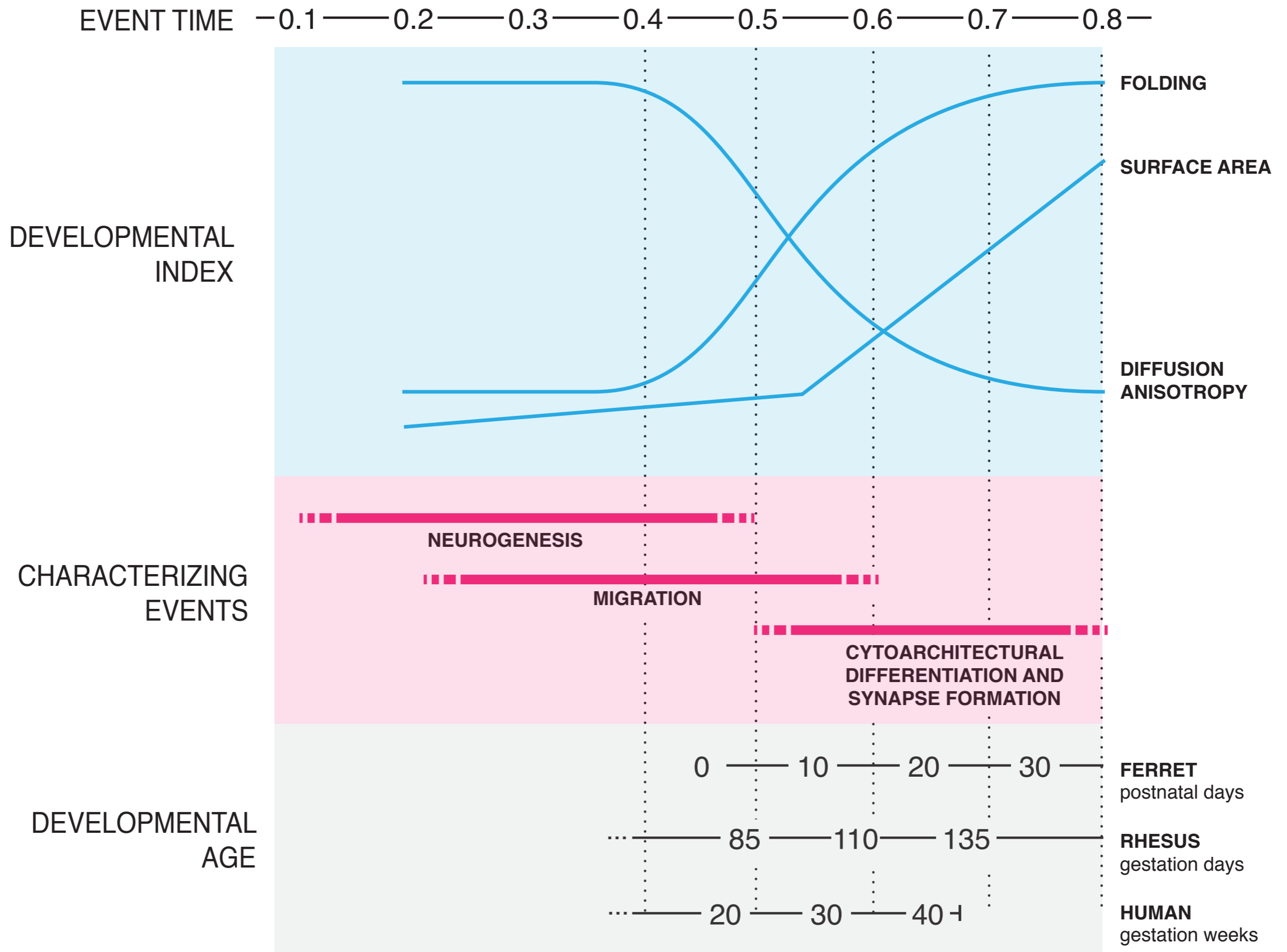






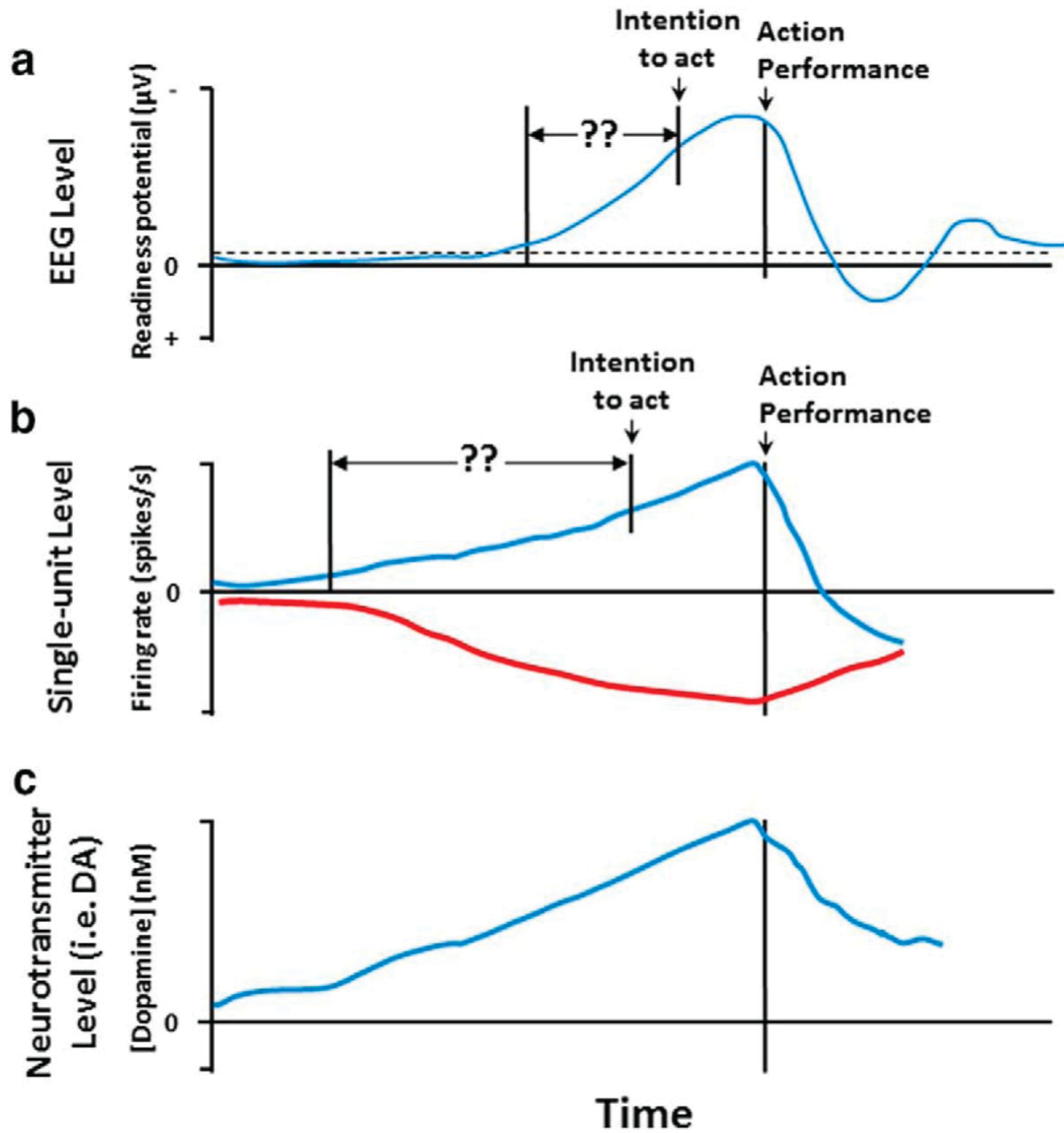


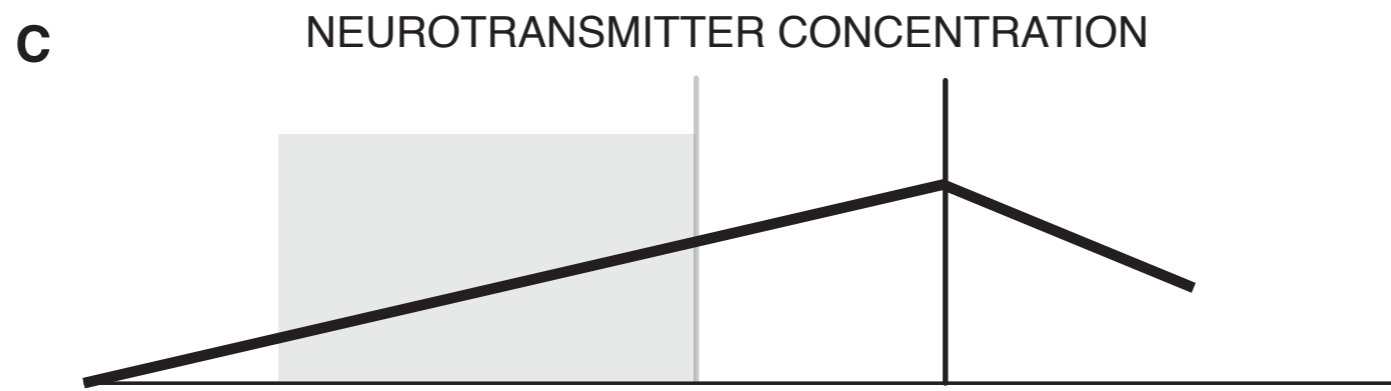
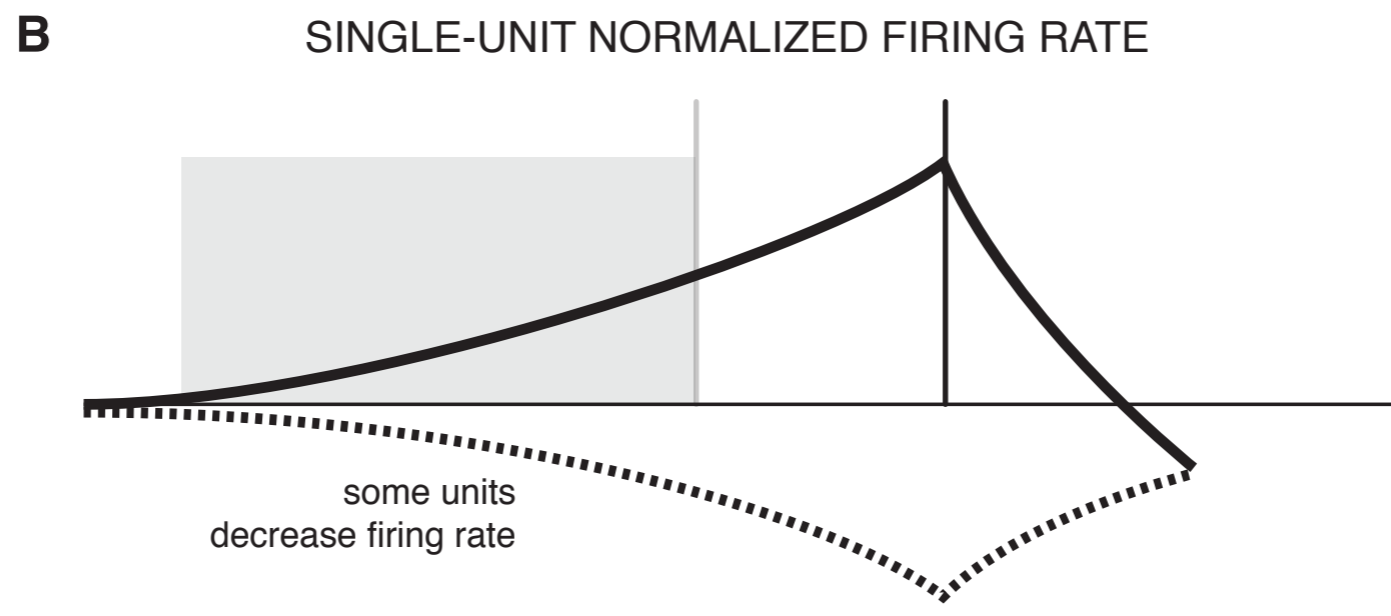
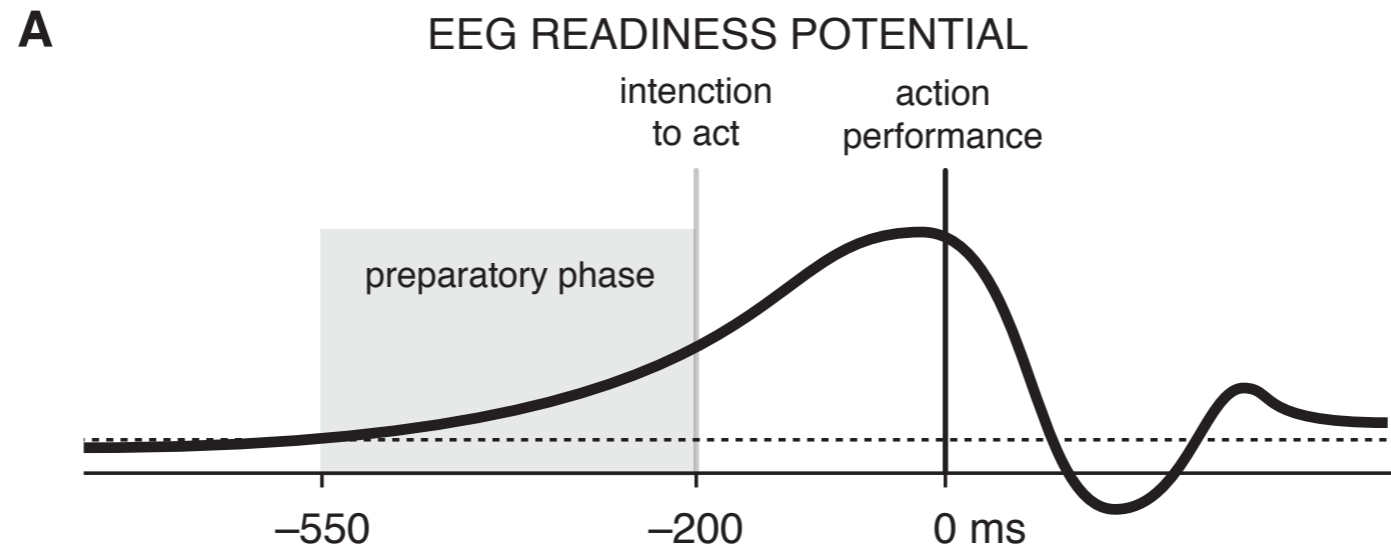




we all know data is noisy

unless you're showing real data or for
some reason the kind of noise is part of the story,
it's ok to show smooth trend lines
(just say that this is what you're doing)

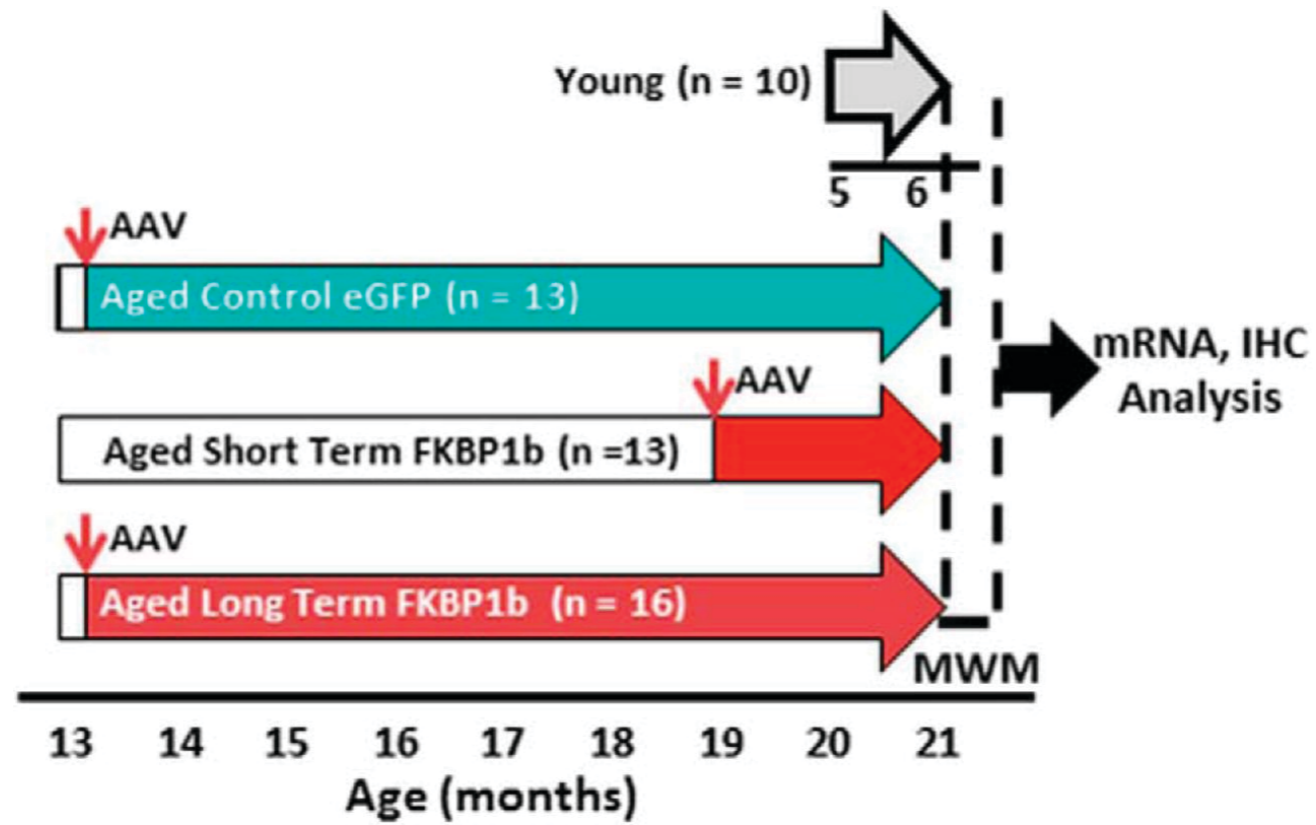


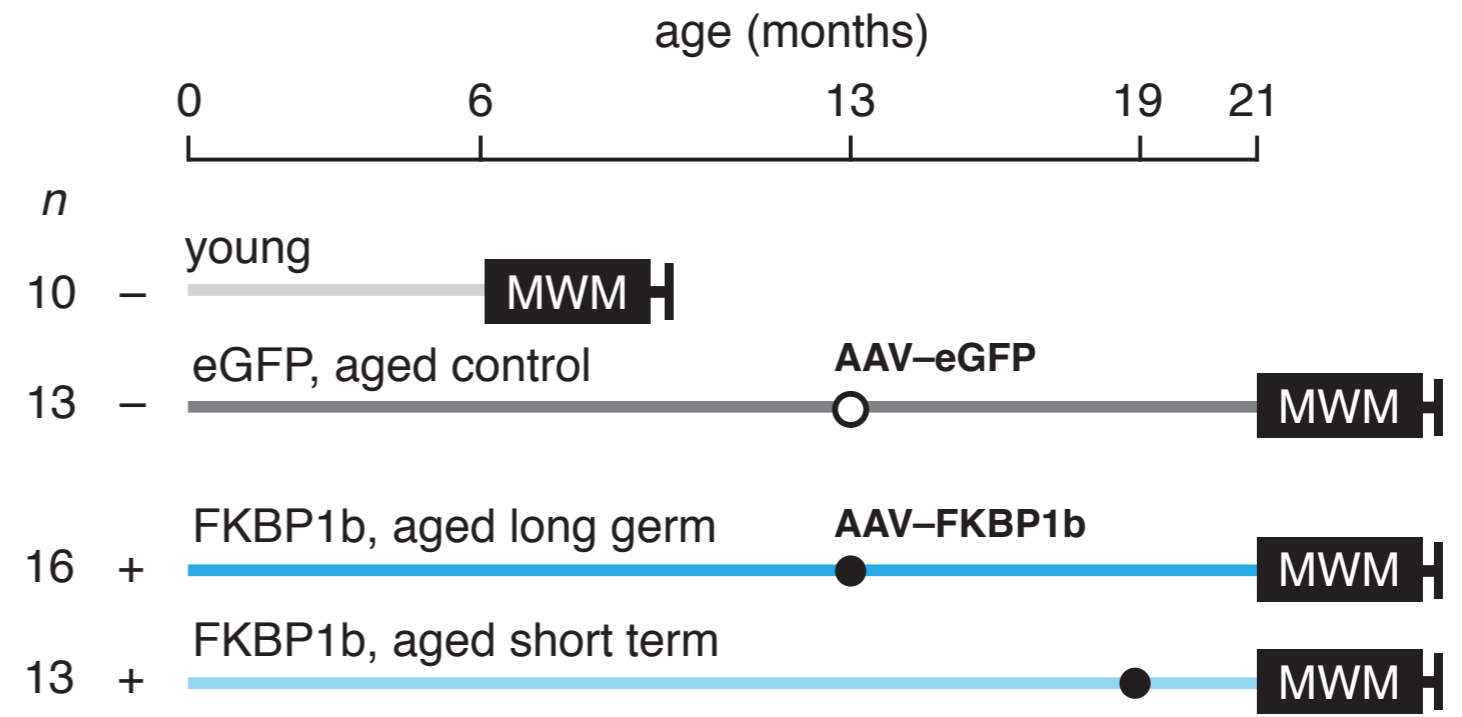
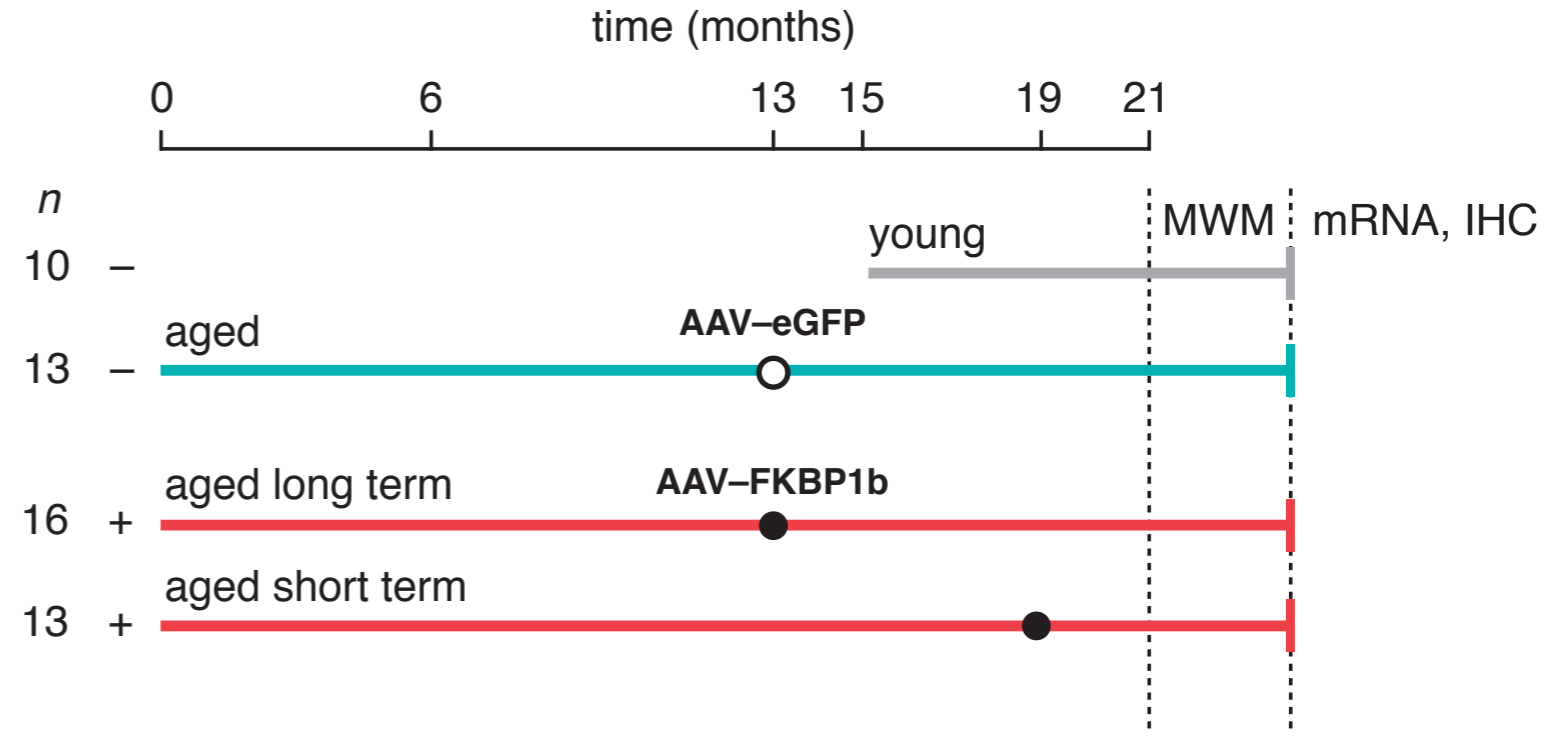
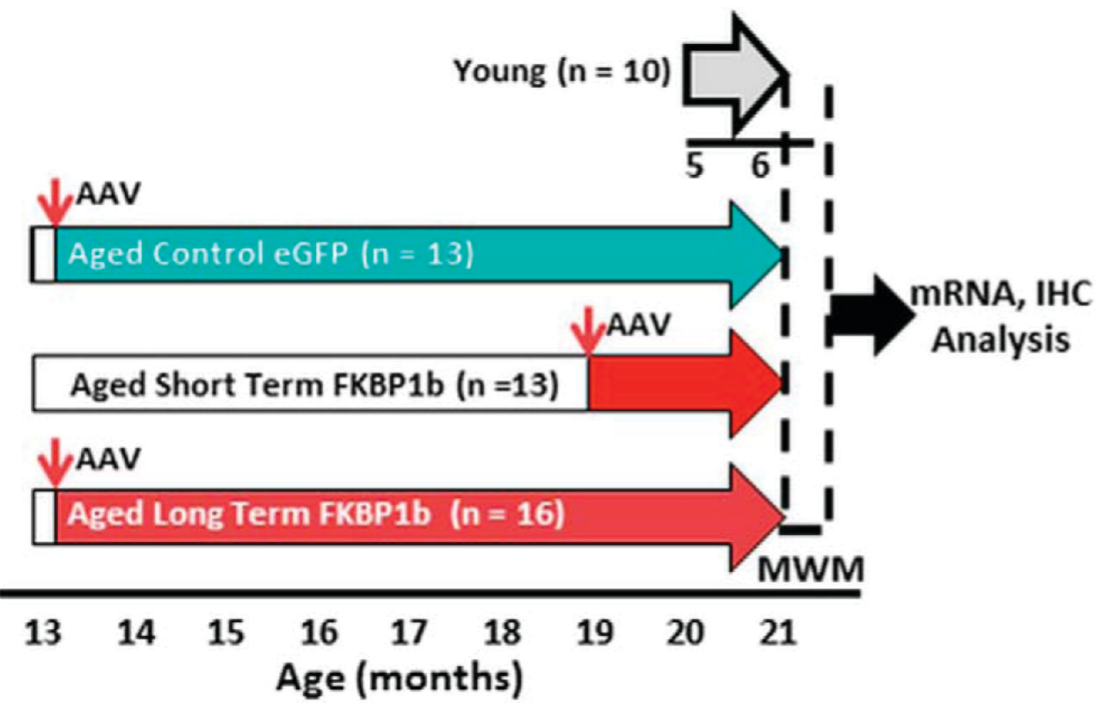


sometimes the choice of axis is obvious
but the start (or end) is not clear

here, should the groups be aligned to their MWM time?

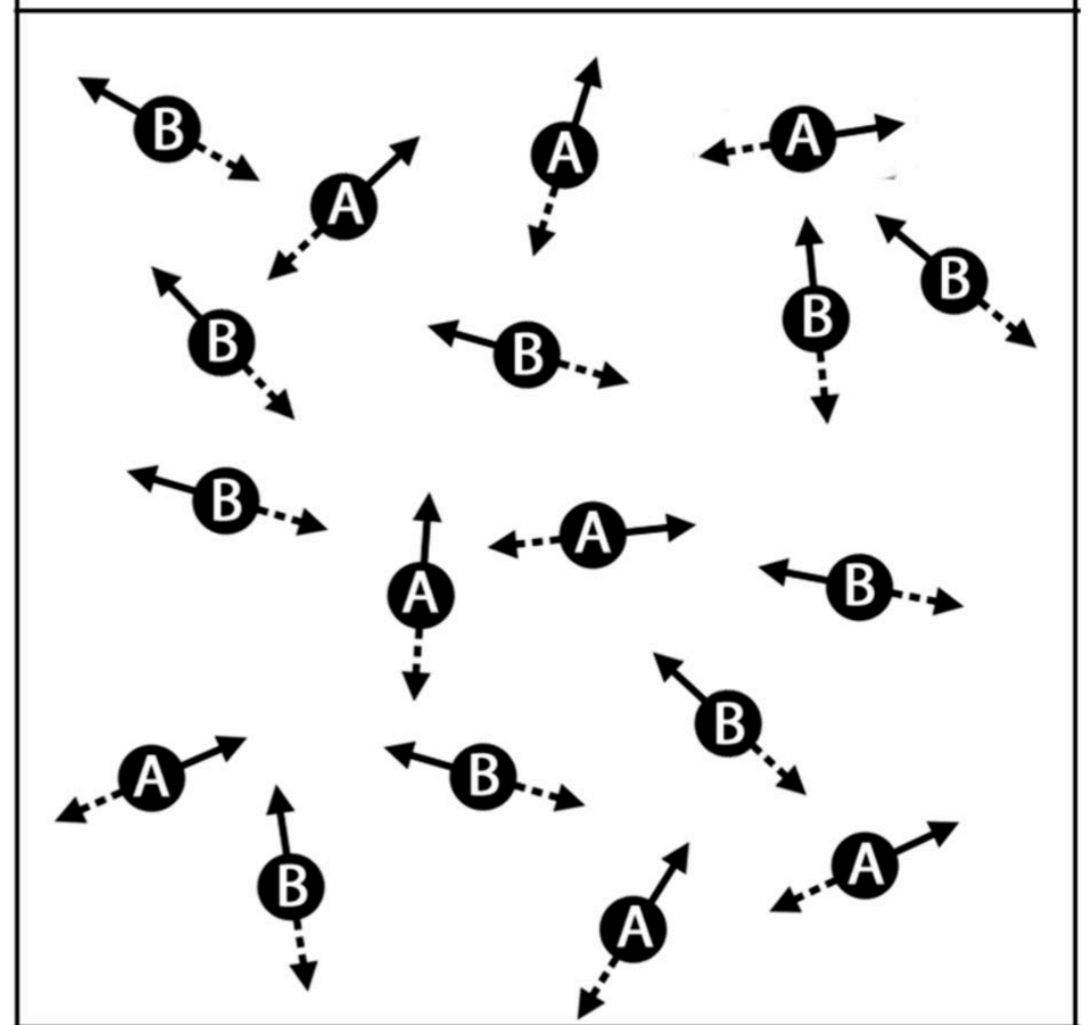
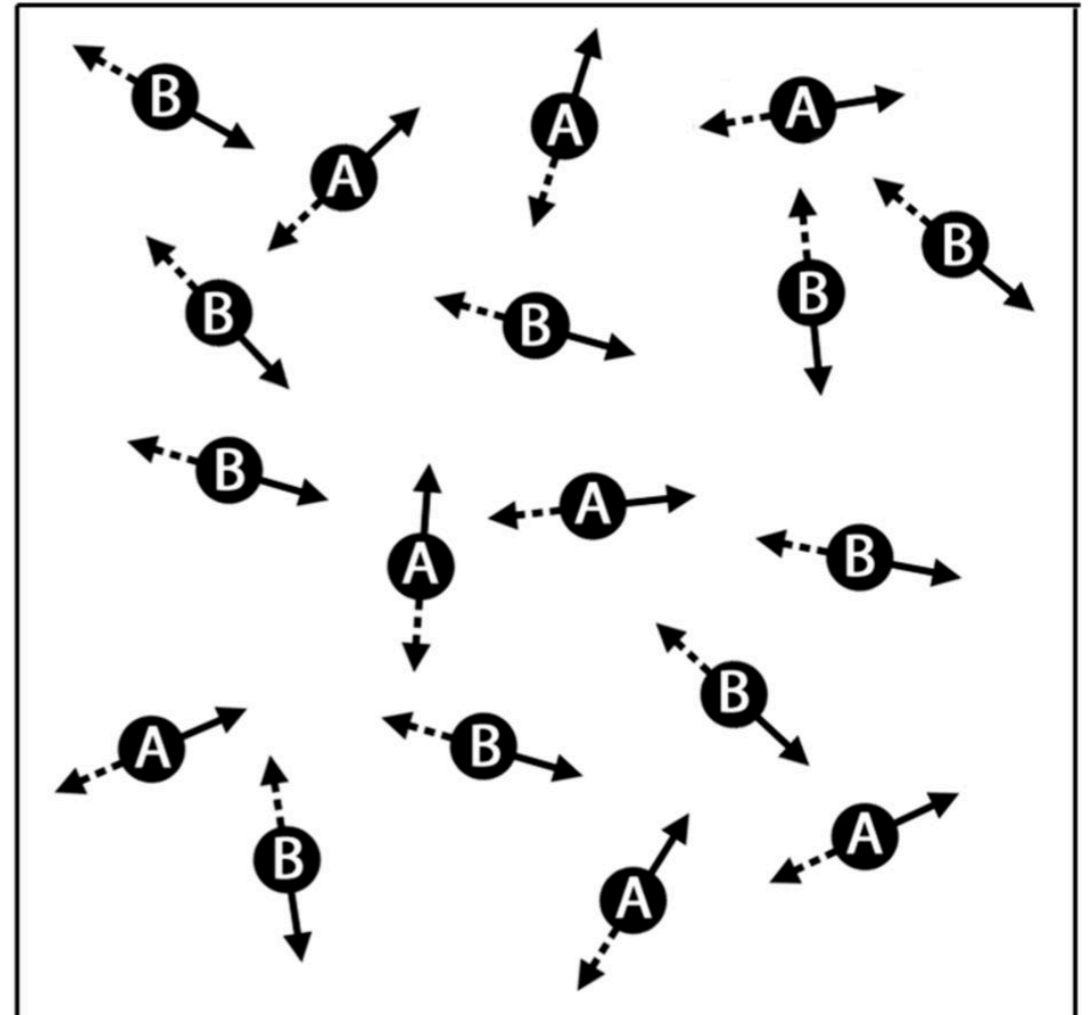
I sense is that they should not.

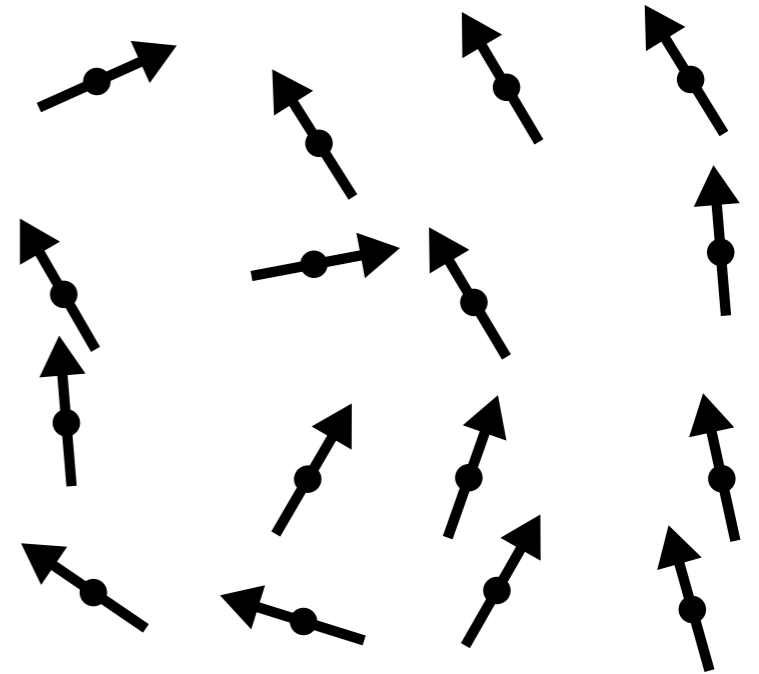
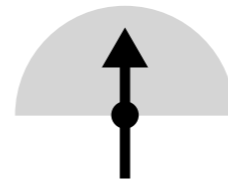
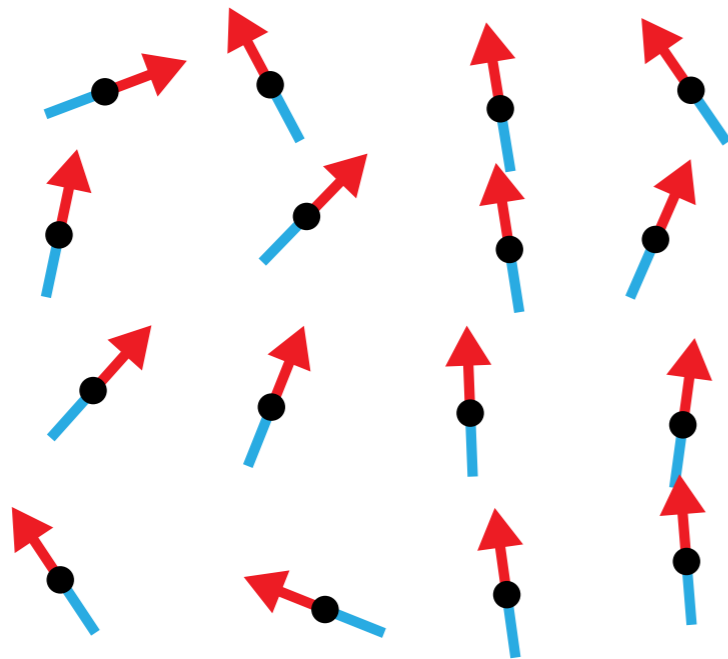
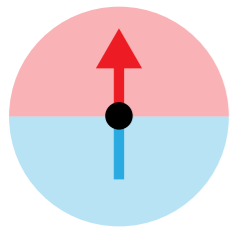
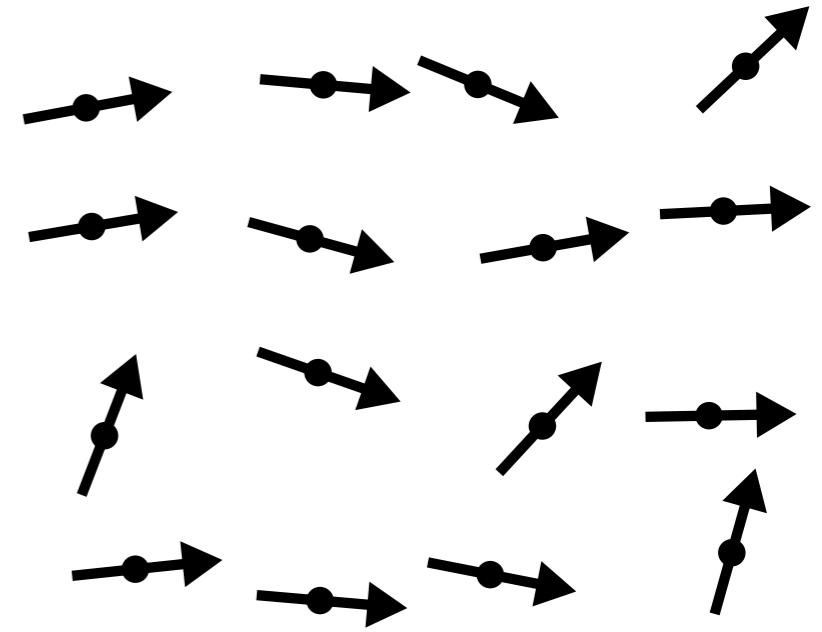
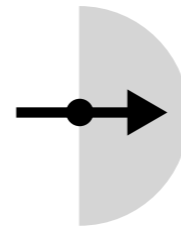
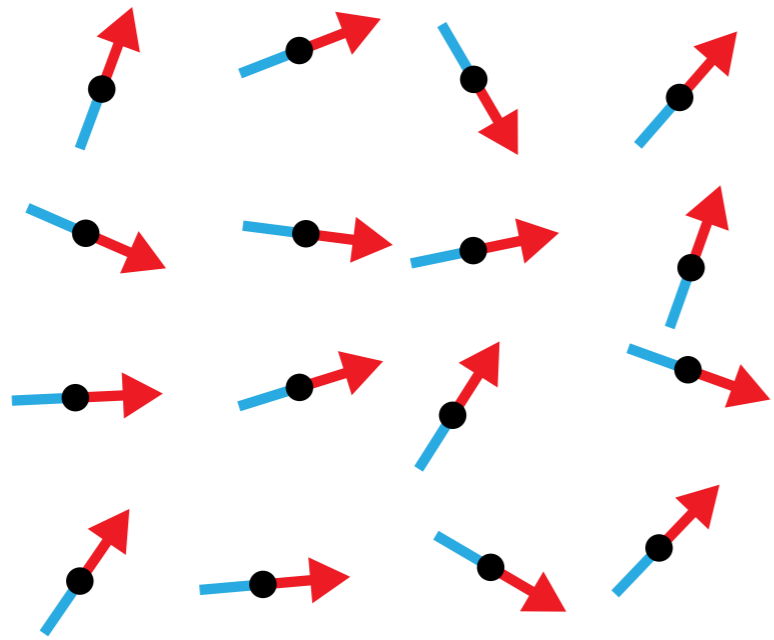
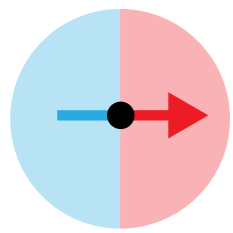


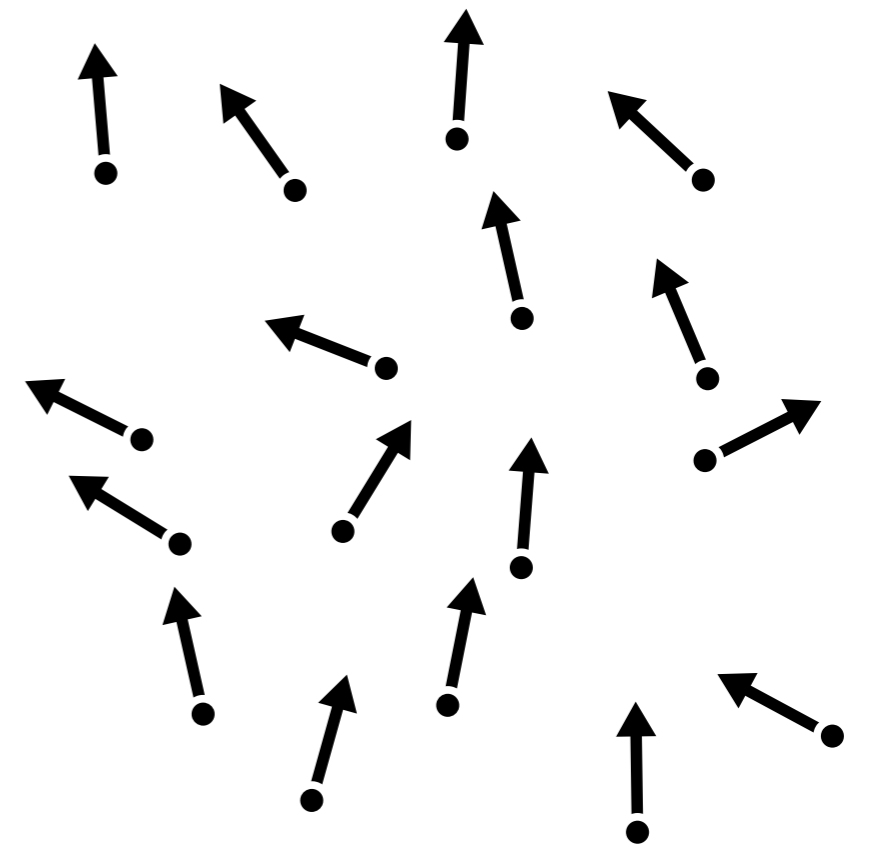
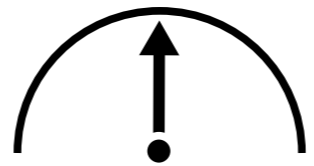
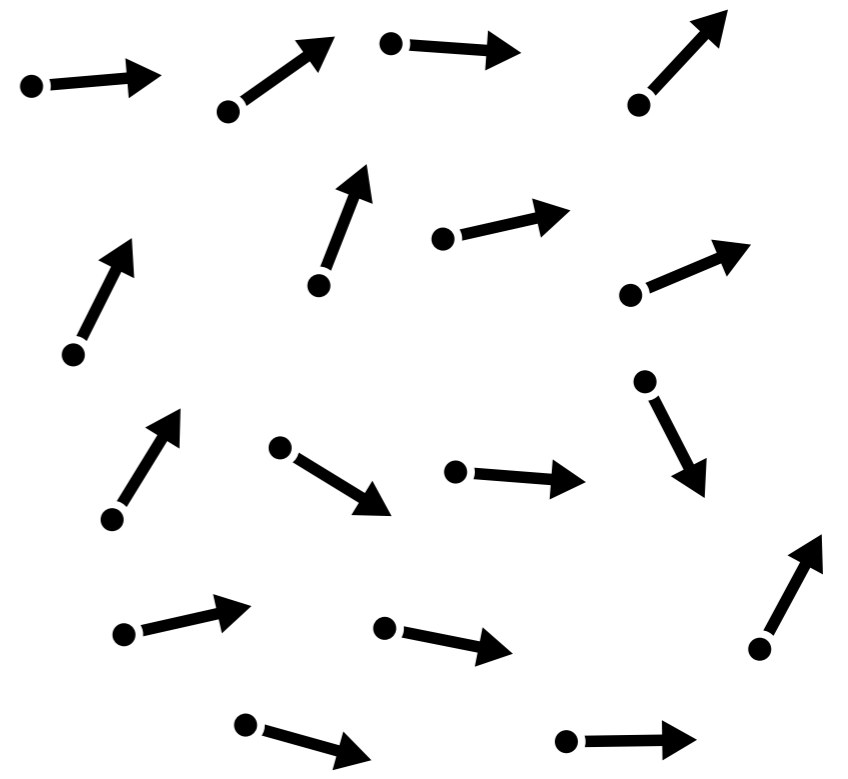
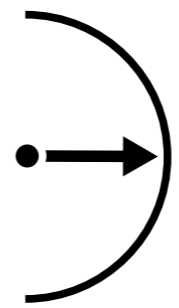


a great example of a relatively simple step that is obfuscated by both the drawing and wordy legend

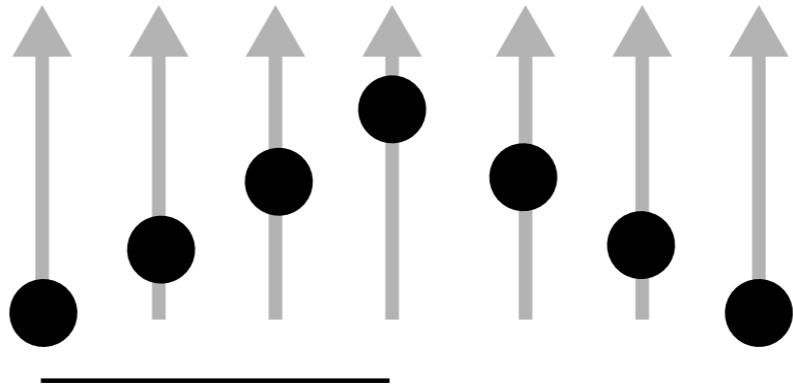
notice that the diagram puts the dot in the middle of the movement axis but the legend implies that dots move in one direction for 500 ms and then in the reverse direction for 500 ms and at no point travel along half the distance for 250 ms





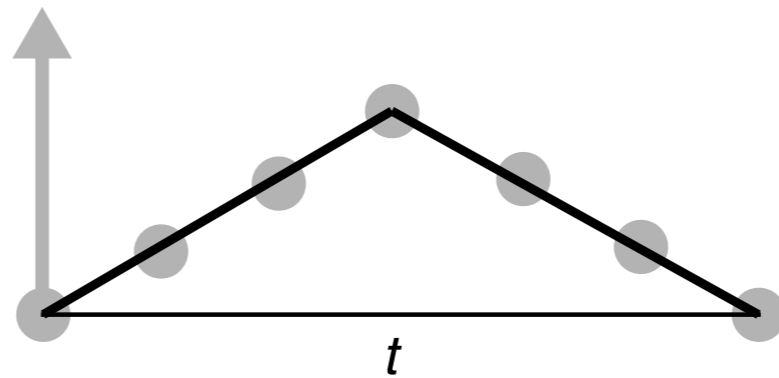


reference

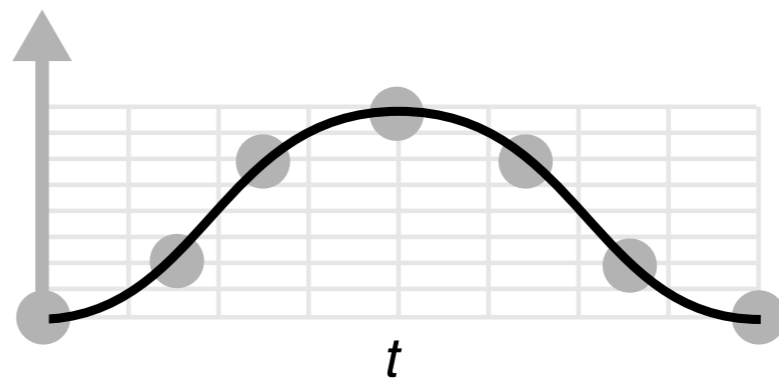


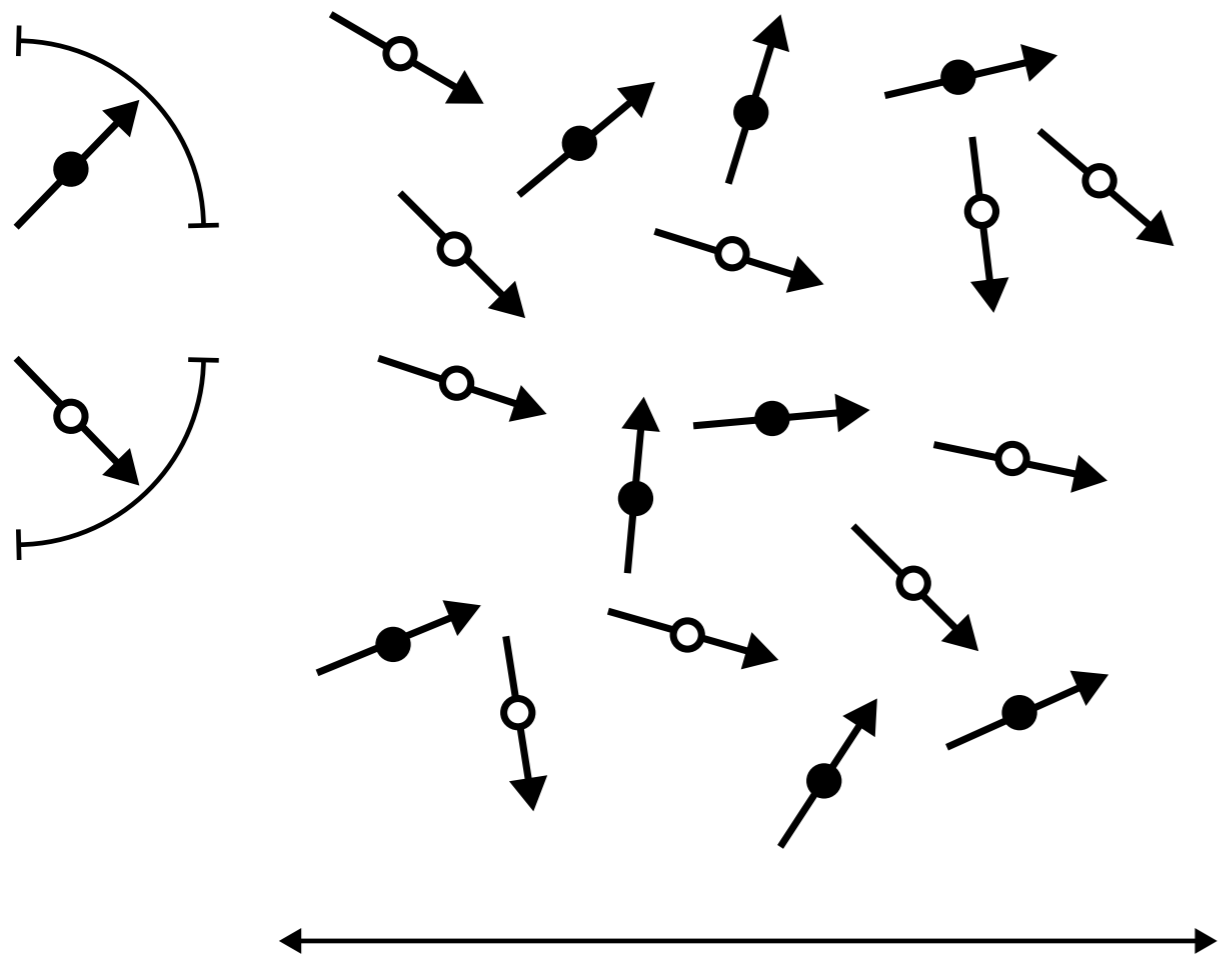
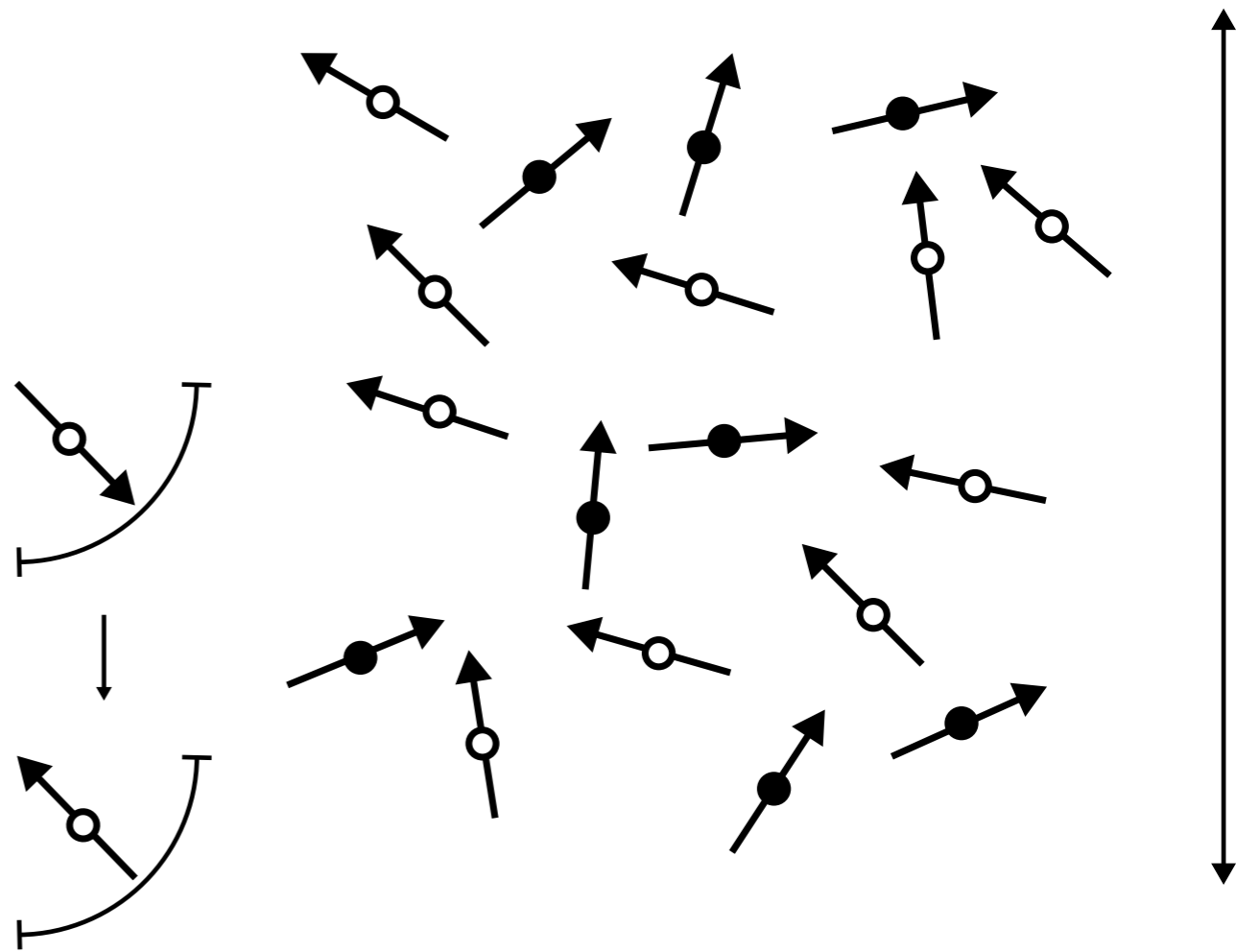
500 ms

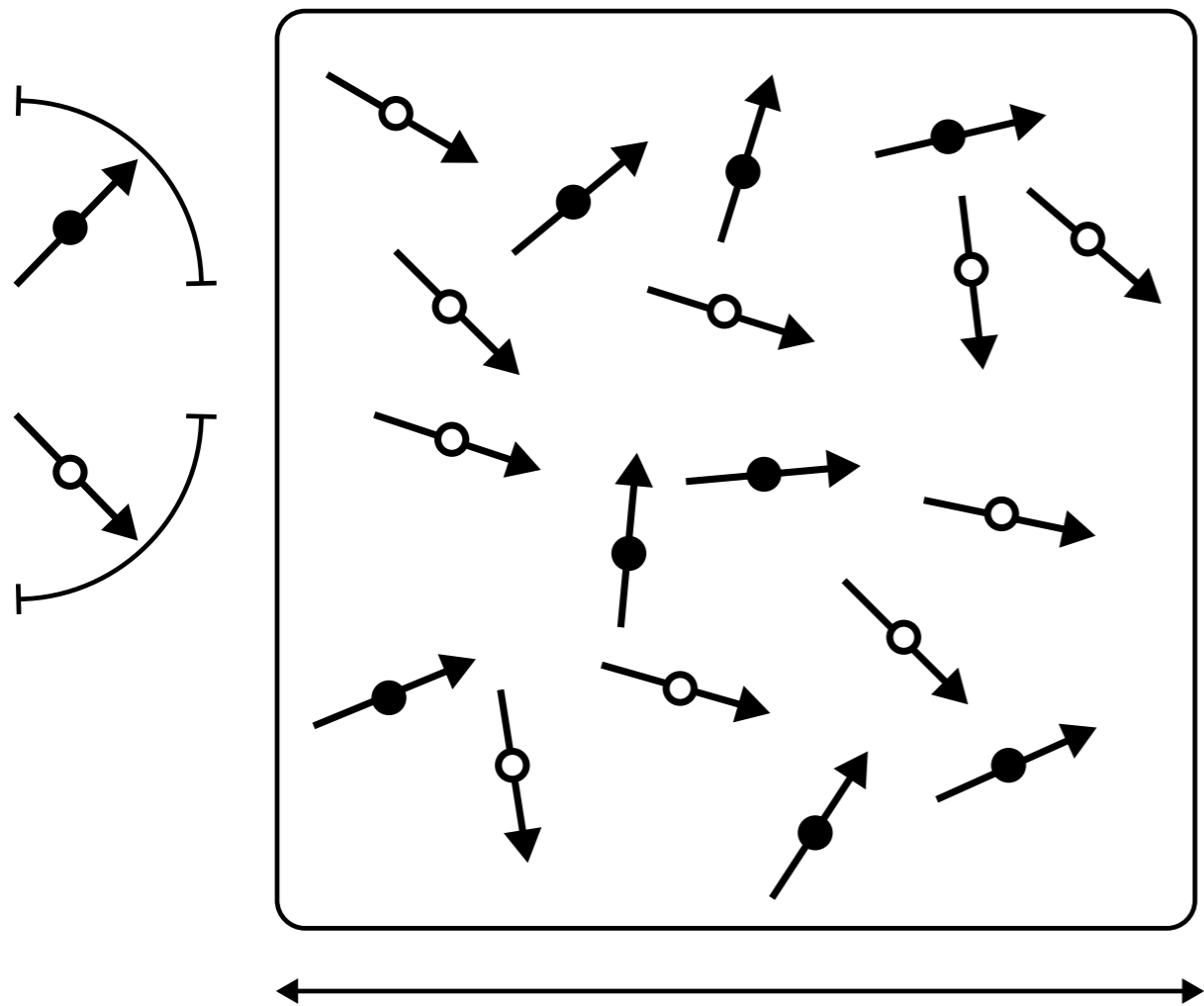
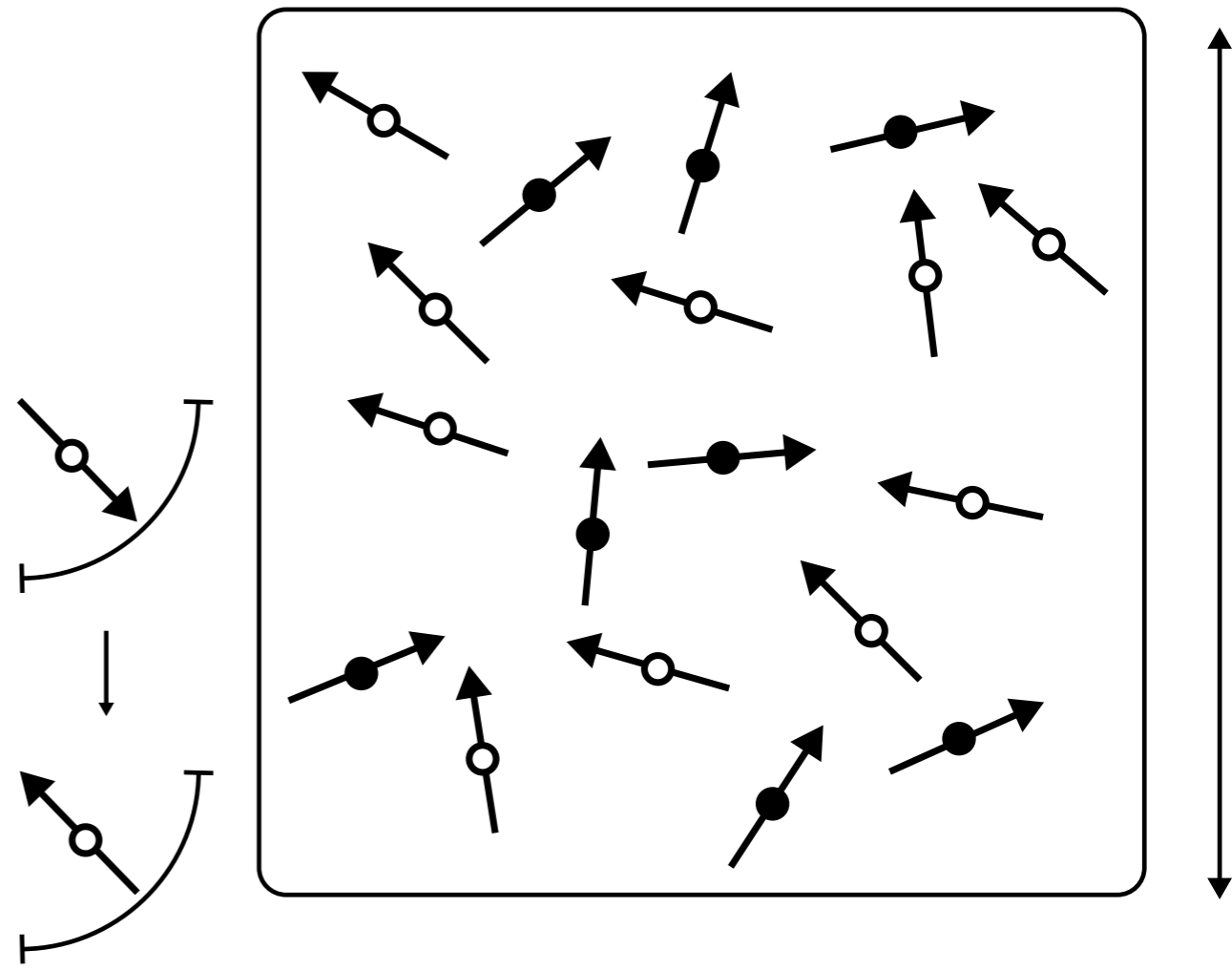
constant speed

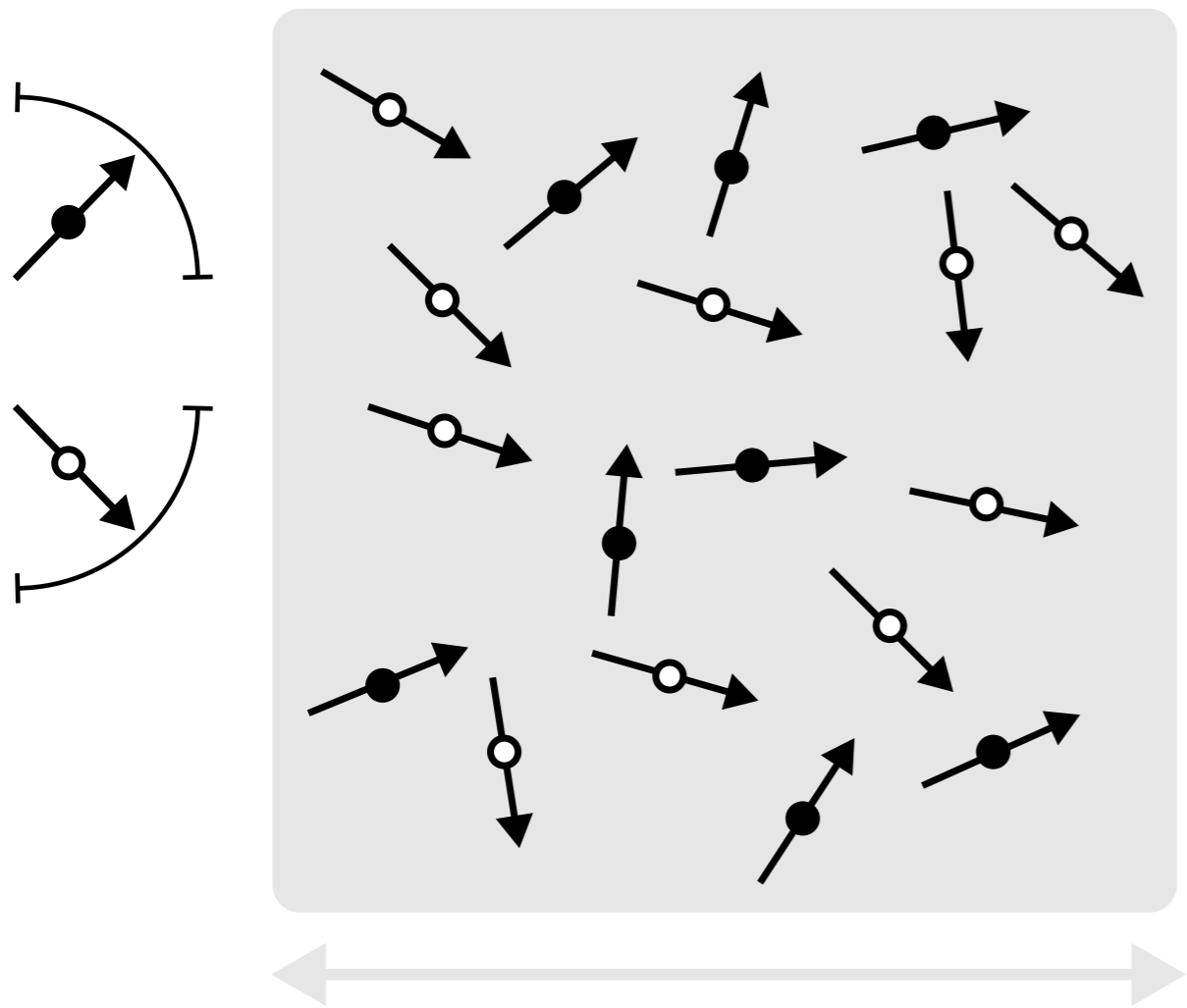
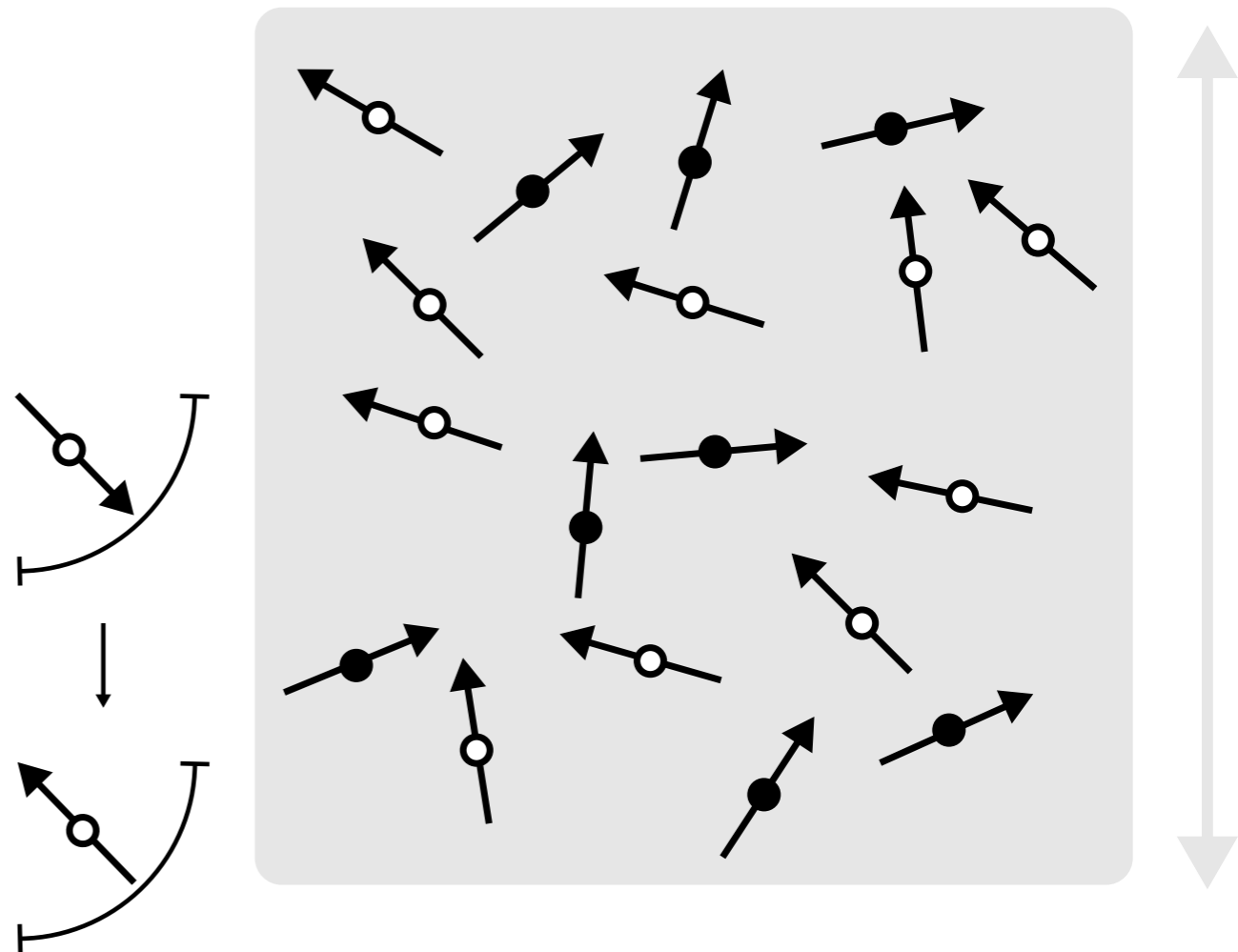


ease in/out

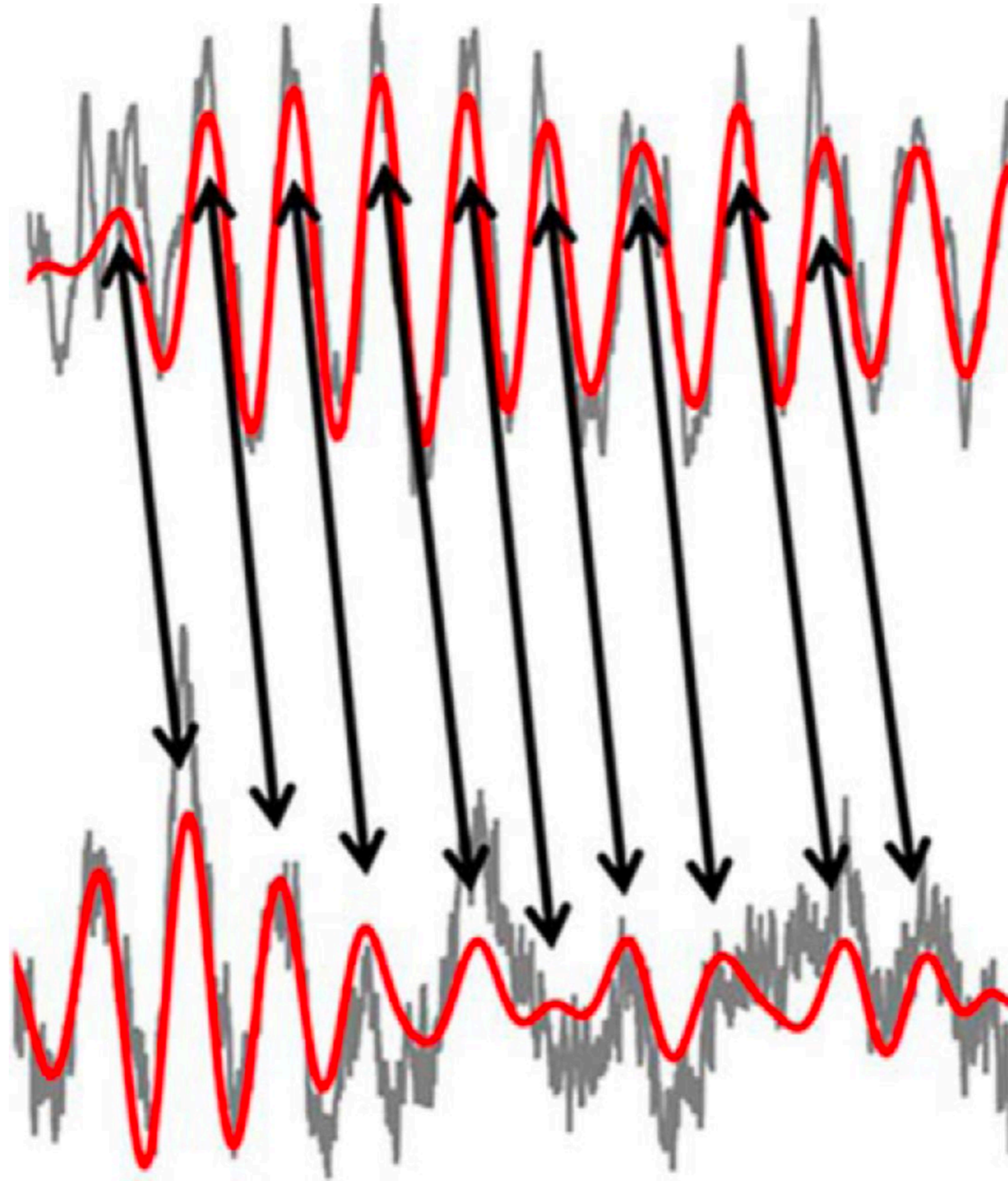


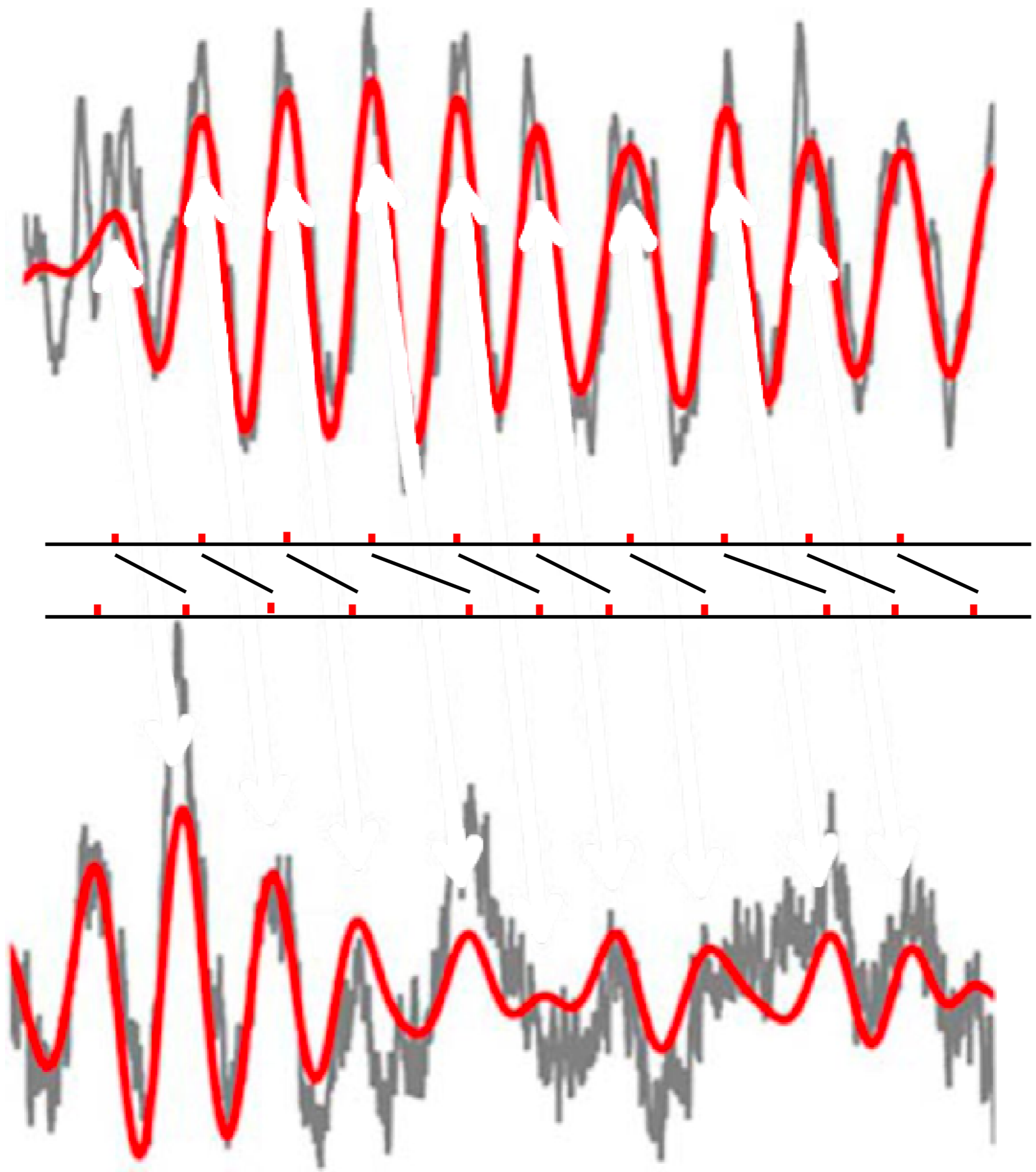
A**B**

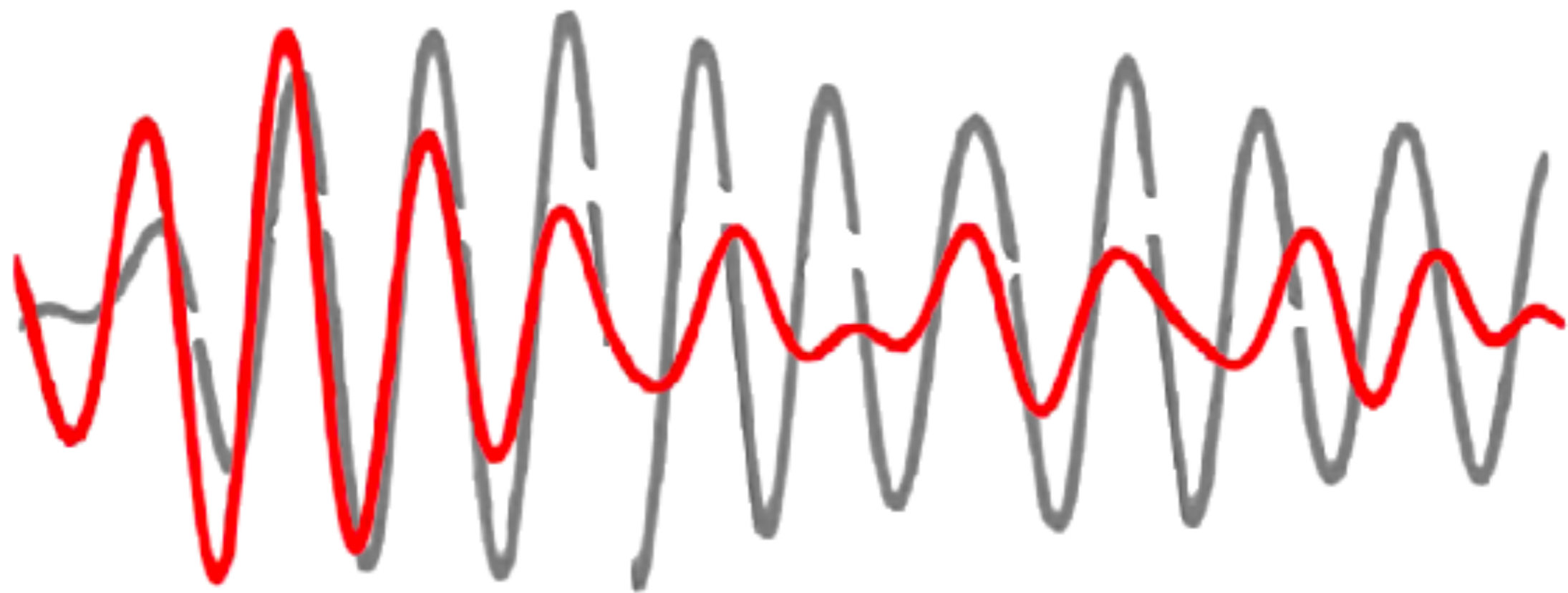
A**B**

A**B**

don't try to compare data by drawing elements
that cover data



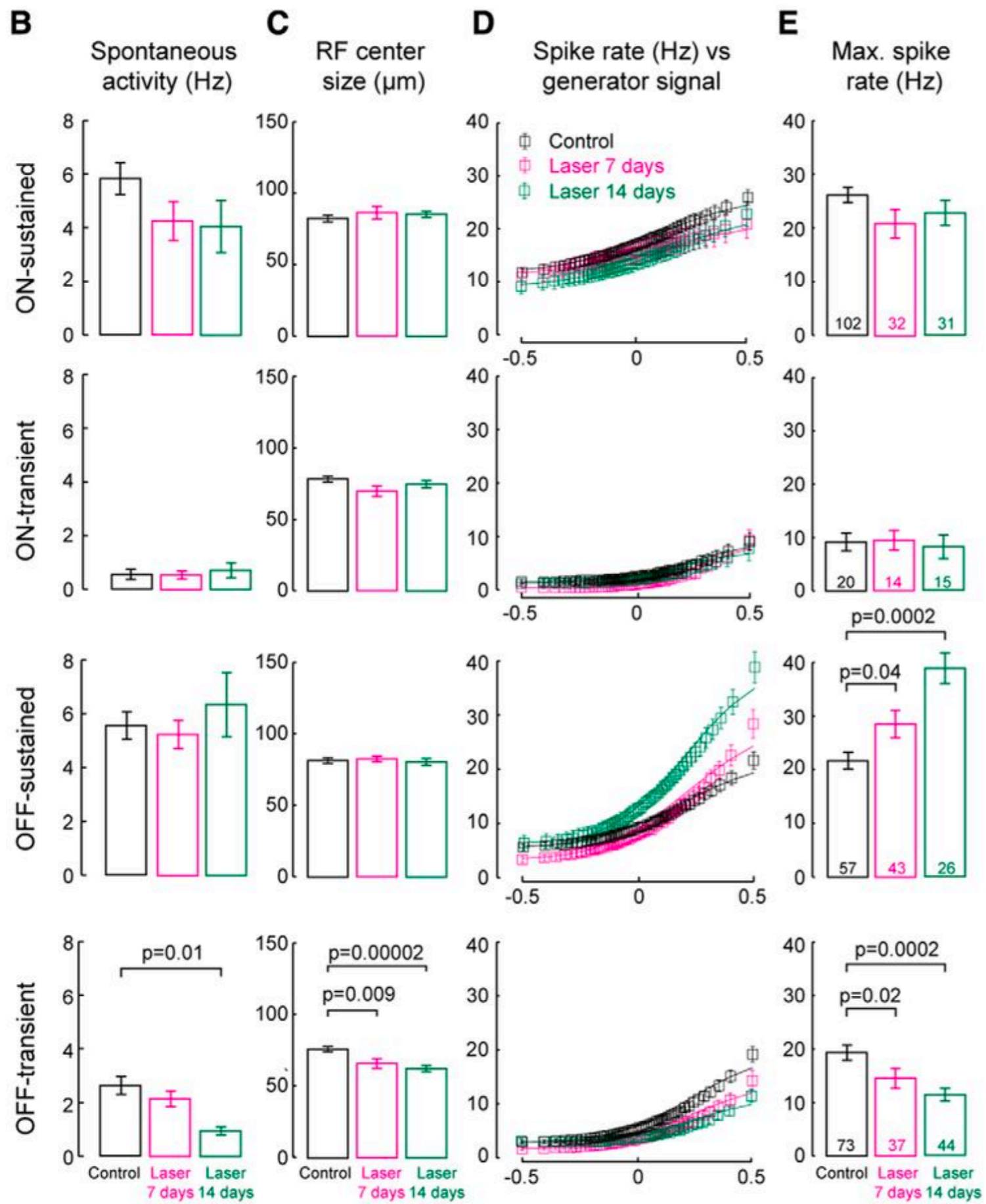


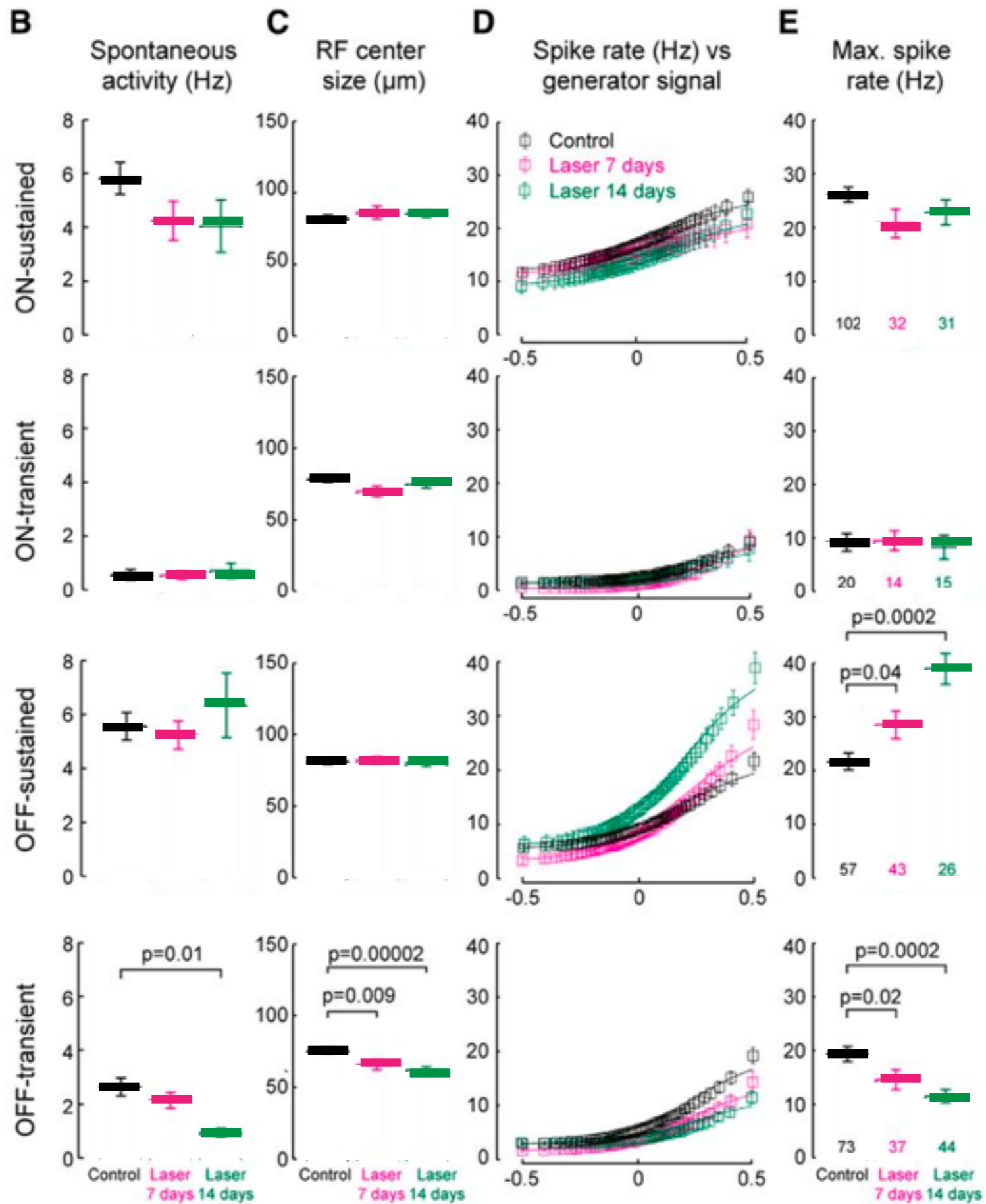


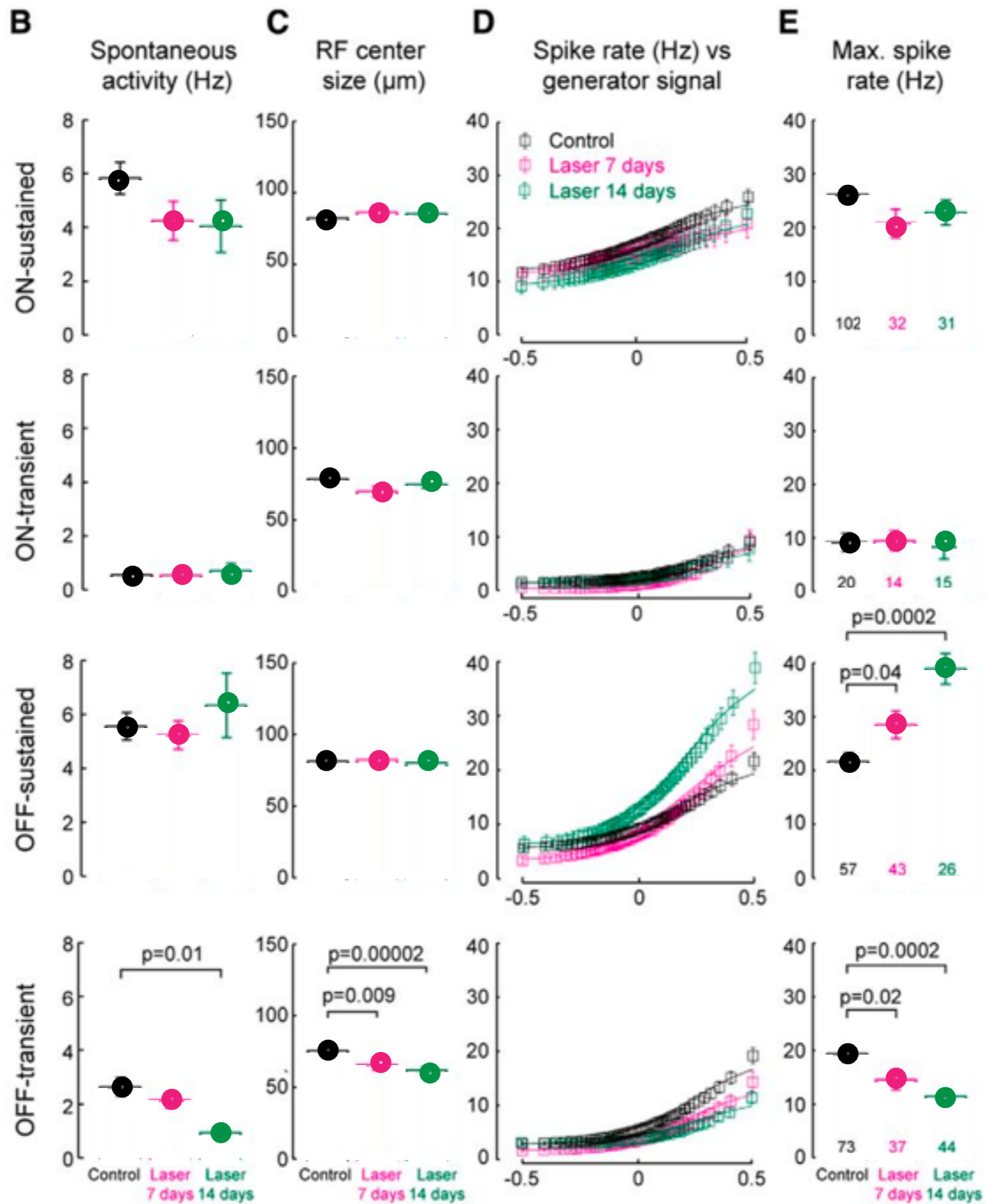
hollow bars are ghosts

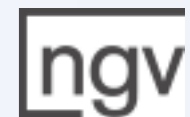
give them weight by filling them in

or better yet, use a scatter plot









Gordon Andrews (designer)
Gazelle chair (c. 1950) designed, 1957 manufactured
plywood, aluminium, wool
74.0 x 48.0 x 55.0 cm
Museum of Applied Arts and Sciences, Sydney
Purchased, 1989 (89/499)