The Birds, and Bees, and Primates,Oh My!

In Defense of a Sparse Theory of Multiple Realization

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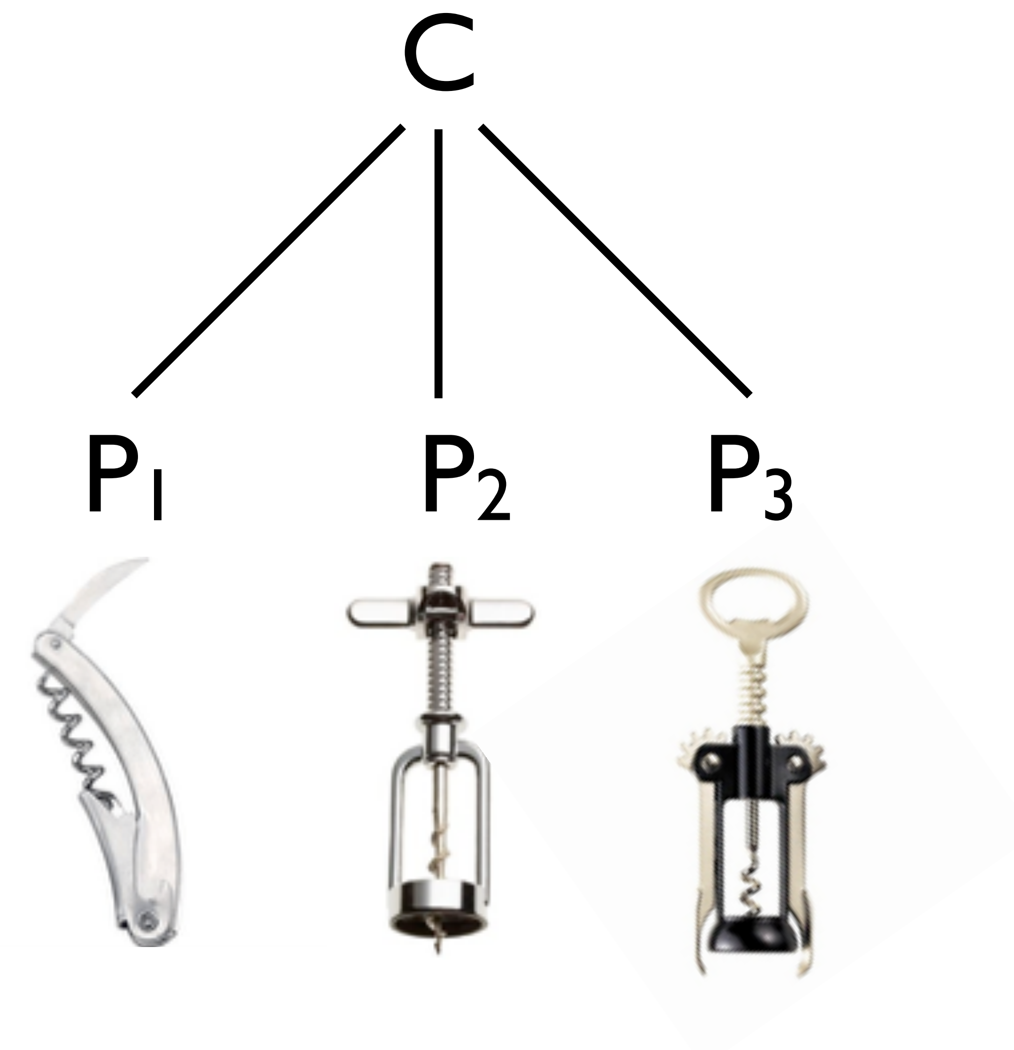
What is Multiple Realization?



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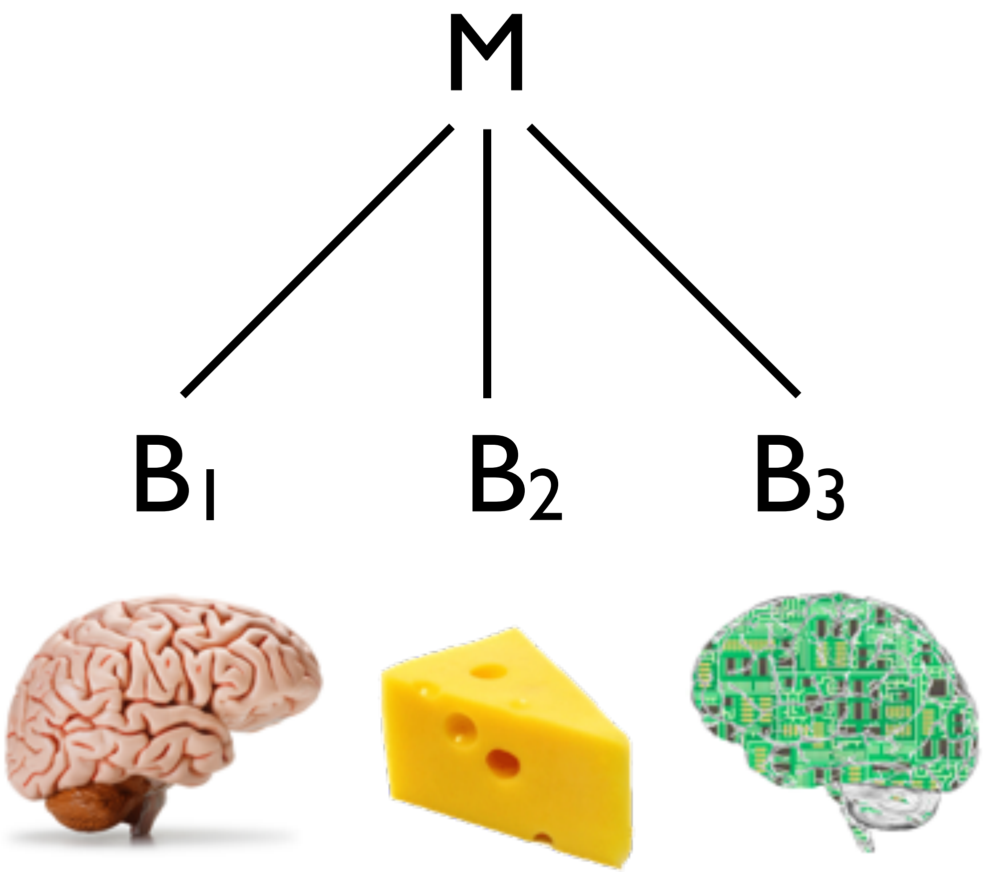


Part 1
Why Care About MR?

Whence Multiple Realization?

So then, why is there anything except physics?… Well, I admit that I don't know why. I don't even know how to think about why. I expect to figure out why there is anything except physics the day before I figure out why there is anything at all, another (and presumably related) metaphysical conundrum that I find perplexing.

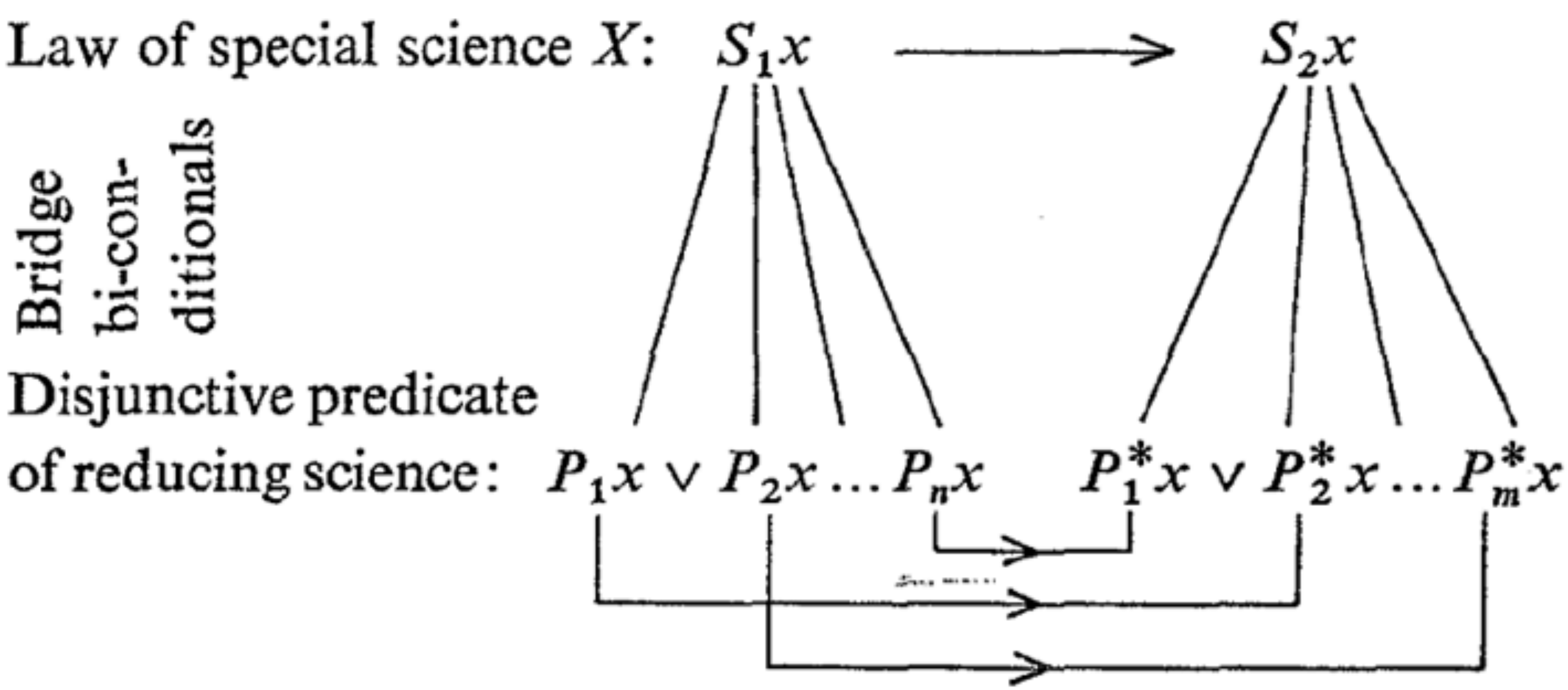
— Jerry Fodor, "Special Sciences: Still Autonomous after All these Years" (1997:161)

Whence Multiple Realization?

The reason it is unlikely that every natural kind corresponds to a physical natural kind is just that (a) interesting generalizations (e.g., counter-factual supporting generalizations) can often be made about events whose physical descriptions have nothing in common, (b) it is often the case that whether the physical descriptions of the events subsumed by these generalizations have anything in common is, in an obvious sense, entirely irrelevant to the truth of the generalizations, or to their interestingness, or to their degree of confirmation or, indeed, to any of the epistemologically important properties, and (c) the special sciences are very much in the business of making generalizations of this kind.

— Jerry Fodor, “Special Sciences (or: The Disunity of Science as a Working Hypothesis” (1974:103)

Whence Multiple Realization?



— Jerry Fodor, "Special Sciences (or: The Disunity of Science as a Working Hypothesis" (1974:109)

Hence Multiple Realization!

Multiple Realization (MR) is important because it plays a central role in a widely endorsed, assumed, and defended account of why there are “special” sciences and why those sciences are legitimate—why they are “autonomous.”

Clarification 1

- When Fodor talks about “interesting generalizations” and “physical descriptions” he is implicitly comparing the “laws” and taxonomies of two sciences—questions about MR are specific and contrastive.

- The question of MR, then, is whether the kinds of one science are “cross-classified” by the kinds of another science.

- Note that MR is supposed to be an objectively occurring phenomenon in the world. (It is reflected in our theories and explanations, but it is not in the first place a phenomenon of theories or explanations.)

Clarification 2

- If the question is whether mental states or processes are MR by neural states or processes, it it important that we focus on MR of the mental rather than just multiple causes of the effect.
  - Not every cause of the extraction of a cork from a bottle involves a corkscrew.

- The question we ask whether there is something (property, process, event, property, etc.) psychologically common that is cross-classified by [all] neuro-sciences (or neuro and other sciences)—not only if produces the same effect.

S → M → R

Part 2
Evidence for MR?

What is Evidence for MR?

Standard: Same but different.

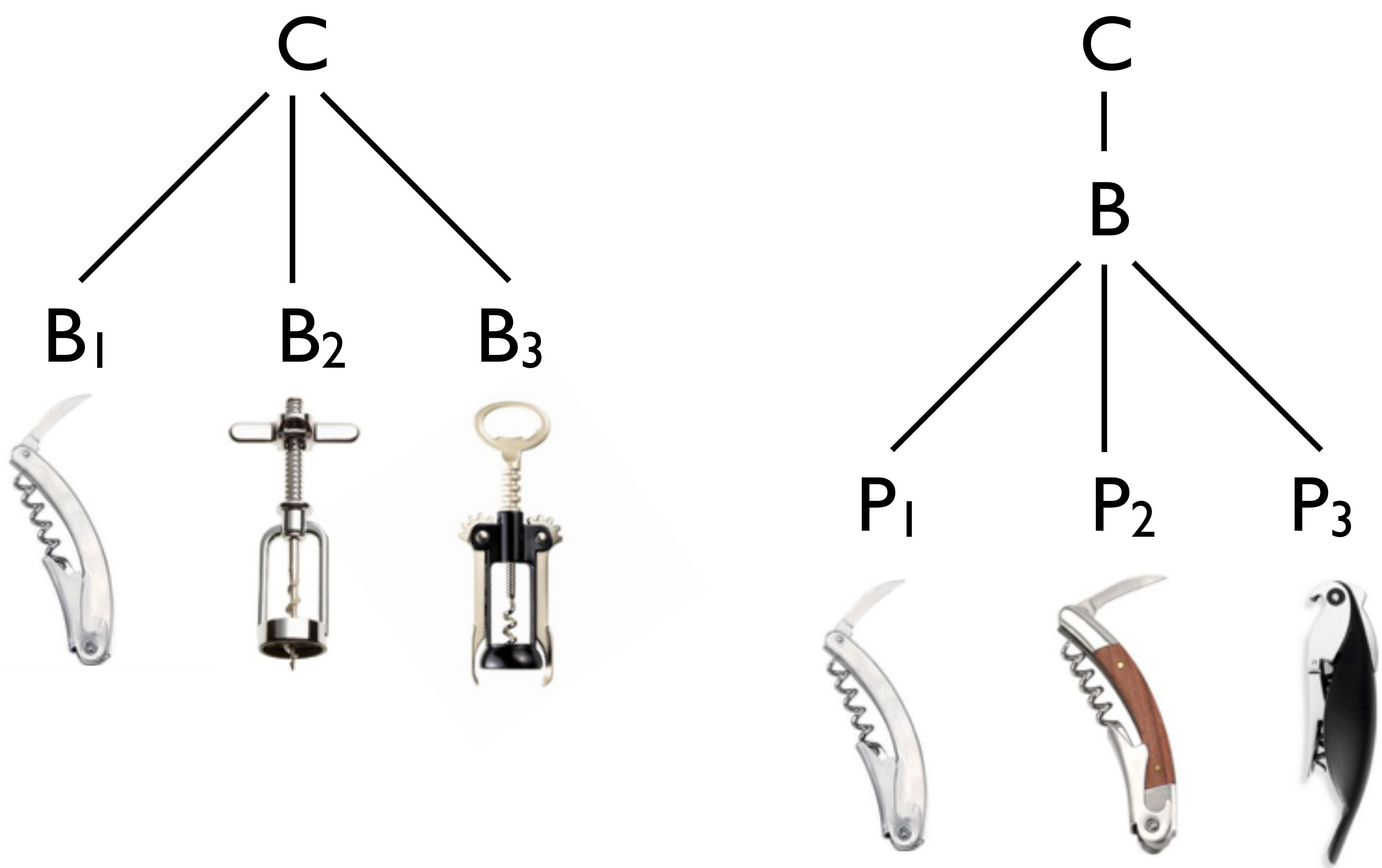
Shapiro 2000, 2004/Polger 2002, 2004:
Same but relevantly different.

Shapiro 2008: Same but relevantly different,
and differently the same.

Shapiro & Polger 2013: clarifies Shapiro 2008.

Polger & Shapiro 2016: elaborates on 2103

Kinds of Variation



Polger and Shapiro

(forthcoming 2016, Oxford UP)

(i) As and Bs are of the same kind in model or taxonomic system S1

(ii) As and Bs are of different kinds in model or taxonomic system S2

(iii) the factors that lead the As and Bs to be differently classified by S2 must be among those that lead them to be commonly classified by S1

(iv) the relevant S2-variation between As and Bs must be distinct from the S1 intra-kind variation between As and Bs

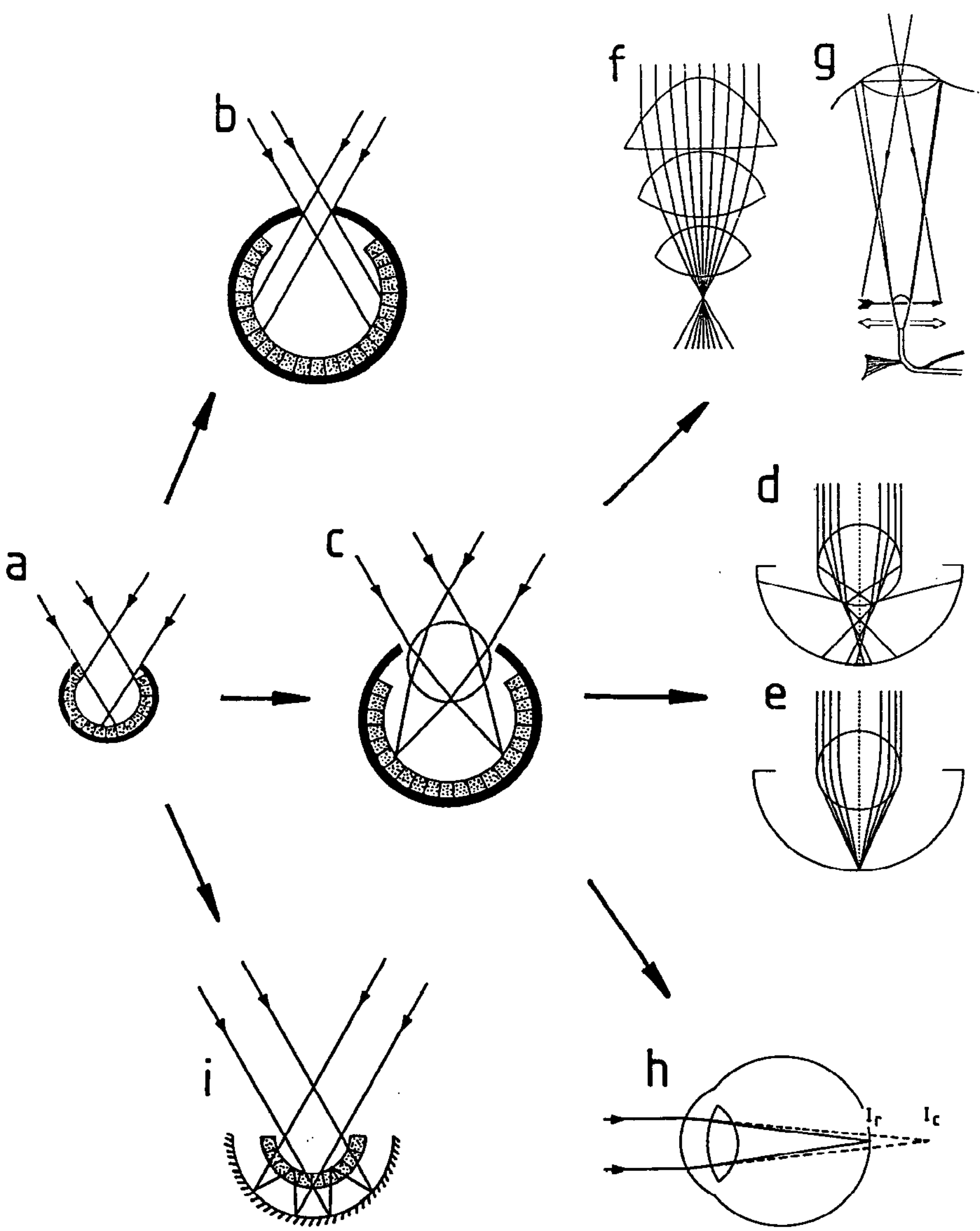
Why (iii)?

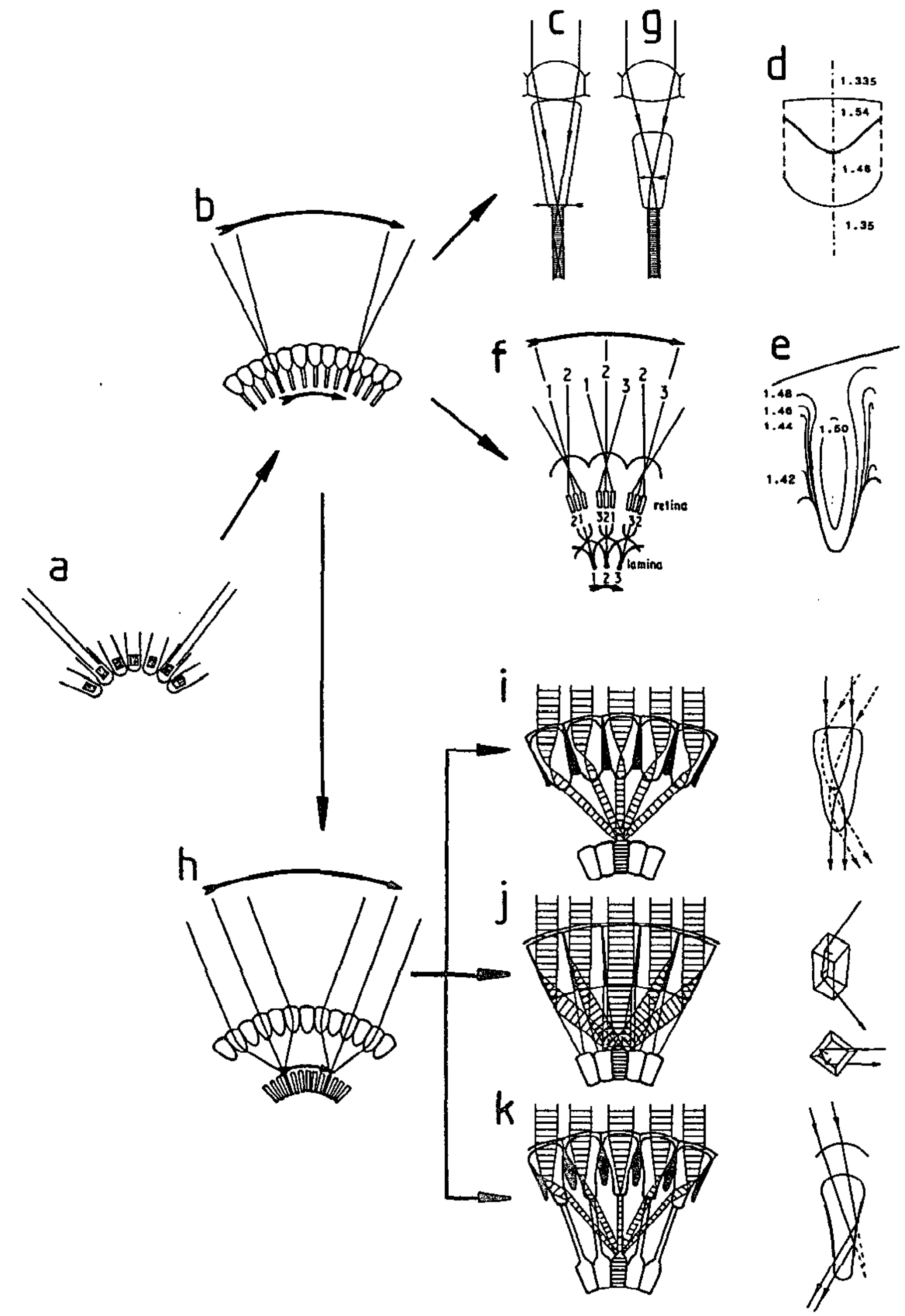
- The world is Heraclitean, replete with variation: All is flux.
  - From this, many philosophers conclude that MR is ubiquitous and the evidence for it is obvious.
  - But sciences are good at finding commonalities among things—they are in the regularity business, after all.
  - Many differences among things are irrelevant to most kind memberships.
- Which differences count as relevant differences? Look at the science and see.

Why (iv)?

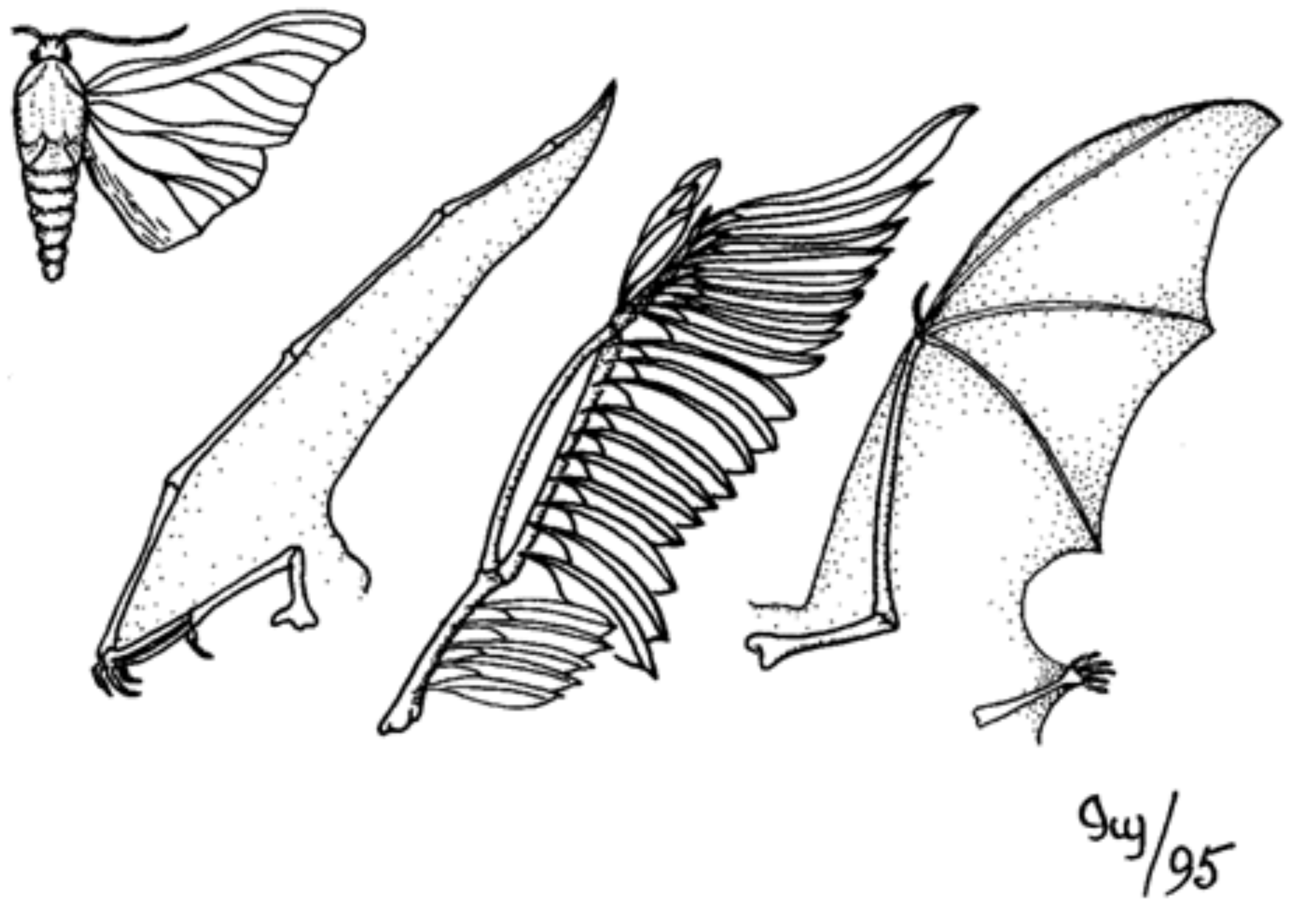
- Individual differences are intra-kind differences. The fact that members of a kind exhibit individual differences does not disqualify them from being of the same kind.
- If one science is sensitive to individual differences in a kind and another is not, this does not prevent the kinds from being identified.
- Nobody argues that we have special sciences because of individual differences.
- Which differences count as individual differences? Look at the science and see.

Eyes

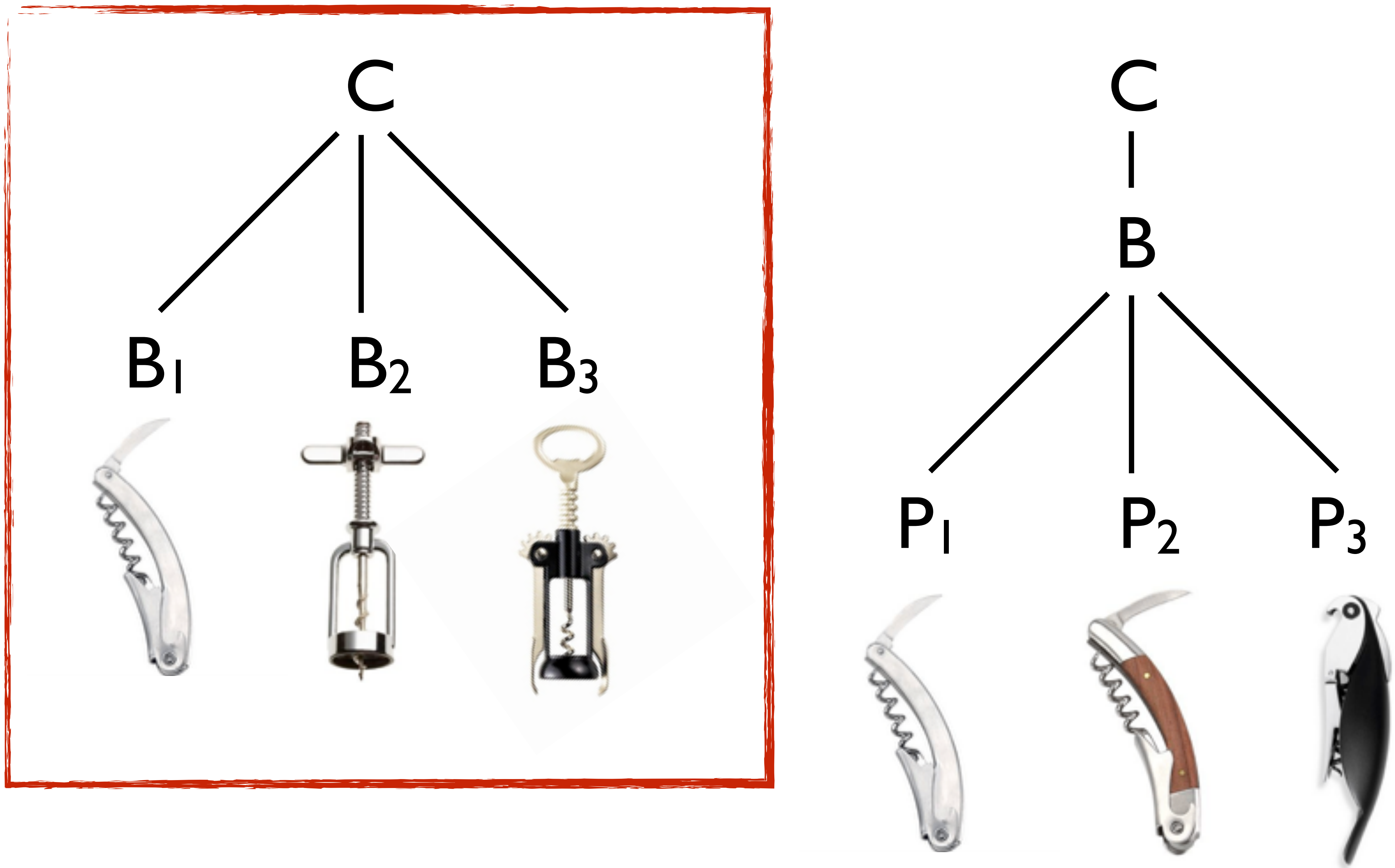




Wings



Kinds of Variation



Cases

1. Corkscrews
2. Eye Anatomy
3. Wing Anatomy
4. Bee face recognition
5. Neocortex and Avian DVR
6. Cone opsins, Part 1
7. Cone opsins, Part 2
8. Cone opsins, Part 3
9. Cone opsins, Part 4

Bee Facial Recognition

Honeybee (*Apis mellifera*) vision can discriminate between and recognise images of human faces

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Configural processing enables discrimination and categorization of face-like stimuli in honeybees

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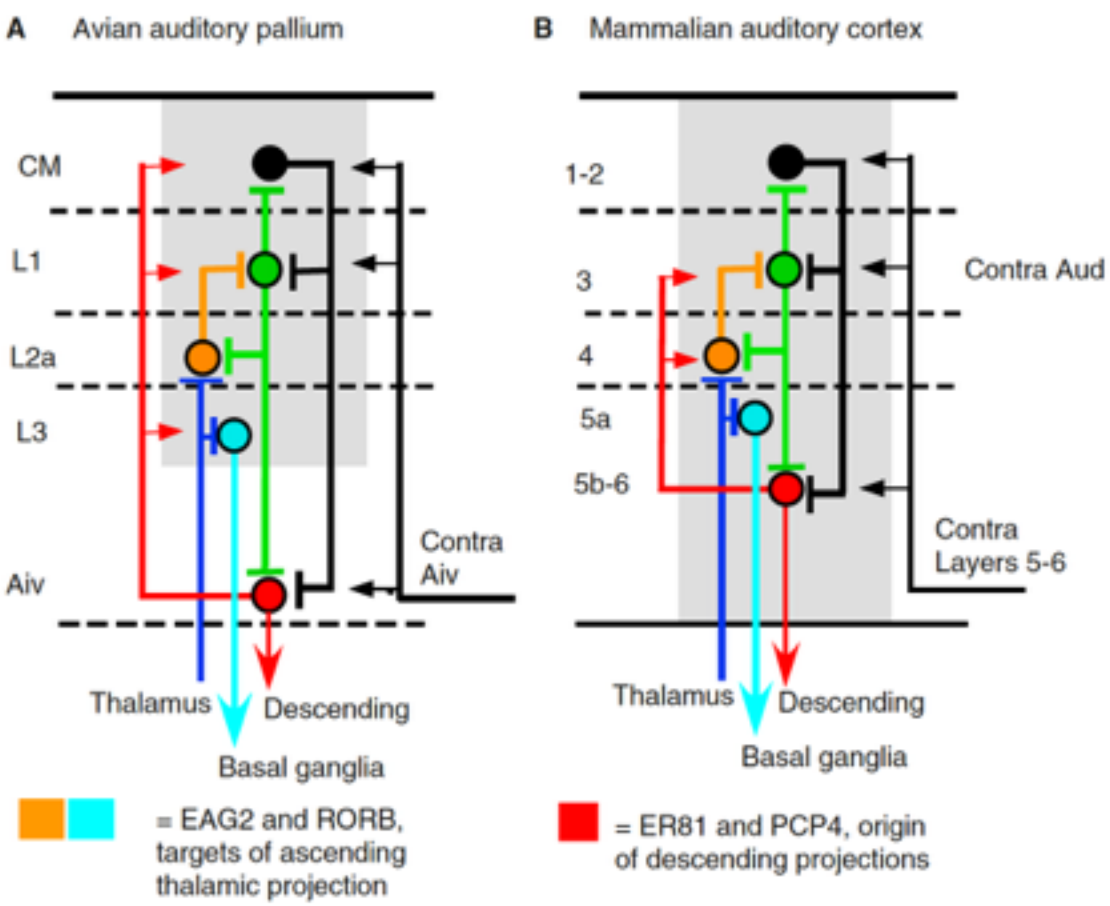
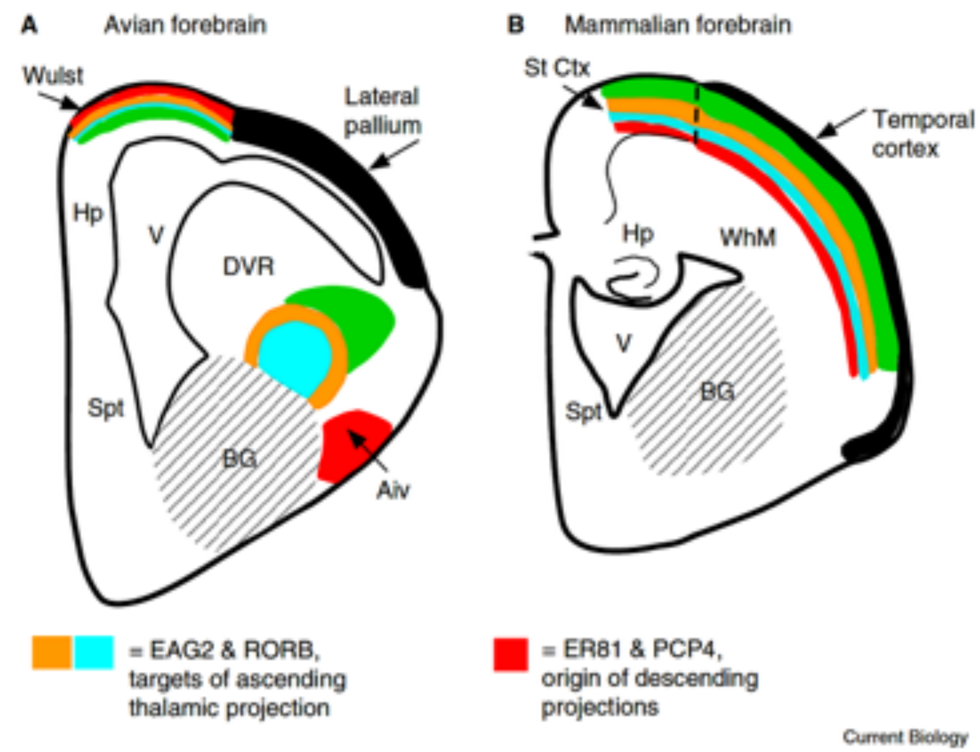
Neocortex and DVR

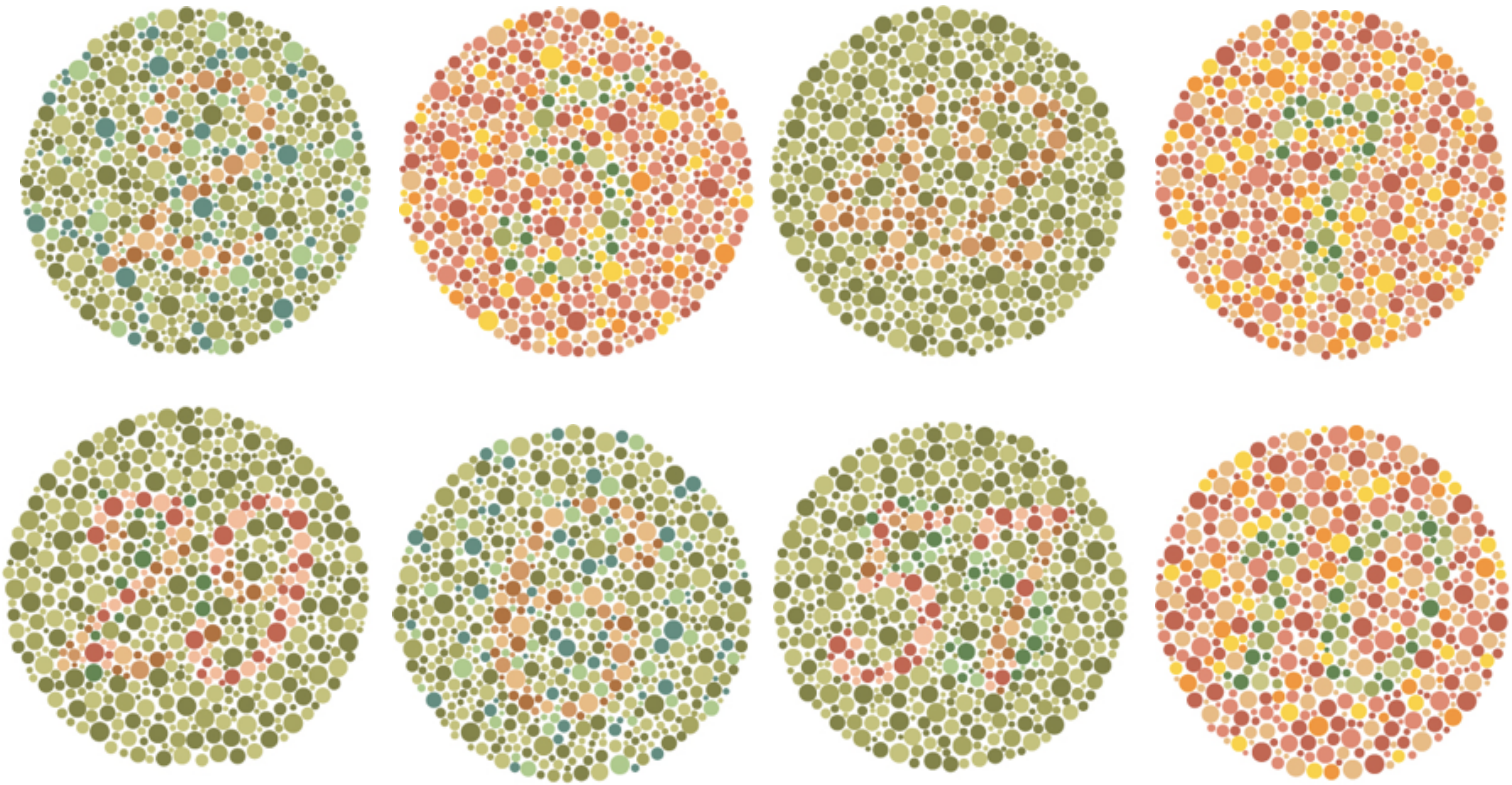




"Though differing in macroarchitecture, the basic cell types and connections of sensory input and output neurons of (A) avian/reptile and (B) mammalian telecephalon are nearly identical…"

"Neocortical Evolution: Neuronal Circuits Arise Independently of Lamination," H. Karten, *Current Biology*, Vol. 23, No. 1, R12 (January 2013)

Trichromatic Color Vision



Mammalian Cone Opsins

(1) What explains trichromacy? Opponent processing spectral vision system with three sensor types.

(2) Why do normal (trichromatic) human beings exhibit small differences in performance on some spectral identification and discrimination tasks?

Potential answers:

a. They use different spectral processing systems (vague)

b. They have different kinds of retinas

c. They have different arrangements or proportions of photoreceptors among their retinal mosaics

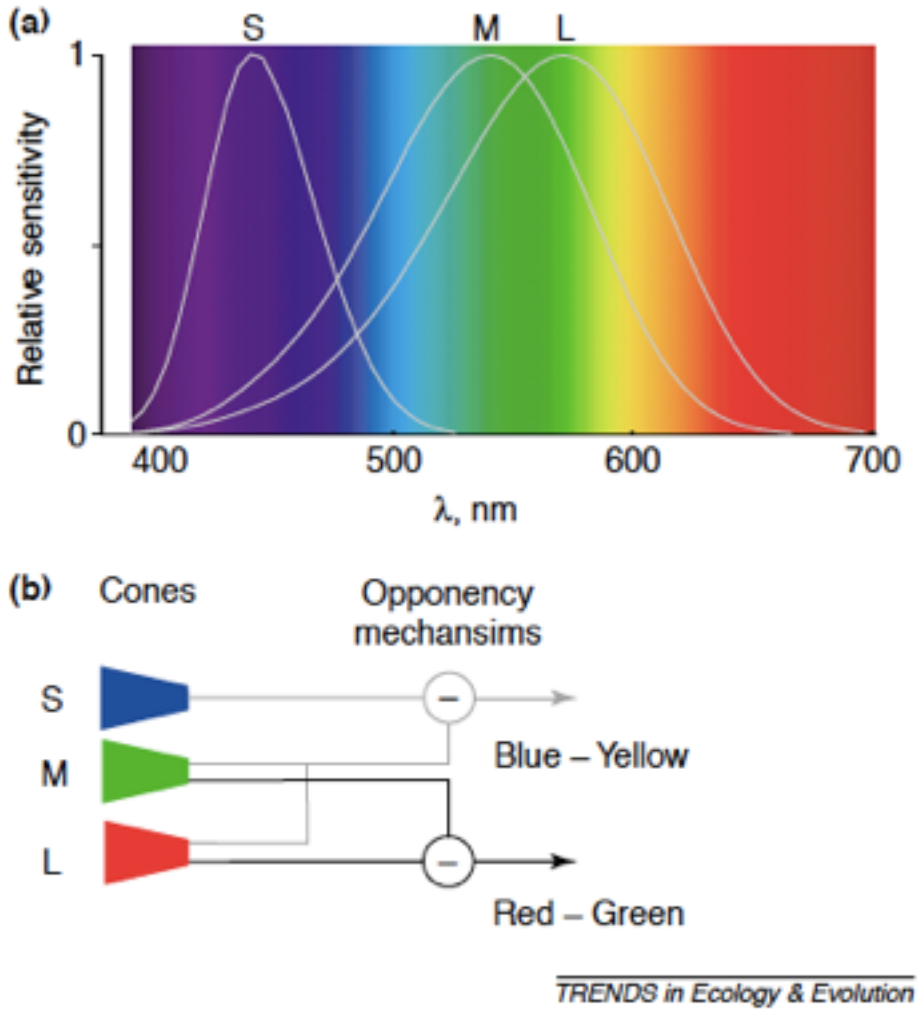
d. They have molecular differences among their photoreceptors

e. They have various (or variable) oil droplets in their cones

f. They have media (e.g., lens or corneal) differences

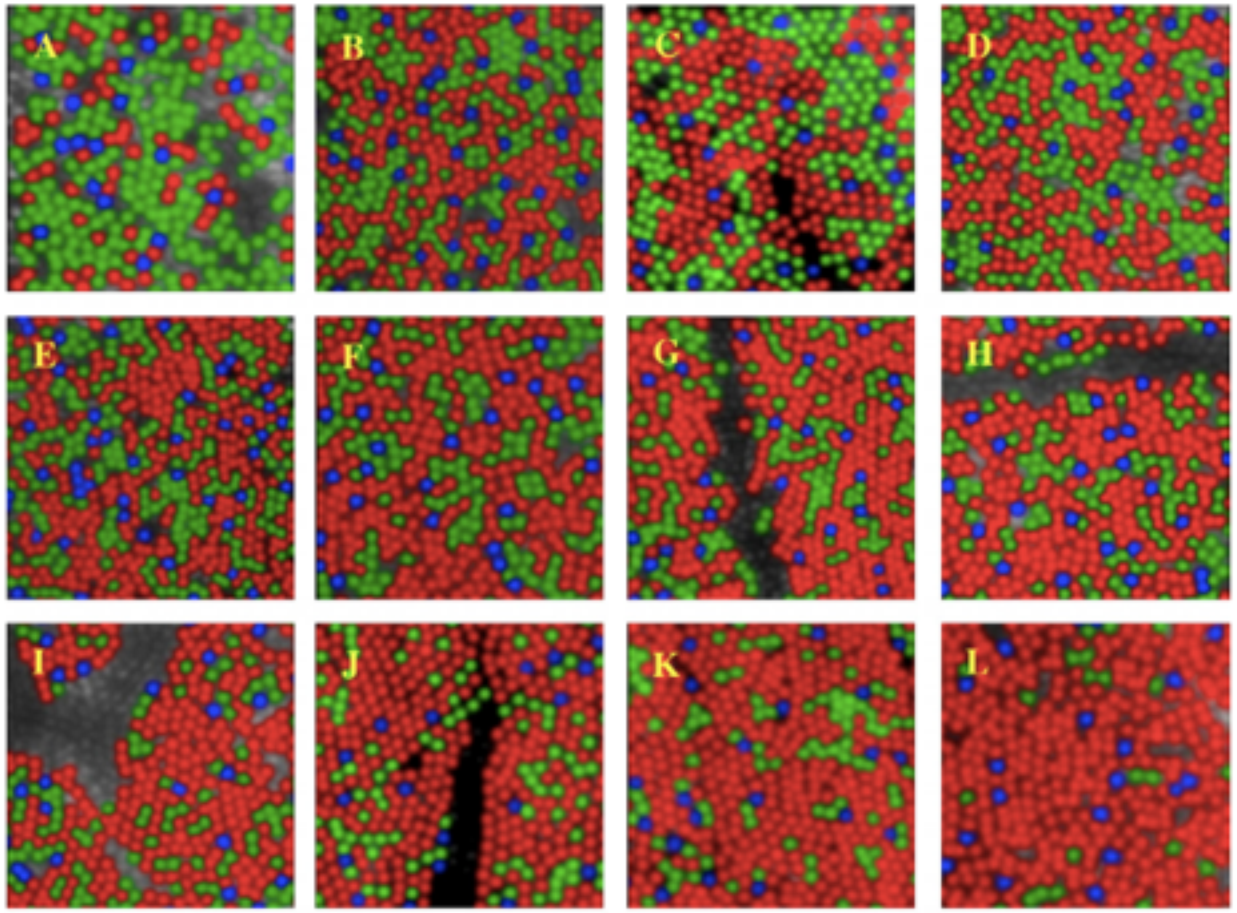
g. They have cortical differences

h. etc.



Cone Opsins

“the distribution of the different photopigments in foveal cones is essentially random and [there is] very large (40-fold) variation in the relative numbers of L and M cones across…. [Yet ordinary/everyday] color experience is not affected by the relative numbers of L and M cones.” (Williams 2011, review article)



Cone Opsins

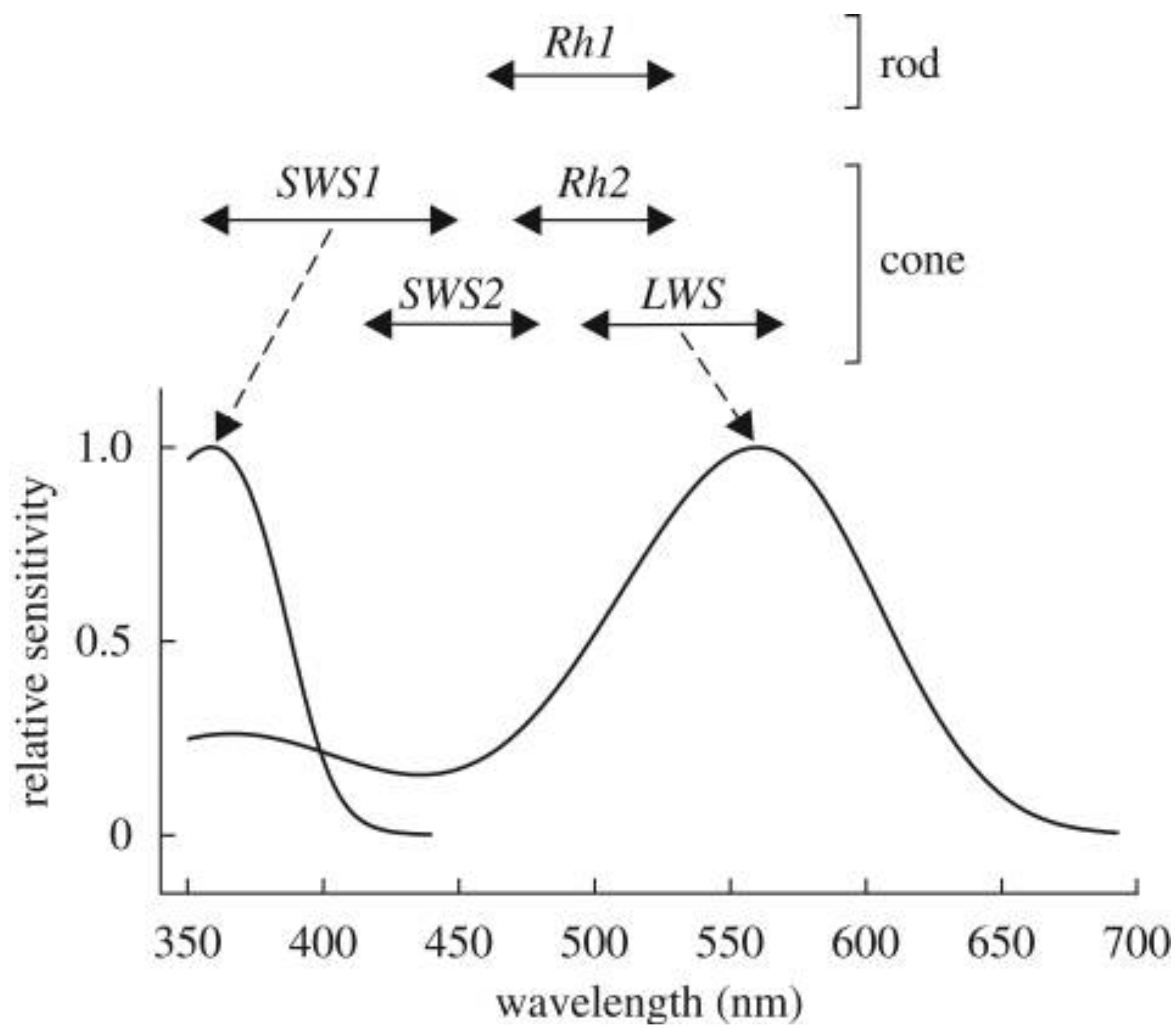
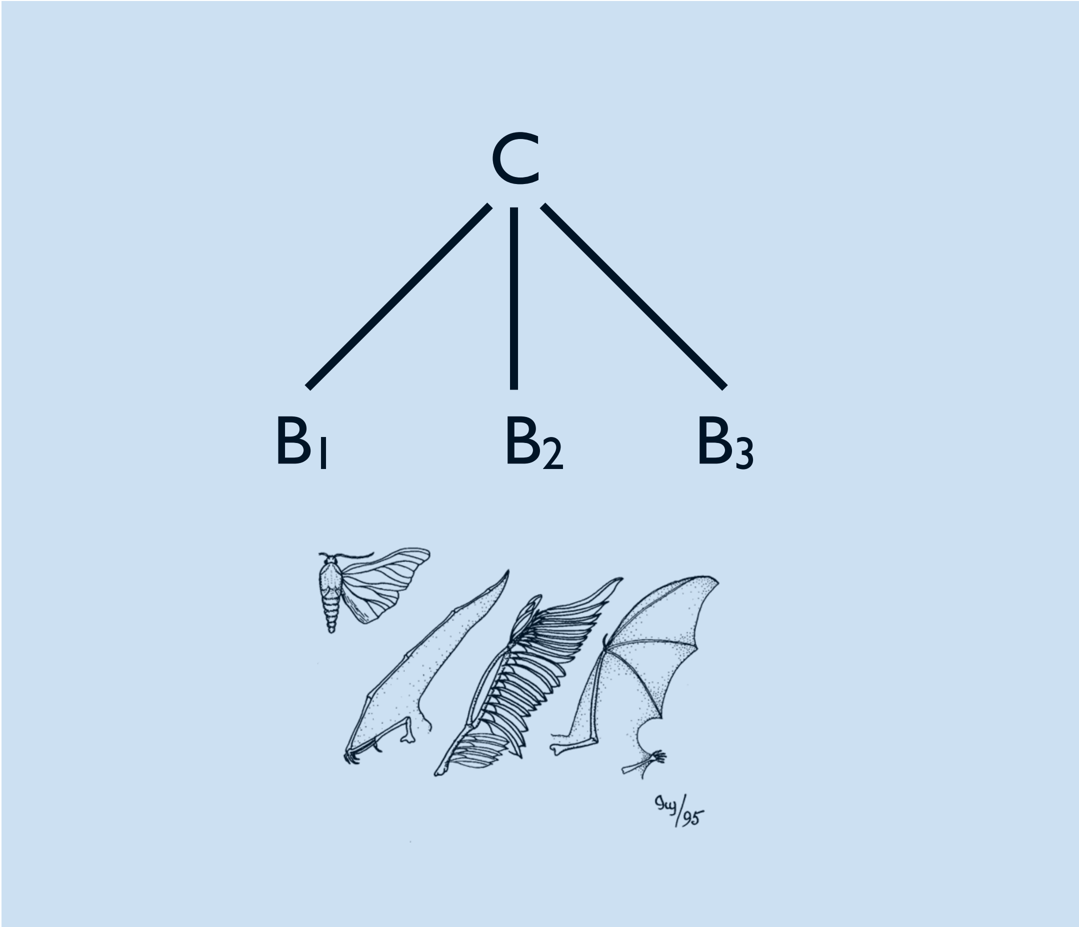


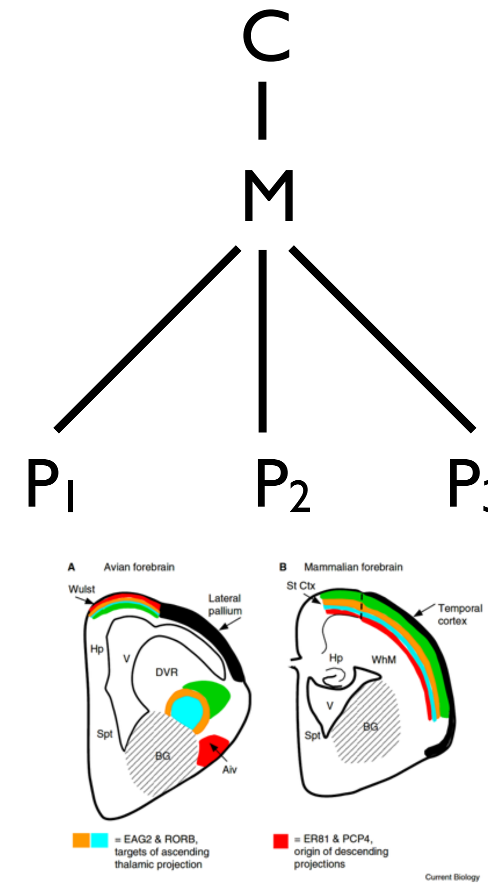
Figure 1 from G. Jacobs, “Evolution of colour vision in mammals,” *Philos Trans R Soc Lond B Biol Sci.* 2009 Oct 12; 364(1531): 2957–2967.

“Vertebrate photopigment opsins are products of five opsin gene families (top). In each of these families, gene sequence variations yield photopigments whose λmax values are drawn from the spectral ranges indicated by the extent of the horizontal lines. The ranges shown are those appropriate for pigments constructed using an 11-cis-retinal chromophore. All of the cone photopigments of eutherian mammals come from two of these gene families, SWS1 and LWS. It can be inferred from gene sequence comparisons that the two types of cone photopigments found in ancestral members of this group had spectral sensitivities given by the curves at the bottom.”

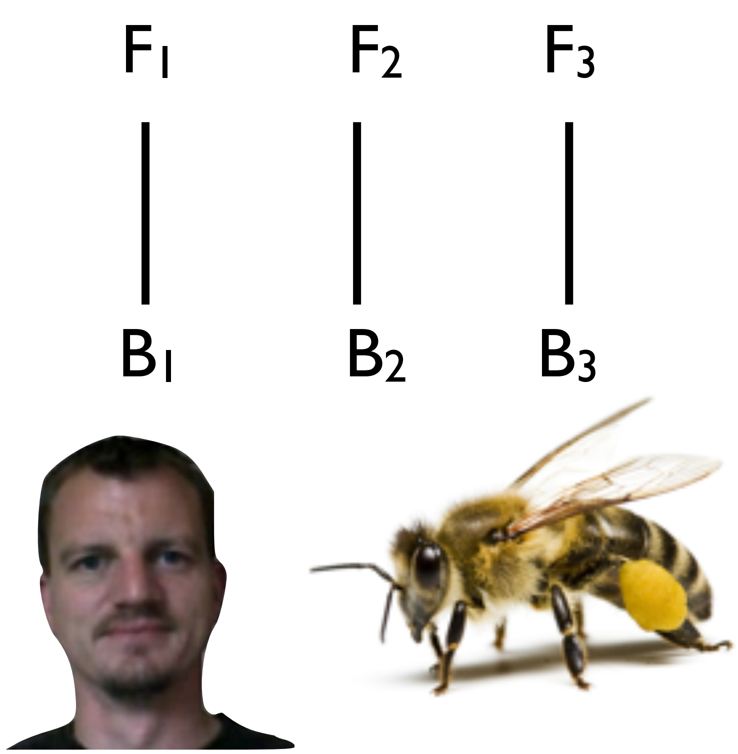
Part 3
Understanding MR



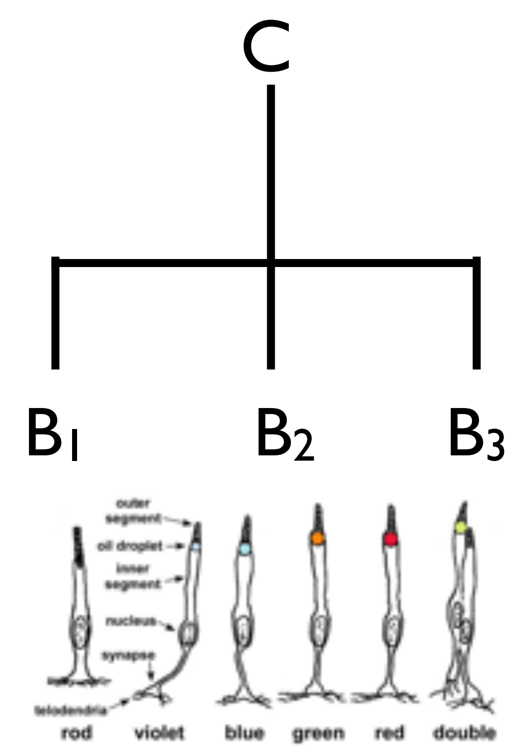
C
B1 B2 B3



C
M
P1 P2 P3
A Avian forebrain
Wulst
Lateral pallium
Hp
V
DVR
Spt
BG
Aiv
B Mammalian forebrain
St Ctx
Temporal cortex
Hp
WhM
V
Spt
BG
= EAG2 & RORB, targets of ascending thalamic projection
= ER81 & PCP4, origin of descending projections
Current Biology

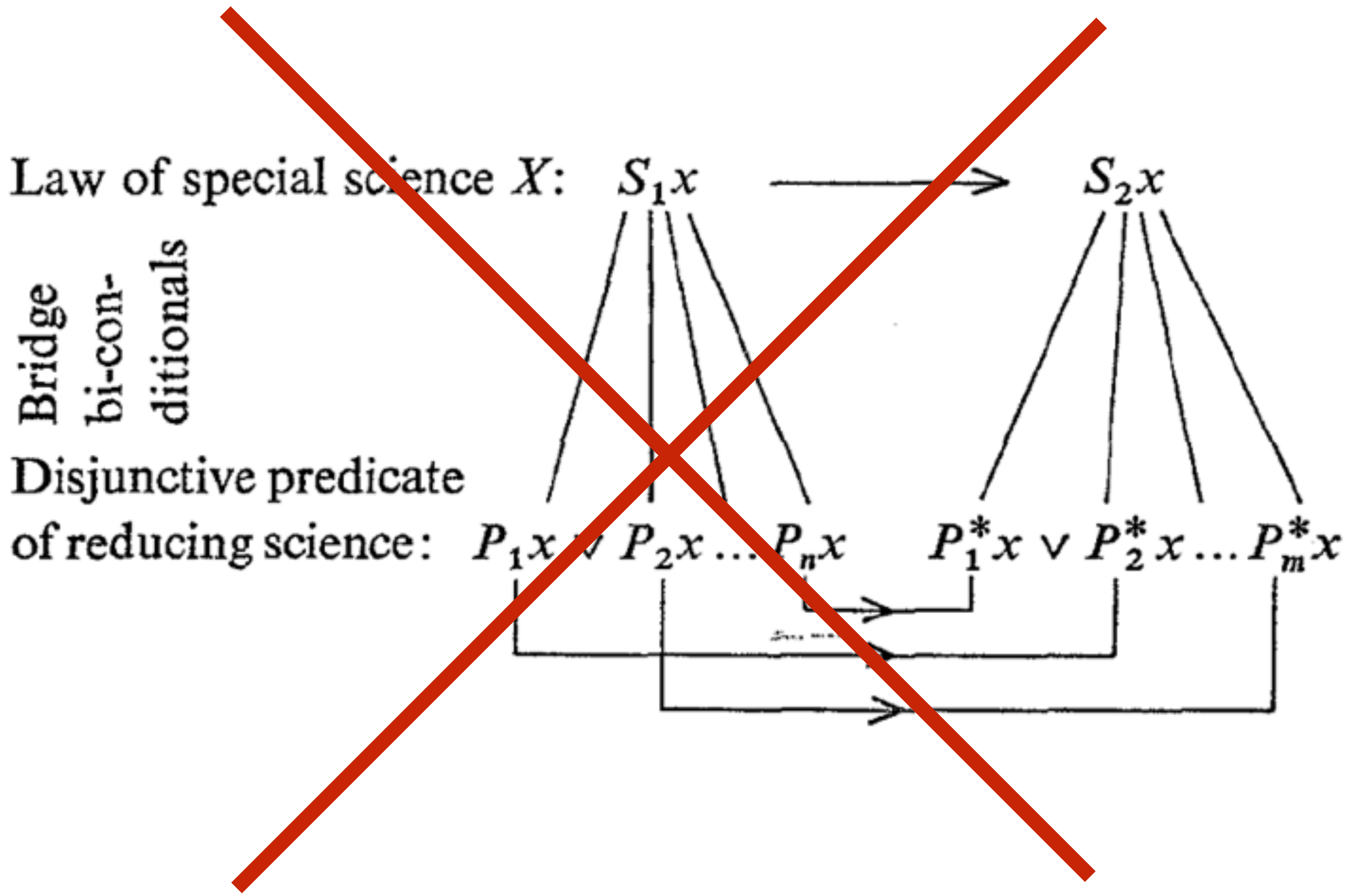


F1 F2 F3
B1 B2 B3

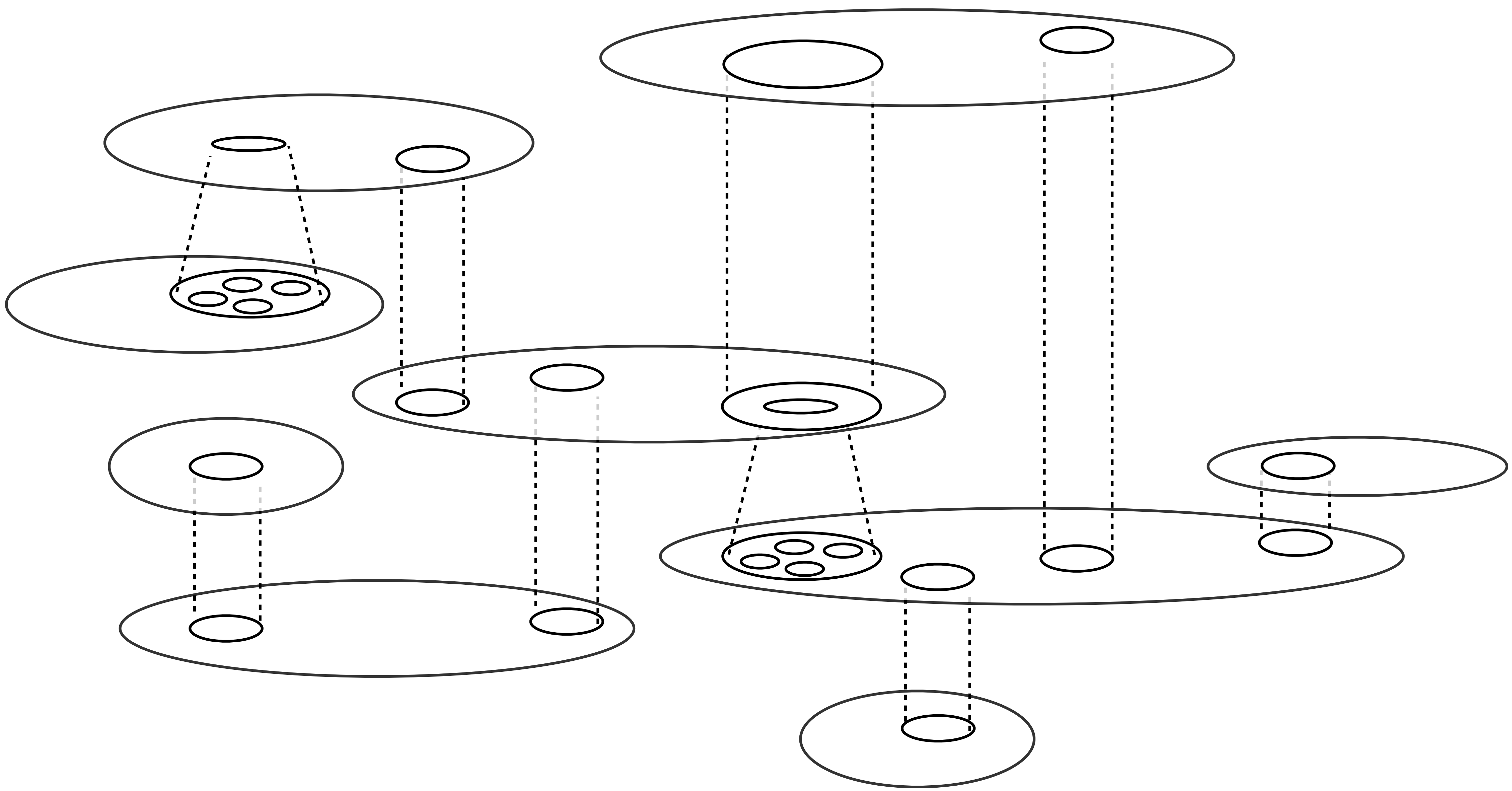


C
B1 B2 B3
outer segment
oil droplet
inner segment
nucleus
synapse
telodendria
rod
violet
blue
green
red
double

Special Sciences?



A Better Picture



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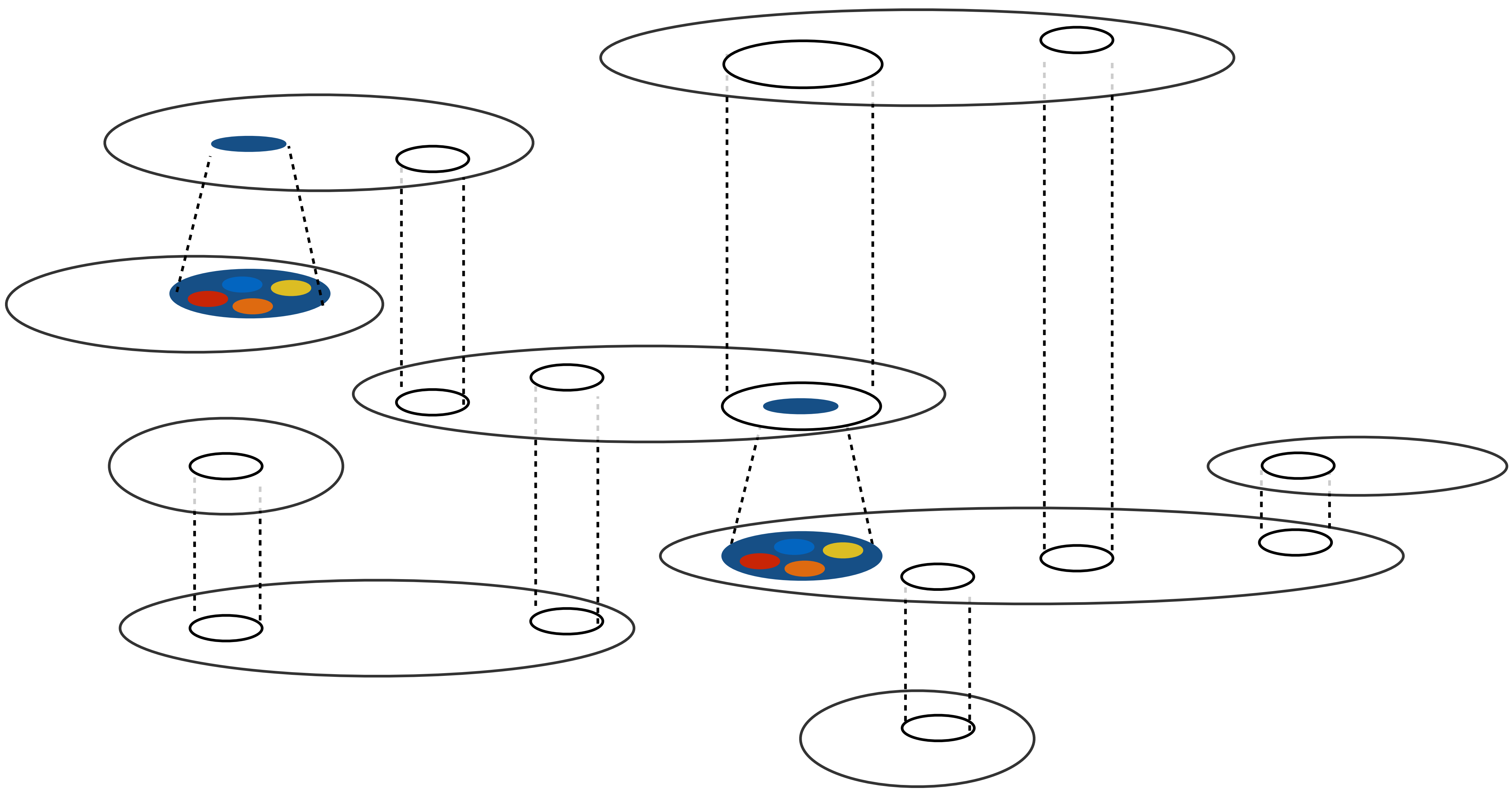

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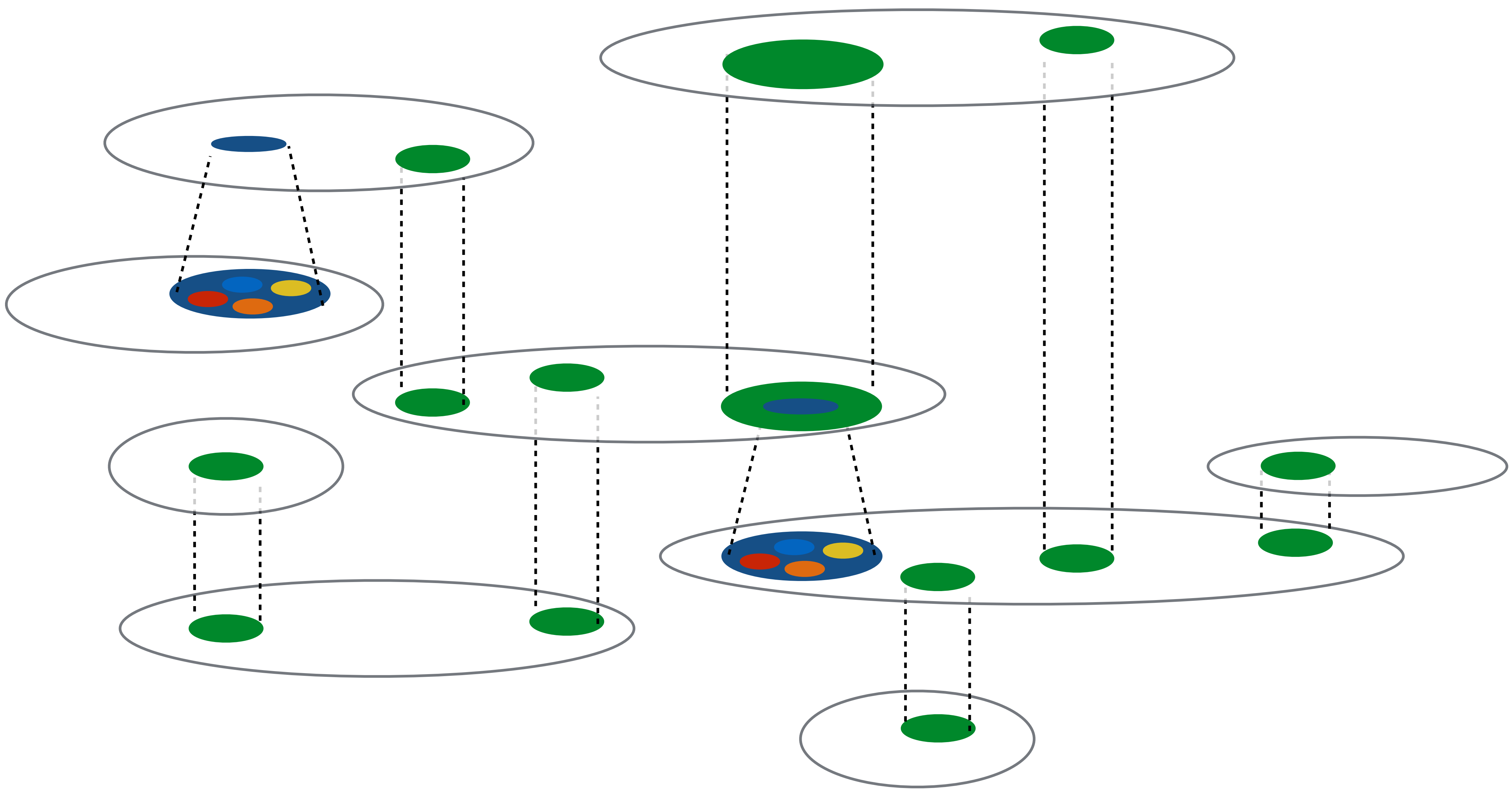

Thank You

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