I was carried to Ohio in a swarm of bees

Knowledge Integration into Neocortex: *Symbolic Neuronal Operations and Subconscious Information Processing*

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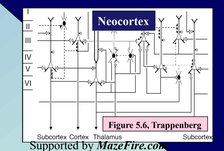
Précis of KI into Neocortex: **To understand how new knowledge (K) is encoded and integrated into human neocortex poses formidable challenges. Early sensory processing steps create initial representations of e.g. phonemes and printed words, but all subsequent steps remain deeply mysterious, advances on the margins notwithstanding.** If one is to integrate some new bit of knowledge, e.g. *Aequorea victoria is bioluminescent*, a host of further processes must occur. We focus here on the incorporation of new K into a cognitively advanced brain, e.g. that of a high school student. In such case, the new K must be fit with existing schemas and this entails: (i) activation of basic autoassociative networks (AANs) encoding grounding-concepts, (ii) organization of basic AANs into epoch-specific collections and (iii) building new representations, possibly with new words/neural words.

Knowledge Integration in Action

How do we use *Neurons* to take WORDS, PHRASES and Real-World Items and make SENSE of them?

A THEORETICAL PERSPECTIVE

Action Networks: motor cortex, PFC
Aequoria victoria "**IS**" *Bioluminescent*
see Pulvermuller, 2013
on 4 semantic mechanisms
referential, compositional, affective, generalized



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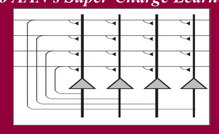
Auto-Associative Networks

AANs can STORE PATTERNS for Pattern Recog / Categorization
Are **AANs** bound in **DMR epochs**?

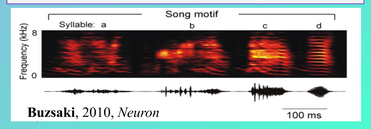
DMR = Daily Memory Records

Do AAN's Super-Charge Learning?



we use AANs all the time:
- storage
- retrieval
- categorization
- connections
- robustness

auditory syllables ➔ belt nuclei
…thence into *Language Parsing* system
"Aequoria victoria" ➔ Novelty System
"Bioluminescence" activates ➔
"bio" AAN AND "lumen/light" AAN



Buzsaki, 2010, *Neuron*

Phonemes ➔ words
words ➔ phrases, sentences & via Grammar Interpreter ➔ Thoughts!

Role of SNOPs in Consciousness

SNOPS-non-linguistic: emerges from U.P. (U.P. = universal physics ➔ universal grammar) *Thoughts* might be "formulated" via SNOPs-nl which then are tagged & routed thru SNOPs-L into our Stream of Consciousness (and into DMR)

Linguistic SNOPS = vastly expressive symbol manipulation system

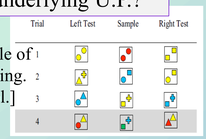
But rides upon SNOPS-nl our sub-linguistic symbol system, which is derived from the far vaster evolutionary learning system which stored vast innate knowledge aka U.P. why? Because Craig's rats like almonds + zf stories! *Neural Words* takes us from invar. Repr. to compact **PACKETS**.

Craig Ferris: Top Shelf small animal fMRI
Dept. Psychology, NU

The Nature and Miracle of Analogies

- Dancers are Flexible; autistics can be Cognitively Inflexible; & Crows?
- Analogies build new Knowledge Arch. from neural circuitry underlying U.P.?

Crows spontaneously learn relational tasks, in first example of non-primate analogical reasoning. [iaw Smirnova 2015 Curr. Biol.]

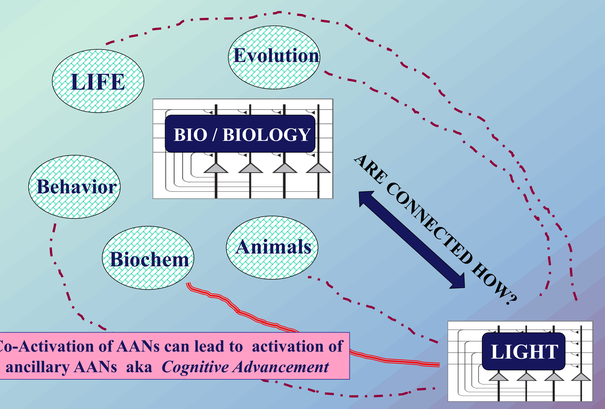


Aequoria victoria
IS
Bioluminescent
exemplar of **NEW KNOWLEDGE**

Packets and Routing

AAN activations, connections & branchings ➔ cognitive advancement.
packets/Neural Words ➔ next AAN.
Richness of system grows over time.
but fragments w/ age: Padani, Bunce, 2016

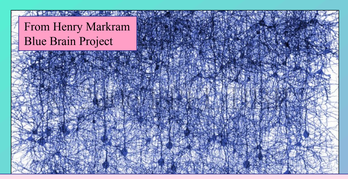
PACKET ROUTING *FUELS* **COGNITIVE ADVANCEMENT**

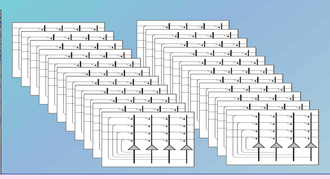


Co-Activation of AANs can lead to activation of ancillary AANs aka *Cognitive Advancement*

"Spaghetti Wiring" vs. AAN Arrays

Arrays are less flexible but might create *Cognitive Synergies*





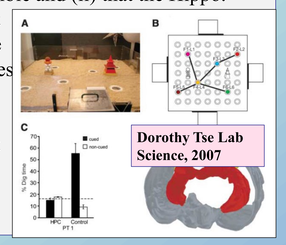
Why Packet Routing & AANs are Required

vs. *Single-Line Coding*

Neuronal assemblies (AANs or other constructs) might be required to do pattern completion, categorization, etc. It seems unlikely that an invariant repr. of e.g. an *apple* could be conveyed by a single neuron, **but if such single-line coding** is possible, then that repr. could be sent to 10,000 other neurons. This vastly increases # of possible permutations, but might come at an exorbitant computational cost. This is analogous to degrees of freedom in motor control, which are greatly reduced by motor synergies (Giszter, 2013, FINS).. We propose that the dimensionality of neocortical computations is reduced by **cognitive synergies**. This fits with packet routing where collections of signals (axons) communicate between AANs (ala DTI image).

Dorothy Tse and Neocortical Schemas: 2007, 2009.

Documentation of fast schema (rule, model) learning by rats shows (i) that fast neocortical learning is possible and (ii) that the Hippo. formation is not required. This is most intriguing b/c DMRs are posited to be written directly in neocortex (.ppt series at zfhindbrain) and the utilization of prior knowledge (see Verfaellie, 2008; Groch, 2017) suggests a means for fast "new circuit" construction by linking existing AANs via nascent or silent synapses. Check your DMR!

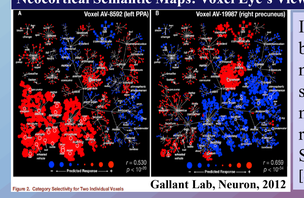


Language and Consciousness Primer

- semantics comes from experience #SCFE
- Universal Physics / U.P. ➔ Universal Grammar
- Though he is completely wrong, read: **Nobrega** *Front. Psych. 2015* for linguistic approach

Neocortical Semantic Maps: Voxel Eye's View

Expressive + Lexical = Fail, Sad



If we consider fMRI voxels to be brain modules (w/ 100k+ neurons), Huth et al. reveal a semantic mapping that spans much of neocortex. This is richly connected w/ sublinguistic SCIP: 200 msec ➔ *semantics.* [see .ppt notes for more on SCIP]

If *words* are indelibly linked to *non-ling. Reprs*, then Language Generation might be deeply rooted in a Universal Physics spanning Neocortex.

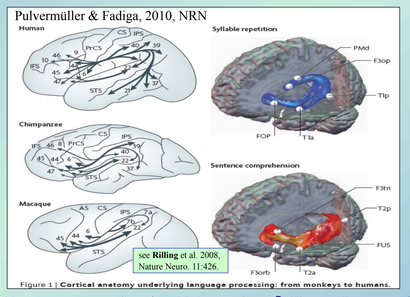
HIGHLIGHTS
- AANs / equiv. are key
- Packet, not SLC routing
- Rapid Learning w/ Schemas
- AAN binding ➔ Cogn. Advances
- SCIP, DMRs, SCFE
- U.P. ➔ Neural Words => SNOPS

your Neuronal Information Processing primer

Monkeys vs. Apes & The Social Brain

Elusive differences, but dispersed Ape groups & need for greater cognitive control paved the way for human analogies and cognitive evolution. Barrett, 2003, TICS

Sign Off, DT, *SIGN OFF!*



Did greater repertoire of AAN connections ➔ Human Language?

DMRs and SCIP/Sub-Consc.IP

your DMR is an excerpt of Consc. experience: all you "know" came thru your DMR, but your Consc. thoughts are the TINIEST fraction of NIP everything else is SCIP: see notes.

Neural Words are *SNOPs-nl* and might be routed in packets/DMRs. alt. NWs = neural syntax: Buzsaki 2010

Wiring of Neocortex seen w/ Diffusion Tensor Imaging

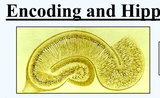
Go to zfhindbrain.com / DMR

- complete history of DMR / U.P. research
- recent *Synaptic Learning Theory* posters
- **Neural Words** book chapter + SNOPS

Background Concepts

- McClellan: complementary learning sys.
- slow vs. fast memory consolidation
- machine vs. human learning algorithms

Encoding and Hippocampal AANs



Rat Hippocampus
Santiago Ramon y Cajal

Storage of new memories fails when ERC ➔ hippo. path is degraded. ERC projections to both CA1 and CA3 are important for AAN encoding and retrieval processes. The cholinergic inputs switch hippo operations between CA1 encoding and CA3/AAN retrieval. Bibliography available on request.