

From Gene to Cognition: Exploration into Human Complexity

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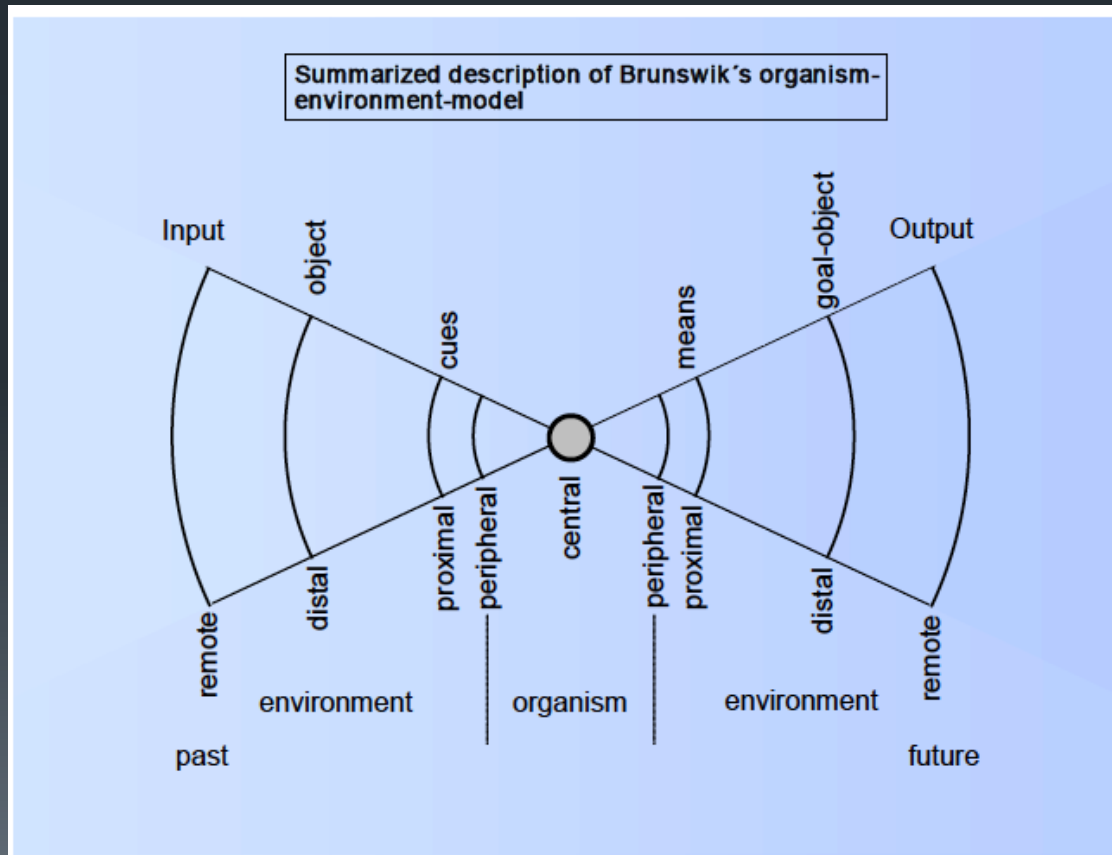


How to understand human behavior?

- Nomothetic approach
- Idiographic approach
- Hypothetic-deductive research framework
- Probabilistic Functionalism

Hypothetic-deductive research framework

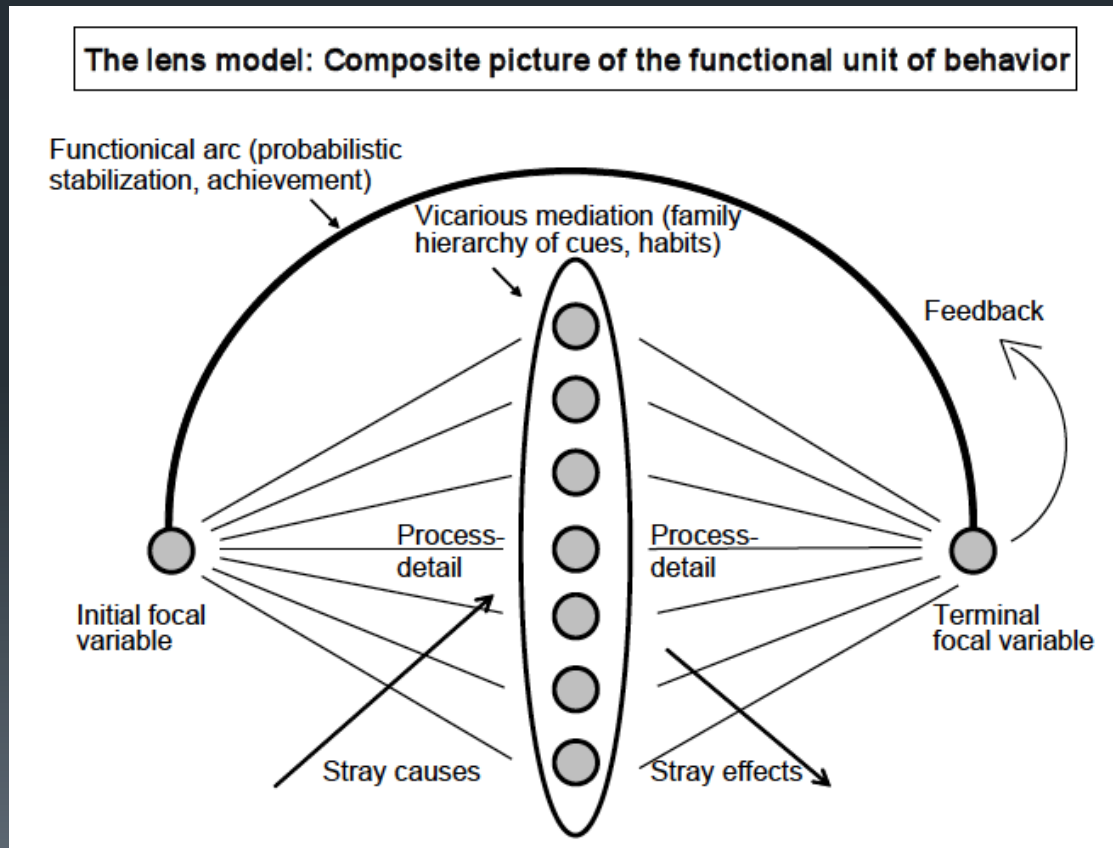
- The Lens model (Brunswik, 1952)



Hypothetic-deductive research framework

■ Brunswik's original lens model

(Wolf, 2005)




Codes

- Broadbent: Information Processing
- Liberman: Special Speech Code
- Sperling: Speech Recoding
- Miller: Chunking
- Tzeng: Temporal Code (automatic vs. organizational)
- Tulving: Episodic vs. Semantic Memory
- Kohler: Procedural Memory

- Psycholinguistics: from phrase structure to strong Grammar to Schema

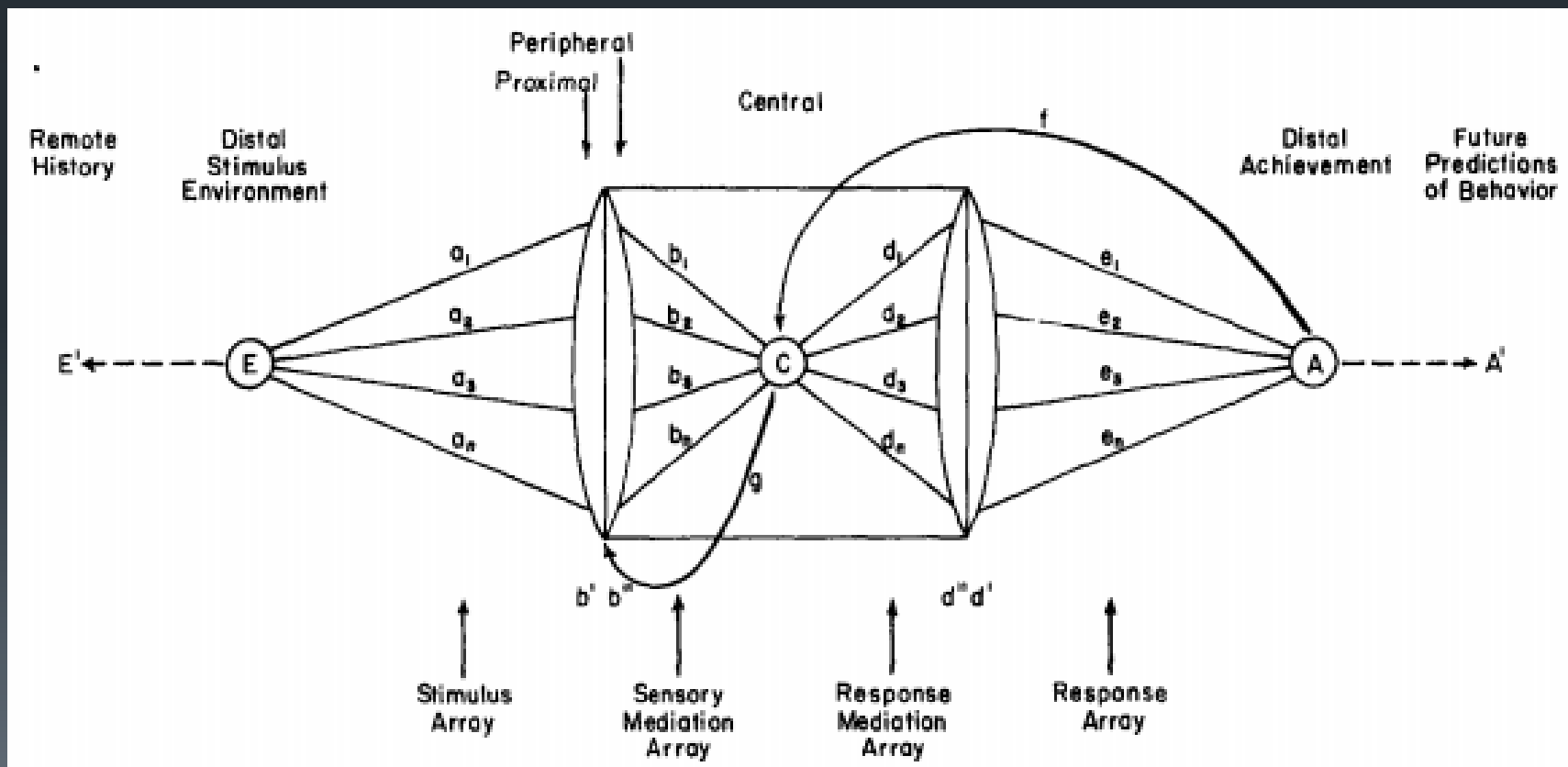
Understanding Behavior from the Perspective of Structural Biology

- Genetic → Genomics → Functional Genomics → Proteomics → epi-Genomics
- Cell 
 - Growth & Branching
 - Functional Connectivity
- Executive Functions in Cognition
 - Attention, Memory, Decision, Abstraction
- Human Complexity

Hypothetic-deductive research framework

■ Probabilistic Functionalism

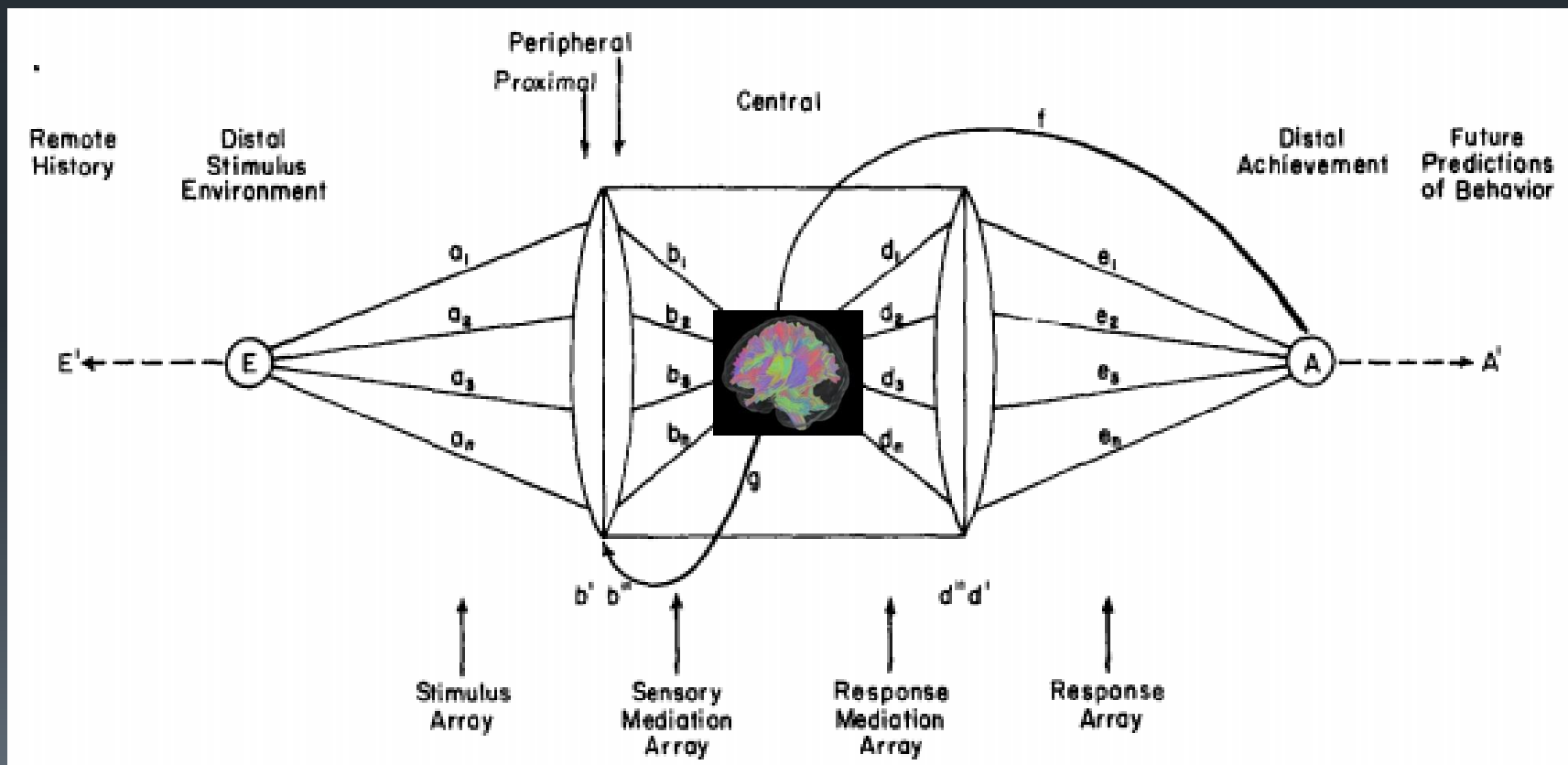
(Lewis Petrinovich, 1979)



Hypothetic-deductive research framework

■ Probabilistic Functionalism

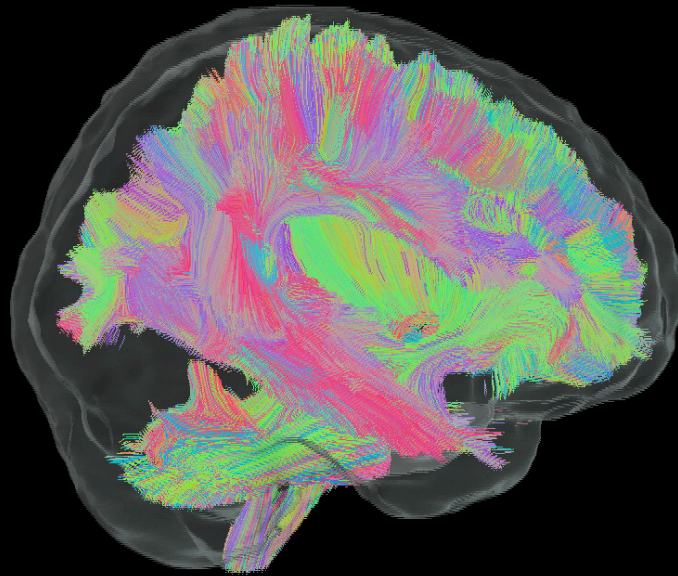
(Lewis Petrinovich, 1979)



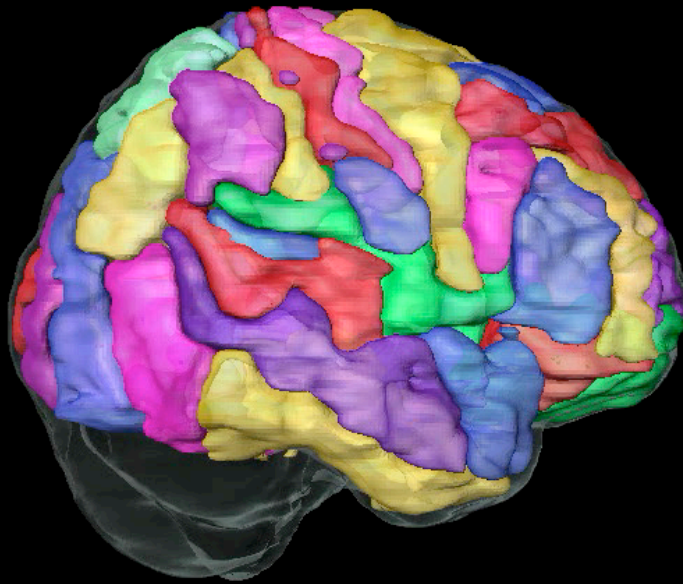
Brain Anatomy



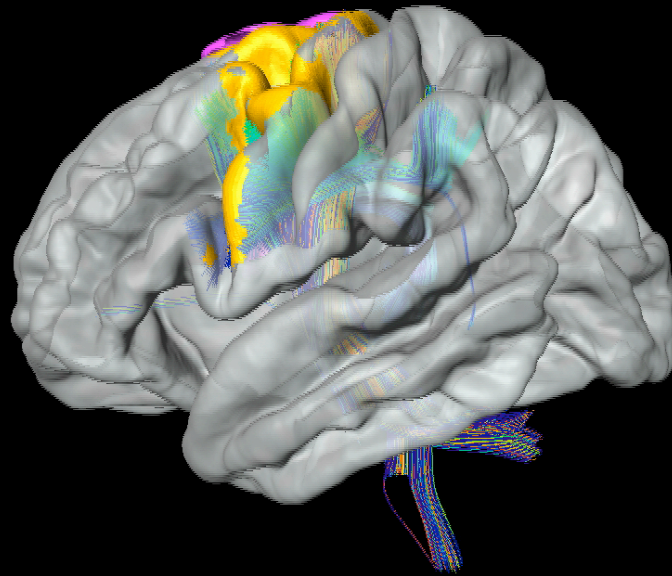
White Matter Circuits



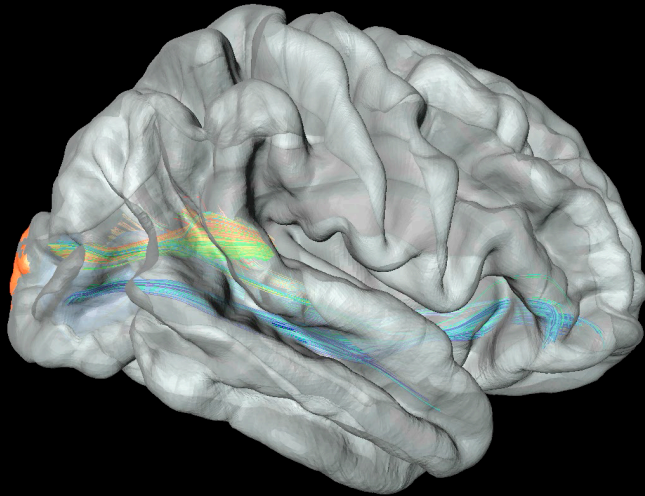
Brain Functional Map



Premotor Cortex & Tracts



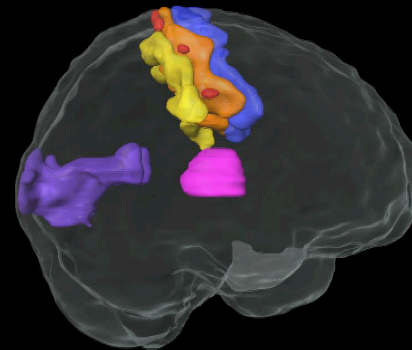
Primary Visual Cortex & Tracts



Sleeping (REM)



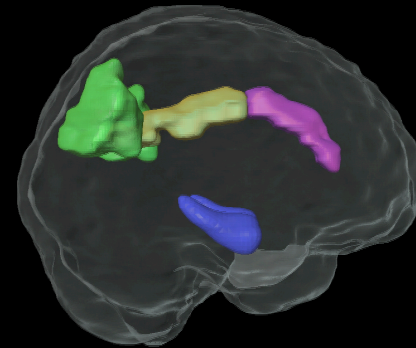
Thalamus
Primary Visual Cortex
Primary Motor Cortex
Primary Sensory Cortex



Resting



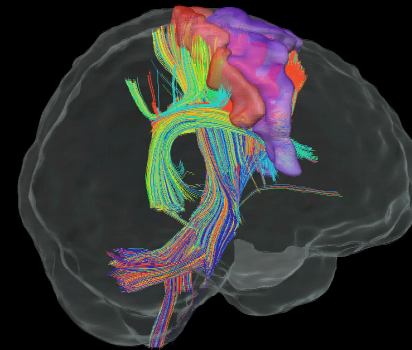
Anterior Cingulate Cortex
Posterior Cingulate Cortex
Inferior Parietal Lobule
Hippocampus





Motor

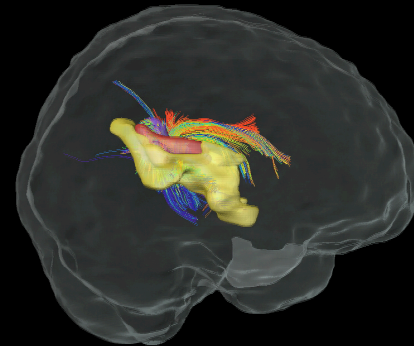
Primary Motor Cortex
Premotor Cortex
Supplementary Motor Cortex



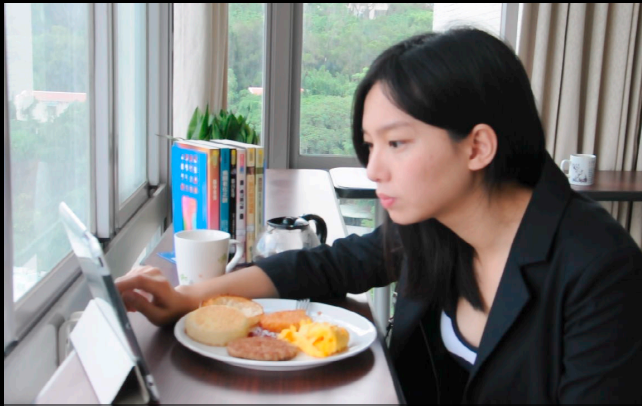


Hearing

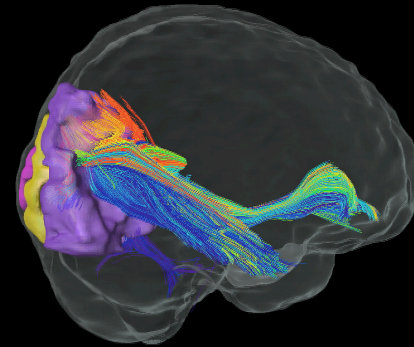
Primary and Auditory Association Cortex



Visual



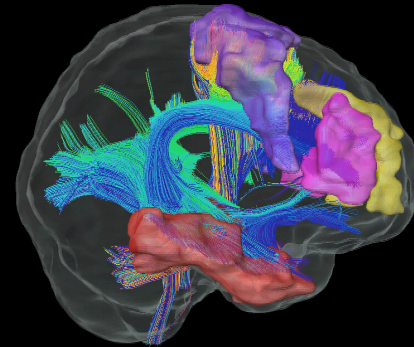
Primary Visual Cortex (V1)
Secondary Visual Cortex (V2)
Associative Visual Cortex (V3, V4, V5)





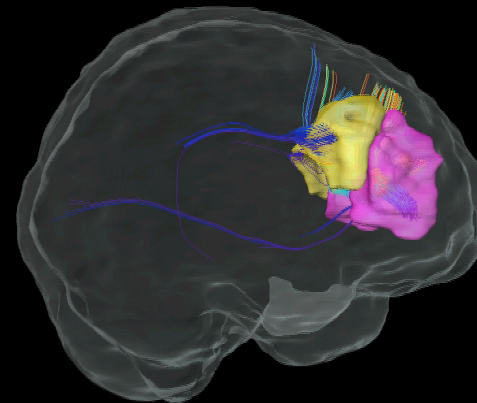
Memory

Inferior Temporal Gyrus
Dorsolateral Prefrontal Cortex



Language

Broca's Area,
Wernicke's Area

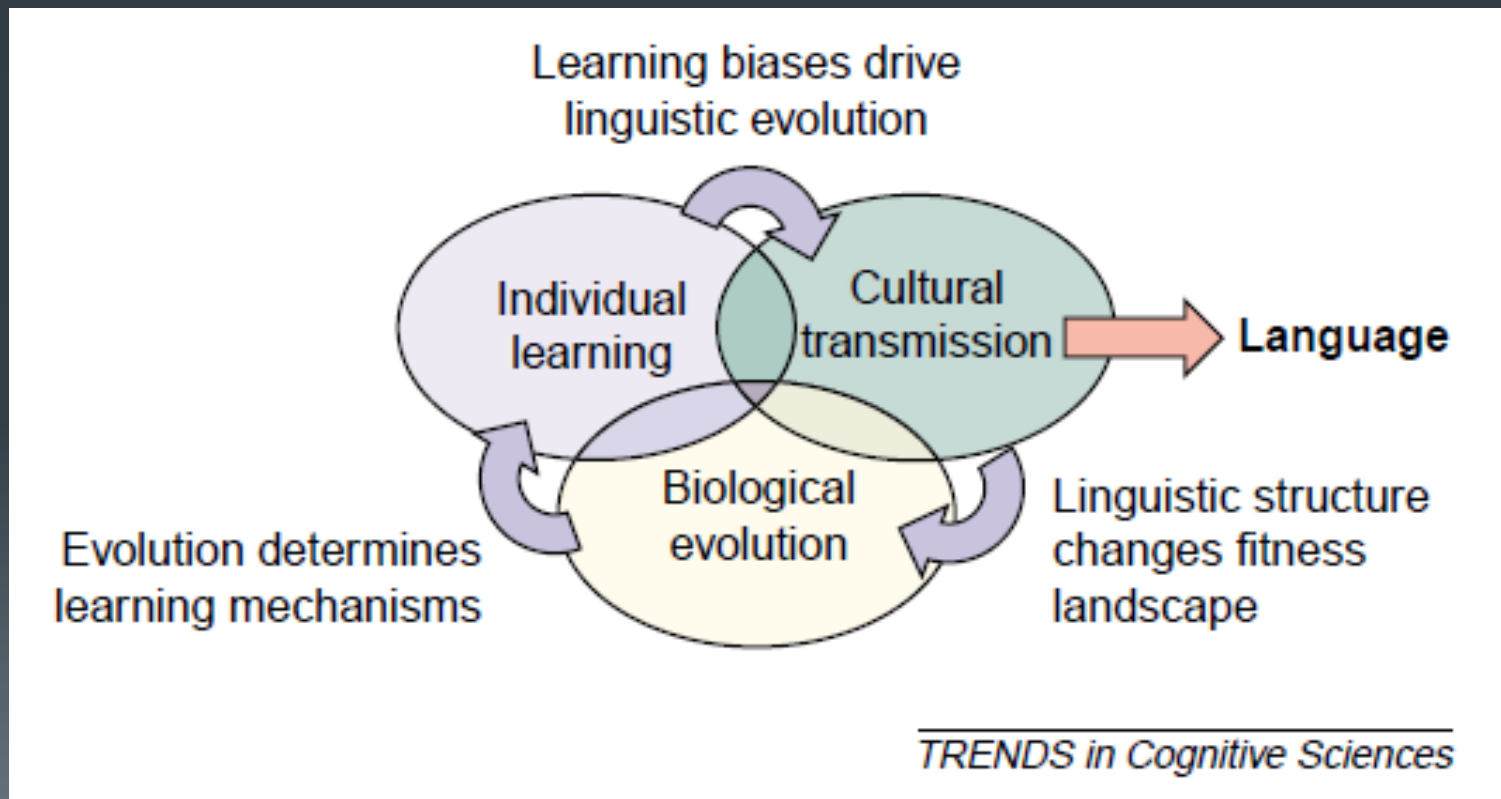


3D Project

Brain Connectivity Lab
Lab for Cognitive Neuroscience

Human complexity: Language perspective

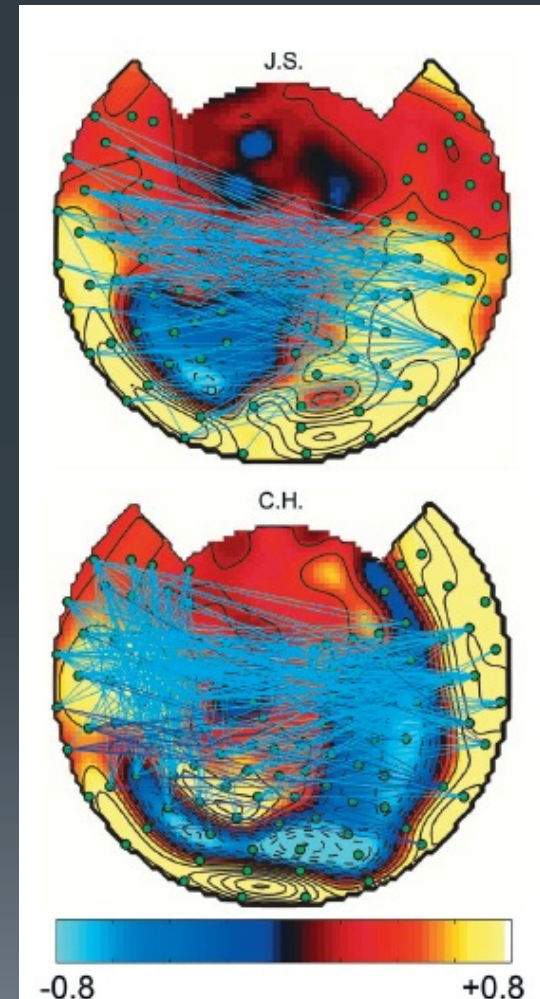
- language is a perfect subject to investigate the interaction among the brain, genes, and culture



Dynamic Core Hypothesis Information Integration Theory -- Human Consciousness --

- Integration
- Differentiation
- Complexity
- Emergent Property
- Reentry

Giulio Tononi and Gerald M. Edelman
1998, Science



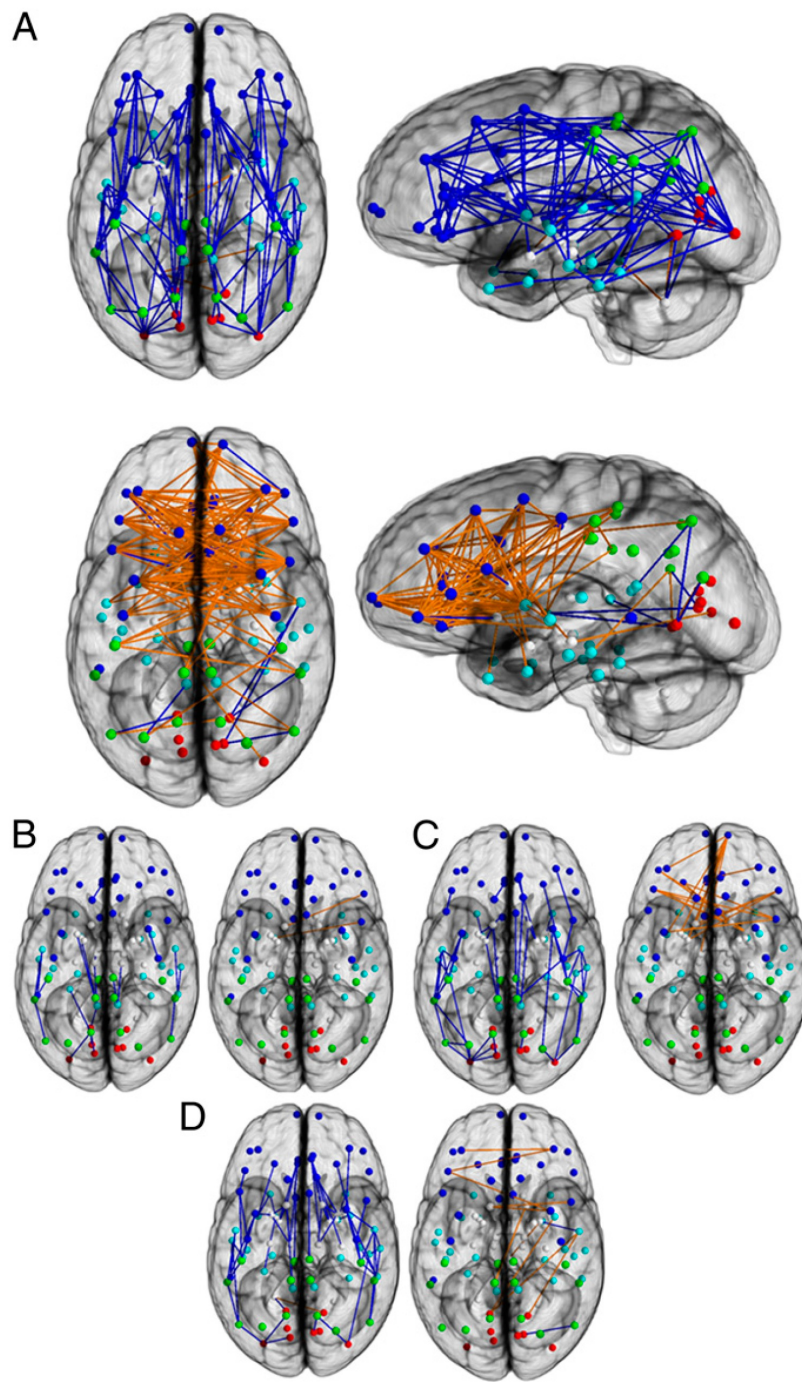
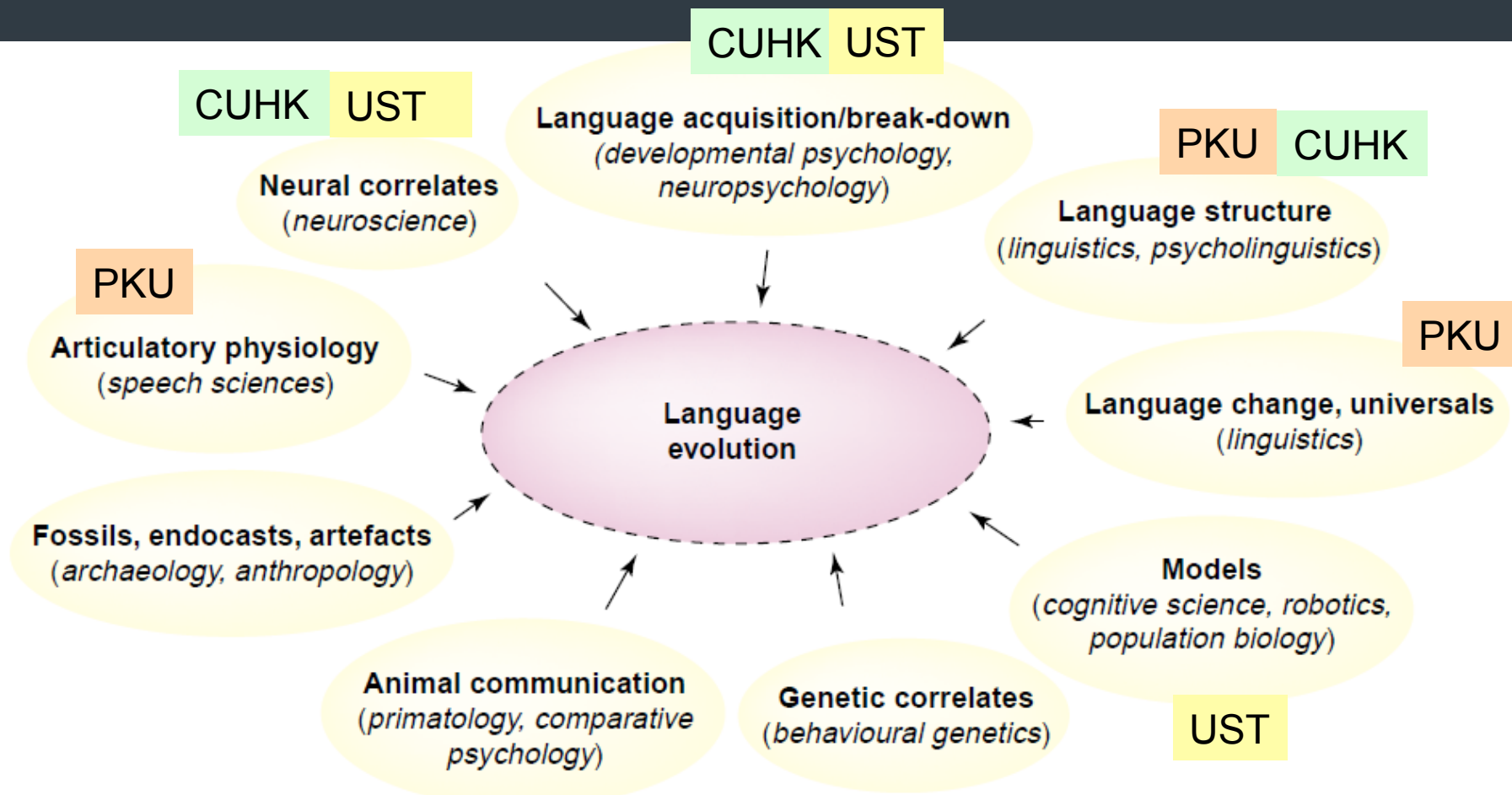
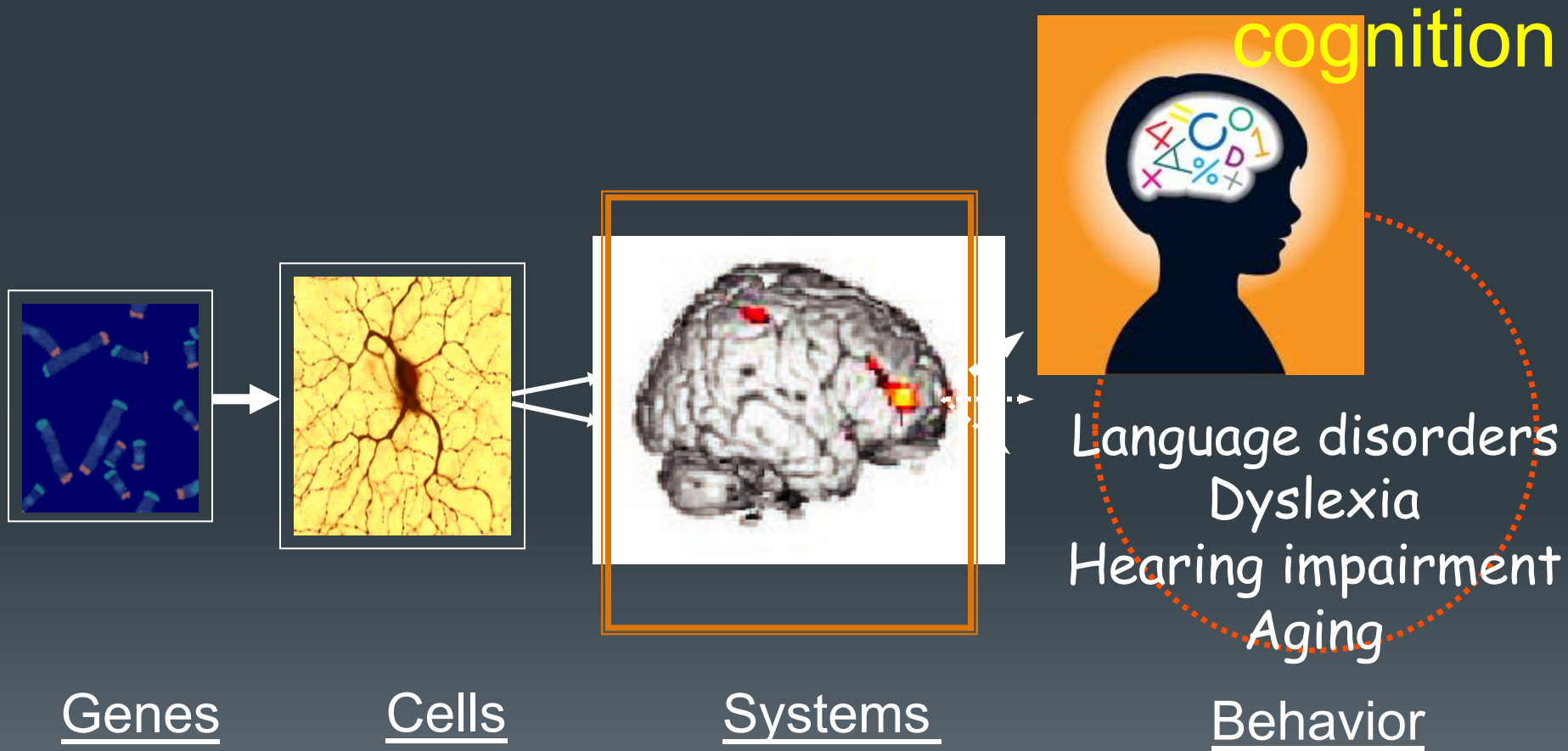


Fig. 2. Connection-wise analysis. (A) Brain networks show increased connectivity in males (*Upper*) and females (*Lower*). Analysis on the child (B), adolescent (C), and young adult (D) groups is shown. Intrahemispheric connections are shown in blue, and interhemispheric connections are shown in orange. The depicted edges are those that survived permutation testing at $P = 0.05$. Node color representations are as follows: light blue, frontal; cyan, temporal; green, parietal; red, occipital; white, subcortical. GM, gray matter.

Interdisciplinary Research



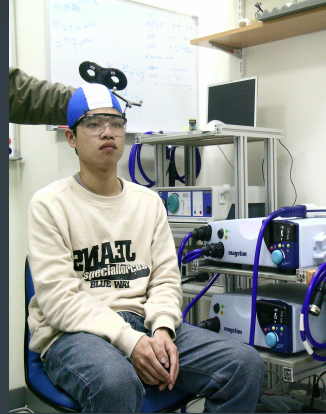
From Genes to Behavior



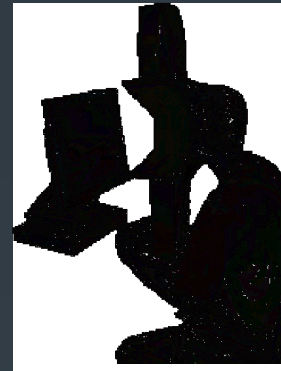
Cognitive Neuroscience as a Bridge

Specialty in cognitive neuroscience

- *Knowledge*
- *Facilities*
- *Tools & Techniques*



TMS



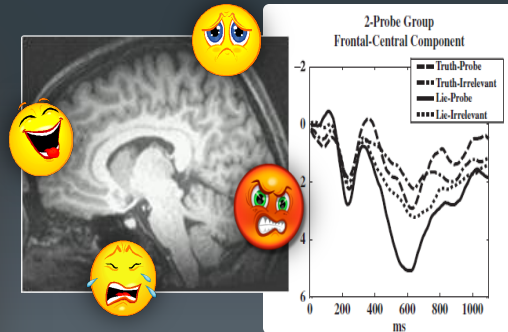
Eyetracker



ERP



Auditory Cognition



Emotion and Criminal Behavior



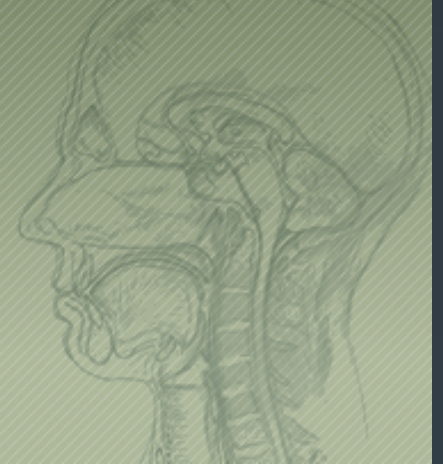
MRI



MEG



Joint Research Centre for Language and Human Complexity
語言與人類複雜系統聯合研究中心



Thank you for
your attention