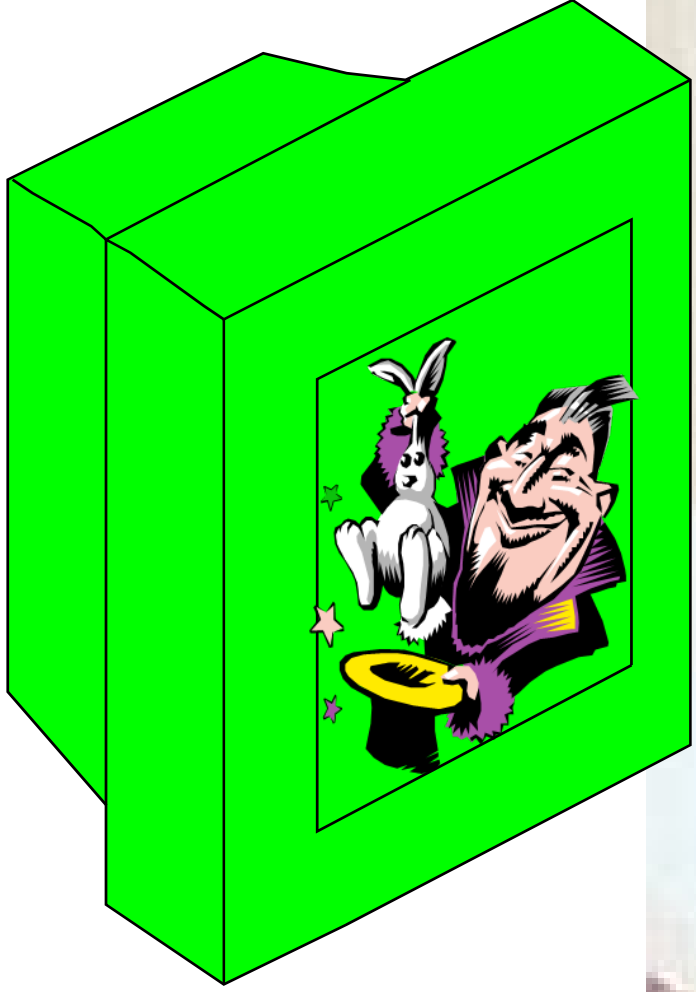
UNIVERSITY OF SOUTH CAROLINA

What's Inside a Baby's Head?

John E. Richards
University of South Carolina

Developmental psychologists studying infant cognitive development often use brain development as an explanation for cognitive development. Until recently it has been impossible to "look inside the baby's head" to determine brain developmental status. Neuroimaging techniques (MRI, PET) were limited to infants with medical indications, and a picture of the brain of the normally developing infant was not possible. Recently normally developing infants and children have had brain imaging with MRI. This includes early scattered reports of functional MRI (fMRI), the NIH MRI study of normal brain development, and my own use of 3T structural MRIs. These studies have resulted in very revealing findings about the nature of the infant brain and its relation to cognitive development.

The current presentation will describe an approach to studying the brain-cognitive relation in infant development with realistic cortical source models of EEG/ERP. High-density EEG is recorded while infants participate in cognitive psychophysiological tasks (e.g., recognition memory; spatial cueing; hidden objects). These infants also have a structural (anatomical) MRI. A realistic model of the spatial topography of the materials in the baby's head is constructed. Equivalent current dipole models of the event-related potentials taken in the psychophysiological tasks give the location of the brain activity during the task; presumably these are tied to the psychological processes involved in the tasks. This neuroimaging technique gives location of the source of the activity, the time-course of the neural activity, and the relationship of the brain activity to the psychological processes involved in the task. The use of this technique with infants has shown several characteristics of infant's head and brain that are strikingly different from adults and older children (myelination; skull thickness; brain material impedances; relation between skull landmarks and underlying brain lobes). This technique also has proven beneficial in locating the brain correlates of psychological processes in the young infant.

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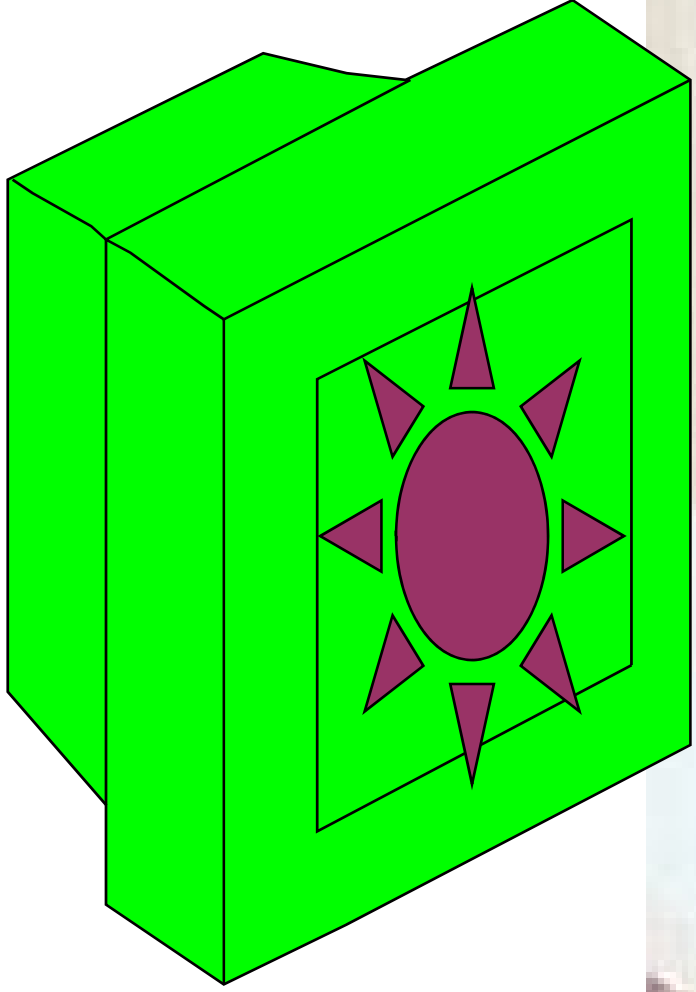


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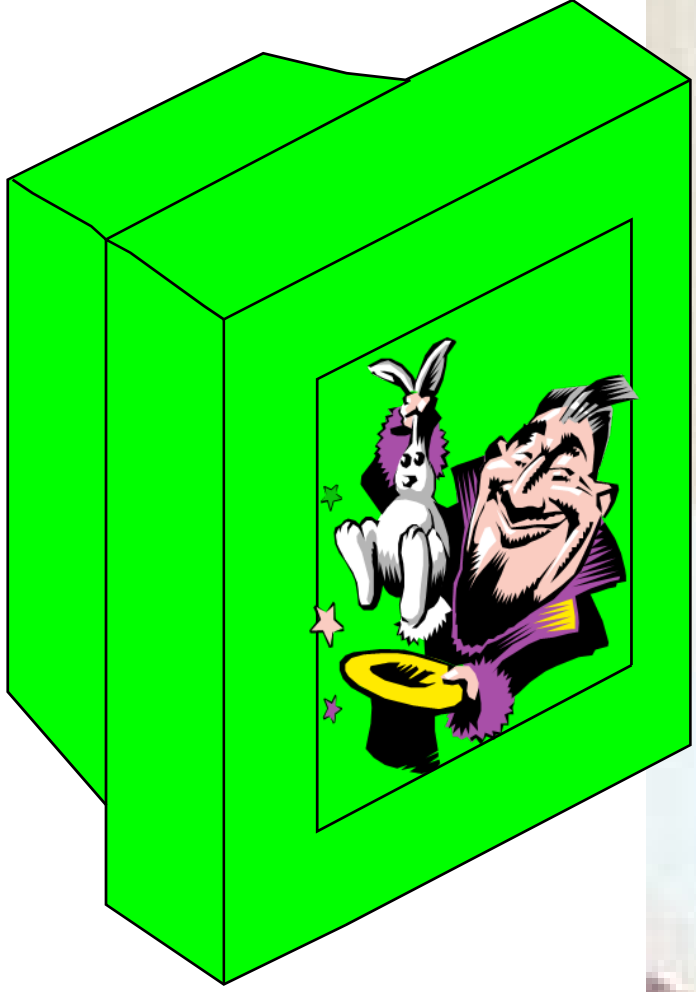


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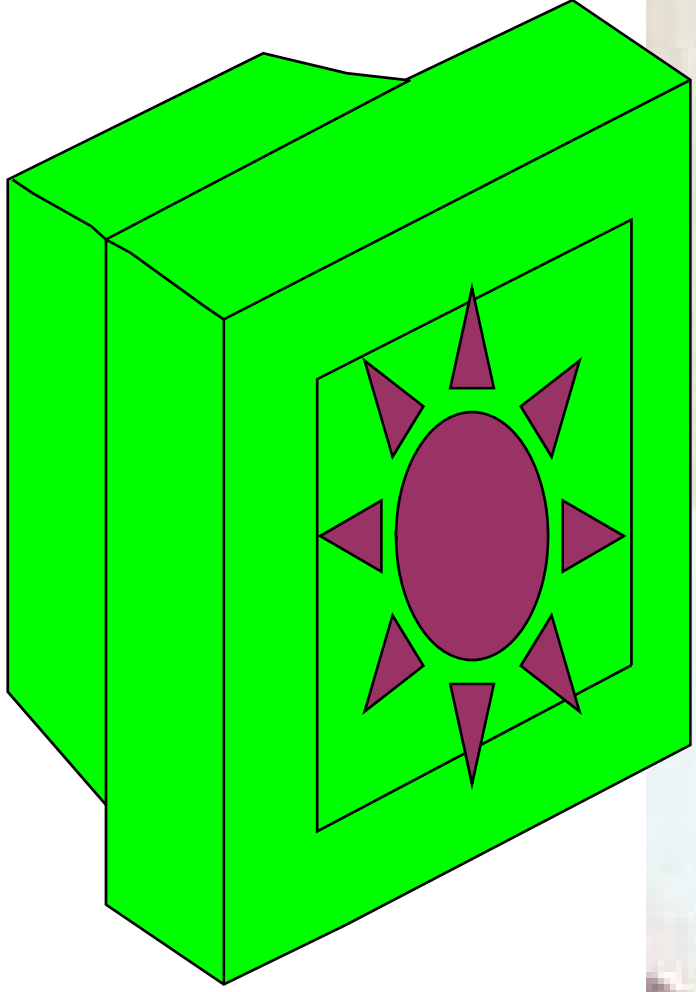


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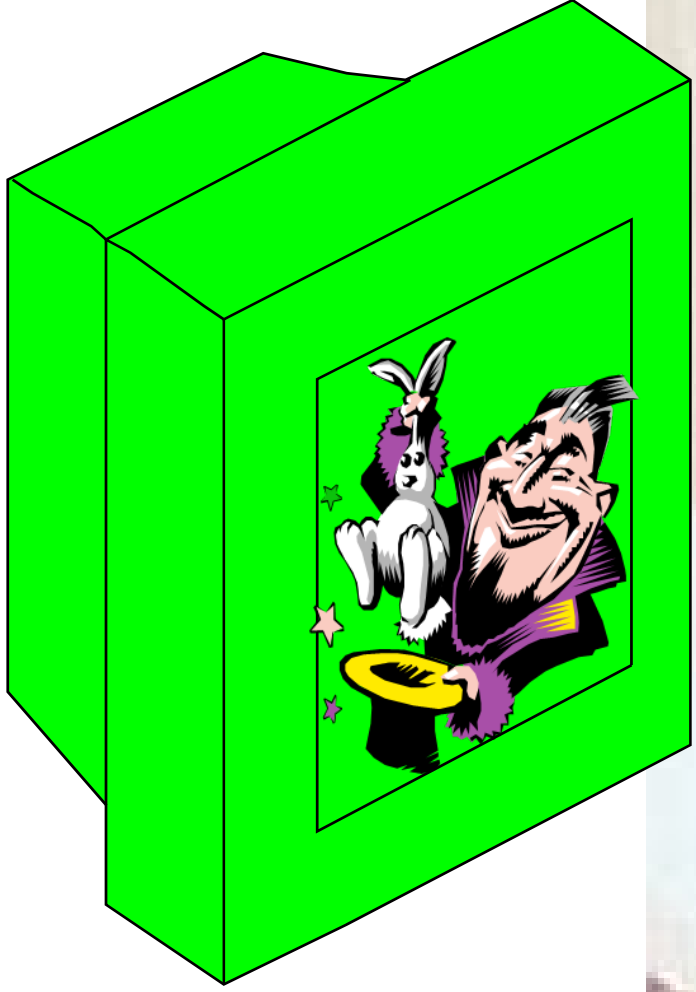


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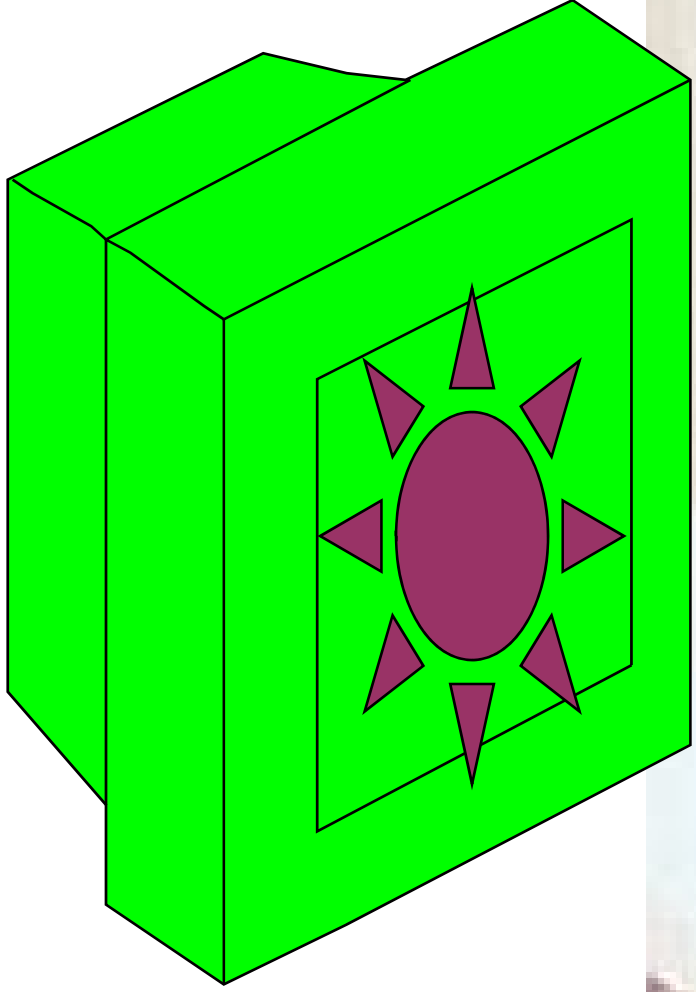


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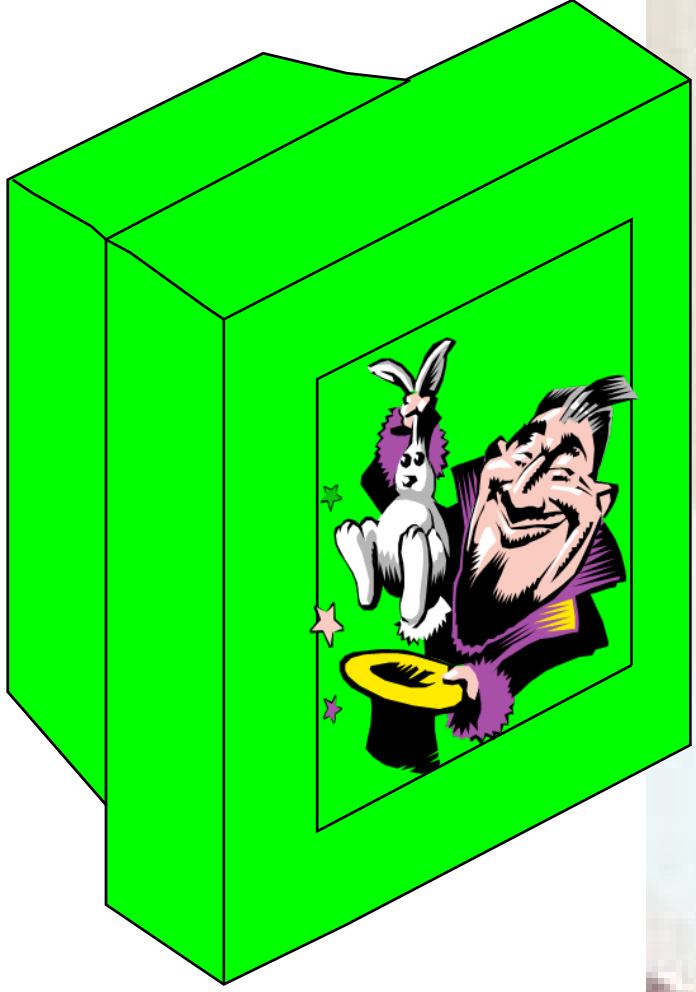


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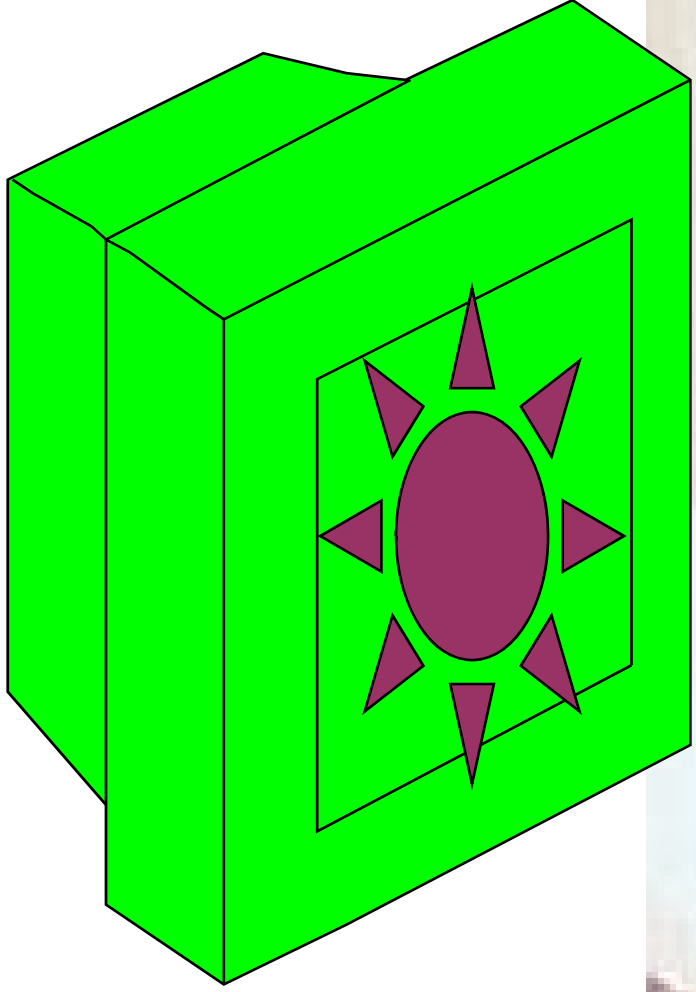


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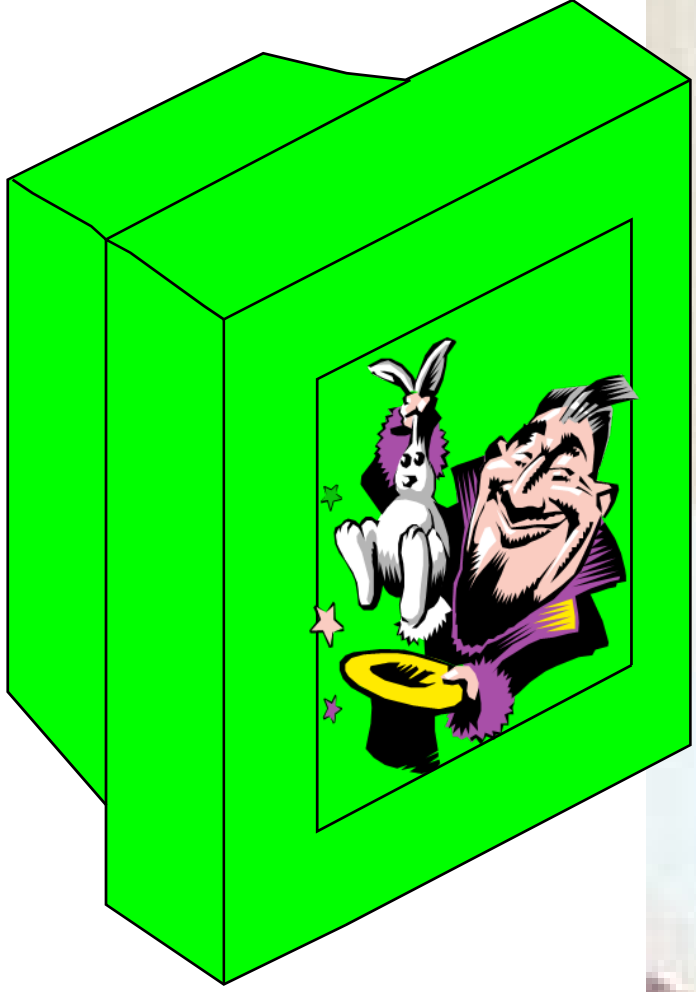


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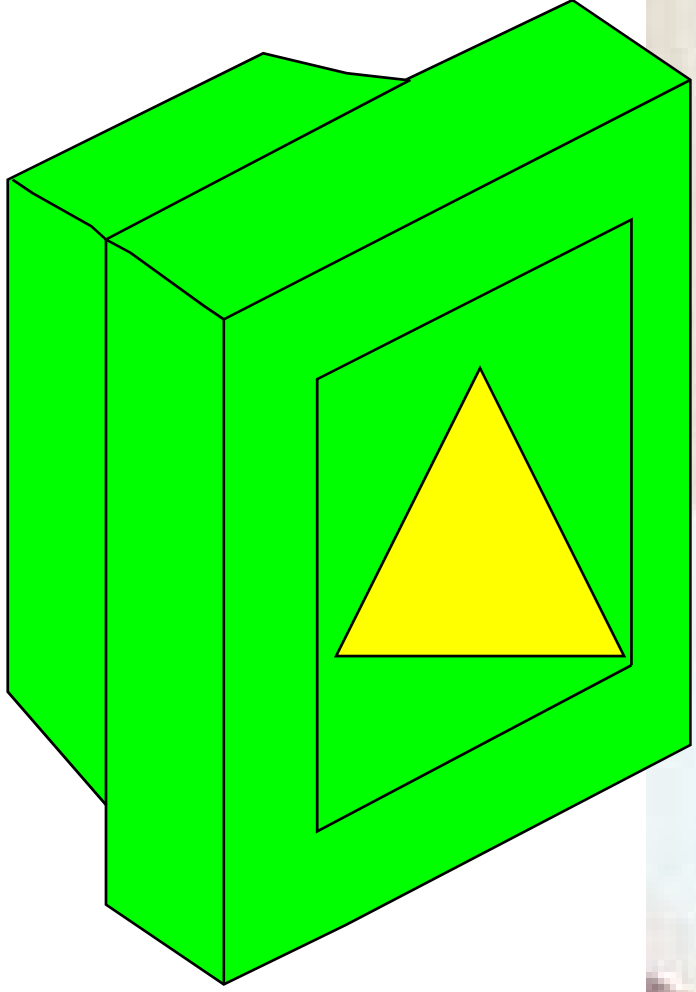


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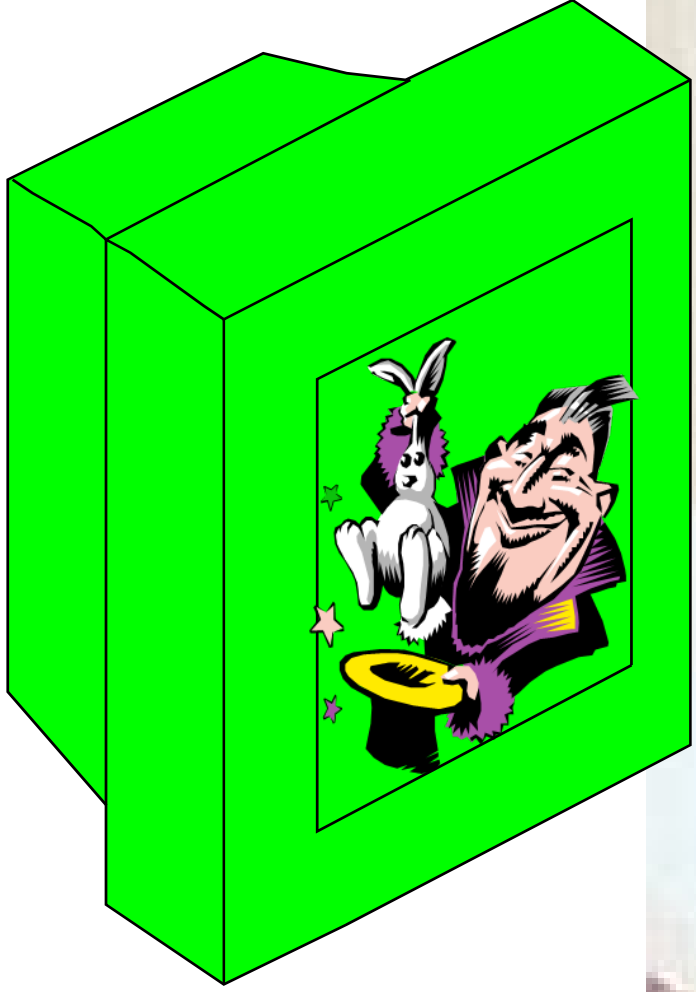


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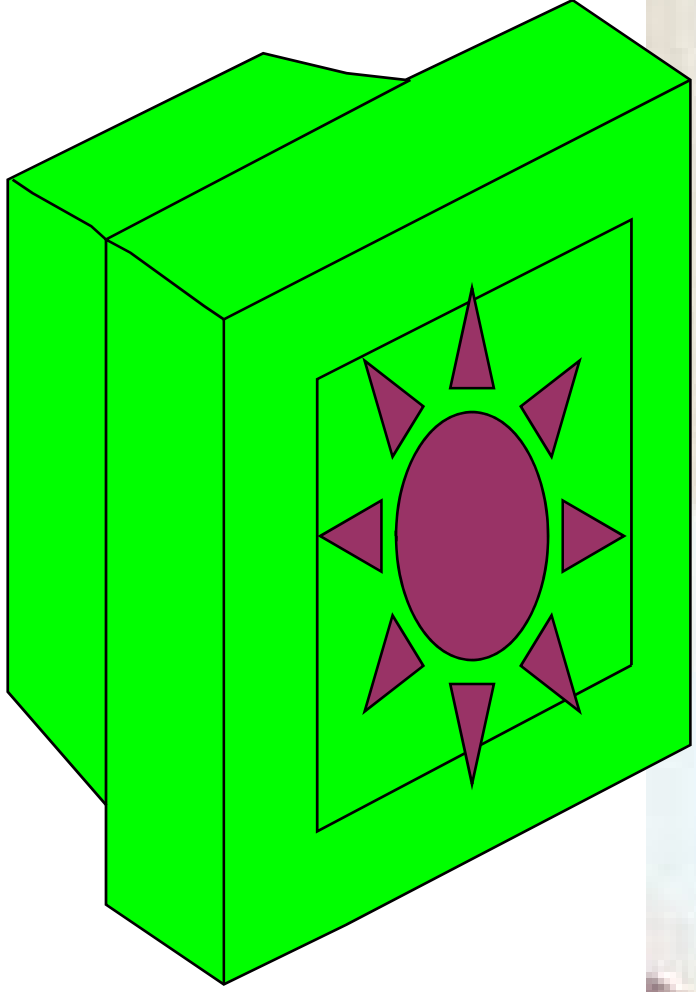


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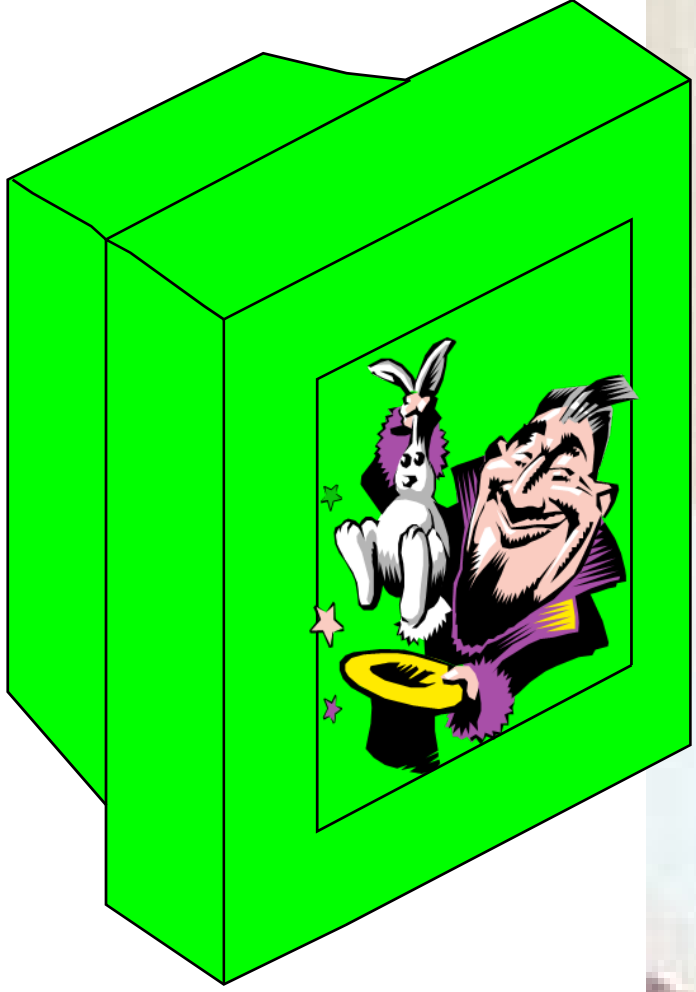


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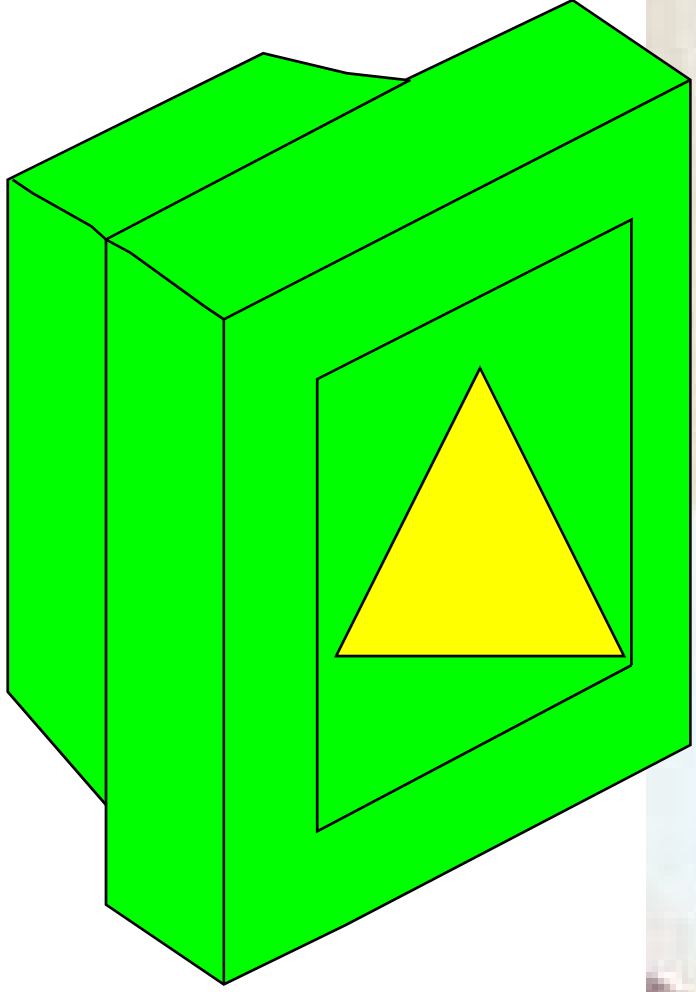


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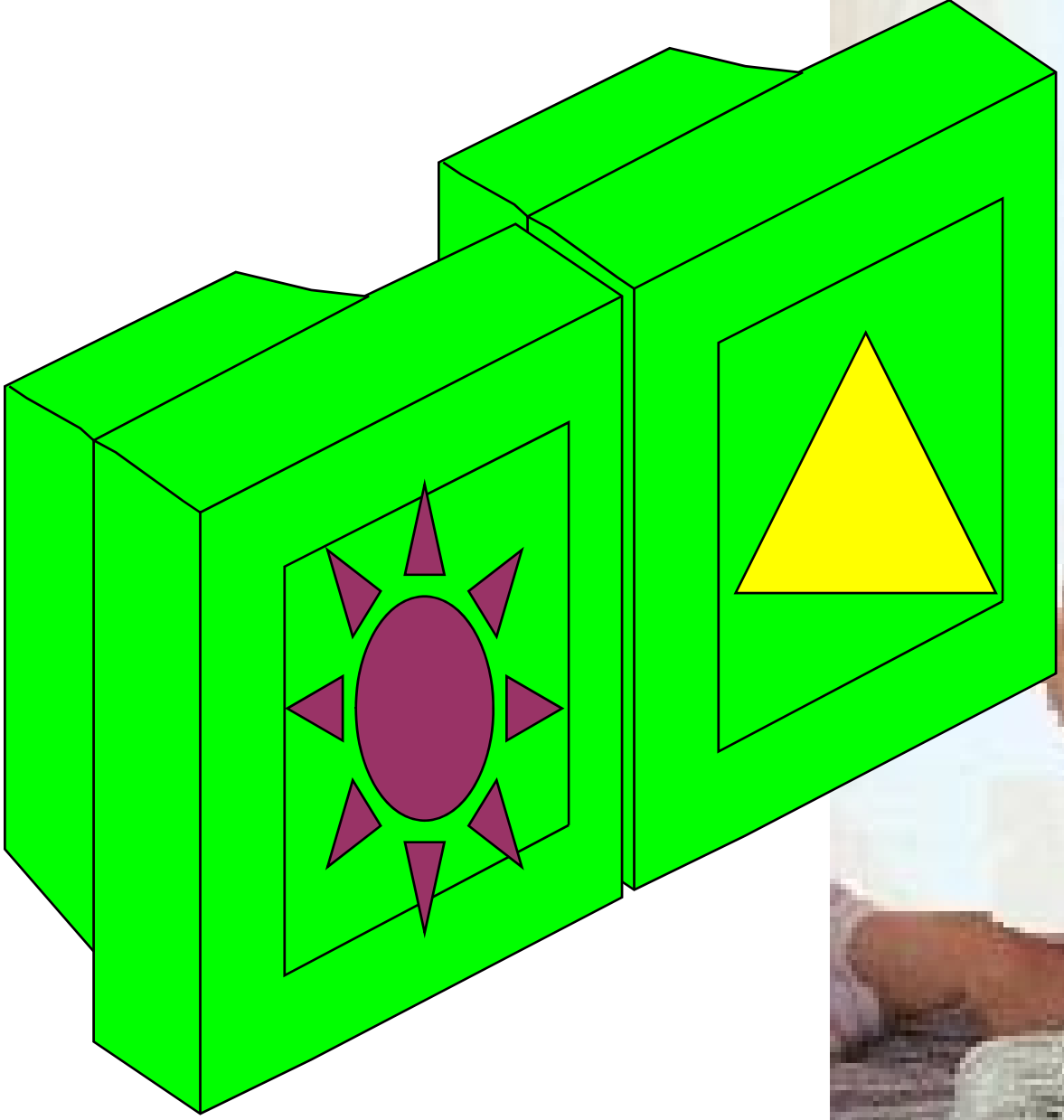

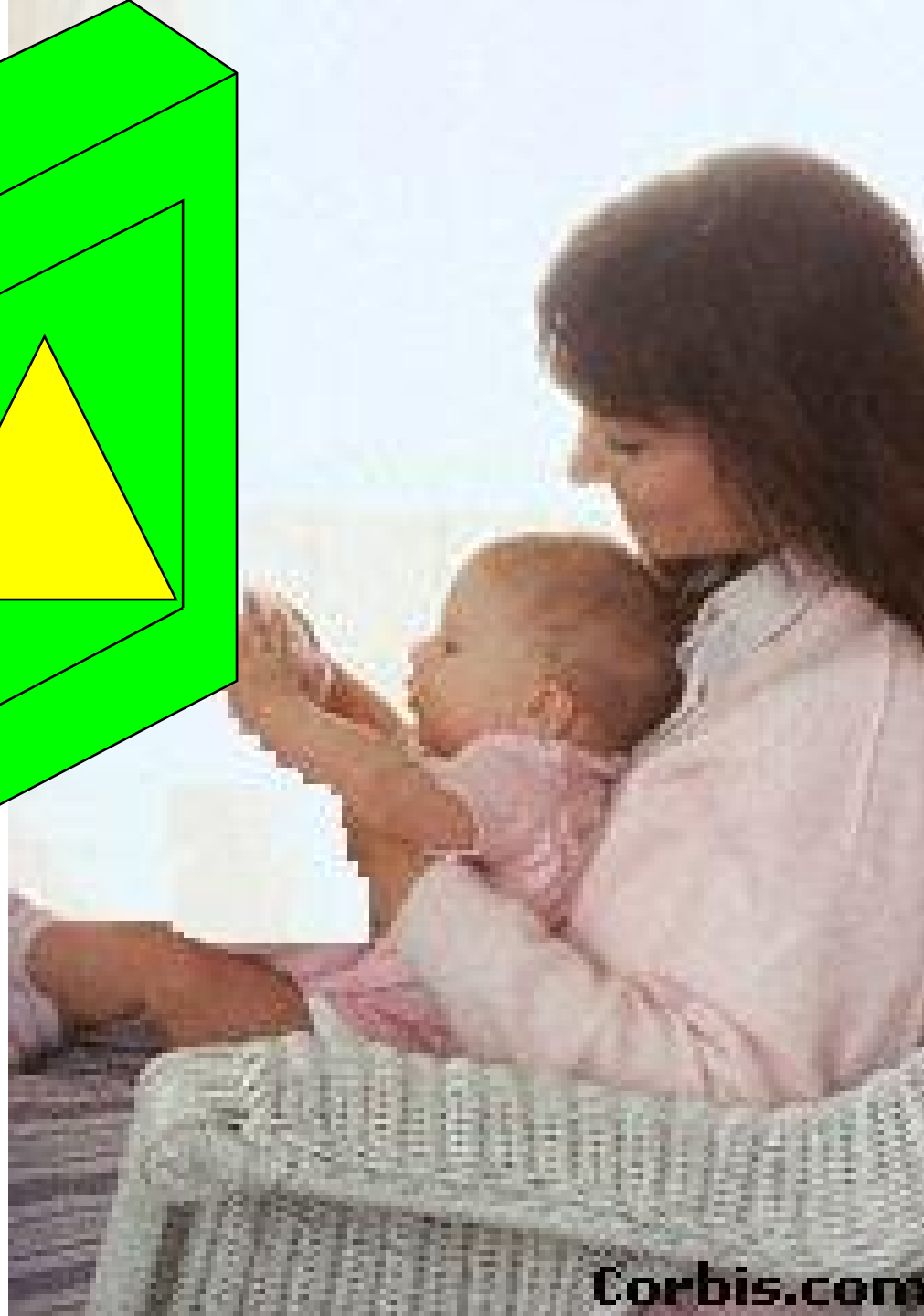
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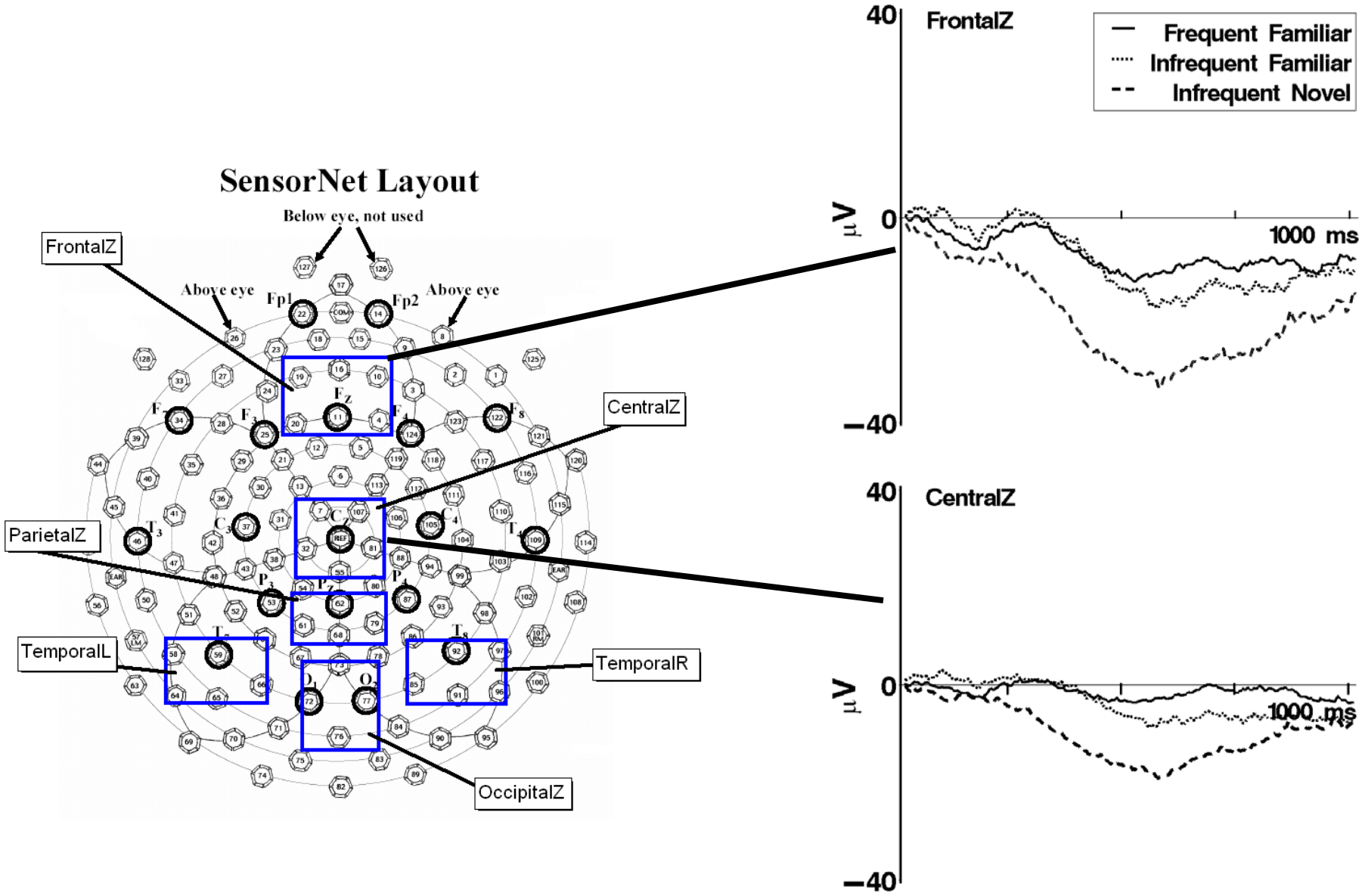
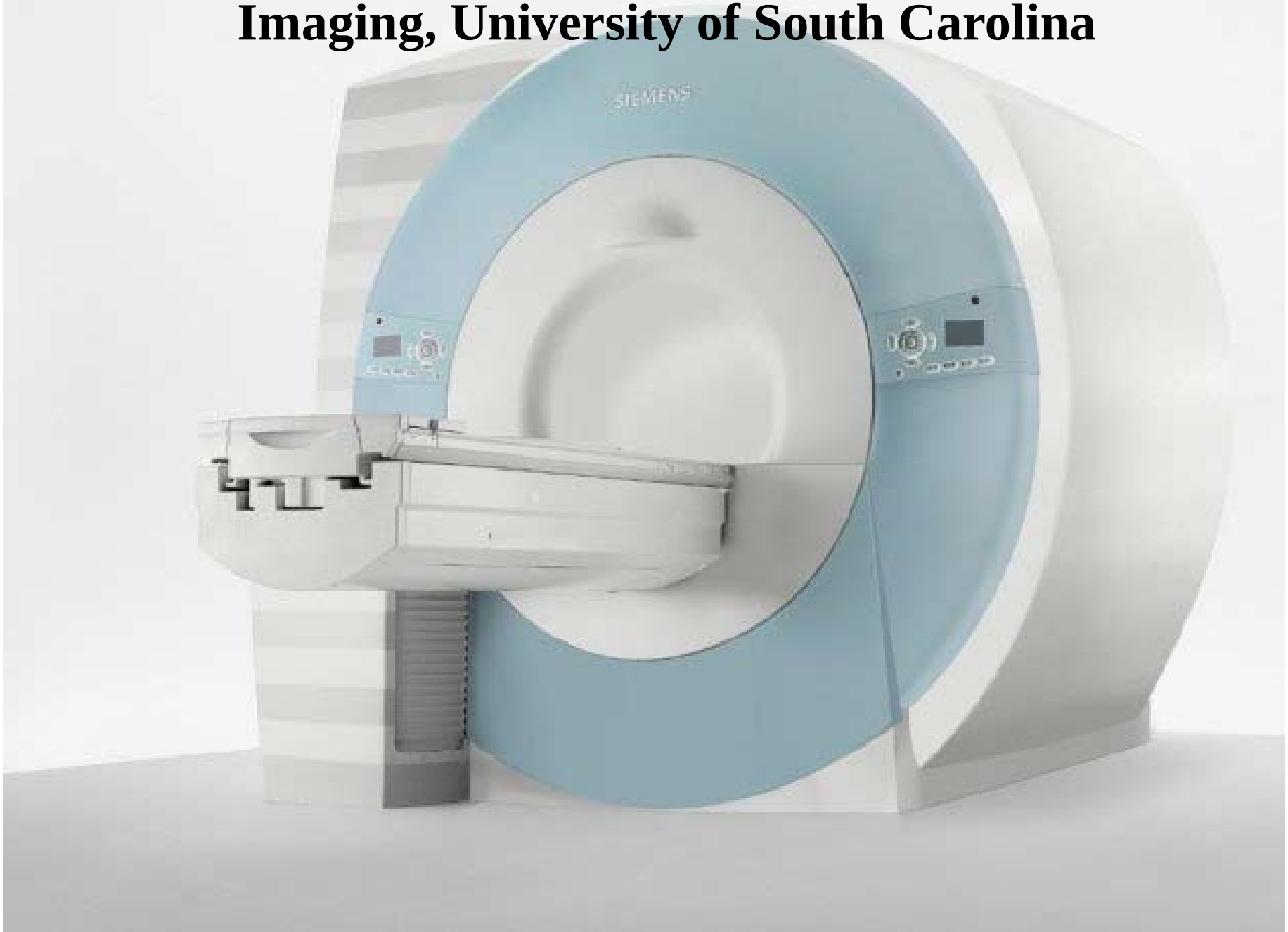
Neuroimaging tools for infant participants are limited
Use high-density scalp-recorded ERP?


04/09/2003

FrontalZ and CentralZ electrodes, "Nc" (Negative central)



3.0T Siemens Trio System at McCausland Center for Brain Imaging, University of South Carolina

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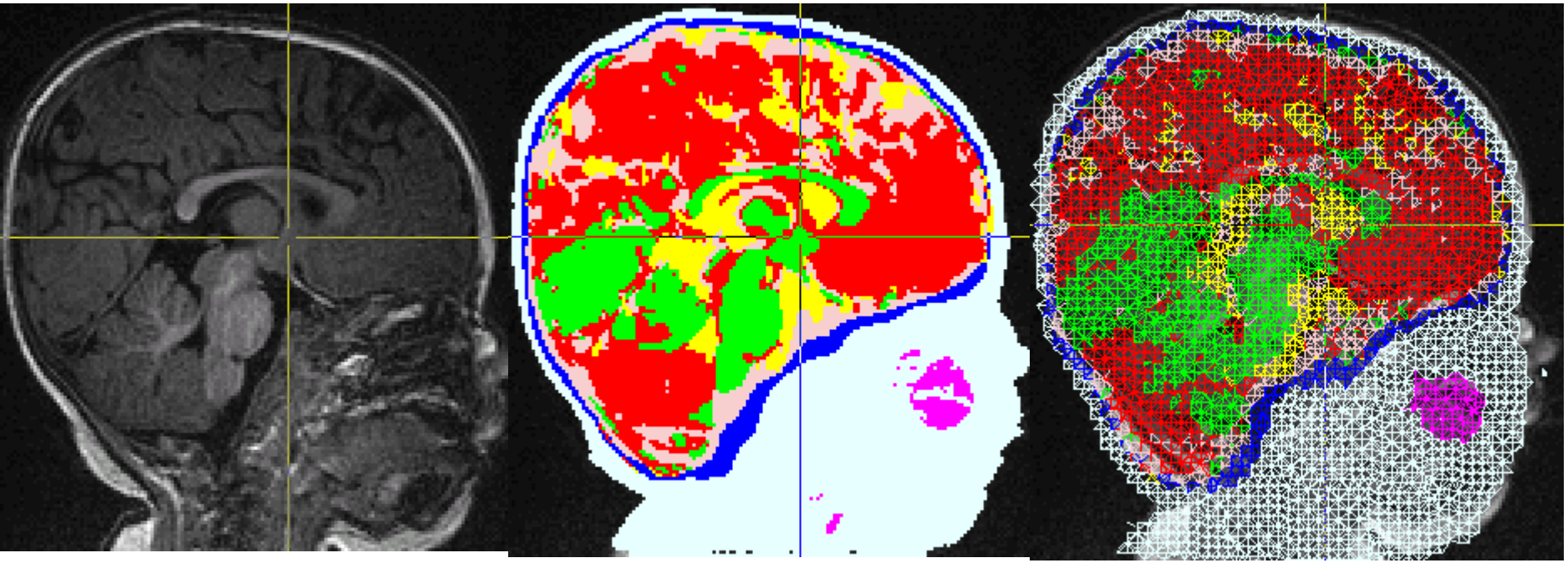

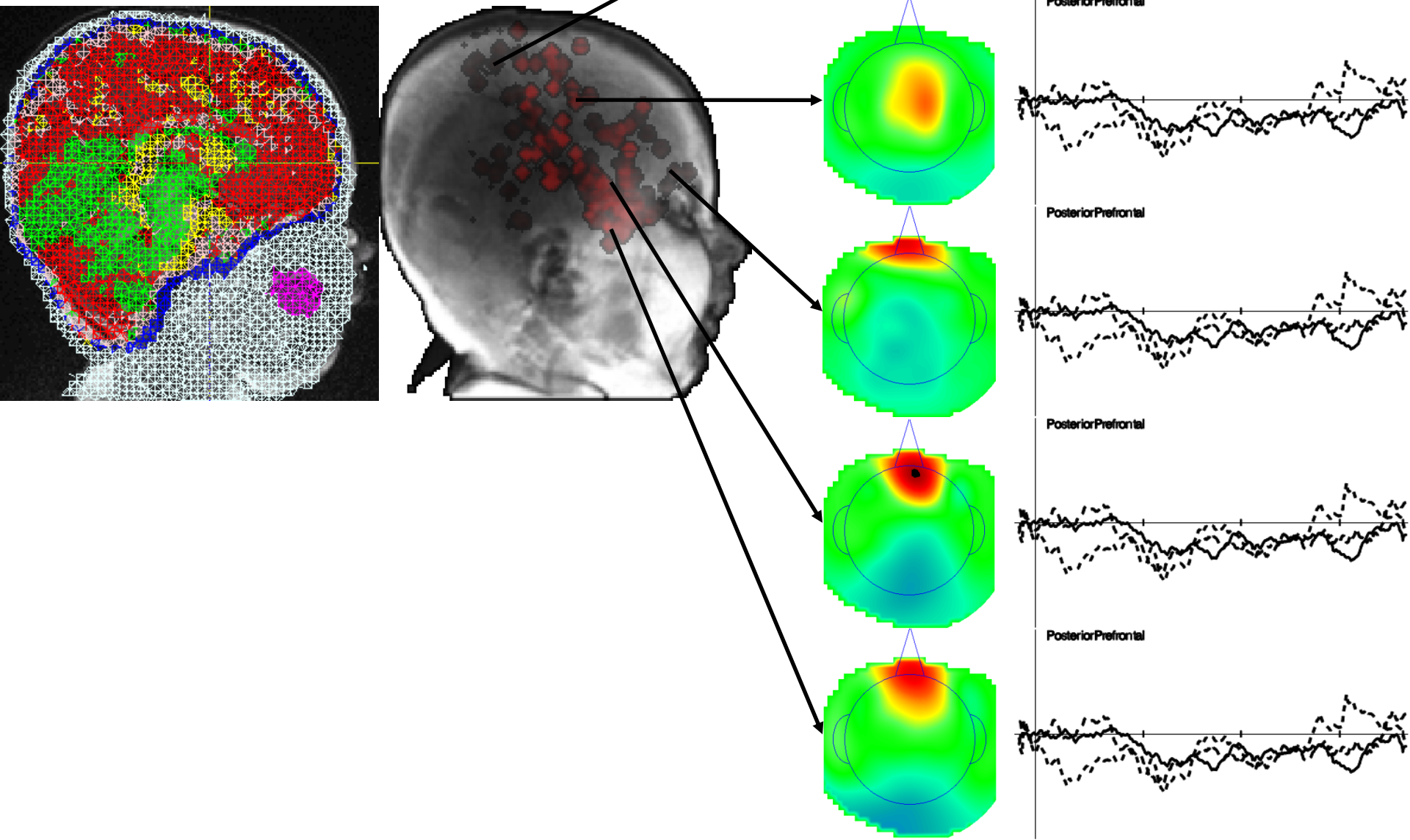
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PosteriorPrefrontal
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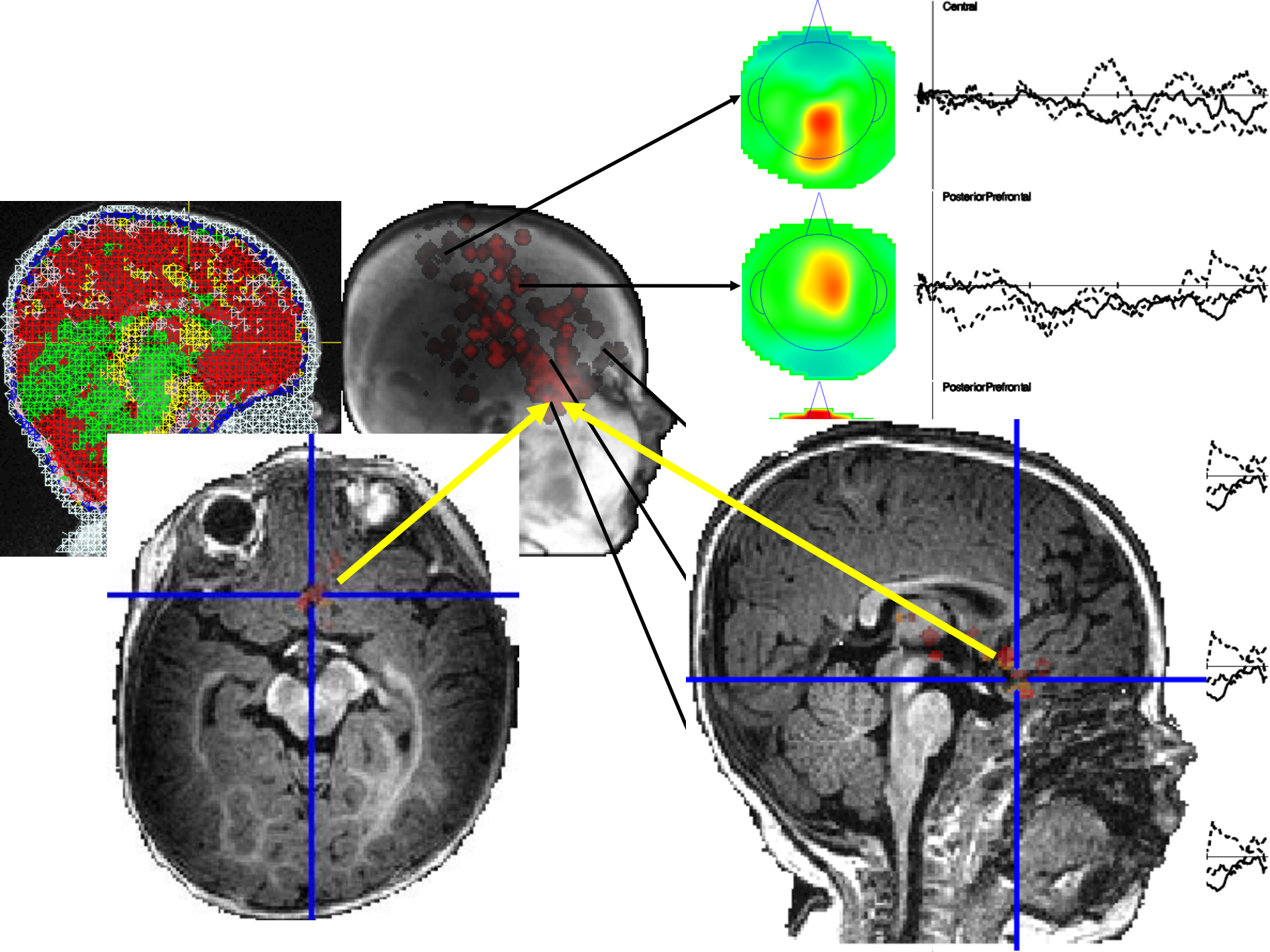
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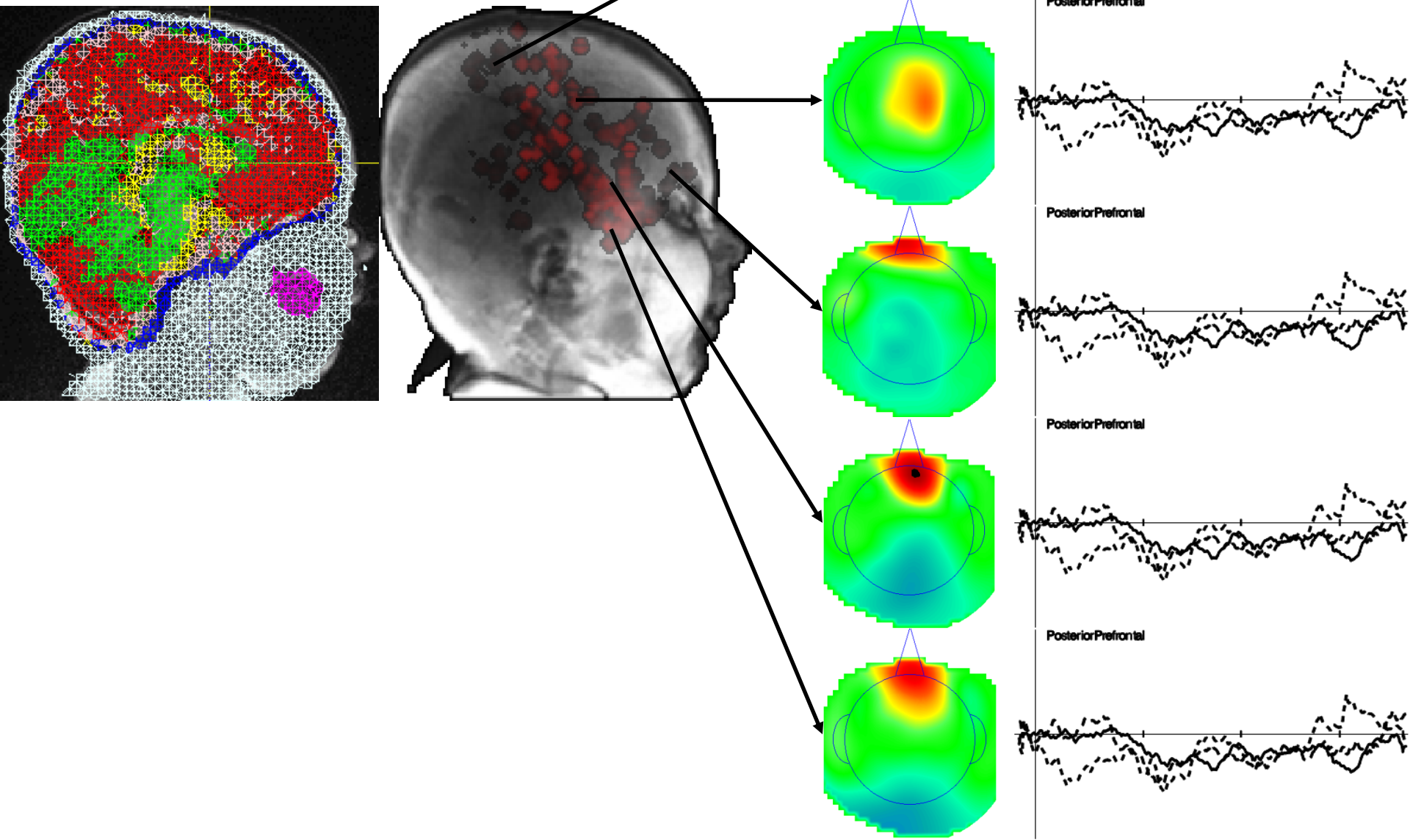
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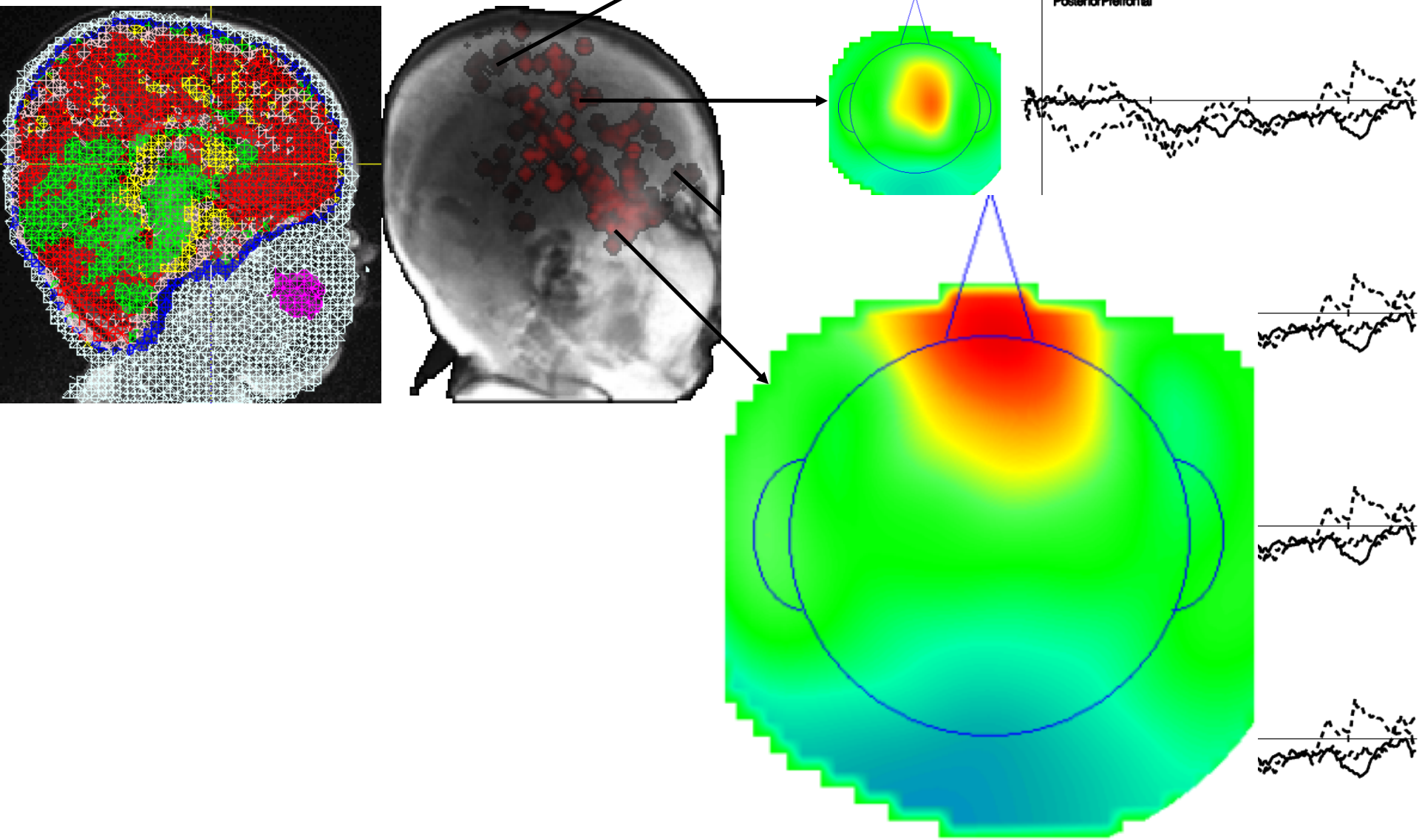
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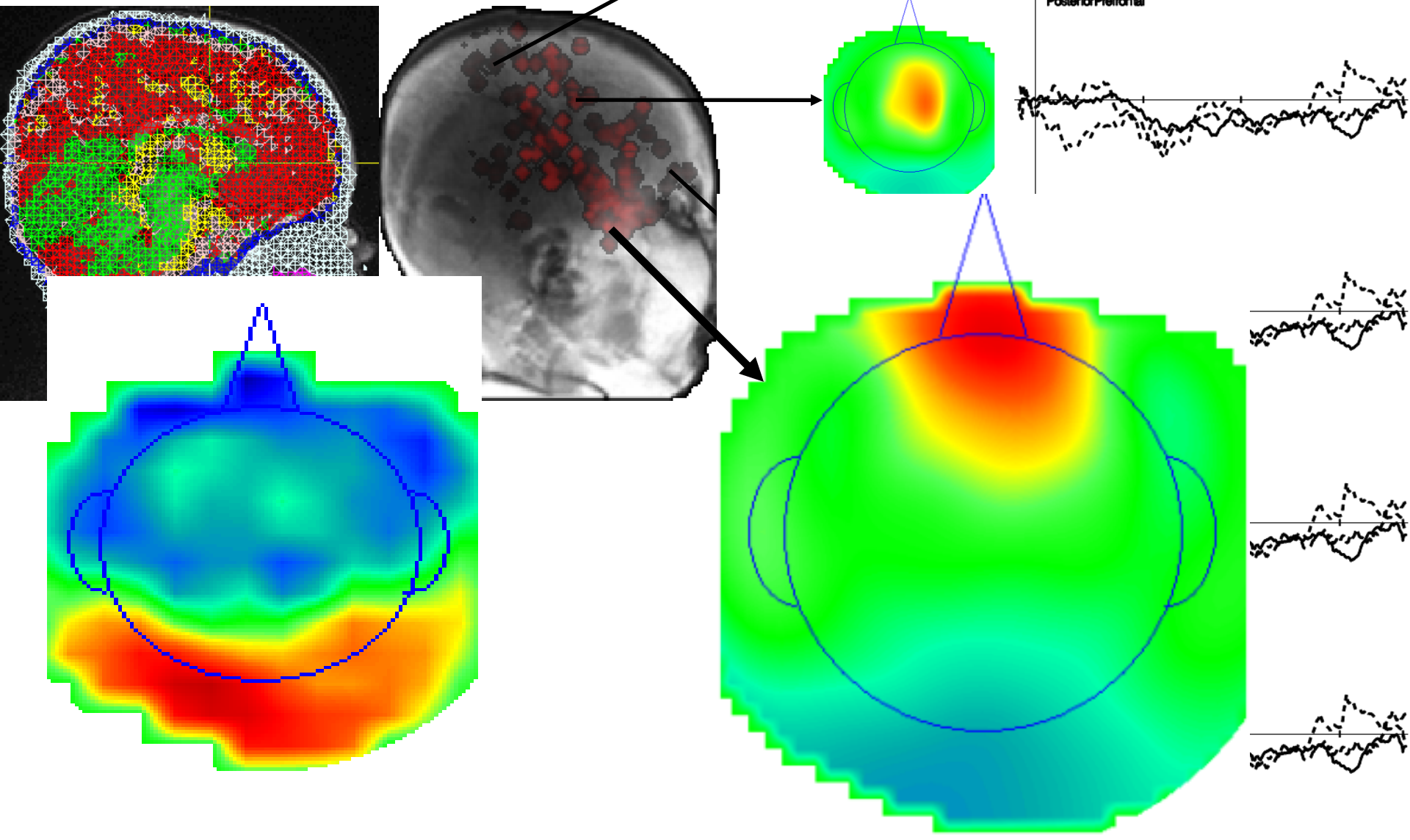
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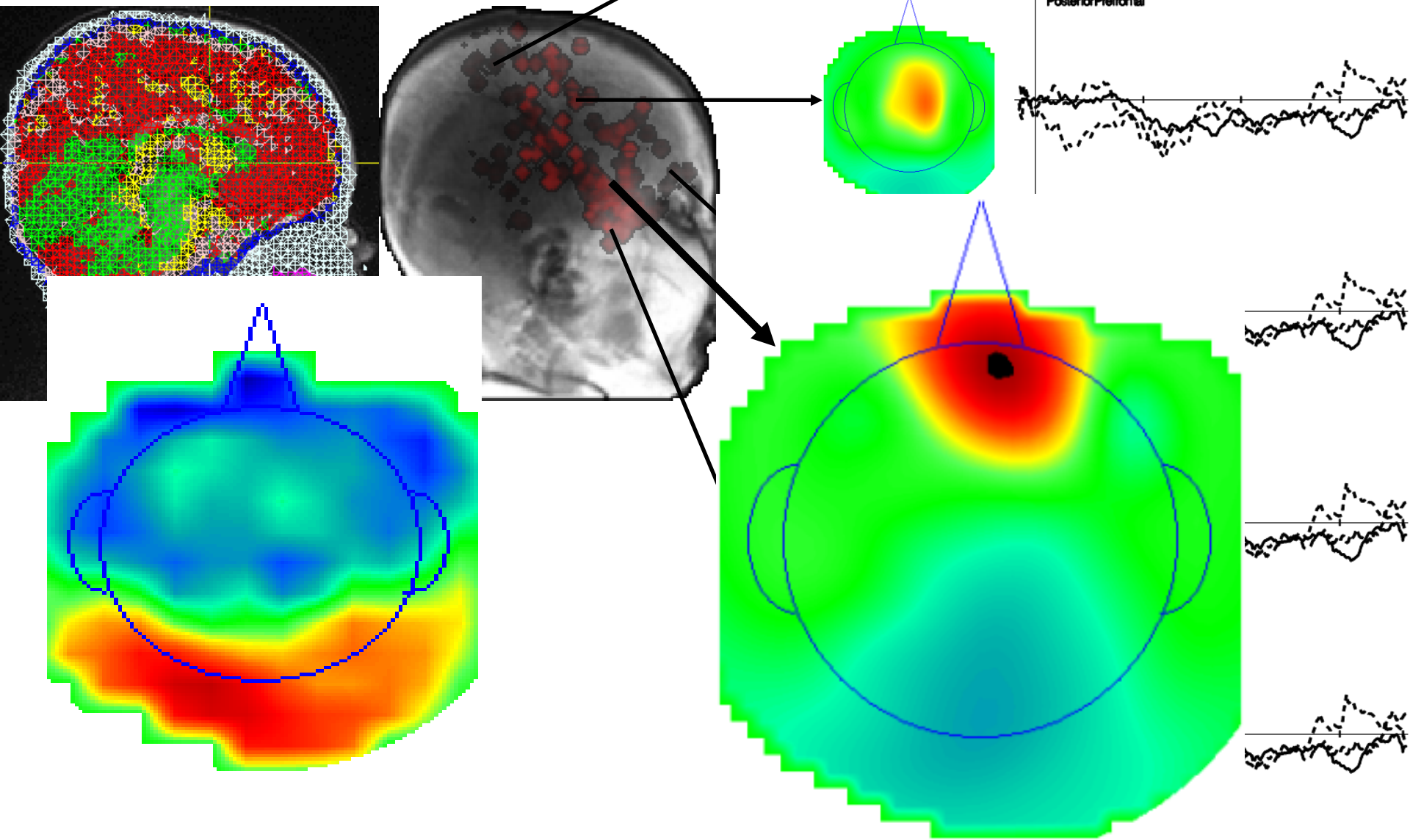
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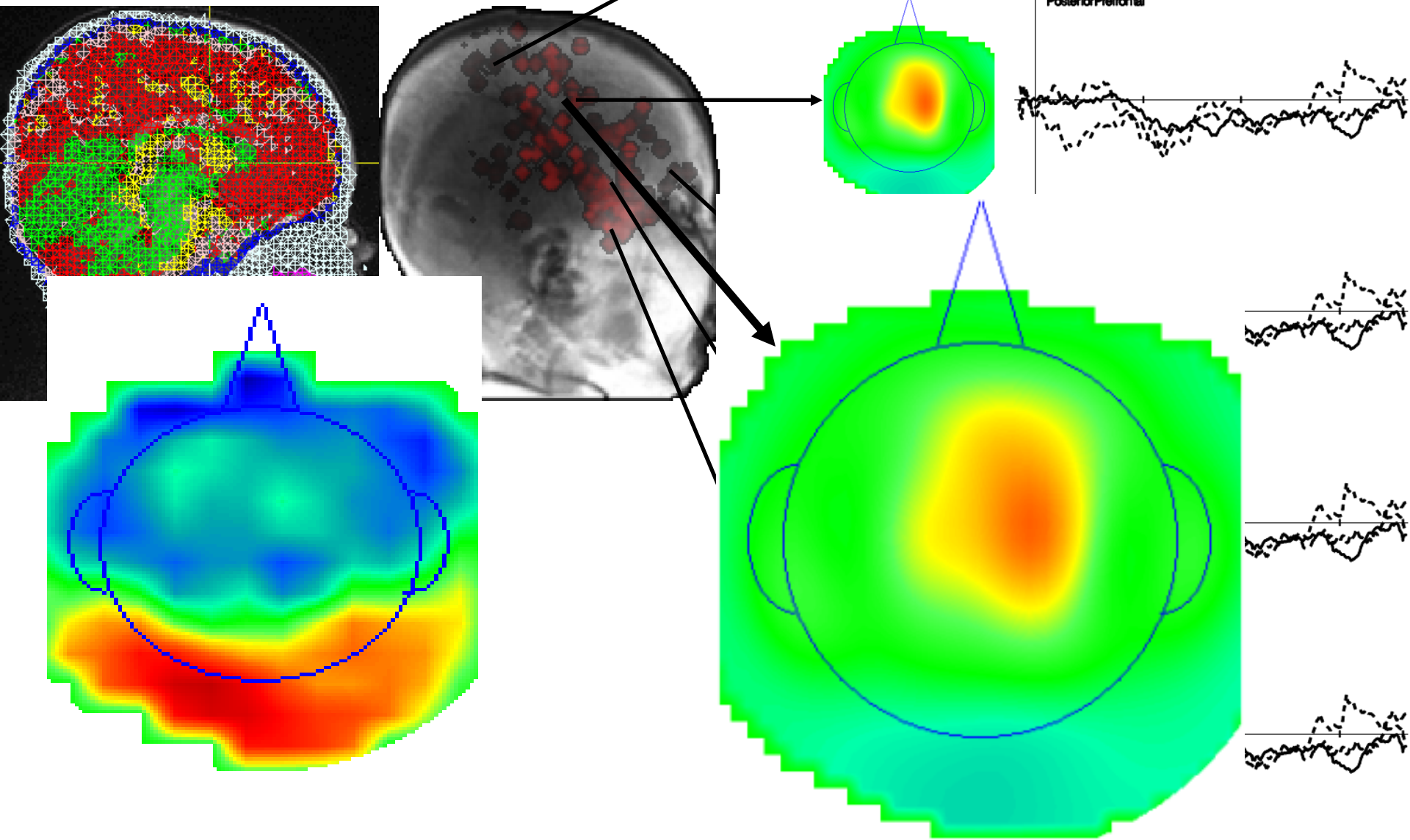
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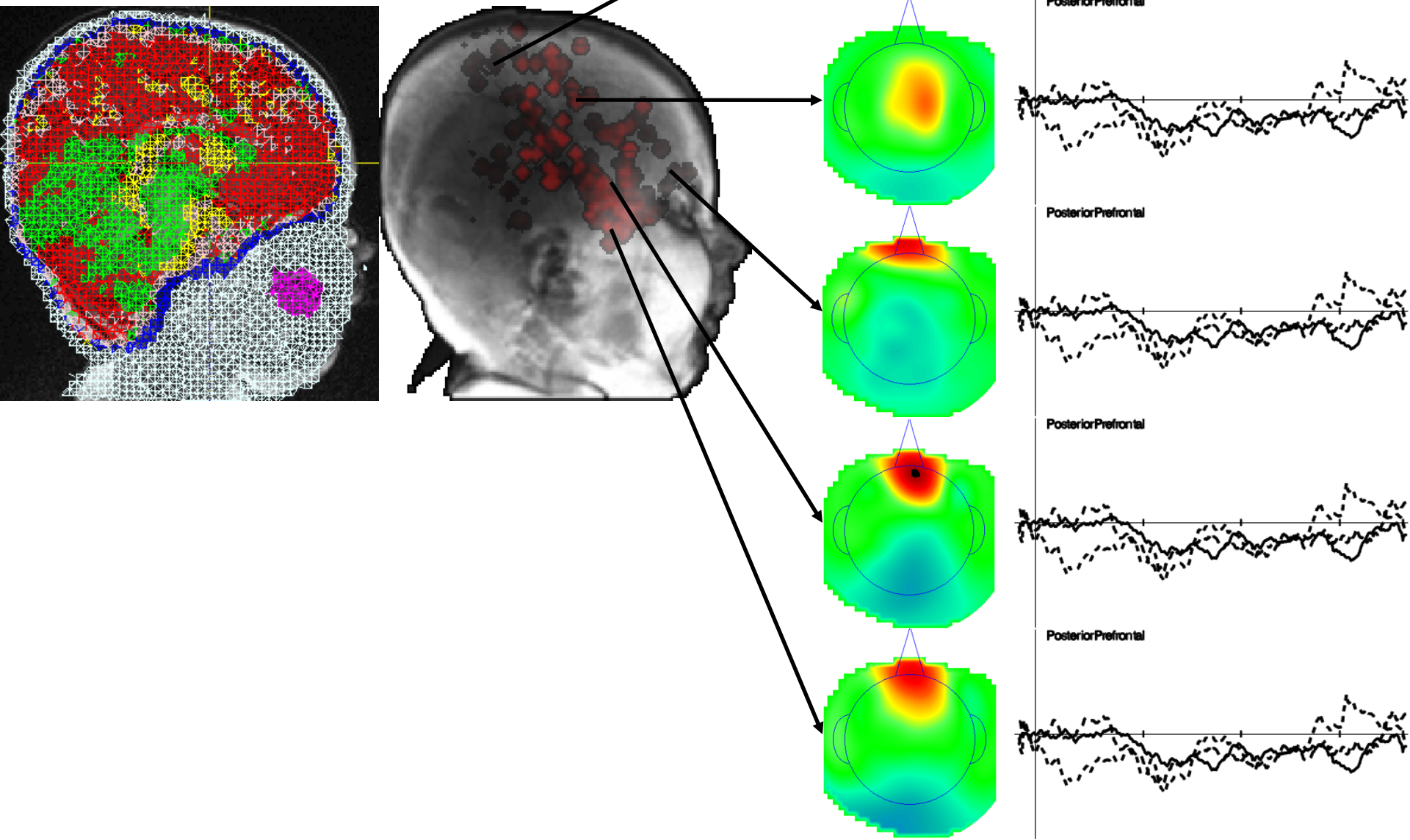
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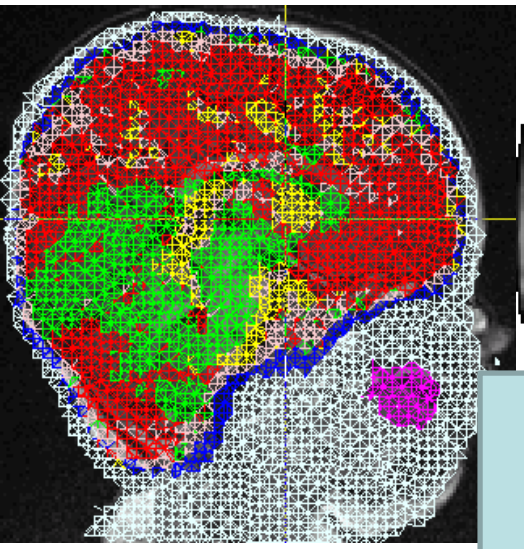

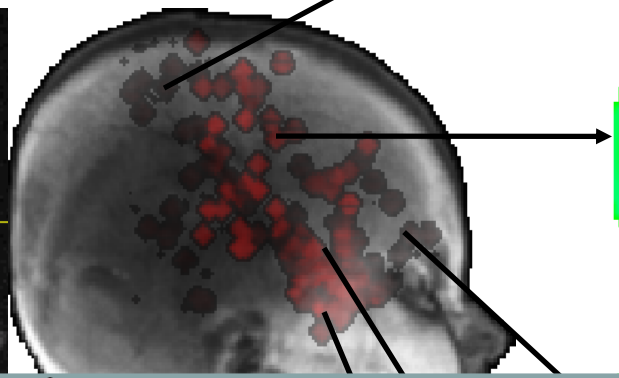

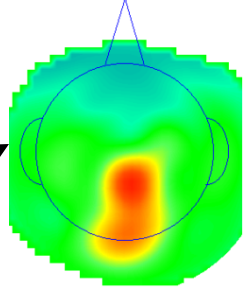

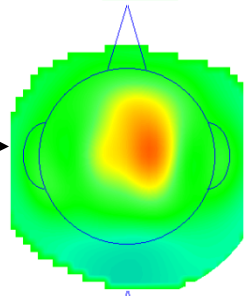

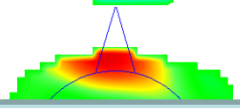

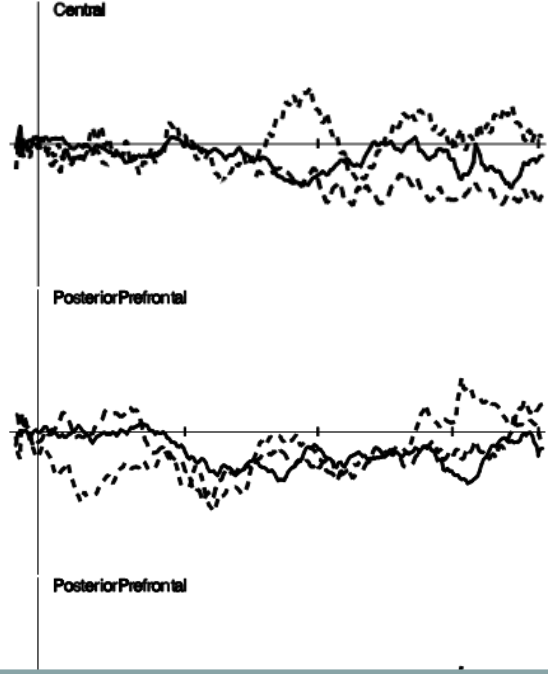
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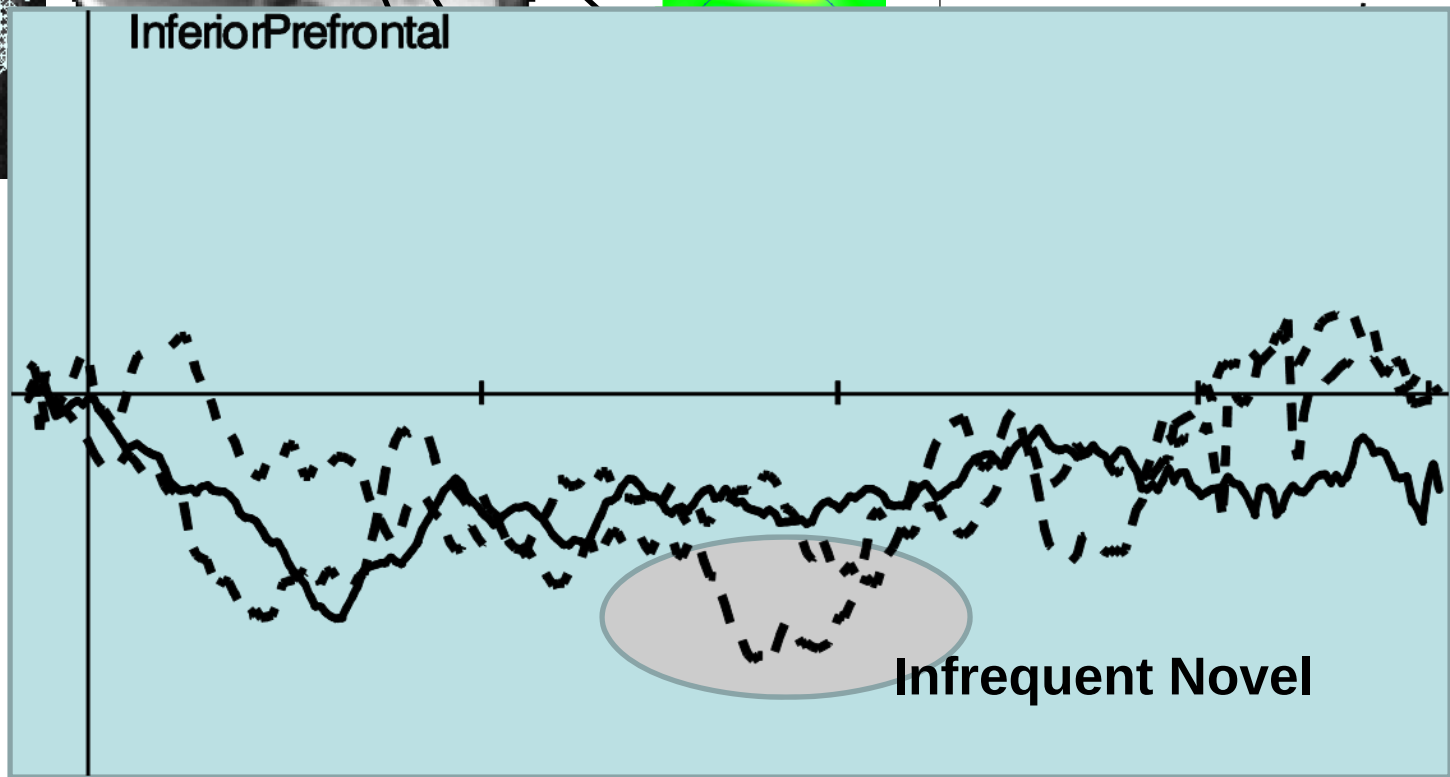
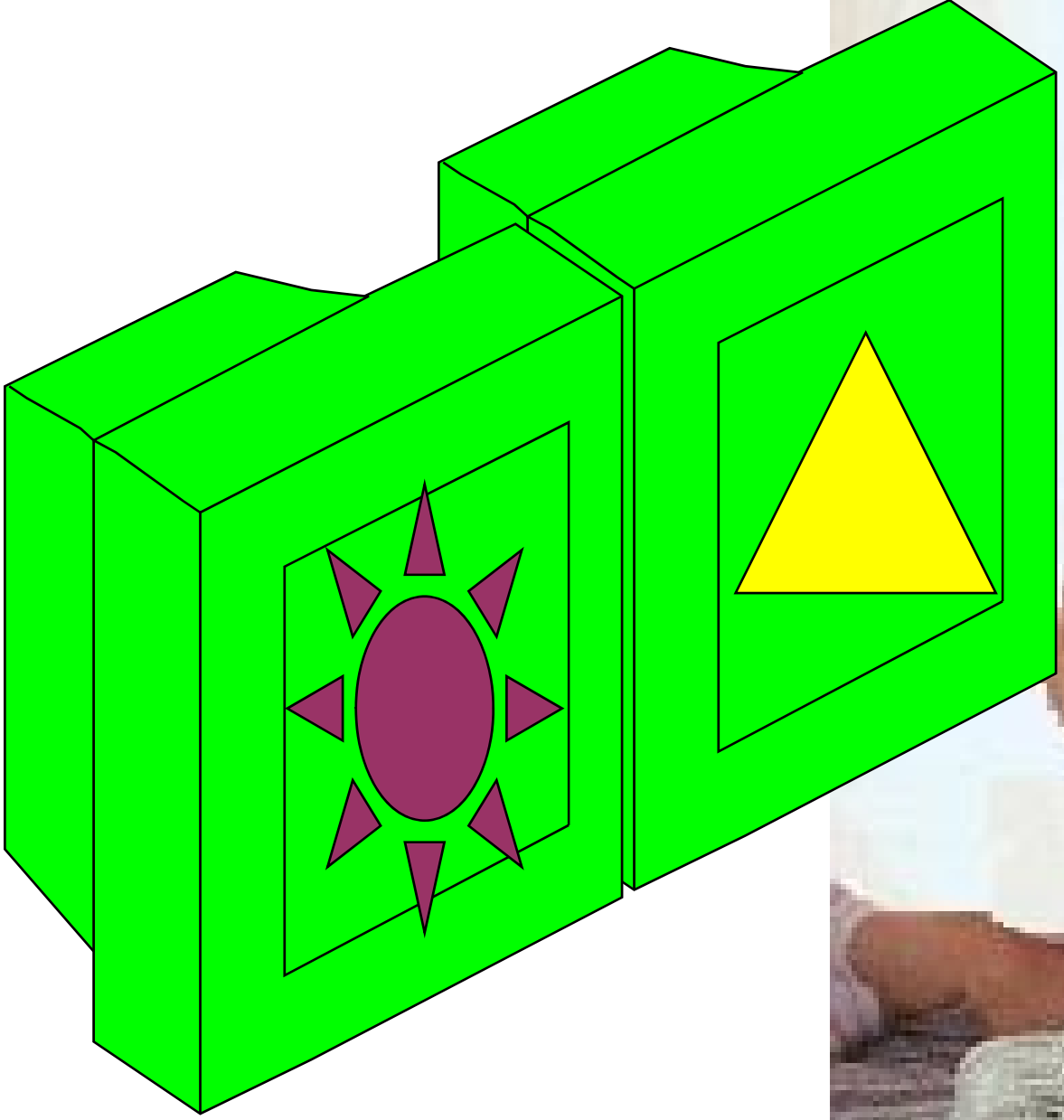
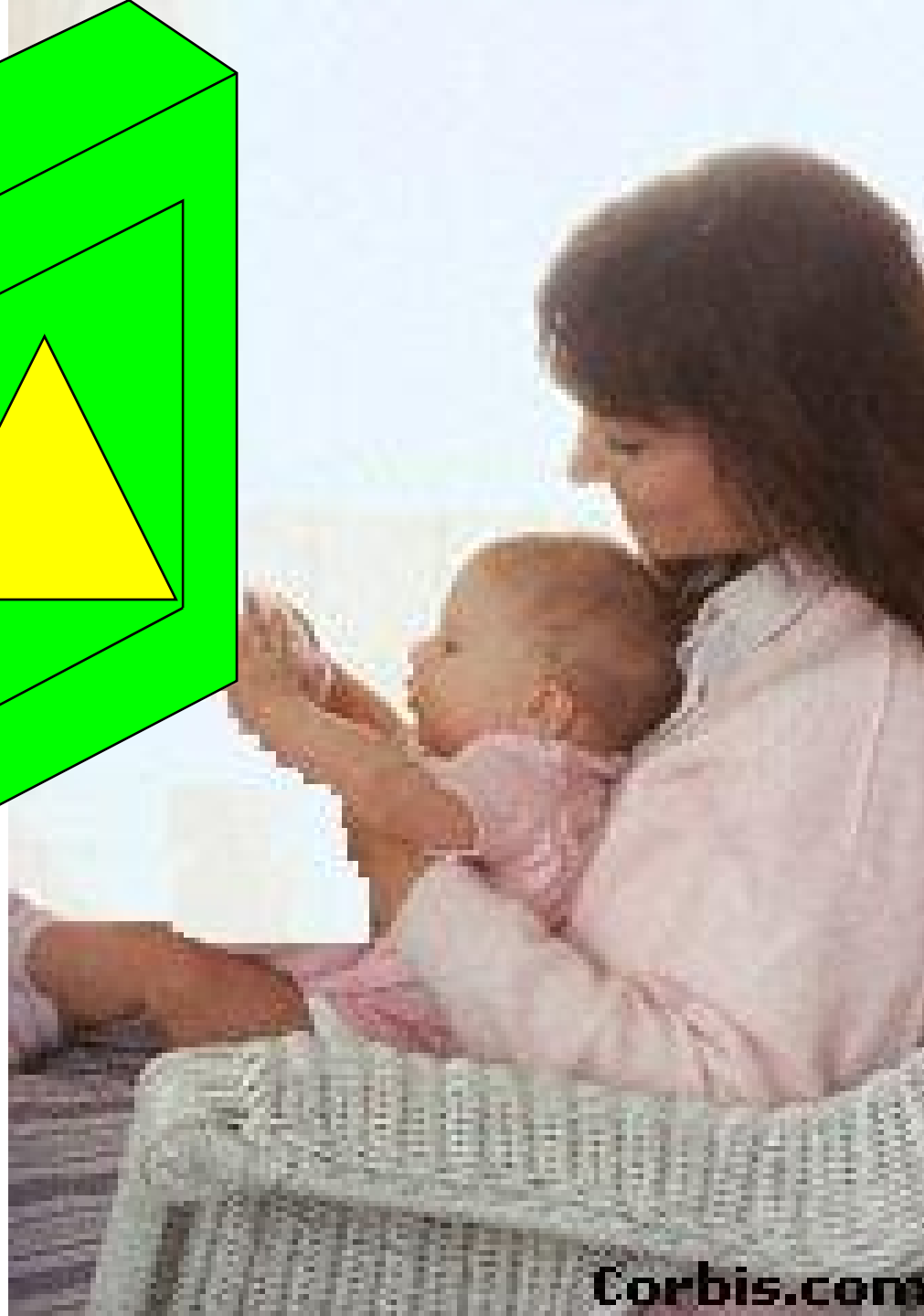
PosteriorPrefrontal
PosteriorPrefrontal


InferiorPrefrontal
Infrequent Novel

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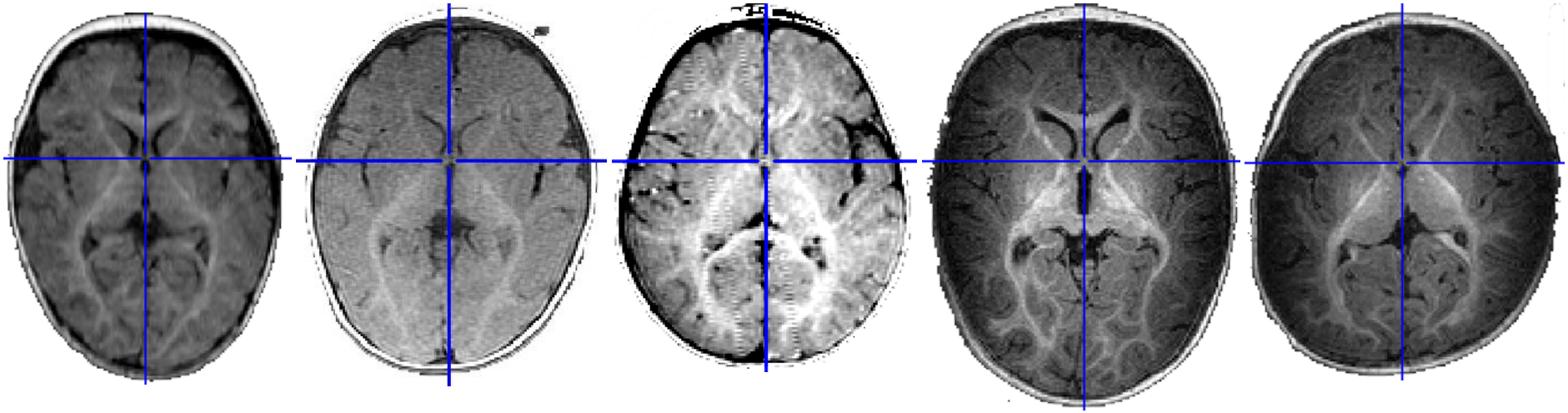
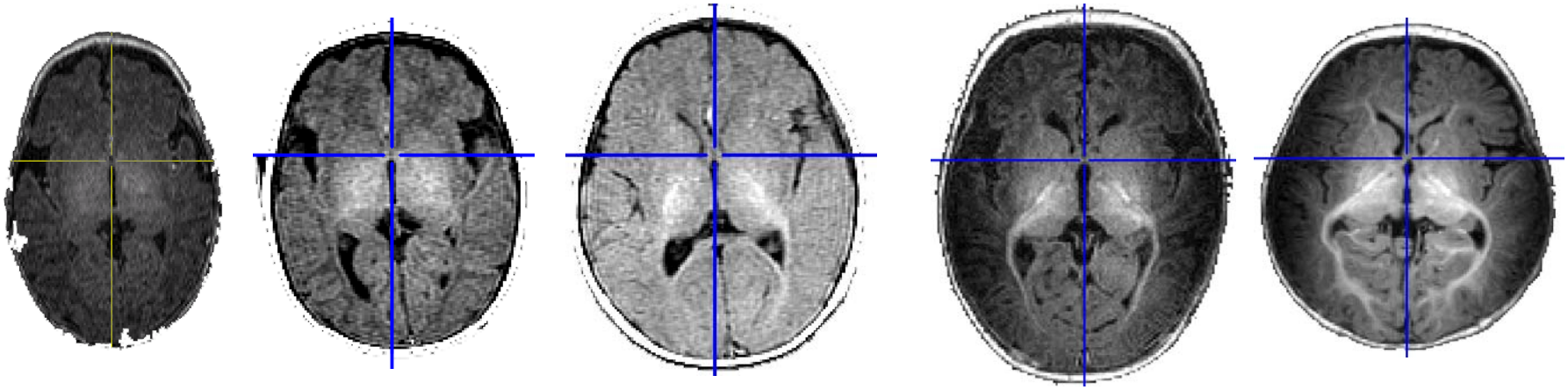
Example Problem: What's In Head Under The Bumps?
6 Months (1.5T, 1.5T, N-1.5T, JER-3.0T

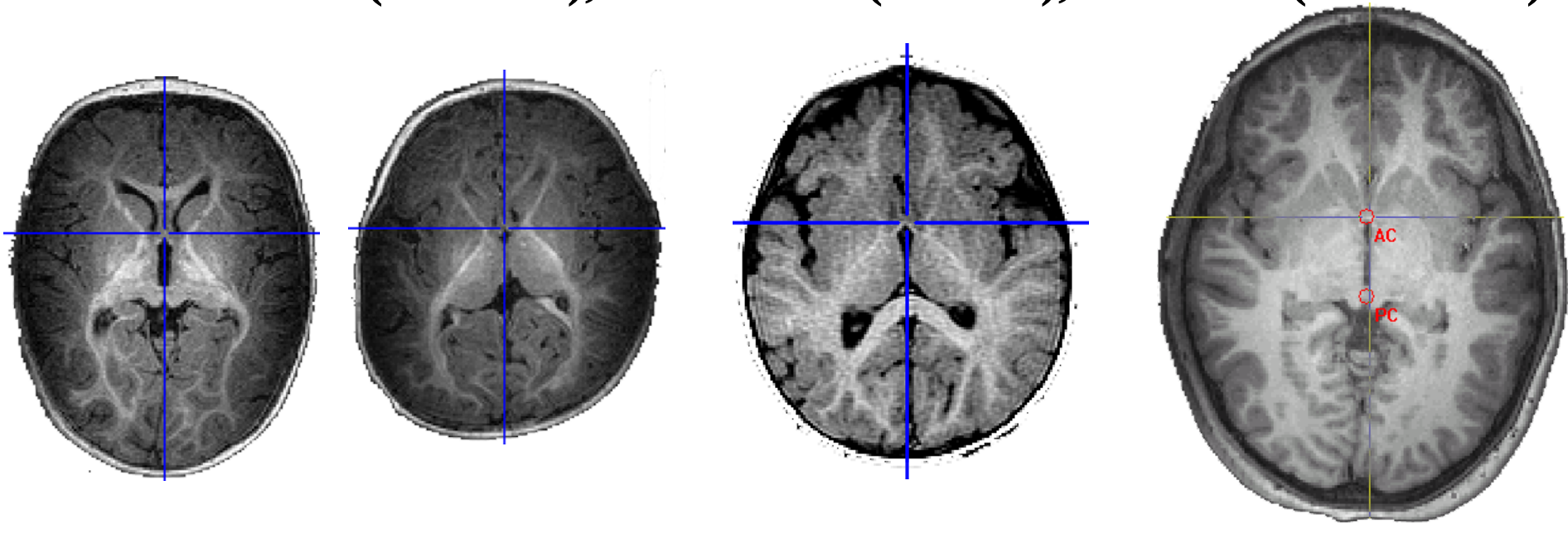


Example Problem: What's In Head Under The Bumps?

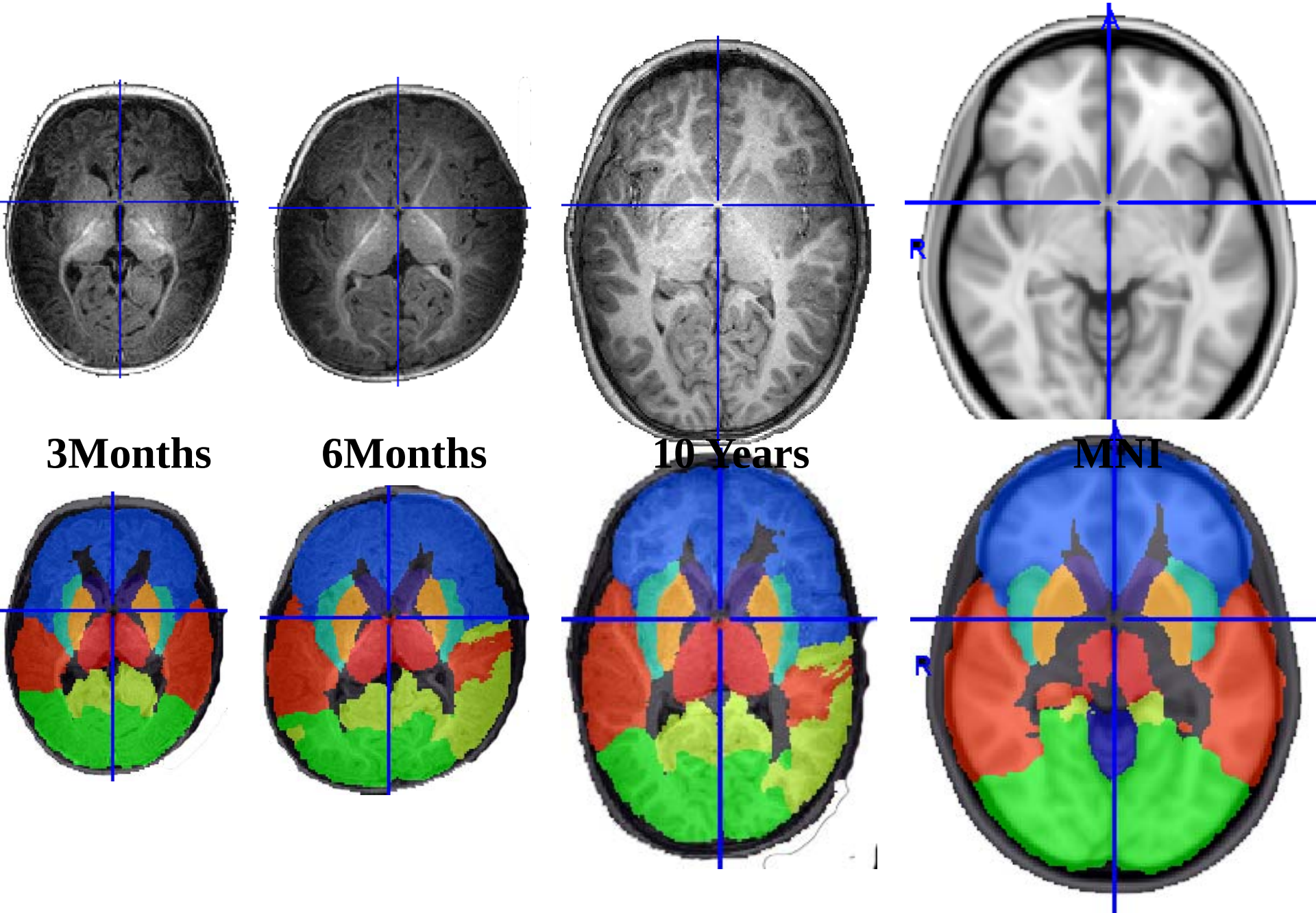
Newborn (3.0T), 1 & 3 Months (N-1.5T), 3.5 & 4.5 Months (JR-3.0T)



6 & 6.5 Months (JR-3.0T), 12 Months (N-1.5T), 12 Years (JER-3.0T)

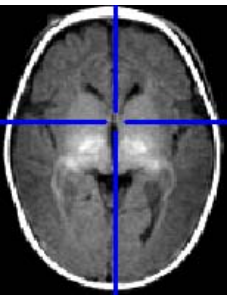


Common Stereotaxic Atlas?

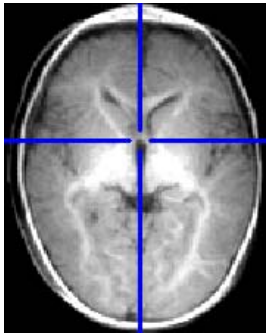


Average Brains for Source Models?

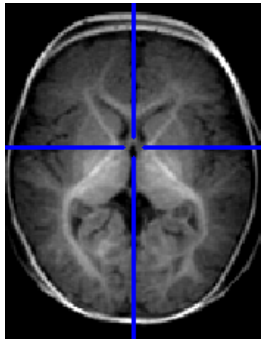
3Months



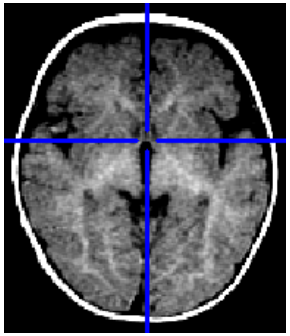
6Months



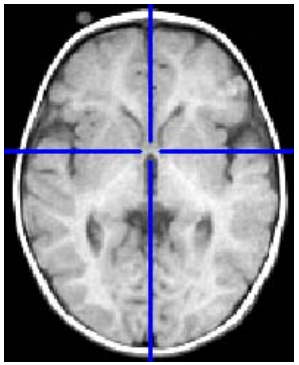
7.5Months



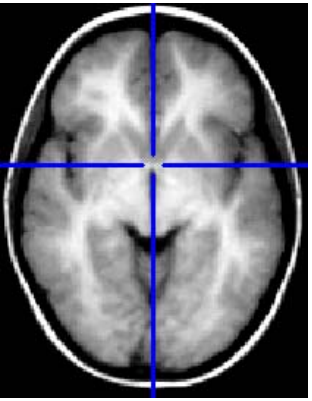
9Months



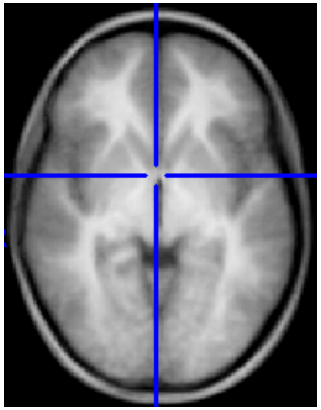
12Months



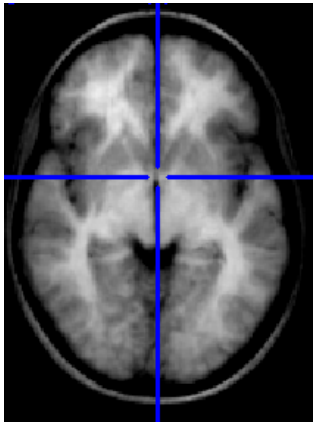
10Years



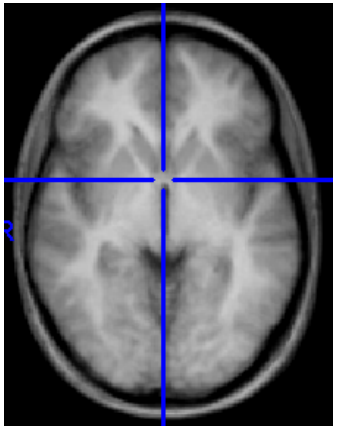
12Years



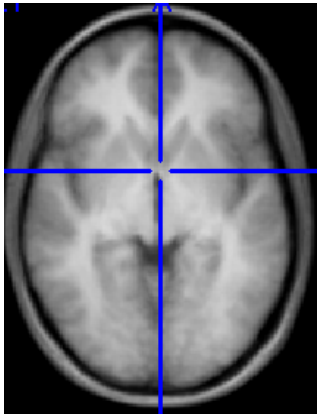
14Years



16Years



18Years



19-24Years