

## “The Right Hemisphere Impairment & SLI, ADHD, and Autism: Neurodevelopmental and Genetic Factors

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2009

Selected Bibliography

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- Ehret, G., (2006) Hemisphere Dominance of Brain Function – Which functions are Lateralized and Why? In Hemmen and Sejnowski (EDS) *23 Problems in Systems Neuroscience*. Oxford University Press.
- Durstun,S. and Kerstin, K.(2007) Integrating genetic, psychopharmacological and neuroimaging studies: A converging methods approach to understanding the neurobiology of ADHD. *Developmental Review*. Elsevier.
- Huttenlocher, P. (2002) *Neural Plasticity*. Oxford University Press
- Other references cited in PPT

New Research Right vs. Left hemisphere  
Hierarchy to Brain Development (Hypothesis of Huttenlocher, 2002)

- Right hemisphere may develop before left
- Formation of functional circuits in primary cortex
  - depends on sensory input
- Development of secondary sensory and association areas
  - depends on input from primary areas
  - could not proceed until input becomes functional
- Pre-frontal cortex – integration of information from multiple association areas
  - Depends on input from association areas

Tuning the developing brain  
to social signals of emotions

- Jukka M. Leppänen and Charles A. Nelson*
- NRNS 1.09*

A cortical network for semantics:  
(de)constructing the N400

*Ellen F. Lau, Colin Phillips and David Poeppel*

NATURE REVIEWS | **Neuroscience** volume 9 | December 2008 | 919-933

New processing research,  
Hale, 2007

General roles of the right vs. left hemisphere (Ehret, 2006)

- Lateralized brain functions are:
  - An expression of, and
  - Proof of the highly developed plasticity of vertebrate
- The right hemisphere represents the default setting of
  - Functions that are active and dominating
  - As long as nothing special is required to see and do
- Left hemisphere dominates when complex and complicated tasks or problems have to be mastered

Example 1 - Language

- Fabbro, Gran and Gran (1991) *Brain and Language Vol.41*, pages 1-42.
- Language dominance of interpreters at a European conference
  - Right hemisphere advantage for processing syntax of their native language
  - Left hemisphere dominance for languages they translate into their mother tongue

Example 3 - Attention

(Hale, 2007) [seen in zebrafish, chick, monkey & human, Ehret]

Other lateralized functions in vertebrates (Ehret, 2006)

•**LEFT**

–**Language**

–**Species specific call recognition (mouse and monkey**

–**Complex time critical sound processing and perception (guinea pig, monkey, human)**

•**RIGHT**

–**Perception of pitch, melody and timbre**

–**Visual and acoustic spatial processing ( chick and human)**

–**Regulation of mood and affect (human)**

Dichotomous relations of the cerebral hemispheres (after Devinsky & Desposito, 2004)

•Left Hemisphere

- Attention – contralateral space and body
- Perception – auditory/linguistic
- Emotional – positive valence; factual; verbal
- Cognitive – logical, concrete, detailed

•Right Hemisphere

- Attention – bilateral; left > right
- Perception – tactile, olfactory, visual spatial
- Emotional – negative valence; social; nonverbal; autobiographical
- Cognitive – creative, metaphorical, gestalt

Right Hemisphere Dysfunction: Specific Disturbances include(Devinsky & D'Esposito, 2004):

- Corporal self – disturbances of relation of body to its affective state and environment
- Perception – visuospatial, somesthetic, auditory (melody and tone discrimination); olfactory, pain and emotional tone in voice and body gestures
- Constructional praxis –
  - Assemble and organize an object from disarticulated pieces
  - Disorders of dressing ability
- Nonlinguistic visuospatial functions
- Relation of self to the environment
- Body schema
  - Alloesthesia – perception of a stimulus at a position remote from actual stimulus
  - Asomatognosia – failure to perceive a body part
  - Anosognosia – denial of deficit
  - Anosodiaphoria – indifferent to symptoms
  - Disorders of appetite

Specific Disturbances (continued)

- Disorders of the psychic self
  - Emotional perception
  - Emotional expression
  - Emotional cognition and memory (editor)
  - Self-recognition
- Alexithymia – diminished ability to identify and describe ones own feelings
- Disturbance in emotion of familiarity
  - Volition – motor impersistence
  - Disorders of social self
- Impoverished eye contact
- Nonverbal emotional communication
- Social language impairments
- Disorders of ego boundary – “response to next patient stimulation”
  - Delusional disorders
  - Conversion disorders

Right Hemisphere in Autism

- Martha Herbert's lateralization and myelination research
    - Similar neuronal shifts seen in Developmental Language Disorders
    - Share many of the same genes
    - Right hemisphere is larger with more myelin
- New genetics research, Smalley, 2007

**Results**

**Categorical Analysis**

Abrahams and Geschwind (2008)

Advances in autism genetics: on the threshold of a new neurobiology

Figure 1 | **Loci implicated in ASD etiology.** Entries in the ID column of the table map link entries to the ideograms of individual chromosomes.

Red and yellow bars correspond to de novo losses and gains, respectively, that are observed in cases but not in controls.

Green bars correspond to genes that are observed to modulate autism spectrum disorder (ASD) risk (either through a rare syndrome or genetic association): light green and dark green bars represent promising or probable candidate genes, respectively

ASD Related Syndromes (Abrahams and Geschwind, 2008)

- Fragile X
- Angelman Syndrome
- Joubert Syndrome
- Rett Syndrome
- Timothy Syndrome
- Tuberous Sclerosis
- Cortical Dysplasia Focal Epilepsy
- Potocki-Lupski
- Smith Lemli Opitz

Right Hemisphere vs. Frontal Lobes in ADHD

- Understanding attention processes: attentional networks
  - The role of neurotransmitters
  - Types of attention
  - Neglect

Attentional Networks

Amir Raz and Jason Buhle (2006)

Nature Reviews Neuroscience

7(5), 367-379

Different dimensions of adult cortical plasticity are enabled by the behaviorally-context-dependent release of:

- acetylcholine (focused attention/reward) (Kilgard, Bao)**
- dopamine (reward, novelty) (Bao)**
- norepinephrine (novelty) (Bollinger)**
- serotonin (Bollinger)**
- et alia**

Tuning the developing brain  
to social signals of emotions

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- *NRNS 1.09*

Can Attention Itself Be Trained?  
Attention Training for Children At-Risk for ADHD

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Leanne Tamm, Ph.D.  
Bruce D. McCandliss, Ph.D.  
Angela Liang, B.A.  
Tim L. Wigal, Ph.D.  
Michael I. Posner, Ph.D.  
James M. Swanson, Ph.D  
Tamm et al

- Although far from conclusive, it does appear that attention can be trained. Further, it appears that ATT can be adapted successfully for preschoolers, and has promising evidence as an intervention for children at-risk for or diagnosed with ADHD. Future studies should examine the specificity of ATT tasks, utilize imaging techniques to explore the impact of ATT on brain function, and investigate whether attentional gains are generalizable to other settings.

**Training, maturation, and genetic influences  
on the development of executive attention**

**• M. Rosario Rueda, Mary K. Rothbart, Bruce D. McCandliss, Lisa Saccomanno,  
and Michael I. Posner**

Rueda, et al., *PNAS* **October 11, 2005** vol. 102 no. 41 **14931–14936**

- **A neural network underlying attentional control involves the anterior cingulate in addition to lateral prefrontal areas.**

- **An important development of this network occurs between 3 and 7 years of age.**

- **Examined the efficiency of attentional networks across age and after 5 days of attention training (experimental group) compared with different types of no training (control groups) in 4-year-old and 6-year-old children.**

- **Strong improvement in executive attention and intelligence was found from ages 4 to 6 years.**

- **Both 4- and 6-year-olds showed more mature performance after the training than did the control groups.**

**-This finding applies to behavioral scores of the executive attention network as measured by the attention network test, event-related potentials recorded from the scalp during attention network test performance, and intelligence test scores.**

**•Overall, the data suggest that the executive attention network appears to develop under strong genetic control, but that it is subject to educational interventions during development.**

Neural mechanisms of selective auditory attention are enhanced by computerized training: Electrophysiological evidence from language-impaired and typically developing children

•Courtney Stevens,, Jessica Fanning, Donna Coch,, Lisa Sandersa,, Helen Neville B R A  
I N R E S E A R C H 1 2 0 5 ( 2 0 0 8 ) 5 5 – 6 9

Left Neglect Syndrome

- Reduction of neural resources that can be mobilized
  - By sensory events located on the left
  - By motor plans directed to the left
- Patient may behave as if one-half of the universe has abruptly ceased to exist
- Often multimodal
- May co-exist with but not caused by hemianopia, hemihypesthesia, or hemiparesis

Clinical characteristics - severe

- May shave, groom, dress only right side of body
- May fail to eat food on left side of plate or tray
- May omit left side of words on a page
- May fail to copy detail on left side of drawing
- May leave wide left margin when writing
- May display a tonic rotation to the right

Clinical characteristics - mild

- May not show obvious deficits except on testing
  - May fail to observe left side of road while driving
  - May tend to ignore objects in left pocket
  - May forget to scan desk for notes or items on the left side of desk or room

Assessment

- Bilateral simultaneous stimulation
- Cancellation tasks
- Drawing of a clock
- It is not a disorder of seeing, hearing, or moving but one of looking, detecting, listening, and exploring

Representational (perceptual) component

- More obvious when competing events are present on the right

–Probed with tests of extinction,

- Demonstration

- Distinguish from hemianopia

–line bisection

- Mark midpoint of horizontal line

- Hemianopics tend to be left of center (compensation)

–covert attentional shifts

External vs. Inner representation

- In many patients inner representation seems skewed to the right

–Close eyes and point to midline of body – pts often point right of midline

–Rapid eye movements during dreams are directed toward the right

–Hallucinations on the right only

- Problems constructing on the left

Motor exploratory aspects of neglect

- A pervasive reluctance to scan and explore left hemispace

–Lack of interest in the left side

–Rightward bias

- Seen in cancellation tasks where pt starts at the right and moves left

- Rightward bias seen in tasks where pt asked to erase targets (rather than cancel) as right targets decrease left sided attention increases

Neglect dyslexia

- Fail to read words on the left or letters on the left side of a word

–May show confabulatory completions of left side of word or sentence

Exploratory deficit & hypokinesia

- Also see problems with manual exploration (tactile search)

–Blindfolded searches of objects

- Hypokinesia – general impairment of leftward movements

- Intentional neglect – reluctance to direct movements to the left

Motivational aspects

- Patients with left neglect devalue the left and assume nothing of importance could be occurring on the left

–May be related to motivation

–I.e., very hungry patient may explore the left side of tray better than less hungry one

Mesulam's neglect model

Male vs. Female developmental brain volume

Nature Reviews Neuroscience

2008

Right Hemisphere Dysfunction

- Functional assessment in adults must determine functioning in the following linguistic areas:

–Spatial organization

- reading

- writing

In children

- Draw a man

- Watch how they follow a route to the therapy room or class room

- Do they often turn right when they first leave or enter a room

- Can they put animals inside and outside a fence

Informal Assessment Adults

- Spatial organization : reading and writing

- Reading: can use any standard print functional reading material (magazine, hospital menu, etc.) , ask person to words, etc. at various points on the page

- Writing: can ask individual to write name, address, short PP about self

- In reading task look for:

- ability to scan whole page

- scanning & tracking

- word recognition

- In writing task look for:

- neglect of left

- crowding or superimposition of letters

Assessment Video Adults

Treatment

- Respond well to therapy using techniques that increase attention to perceptual cues

- Spatial or defining barriers

- Graphic grids

- Red or yellow reference lines

- External space organizers – eg. Cards, straight edges, etc.

- Teaching internal spatial representation strategies, eg. “edgeness” therapy

Children

- Work on tracking left to right, top to bottom with age appropriate activities

- Line up toys

- Describe pictures

- Move to picture books to instill concepts of sequence and scanning and tracking for details

Edgeness and Bookness

Begin by having the patient feel the edges of a table top, blotter, or book cover

Divide the surface into quadrants and ask the patient to find words or objects in each quadrant beginning on the upper right

Gradually remove the quadrant markers and have the patient scan for designated objects or words

Available Assessment Tools

- RICE - Rating scale for written language and Scanning & Tracking, or RICE R, Burns Brief Inventory – Right Hemisphere Screen

- Pimental & Kingsbury (1989) *Mini Inventory of Right Brain Injury* (MIRBI) - visuo-verbal processing, visual scanning

- Wilson, et.al. (1987) *Behavioral Inattention Test* - functional assessment of telephone dialing, menu reading, article reading, etc.

Right Hemisphere Dysfunction

- Non-verbal perception

  - recognition of familiar faces

  - gestalt perception

  - construction

Kim M Dalton, Brendon M Nacewicz, Tom Johnstone, Hillary S Schaefer, Morton Ann Gernsbacher, H H Goldsmith, Andrew L Alexander & Richard J Davidson

- Published online: 6 March 2005; | doi:10.1038/nm1421

- Gaze fixation and the neural circuitry of face processing in autism**

Available Assessment Tools

- Behavioral Inattention Test - picture scanning, telling and setting the time

- DTLA-3; ITPA; closure tasks

- DTLA-A; WAIS - construction tasks (geometric designs, block design)

- Burns Brief Inventory – Right hemisphere screen

Technological Approaches

- Bungalow software

- Cortex Insight – new from Posit Science

  - Demonstration