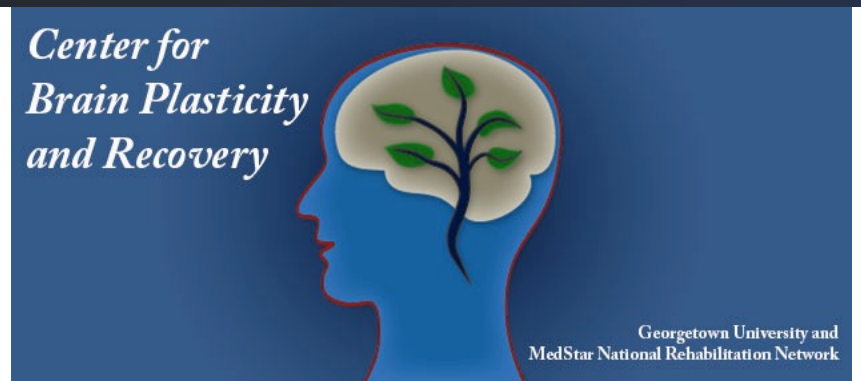
CRL Lecture Series
11/07/2022

The right hemisphere: Why it should not be neglected even if it may be clinically silent

Anna Greenwald, PhD
(as2266@georgetown.edu)

GEORGETOWN UNIVERSITY



MedStar National Rehabilitation Network

Left vs. Right Brain?

Left Brain vs. Right Brain...
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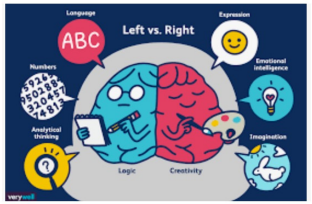

Left Brain vs. Right Brain Dominance
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Left Brain vs. Right Brain Dominance ...
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side of the brain ...
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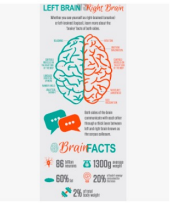

INFOGRAPHIC: Left brain...
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Right brain/left brain, right ...
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left-brain personality traits ...
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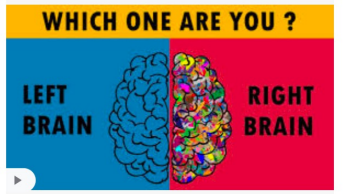

Left Brain Dominance ? Personality Test ...
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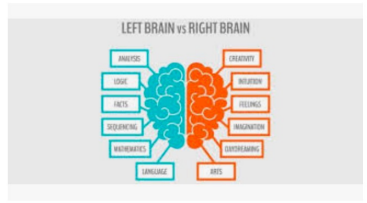

The Left Brain Vs. Right Brain Myth ...
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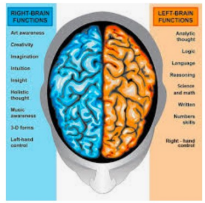
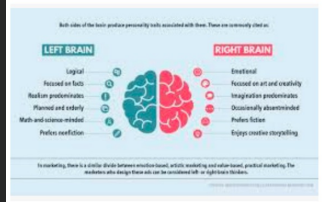


Left & Right Hemispheres Rol...
brainmadesimple.com



Left-Brained vs. Right-Brained ...
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personality displays a right-br...
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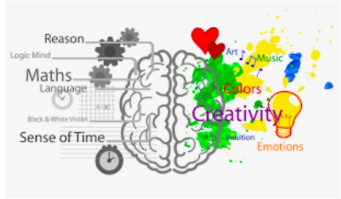
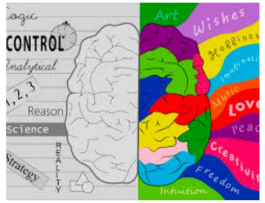


Right Brain Dominance – Experiment ...
experimentexchange.com



Are you right- or left-brained ...
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Left Brain Right Brain is a MYTH - YouTube
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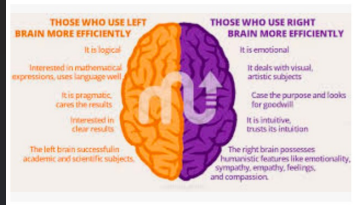
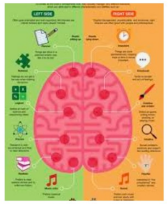
Left Brain vs. Right Brai...
wellness360magazine.com

Left- vs. Right-Brained: Why the Brain ...
biomedicalodyssey.blogs.hopkinsmedicine....



Right Brain – Left Brain Test | MentalUP
mentalup.co

Are you left-brained or right-brained?
thestatesman.com



Left versus right brain ...
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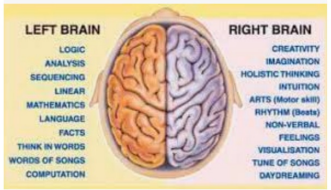

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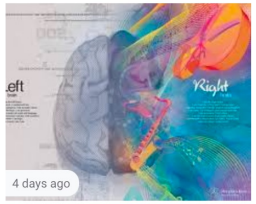


Left brain versus right brain thinkers ...
educationalneuroscience.org.uk

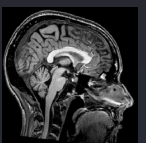
Left vs. Right Brain?

Left
brain

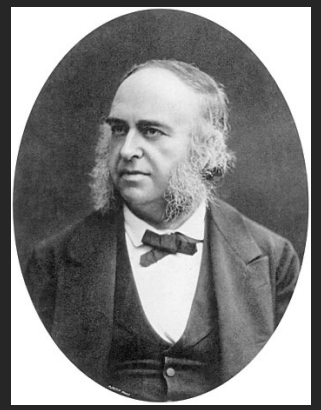
I am the left brain.
I am a scientist. A mathematician.
I love the familiar. I categorize. I am accurate. Linear.
Analytical. Strategic. I am practical.
Always in control. A master of words and language.
Realistic. I calculate equations and play with numbers.
I am order. I am logic.
I know exactly who I am.

Right
brain

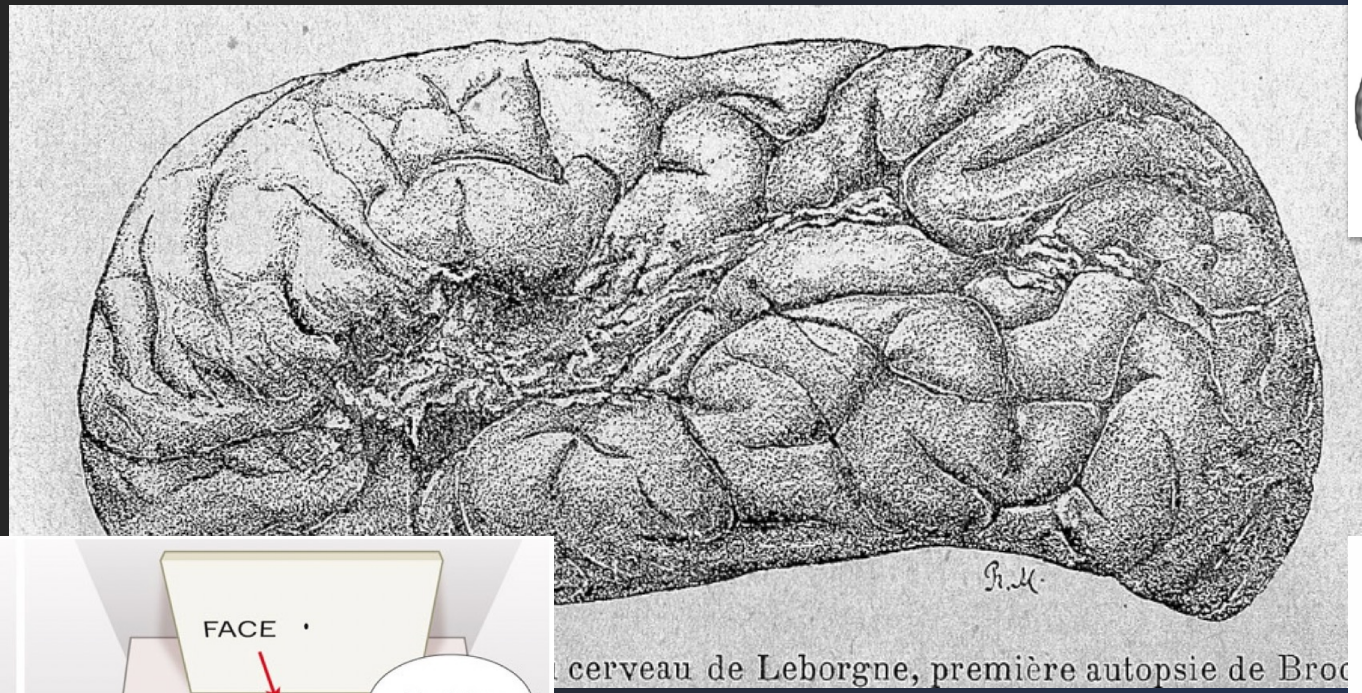
I am the right brain.
I am creativity. A free spirit. I am passion.
Yearning. Sensuality. I am the sound of roaring laughter.
I am taste. The feeling of sand beneath bare feet.
I am movement. Vivid colors.
I am the urge to paint on an empty canvas.
I am boundless imagination. Art. Poetry. I sense. I feel.
I am everything I wanted to be.



The LH is the “eloquent” one

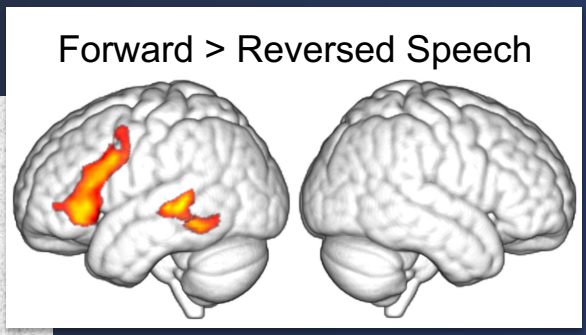


Broca
(1865)

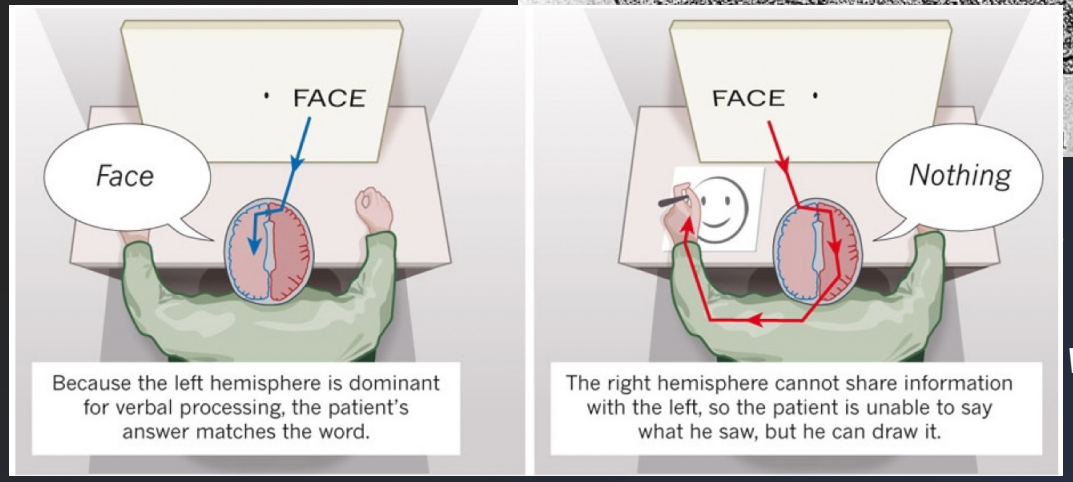


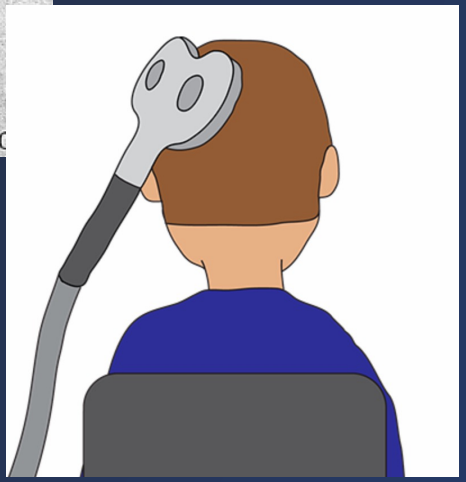
avec l’hemisphere gauche”

with the left hemisphere)

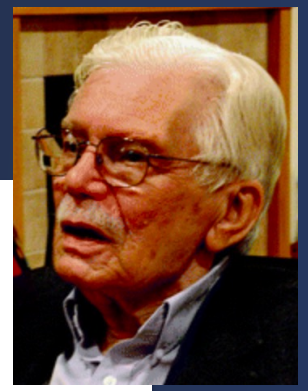


Newport et al. (2022)





Clinically silent == minor?



J Hist Med Allied Sci. 1972 Jan;27(1):5-14.

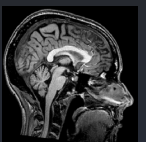
The 'minor' hemisphere.

Benton AL.

The concept of left hemisphere dominance was applied at first only to language functions. However, as continuing clinical study indicated that the left hemisphere apparently subserved a number of other aspects of mentation and cognition, the concept was broadened considerably. [...]

The designation of the left hemisphere as 'major' implied, of course, that the right hemisphere was the minor hemisphere. In this context, the term 'minor' evidently had a number of interrelated meanings. [...]

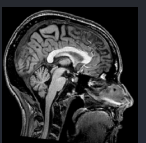
Finally, the term 'minor,' as applied to the right hemisphere, implied that it had no distinctive functions. It shared certain functional properties with the left hemisphere but, at least with respect to higher-level performances, whatever it could do, the left hemisphere could do better.



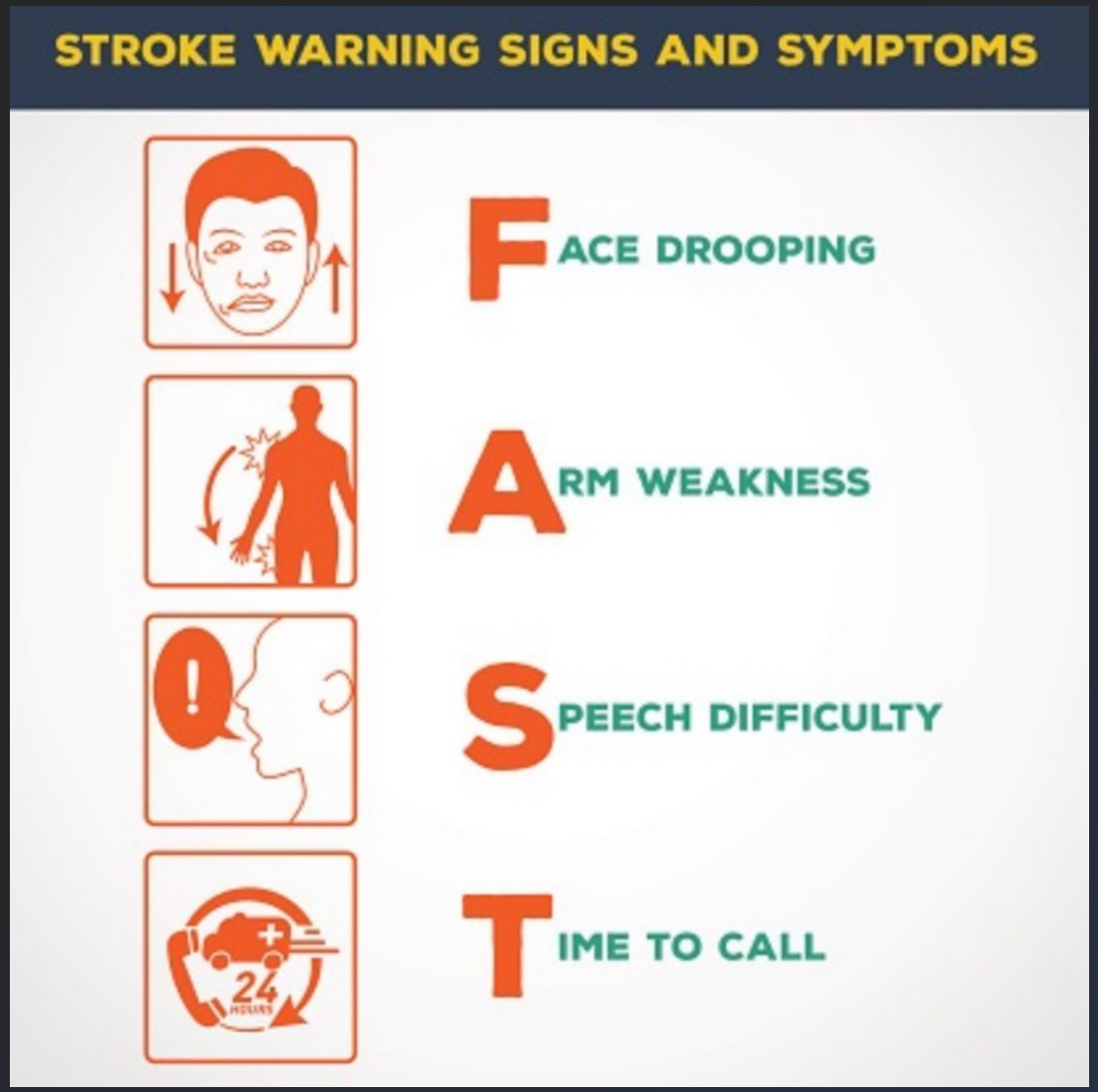
Minor = unimportant?

Wada Test -- This test is done to determine which hemisphere (side of the brain) is dominant, or most responsible, for critical functions such as speech and memory. If the seizure focus and speech or memory center are on the same side, the surgery may be slightly altered to avoid damaging or removing the speech/memory area of the brain. During this test, each hemisphere is alternately injected with a medication to "put it to sleep." While one side is asleep, the awake side is tested for memory, speech, and ability to understanding speech. The patient may need to stay in the hospital overnight.

Section on “Tests before epilepsy surgery” from https://www.webmd.com/epilepsy/presurgical-evaluation#1



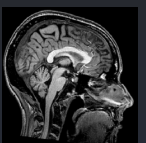
Stroke diagnostics emphasize LH stroke symptoms



	NIHSS item	max score
1	Level of Consciousness	
1a	Responsiveness	3
1b	Questions	2
1c	Commands	2
2	Gaze	2
3	Visual Fields	3
4	Facial Palsy	3
5	Motor Arm	
5a	right arm	4
5b	left arm	4
6	Motor Leg	
6a	right leg	4
6b	left leg	4
7	Limb ataxia	2
8	Sensory	2
9	Language	3
10	Dysarthria	2
11	Extinction and Inattention	2

Favors LH stroke

Favors RH stroke



RH injury is underdiagnosed

Stroke. 1994 Jun;25(6):1122-9.

Baseline silent cerebral infarction in the Asymptomatic Carotid Atherosclerosis Study.

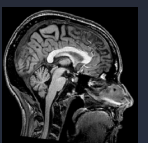
Brott T[1], Tomsick T, Feinberg W, Johnson C, Biller J, Broderick J, Kelly M, Frey J, Schwartz S, Blum C, et al.

BACKGROUND AND PURPOSE: In a group of patients with high-grade asymptomatic carotid artery stenosis, we prospectively determined the prevalence and radiological characteristics of clinically asymptomatic brain infarction evident on computed tomography. Risk factors and extent of carotid disease were also determined.

RESULTS: Among 1132 patients, 848 had no history of s
patients (15%) had a silent infarct; 95 (11%) had one, 24
infarct size was small and deep for 117 patients (72%), l
one lobe for 1 (0.5%). The silent infarcts were evenly dis
were significantly more frequent in the right hemisphere

TABLE 3. Location of Silent Cerebral Infarction by Computed Tomography

Location	No.*	%
Ipsilateral to study artery	71	43
Contralateral to study artery	72	44
Right	84	51
Left	59	36

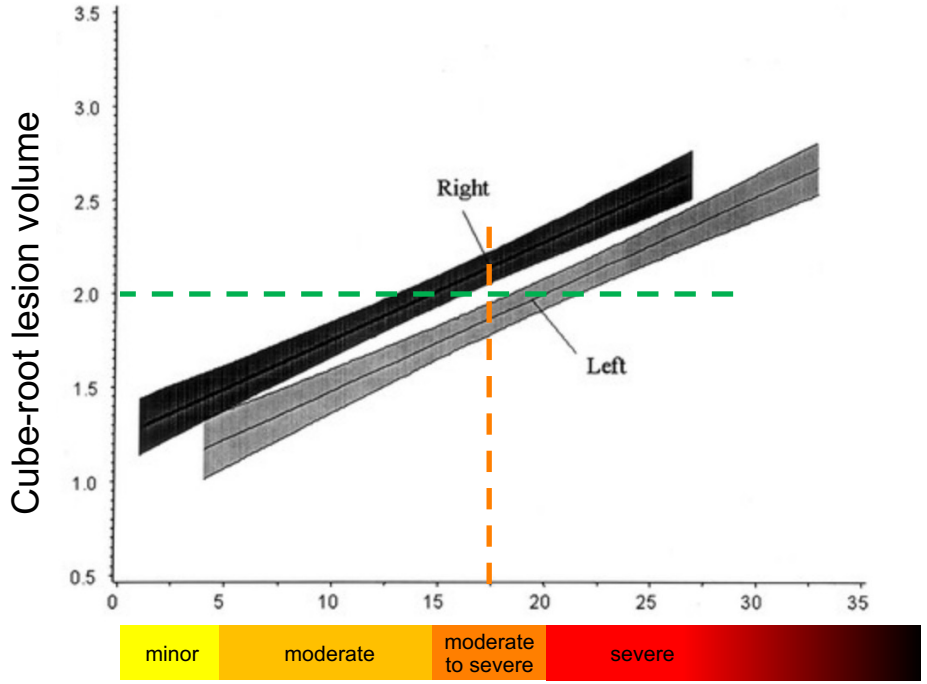


RH injury's severity is underestimated

Stroke. 1999 Nov;30(11):2355-9.

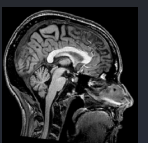
Does the National Institutes of Health Stroke Scale favor left hemisphere strokes? NINDS t-PA Stroke Study Group.

Woo D[1], Broderick JP, Kothari RU, Lu M, Brott T, Lyden PD, Marler JR, Grotta JC.

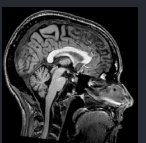


"For each 5-point category of the NIHSS score <20, the median volume of right hemisphere strokes was approximately double the median volume of left hemisphere strokes."

Note: This Left/Right difference is driven specifically by MCA strokes (*Vitti et al., 2015*)



Underdiagnosed → undertreated?



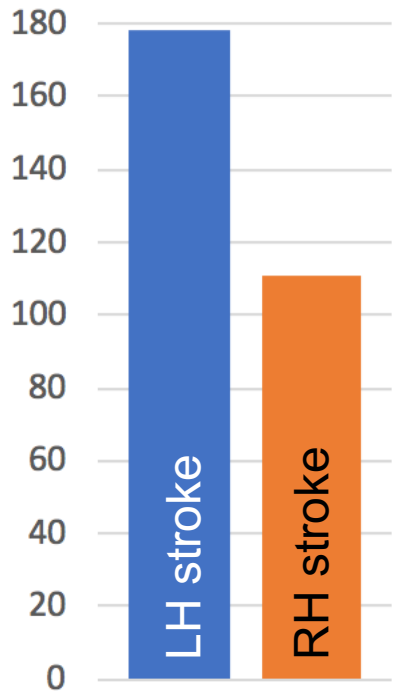
Patients with RH injury are underserved

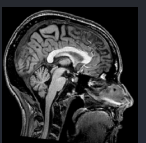
Neurology. 2005 Jul 12;65(1):81-6.

The impact of lesion side on acute stroke treatment.

Di Legge S[1], Fang J, Saposnik G, Hachinski V.

Of 289 patients treated with rt-PA for acute stroke, only 111 (38.4%) had RH stroke.





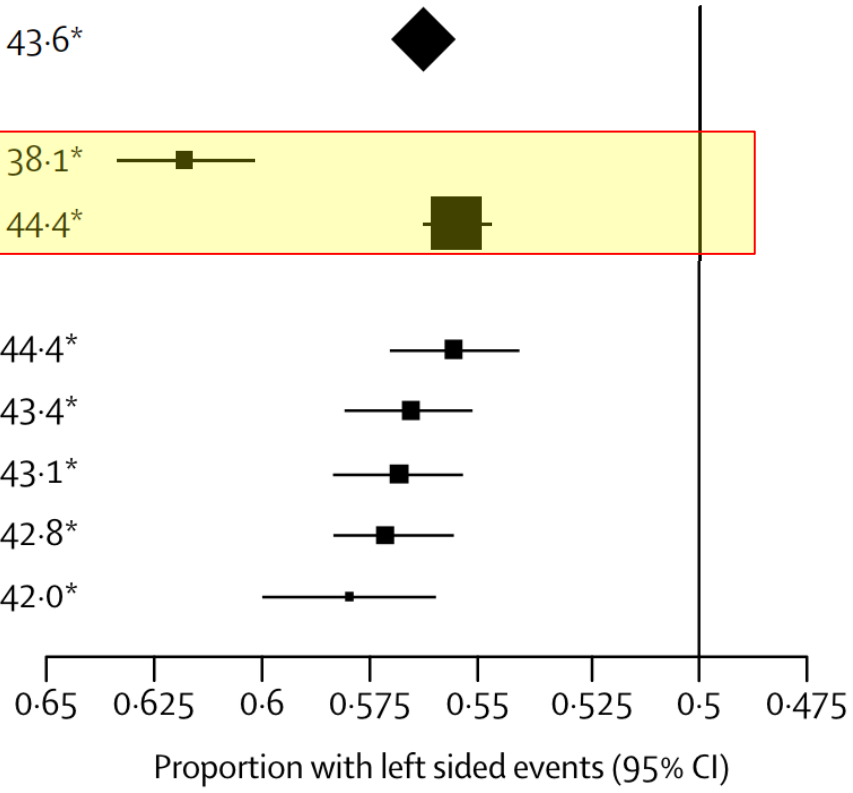
Patients with RH injury are underserved

Lancet. 2005 Jul 30-Aug 5;366(9483):392-3.

Difference in recognition of right and left hemispheric stroke.

Foerch C[1], Misselwitz B, Sitzer M, Berger K, Steinmetz H, Neumann-Haefelin T; Arbeitsgruppe Schlaganfall Hessen.

	n	Left (%)	Right (%)
All patients	20097	56·4	43·6*
Stroke subtype (n=20 097)			
Transient ischaemic attack	3502	61·9	38·1*
Ischaemic stroke	14 838	55·6	44·4*
Subtype of cerebral ischaemia			
Atherothrombotic	4093	55·6	44·4*
Small vessel	4265	56·6	43·4*
Cardioembolic	4222	56·9	43·1*
Other/unknown	3703	57·2	42·8*
Data not available	2344	58·0	42·0*



Interim summary I

Because the RH has no obvious role in language, it is regarded as "clinically silent", which is too often equated with "unimportant."

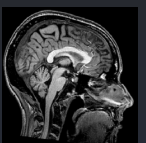
Current stroke diagnostics emphasize language symptoms.

→ RH stroke is underdiagnosed and its severity underestimated:

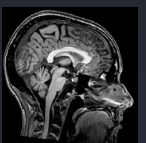
- More RH infarcts go undetected
- Among diagnosed strokes, those affecting the RH have larger lesion volumes and lower NIHSS scores at the same time

→ RH stroke is undertreated:

- Patients with RH infarcts are less likely to receive t-PA
- It takes a larger lesion volume and higher symptom severity to be admitted to a hospital with RH stroke



But does it matter?



Outcomes of RH injury may be worse than those of LH injury

Brain. 1982 Sep;105 (Pt 3):543-52.

Unilateral spatial neglect and recovery from hemiplegia: a follow-up study.

Denes G, Semenza C, Stoppa E, Lis A.

A follow-up study was undertaken in order to investigate the outcome of recovery from right and left hemiplegia on simple motor function and activities of daily living. The role of concomitant neurophysiological deficits was also investigated. The main results indicate that after six months from onset, left hemiplegics show a lesser degree of improvement in independence and social adjustment coupled with a tendency to a poorer recovery of motor function than the corresponding group of right hemiplegics. Unilateral spatial neglect, which is more frequent and severe in the group of left hemiplegics, seems to be crucial in hampering their performance.

Neurology. 1996 Aug;47(2):388-92.

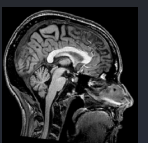
Factors predictive of stroke outcome in a rehabilitation setting.

Ween JE[1], Alexander MP, D'Esposito M, Roberts M.

Arch Phys Med Rehabil. 1998 Oct;79(10):1255-7.

Ischemic stroke: relation of age, lesion location, and initial neurologic deficit to functional outcome.

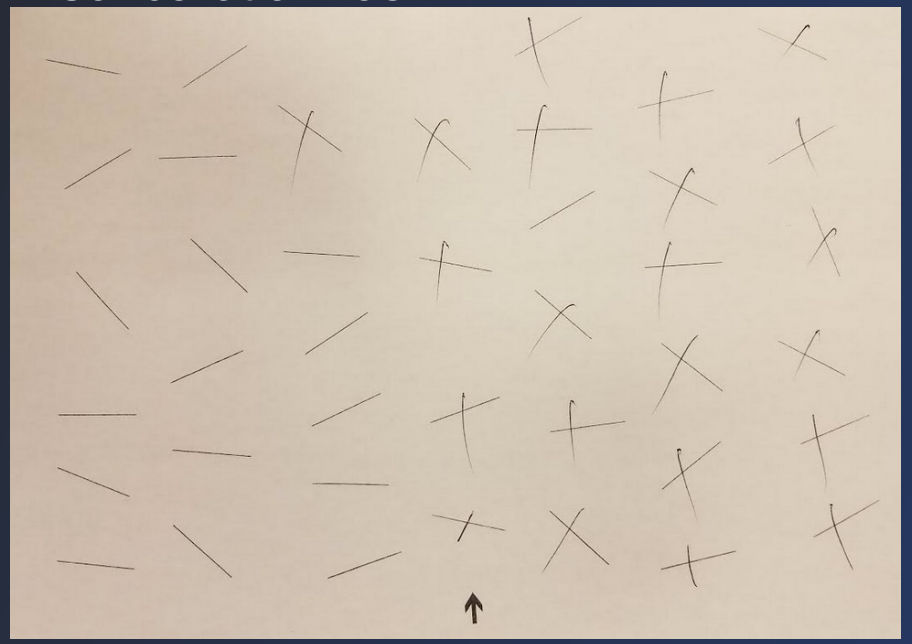
Macciocchi SN[1], Diamond PT, Alves WM, Mertz T.



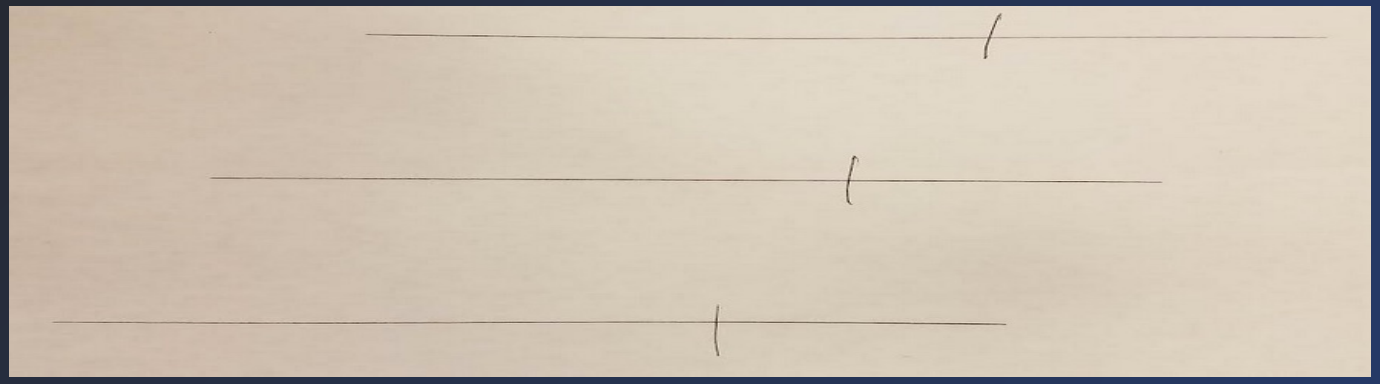
Hemispatial neglect

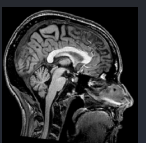
"A failure to report, respond, or orient to contralateral stimuli that is not caused by an elemental sensorimotor deficit" (Heilman et al., 2000)

Cancellation Task

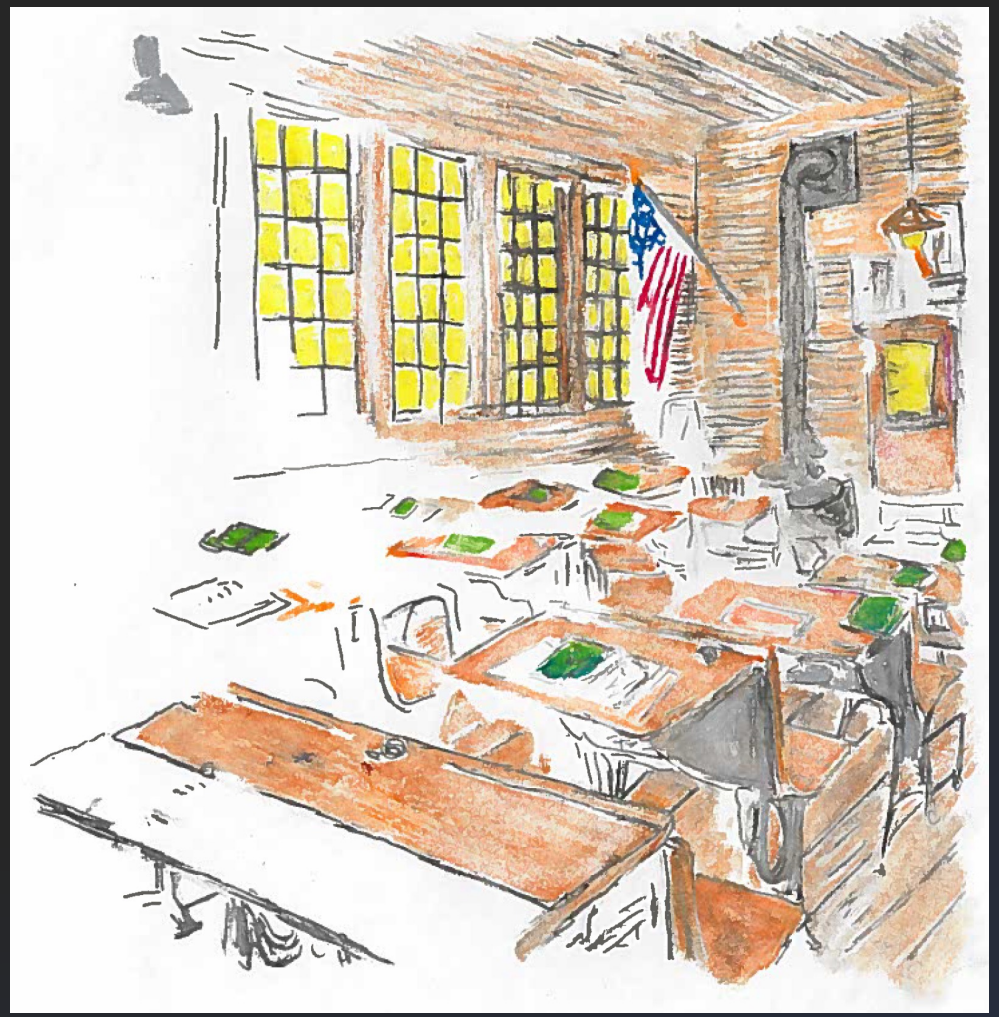


Line Bisection Task



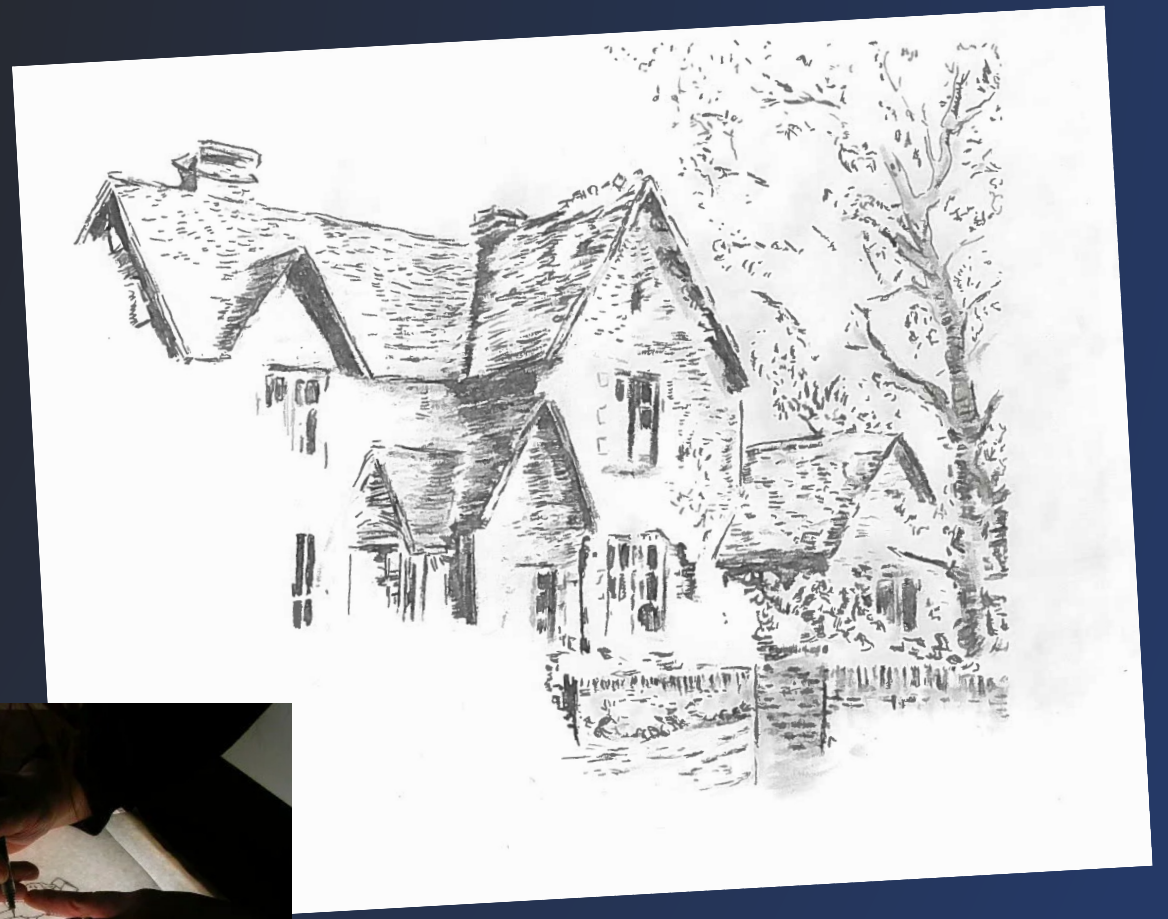


Hemispatial neglect



Hemispatial neglect

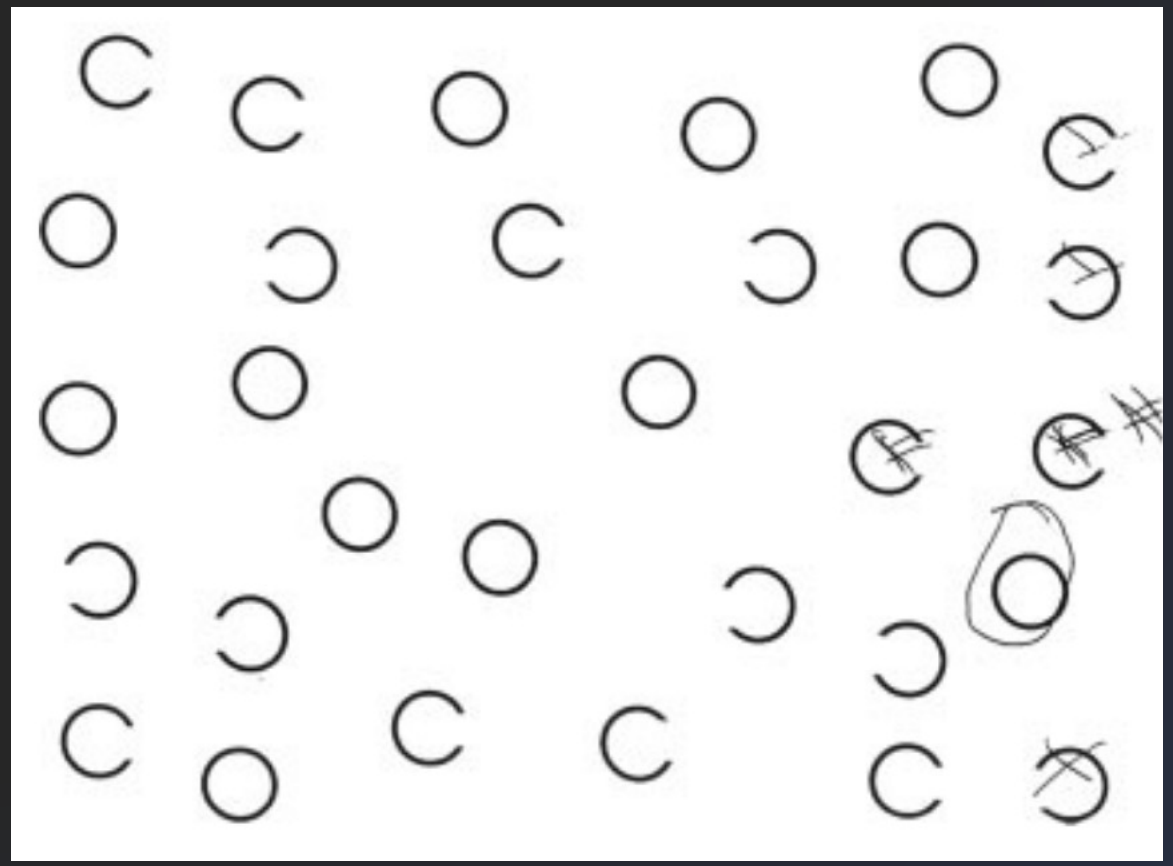
original



light table copy

Ego- vs. allocentric neglect

person-centered



object-centered

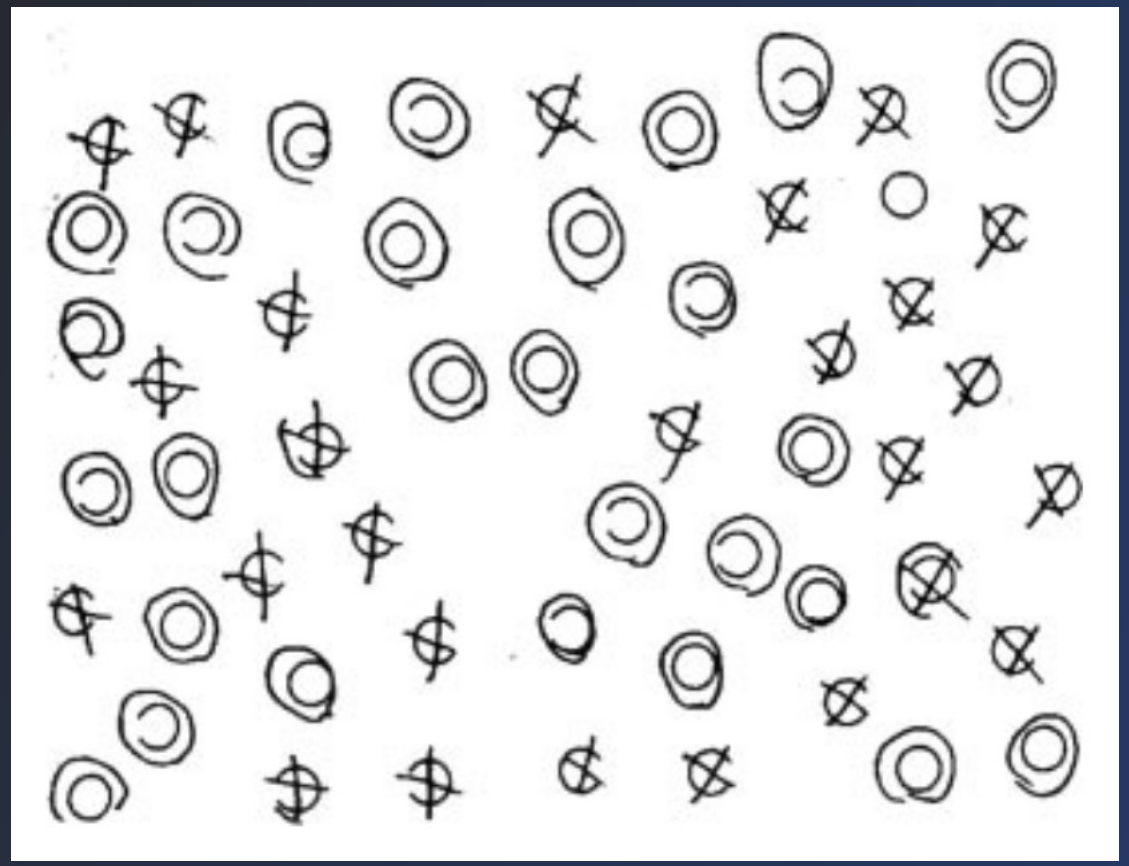
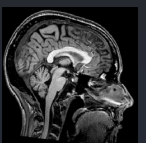


Figure from Hillis et al. (2005)



A footnote on “hemispatial” neglect

Encyclopedia of Clinical Neuropsychology

2011 Edition | Editors: Jeffrey S. Kreutzer, John DeLuca, Bruce Caplan

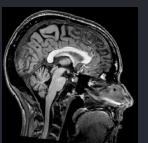
Neglect

- Hemiagnosia
- Hemiinattention
- Left (or Right) Neglect
- Neglect Syndrome
- Spatial Neglect
- Unilateral Neglect
- Visual Neglect
- Visuospatial Agnosia
- Visuospatial Neglect

“Neglect is a heterogeneous disorder with many variations […]

most commonly attributable to a **disorder of spatial attention**,
but it involves other types of disorders as well, including **deficits of intention**,
a disinclination to move in and toward neglected space;
deficits in arousal, which limit the capacity of attention and sensory integration;
deficits in spatial working memory that impair visual and manual search […].

[…] signs and symptoms of neglect may change over time.”



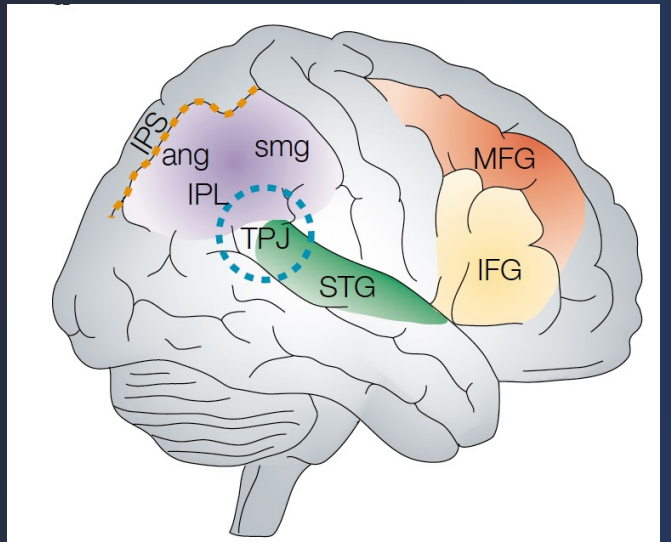
A footnote on “hemispatial” neglect

Neglect

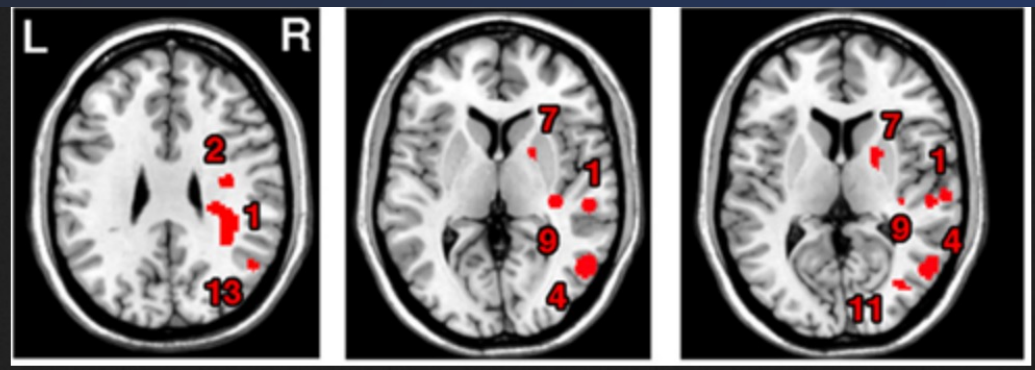
- doesn’t have to be left-sided, unilateral, or limited to specific spatial locations

- can be dissociable for
  - different modalities (e.g. vision vs. touch; external stimuli vs. internal representations),
  - different spaces (e.g., peripersonal vs. extrapersonal),
  - perception vs. action

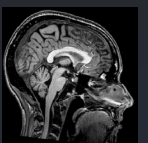
- can occur after lesions in a vast range of locations (including subcortical ones)



Husain & Rorden (2003)



ALE meta-analysis (22 studies; N = 1306) by *Chechlacz et al., 2012*)



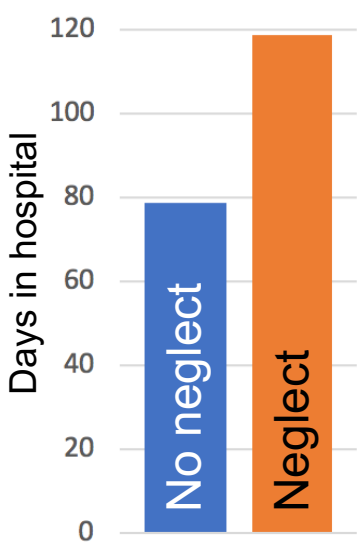
Neglect and long-term outcomes

Arch Phys Med Rehabil. 1999 Apr;80(4):379-84.

Functional disability and rehabilitation outcome in right hemisphere damaged patients with and without unilateral spatial neglect.

Katz N[1], Hartman-Maeir A, Ring H, Soroker N.

PATIENTS: Forty consecutive admissions of adult right-handed patients with a first, single, right hemispheric stroke proven by computed tomography. Based on their total score in the Behavioral Inattention Test for neglect, patients were divided into two groups: 19 with neglect (USN+) and 21 without neglect (USN-).



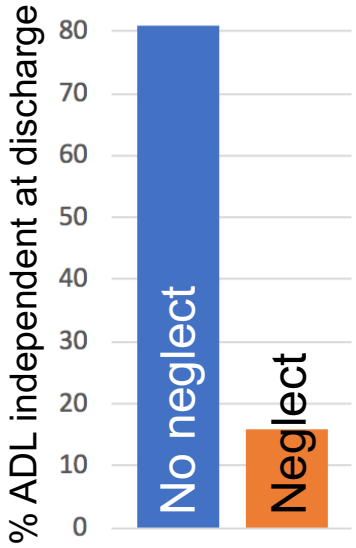
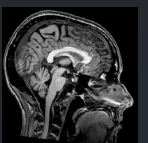


Table 3: Length of Stay in the Rehabilitation Hospital and Discharge ADL Status of RHD Patients With and Without USN

	USN+	USN−	
Length of stay (days)	118.7 ± 48.7	78.4 ± 52.4	$t = 2.48$ $p < .02$
Discharge ADL status			
Home—independent	15.8%	81.0%	$\chi^2 = 16.94$
Home—with caregiver	78.9%	19.0%	$p < .0000$
Nursing home	5.3%	—	



Neglect and long-term outcomes

Arch Phys Med Rehabil. 2001 Mar;82(3):322-8.

Recovery of functional status after right hemisphere stroke: relationship with unilateral neglect.

Cherney LR[1], Halper AS, Kwasnica CM, Harvey RL, Zhang M.

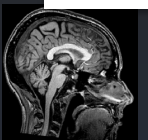
PATIENTS: Fifty-two consecutive admissions of adult right-handed patients with a single, right hemispheric stroke, confirmed by computed tomography scan.

"Severity of neglect was correlated with total, motor, and cognitive FIM scores at admission, discharge, and follow-up." (3 months post-stroke)

"FIM outcomes were significantly different for subject groups with more severe neglect."

Table 6: Pearson's Product Moment Correlations and Significance Levels Obtained Between BIT[12] Conventional Subtest Score and FIM Measures at Admission, Discharge, and Follow-Up

	Total FIM (18 Items)	FIM Motor (13 Items)	FIM Cognitive (5 Items)
Admission ($n = 52$)	.54*	.55*	.39*
Discharge ($n = 48$)	.51*	.48*	.42*
Follow-up ($n = 40$)	.36†	.33†	.40*



Neglect and long-term outcomes

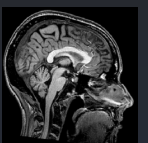
Neurology. 2004 Mar 9;62(5):749-56.

Hemispatial neglect: Subtypes, neuroanatomy, and disability.

Buxbaum LJ[1], Ferraro MK, Veramonti T, Farne A, Whyte J, Ladavas E, Frassinetti F, Coslett HB.

METHODS: The authors assessed 166 rehabilitation inpatients and outpatients with right hemisphere stroke with measures of neglect and neglect subtypes, attention, motor and sensory function, functional disability, and family burden. Detailed lesion analyses were also performed.

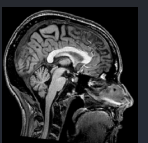
RESULTS: Neglect was present in 48% of right hemisphere stroke patients. Patients with neglect had more motor impairment, sensory dysfunction, visual extinction, basic (nonlateralized) attention deficit, and anosognosia than did patients without neglect. Personal neglect occurred in 1% and peripersonal neglect in 27%, motor neglect in 17%, and perceptual neglect in 21%. Neglect severity predicted scores on the Functional Independence Measure and Family Burden Questionnaire more accurately than did number of lesioned regions.



Anosognosia

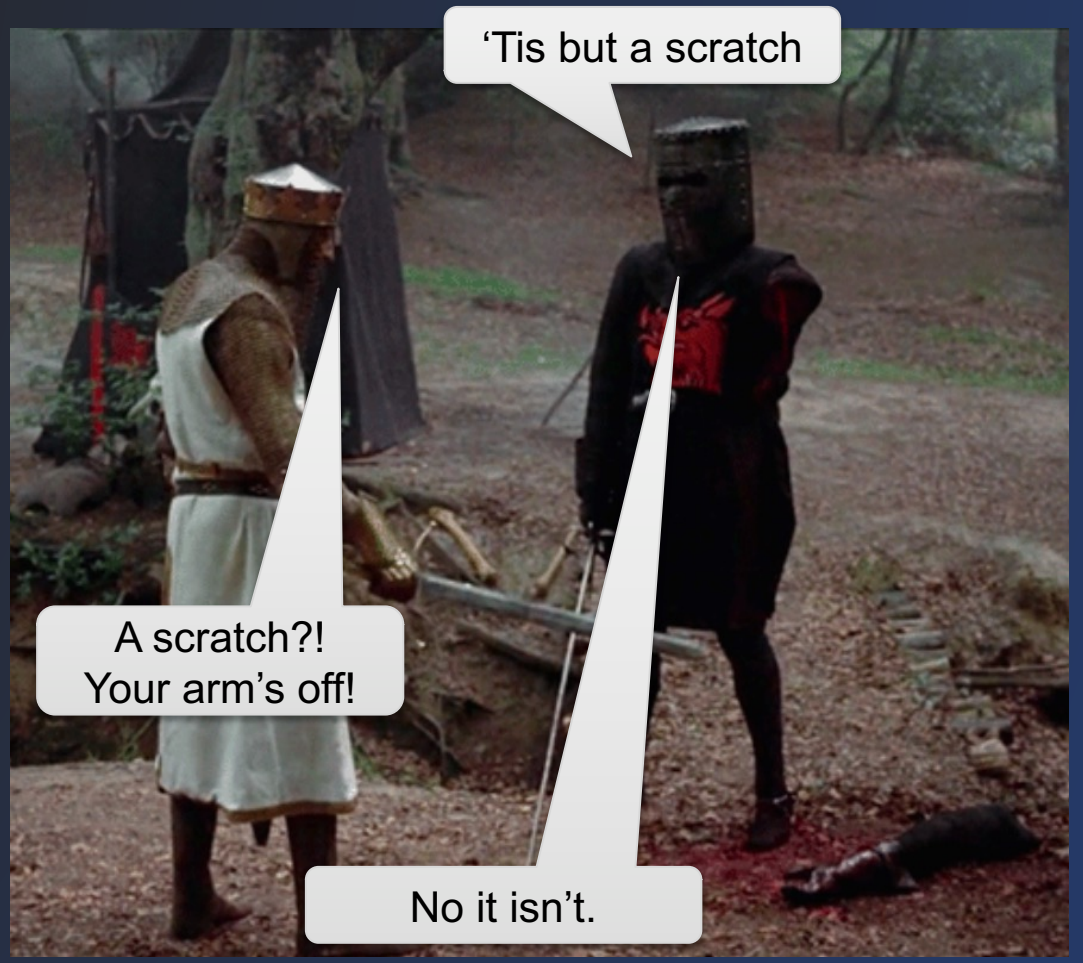
https://www.facebook.com/Anosognosiasupport/

https://modifieddriving.com.au/driving-after-a-stroke/

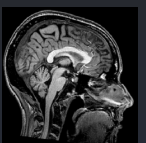


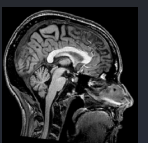
Interim summary II

- Long-term functional outcomes of RH strokes tend to be worse than those of comparable LH strokes
- This is often ascribed to hemispatial neglect
- ”Neglect” is a very heterogeneous disorder with many dissociable, but often co-occuring variations, not all of which are lateralized, or even “spatial”
- Associated lesion locations are not well understood yet, but behaviorally, neglect severity is a predictor of functional outcomes beyond lesion size
- Anosognosia further exacerbates the problem

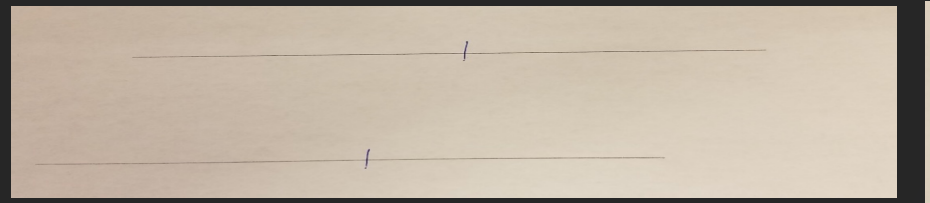


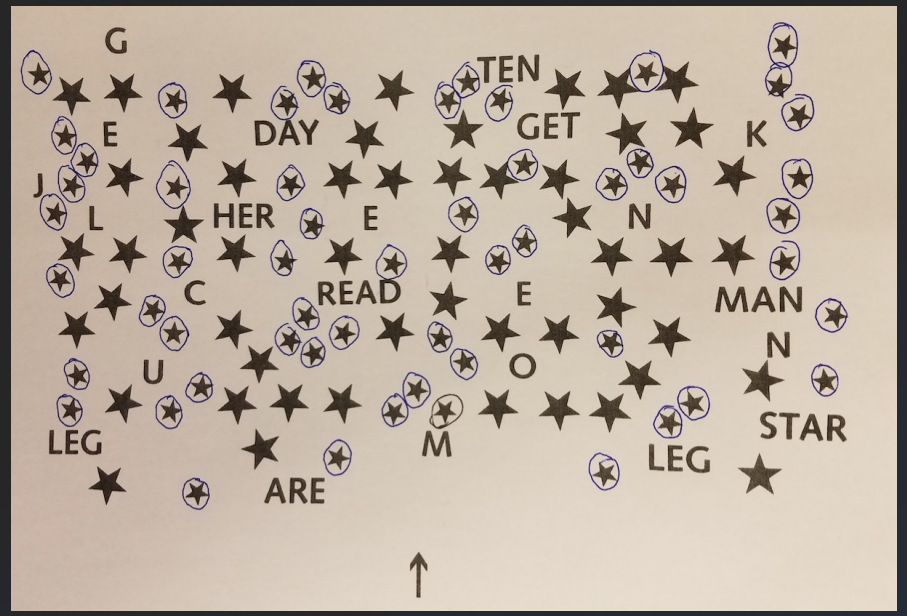
Monty Python & The Holy Grail

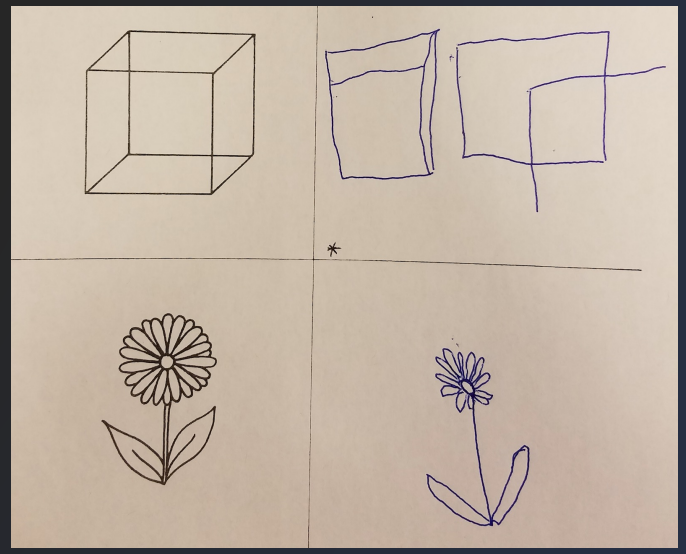


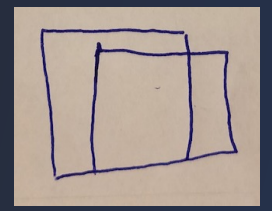


Constructional apraxia

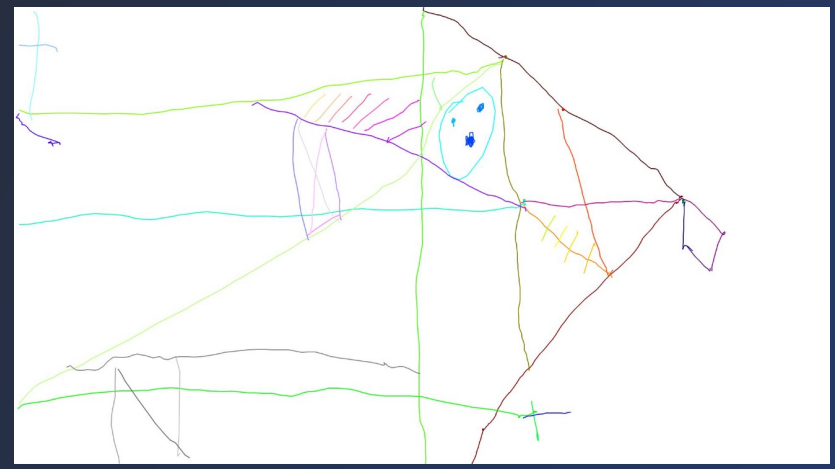


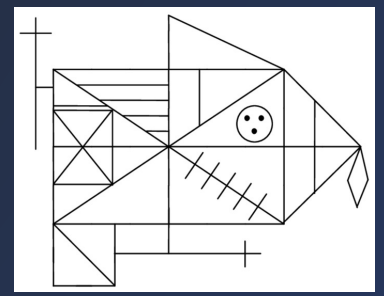


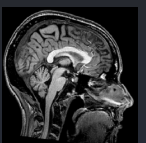




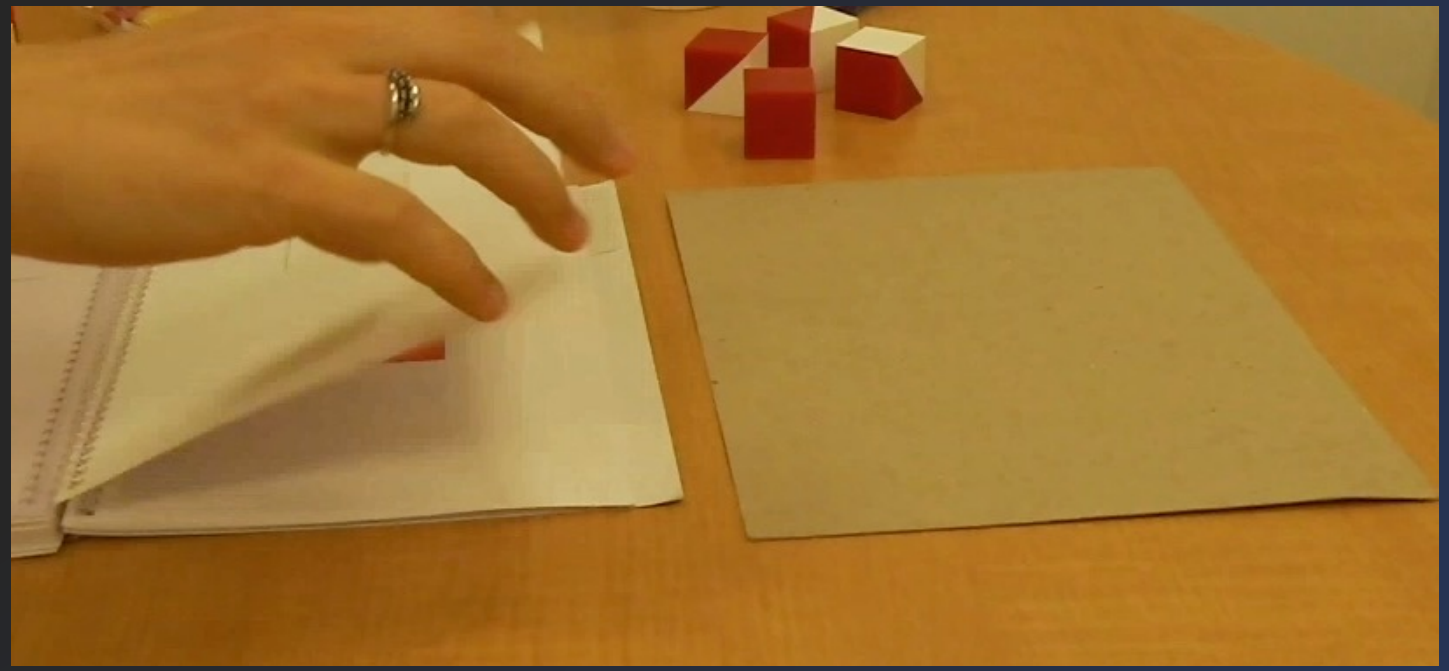
"I KNOW these. We used to draw them in school all the time! You just make two boxes, and then you connect them."







Constructional apraxia



Dressing apraxia

Table 3. Correlation matrix for the behavioral deficits in the right hemisphere stroke patients* (N = 41)

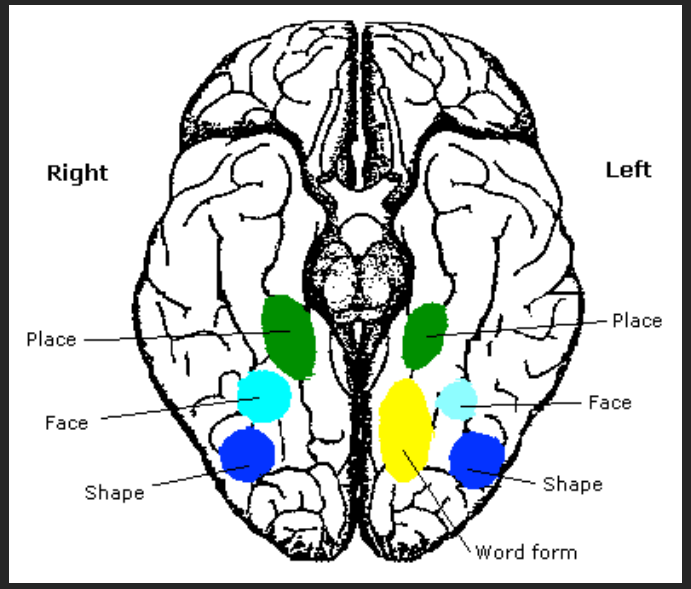
Deficit		1	2	3	4	5	6	7	8	9	10	11	12
1. Hemianopia	46%	—											
2. Arm weakness	88%	08	—										
3. Leg weakness	80%	38†	38†	—									
4. Extinction	63%	23	10	31†	—								
5. Neglect	85%	44†	21	23	50†	—							
6. Denial	36%	27	36†	53†	46†	42†	—						
7. Impersistence	46%	24	38†	52†	53†	48†	82†	—					
8. Face naming	44%	38†	08	29	25	58†	46†	47†	—				
9. Rey figure	93%	45†	44†	51†	25	56	42†	41†	36†	—			
10. Block design		32†	24	27	40†	49†	37†	38†	47†	79†	—		
11. USND	85%	35†	26	17	12	33†	25	24	21	69†	63†	—	
12. Dressing apraxia	51%	47†	12	25	64†	62†	51†	56†	56†	56†	56†	40†	—

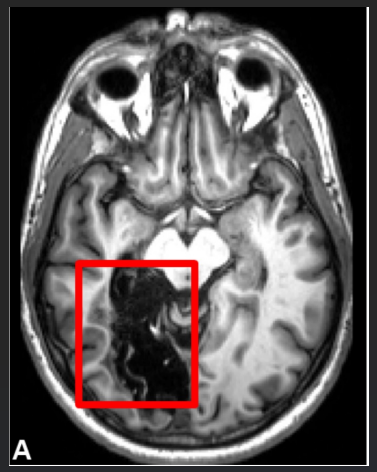
* Decimal points deleted.
† $p < 0.05$, two-tailed t tests, df = 39.

Hier et al. (1983)

https://www.youtube.com/watch?v=xjm0AAvEOUs

Prosopagnosia





Davies-Thompson et al. (2014)

Table 1. Patients' performance on face tests

Test C	P.A.	O.R.	L.M.
1. *Unknown face matching*	13 27*	14 27*	22 41
2. *Age estimation*	8 96	26 96*	4 56
3. *Familiar face recognition*	13 36*	17 36*	9 20*
4. *Face recognition*	7 32*	12 32*	8 20*

The numbers given for each test correspond to the errors made by the patient and to the maximum number of possible errors.

*Means that the error score exceeded the cut-off score determined in normals.

De Renzi et al. (1994)

Emotion recognition / expression

Spontaneous quotes from right-brain stroke survivors:

"You know, I've often wondered whether the stroke somehow gave me autism. Like… it threw me up in the ether, and when I came down, I landed somewhere on the spectrum."

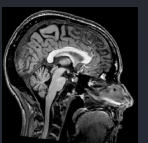
"Sorry, direct eye contact hasn't really been one of my strengths since the stroke."

Spontaneous quote from a spouse:

He's different. I know it's hard for him, being dependent on me for so many things. But it's like he doesn't care at all about how hard this is on me, too.

He says he hates being a burden on me, but the way he says it is... more like he's angry than that he feels bad for me.

And when I'm sad or tired or about to lose it, he doesn't even seem to notice.



RH stroke is closely associated with emotion recognition impairments

Psychosom Med. 2001 Nov-Dec;63(6):944-50.

Alexithymic features in stroke: effects of laterality and gender.

Spalletta G[1], Pasini A, Costa A, De Angelis D, Ramundo N, Paolucci S, Caltagirone C.

Characteristic	Right Hemisphere (N = 21)	Left Hemisphere (N = 27)	t	χ^2	p
TAS-20, mean ± SD (range)	60.5 ± 7.5 (45–74)	54.7 ± 7.7 (39–71)	2.60		.012
F1 (identifying)	20.8 ± 5.4 (10–31)	17.4 ± 5.7 (9–30)	2.01		.041
F2 (describing)	16.7 ± 4.0 (8–24)	14.1 ± 3.9 (6–21)	2.26		.028
F3 (externally oriented)	23.0 ± 4.9 (15–32)	23.2 ± 4.6 (14–35)	−0.16		.872
Nonalexithymic, N (%)	1 (4.8)	8 (29.6)			
Borderline alexithymic, N (%)	10 (47.6)	13 (48.1)		6.182	.045
Alexithymic, N (%)	10 (47.6)	6 (22.2)			

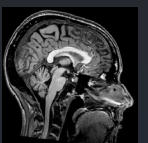
RESULTS: The 21 stroke patients with a lesion in the right hemisphere were more alexithymic than the 27 patients with a lesion in the left hemisphere. This evidence was strengthened by the categorical analysis: 48% of the patients with a right-hemisphere lesion had alexithymia, compared with 22% of patients with a left-hemisphere lesion. Univariate analyses of covariance showed significant differences between the

The case for a link to stroke outcomes

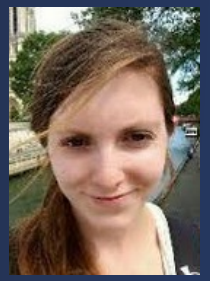
- Emotion recognition impairments are associated with poor social support

  (e.g., *Posse et al., 2002; Knox & Douglas, 2008*)

- Social support is a key determinant of
  - health (*Uchino, 2006*)
  - mortality (*Berkman & Syme, 1979*; *Holt-Lunstad et al., 2015*)
  - functional status (*Newsome & Schulz, 1996*)
  - likelihood of institutionalization (*Steinbach, 1992*)
  - quality of life (*Newsome & Schulz, 1996*)
  - stroke recovery (*Eslinger et al., 2002*; *Glass et al., 1993*; *Tsouna-Hadjis et al., 2000*)

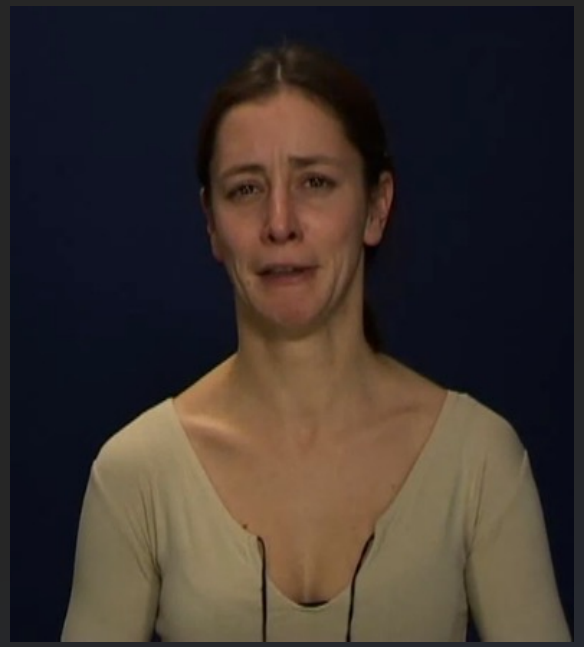


Emotion recognition impairment after stroke is associated with lower retention of social activities

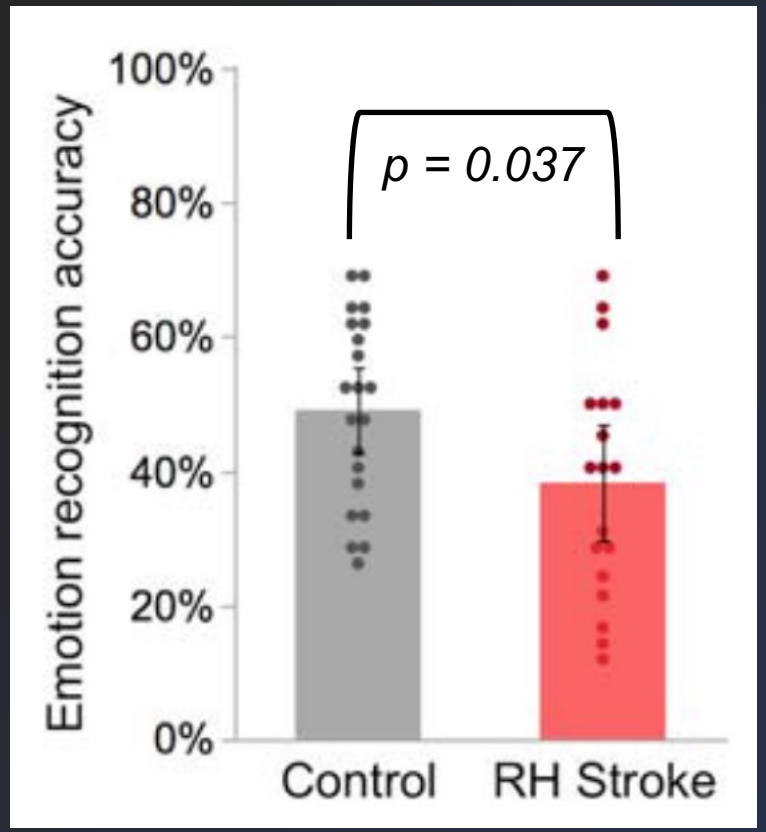


Katie O'Connell

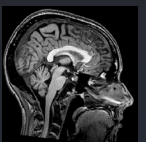
Multimodal emotion recognition test



Schlegel & Scherer (2016)



O'Connell et al. (2021)



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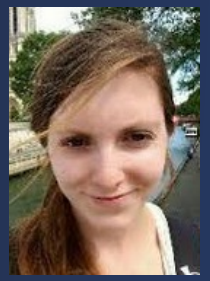
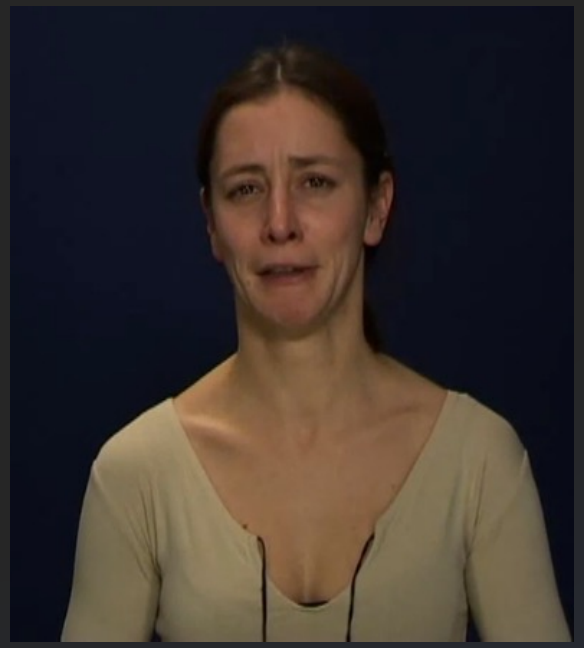


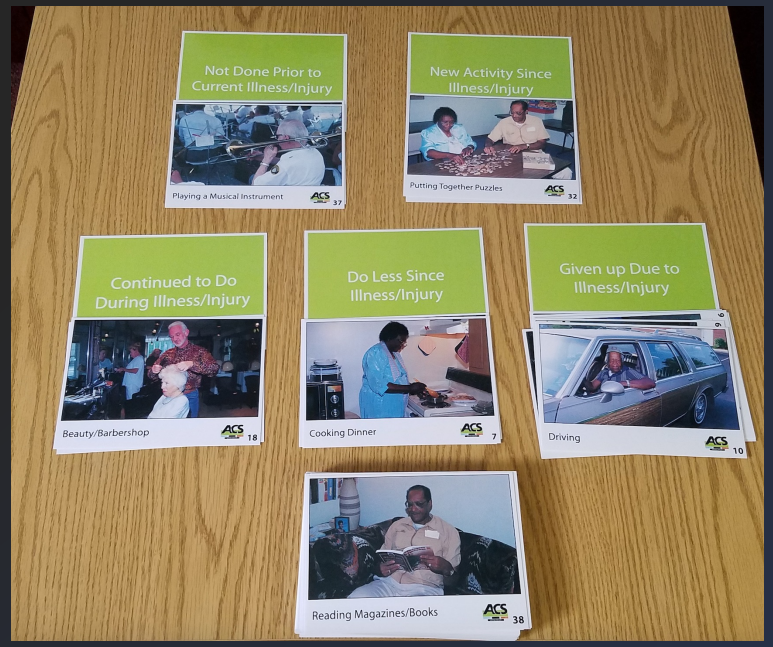
Katie O'Connell

Multimodal emotion recognition test

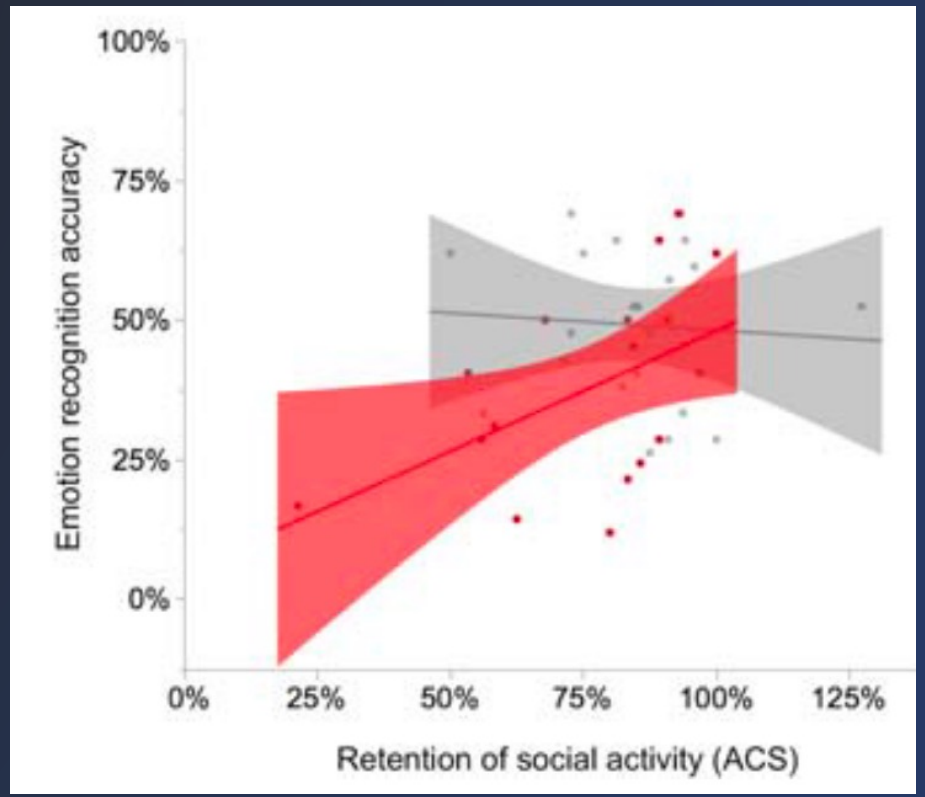


Schlegel & Scherer (2016)

Activity Card Sort Test



Baum & Edwards (2008)



O'Connell et al. (2021)

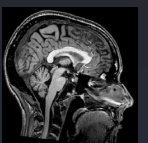
Interim summary III

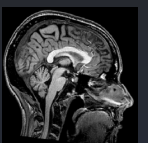
- In addition to hemispatial neglect and anosognosia, constructional apraxia, dressing apraxia, and impairments of emotion recognition and expression are also common after RH stroke

- There are plausible links (and demonstrated correlations) with long-term outcomes

→ These deficits have potential diagnostic power

→ Targeting them during rehabilitation might improve long-term outcomes for RH stroke survivors





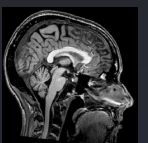
The role of the RH in communication - Prosody

TABLE 1: Sequelae reported by stroke survivors and their caregivers (in percent) who reported impairment as one of the "top 5" most important problems or moderate/important problems (n = 14 each group)*.

Note: testing on average 22.2 months after stroke

Domain**	Left hemisphere stroke survivor	Right hemisphere stroke survivor	Caregiver of left stroke survivor	Caregiver of right stroke survivor
Word retrieval	43	0	57	0
Reading	50	21	50	36
Writing/spelling	71	0	71	43
Memory	21	0	50	43
Energy (fatigue)	43	21	50	43
Mood	29	21	57	43
Walking	50	14	36	29
Right motor function	57	0	7	0
Left motor function	0	21	0	29
Prosody	0	0	0	29
Empathy	0	14	0	50
Spatial attention	0	0	0	29
Other cognitive	0	7	0	43
Personality/behavior	0	0	0	43
Sexual function	36	21	0	0

Hillis & Tippet (2014)



The role of the RH in communication - Prosody

J Neurol Transl Neurosci. 2014 Jan 1;2(1):1037.

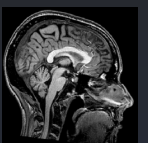
Right hemisphere dysfunction is better predicted by emotional prosody impairments as compared to neglect.

Dara C[1], Bang J[2], Gottesman RF[3], Hillis AE[4].

METHODS: We tested 28 right hemisphere stroke (RHS) patients and 24 hospitalized age and education matched controls with MRI, prosody testing and a hemispatial neglect battery.

RESULTS: ROC analyses revealed that the Prosody Score was more effective than the Neglect Battery Score in distinguishing stroke patients from controls, as measured by area under the curve (AUC); Prosody Score = 0.84; Neglect Battery Score =0. 57. The Prosody Score correctly classified 78.9%, while Neglect Score correctly classified 55.8% of participants as patients versus controls.

Note: testing within 48 hours of admission



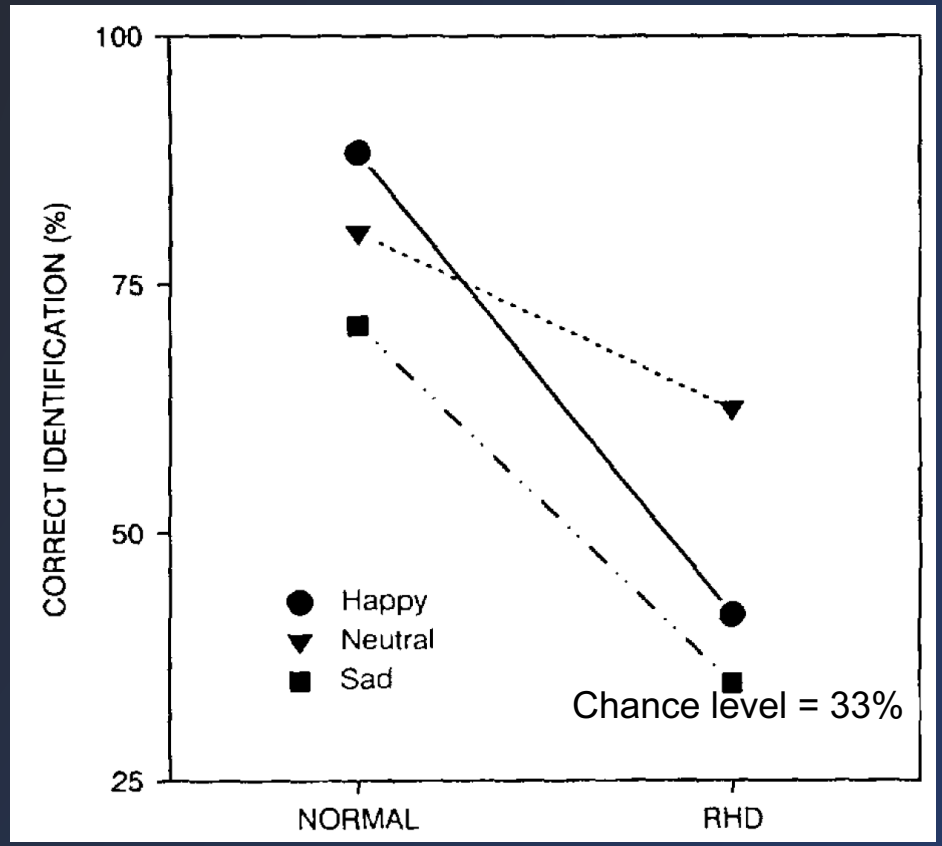
The role of the RH in communication - Prosody

Subjects were given paragraphs to read that provided context given which a content-neutral sentence (like “He will be here tomorrow”) was supposed to be read in happy, sad, or neutral tone.

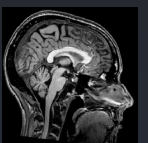
The sentences were then played to 4 listeners who tried to discern if the speaker was trying to sound happy, neutral, or sad.

Confusion matrix for RHD

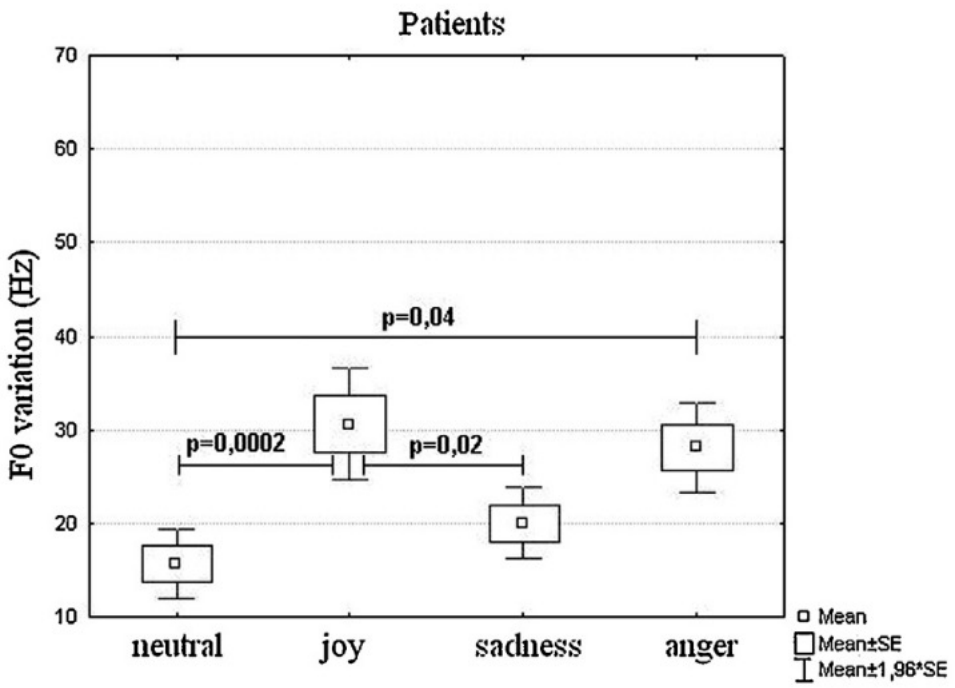
intended emotion	guessed emotion: Happy	Neutral	Sad	Total
Happy	315	373	68	756
Neutral	153	472	131	756
Sad	64	430	262	756
Total	532	1275	461	2268



Gandour et al. (1995)



The role of the RH in communication - Prosody



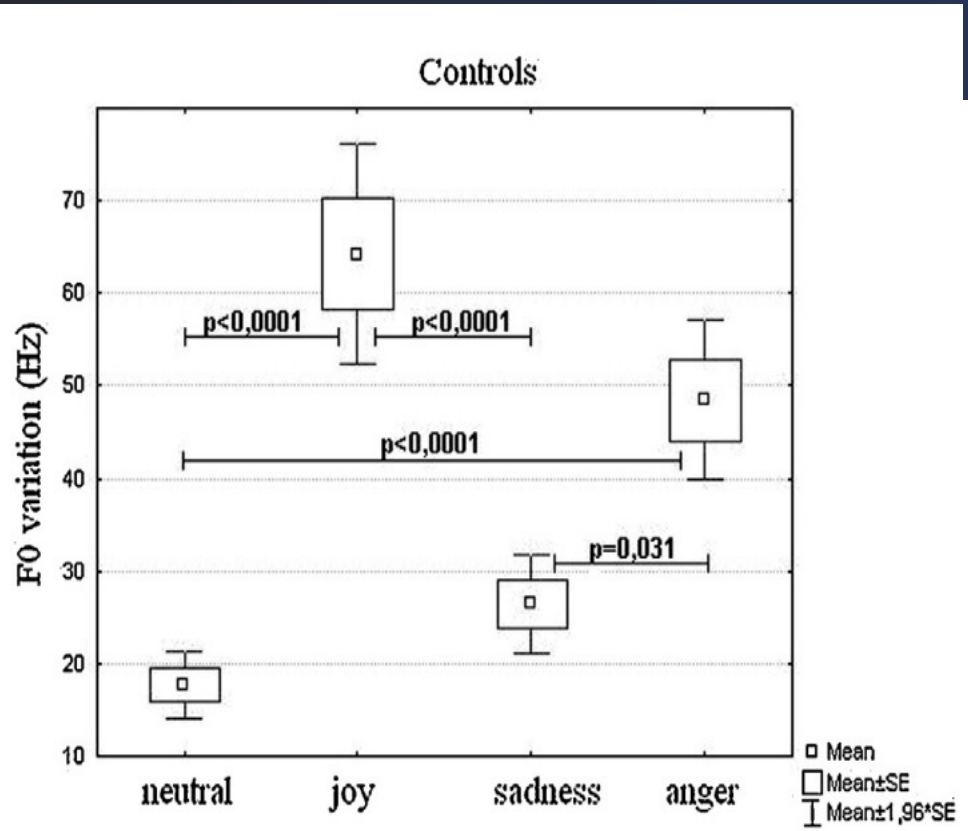
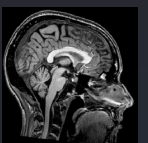


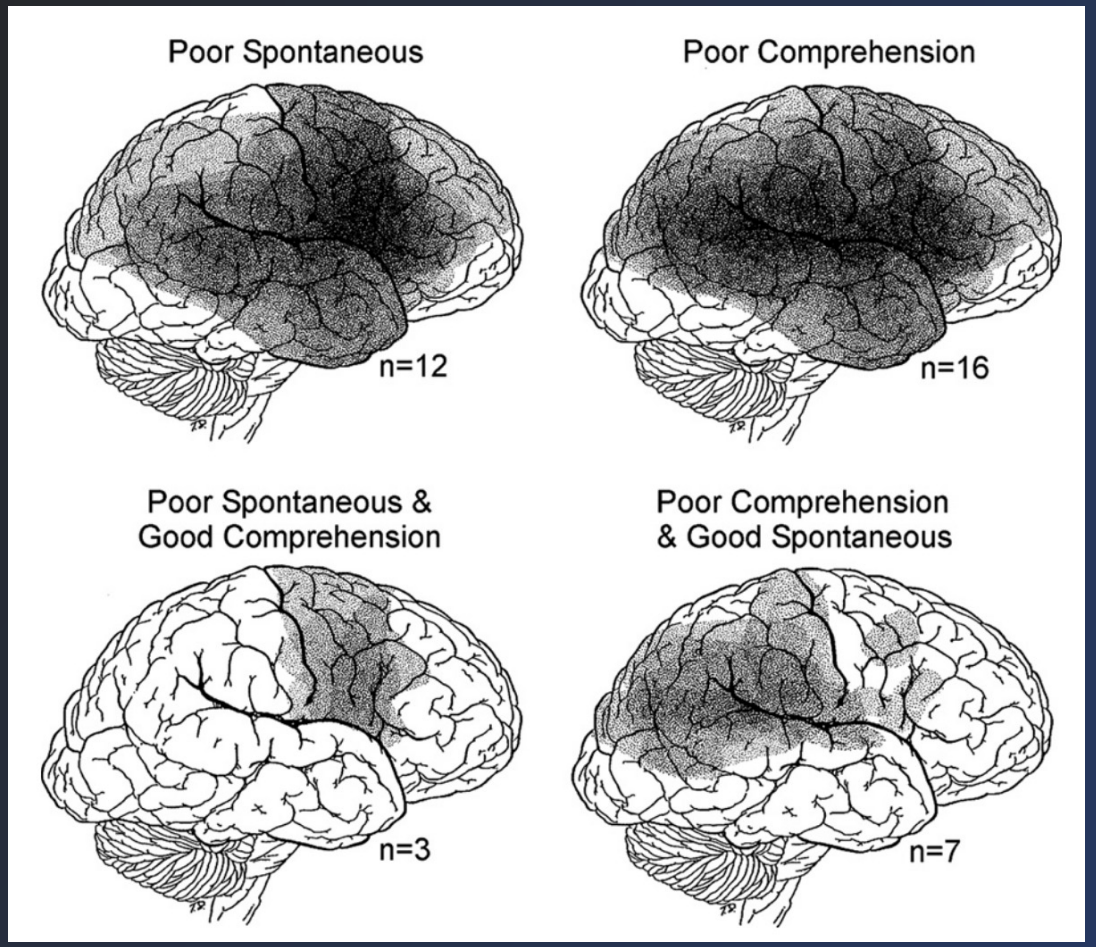
Fig. 1 – Fo variation in utterances with different emotional coloring: patients and control group.

Guranski & Podemski (2015)

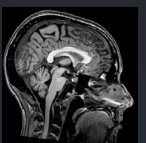


The role of the RH in communication - Prosody

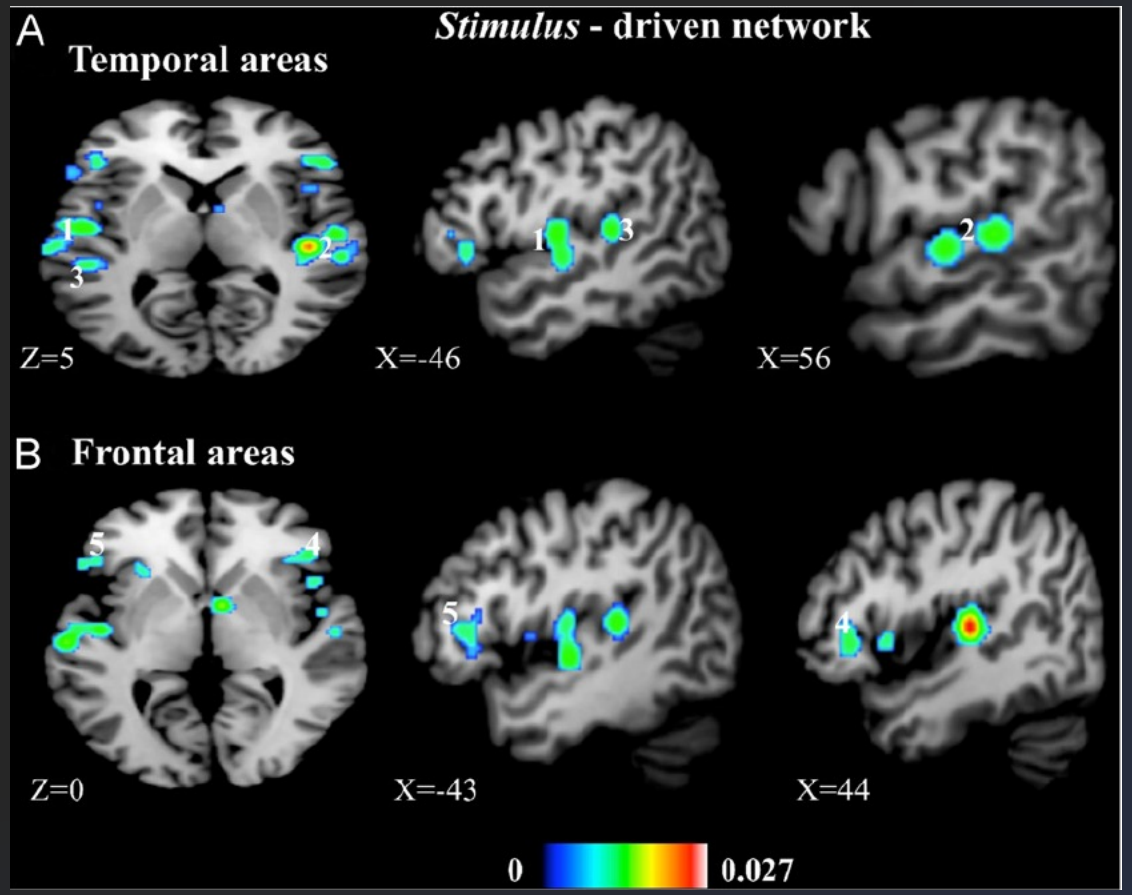
"aprosodic deficits following acute focal RBD have analogous functional-anatomic correlations to aphasic deficits following acute focal LBD"

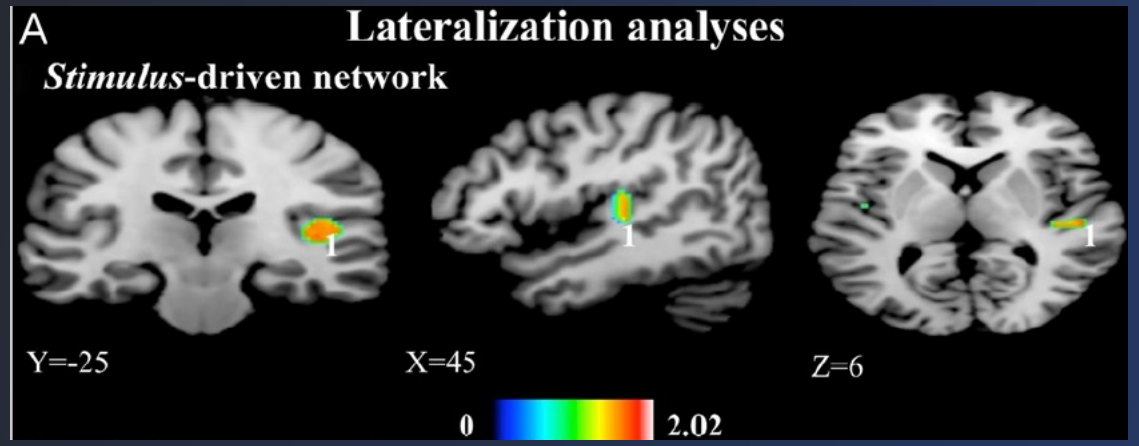


Ross & Monnot (2008)



The role of the RH in communication - Prosody

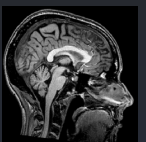




Stimulus-driven:
Studies contrasting listening to emotional and neutral prosody.

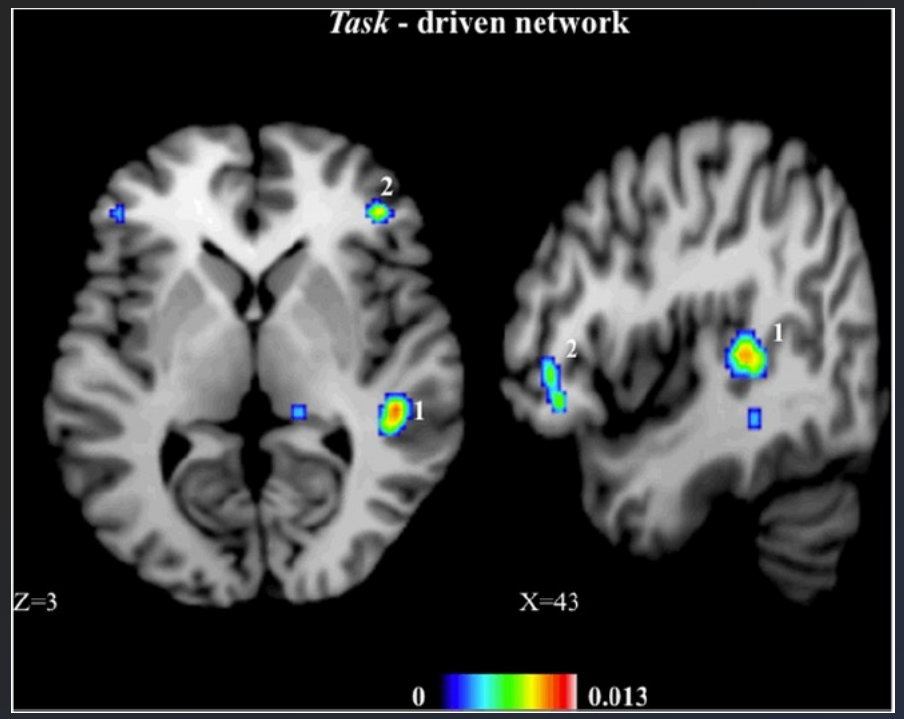
Lateralization:
Original – flipped ALE maps

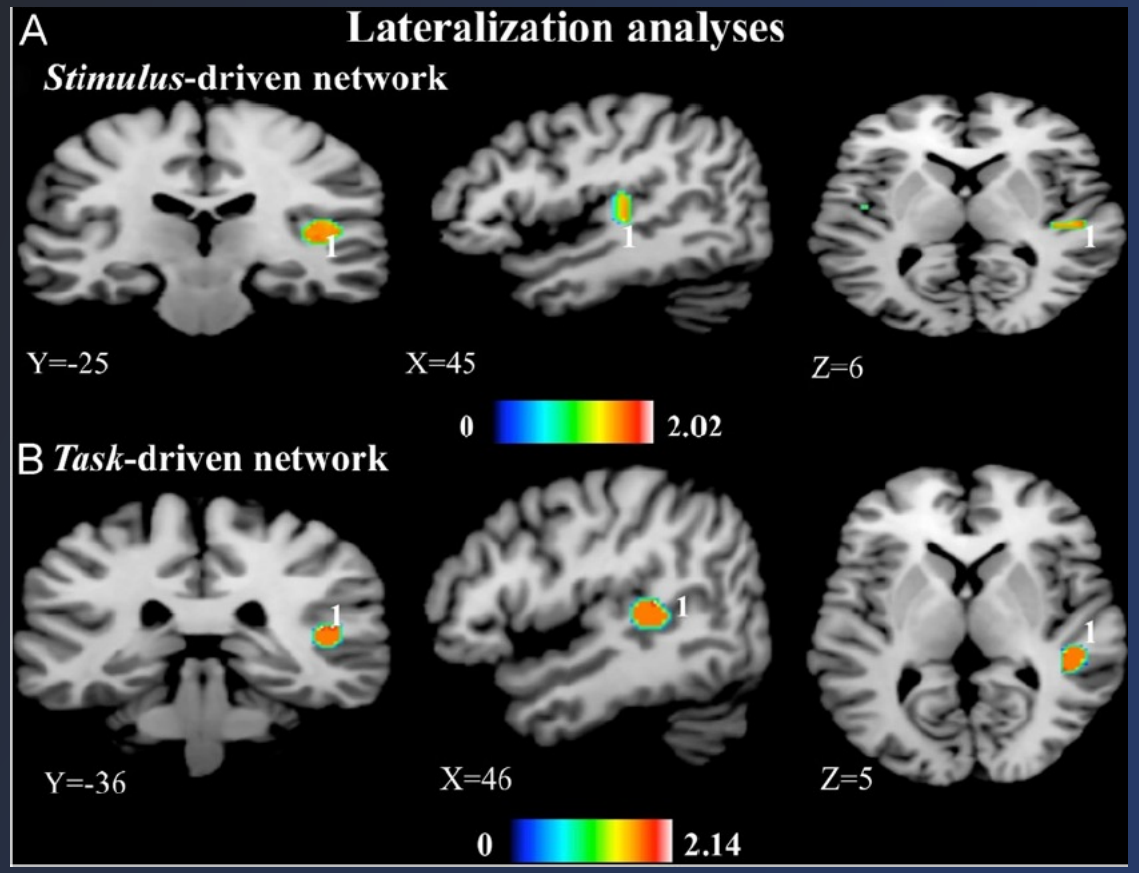
Witteman et al. (2012)



The role of the RH in communication - Prosody

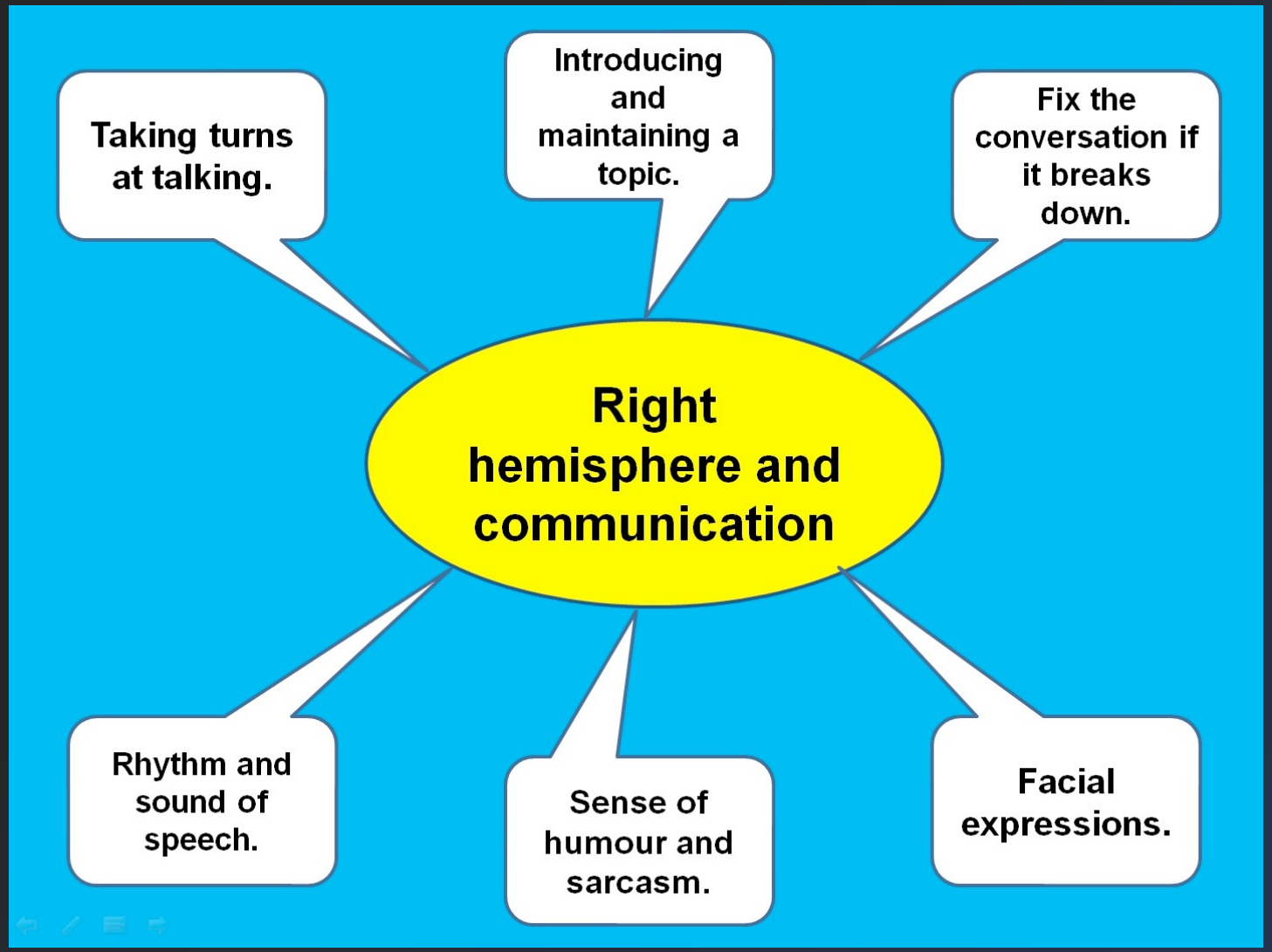
Task-driven:
Studies contrasting conditions in which participants perform an emotion task with a control condition in which they do not (but stimuli are held constant)





Witteman et al. (2012)

The role of the RH in communication - pragmatics

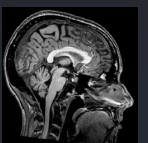


https://twitter.com/nhsfife/status/1200100791937359875/photo/1

The role of the RH in communication – pragmatics

Digressions	(highlights) "...probably cleaning up after a meal. I suppose the meal was an excellent one, very similar to those I am provided...
Related, but inaccurate content	(highlights) "She's fixing lunch... boy is putting dishes away... handing dishes up...he's tasting cookies"
Tangential content	(highlights) "Well, it's on 8½ x 11 inch paper overall covered by plastic. Looks like it may have been done in drawing pens and India ink on white paper. It's less than 20 lb. paper."
1) Unnecessary detail	(highlights) 1) "She has already dried one plate and two cups. So she evidently has two more plates to go..."
2) Digressions	2) "They have a garden in other words, so they probably have to do watering each morning, or maybe after sundown in the afternoon..."

Trupe & Hillis (1985)

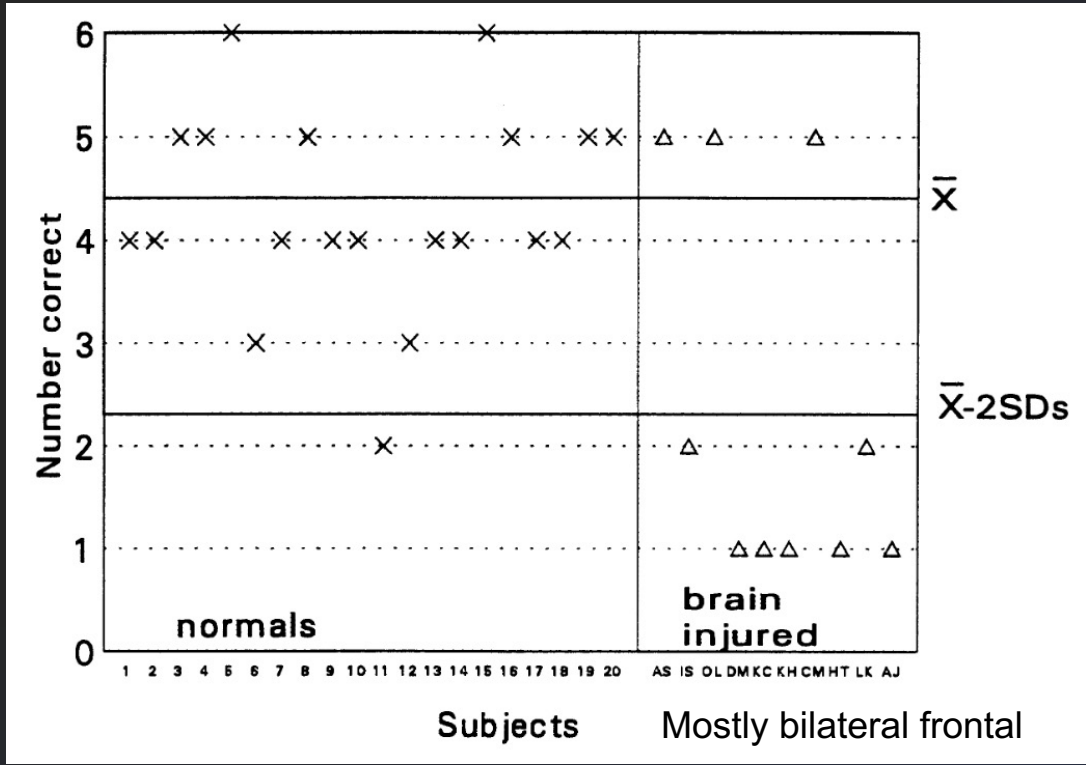


The role of the RH in communication – pragmatics

Mark: "What a great football game."

Wayne: "So you're glad I invited you." *Wayne: "Sorry I made you come."*

Did Mark think the game was good?
Is Wayne pleased that he asked Mark to the game?



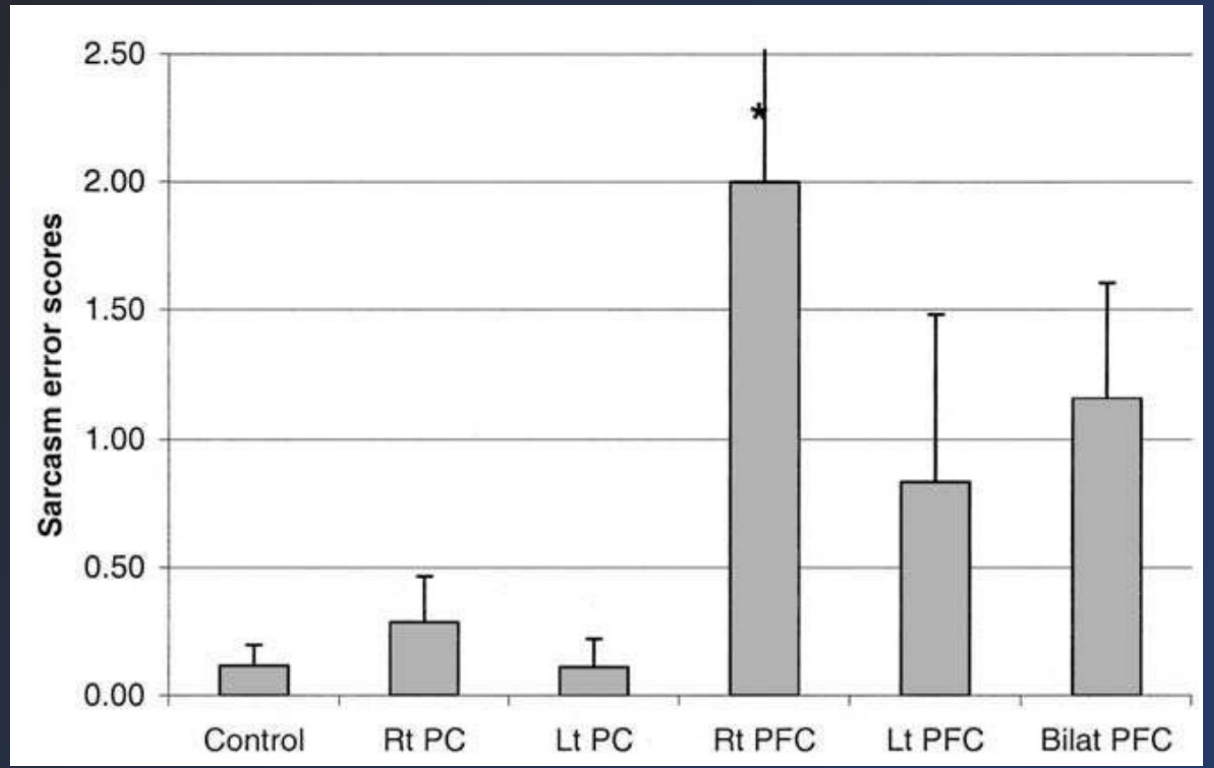
Mostly bilateral frontal

McDonald & Pearce (1996), see also Kaplan et al. (1990)

Joe came to work and immediately began to work. *Joe came to work, and instead of beginning to work, he sat down to rest.*

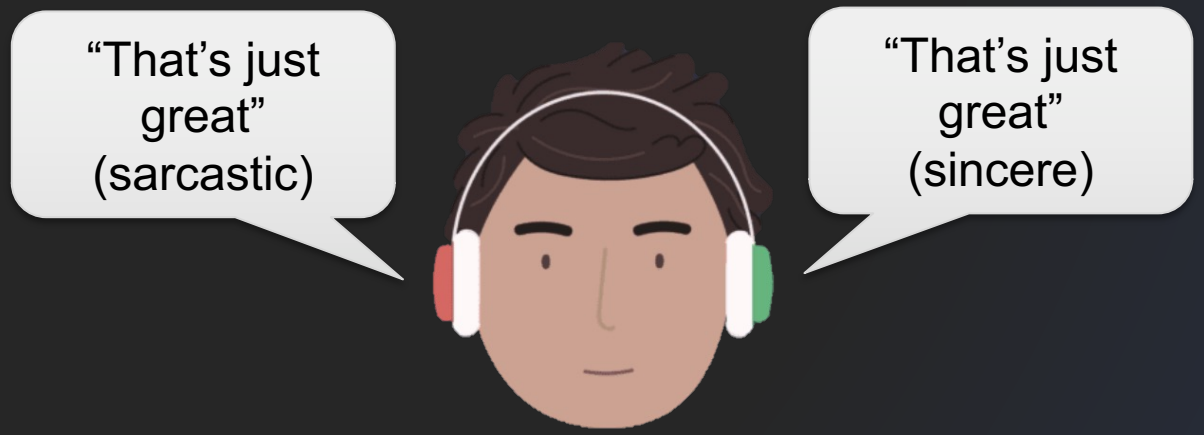
Joe's boss noticed his behavior and said, "Joe, don't work too hard!"

Did Joe work hard?
Did Joe's boss think Joe was working hard?



Shamay-Tsoory et al. (2005)

The role of the RH in communication – pragmatics

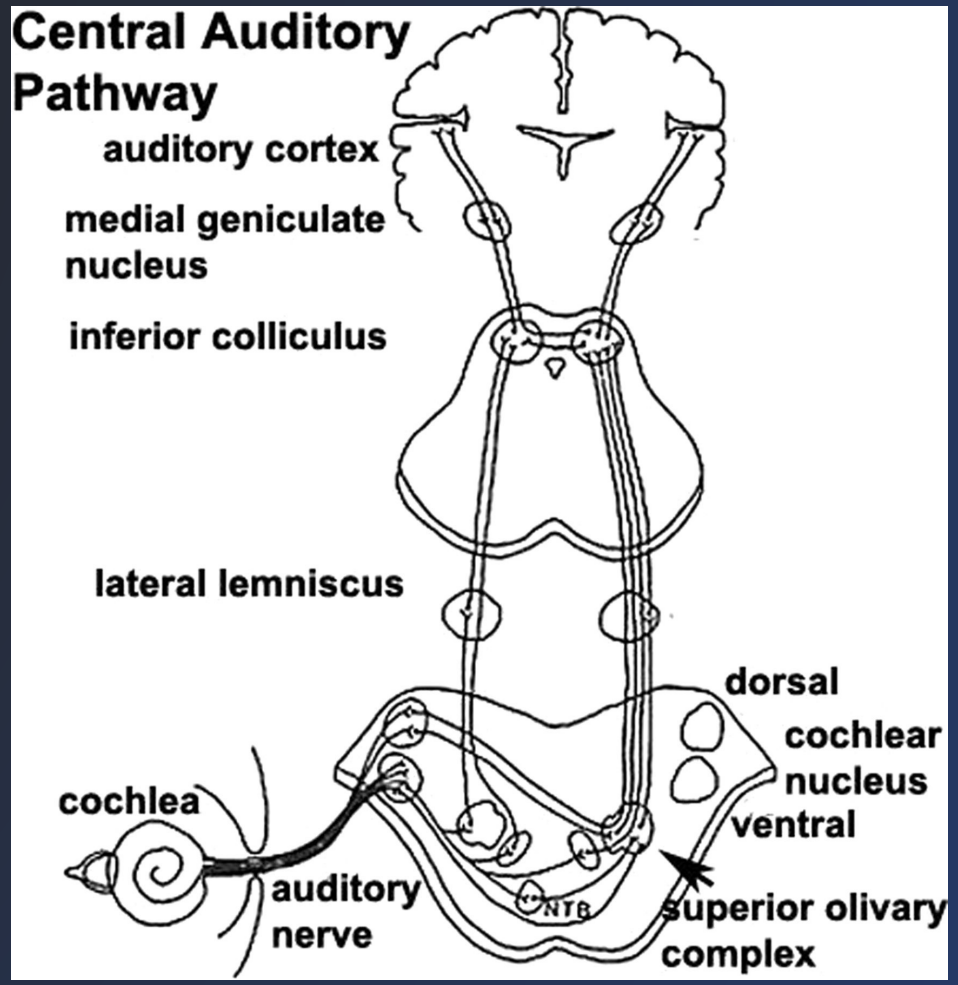


Task 1: Which ear was the sarcastic version in?
Task 2: Which ear was the sincere version in?

Mean Percentage of Correct Responses and SD *(in parentheses) for the Sarcastic and Sincere Tasks as a Function of Ear of Presentation*

Task	Left ear	Right ear	Cohen's *d*
Sarcastic	75.6 (13.3)	66.3 (11.9)	−0.87
Sincere	67.5 (15.3)	76.2 (14.3)	0.80

Voyer et al., (2008)



Cope et al., (2015)

The role of the RH in communication – pragmatics

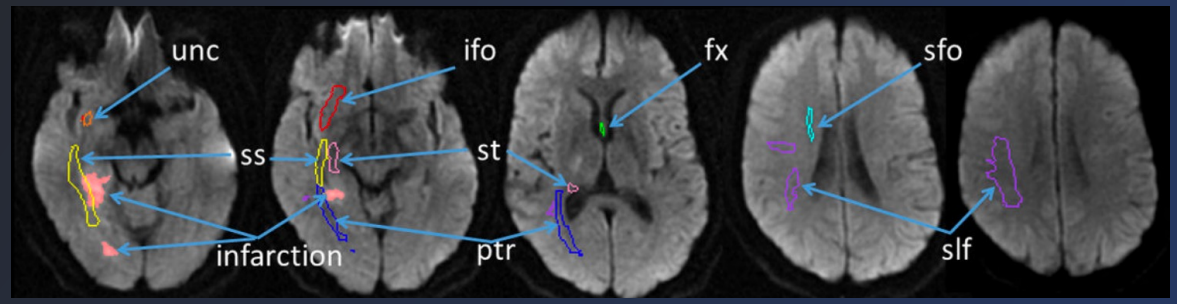
Does damage to the white matter tracts of the RH predict error rate on a sarcasm comprehension task?

Sarcasm (prosody) task:

"That looks like a safe boat"
(spoken in sincere or sarcastic tone)

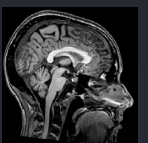
Task: Was that sincere or sarcastic?

Diffusion assessment in acute ischemic stroke
(RH white matter regions of interest):



Davis et al., (2016)

Lesions in the right sagittal stratum predict poor performance on the sarcasm task.



The role of the RH in communication – pragmatics

Jim cleaned the yard all day. He didn't take any breaks.
Mother said, "Jim, maybe you should eat something"

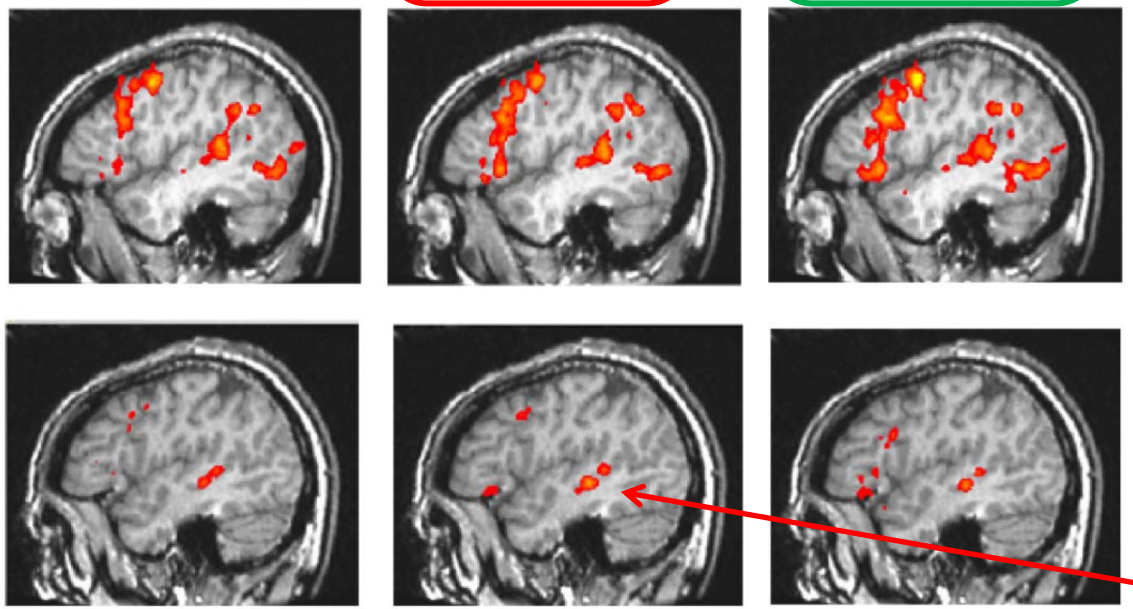
Literal

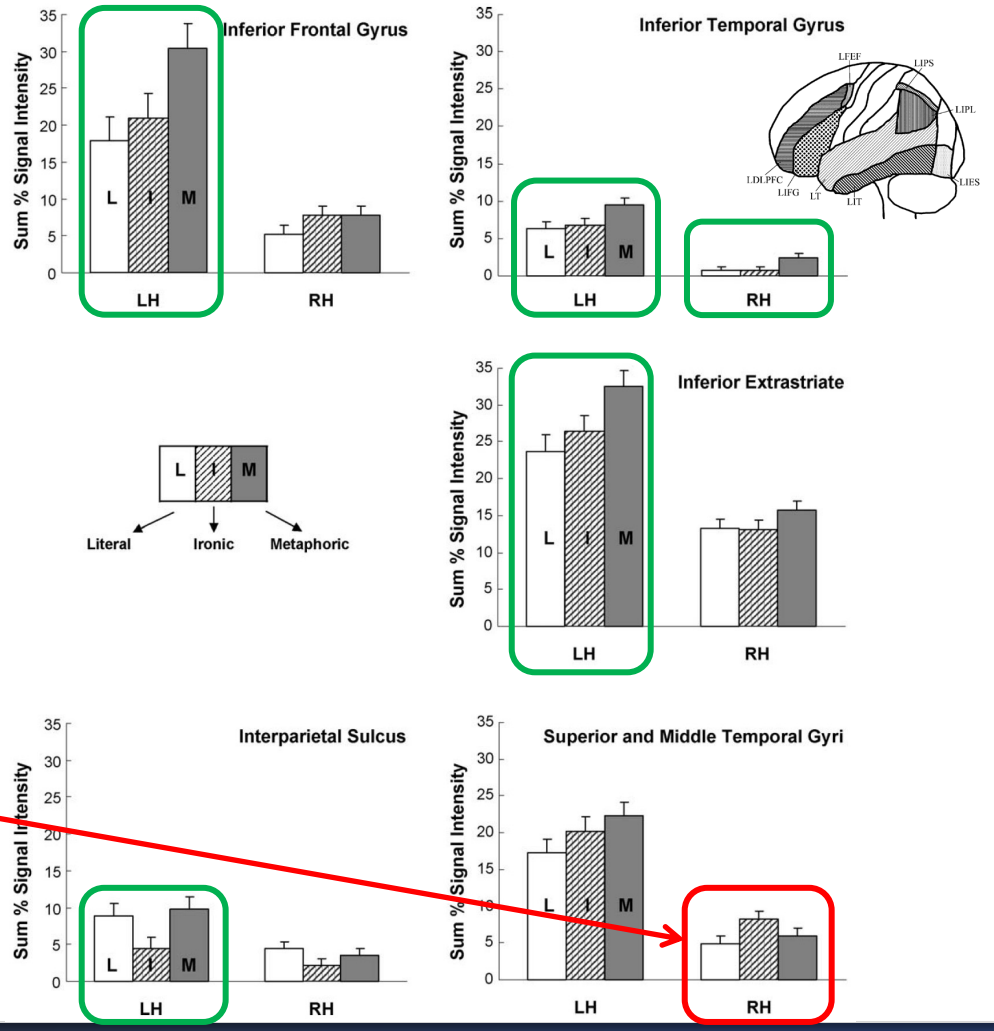
George went to Betty's party. Only two others came.
He said, "It's really crowded here"

Ironic

Laura was out sick for a week. Johnny called her every day.
Laura said, "You are a mother hen"

Metaphoric

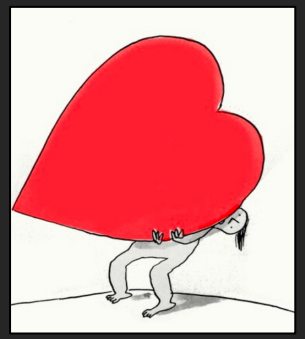




The role of the RH in communication – pragmatics

"A heavy heart can really make a difference"

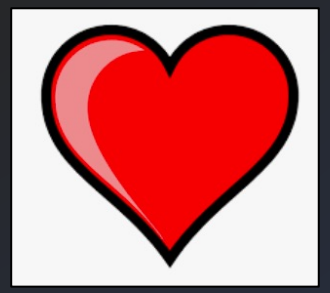
literal

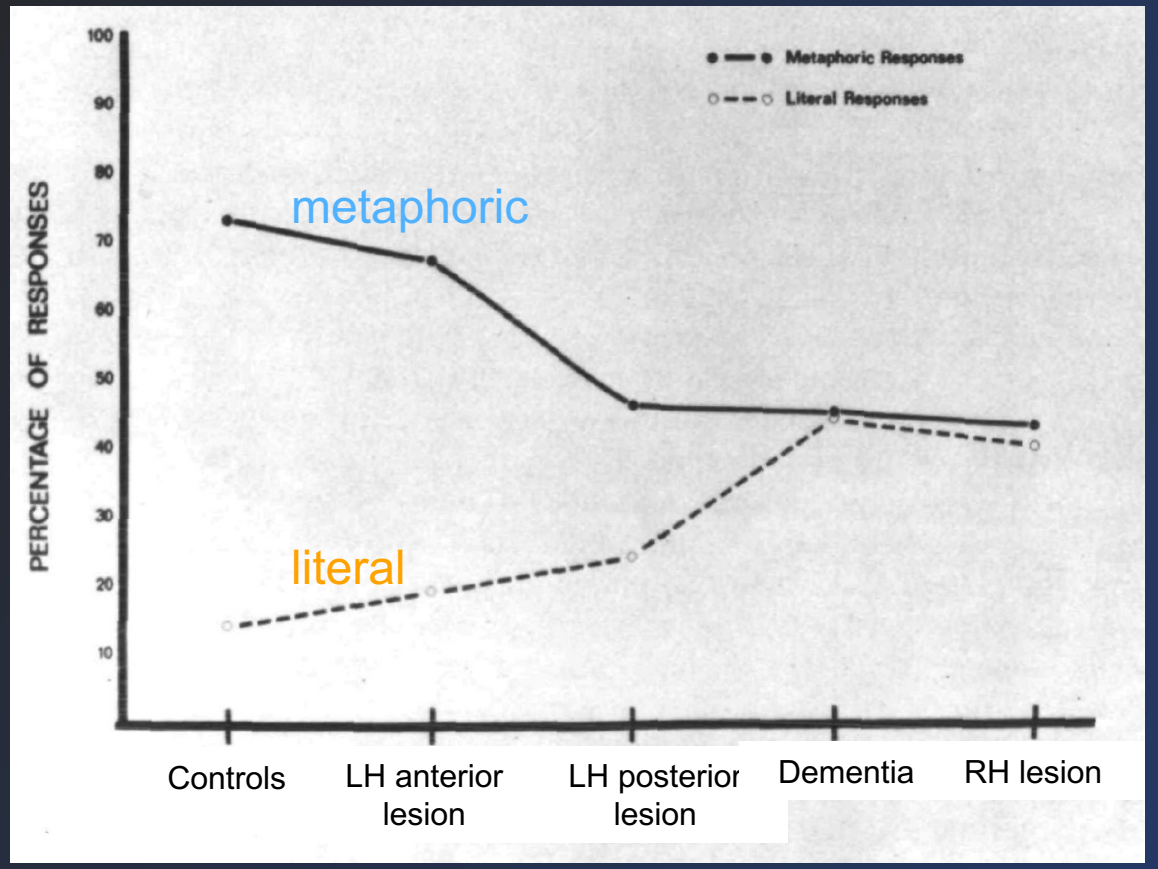


metaphoric

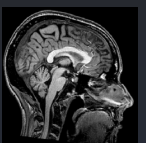
adjective

noun





Winner & Gardner (1977)



The role of the RH in communication – automatic speech

Densely aphasic patients can often flawlessly say their prayers, recite nursing rhymes and poems, or highly overlearned sequences (ABC, 123, Monday Tuesday Wednesday, January February March, etc. (Wernicke, 1874; Hughlings-Jackson, 1878))

Neurology. 1993 Sep;43(9):1768-74.

Disruption of automatic speech following a right basal ganglia lesion.

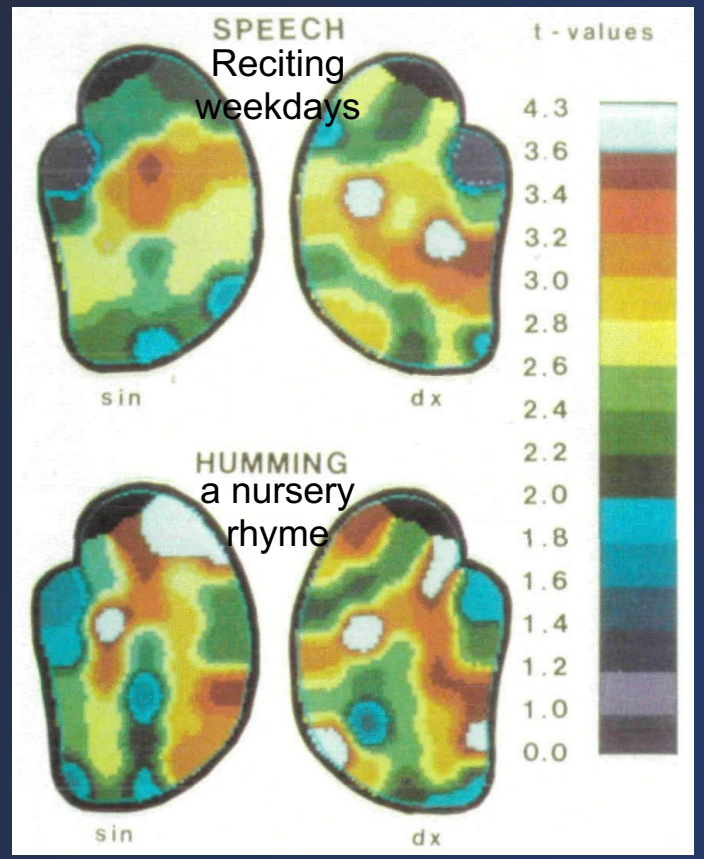
Speedie LJ[1], Wertman E, Ta'ir J, Heilman KM.

Author information

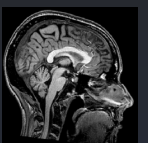
Abstract

Following a right basal ganglia lesion, a right-handed man, age 75, was unable to recite familiar verses. Serial automatic speech, singing, recitation of rhymes, and swearing were impaired, and only idioms and social greetings were preserved. Speech no longer contained overused phrases and he could comprehend automatic speech. In contrast, propositional speech was preserved in both French and Hebrew. Right basal ganglia lesions may impair production but not comprehension of automatic speech.

rCBF increase from Rest



Ryding at al.(1987)

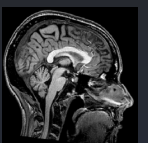


Interim summary IV

- The RH is heavily involved in
  - Prosody (comprehension and production)
  - Pragmatics
  - Automatic speech

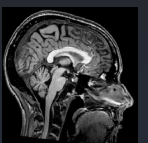
→ RH lesions can result in communication issues despite fluent language

  - Apparent lack of empathy / emotional responsivity (can be misinterpreted as depression)
  - Digressions / ineffective communication
  - Misunderstandings due to literal interpretations of language
  - Disruption of automatic speech



Final Summary

- RH injury is underdiagnosed and undertreated
- While the associated impairments are less obvious, their impact on functional outcomes is as significant as that of impairments following LH injury
- Areas to pay particular attention to in diagnosis and treatment of RH stroke are
  - Neglect (not just left-sided, not just visual, not just spatial)
  - Anosognosia
  - Constructional apraxia and other “non-neglect” visuospatial impairments
  - Emotion recognition impairment
  - RH communication disorders

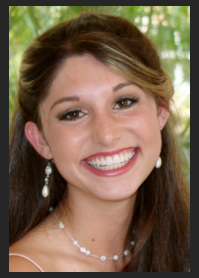


Thank you!

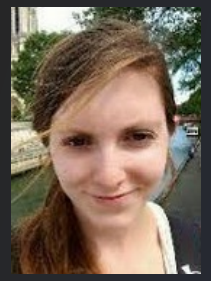

Sunju Ahmadu


Juby Mathews


Ashley Carroll


Hannah Brown


Catherine Chambers


Katie O'Connell


Abigail Marsh


Alex Dromerick


Peter Turkeltaub


Dorothy Edwards


Elissa Newport


Jason Umans

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- Music for the Mind Young Investigator Award
- R01 DC016902 to Elissa Newport and William Davis Gaillard
- Center for Brain Plasticity and Recovery (Georgetown University and MedStar National Rehabilitation Hospital)

Our research participants and their families

We're recruiting!
If you know a person with RH stroke who is looking for a research study, please have them reach out to us!

as2266@georgetown.edu