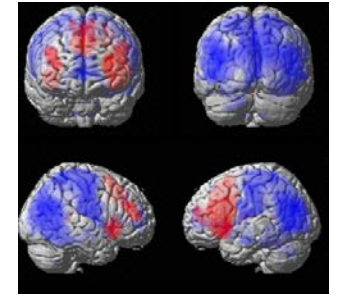




D. Y. Patil PG Lecture Series
13 September 2019
Sion Hospital and Lokmanya Tilak Medical College, Mumbai



'Thought, Language and Communication (Speech): Concepts, Clinical Assessment & Neurobiology'

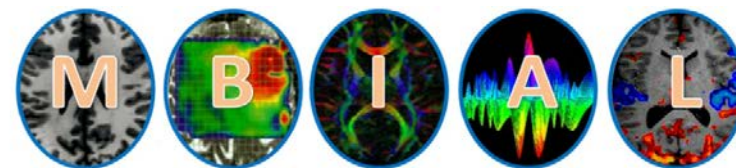
John P. John, M.D.

Professor of Psychiatry

Multimodal Brain Image Analysis Laboratory (MBIAL);

ADBS Neuroimaging Centre (ANC); Centre for Brain Mapping (CBM)

National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore



MULTIMODAL BRAIN IMAGE ANALYSIS LABORATORY

Why should we study these phenomena??

“We need to make a serious investment in training a new generation of real experts in the science and art of psychopathology. Otherwise, we high-tech scientists may wake up in 10 years and discover that we face a silent spring. Applying technology without the companionship of wise clinicians with specific expertise in psychopathology will be a lonely, sterile, and perhaps fruitless enterprise”

--“DSM and the Death of Phenomenology in America: An Example of Unintended Consequences.” Nancy C. Andreasen, Schizophrenia Bulletin, 2007

Thinking/Thought: Definitions

- **Thinking:**

- the systematic transformation of mental representations of knowledge to characterize actual or possible states of the world, often in service of goals

--Oxford Handbook of Thinking and Reasoning (2012)

- allows humans to make sense of, interpret, represent or model the world they experience, and to make predictions about that world

--Wikipedia

- **Thought:** an "aim-oriented flow of ideas and associations that can lead to a reality-oriented conclusion" **(Maric, 2005)**

Types of thinking (Fish, 1967)



1. Undirected fantasy thinking/ Dereistic/ Autistic thinking

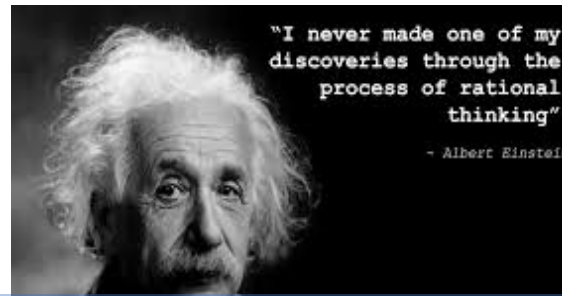
<https://depositphotos.com/110377314/stock-photo-fantasy-teacher-looking-up-as.html>



2. Imaginative thinking

alamy stock photo

<https://www.alamy.com/stock-photo/imaginative-thinking.html>



3. Rational/Conceptual thinking

<https://www.thenewsgeeks.com/rational-thinker-will-relate/>

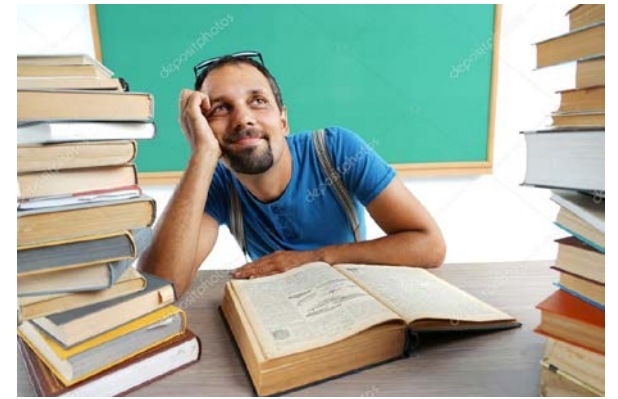
Fantasy thinking

HEALTHY

- Typically, of short duration, in healthy
 - e.g., the daydream before going to sleep
- **Fantasy**: the creation of images or ideas that may have no external reality OR denial of external events
- **Important functions**:
 - Modeling, rehearsing and evaluation

PATHOLOGY

- To escape from or deny reality
- To convert reality into something more tolerable and less requiring of corrective action
- Used by shy, reserved people to compensate for disappointments in life
- Characteristic autistic thinking of schizophrenia (Bleuler, 1911)



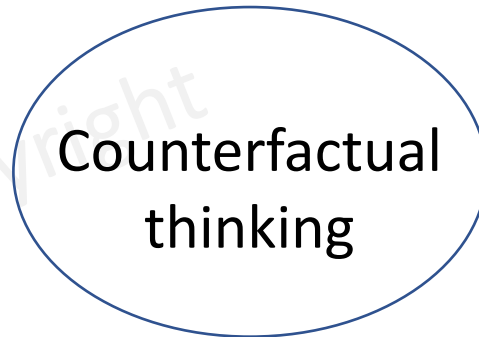
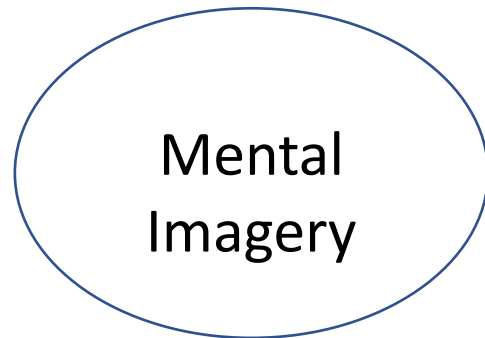
Imaginative thinking

Imagination:

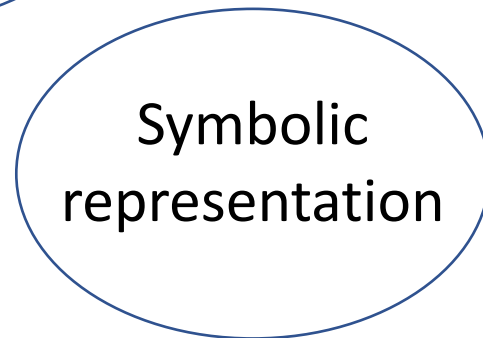
the generation of novel ideas and the creative outputs that constitute art or discoveries in science.



ability to create image-based mental representations of the world



the capacity to disengage from reality in order to think of events and experiences that have not occurred



The basis of language, art and mathematics

the use of concepts or images to represent real world objects or entities

Roth, 2004

Rational/ conceptual thinking

Conceptual thinking:
the capacity to form concepts

Rational thinking

Abstraction:
the ability to
theorize about the world;
categorization of
objects or events
in the world

The cognitive process that
we use to make inferences
from knowledge and to draw
conclusions

Reasoning

Problem solving

The set of cognitive processes
that we apply to reach a goal
when we must overcome
obstacles to reach that goal

Analogic
reasoning

Application of solutions to
already known problems to
new problems with similar
characteristics

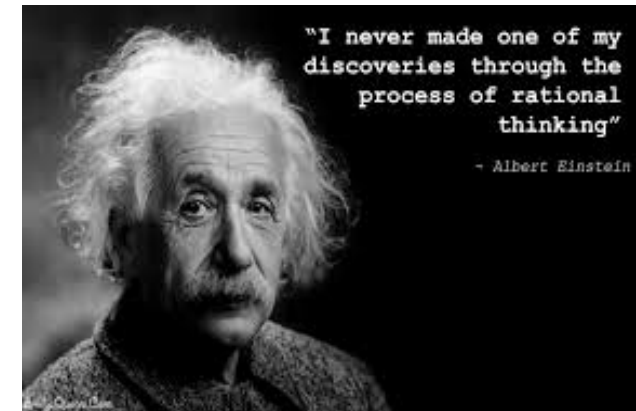
Inductive
reasoning

Use of specific known instances
to draw an inference about
unknown instances

Deductive
reasoning

Involves an argument in which if
the premises are true, the
conclusion cannot be false

Use of
heuristics/rules
of thumb



Characteristics of healthy thinking

The characteristic persistence of a completed thought, whether or not it is simple or complicated in its content

Constancy

Healthy thinking

Organization

Continuity

The contents of thought are related to each other in consciousness and do not blend with each other, but are separated in an organized way

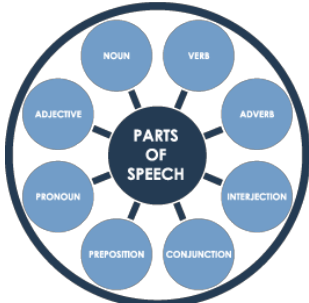
Even the most heterogeneous subsidiary thoughts, sudden ideas or observations which emerge are arranged in order in the whole content of consciousness

Carl Schneider, 1944

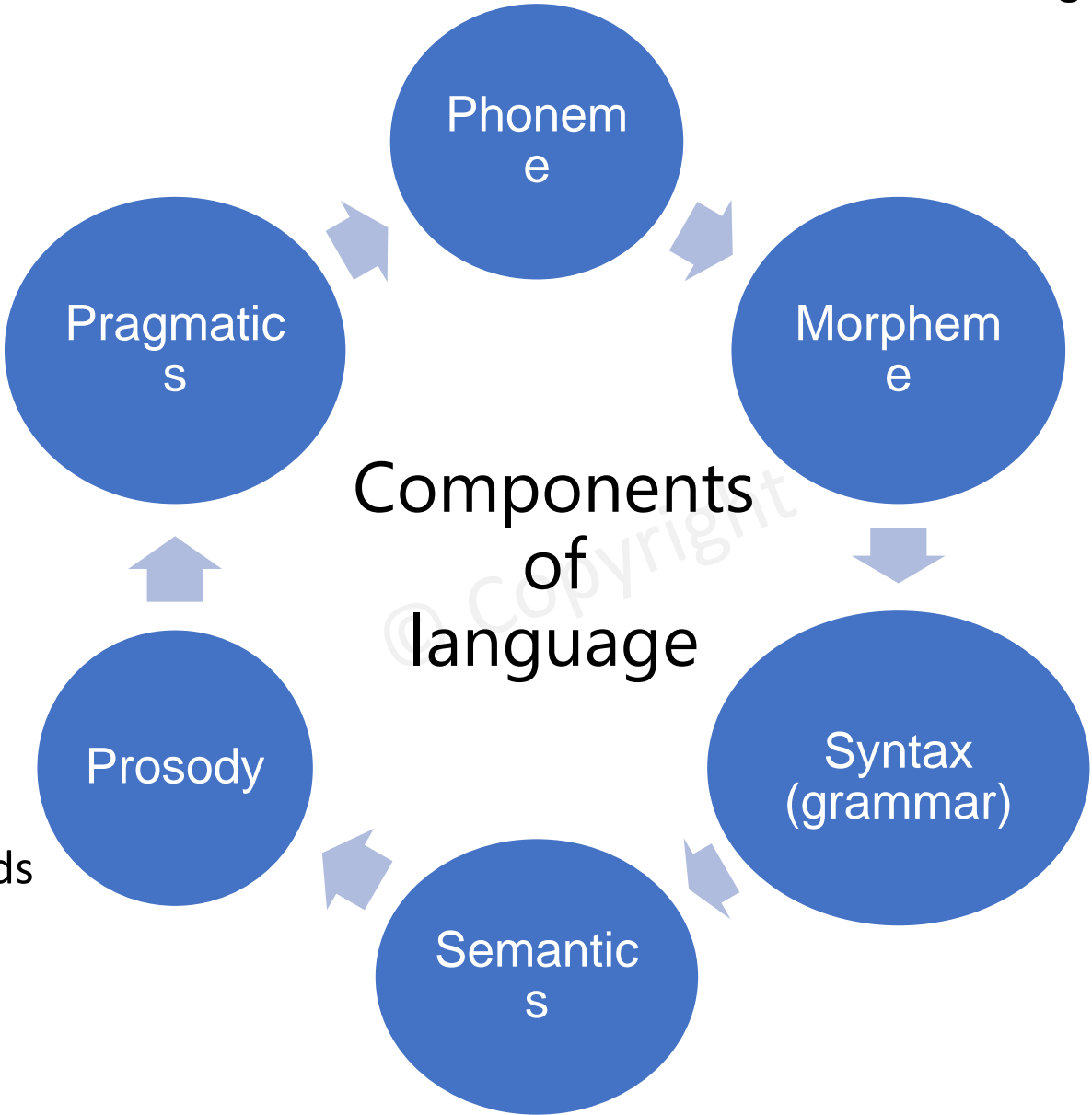
Language

The communication of information
through symbols
arranged according to systematic rules

The most basic sounds that are available for use in language



© 2016 Clever Prototypes, LLC



The ways that language is used in practice; the multiple potential meanings of any utterance

Produced from phonemes; the smallest meaningful unit of a word; combinations of morphemes make up words

the modulation of vocal intonation that influences accents; the literal and emotional meanings of words and sentences

The allowable combination of words in phrases and sentences; includes the rules that determine word order

The meanings that correspond to the words and all possible sentences



Chomsky's theory of language (1986)

- Language is like an instinct; 'every sentence that a person utters or understands is a brand new combination of words, appearing for the first time in the history of the universe.'
- Therefore; the brain must contain a recipe or programme that can build an unlimited set of sentences out of a finite list of words.
 - The programme may be called a 'mental grammar' (Pinker, 1994).
- Children rapidly develop these complex grammars without formal instruction.
 - This suggests that they must be innately endowed with a plan common to the grammars of all languages, a universal grammar

Steven Pinker



People do not think in English or Chinese or Apache; they think in a language of thought. This language of thought probably looks a bit like all these languages. But compared with any given language, mentalese must be richer in some ways and simpler in others.

— *Steven Pinker* —

AZ QUOTES

Thought—Language: Pinker (1994)'s hypothesis

- This language of thought probably looks a bit like all these languages; presumably it has symbols for concepts, and arrangements of symbols that correspond to who did what to whom'

Communicatio

n

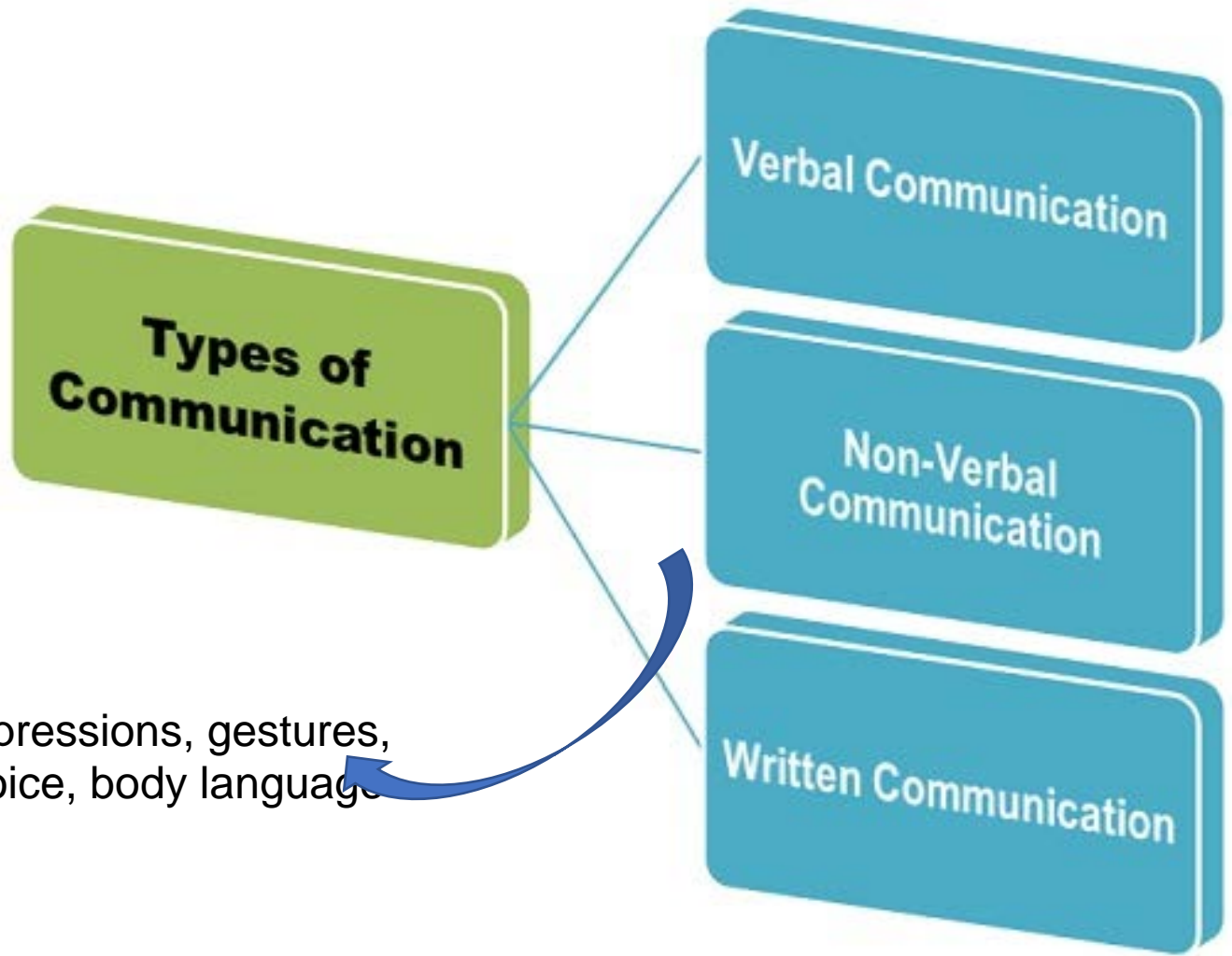
Types of Communication

Verbal Communication

Non-Verbal Communication

Written Communication

Facial expressions, gestures,
tone of voice, body language



Speech

Phonology

The system of speech sounds used to contrast the words of a particular language, i.e. the system or pattern of sounds used in a language.

Articulation

The motor skills for speech and thus how the articulators of the tongue, teeth, palate and lips are employed to produce sounds, words and sentences.

Prosody

Prosody is the stress, intonation and voice quality used in spoken communication and involves the rise and fall of the pitch of the voice and the rhythm of words. Alterations in prosody can alter the meaning of an utterance, and the emotions conveyed.

Thought—Language—Speech: Maher(1972)'s model

“Conceptualizing the relationship between language and thought. The model might be likened to a typist copying from a script before her. Her copy may appear to be distorted because the script is distorted although the communication channel of the typist’s eye and hand are functioning correctly. Alternatively, the original script may be perfect, but the typist may be unskilled, making typing errors in the copy and thus distorting it. Finally, it is possible for an inefficient typist to add errors to an already incoherent script. Unfortunately, the psychopathologist can observe only the copy (language utterances): he cannot examine the script (the thought). In general most theorists concerned with schizophrenic language have accepted the first of the three alternatives, namely that a good typist is transcribing a deviant script. The patient is correctly reporting a set of disordered thoughts. As Critchley put it: ‘Any considerable aberration of thought or personality will be mirrored in the various levels of articulate speech – phonetic, phonemic, semantic, syntactic and pragmatic’. The language is a mirror of the thought.”

Recent linguistic theories used for the analysis of speech in patients with schizophrenia contradict the primacy of thinking

Thought—language—Communication (speech)

Thought

- An "aim-oriented flow of ideas and associations that can lead to a reality-oriented conclusion"
- Abnormalities of thinking are common in psychiatry, but rare in neurology

Language

- The communication of information through symbols arranged according to systematic rules
- Abnormalities of language are common in psychiatry and neurology

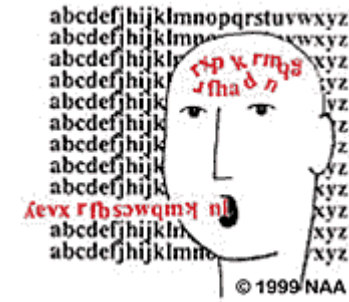
Speech

- The aspect of language that corresponds to the mechanical and articulatory functions that allow language to be vocalized
- Abnormalities of speech are common in neurology, but rare in psychiatry

❖ Language and speech cannot be considered in isolation from thinking

Assessment of Language in Neuropsychiatry

Testing language functions in Neuropsychiatry



- Spontaneous speech
- Comprehension
- Repetition
- Naming
- Reading
 - Aloud
 - Comprehension
- Writing
- Word list generation
- Speech prosody
- Miscellaneous
 - Automatic speech
 - Completion phenomenon
 - Singing

Testing language functions in Neuropsychiatry

• Spontaneous speech

- Non-fluent aphasia
 - Left frontal lobe
- Fluent aphasia
 - left posterior temporal, inferior parietal or temporo-parieto-occipital junction
- Dysprosody
 - Right-sided frontal lesion, sub-cortical dysfunction in extrapyramidal disturbances
- Use of words and phrases
 - Misuse of stock words or phrases
 - Neologisms
 - Grammar and syntax

• Comprehension

- One, two and three-step commands
 - “Point to the door, the window and the chair”
- Series of easy to difficult questions
 - Easy: “Is your name Ramesh?”
 - Difficult: “Do you put your shoes on before your socks?”
- Comprehension of more sophisticated linguistic structures
 - Sentences with passive constructions: If a lion and a tiger are in a fight and lion is killed by the tiger, which animal is dead?”

Testing language functions in Neuropsychiatry

- **Repetition**

- Graded series of phrases and sentences of increasing complexity
 - “He is here”;
 - “The quick brown fox jumped over the lazy dog”
 - “No ifs ands or buts”

- **Repetition errors**

- Aphasia:
 - Omission of words;
 - alteration of word sequence;
 - paraphasic intrusions, when trying to reproduce the test sentence

Testing language functions in Neuropsychiatry

• Naming

- Anomia in spontaneous speech
 - Word-finding pauses, emptiness and circumlocution
- Confrontation naming
 - High frequency
 - (“wrist-watch”); low frequency (“strap; dial”)
 - Names in several linguistic categories
 - (colours; body parts; room objects)

• Naming errors

- Literal (phonemic) paraphasias
 - Phonemic substitutions
 - “*greel*” for “green”
- Verbal (semantic) paraphasias
 - “*blue*” for “green”
- Neologisms
 - Completely new constructions
- Failure to make any response
- Circumlocutions
 - Descriptions of the object or its use

Testing language functions in Neuropsychiatry

• Reading

- Letter, word and sentence reading
 - Ability to read aloud
 - Reading comprehension
- Both anterior and posterior left-sided lesions

• Writing

- Neutral topic
- All aphasics will make errors in their written as well as their oral productions
- The characteristics of the written language resemble those of the spoken output

Testing language functions in Neuropsychiatry

- **Word list generation (Verbal fluency)**

- Name as many animals as possible in 1 minute
 - Normal: 18 ± 6
- FAS: 1minute for each letter
 - Normal: 15 ± 5 words per letter; or mean total of 45 for the test
- Poor performance: all aphasics
- Also, prefrontal lesions, basal ganglia disorders, patients with psychomotor retardation

- **Prosody**

- Melodic, rhythmic and inflectional elements of speech
- Aprosody: monotonic, amelodic and affectless
- Spontaneous prosody
 - Listening to verbal output during the course of conversation
 - Right frontal lesions; extrapyramidal disturbances
- Prosodic comprehension
 - 4 prosodic styles: surprised, happy, angry, sad
 - Right temporo-parietal lesions

Testing language functions in Neuropsychiatry

- **Linguistic probes in special circumstances**
 - Testing remnants of intact language function in profoundly aphasic patients
- Automatic speech
 - Counting; reciting the alphabet; naming days of the week; months of the year
- Attempting to complete overlearned sequences
 - Filling the last line of nursery rhymes; prayers
- Reproducing tune of a familiar song

Types of Aphasia

Fluent?

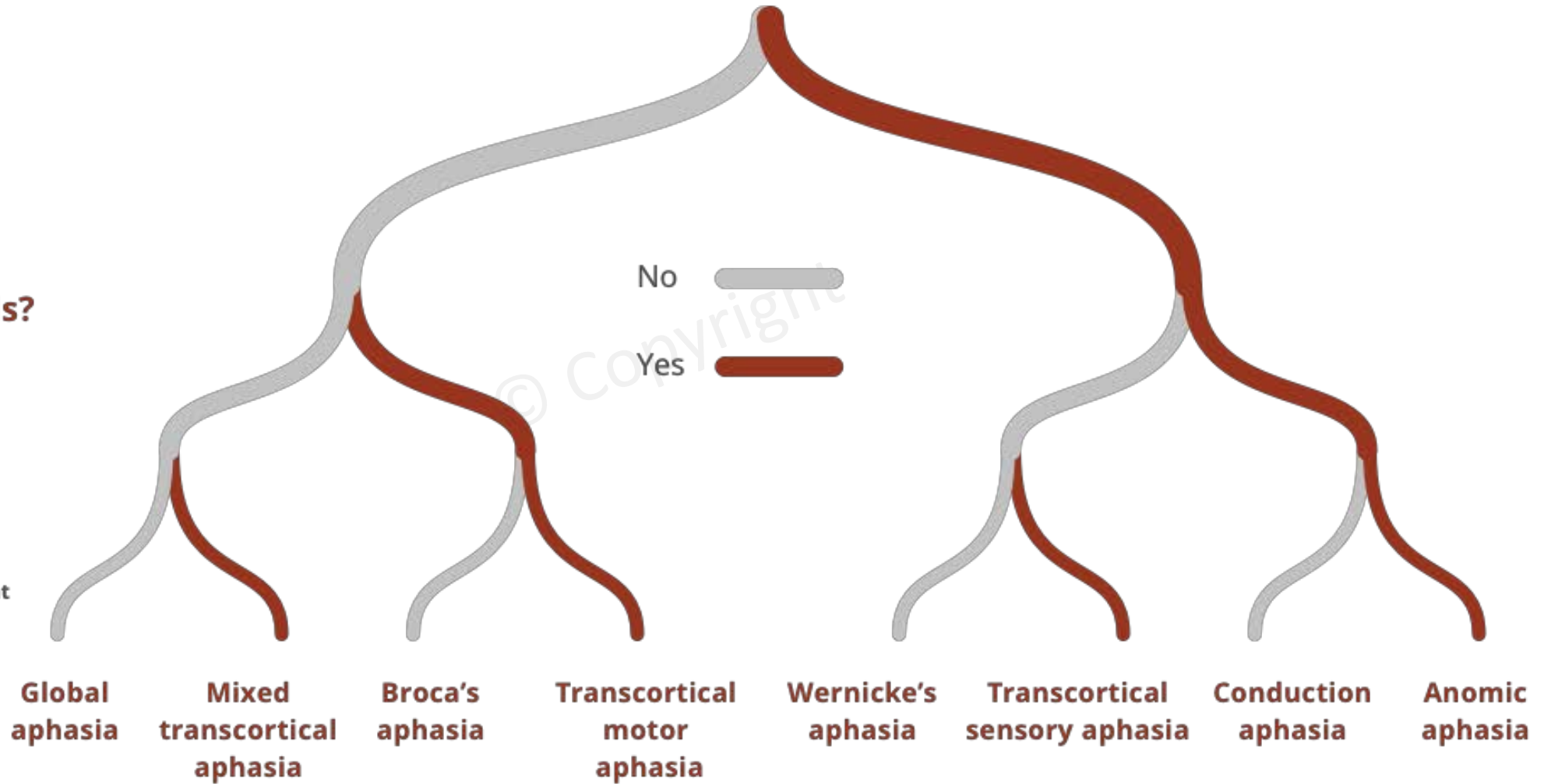
Is speech fluent?

Comprehends?

Can you comprehend of spoken messages?

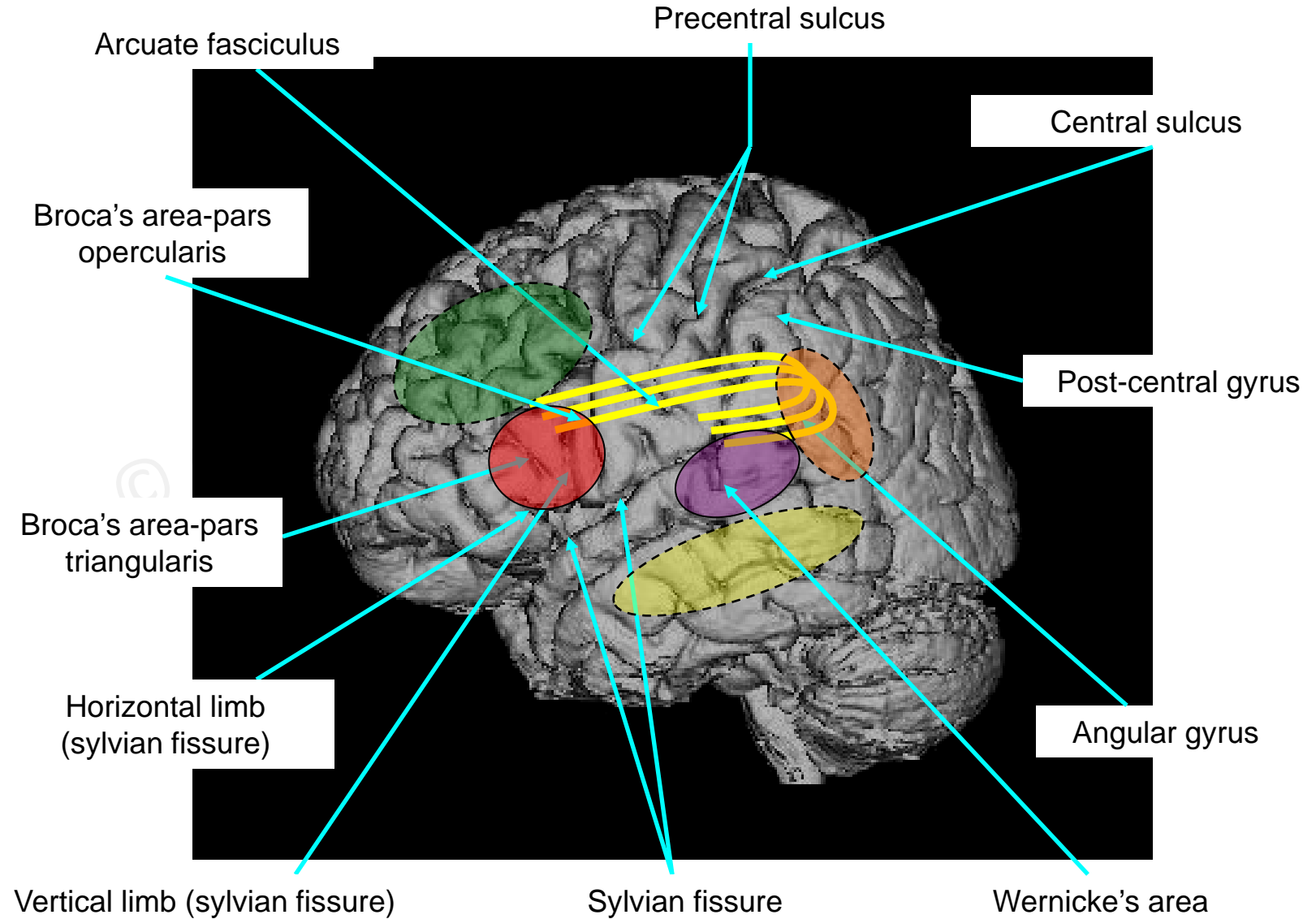
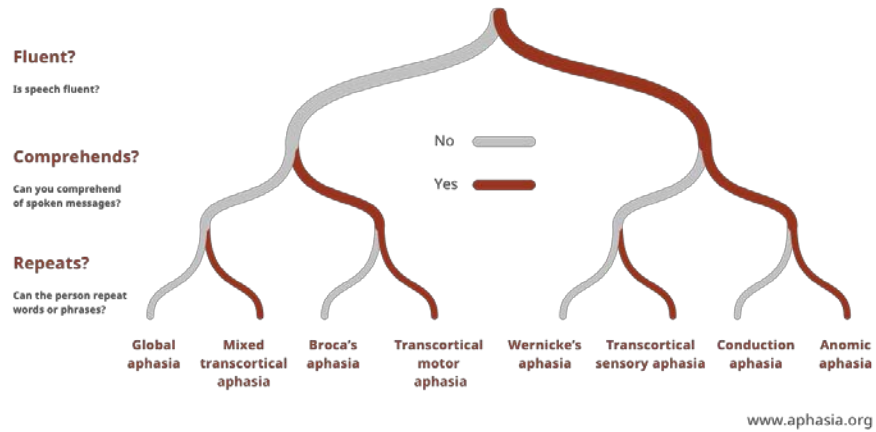
Repeats?

Can the person repeat words or phrases?

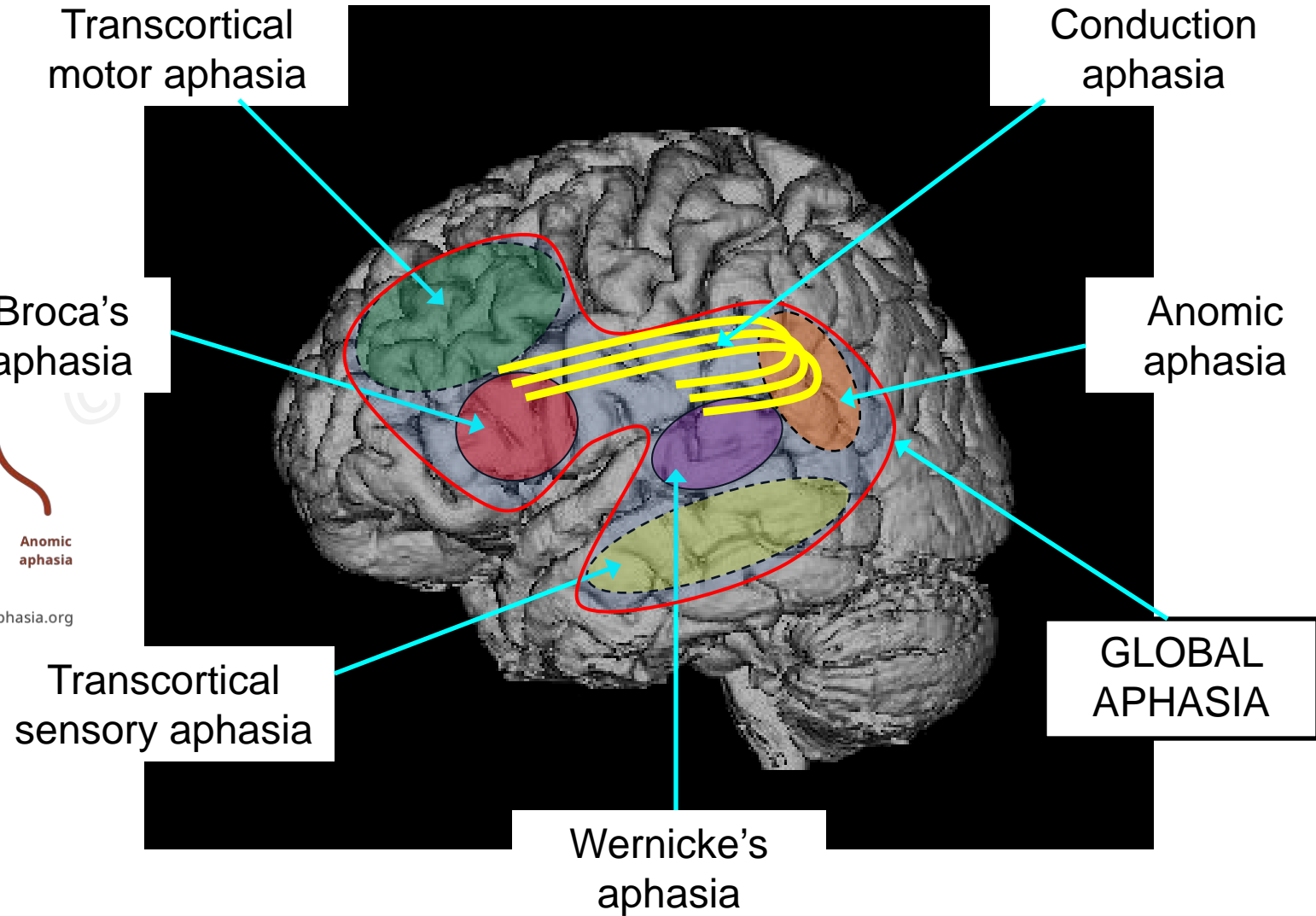
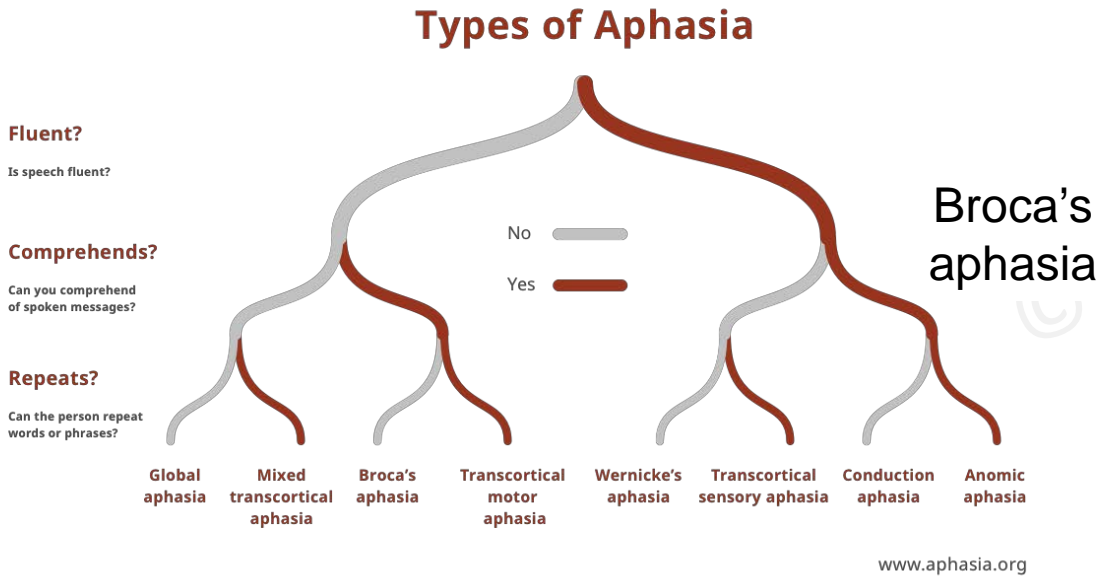


Anatomy of aphasia

Types of Aphasia



Aphasias: Wernicke-Lichtheim-Geschwind Model



Assessment of form of thought in Psychiatry

Clinical Assessment of Form of Thought

- Amount of speech
 - Pressured speech
 - Poverty of thought
- Association between trains of thought
 - Loosening
 - Chance associations
 - The number of associations
- Determining tendency
 - Goal-directedness of thought
- Amount of thought content
 - Poverty of content of thought
 - Embellished speech
- Figure-ground differentiation
 - Circumstantiality
- Relevance of response
 - Tangentiality
- Logicality
 - Illogical thinking

Specific FTD scales

- Thought, Language and Communication (TLC) Disorders scale: Andreasen, 1985
- Thought and Language Index (TLI): Liddle et al., 2002
- Thought Disorder Index (TDI): Andreasen, 2007
- Thought and Language Disorder (TALD) scale: Kircher et al., 2014

Formal thought disorders

Formal thought disorders—facts and figures

- Occurs in
 - general population (Rossler, et al., 2013)
 - Relatives of patients with schizophrenia (Morgan et al., 2017)
 - People at high risk of developing psychosis (Demjaha et al., 2012; Katsura et al., 2014) and
 - Patients with non-affective psychoses; affective psychoses and non-psychotic disorders (Nagels et al., 2016)
- Prevalence
 - Schizophrenia: 50-80%
 - Schizoaffective disorders: 60%
 - Depression: 53%
 - Healthy controls: 6%

Cavelti et al., Schizophrenia Research, 2018

Types of formal thought disorders

- **Quantitative and Qualitative**

- Quantitative: e.g., speed of speech; poverty of content of speech
- Qualitative: e.g., neologisms, semantic and phonemic paraphasia

- **Objective and Subjective**

- Objective: e.g., observer-rated circumstantiality, illogicality
- Subjective: e.g., self-reported inhibited thinking, pressure of thought

- **Positive and Negative**

- Positive: e.g., derailment, tangentiality
- Negative: e.g., poverty of thought, thought blocking

Cavelti et al., Schizophrenia Research, 2018; Kircher et al., 2014; Strik et al., 2010

Formal thought disorders—HISTORY

- 1835: Pritchard
 - Incoherence
- 1838: Esquirol
 - First to refer to primary pathology of the faculty in charge of coordinating ideas
- 1910: Emil Kraeplin
 - Akataphasia
- 1911: Eugen Bleuler
 - Loosening of associations; absence of central deterministic tendency
- 1914: Kleist
 - Stock words or phrases
- 1930: Carl Schneider
 - ❖ 3 components of normal thinking:
 - ✓ Constancy
 - ✓ Organization and
 - ✓ Continuity
 - ❖ Disorders of thinking in schizophrenia corresponding to the 3 features of normal thinking:
 1. A peculiar transitoriness of thinking: Transitory thinking
 2. The lack of normal organization of thought: Drivelling thinking
 3. Impairment in continuity of thought: Desultory thinking

Formal thought disorders—HISTORY

- 1944: Norman Cameron

- Asyndesis: lack of connections between successive thoughts in patients with psychiatric disorders
- Types of FTD:
 - Overinclusiveness: when the patient cannot maintain the boundaries of a concept, including in its attributes from other concepts
 - Metonyms: use of imprecise expressions in which a term or a phrase is used instead of more accurate ones;
 - Interpenetration of themes: similar to Carl Schneider's fusion concept
 - Thought fragmentation: similar to Carl Schneider's derailment concept

- 1967: Frank Fish

- Presented a psychopathological classification by bringing together the classical descriptions of psychiatric symptoms (*Clinical Psychopathology: Signs and Symptoms in Psychiatry*)
- Described and organized FTD into Negative and Positive FTD
- After Fish's death, the text was revised and updated by Max Hamilton in 1974 and 1985

- 1974: Max Hamilton

- Apophany and alogy

Formal thought disorders—HISTORY

- 1979; 1985: Nancy C. Andreasen

- sub-divided classic FTD into Thought, language and communication (TLC) disorders and suggested that FTD be renamed as disorders of TLC:

- Thought disturbances: when thinking alone seems affected
 - e.g., poverty of thought, illogicality, aberrant inferential processes
- Language disturbances: when the speaker violates the semantic and syntactic conventions
 - e.g., incoherence, clang association (e.g., neologisms, use of word approximations

- Communication disturbances: when the speaker does not meet the necessary requirements for the listener's understanding

- Poverty of content of speech, pressure of speech, distractible speech, tangentiality, derailment, stilted speech, echolalia, self-reference, circumstantiality, loss of goal, perseveration, blocking

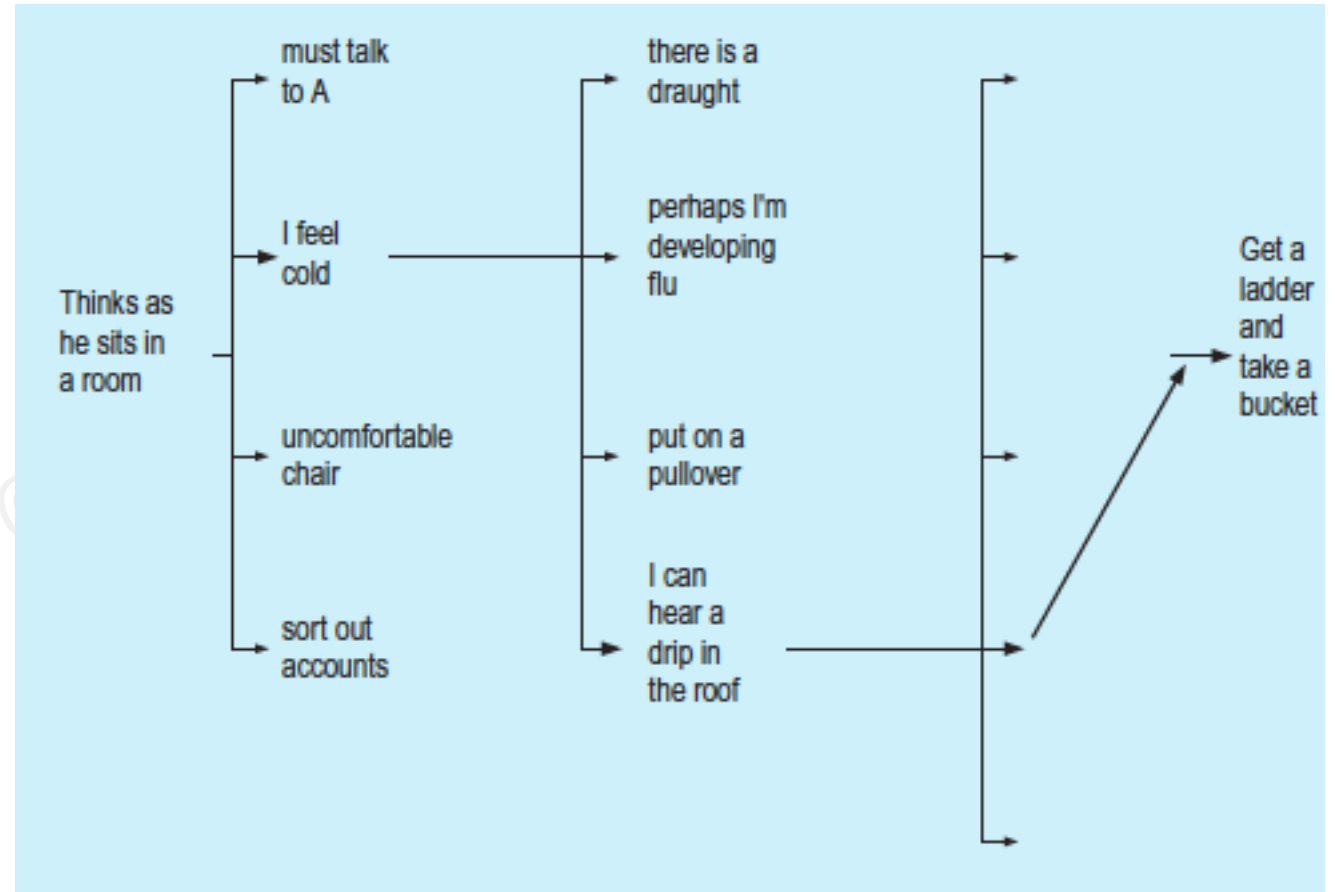
- Good reliability; not specific to schizophrenia; also common in other mental disorders such as mania

- 1988: Sims

- Symptoms in the Mind: An Introduction to Descriptive Psychopathology

Jaspers: Associations and determining tendency

- The sequence of thoughts, with the associations linking them, forms the framework of this model
- The mass of possible associations resulting from a psychic event is called a **constellation**
- The consistent flow of thinking towards its goal is called the **determining tendency**
- One thought results in the formation of a number of other concepts, one of which is given prominence by operation of the determining tendency



Carl Schneider's description

Components of normal thinking

1. Constancy
2. Organization and
3. Continuity

Corresponding disorders of thinking in schizophrenia

1. A peculiar transitoriness of thinking: Transitory thinking
2. The lack of normal organization of thought: Drivelling thinking
3. Impairment in continuity of thought: Desultory thinking

Disorders of thinking in schizophrenia-- Schneider

1. Transitory thinking

- Impairment in persistence/completion of thinking
- Manifestations of transitory thinking include
 - Derailments
 - Substitutions
 - Omissions
- Omissions vs. desultoriness
 - In desultoriness, the continuity of thinking is loosened, but, in omission, the intention itself is interrupted, and there is a gap.
- The grammatical and syntactical structure are both disturbed in transitory thinking

Disorders of thinking in schizophrenia-- Schneider

2. Drivelling thinking

- Impairment in healthy organization of thought wherein contents of thought are related to each other in consciousness, but separated in an organized way and not blend with each other
- The patient has a preliminary outline of a complicated thought with all its necessary particulars, but he loses his preliminary organization of the thought, so that all the constituent parts get muddled together.
- The inner material relationship between the thoughts become obscured and change in significance

Disorders of thinking in schizophrenia-- Schneider

3. Desultory thinking

- Impairment in the continuity of thought resulting from inability to arrange subsidiary thoughts, sudden ideas or observations in order, in the whole content of consciousness
- Sudden ideas force their way in from time to time, even though speech is grammatically and syntactically correct
 - Each of these ideas is a simple thought, which if used at the right time would be quite meaningful

Interruption to the flow of thought in desultory thinking

- Carl Schneider (1930) has described the way in which continuity of flow of thinking may be disturbed:
 - entgleisen: derailment
 - verschmelzung: fusion (literally, melting)
 - entgleiten: snapping off; suspension
 - faseln: muddling
- Asyndesis: lack of adequate connection between two consecutive thoughts

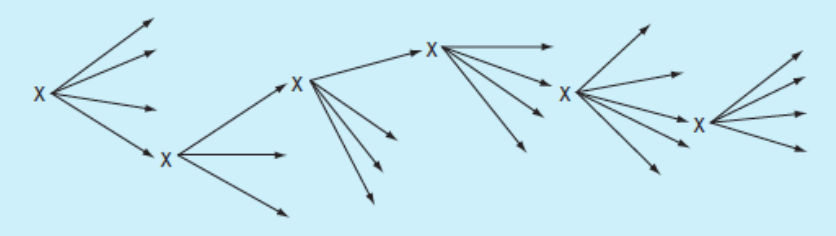
Thought, language and communication (TLC) disorders

1. Poverty of speech
2. Poverty of content of speech
3. Pressure of speech
4. Distractible speech
5. Tangentiality
6. Derailment
7. Incoherence
8. Illogicality
9. Clanging
10. Neologisms
11. Word approximations
12. Circumstantiality
13. Loss of goal
14. Perseveration
15. Echolalia
16. Blocking
17. Stilted speech
18. Self-reference
19. Phonemic paraphasia
20. Semantic paraphasia

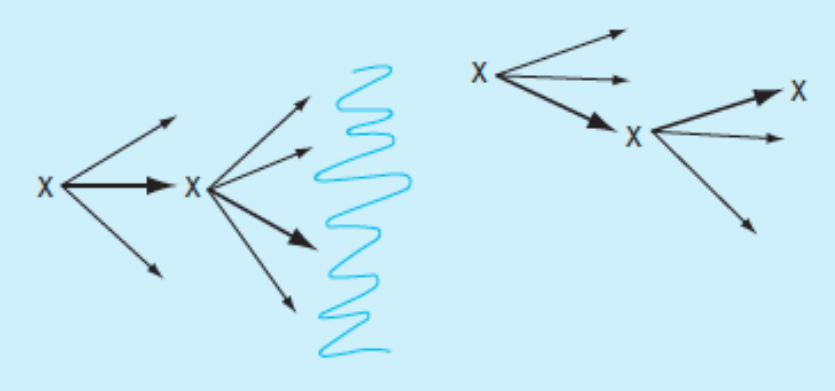
Andreasen, Schizophrenia Bulletin, 1979

Pictorial examples of FTD from Sims

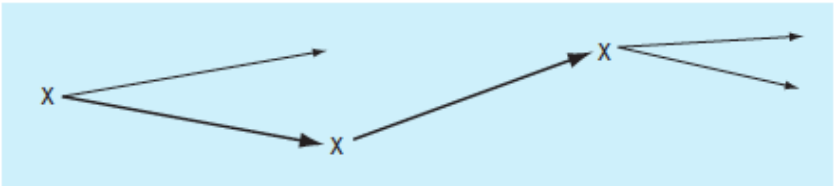
Acceleration of thinking



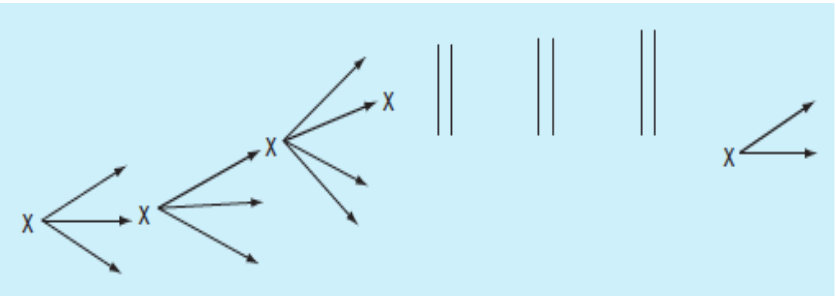
Derailment



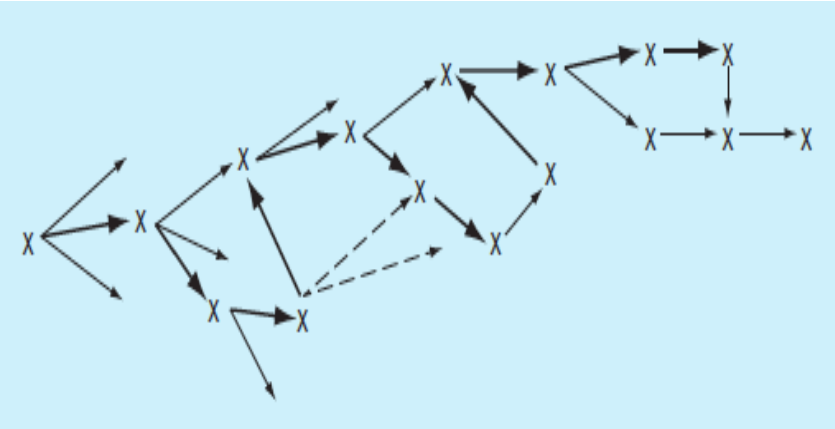
Retardation of thinking



Thought blocking

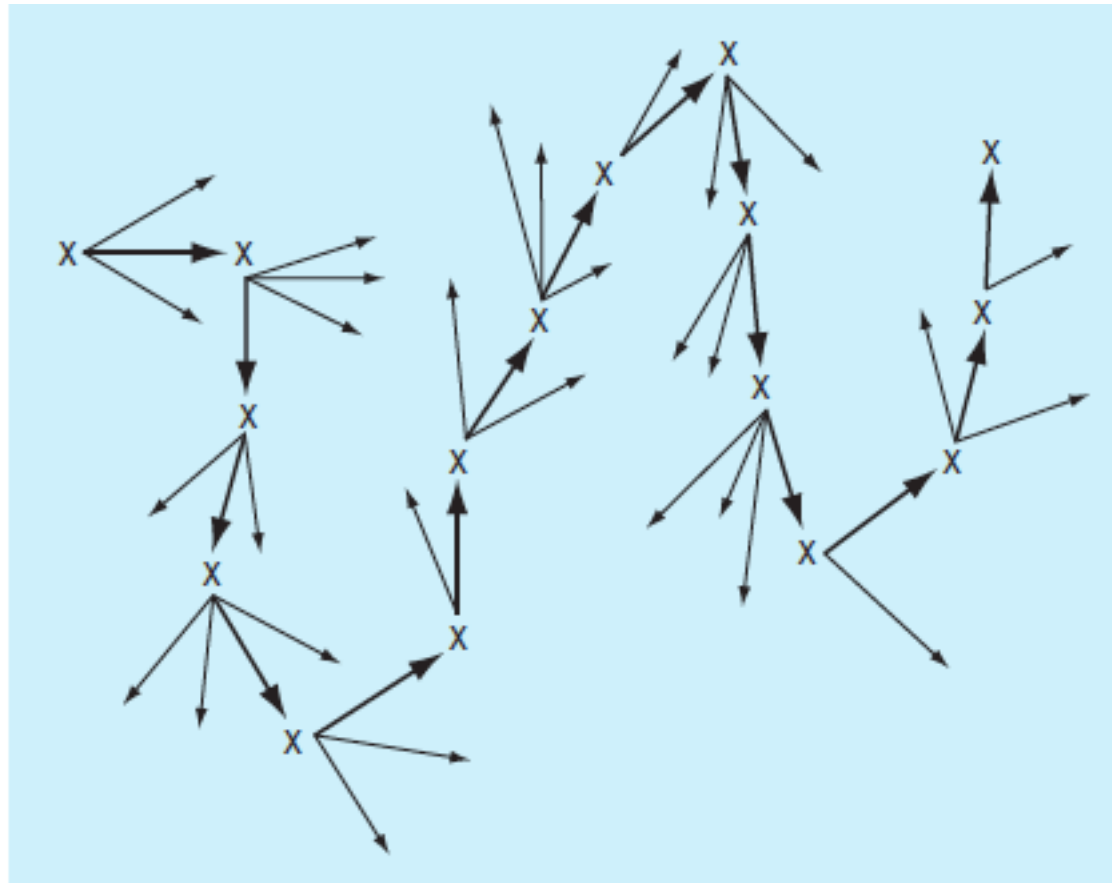


Fusion



Pictorial examples of FTD from Sims

Circumstantiality



Statistical model of language

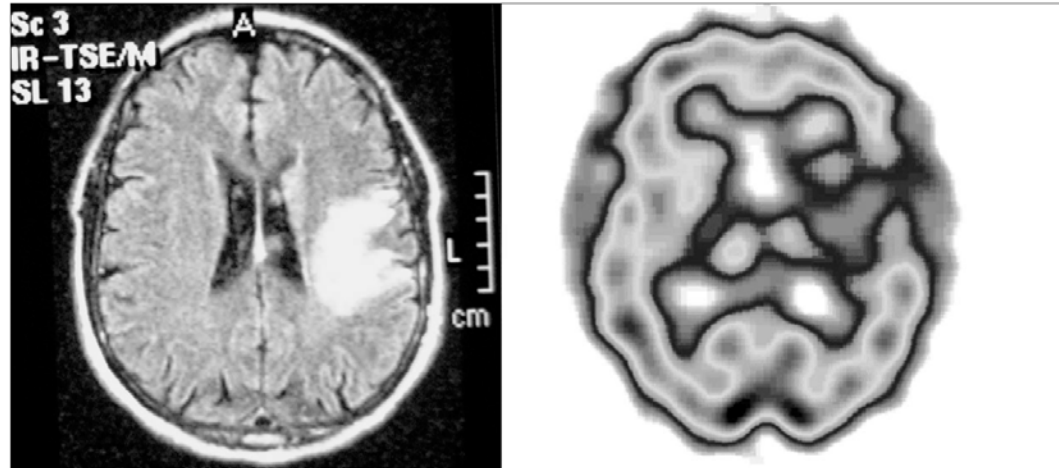
- Cloze procedure:
 - Deleting words from the transcripts of speech and assessing whether the omitted word can be guessed
 - In schizophrenia, the greater the severity of illness, the greater is the degree of unpredictability
 - Fifth-word deletion: thought disordered schizophrenia speech was less predictable
- Type-token ratio
 - A measure of the number of words as compared with the total number of words
 - Lower in schizophrenia than normal

Overlap between neurological and psychiatric conditions causing thought and language disorders

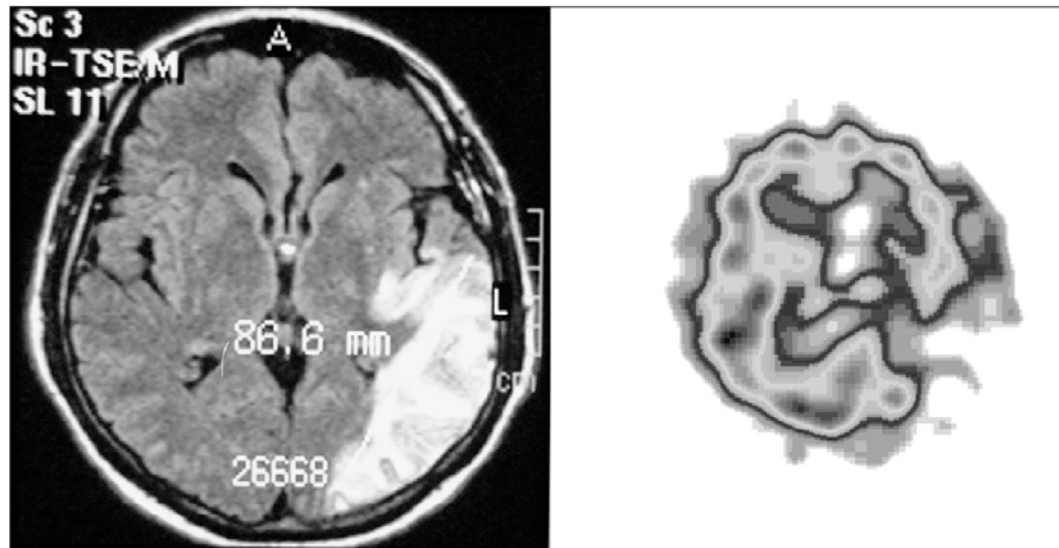
- Overlap between aphasias and FTD in schizophrenia
 - Receptive aphasia >> Word salad; loosening of associations; derailment; poverty of content of speech
 - Expressive aphasia >> Poverty of speech
 - Paraphasia >> Neologisms
- Overlap between coarse brain disorders and schizophrenia
 - Perseveration: Frontal lobe lesions
 - Echolalia: Frontal lobe lesions, dementia

Neurobiology of formal thought disorders

Aphasias: brain localization



Broca's aphasia

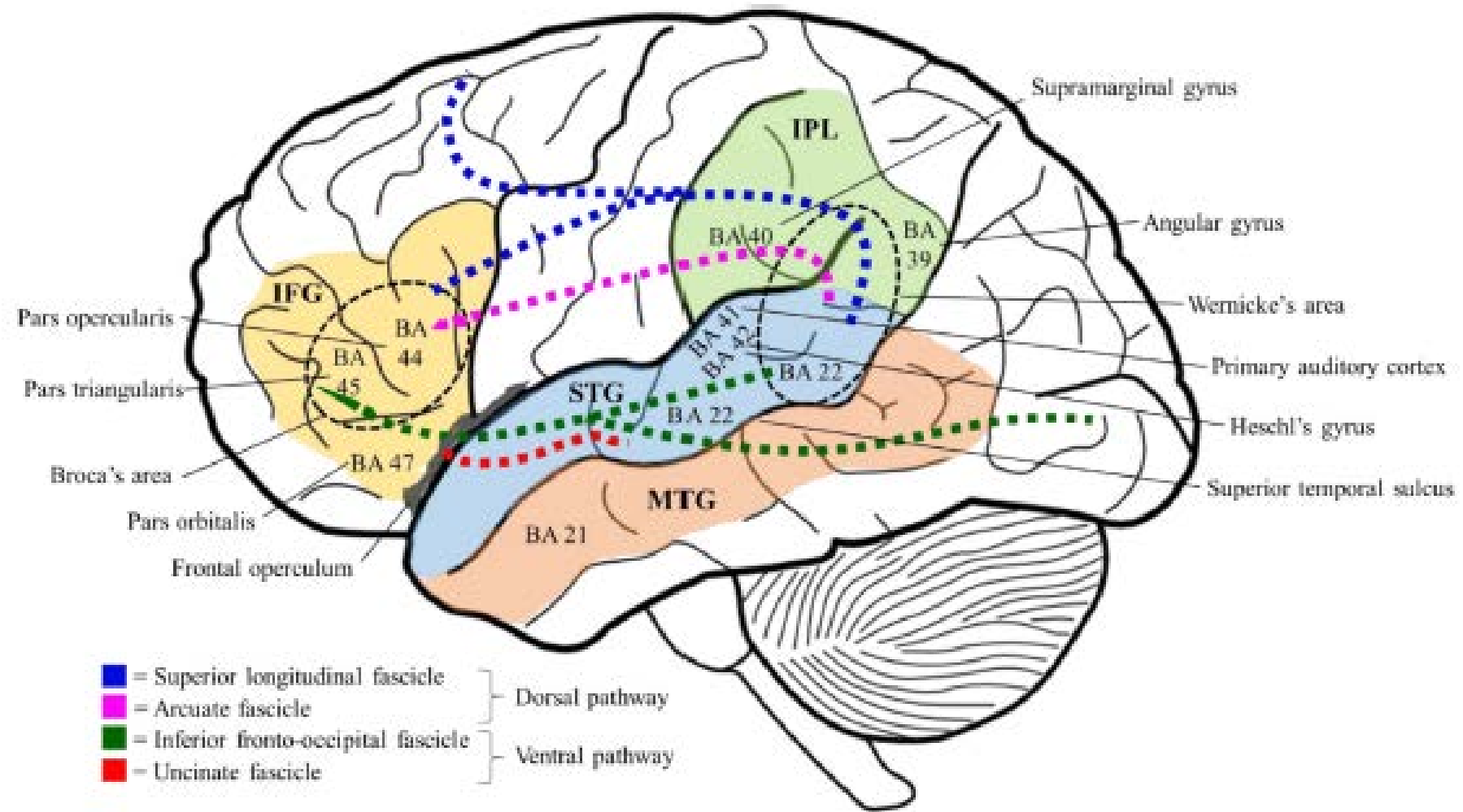


Wernicke's aphasia



Is formal thought disorder in schizophrenia related to structural and functional aberrations in the language network? A systematic review of neuroimaging findings

Marialuisa Cavelti ^{a,b}, Tilo Kircher ^c, Ame Nagels ^e, Werner Strik ^a, Philipp Homan ^{a,d,*}



Structural and functional aberrations of language network associated with FTD in schizophrenia

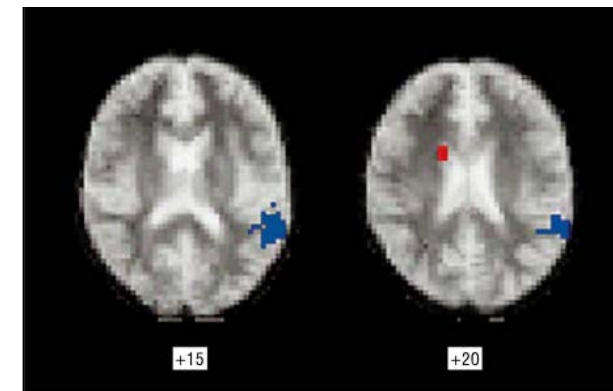
(Kircher et al, 2001 Schiz Res)

• Structural

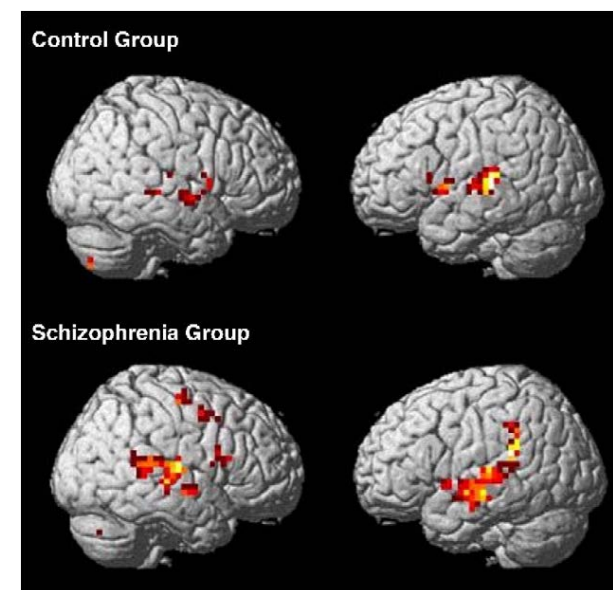
- Bilateral (L>R) grey matter deficits in
 - Inferior frontal gyrus (IFG), superior temporal gyrus (STG) and inferior parietal lobule (IPL)
- White matter aberrations in
 - Fibre tracts that connect the frontal and temporo-parietal regions

• Functional

- Resting state functional MRI
 - Hyperactivity in IFG, STG and IPL
- Task-based fMRI
 - Both hyper and hypo activity in above regions



(Weinstein et al, 2006)



Cavelti et al., Schizophrenia Research, 2018

Schizophrenia as failure of hemispheric dominance for language

T.J. Crow *Trends Neurosci.* (1997) 20, 339–343

- Schizophrenia occurs in all populations with the same incidence
- Has persisted despite disadvantages in all populations
- Understood as an anomaly of a function that is most characteristically human, namely, language
- Language—the key function that separates humans from earlier hominid species
- Language—evolved through hemispheric lateralization
- Failure or delay in structural and functional asymmetry in schizophrenia
- Symptoms of schizophrenia, esp. positive symptoms—may be understood as deviations in interpretation and organization of speech/language

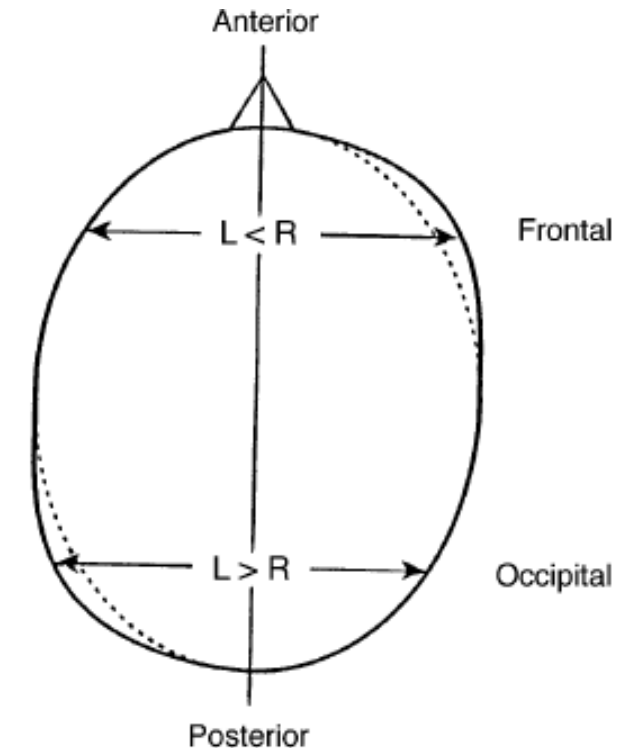


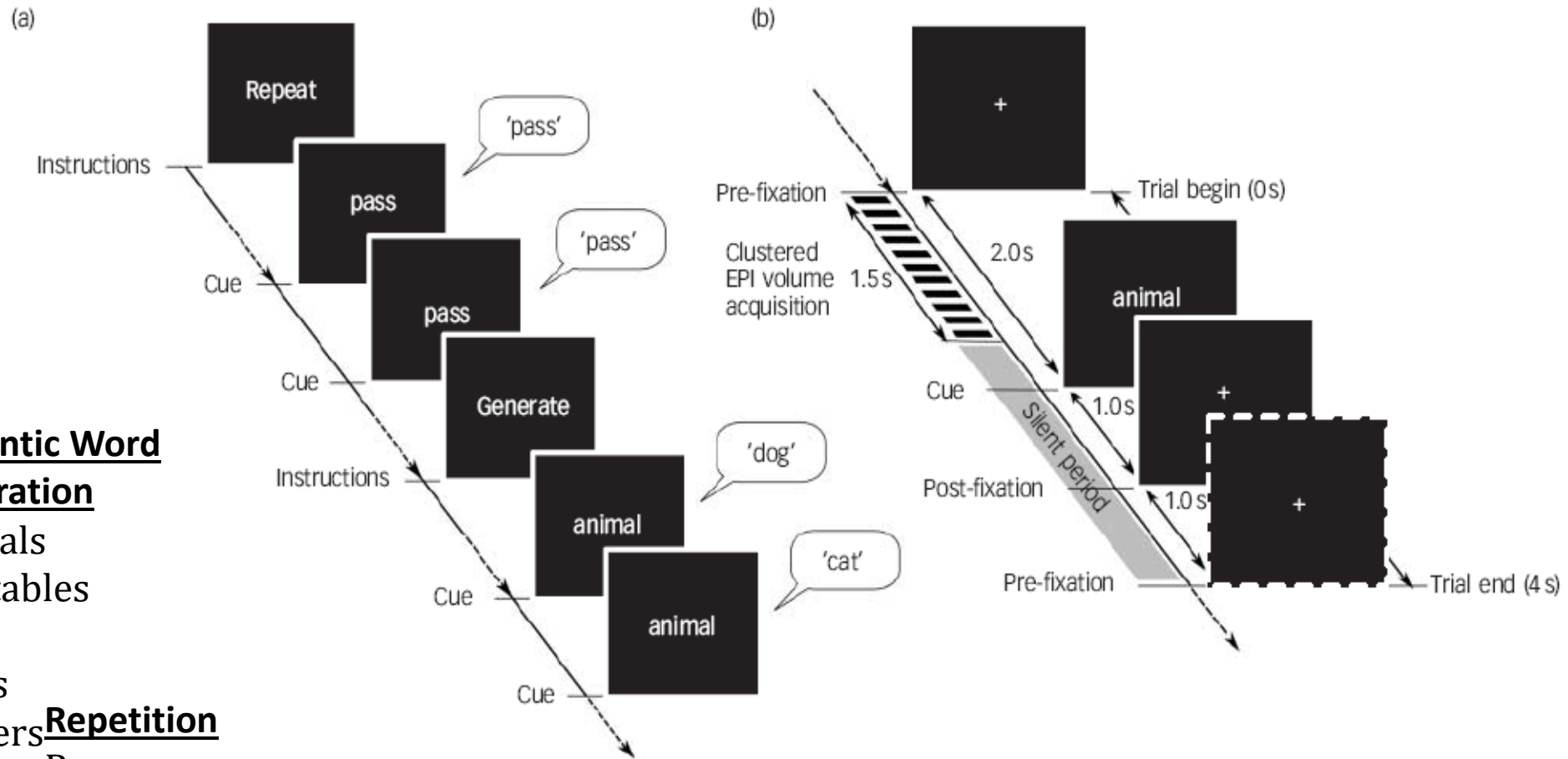
Fig. 1. Width asymmetries in the human brain. Adapted from Calvert and Crow².

Semantic Word Generation in schizophrenia

- *The best candidate cognitive endophenotype of schizophrenia*
 - Szoke et al., 2008
- Semantic verbal fluency has higher discriminatory power than phonological verbal fluency
 - to differentiate schizophrenia v. healthy subjects



Verbal Fluency: fMRI task design



Semantic Word
Generation
Animals
Vegetables
Birds
Fruits
Flowers
Trees

Repetition
Pass

Behavioral performance

	Control group (n = 24)		Schizophrenia group (n = 24)		Mann-Whitney U-test	P
	Mean (s.d.)	Percentage of total number of trials	Mean (s.d.)	Percentage of total number of trials		
Total verbal responses	40.08 (1.93)	95	34.54 (4.52)	82	85.5	<0.001
Correct responses	36.25 (3.96)	86	29.38 (5.77)	70	81.00	<0.001
Incorrect responses	0.08 (0.41)	<1	0.22 (1.04)	<1		
Repetitive responses	0.25 (0.53)	<1	0.65 (1.11)	<1		
Pass responses	3.50 (3.56)	8	4.90 (6.32)	10		
No responses	1.88 (1.96)	5	7.43 (4.62)	13	83.5	<0.001

a. Scores are out of a maximum of 42.

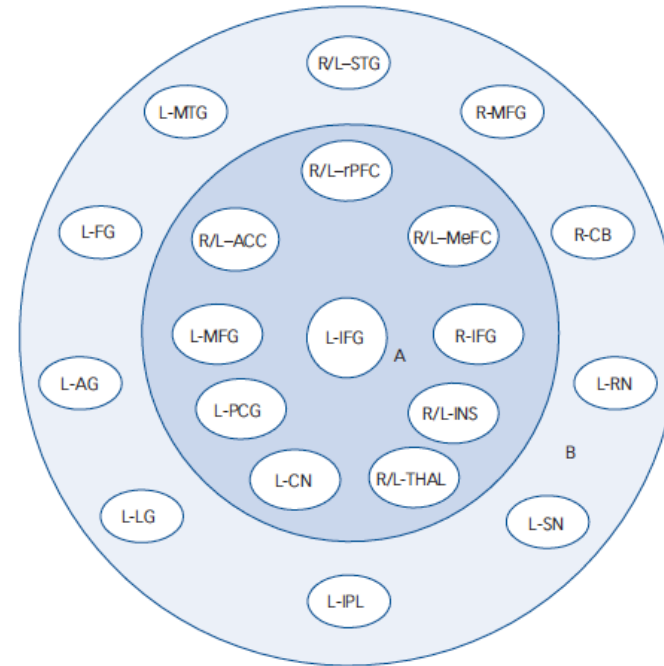
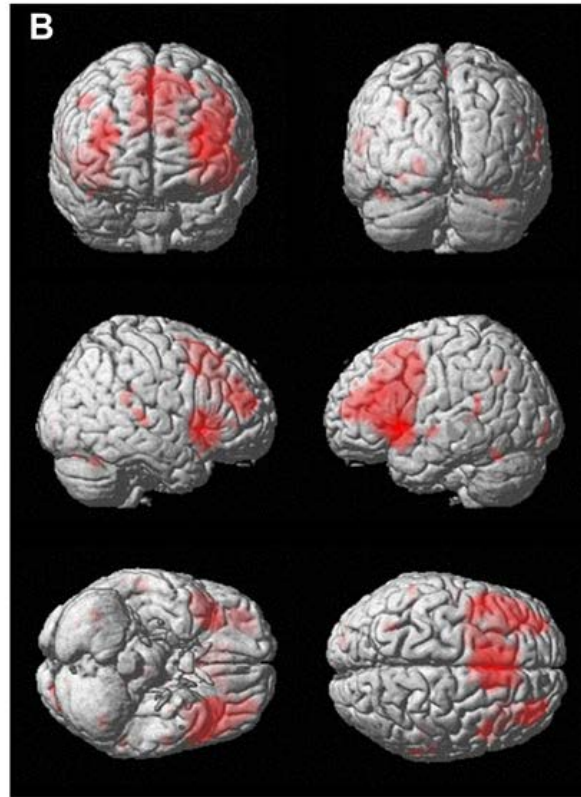
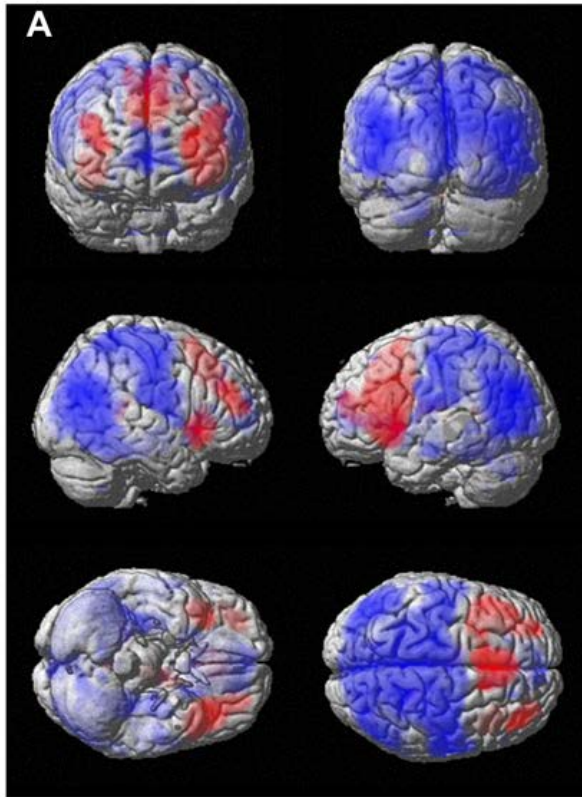
Difference in response latency between word generation and word repetition trials ($\text{lat}_{\text{gen}} - \text{lat}_{\text{rep}}$)

Healthy subjects: 37.57 ms (s.d.=111.68)

Schizophrenia subjects: 131.29 ms (s.d.=122.86)

t=-2.59, p<0.013

Healthy vs. Schizophrenia subjects



The central area (A) shows the core/essential brain regions and cognitive/associated processes underlying overt, semantic category word generation in healthy individuals

1. L-IFG – Semantic search, word retrieval and selection
2. R-IFG – Suppression of inappropriate responses
3. ACC – Control functions (e.g. selective attention: facilitation and suppression of within-category responses: task adherence; monitoring of conflicting responses and errors; recruiting essential brain regions)
4. MeFC – Higher-order motor control processes such as setting up goals of internal selection of individual actions (pre-SMA); motor preparation for oral expression (SMA)
5. rPFC – Executive control and maintenance of internally generated cognitive operations in word generation
6. INS – Sensory, motor and mental control of selection and suppression mechanisms
7. L-MFG – Updating generated words in verbal working memory
8. THAL – Speech production and articulation; generation of mental images and visual details
9. CN – speech production and articulation
10. L-PCG – Articulatory processes during production of verbal responses

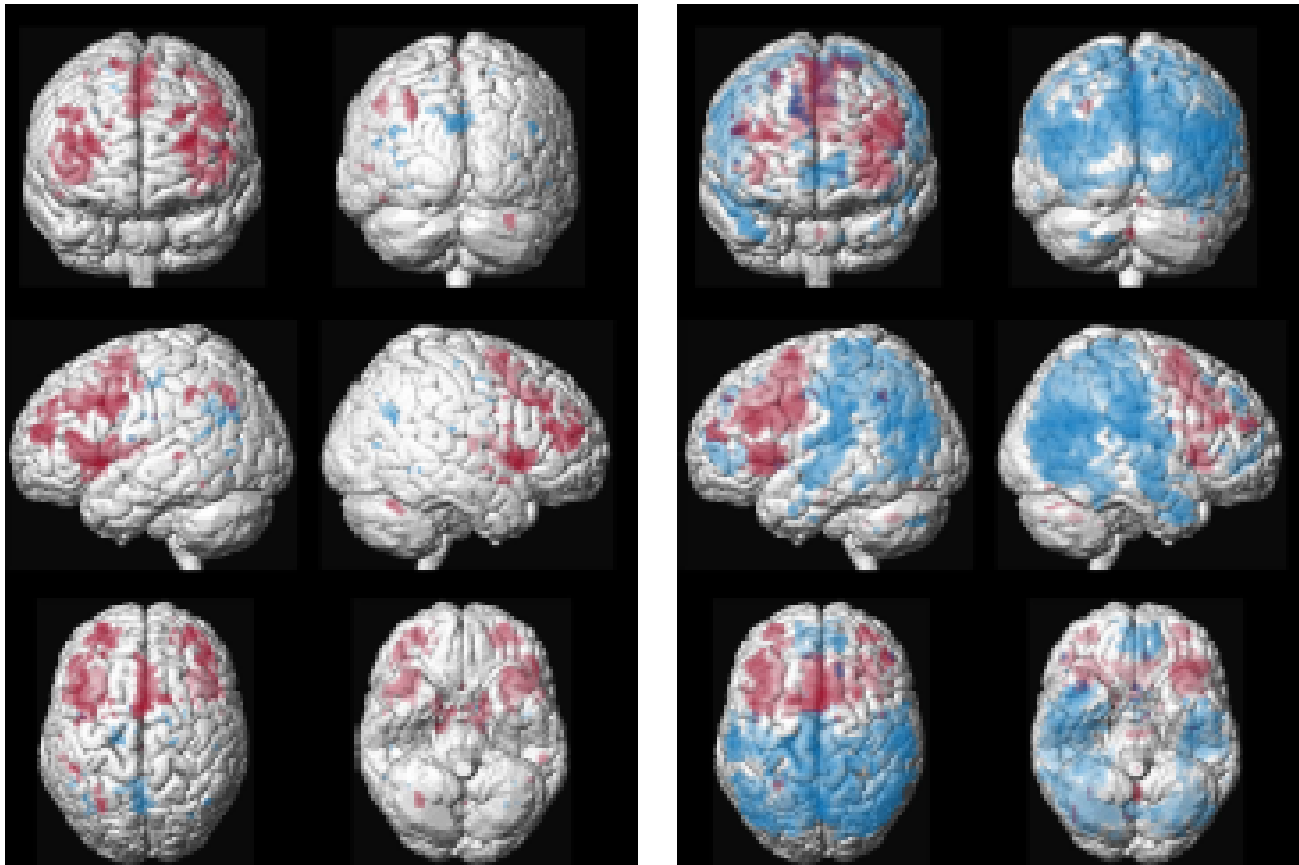
John et al 2011, *British Journal of Psychiatry*

Recent replication

Activation and deactivation

Patients with schizophrenia (SZ)

Healthy subjects (HS)



■ Activation
■ Deactivation

Results corrected for multiple comparisons using voxel-wise false discovery rate (FDR)
Images as per neurological convention (image left corresponds to subject's left)

Common areas of activation in HS and SZ:

- Caudate
- Cingulate Gyrus
- Declive
- Inferior Frontal Gyrus
- Insula
- Middle Frontal Gyrus
- Precentral Gyrus
- Sub-gyral
- Superior Frontal Gyrus
- Thalamus

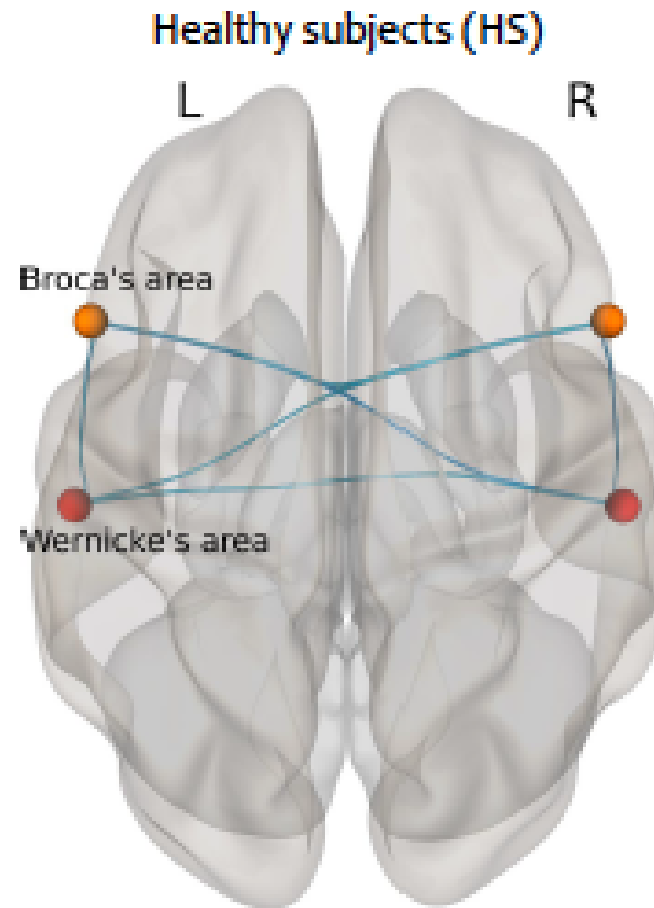
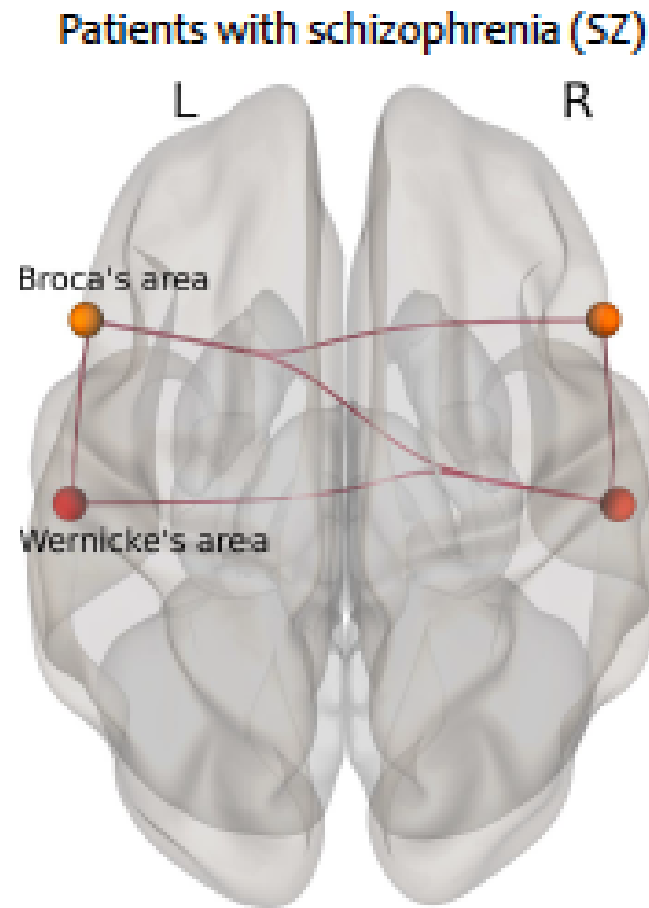
Additional areas of activation in SZ:

- Culmen of Vermis
- Fusiform Gyrus
- Inferior Parietal Lobule
- Lentiform Nucleus
- Medial Frontal Gyrus
- Middle Temporal Gyrus
- Postcentral Gyrus
- Superior Parietal Lobule
- Superior Temporal Gyrus

*D'Cruz, Parekh..John et al.,
in preparation*

Functional disconnection of primary language areas in schizophrenia

Connectivity results for word generation



	L-WK	L-BC	R-WK	R-BC
L-WK	–	0.20	0.67	NS
L-BC	0.30	–	0.28	0.41
R-WK	0.90	0.35	–	0.14
R-BC	0.34	0.45	0.34	–

■ Patients with schizophrenia
 ■ Healthy subjects

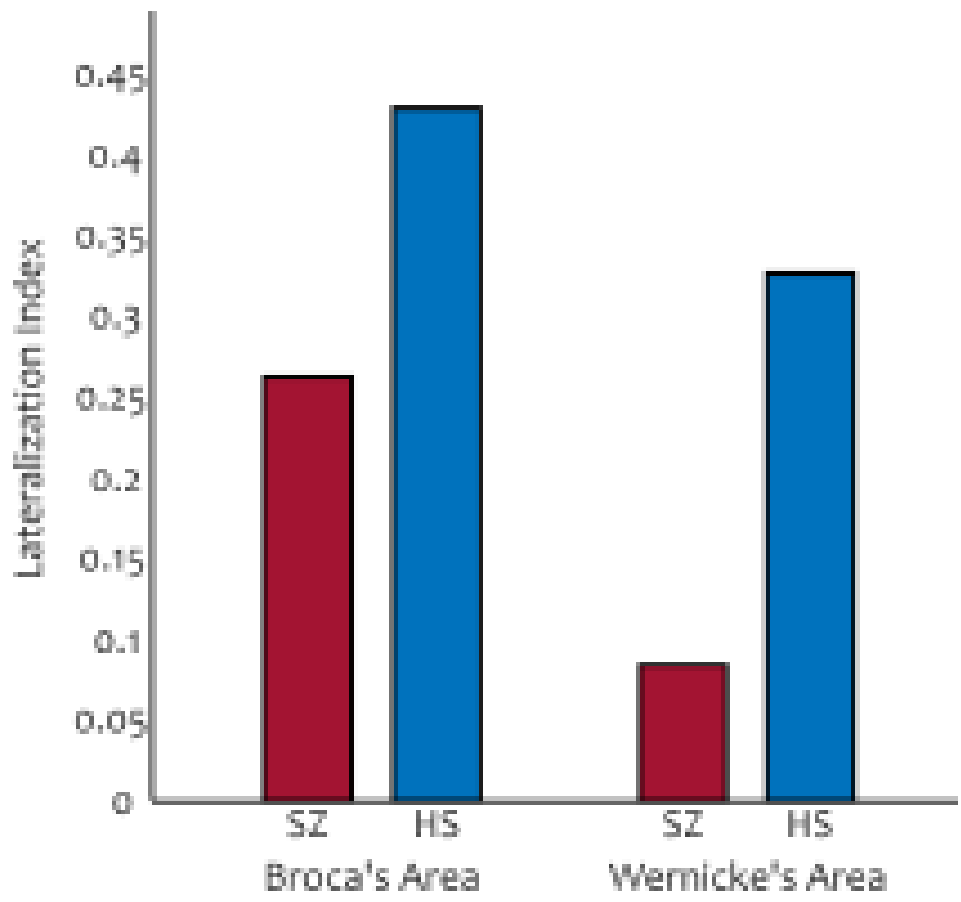
Regions of interest

L-WK: Wernicke's area
 L-BC: Broca's area
 R-WK: Right homotope of Wernicke's area
 R-BC: Right homotope of Broca's area

*D'Cruz, Parekh..John et al.,
 in preparation*

Impaired left lateralization during word generation in schizophrenia

Lateralization index for WG-WR contrast



	Broca's Area	Wernicke's Area
Mean	0.26	0.08
SD	0.42	0.48
Mean	0.43	0.33
SD	0.32	0.42
T	1.08	1.32
p	0.29	0.20

■ Patients with schizophrenia
■ Healthy subjects

D'Cruz, Parekh..John et al., in preparation

Summary of fMRI findings during word generation

- Patients with schizophrenia may have a core dysfunction involving the word generation network
 - Impaired left lateralization during word generation
- Inefficient activations and deficient deactivations in schizophrenia during word generation
 - ? the core neurophysiological disturbance in schizophrenia
 - deficient deactivations--? neurophysiological signature of the 'defective cognitive filter' in schizophrenia

Summary

- Thought, language and speech
- Assessment of language and thought in neuropsychiatry
- Language/thought abnormalities in psychiatric conditions
- Neurobiology of formal thought disorders
 - Impaired left lateralization of language
 - Impaired functional connectivity in the language network
 - Excessive activations and deficient deactivations of brain regions during word generation

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