Who, What and Where: Word Retrieval Impairments in Aphasia

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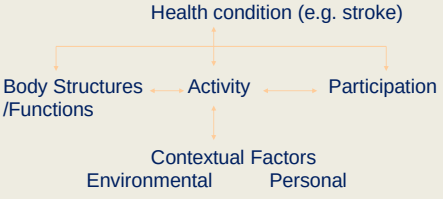
Perspectives to Consider in Aphasia Treatment

- WHO & I-FROM models
- What:
  Cognitive neuropsychological influences
  Evidence based clinical practice
- Where:
  Neural correlates of impairments and recovery - restoration and reorganization

WHO International Classification of Functioning, Disability, & Health (2001) http://www3.who.int/icf/



Body/Structure Functions: Mental Functions

Reception of Language

Expression of Language
Word Retrieval
Morphosyntactic Operations
Phonologic Processing
Articulatory/Phonetic Processes

Activities: execution of a task

Communication
verbal
nonverbal

Participation: involvement in life situations

Education, Economic, Community, Social, Civic, Leisure, Religious Activities

Contextual Factors: Facilitators and Barriers

Personal:
e.g., age, background, style, personality

Environment:
e.g., community attitudes, architecture, transportation, climate

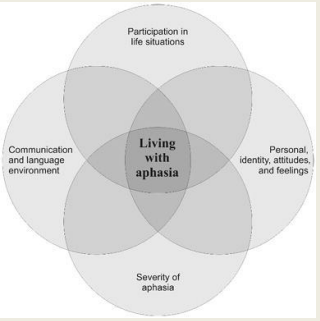
WHO Model

-guiding framework for all ASHA policy documents

A-FROM Living with Aphasia: Framework for Outcom Measurement

Kagan & Simmons-Mackie, 200

-Also should impact on treatment options



Aphasia Treatment: WHO + A-FROM

Language Functions/Severity of Aphasia

Restorative & Reorganization treatments for language abilities

Activities/ Participation: Communication in ADLs, personal interactions, education, employment, social activities

Compensatory and functional communication strategies

Environment/Personal Facilitators/Barriers to Language Use

Modify communication environment: support systems/technology/partner training

- Impacts on our treatment choices and outcomes measured

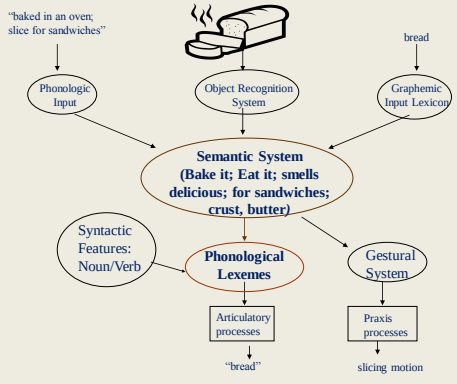
What: Body Functions - Language

Cognitive Neuropsychological Perspective

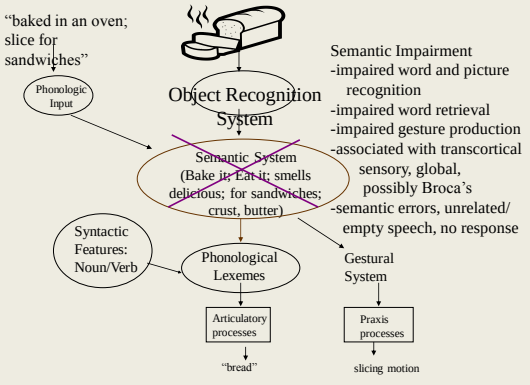
Normal System: Representations and Processes

Word Retrieval Impairments: Systematic disruption of this system

Word Retrieval Mechanisms



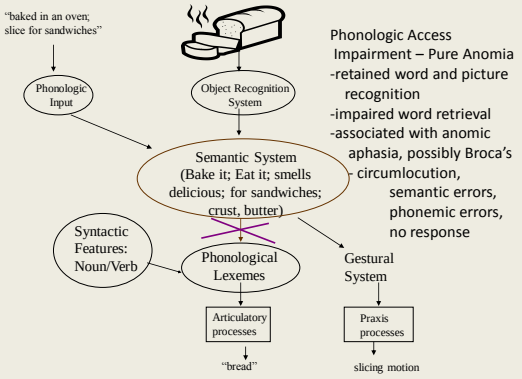
Word Retrieval Mechanisms



Semantic Anomia

Picture Naming Nouns 21.7% Verification Nouns 46.7%
Picture Naming Verbs 53.3% Verification Verbs 26.7%

Word Retrieval Mechanisms

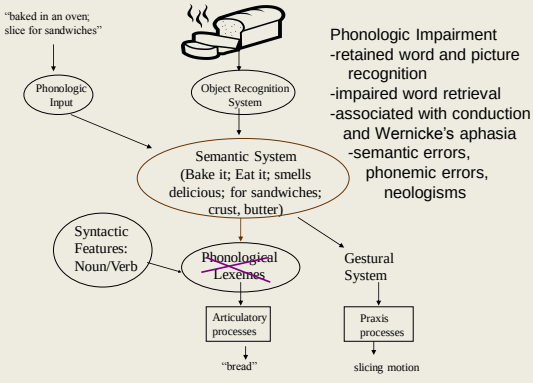


Phonologic Access Impairment – Pure Anomia
-retained word and picture recognition
-impaired word retrieval
-associated with anomic aphasia, possibly Broca's
- circumlocution,
semantic errors,
phonemic errors,
no response

Phonologic Access Anomia

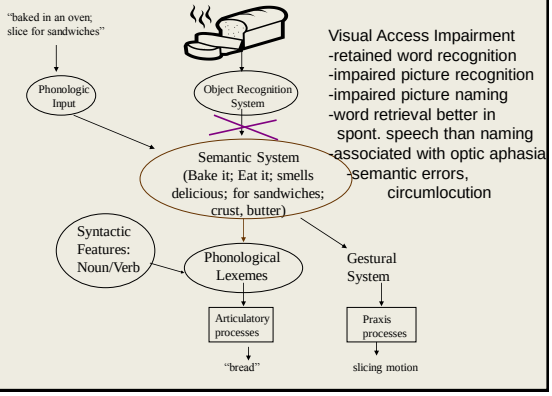
Picture Naming Nouns 48.3% Verification Nouns 98.3%
Picture Naming Verbs 40.0% Verification Verbs 93.3%

Word Retrieval Mechanisms



Phonologic Impairment
-retained word and picture recognition
-impaired word retrieval
-associated with conduction and Wernicke's aphasia
-semantic errors,
phonemic errors,
neologisms

Word Retrieval Mechanisms



Visual Access Impairment
-retained word recognition
-impaired picture recognition
-impaired picture naming
-word retrieval better in spont. speech than naming
-associated with optic aphasia
-semantic errors,
circumlocution

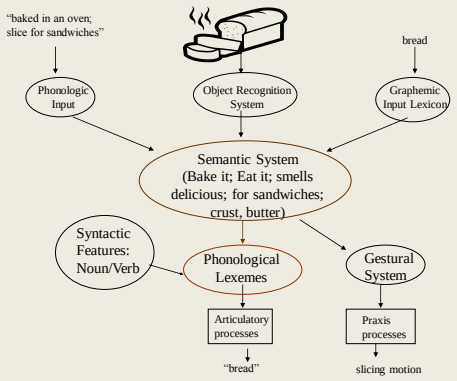
Optic Aphasia

	Anomic Aph	Optic Aph
WAB AQ	84.6	77.0
Aud comp	8.9	8.4
Naming	6.0	5.7
BNT	17/60	4/60

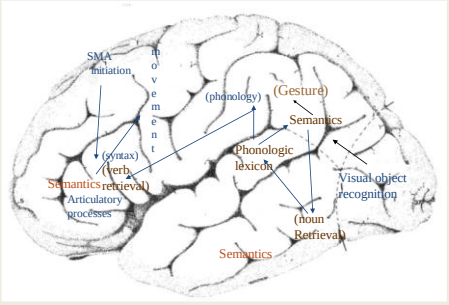
Optic Aphasia

	Anomic	Optic
Picture Name	50%	15%*
Name to Def	55%	63%*
Aud Word/Pic Match	95%	87%

Word Retrieval Mechanisms



Where: Neural Correlates of Lexical Processing



Antonucci et al., 2005; Damasio et al 1993; Tranel et al 1997; Caramazza & Hillis, 1991; Shapiro et al., 2006

Word Retrieval Impairments in Aphasia

- Disturbance at some step in complex process
  - Semantic, Access, Phonologic
- Symptoms vary across patients
- Associated with damage in many brain regions
  - Left Inf. Temp.: Nouns < Verbs
  - Left Inf. Frontal: Verbs < Nouns
    - (Damasio & Tranel, 1993; Tranel et al., 1997)
- Many have impairments for both nouns and verbs (Berndt et al., 1997)

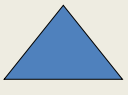
Treatment Implications

- Treatment effects may differ depending on pattern of word retrieval impairment: semantic vs phonologic
- Word retrieval training effects may differ for nouns versus verbs
- Restorative treatments: Relearning
  - Need to address semantic and/or phonologic aspects of word retrieval
- Reorganization approaches:
  - Attempt to engage alternative cognitive systems, e.g., gesture, to facilitate word retrieval

Evidence-based Clinical Practice

Clinical decision-making based on:
(Sackett et al., 2000)

best current scientific evidence



clinical expertise client values

Evidence-based Clinical Practice

E Model of clinical decision-making:
Pollock & Rochon (2002); Hopper (2007)

Evidence: lacking in many areas
Experience: personal knowledge developed over time
Expectations: patient's (family's) goals/values
Environment: context in which rehab takes place
Ethics: personal and professional code of conduct

Evidence: Practice Guidelines

Recommendations based on a consensus derived from a review of the research evidence and expert opinion

Useful evidence resources:
Academy of Neurologic Communication Disorders and Sciences (ANCDS) www.ancds.org

ASHA Compendium of Clinical Practice Guidelines and Systematic Reviews www.asha.org/members/ebp
(Current 'ASHA Guidelines' documents are not 'Practice Guidelines')

Cochrane Reviews www.cochrane.org

WHAT can we do about word retrieval impairments?

Posting to Div 2 Listserve:

"I'm searching for Internet resources for information about treatment for anomia. Any treatment suggestions from the more experienced would be appreciated."

Several Options (Nickels, 2002; Raymer, 2005)
- Restorative treatments
- Reorganization approaches
- Compensatory strategies

Treatment of Word Retrieval Impairments

- Many studies used single participant experimental designs
  Baseline phase/Training Phase/Maintenance
- Primary Outcome measure:
  Picture naming – trained/untrained words
  i.e. WHO 'Language Functions'
- Fewer report outcomes for
  'Communication Activities/Participation'

Restorative Word Retrieval Training: Cueing Hierarchies

Systematically present cues of increasing potency
(Linebaugh & Lehner, 1977; Linebaugh, 1983)
e.g. Semantic category cue
Rhyme cue
Initial phoneme cue
Repetition cue

Patterson (2001) reviewed evidence
9 studies (17 total subjects)

Improves retrieval of trained words (nouns)
Little generalization to untrained words
Effects for conversational abilities untested

Semantic Cueing Treatment

Wambaugh et al., 1999, 2001-2003

Prestimulation: Which of these is used to make juice in Florida?

Cueing hierarchy: picture presented alone
What is this?
Semantic cue:
To make juice we squeezed a ripe Florida >>>
Repetition cue: "orange"

Phonologic Cueing Treatment

Wambaugh et al., 1999, 2001-2003

Prestimulation: Which of these sounds like 'kell'?

Cueing hierarchy: picture presented alone
What is this?
Phonologic cues:
It sounds like 'kell'; It starts with /b/.
Repetition cue: "bell"

Semantic & Phonologic Cueing Treatment

Wambaugh et al

- Both treatments lead to improved naming of trained words
- Improvements occur for nouns and verbs
- Improvements occur in individuals with semantic, phonologic, and mixed anomias
- Little generalized improvement in discourse measures

Cueing Hierarchy Training: Personalized Cues

Marshall, Freed and colleagues 2001; 2002

Contrasted word retrieval training effects when using:
personalized cues (i.e. phrase developed by client)
phonologic cues (i.e. provided by clinician)

Both types effective for improving picture naming
Personalized > Phonologic

Personalized cues with semantic information
(e.g. my whiskers need a ..razor) >
Personalized cues with phonologic information
(e.g. sun rays ..razor)

Cueing Hierarchy Training: Computer Application: MossTalk Words

Fink et al. (2002)
6 patients with moderate to severe phonologically-based naming impairments
Computerized phonologic cueing hierarchy training
Clinician guided versus Partial Self-guided

Results:
5/6 Improved trained picture naming
2/6 small improvements for untrained items

Cueing Hierarchy Training: Computer Application: MossTalk Words

Ramsberger & Marie (AJSLP 2007)
4 patients with moderate to severe naming impairments
Computerized phonologic cueing hierarchy training
Compared intensive (5/wk) and less intensive (2/wk)

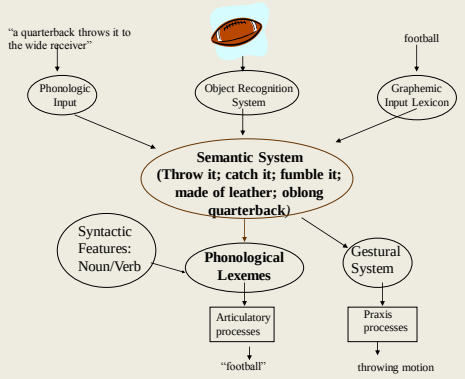
Results:
3/4 Improved trained picture naming
2/4 greater improvements for intensive tx
1/4 generalized to untrained picture naming

Alternative Word Retrieval Treatments: Semantic Comprehension Training

Treatment tasks:

Answer yes/no Qs: semantic attributes
e.g. Does this have to do with a quarterback?
Spoken word/picture matching*
Written word/picture matching*
*related distractors
(e.g., basketball, bat, helmet)
Category sorting (sports/clothing)

Word Retrieval Mechanisms



Semantic Comprehension Training: Evidence

Reviews by Ennis (2001); Nickels (2002)
7 studies (35 subjects)

Improved naming of trained nouns 17/20 (one group study)
Little generalization to untrained words
No evidence of effects in conversation

Treatment effects greatest when comprehension paired with production, i.e. semantic-phonologic training (Drew & Thompson, 1999)

Patients with semantic and phonologic word retrieval impairments respond in treatment

Semantic-Phonologic Training for Verbs (Rodriguez et al., 2006)
Noun vs Verb Retrieval (Raymer et al., 2007)

Answer yes/no Qs: "pounding"

semantic attributes
e.g. Is this similar to knocking?
Does this have to do with a carpenter?
phonologic attributes
e.g. Does this start with /p/?
Does this sound like mound?

Rehearsal phase: repeat 3 times

Semantic-Phonologic Training Effects for Noun versus Verb Retrieval in Aphasia

Raymer et al. (2007, Neuropsych Rehab)

•8 individuals with aphasia and word retrieval impairments for nouns and verbs

•Single participant multiple baseline design:

One phase noun training; one phase verb training (order counterbalanced across participants)

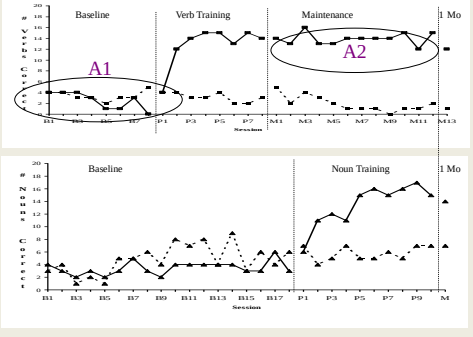
Main outcome measure: Picture Naming

Trained/Untrained Nouns

Trained/Untrained Verbs

Predict differences between nouns and verbs

Picture naming accuracy: Effect sizes: Mean A2 – Mean A1/SD A1



Picture Naming Effect Sizes (d): Nouns vs Verbs

Raymer et al. (2007)

PT	ORDER	Effects Nouns Tx	Untx	Effects Verbs Tx	Untx
P1 Bro	1N2V	**13.2****	1.40	**17.34****	1.63
P2 Bro	1V2N	**9.91****	.05	**11.12****	.27
P3 Bro	1N2V	**7.69****	2.92*	**4.61****	0
P4 Bro	1V2N	**5.89****	1.93	**10.64****	.52
P5 Bro	1N2V	**3.41****	1.10	**2.56****	1.27
P6 Bro	1N2V	.85	-.16	.10	.10
P7 Wern	1V2N	1.39	-1.33	1.32	.80
P8 Anom	1V2N	.98	.67	-.44	.39
Mean		**5.42**	**.82**	**5.91**	**.62**
Responders		5/8	1/8	5/8	0/8

No group diff: t=.36

Pre-treatment predictors **p<.01

	Effect Size Verb Tx	Effect Size Noun Tx
WAB Aph Quotient	.31	.42
WAB Naming	.87**	.91**
WAB Repetition	.26	.36
WAB Aud Comp	.34	.38
BNT	.83*	.86**
ANT	.79*	.91**
Picture Name Nouns	.71*	.81*
Picture Name Verbs	-.12	-.04
Verification Nouns	.07	-.05
Verification Verbs	.23	.16

Relationship to Changes on Secondary Outcome Measures **p<.01

	Effect Size Tx Verb	Effect Size Tx Noun
WAB	.05	-.33
BNT	.-.05	.27
ANT	.23	-.13
FOQ	-.14	.60
CETI	**.94****	-.60
ASHA-FACS Basic	.04	-.41
ASHA-FACS Social	.21	.66
% Nouns	.02	-.87*
% Verbs	-.14	.14

3 Nonresponders

- Severity of word retrieval impairment influential
  3 severe naming impairments
- 1 Broca's: severe apraxia of speech/nonfluency
- Nature of impairment partly important
  2/3 severe semantic impairment

By the way….
- Time post stroke: not influential
  2/3 earliest post stroke in the sample

Computerized Semantic Comprehension Training: MossTalk Words

Raymer et al. (2006)

2 patients with severe semantic anomia aphasia

3 with phonologic access anomia

10 sessions training: Word/picture matching modules (written and spoken word/picture matching tasks)

Results:

Improved comprehension for trained and untrained words in 1/2 when trained 1-2 times/wk

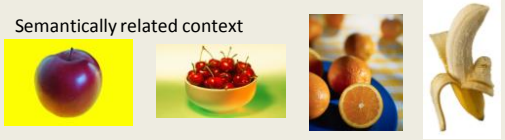
Improved picture naming for trained words

5/5 when trained 3-4 times/wk

2/5 when trained 1-2 times/wk

Contextual Priming
Martin et al., 2004, 2006

Semantically related context



Match spoken name to picture – then repeat name several times

Phonologically related context

Contextual Priming
Martin et al., 2004, 2006

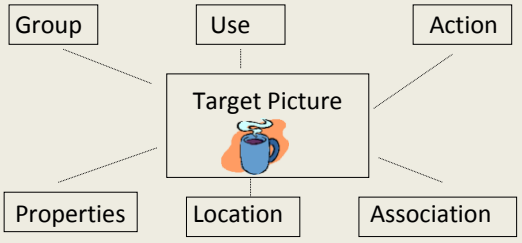
- Premise: thru massed repetition priming, leads to spreading of activation to semantically and phonologically related words
- Initially during training - may lead to interference in naming across related items
- Over time – see improve naming of trained items
- Best effect in patients with preserved semantic abilities

Semantic-Phonologic Treatments Summary

- Large effects for trained words
- Less potent generalized training effects to untrained words
- Despite neural differences, no apparent differences between nouns and verbs

Other Methods for Improving Generalization in Word Retrieval Training

Semantic Feature Analysis Training



Semantic Feature Analysis Training

Boyle & Coelho, 1995	n=1 Bro
Boyle, 1997	n=2 anom/Wern
Coelho et al, 2000	n=1 fluent
Lowell et al, 1995	n=3 2 cond/1 anom
Boyle, 2004	n=2 Wern.

Semantic Feature Analysis Training

Trained picture naming	8/9 improved
Untrained picture naming	8/9 improved
Connected speech	3/4 improved
	(5 not reported)

*All studies trained noun retrieval

Training within Semantic Categories

Spencer et al. (2000)

Single participant design (n=1)
Trained with rhyme cues across 3 semantic categories:
- animals
- household items
- tools

- Improvements in picture naming for trained words
- Generalization to untrained pictures within category
- Eventually…generalization to untrained category

Surprise: Training with Atypical Exemplars

Kiran & Thompson (2003)
4 individuals with fluent aphasia and word retrieval deficits
single participant design
Semantic training within categories (birds, vegetables)
Contrasted training targets: typical vs atypical examples
- typical (n=8): robin, carrot
- atypical (n=8): ostrich, artichoke

Results:
Typicals trained: little generalization to untrained
Atypicals trained: greater generalization to untrained!

Replicated by Waters et al. 2006; Kiran 2007

Amount Matters: Train for Many Sessions

Some studies report generalized improvement in picture naming for untrained words
- McNeil et al 1998
- Richards et al 2002
- Spencer et al 2000

Common element?
- Many, many training sessions

Intensity of Treatment

Hinckley & Craig (1998)

Retrospective group analyses of aphasia treatment
- No therapy
- Intensive speech therapy (23 hrs/wk for 6 wks)
- Non-intensive therapy (2-3 hrs/wk for 6 wks)

Outcome: Boston Naming Test scores

Result: Effects sizes
- Intensive therapy: very large effect sizes
- Non-intensive therapy: no effect to small effect
- No therapy: small effect

Problem: Amount and intensity confounded

Computerized Semantic Comprehension Training: MossTalk Words

Raymer et al. (2006)
Improved picture naming for trained words
- 5/5 when trained 3-4 times/wk
- 2/5 when trained 1-2 times/wk

Cueing Hierarchy Training: Computer Application: MossTalk Words

Ramsberger & Marie (2007)
- compared 5 times/wk vs 2 times/wk
- all received overall same amount of tx

Results:
- 3/4 Improved trained picture naming
- 2/4 greater improvements for intensive tx
- 1/4 generalized to untrained picture naming

WHAT: Reorganization Approaches to Word Retrieval Treatment

Use of Gesture to Facilitate Communication

- Reorganization approach to treatment to facilitate improvement of language abilities
- Compensatory strategy to circumvent blocks in communication
- Problem to consider: Limb Apraxia, as it may impede the use of gesture for compensatory communication

Gestures to Facilitate Communication

- Not a new idea
- AmerInd
  - Skelly, 1974; 1975
  - Rao & Horner, 1978
- Recent research has examined active factors to enhance treatment effects

Reorganization Approaches: Verbal + Gestural Treatment

Pair pantomime + word to facilitate word retrieval

Rehearse pantomime: pounding the nail -manipulate limb if necessary

Rehearse spoken word production: pound

Pair pantomime and spoken word production

Reorganization Approaches: Verbal + Gestural Treatment

Raymer 2001 reviewed 9 studies n=16 participants
Rose et al 2002 n=1

	Improvements
Naming (nouns)	14/17
Gestures	15/15

Who didn't improve? Severe apraxia of speech

Prior research focused on noun retrieval

- Neural networks for gesture tend to be more tightly linked to verbs than nouns (Druks, 2001)
- Are verbal+gestural treatment effects greater for verbs than nouns?

Contrasting Verbal+Gestural Training Effects for Nouns versus Verbs

Raymer et al. (2006)

•9 individuals with aphasia and word retrieval impairments for nouns and verbs

•Single participant crossover design (order counterbalanced across participants)

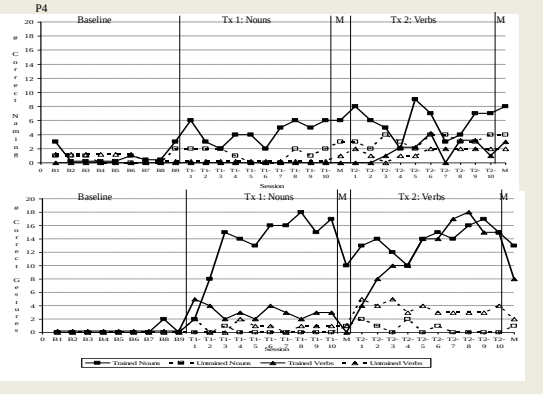
•Verbal+Gestural Training 10 sessions

•Outcomes:

Picture naming, Gesture production:

trained and untrained nouns and verbs

Videotaped Conversations



Picture Naming Effect Sizes (d) Raymer et al. (2006)

	Tx Order	Trained Nouns	Untrained Nouns Verbs	Trained Verbs	Untrained
P1 fl	V-N	.32	1.69	8.61*	1.39
P5 nonfl	V-N	.50	.03	3.05*	-.39
P9 fl	V-N	1.92	-1.13	2.61*	.60
P2 nonfl	N-V	15.97*	1.18	3.42*	-.16
P6 nonfl	V-N	10.18*	-.36	7.9*	.30
P7 nonfl	N-V	4.5*	1.15	4.14*	.14
P3 nonfl	V-N	6.88*	-.75	1.42	.94
P4 nonfl	N-V	2.71*	.88	1.6	1.5
P8 fl	N-V	.20	.80	-.36	-.73
Mean		**4.80**	**.39**	**3.60**	**.40**
Responders		5/9		6/9	
Nouns vs Verbs		t=.09, p=.93			

Gesture Effects sizes (d) Raymer et al. (2006)

	Tx Order	Trained Nouns	Untrained Nouns	Trained Verbs	Untrained Verbs
P1 fl	V-N	**19.38***	**4.00***	**16.30***	**3.20***
P4 nonfl	N-V	**19.67***	.10	**8.48***	**3.78***
P6 nonfl	V-N	**10.16***	**4.68***	**16.51***	**20.10***
P7 nonfl	N-V	**16.49***	**3.59***	1.34	**6.92***
P3 nonfl	V-N	**13.60***	1.02	**5.86***	.77
P5 nonfl	V-N	**23.44***	-.08	**12.50***	0
P9 fl	V-N	**6.11***	.72	**8.99***	1.41
P2 nonfl	N-V	4.00*	1.6	.98	.98
P8 fl	N-V	0	0	0	0
Mean		**12.54**	**1.74**	**7.88**	**4.13**
Responders		**8/9**	**3/9**	**6/9**	**4/9**
Nouns vs Verb		trained: t=.06, p=.96		untrained: t=1.87, p=.10	

Naming: Nonresponders vs Responders

Raymer et al. (2006)

	Noun retrieval Impairment		Verb retrieval Impairment	
	Sem	Phon	Sem	Phon
Respond	3	2	3	2
Nonrespond	3	1	4	0

Treatment effects

Phonologic impairment > Semantic impairment
Within semantics: Mild > Severe

•No improvement:
fluent aphasia/ severe semantic impairment

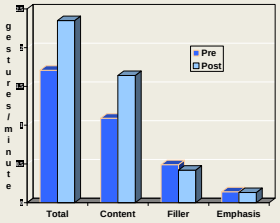
Influence of Limb Apraxia

Raymer et al. (2006)

- No significant correlation between treatment outcomes and limb apraxia
- All participants improved gesture production, regardless of apraxia severity

Raymer et al. (2006)

Conversational Gestures/Minute Pre vs Post Gesture Training



T-test: No significant differences pre vs post

Total: t=1.05, p=.32; Content: t=.78, p=.46;
Filler t=.40, p=.70; Emphasis t=.36, p=.73

Significant Correlations

Raymer et al. (2006)

•Effect sizes for Untrained Verb Gestures & Total Gesture Use (r=.76, p=.02)

•Effect sizes for Untrained Noun Gestures & Total Gesture Use (r=.94, p=.00)

•If participant generalized gesture use in constrained picture naming task, also saw increased gesture use in conversations

Verbal+Gestural Treatment Summary

Large word retrieval effects trained words

Large gesture production effects for trained and some untrained words

Gesture changes in conversation in some participants

Despite neural differences, no apparent differences between nouns and verbs

Problem: Pantomime treatment confounds symbol & movement

Hanlon et al., 1990

Nonsymbolic limb movements may enhance word retrieval

-nonfluents named better when producing distal flexing movements of right hand

Rose & Douglas, 2001

Iconic gestures > visualization, pointing or cued articulation gesture (pointing to mouth)

-only in patients with phonologic retrieval impairments

Think about MIT

- In addition to intonation during training, the clinician taps with the patient's left hand.
- Is tapping playing an important role in MIT effects?
- Boucher et al 2001
- Tones vs rhythmic hand tapping effects during sentence repetition training
- Hand tapping was as effective as intonation alone during training

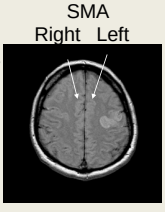
Is simply movement of the limb sufficient to incite word retrieval changes, without an actual pantomime?

Intentional Treatment for Word Retrieval

Richards, Crosson et al., 2002; Crosson et al., 2007

Premise:
Left hemisphere mesial frontal regions (pre-SMA) critical during initiating of language

If damaged or disconnected from left frontal language regions, disrupts ability to initiate language production



If move left limb in a complex action, can activate right pre-SMA regions.

If use left limb movements during word retrieval, perhaps right pre-SMA might facilitate initiation of production – intentional treatment

Intentional Treatment for Word Retrieval

Richards, Crosson et al., 2002; Crosson et al., 2007

During naming practice, patients perform complex movement:
reach into a box and push button,
eventually reduce movement to a circular movement
- left hand in left space

Richards et al. 2002: 8 patients with nonfluent aphasia

7 of 8 improved picture naming for trained words
Some improvements for untrained words

Intentional Treatment for Word Retrieval

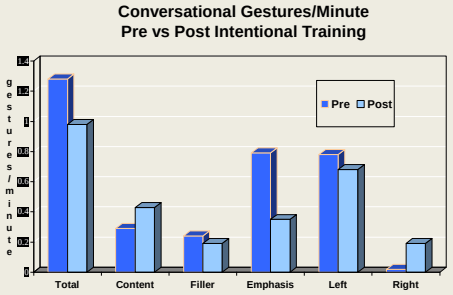
Crosson et al. (2007)

34 patients with mod-profound word retrieval impairments

10 sessions: 5x/wk

Results:	% improvement picture naming	
	trained	untrained
Mod-severe group:	20.23%	15.86%
Profound group:	9.50%	2.73%

Conclusion: Complex limb movement, not necessarily pantomime, may be sufficient to incite training effects



T-test: No significant differences pre vs post

To summarize….

- Aphasic word retrieval can be facilitated through use of
  - Gestural pantomimes – verbal+gestural treatment
  - Nonsymbolic left limb movements – intentional treatment
  - Advantage of pantomimes: compensatory communication
  - Advantage of nonsymbolic movements: can be used for any conversational topic
  - Need to be aware of limb apraxia as it may disrupt ability to use gesture as a compensatory strategy

Restoration versus Reorganization?

Lessons from Constraint-Induced Language Therapy

Constraint Induced Language Therapy (CILT)

(Pulvermuller et al., 2001)

Barrier activity with dyad of patients
Verbal games

Forced use of verbal responses: no compensatory communication strategies

Intensive treatment schedule: 3 hr/day for 2 wks

Results: Forced language group > traditional tx group in auditory comp and naming

Are the results due to forced language use or intensive treatment schedule?

Forced Language Use?
CILT versus PACE: Intensive

Maher et al. 2006

CILT: N = 4 PACE: N=5

TX: 4 days/week, 3 hours/day, 2 weeks = 24 total TX hours

WAB improved: 3/4 CILT, 1/5 PACE
BNT improved: 3/4 CILT, 0/5 PACE
ANT improved: 2/4 CILT, 1/5 PACE

*Intensity also plays a role

ASHA Sponsored First Systematic Review:

Constraint Induced Language Therapy (CILT) for Aphasia

Cherney, Patterson, Raymer et al., 2008

- Public policy or reimbursement issues
- Importance to clients consumers

Framing the clinical question

- Two principles of CILT are intertwined
  - Constraint
  - Intensive/Massed practice
- PICO (Population-Intervention-Comparison-Outcome)
  - P = stroke-induced chronic aphasia,
  - stroke-induced acute aphasia
  - I = CILT and intensive aphasia treatment
  - C = contrasting treatment or no treatment
  - O = measures of language impairment, communication activity/participation (WHO ICF)

5 CILT Questions

- For stroke-induced chronic aphasia, what is the influence of CILT on…
- measures of language impairment?
- measures of communication activity/participation?
- For stroke-induced acute aphasia, what is the influence of CILT on…
  measures of language impairment?
- measures of communication activity/participation?
- For stroke-induced chronic aphasia, what treatment outcomes are maintained following CILT?

5 Intensity Questions

- For stroke-induced chronic aphasia, what is the influence of treatment intensity on…
- measures of language impairment?
- measures of communication activity/participation?
- For stroke-induced acute aphasia, what is the influence of treatment intensity on…
- measures of language impairment?
- measures of communication activity/participation?
- For stroke-induced chronic aphasia, what treatment outcomes are maintained following intensive language treatment?

Search Parameters

- Inclusion:
  - Peer-reviewed English literature from 1990 to 2006
  - Adults with stroke-induced aphasia
  - Direct comparison of CILT with other treatment/no treatment; direct comparison of treatment intensities
  - Extensive Literature Search of several databases

Identified 10 Studies

CILT	Intensity
Maher et al., 2006	Basso & Caporali, 2001
Meinzer et al., 2004	Denes et al., 1996
Meinzer et al., 2005	Hinckley & Craig, 1998
Pulvermuller et al., 2001	Hinckley & Carr, 2005
Pulvermuller et al., 2005	*Pulvermuller et al., 2001*
	Raymer et al., 2006

Evaluating the Evidence - Methodological Quality

ASHA Levels of Evidence Scheme (Mullen, 2007)
Similar to PEDRO scale (Maher et al., 2003)

9 dimensions	Highest quality
Study Design	Controlled trial
Blinding	Assessors blinded
Sampling	Random sample adequately described
Group Comparability/	Groups comparable at baseline or
Participants described	Participants well described
Treatment Fidelity	Evidence provided
Outcomes	Valid & reliable outcome measure
Significance	p value reported/calculable
Precision	Effect size & confidence interval reported/calculable
Intention to Treat *(controlled trials only)*	Analyzed by intention to treat

highest quality indicators across 10 studies of the EBSR

- Design: Controlled trial 5
- Assessor blinded 2
- Random sample well-described 1
- Comparable groups/
- Participants well-described 10
- Treatment fidelity 2
- Valid outcomes 9
- Significance calculable 10
- Precision calculable 7
- Intention to treat 3/5

Quality Scores & Effect Sizes (d) CILT Studies Impairment Outcomes

	Score	Outcome measure	d
Maher et al., 2006	6/9	WAB AQ	1.01
		BNT	-.16
		ANT	.14
Meinzer et al., 2004	4/8	AAT TT	.81
		AAT Profile	.34
Meinzer et al., 2005	5/9	AAT Profile	1.63
Pulvermuller et al., 2001	6/9	AAT Profile	2.18
		TT	.92
		Naming	1.12
		Comprehension	1.12
Pulvermuller et al., 2005	3/8	AAT Token Test	.25
		Repetition	.11
		Naming	.25
		Comprehension	.46

Quality Scores & Effect Sizes (d) CILT Studies Activity/Participation Outcomes

	Score	Outcome measure	d
Maher et al., 2006	6/9	story retelling # wds	-.72
		#utterances	-.82
		#sentences	-.19
		mean length utt.	.33
Meinzer et al., 2005	5/9	Comm Effect. Index	1.86
		Comm Activity Log	
		Quantity Pt.	1.99
		Quantity Fam.	2.35
		Comp. Pt.	.47
		Comp. Fam.	1.1
Pulvermuller et al., 2001	6/9	Comm Activity Log	
		Patient.	3.77
		Family	2.64

Quality Scores & Effect Sizes (d) Intensity studies Impairment Outcomes

	Score	Outcome measure	d	
Denes et al., 1996	7/9	AAT TT	.60	
		Repetition	.39	
		Written Lang	1.20	
		Naming	.73	
		Comprehension	.91	
		Profile	.83	
Hinckley & Craig, 1998	4/8	BNT	1.12	
Hinckley & Carr, 2005	7/9	PALPA Oral Naming	.16	
		Written Naming	1.48	
Pulvermuller et al., 2001	6/9	AAT Profile	2.18	
		TT	.92	
		Naming	1.12	
		Comprehension	1.12	
Raymer et al., 2006 (SSD)	5/8	Picture Naming	Low 4.35	High 11.37
		Pic Name Maint	Low 4.85	High 7.45
		Comprehension	Low 2.72	High 2.14
		Comp Maint	Low 2.14	High 1.75

Quality Scores & Effect Sizes (d) Intensity studies Activity/Participation Outcomes

	Score	Outcome measure	d
Hinckley & Craig, 1998	4/8	Content Units	.53
Hinckley & Carr, 2005	7/9	Catalogue order	
		Oral (Quiet)	-.81
		Oral (Concurrent)	-.05
		Written (Quiet)	-.54
		Written (Concurrent)	.18
		CADL-2	-1.15
Pulvermuller et al., 2001	6/9	Comm Activity Log	
		Patient.	3.77
		Family	2.64

Findings - CILT

- 5 studies with 90 participants
- Language impairment measures:
  CILT resulted in positive changes
- Communication activity/participation measures:
  mixed results; some large positive favoring CILT; some large positive favoring comparison treatment
- Data available only for chronic aphasia. No data speak to the effects of CILT in acute aphasia.
- Maintenance of CILT effects: reported to lead to positive changes; no effect sizes calculable.

Findings - Treatment Intensity

- 6 studies with 68 participants
- Language impairment measures: Increased treatment intensity was associated with positive changes in both chronic and acute aphasia.
- Activity/Participation measures: Equivocal results, favoring neither more intensive nor less intensive treatment for persons with chronic aphasia.
- Maintenance of treatment: little data; also equivocal, favoring more intense treatment for one outcome measure and less intense for the other.

CILT and Treatment Intensity

- Observations suggest that there can be complex interactions among intensity of treatment schedule, type of treatment, and type of outcome measure.
- Forced verbal is important influence
- Intensity also is important factor

Here's Some Evidence….

Several effective methods available for treatment of word retrieval impairments

Effects are mostly training specific unless provided in intensive or extended schedules

How can we extend our treatment effects given limited treatment resources?

computers
groups
caregiver training

Where:
Neural Correlates of Word Retrieval Treatment

Structural Variables – Aphasia Recovery
Word Retrieval/Naming

- Critical cortical regions for naming recovery

Hillis et al 2006

-perfusion- and diffusion-weighted imaging to assess dysfunctional brain regions at stroke onset
-3-5 days later, evaluated which re-perfused brain regions associated with increased naming abilities

- left posterior middle temporal/fusiform gyrus,
- Wernicke's area – left superior temporal
- Broca's area – left inferior frontal

Structural Variables – Aphasia Recovery
Word Retrieval/Naming

Poor recovery of word retrieval associated with:
- larger lesions (>60 cm^3)
- extensive lesions affecting left superior temporal and inferior parietal regions
-less severe but persistent problems associated with insula & putamen lesions

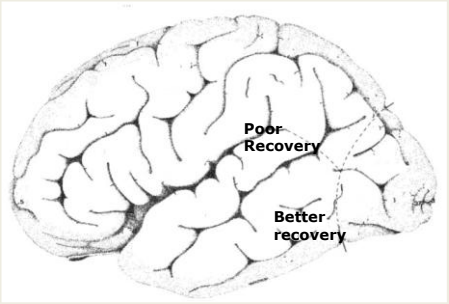
Knopman et al., 1984

-not clear whether pts involved in treatment

Considerable spontaneous recovery of naming functions in patient with inferior temporal lesion (area 37)

Raymer et al 2000

Naming Recovery



-Pertains to noun recovery
-Little information about recovery of verbs

Structural Predictors of Word Retrieval Treatment Response

Despite fact that word retrieval treatment very common for aphasia, limited evidence of neural correlates of response to word retrieval treatment

Intentional treatment for word retrieval in aphasia
-poorer treatment success in pts with lesions in:
- Wernicke's area
- left supramarginal gyrus
- anterior and posterior periventricular white matter
- left insula

Cato et al. 2006

Word Retrieval Impairments in Aphasia

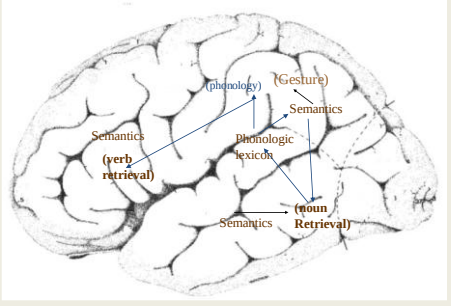
Common across aphasia syndromes Goodglass et al., 2000

Noun Retrieval Impairments
-often greater than for verbs in fluent aphasias
-associated with *left inferior temporal* lesions

Verb Retrieval Impairments
-often greater than nouns in nonfluent aphasias
-associated with *left inferior frontal* lesions

Noun & Verb Retrieval Impairments common in many individuals
Damasio et al., 1993, Hillis et al., 2002; Miceli et al., 1984; Tranel et al., 1997; Zingeser & Berndt, 1990

Neural differences for noun & verbs may translate to differences in word retrieval treatment response



Neural Correlates of Successful Treatment of Word Retrieval Impairments

Raymer 2002

14 participants in word retrieval treatment studies:
- word retrieval impairments/no severe apraxia of speech
- i.e. able to repeat words

Treatments: Restitutive semantic-phonologic
Substitutive Verbal + Gestural

- 13 received noun retrieval training
- 11 received verb retrieval training
  - 3 only noun, 1 only verb
  - -order counterbalanced

Mapped CT/MRI scans of 10 participants (Damasio et al., 1989)
Reports from 4 others

Response to Noun Treatment

Improvement		Lesion localization in Left Hemi				
6 signif		white	inf front	39/40	22	37
Wre	nonfl	frontal>post				
Aw	nonfl	frontal>post	XX			
Js	nonfl	frontal>post	XX	XX		
Mq	nonfl	frontal>post	XX	XX		
Ac	nonfl	frontal>post	XX		X	
Drs	fl	frontal				
2 mild						
Jl	fl	post			X	
Sd	nonfl	front>post	XX	XX		
5 no resp						
Rc	fl	post		XX	X	X
Bj	fl	post		X	XX	
Rs	fl	post		XX	XX	XX
Dr	nonfl	post		XX	XX	
Ep	nonfl	front>post	XX	XX		

Response to Verb Treatment

Improvement		Lesion localization in Left Hemi				
5 signif		white	inf front	39/40	22	37
Wre	nonfl	frontal>post				
Wra	nonfl	frontal	XX			
Js	nonfl	frontal>post	XX	XX		
Mq	nonfl	frontal>post	XX	XX		
Ac	nonfl	frontal>post	XX		X	
1 mild						
Bj	fl	post		X	XX	
5 no resp						
Rs	fl	post		XX	XX	XX
Dr	nonfl	post		XX	XX	
Jl	fl	post			X	
Sd	nonfl	front>post	XX	XX		
Ep	nonfl	front>post	XX	XX		

Neural Correlates of Successful Word Retrieval Treatment

Parkinson et al. (2006)

15 participants in word retrieval treatment studies:
retrievable CT (n=7) or MRI (n=8) scans

	Noun Tx	Verb Tx
Sem-Phon	n=6	n=4
Verbal+Ges	n=7	n=8
Total	n=13	n=12

Lesion Ratings of 29 cortical and subcortical regions on 6 point scale (Naeser et al., 1989)
2 raters (r=.887)

Partial Correlations between Naming Improvements (d) and Cortical Lesion extent controlling for Basal Ganglia lesion

Parkinson et al. (2006)

Anterior lesion x Noun improvement	.858	<.0005
Posterior lesion x Noun improvement	.373	.232
Anterior lesion x Verb improvement	.821	.002
Posterior lesion x Verb improvement	-.256	.448

-the larger the anterior lesion, the greater improvement associated with treatment - for both nouns and verbs

Partial Correlations between Naming Improvements (d) and Basal Ganglia Lesion extent controlling for Frontal lesion

Parkinson et al. (2006)

	r	p
Anterior lesion x Noun improvement	-.749	.005
Posterior lesion x Noun improvement	.249	.434
Anterior lesion x Verb improvement	-.785	.004
Posterior lesion x Verb improvement	-.159	.641

-the smaller the anterior basal ganglia lesion, the better the response to word retrieval treatment
---for both nouns and verbs

Interpretations: "Noisy Output"

Parkinson et al. 2006

- Smaller anterior lesions generate noisy, imperfect output
- Larger anterior lesions eliminate 'noisy' activity and competition with other regions for recovery of function
- Basal ganglia allow suppression of 'noisy' activity of the cortical regions

Why no differences: Neural Networks of Nouns vs Verbs

Functional Neuroimaging Studies

Nonoverlapping networks

(e.g., Kable et al., 2002; Shapiro et al, 2005)

- Left Inferior Frontal – verb mediation
- Left/Bilateral Ventral Temporal – noun mediation

Overlapping networks

(e.g., Soros et al., 2003; Tyler et al., 2001)

So…. What are the neural regions mediating word retrieval recovery?

- Studies of word retrieval recovery and treatment suggest important role of left perilesional cortex
  (e.g., Fernandez et al., 2004; Leger et al., 2002; Thulborn, Carpenter & Just, 1999; Cornelissen et al., 2003)
- Other patients show contralesional changes
  (e.g., Peck et al 2004; Crosson et al., 2005)
- And still others show bilateral changes
  (e.g., Crosson et al., 2005; Pulvermuller et al., 2005; Winhuisen et al., 2005)

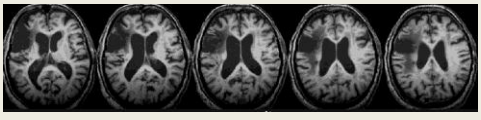
fMRI Pre- & Post- Noun Retrieval Treatment

Moore et al., 2004

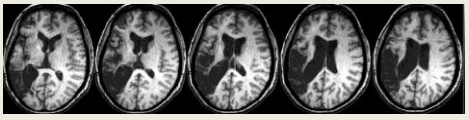
P115 – 81 years old, 5 years post stroke,
right hemiplegia, nonfluent aphasia
semantic+phonologic treatment
Phase 1: nouns

P105: 49 yr old woman, 3 years post stroke
verbal+gestural treatment
Phase 2: nouns

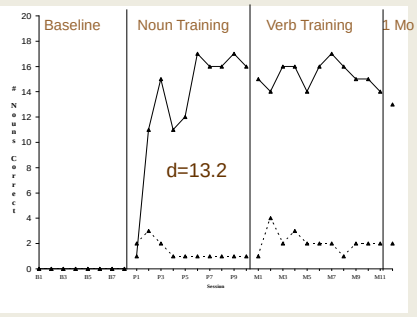
S115 Structural Scan: Left frontal-subcortical lesion



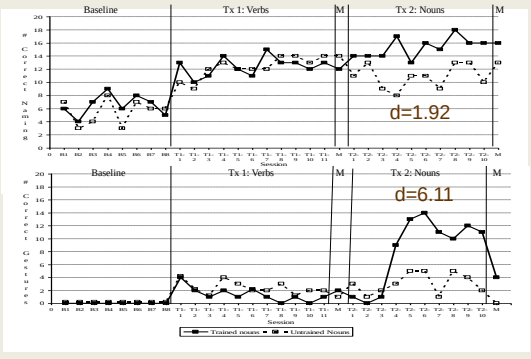
S105 Structural Scan: Left temporal-parietal



S115: Picture naming accuracy for trained nouns and untrained nouns following semantic-phonologic training



P105 Naming and Gesture Production for trained and untrained Nouns: Verbal+Gestural Treatment



fMRI Procedures

Scanner. 1.5 T GE Signa;
Dome-Shaped Quadrature RF Head Coil

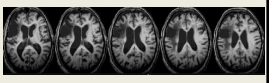
Functional Images. 2-Interleave Spiral Scan,
Gradient Echo Pulse Sequence, TE=40 ms

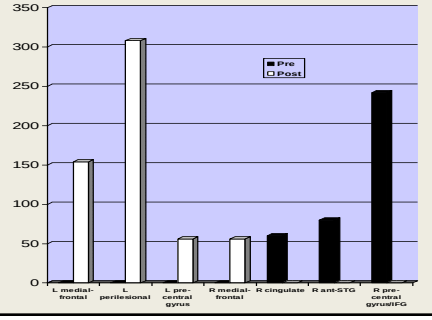
Structural Images. Spoiled GRASS Sequence

Task. Overt naming of viewed line drawings of objects used in treatment study

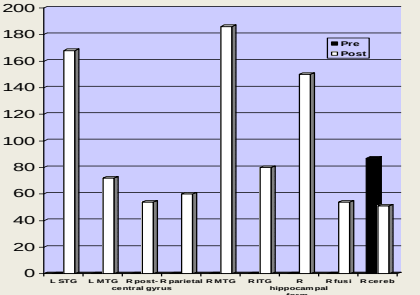
Analyses. Hemodynamic responses during naming deconvolved from baseline resting state of activation

P1115 Left frontal lesion
Post Noun training:
Increased Left frontal
Reduced Right frontal

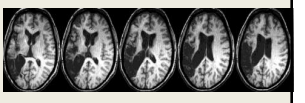


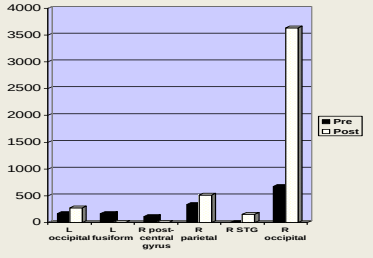


P115 Left Frontal Lesion
Post Noun Training:
Increased Bilateral posterior

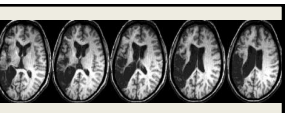


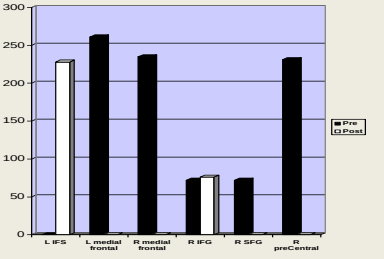
P105: Left Posterior Lesion
Post Noun Training:
Increased Right Posterior





P105: Left Posterior Lesion
Post noun training:
Increased Bilateral Inferior Frontal





Summary of Neural Findings

Greater improvements in word retrieval training for nouns and verbs when preserve
- left posterior cortex
- left basal ganglia

Word retrieval training improvements mediated by:
- Patient with left frontal lesion (large effect size)
  - left frontal
  - bilateral posterior cortex
- Patient with left posterior lesion (smaller effect size)
  - left frontal
  - right posterior

What determines neural reorganization in left perilesional vs right hemisphere?

- Smaller left hemisphere lesions allow for perilesional mediation
- Larger left hemisphere lesions require more right hemisphere mediation Crosson et al (2008)
- Neural mediation may change over time
  - Acute - little activation of perilesional or right
  - Subacute – more right hemisphere mediation
  - Chronic – more left perilesional mediation

  Saur et al 2006
- Better treatment response seen when perilesional left hemisphere regions engaged compared to right homologous regions Heiss & Thiel 2006

WHO, What, and Where

- Good deal of evidence
- Still more to learn
- Use clinical judgment, patient values to make best decision for each patient

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