Treatment Sequences to Maximize Recovery from Aphasia

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  - *Developing an Evidence-Based Treatment Continuum for Spoken and Written Language* (R01DC007646-08)

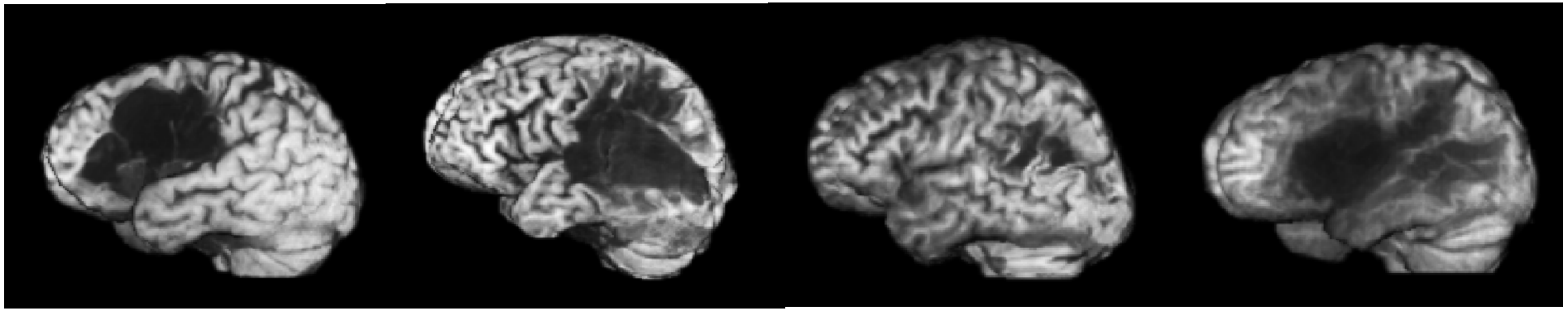
- Pélagie Beeson is employed by the University of Arizona, and has no other financial or nonfinancial relationships to disclose.

Overarching research question: How do we maximize recovery from aphasia?

- Primary goal of the Aphasia Research Project is to develop and test treatments intended to maximize recovery from spoken and written language impairment
  - We aim to
    - understand the nature of the impairment (behavioral and neural underpinnings)
    - develop treatment sequences that build upon one another
    - examine behavioral and neural changes in response to treatment

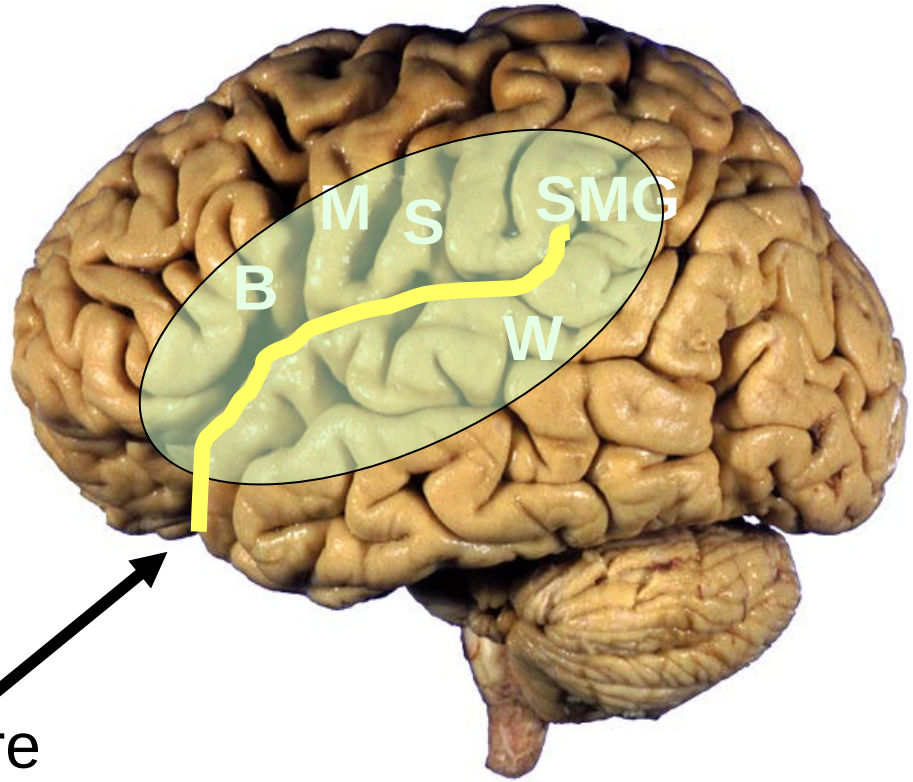
Left middle cerebral artery stroke

- Most common cause of aphasia
- Disrupts vascular support for left perisylvian brain regions
- Damage results in classic “perisylvian” aphasia types



Broca’s Wernicke’s Conduction Global

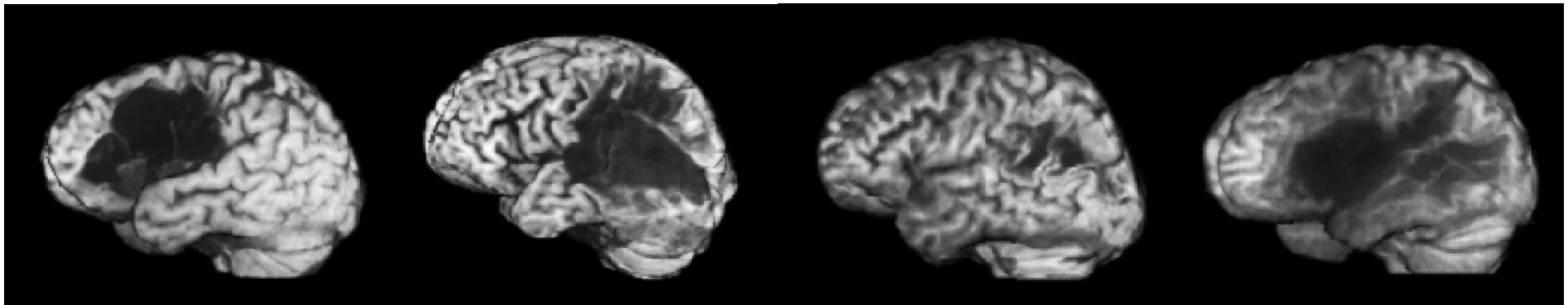
Left perisylvian region



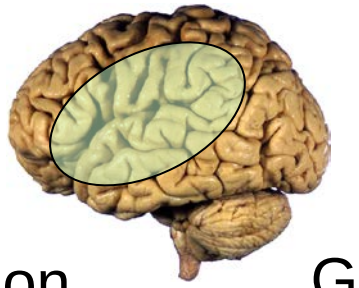
Sylvian Fissure

B = Broca's area
M = Primary Motor
S = Somatosensory
SMG = Supramarginal gyrus
W = Wernicke's area

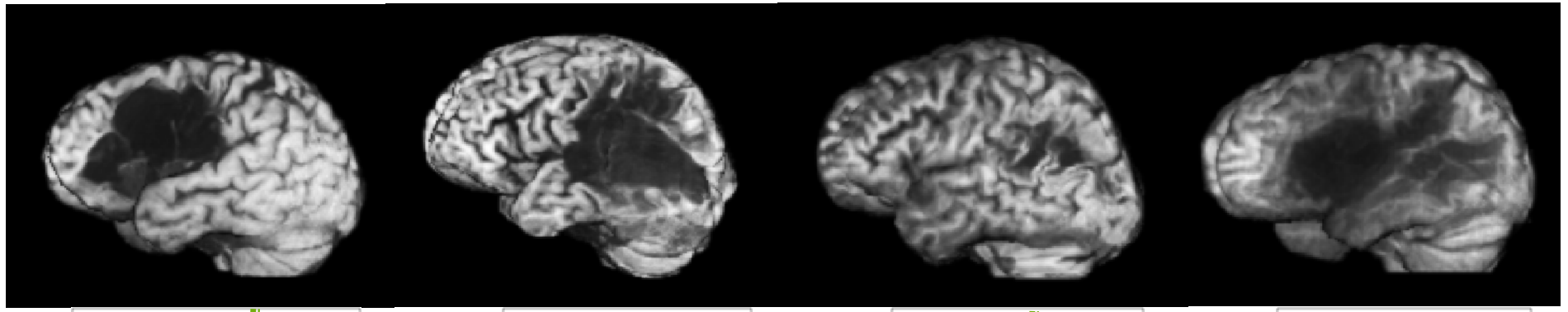
Damage to left perisylvian region due to strokes.

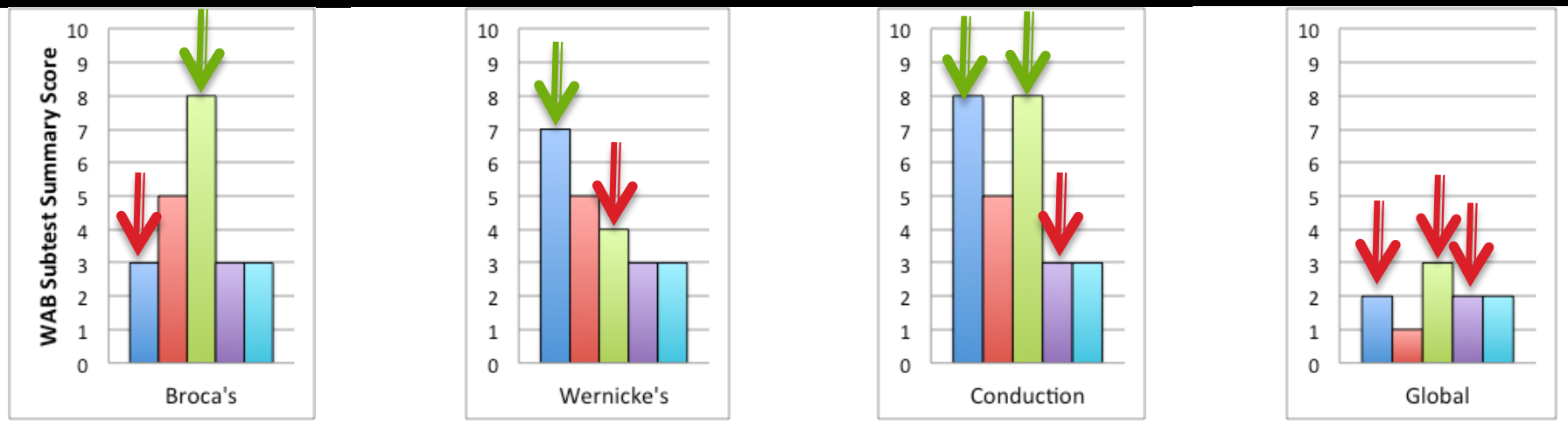


Perisylvian Aphasias



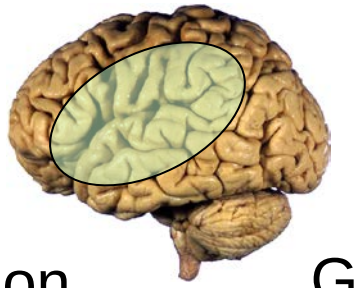
Broca's Wernicke's Conduction Global



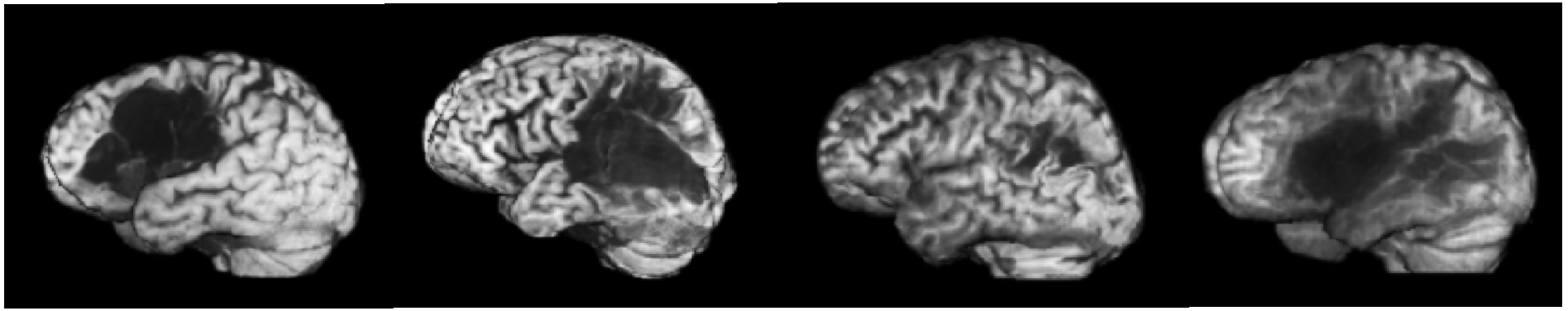


Aphasia profiles vary with regard to comprehension and production of language.

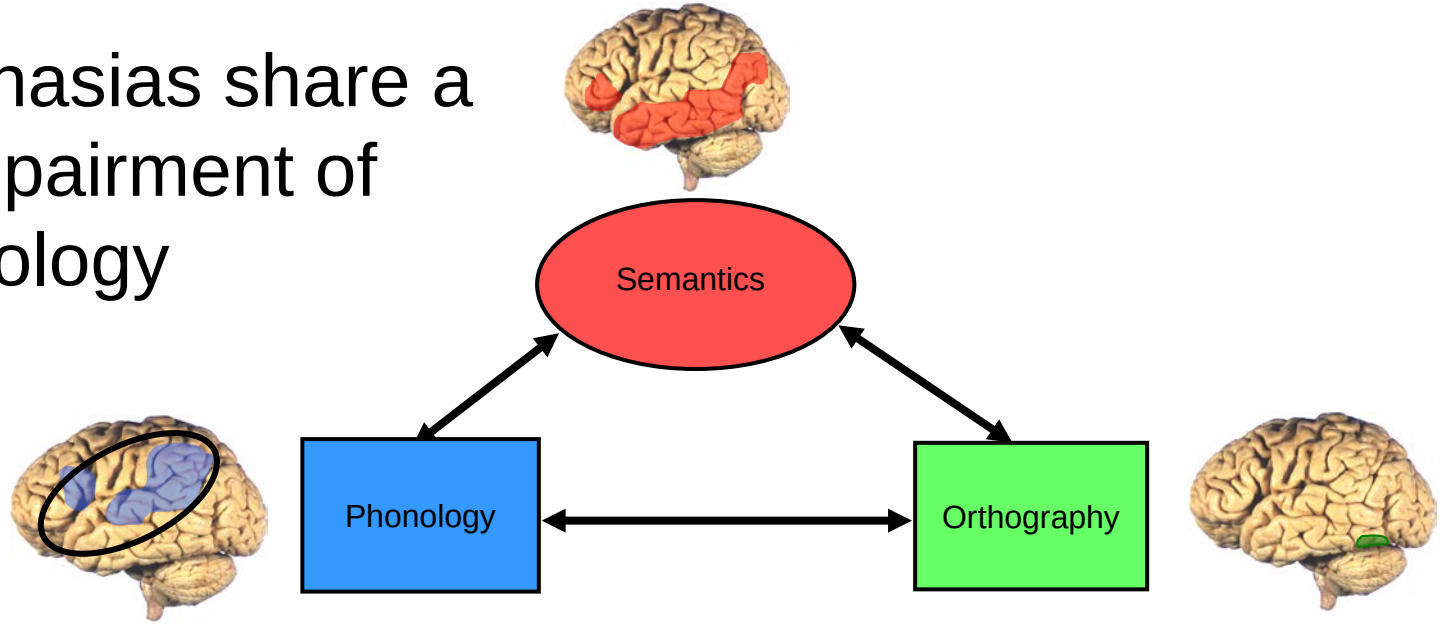
Perisylvian Aphasias



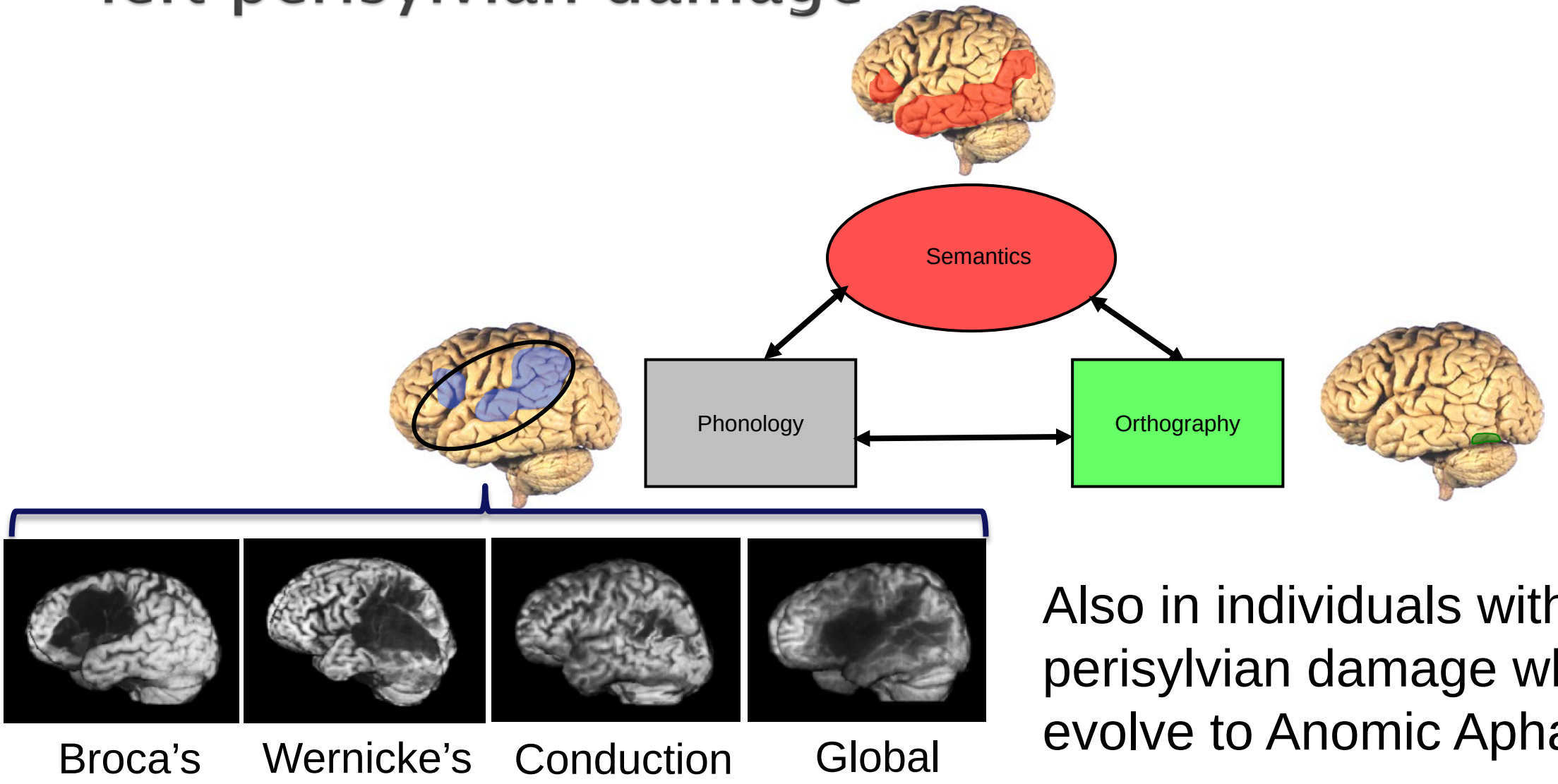
Broca's Wernicke's Conduction Global



Perisylvian aphasias share a common impairment of phonology



Phonological impairment is common following left perisylvian damage



Broca's Wernicke's Conduction Global

Also in individuals with perisylvian damage who evolve to Anomic Aphasia

What does phonological impairment look like?

"No, there's too many things… too many things different… There's too many things"

"pa…puh… puh…puh… piles"

"*kofale*….We have thousands of those in our …. all around it… where we live. They're all over the place… And they're good to eat."

phonemic paraphasias

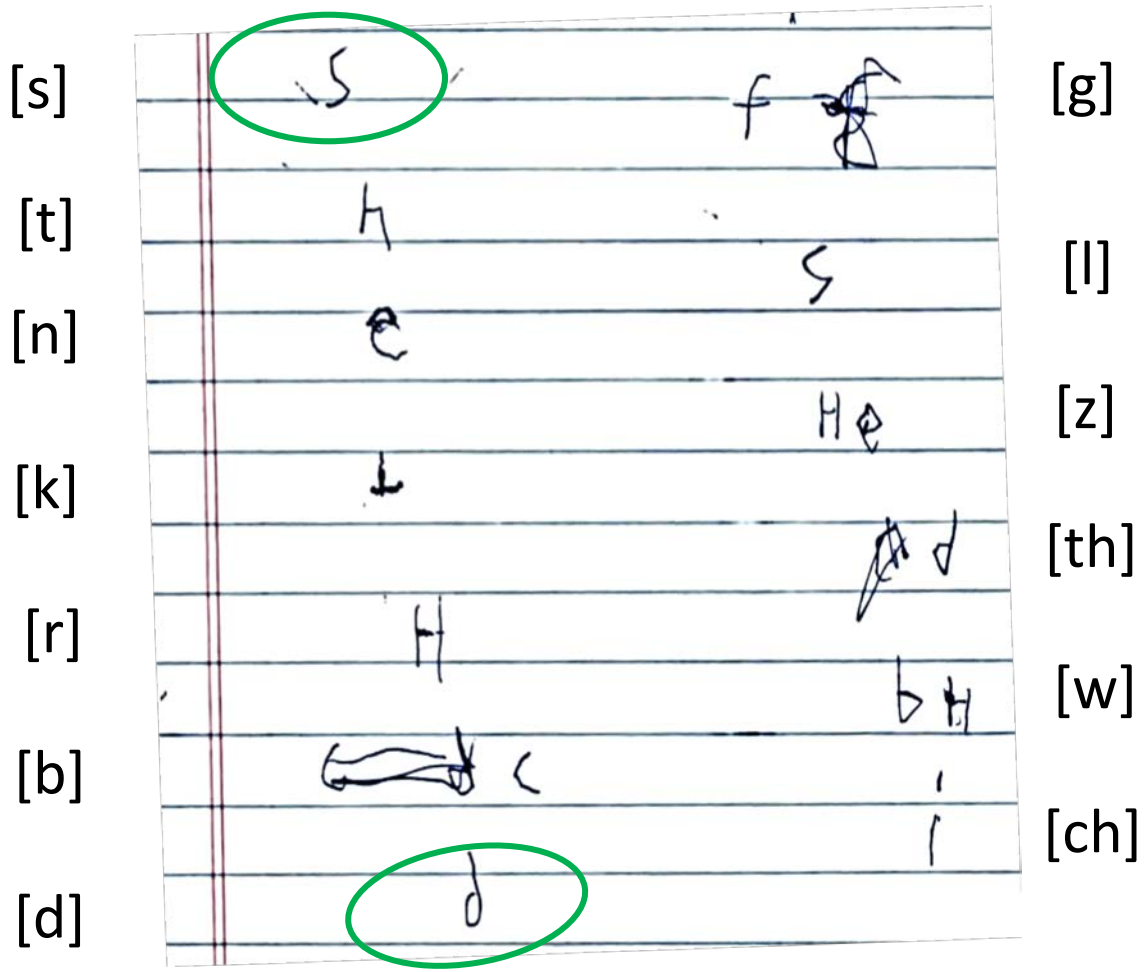
What does phonological impairment look like?

Impaired phonological awareness and phonological manipulation skills

/d/-/I/-/g/ [dig]
/p/-/A/-/t/ [pat]
/b/-/oI/-/l/ [boil]

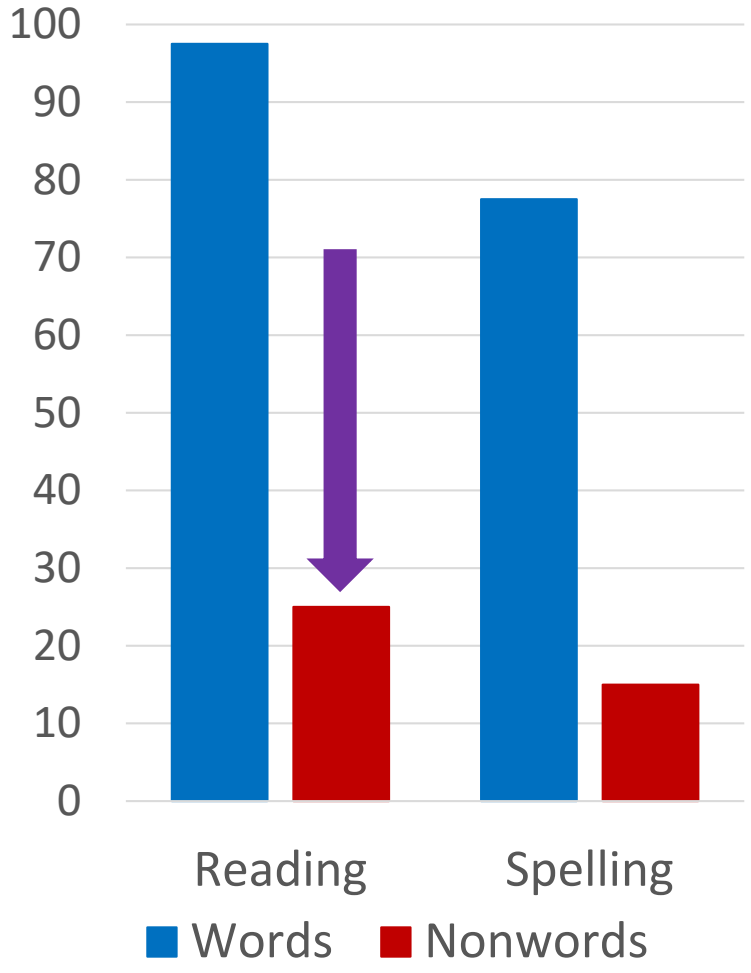
Impaired sound-letter correspondences

“Write the letter that goes with the sound.”



2/20 correct

Phonological Alexia



Arizona Battery for Reading and Spelling
(http://www.aphasia.arizona.edu/)

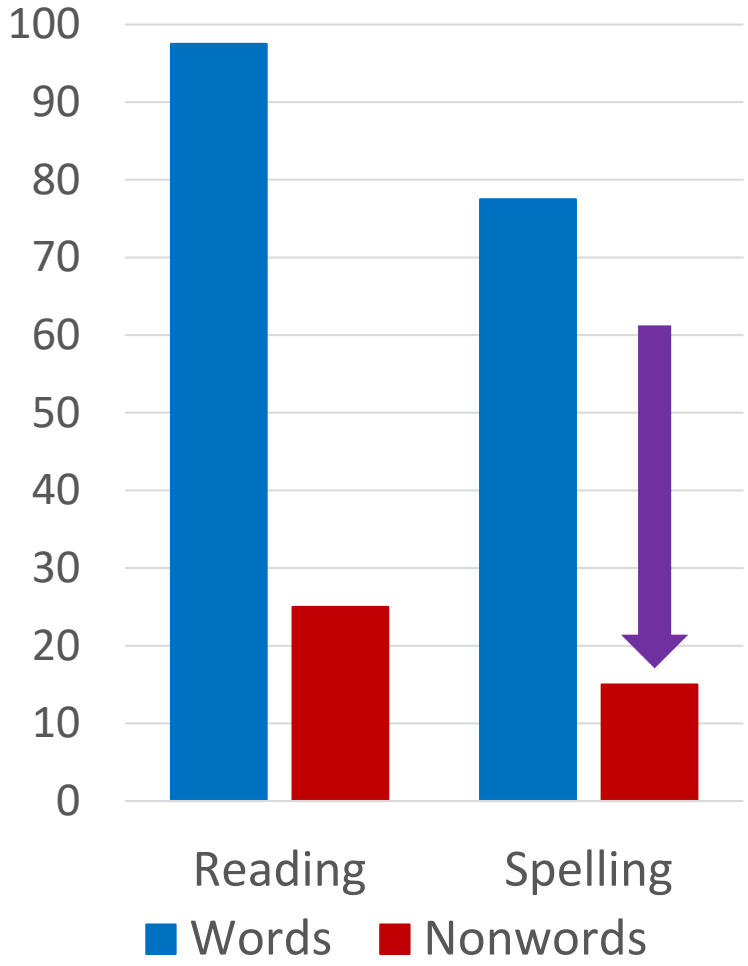
Reading Words

machine +
head +
laugh +
kept +
storm +
count +
glacier +
bribe +

Reading Nonwords

dringe *"princh"*
mofer *"morph"*
andon *"annock"*
barcle *"bercel"*

Phonological Agraphia



Arizona Battery for Reading and Spelling
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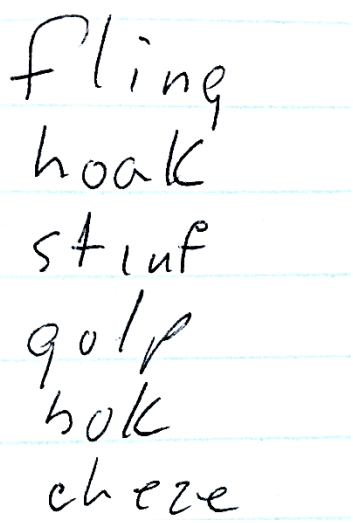
Spelling Words

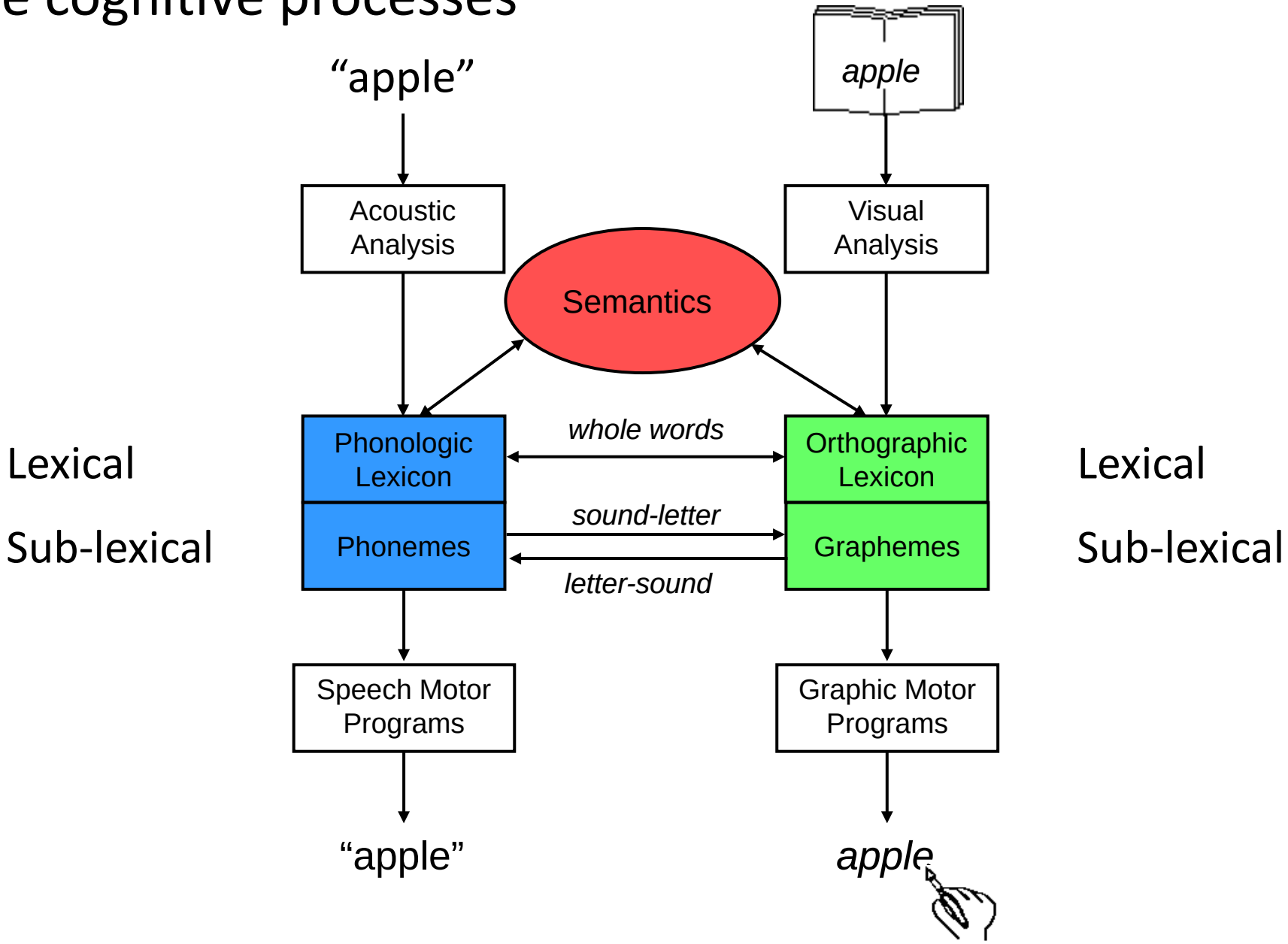
vague +
field +
bump +
debt +
pint +
trade +
gross -

Spelling Nonwords

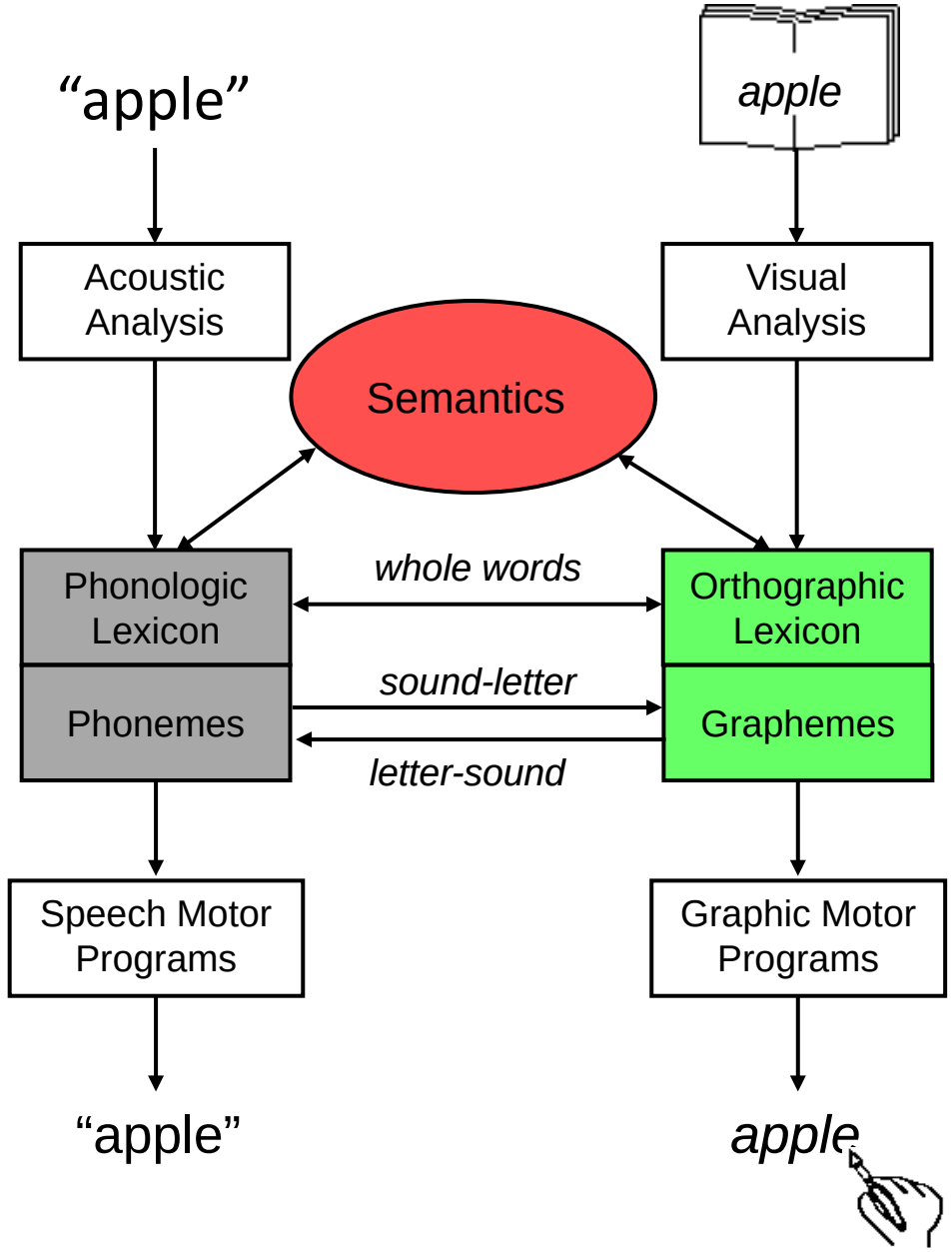


flig -
hoach -
snite -
glope -
boak +
cheed -

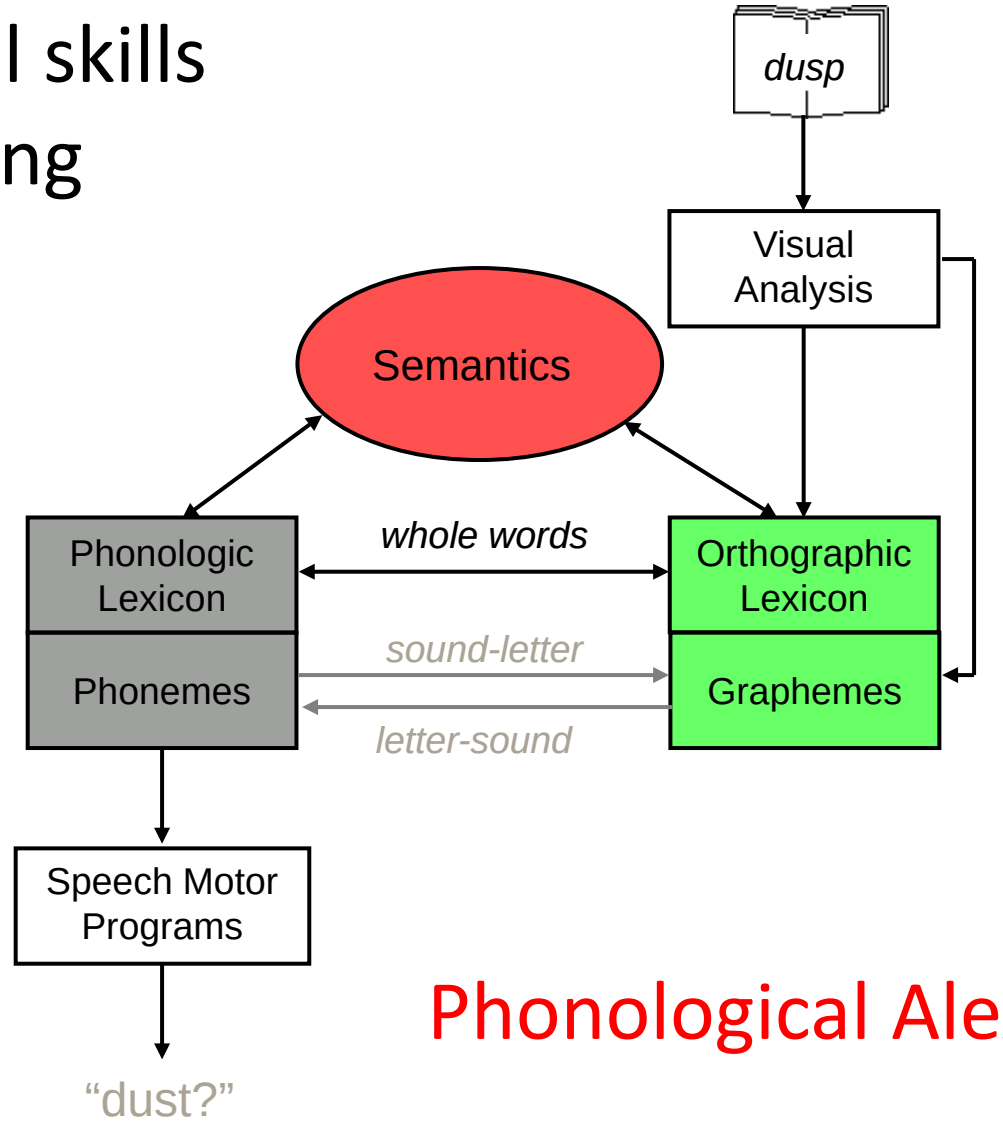
Consider the cognitive processes



Phonological Impairment



Testing phonological skills with nonword reading



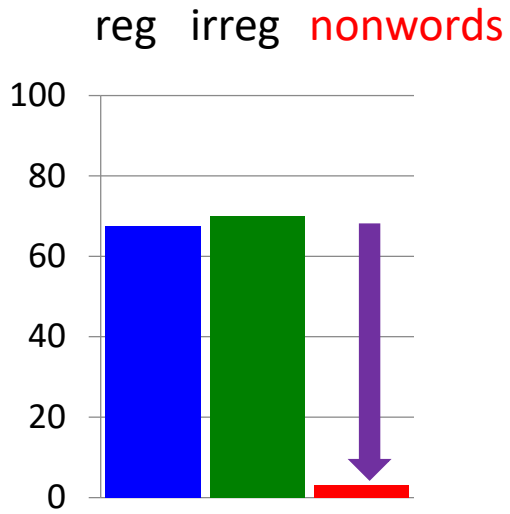
Can't use sublexical route to assist with reading

Can't sound out words or nonwords

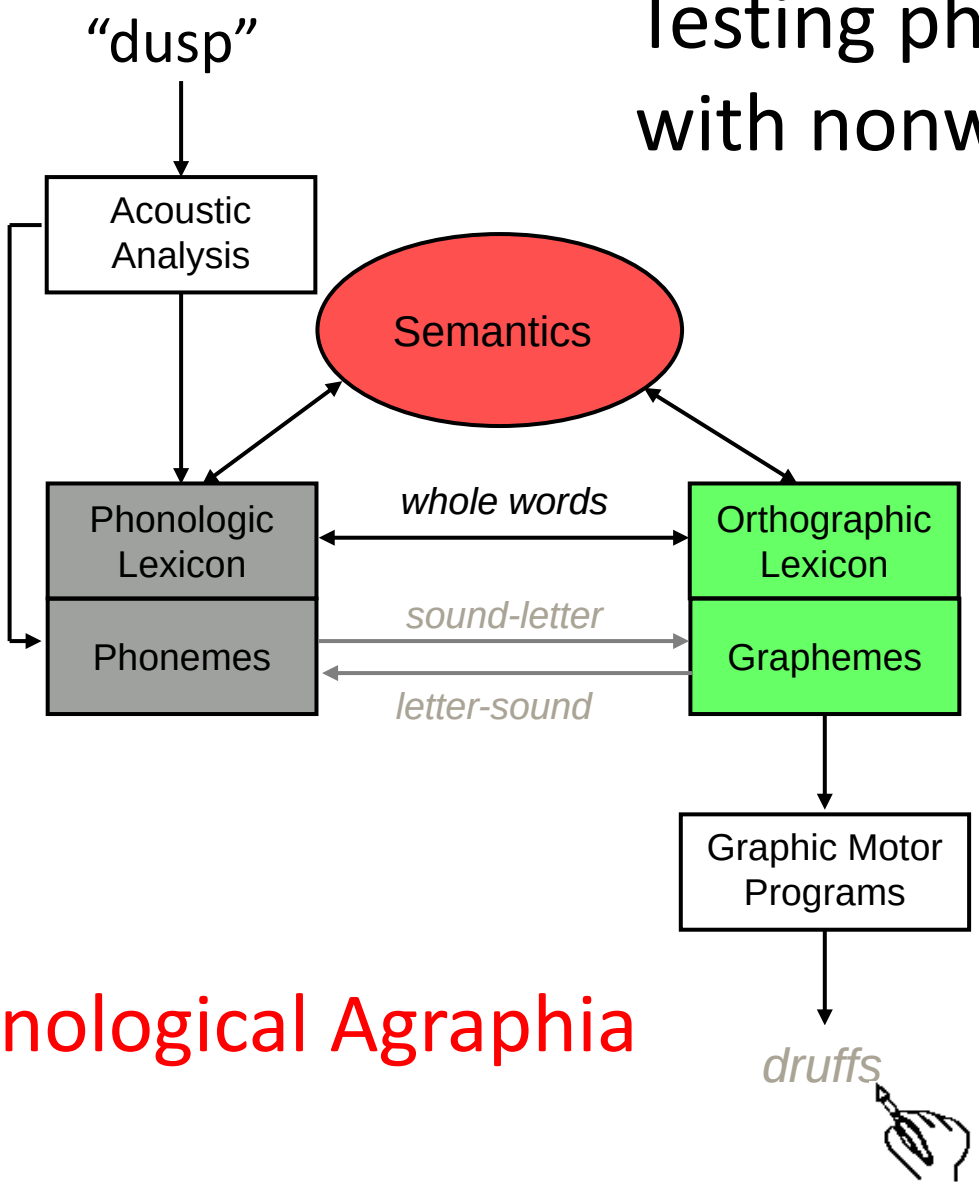
Lexical

Sub-lexical

Phonological Alexia

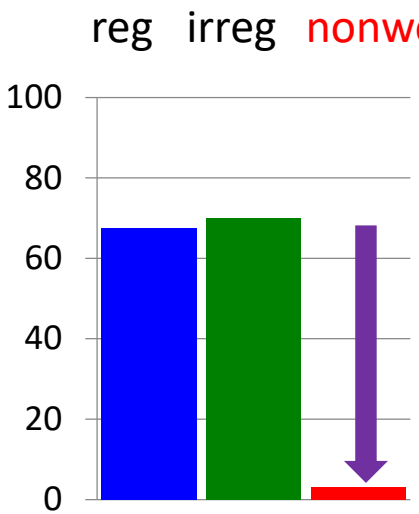


Testing phonological skills with nonword spelling



Lexical

Sub-lexical



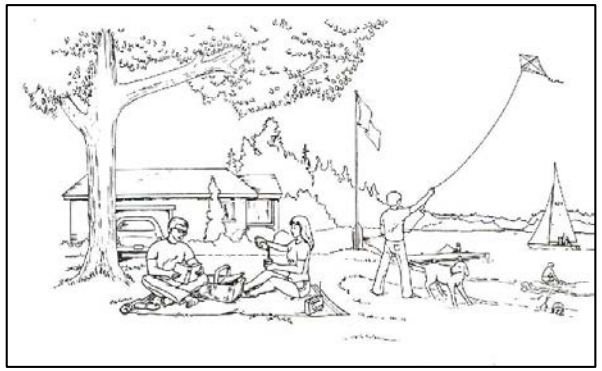
Phonological Agraphia

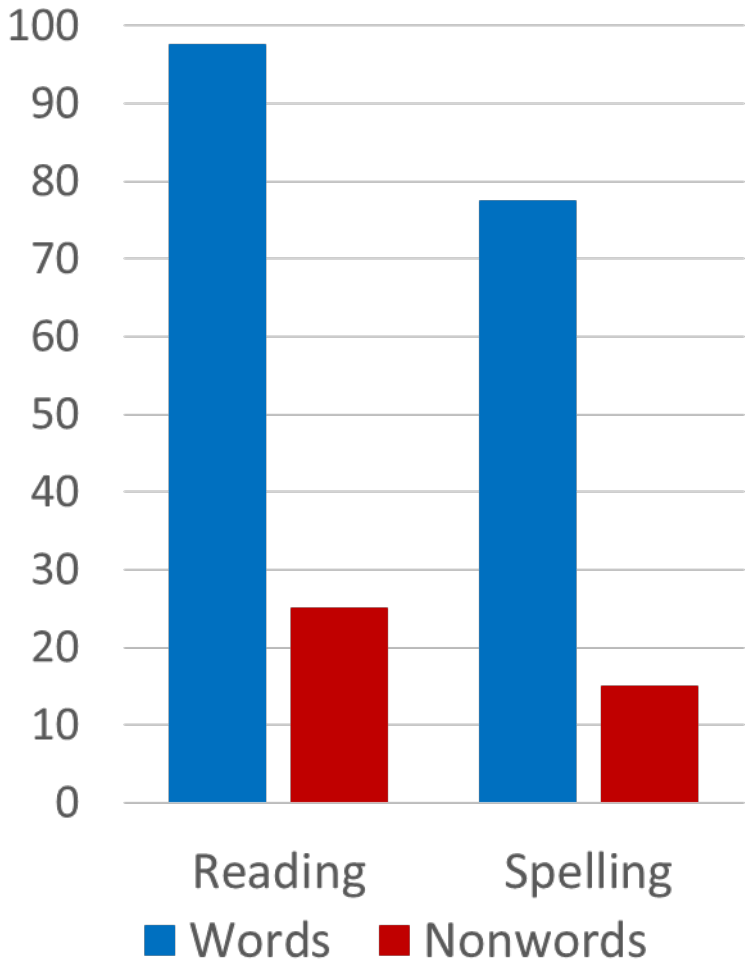
Can't use sublexical route to assist with spelling

Can't sound out spellings for unfamiliar words or nonwords

Anomic Aphasia with Phonological Alexia/Agraphia

- 4 months post LMCA stroke
  - Anomic aphasia
    - WAB: 82.2
    - BNT: 50/60

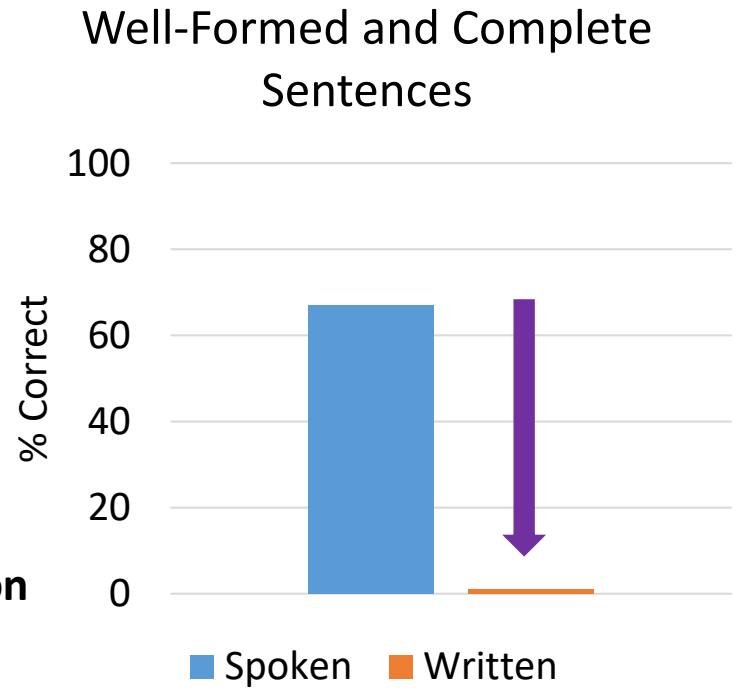




"This guy flying a kite. Um, he's walking a dog, or his dog's walking him, I dunno. Um, this man is fishing….. This man or, man, or m-, is um sailing…This couple is reading a book and pouring a wine. Or listening to the radio. Um… there car in the garage... The frag up the pole… Uh… um it's a scenery behind 'em… I don't know."

Phonological impairment has striking effect on sentence-level writing!

- 4 months post LMCA stroke
  - Anomic aphasia
    - WAB: 82.2
    - BNT: 50/60



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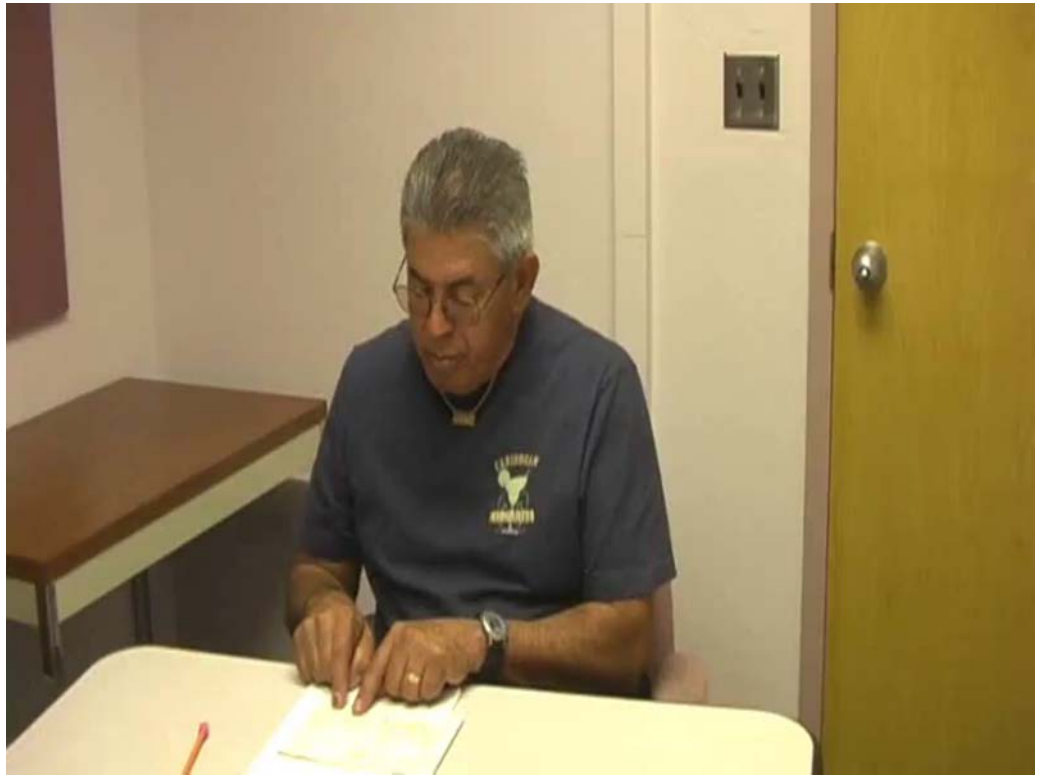
Written picture description

Dog is cuming
Man is fly kite
sailboat
lady & guy the picnic and book and with wine

Phonological Text Agraphia

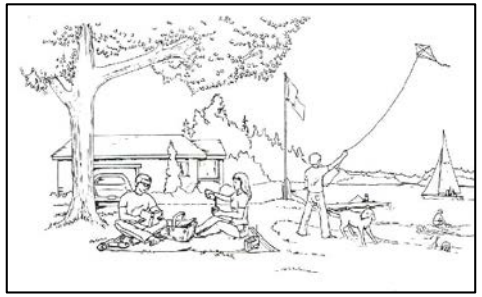
Beeson, Rising, et al. (2016)
Neuropsychological Rehabilitation

Broca's Aphasia with Alexia/Agraphia

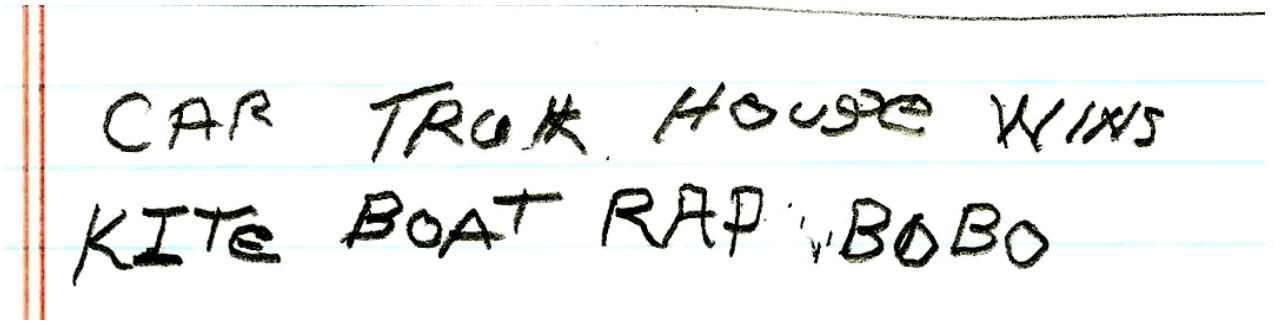


"Bobo … one … Bobo one … bye… bye"

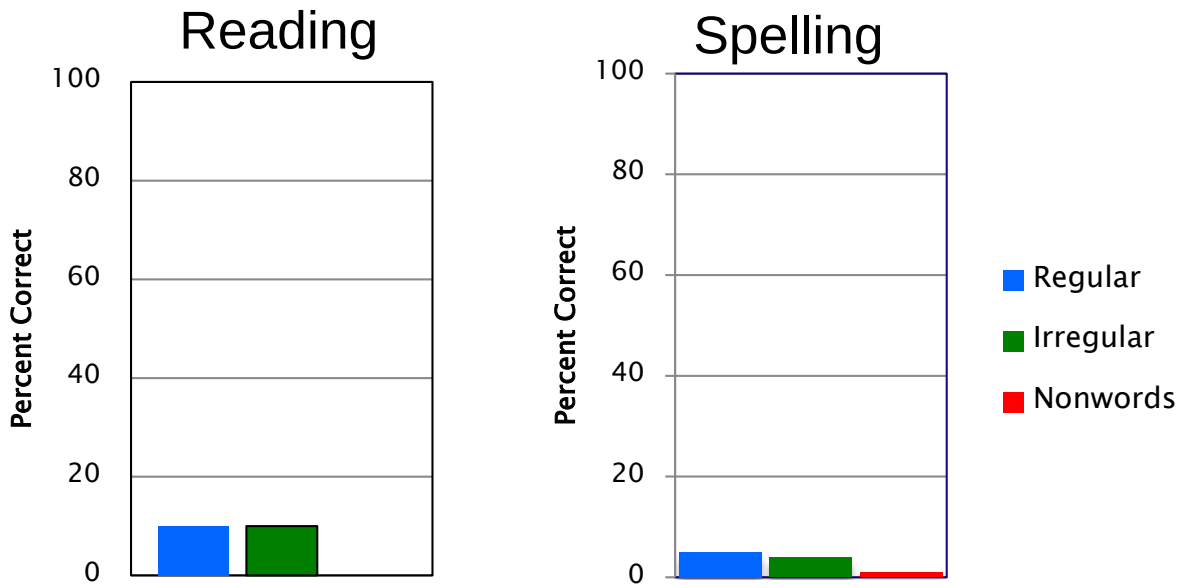
- 2 years post left MCA stroke
- Broca's Aphasia with severe apraxia of speech
- AQ = 40



Written picture description

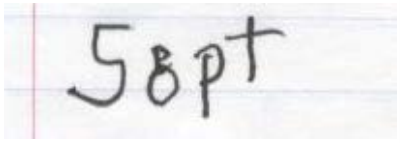
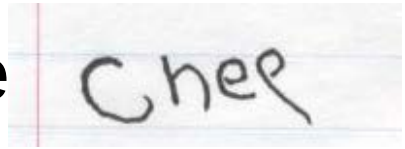
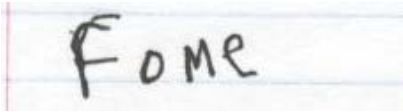
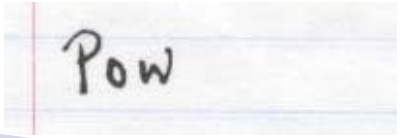
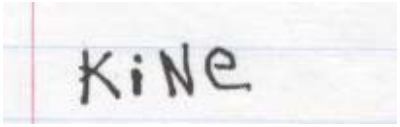
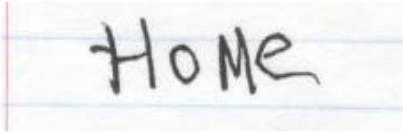


Phonological + Lexical Impairment



Global Alexia

Global Agraphia

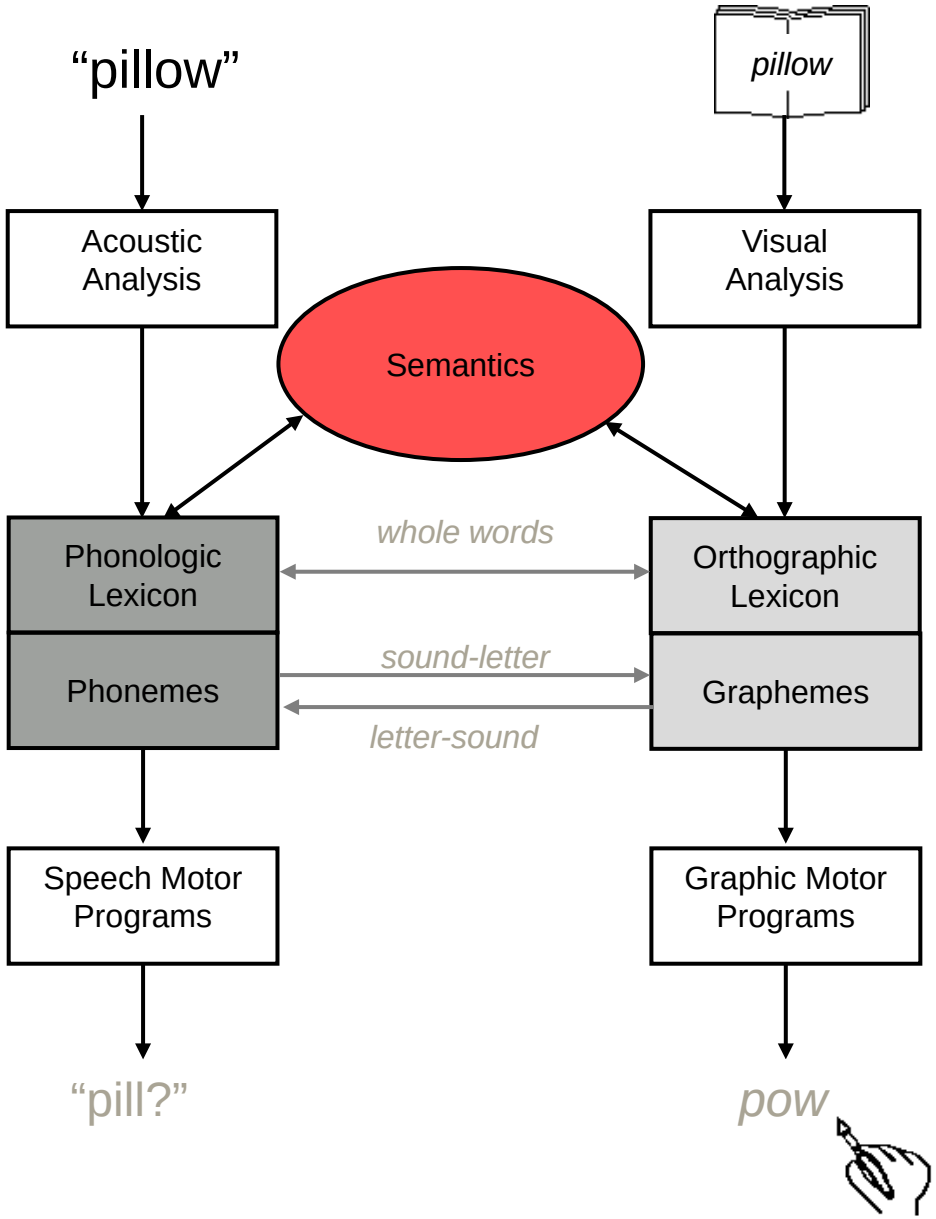
Regular Words		Irregular Words		Nonwords	
stop		castle		flig	
pillow		type		hoach	

Phonological Impairment

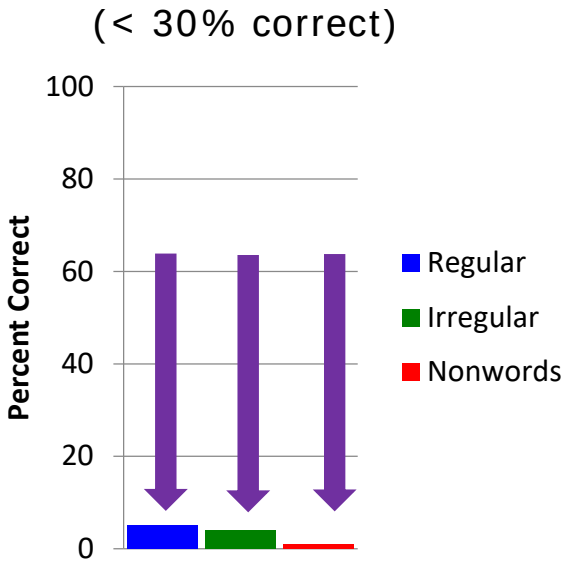
plus lexical-semantic and orthographic impairment

Lexical

Sub-lexical



Global Alexia/Agraphia

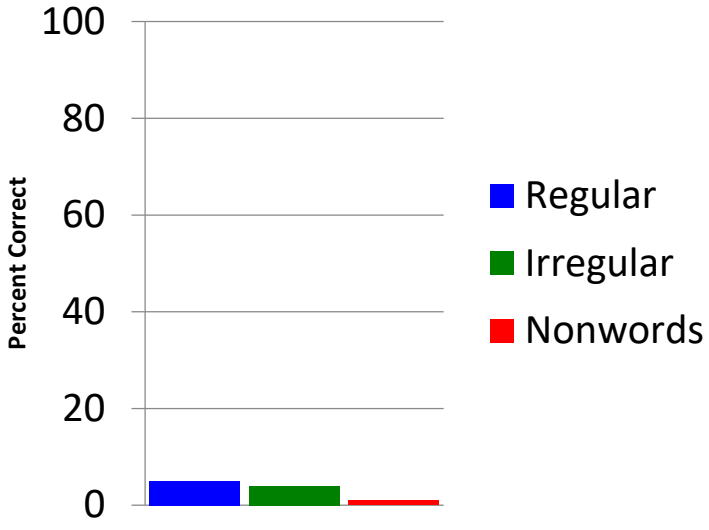


Two Profiles with Perisylvian Damage showing Phonological Impairment

Global Agraphia

Lexical-Semantic & Phonological Impairment

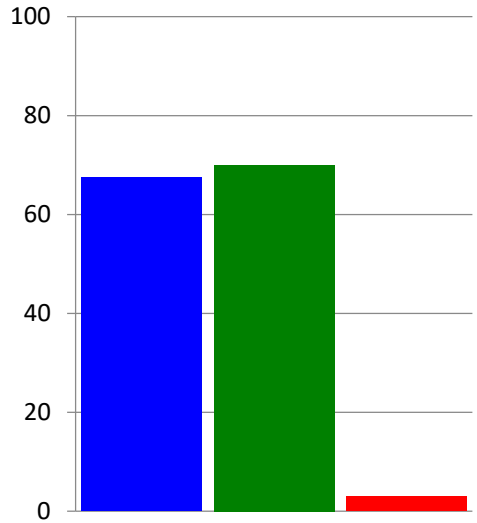
ABRS* (< 30%)



Phonological Agraphia

Predominantly Phonological Impairment

(lexicality effect)

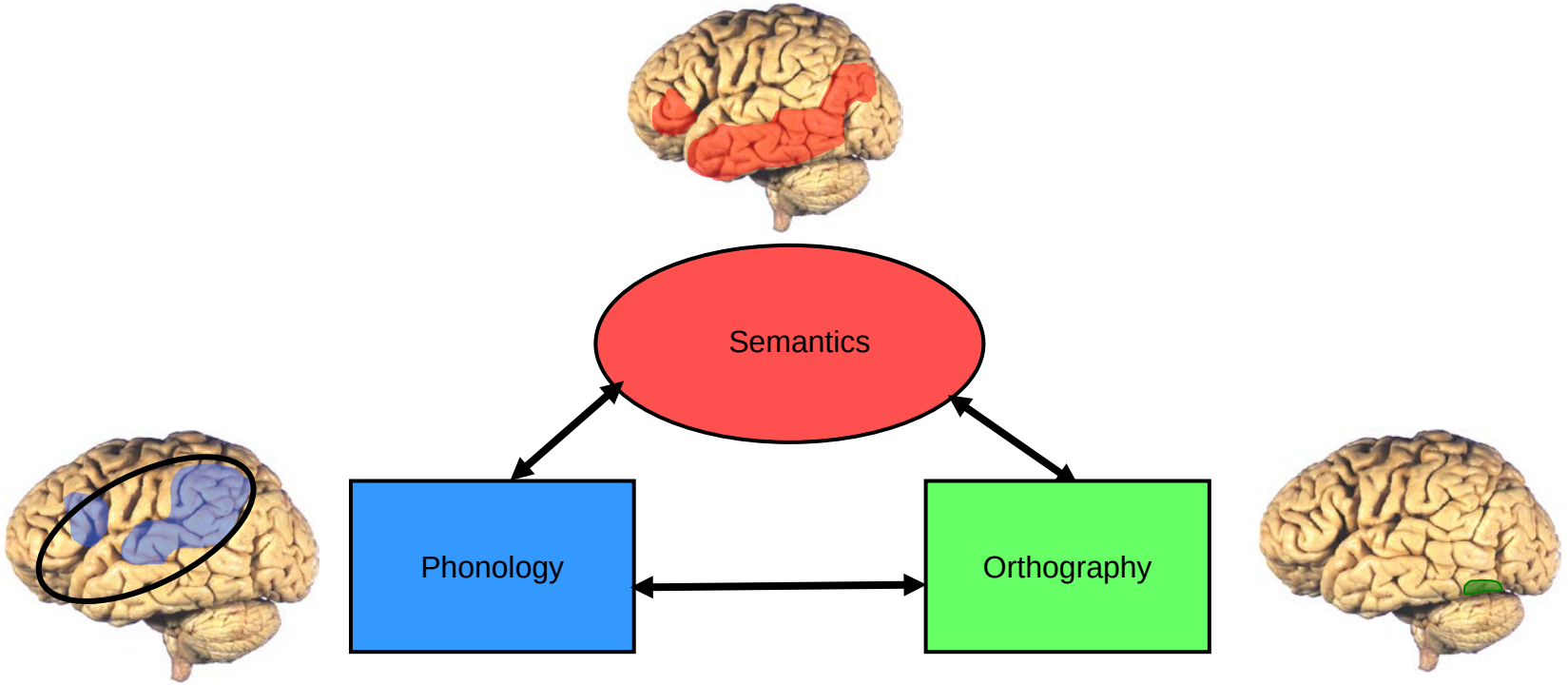


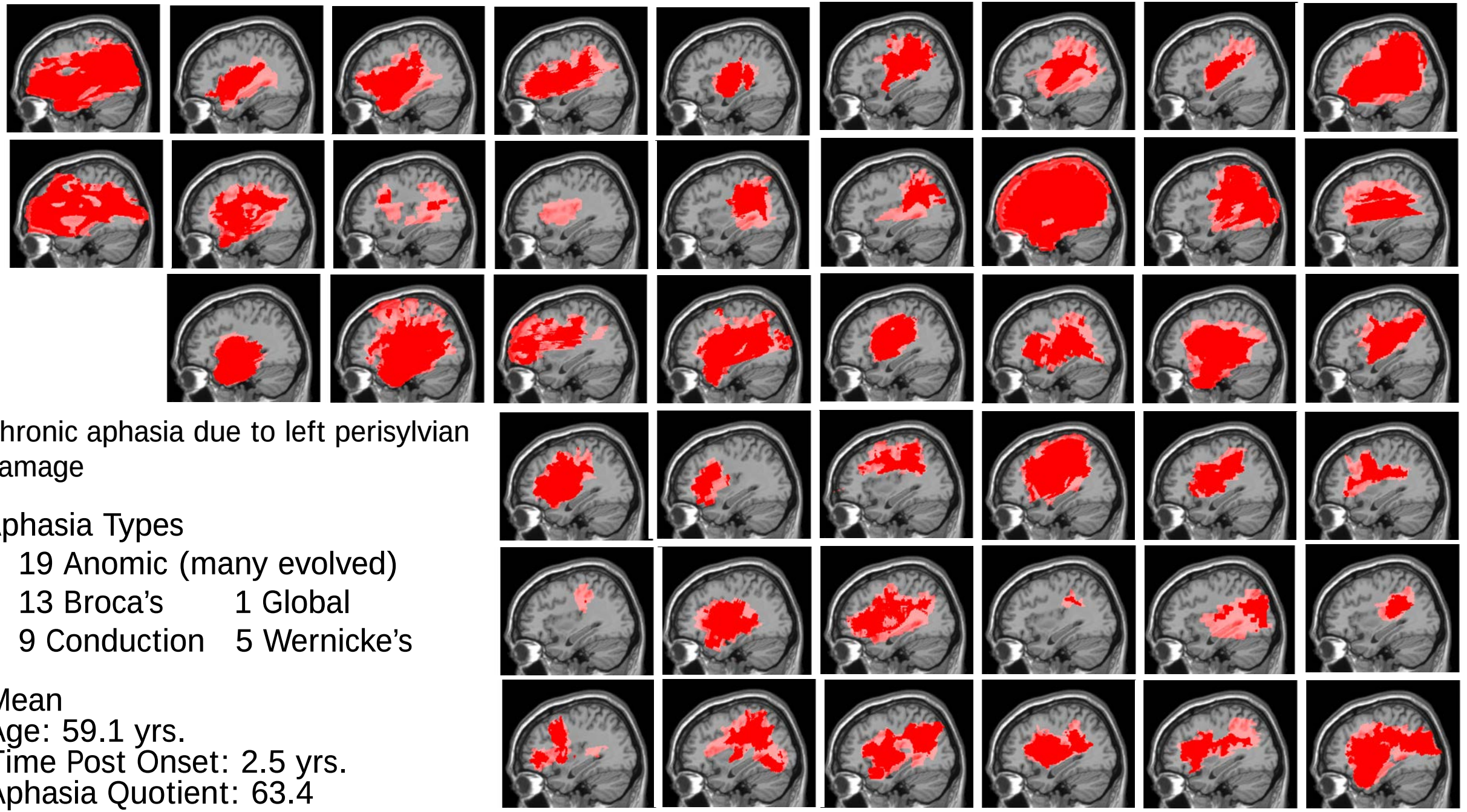
Both have impaired phonological skills.

Both warrant phonological treatment.

* Arizona Battery for Reading and Spelling (http://www.aphasia.arizona.edu/)

How common is phonological impairment after left perisylvian damage?





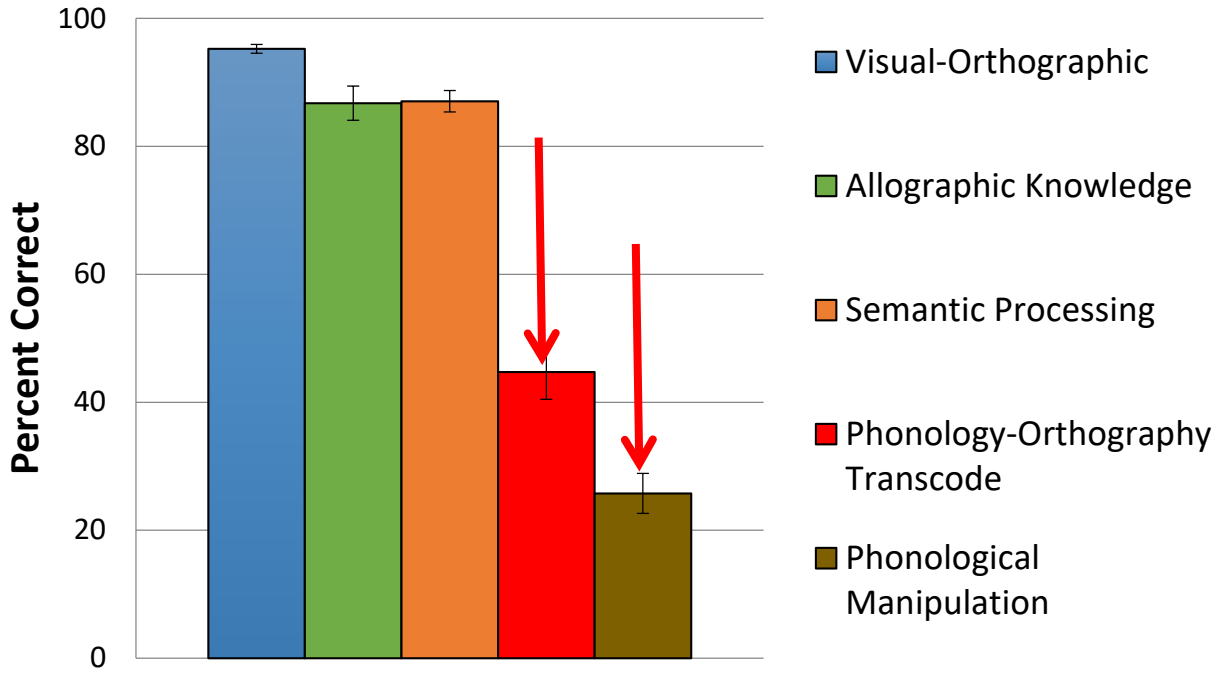
Chronic aphasia due to left perisylvian damage

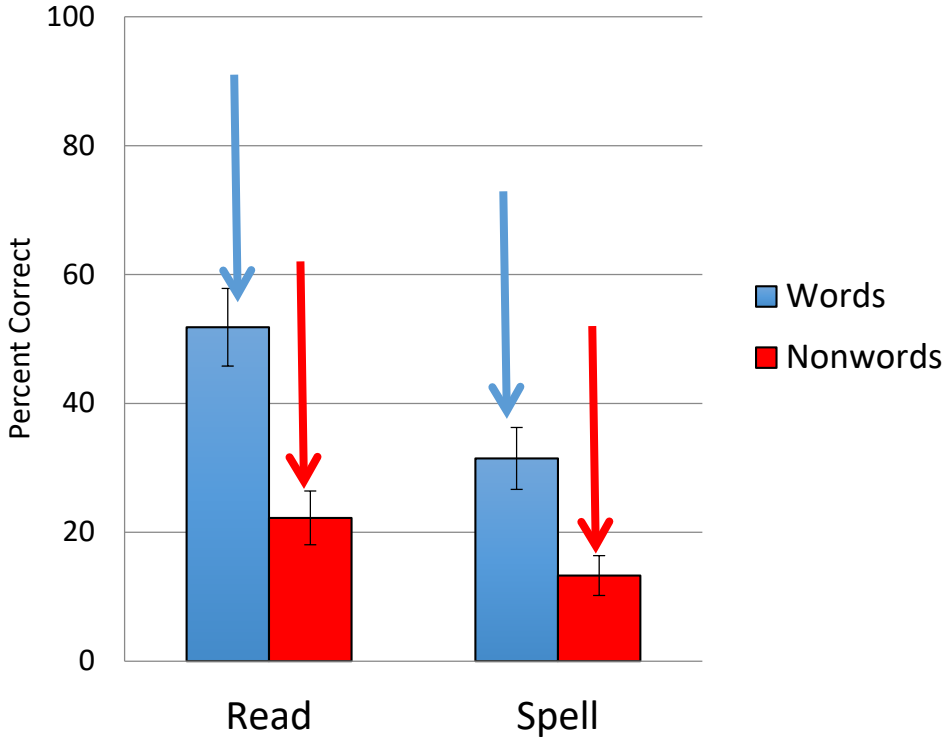
Aphasia Types

- 19 Anomic (many evolved)
- 13 Broca's 1 Global
- 9 Conduction 5 Wernicke's

Mean
Age: 59.1 yrs.
Time Post Onset: 2.5 yrs.
Aphasia Quotient: 63.4

Performance on Test Battery (N = 47)



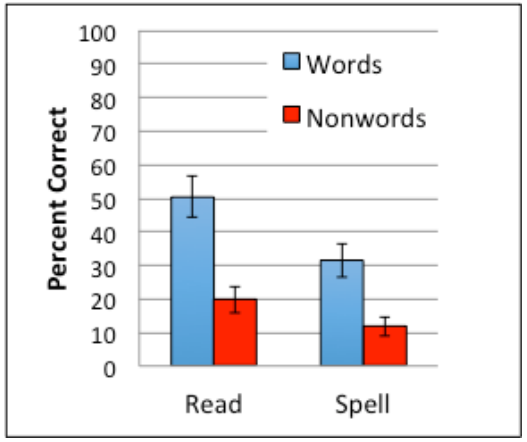


Visual-Orthographic Processing
Allographic/Graphomotor Skills
Semantic Processing
Phonology-Orthography Transcoding
Phonological Manipulation

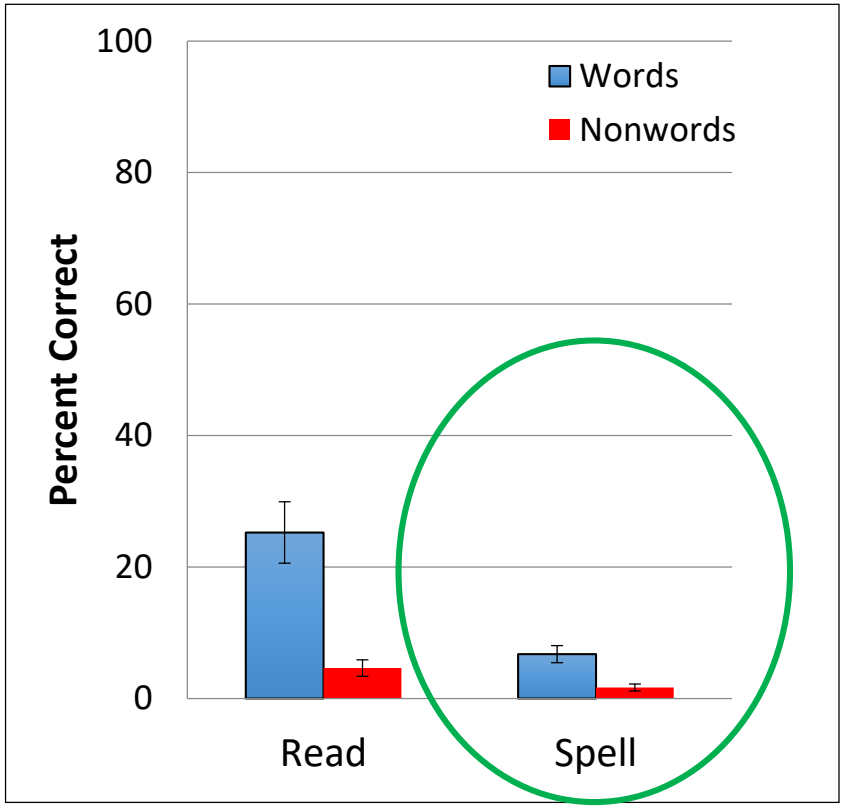
Phonological impairment easily detected on nonword reading and spelling tasks.

- Reading and spelling of real words also impaired.
- Written spelling more impaired than oral reading.

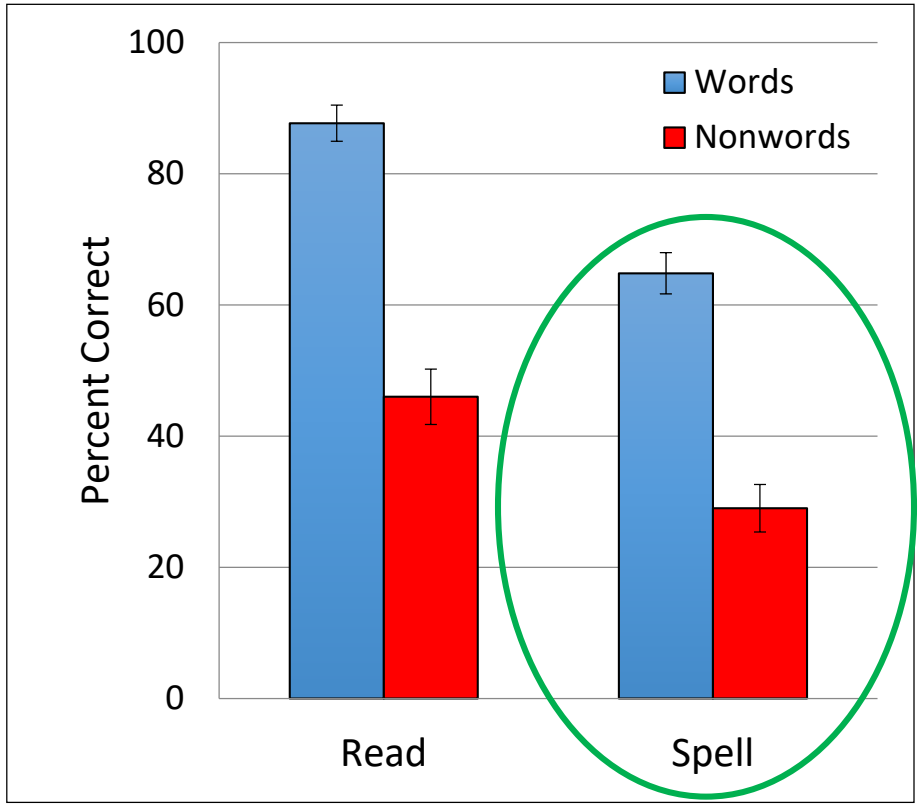
All participants had phonological impairment, but single word reading and writing was more impaired in some.



n = 47



Global Agraphia (n = 27)
(<30% correct spelling of real words)



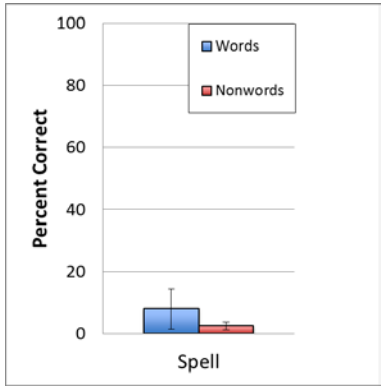
Phonological Agraphia (n=20)

Treatment Sequence for Individuals with Phonological Impairment

Perisylvian Aphasia with Global Agraphia

Lexical-Semantic Tx

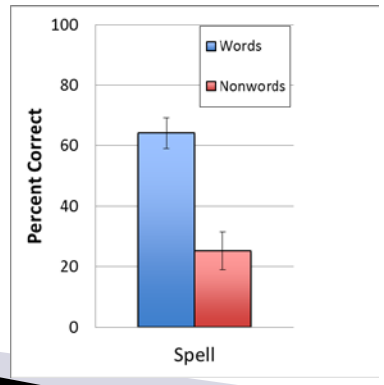
retrain spelling for specific words



Perisylvian Aphasia with Phonological Agraphia

Phonological Tx

retrain sound-letter correspondences and phonological manipulation skills



Interactive Tx

train problem-solving strategies to self-correct spelling errors

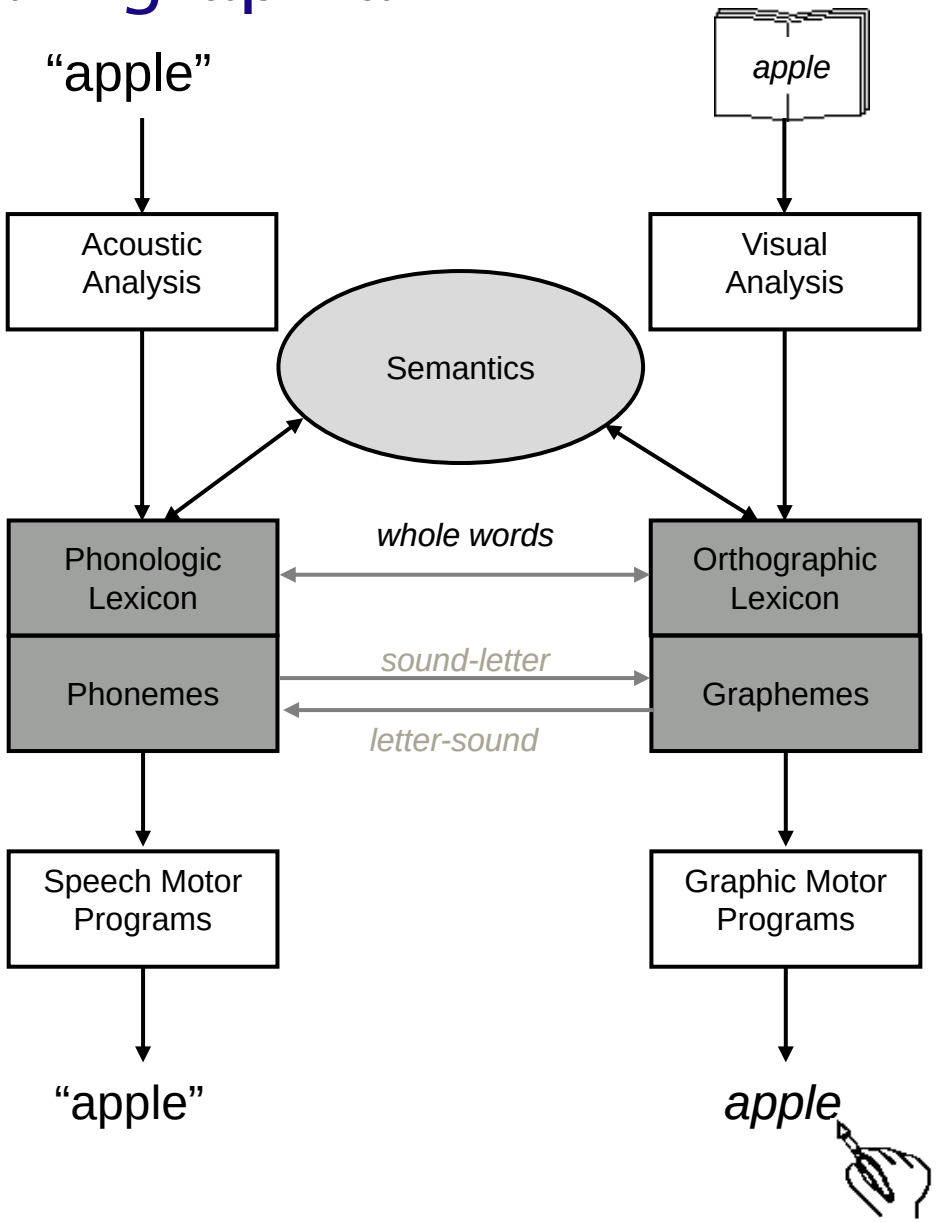
Lexical Retrieval Tx

train lexical retrieval strategies including semantic and phonological self-cuing

Sentence Writing Tx

Improve speed and accuracy of sentence writing with copy and recall at the sentence level

Treatment for Global Agraphia



retrain spellings for specific words

lexical spelling treatment paired with repeated spoken production of target words and links to meaning

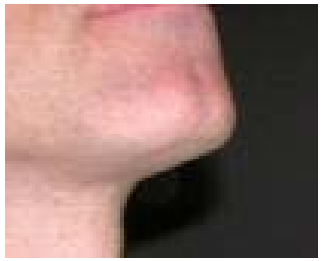
Follow with phonological treatment directed toward sublexical skills

Lexical-Semantic Treatment

- Purpose
  - Strengthen written spelling for specific words
    - and the links to meaning
- Goal
  - To retrain single-word written vocabulary for use in communication (and to stimulate spoken production)
  - To establish written "key words" for use in phonological treatment
- Approach
  - Copy and Recall Treatment (CART)
    - Train 24 words (4 groups consonants/2 groups vowels)

leaf

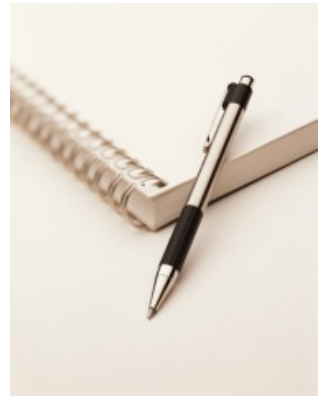
net



chin

cake

Lexical Spelling Treatment



Copy and Recall Treatment

Model
"hammer"

hammer

Repeat
"hammer"

hammer

Recall

Beeson, 1999, *Aphasiology*
Beeson, Rewega, Hirsch, 2002, *Aphasiology*
Beeson, Rising, & Volk, 2003, *JSLHR*

Lexical spelling treatment
(also includes repetition of spoken words)

Homework for Copy and Recall Treatment

“talking” photo album

Listen, repeat word, copy word.

Words Trained in Lexical Treatment

Key words-Consonants

Set 1 rug, top, leaf, safe, net

Set 2 cake, fire, moon, pie, dog

Set 3 book, goat, zoo, ship, van

Set 4 hat, web, chin, judge, three

Key words-Vowels

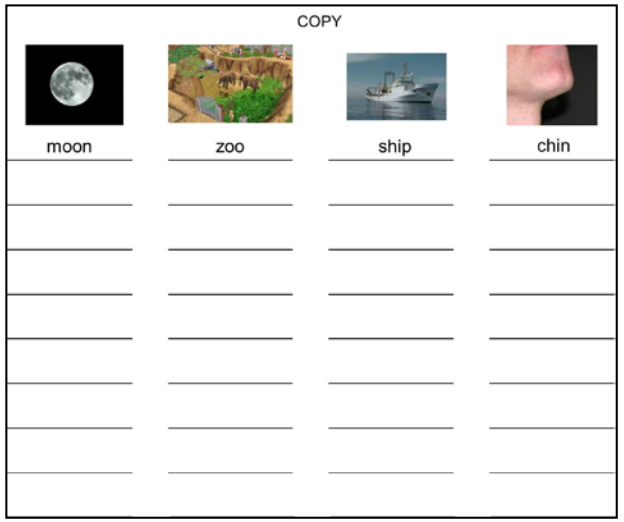
Set 1 hat/van, cake/safe, ship/chin
fire/pie, net/web, leaf/three

Set 2 top/dog, bone/goat, rug/judge
moon/zoo, cow/mouth, foot/book

pictures available at
http://www.aphasia.arizona.edu/

Copy and Recall Homework

- Daily homework pages for repeated copy practice
- Review each session for accountability



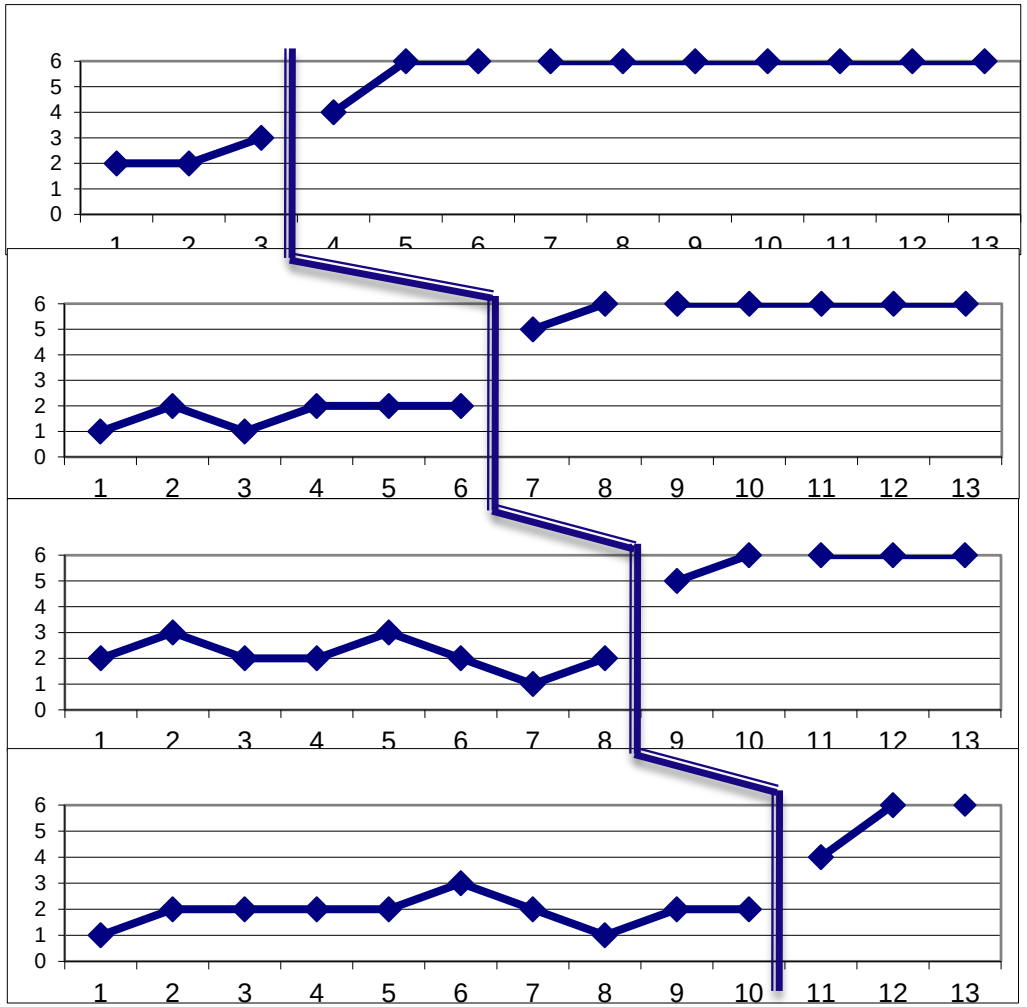
Homework is fun!

Example Response to Lexical Treatment (spelling)

Treatment 2 x per week with homework

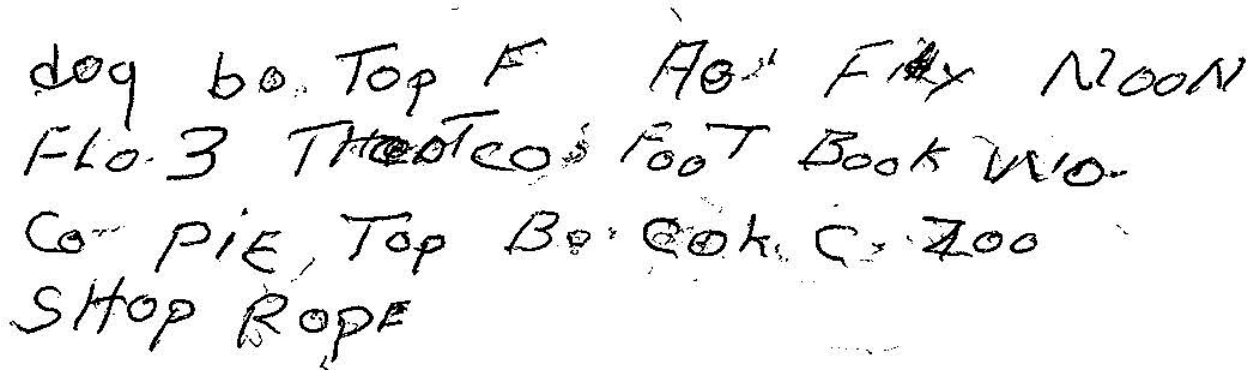
Treatment duration ~ 4-8 weeks

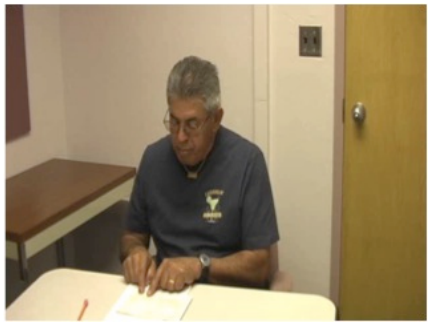
4 sets/6 words trained to >80% accuracy.



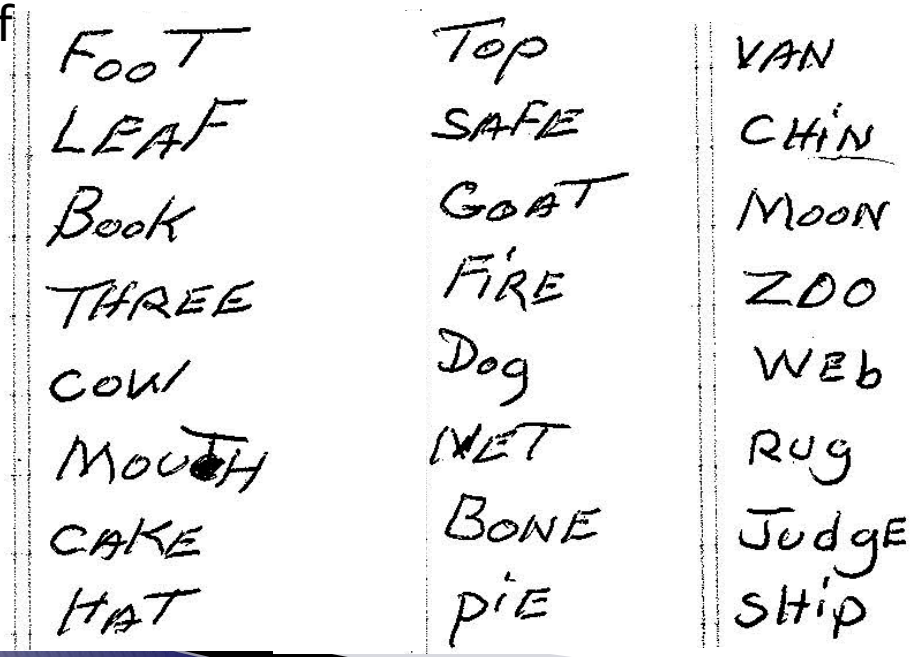
Response to Copy and Recall Treatment

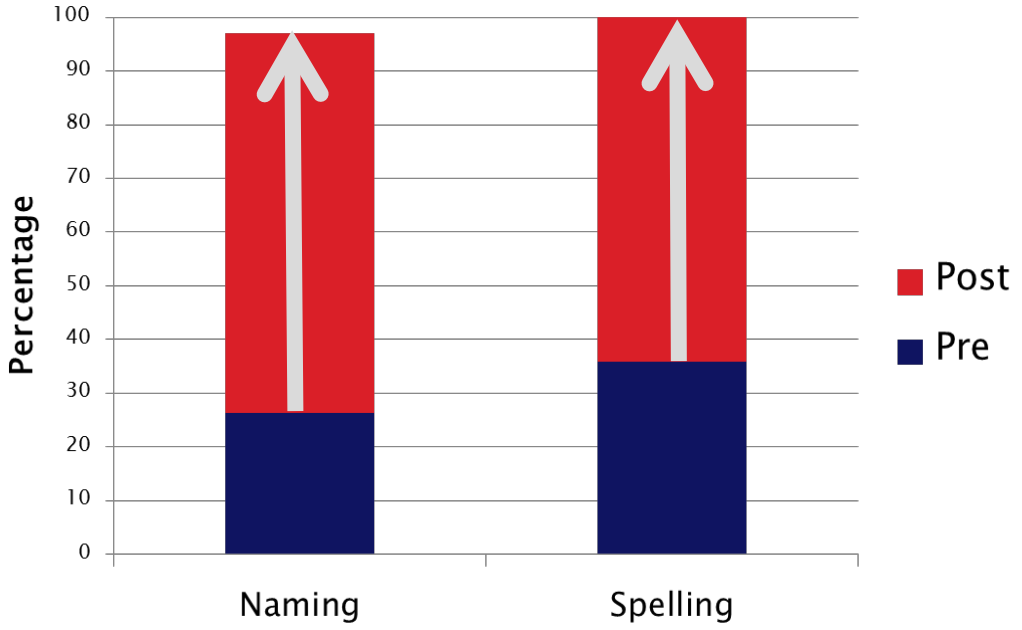
Pre-treatment
(1st probe)



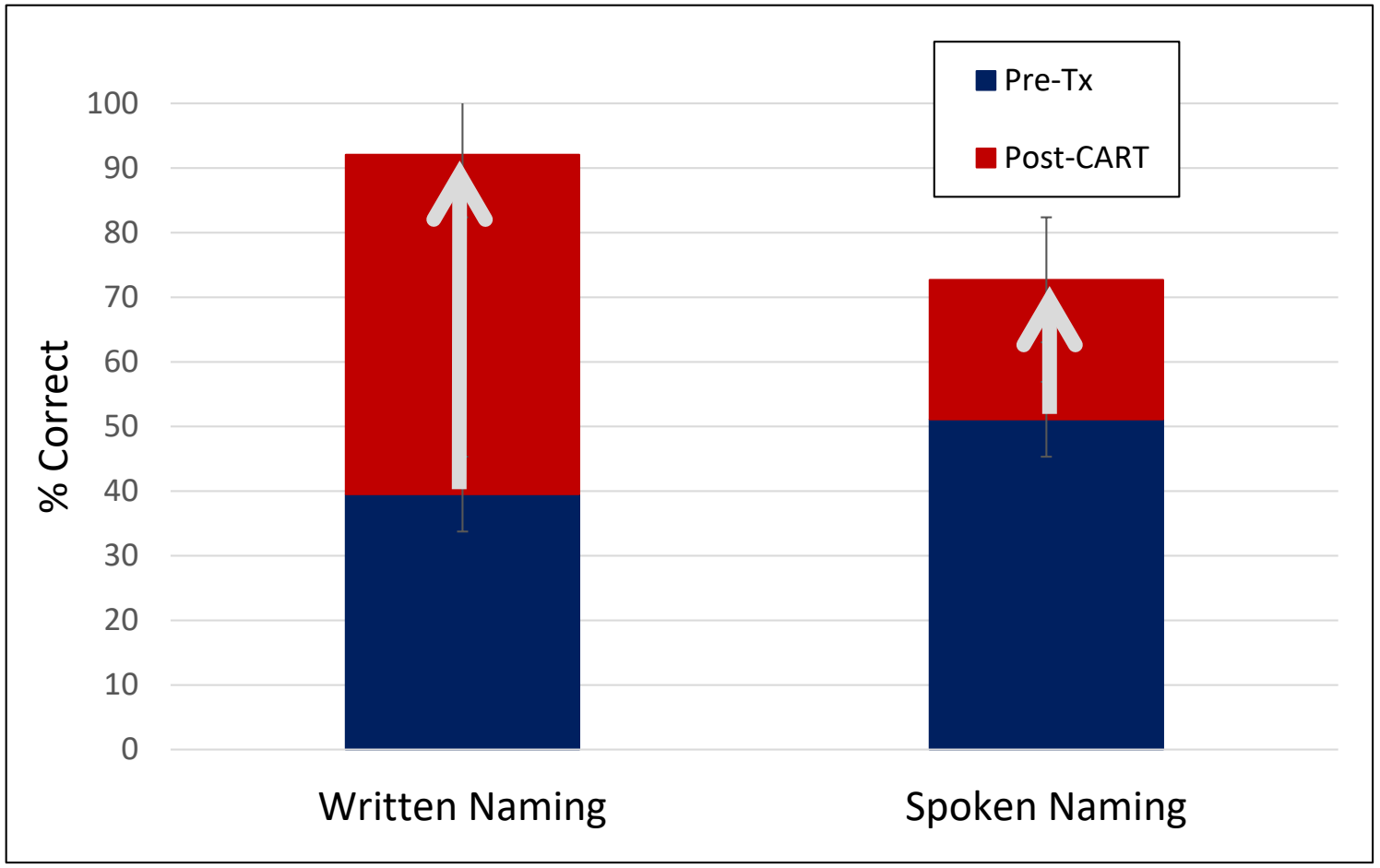


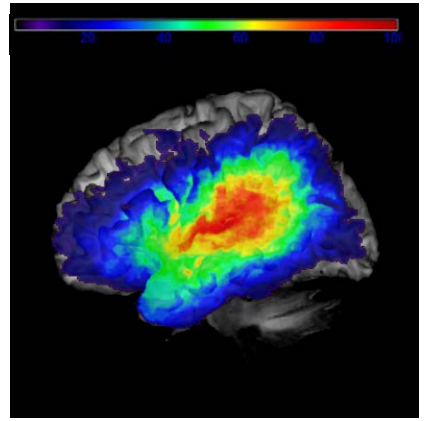
After 4 weeks of treatment





Improved written and spoken production of targeted words





Global Agraphia

n = 27

Lexical Spelling Treatment (Texting modality)

Texting Copy and Recall Treatment (T-CART)

Model

"hammer"

hammer

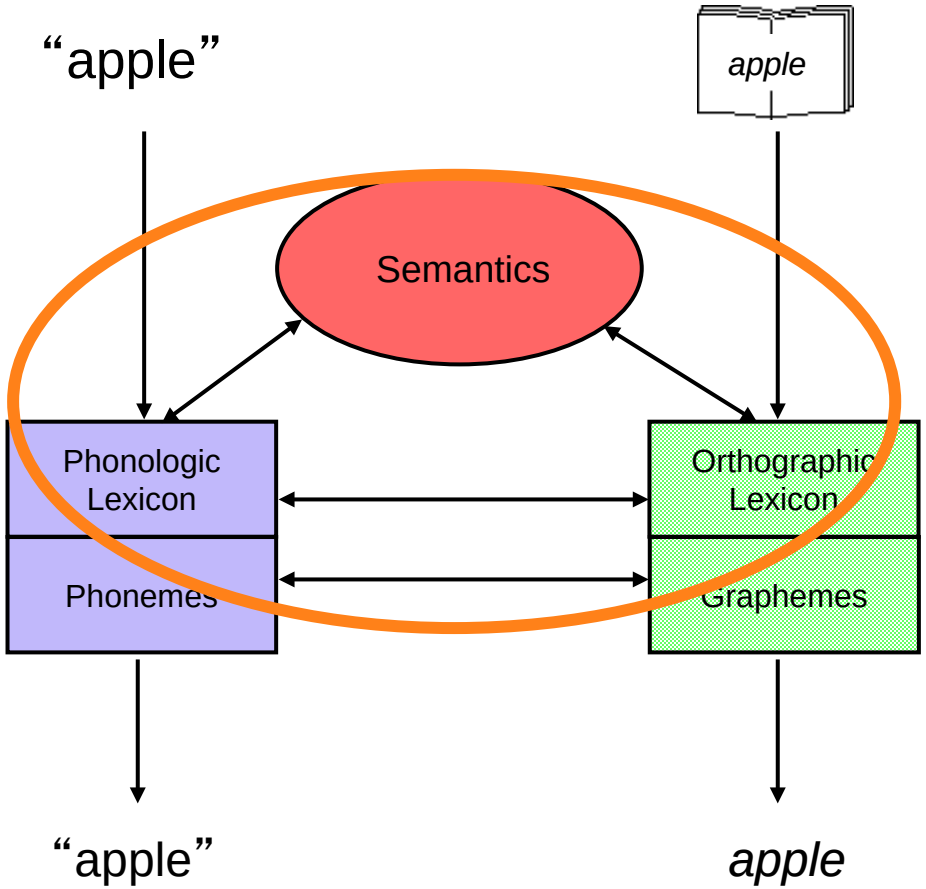
Repeat

"hammer"

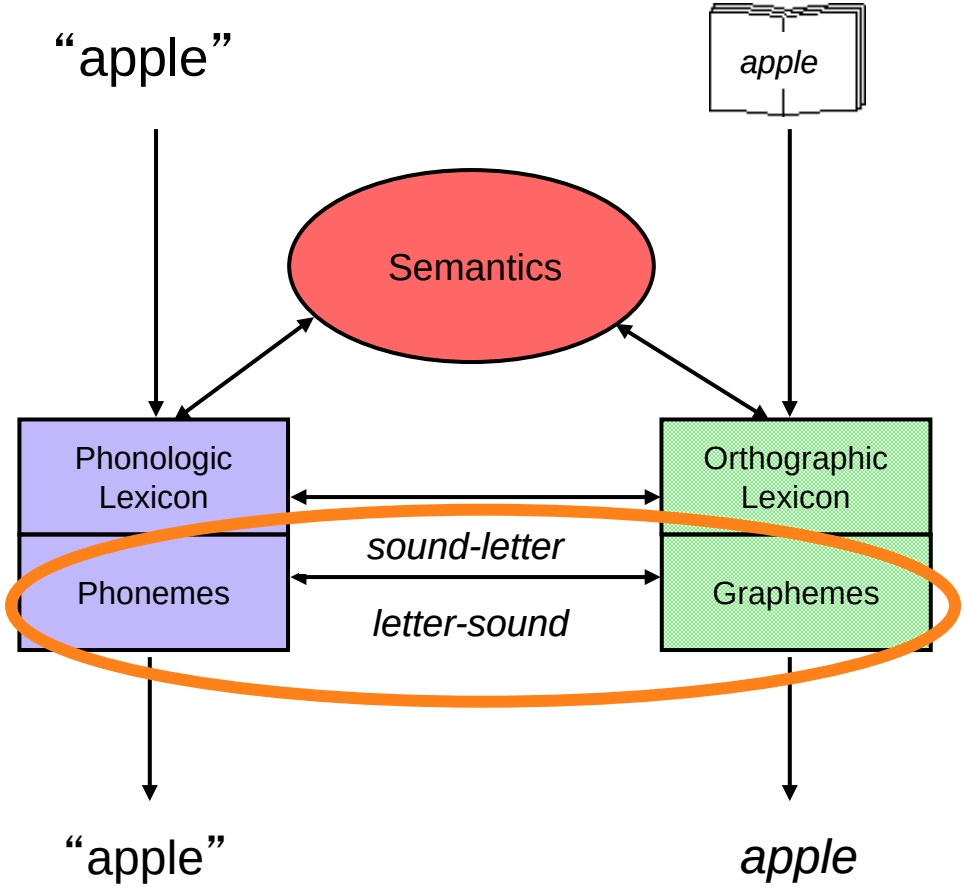
Retrain spelling and
left-handed text messaging

Beeson, Higginson, Rising (2013) JSLHR

Lexical Semantic → Phonological Treatment



retrain specific words



retrain sound-letter correspondences

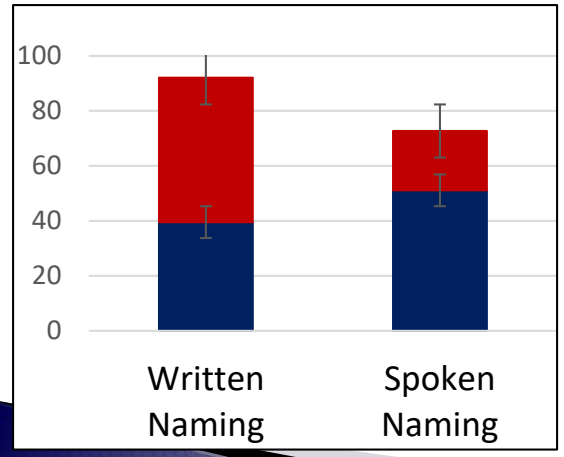
Treatment Sequence for Individuals with Phonological Impairment

Perisylvian Aphasia with Global Agraphia

Lexical-Semantic Tx

27

retrain spelling for specific words



Perisylvian Aphasia with Phonological Agraphia

20

Phonological Tx

retrain sound-letter correspondences and phonological manipulation skills

Phonological Treatment:
To strengthen sound-letter correspondences and phonological manipulation skills

/f/ = *f* *m* = /m/ *b – a – t* = *bat*

Use “key words” as needed to retrieve phonology/orthography

fire --- /f/ --- f

Phonological Treatment

- Prerequisite skills
  - Able to read, write, and name key words for consonants and vowels (we typically use the 24 items from CART)
    - high frequency, concrete, regularly spelled nouns
    - used to retrain sound-letter (and letter-sound) correspondences
  - Train with lexical approach if necessary (CART)

Example Key Words (trained with CART as needed)

Key words-Consonants

Set 1 rug, top, leaf, safe, net
Set 2 cake, fire, moon, pie, dog
Set 3 book, goat, zoo, ship, van
Set 4 hat, web, chin, judge, three

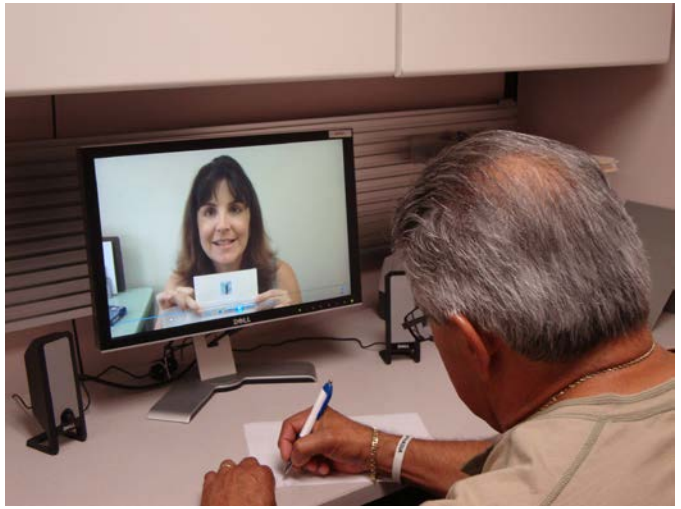
Key words-Vowels

Set 1 hat/van, cake/safe, ship/chin
fire/pie, net/web, leaf/three
Set 2 top/dog, bone/goat, rug/judge
moon/zoo, cow/mouth, foot/book

available at http://web.me.com/pelagie1/Aphasia_Research_Project/CART.html

Phonological Treatment: Sound-to-Letter Training

Clinician		Patient
Say /p/		/p/
What is your key word for /p/? *(Show picture if necessary).*		"pie"
Write your key word for /p/		*pie*
Underline /p/ in your word		*pie*
Now say the sound		/p/



DVD or YouTube homework

Beeson, Rising, Kim, & Rapcsak, S. Z. (2010). *JSLHR*.

Phonological Treatment

Sound → Letter

/f/ - f [fire]

/d/ - d [dog]

Sound-to-letter correspondences: Using key word

Phonological Treatment:
Letter-to-Sound Training

Clinician

- Show the letter “s” | s
  - What is your key word for this ?
- Show the picture if necessary
  - Your key word is “safe”, write “safe”
- What’s the 1st sound?
- Show the letter “s” | s
  - What is this sound?

Patient

“safe”

safe

“ssss”

“ssss”

Phonological Treatment (Letter → Sound)

s - /s/

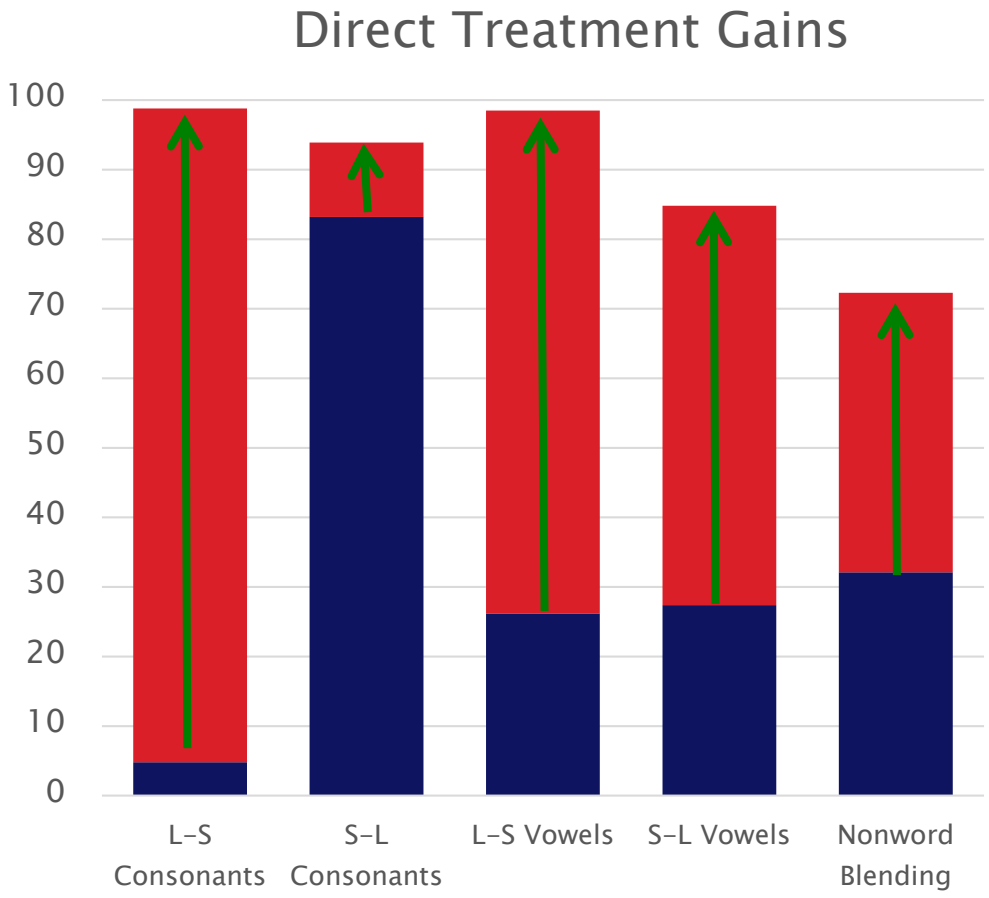
n - /n/

What sound goes with this letter?

Advanced Phonological Treatment: Phoneme Manipulation Tasks

- Blending
  - What word (or nonword) do these sounds make?
    - e.g., m-ea-n p-o-t n-a-p
- Segmenting
  - What is the last sound of “hood”?
  - What is the vowel sound in “zone”?
  - What’s the last sound of “maze”?

Treatment Sequence for Individuals with Phonological Impairment



Perisylvian Aphasia with Phonological Agraphia

Phonological Tx

5 weeks consonants
6 weeks vowels
5 weeks blending

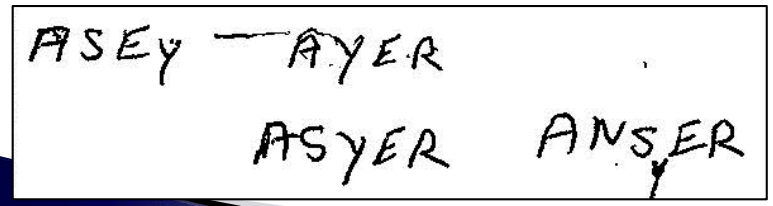
retrain sound-letter correspondences and phonological manipulation skills

Interactive Tx

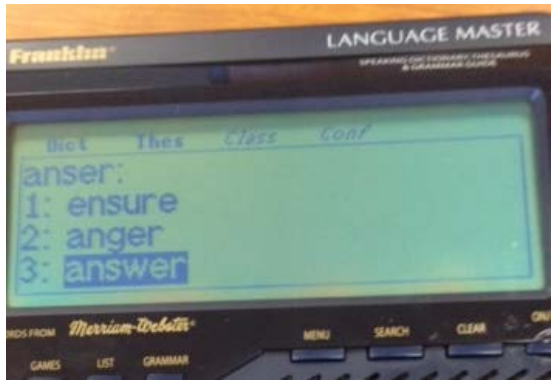
train problem-solving strategies to self-correct spelling errors

Interactive Spelling Treatment

- Purpose
  - Strengthen the interactive use of orthography and phonology
- Goal
  - To improve spelling accuracy by increasing self-detection and correction of errors
- Approach
  - Use residual or re-trained phonology to sound-out plausible spellings
  - Identify and correct errors
  - Use of electronic spell-checker to aid in error correction



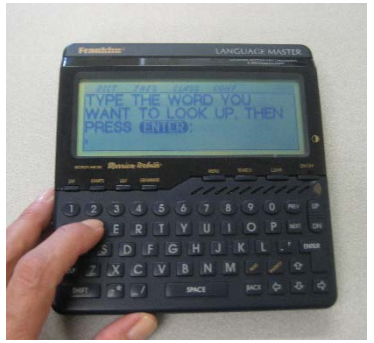
anser→

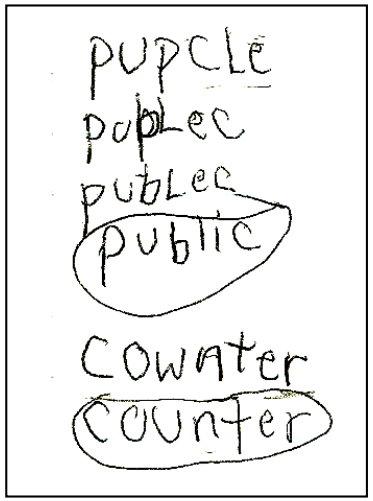


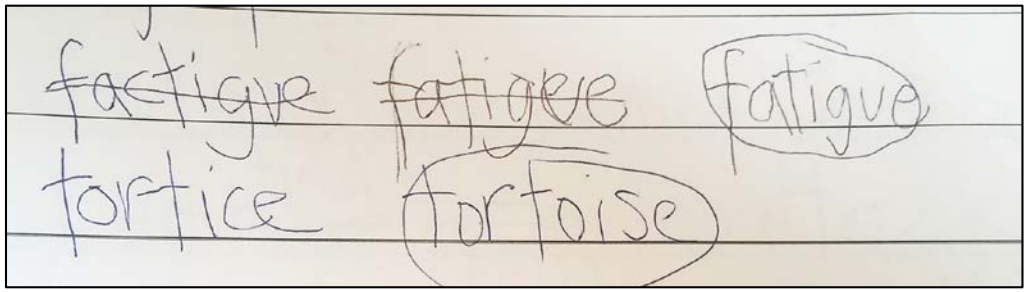
→answer

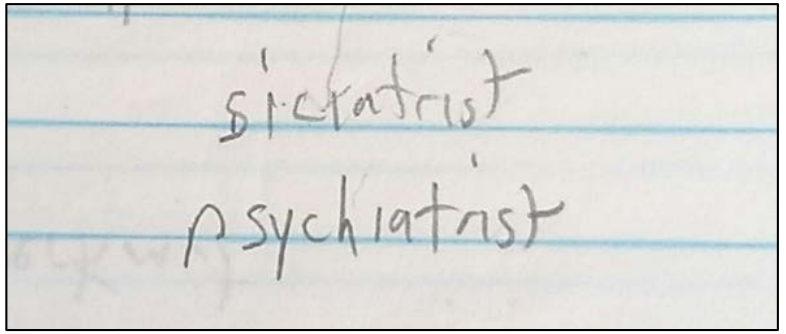
Interactive Spelling Treatment: *Problem-solving approach*

1. Listen to the word.
2. Repeat it.
3. Sound out the word and try to write it.
4. Look at it. Is it correct?
5. Correct it. Try to get as close as you can.
6. Type in spell checker.
7. Is it correct?
8. If not, do you see the correct word?
9. Copy the correct spelling.
10. Circle the correct spelling.









Interactive Treatment

Phonological Agraphia

"Write 'magic'"

He wrote: *m a j c*

[typed into spellchecker]

→ magic

Interactive treatment promotes a problem-solving approach to spelling.

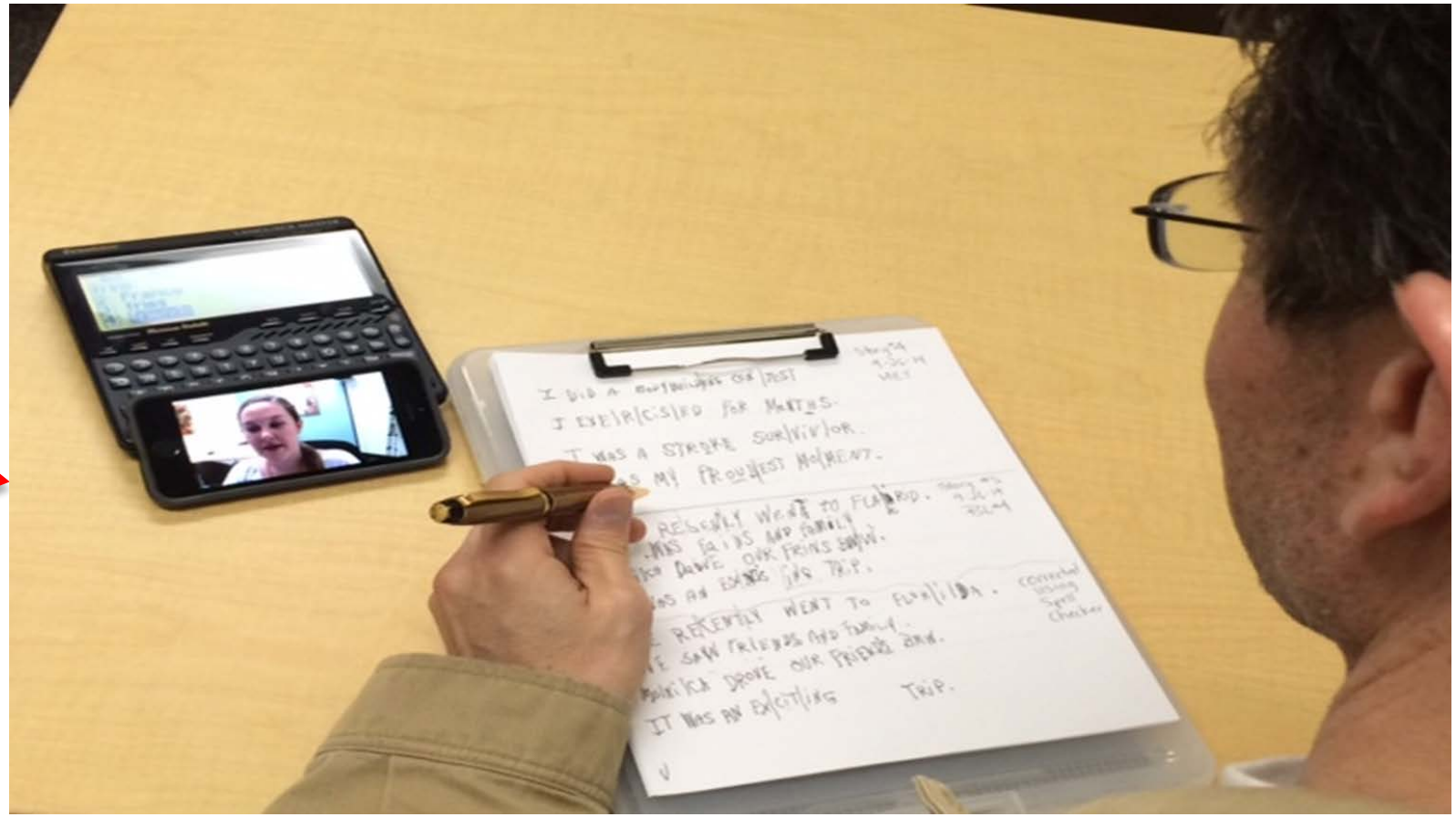
Problem Solving at Sentence Level

1. Generate sentence using target spelling word.
2. Read sentence aloud.
3. Identify spelling errors and missing words.
4. Correct spelling errors using problem solving (sound out, examine for errors, use spell checker).
5. Note: grammatical/morphemic errors may also be detected/corrected.
   - Wrote: *My surgean approve me for surgery.*
   - Read as, "My surgeon approved me for surgery."
   - Participant corrected *surgeon* using the spell checker, and sounded out and identified the missing /d/ in *approved*.

Interactive Treatment Homework

Franklin Spell Checker

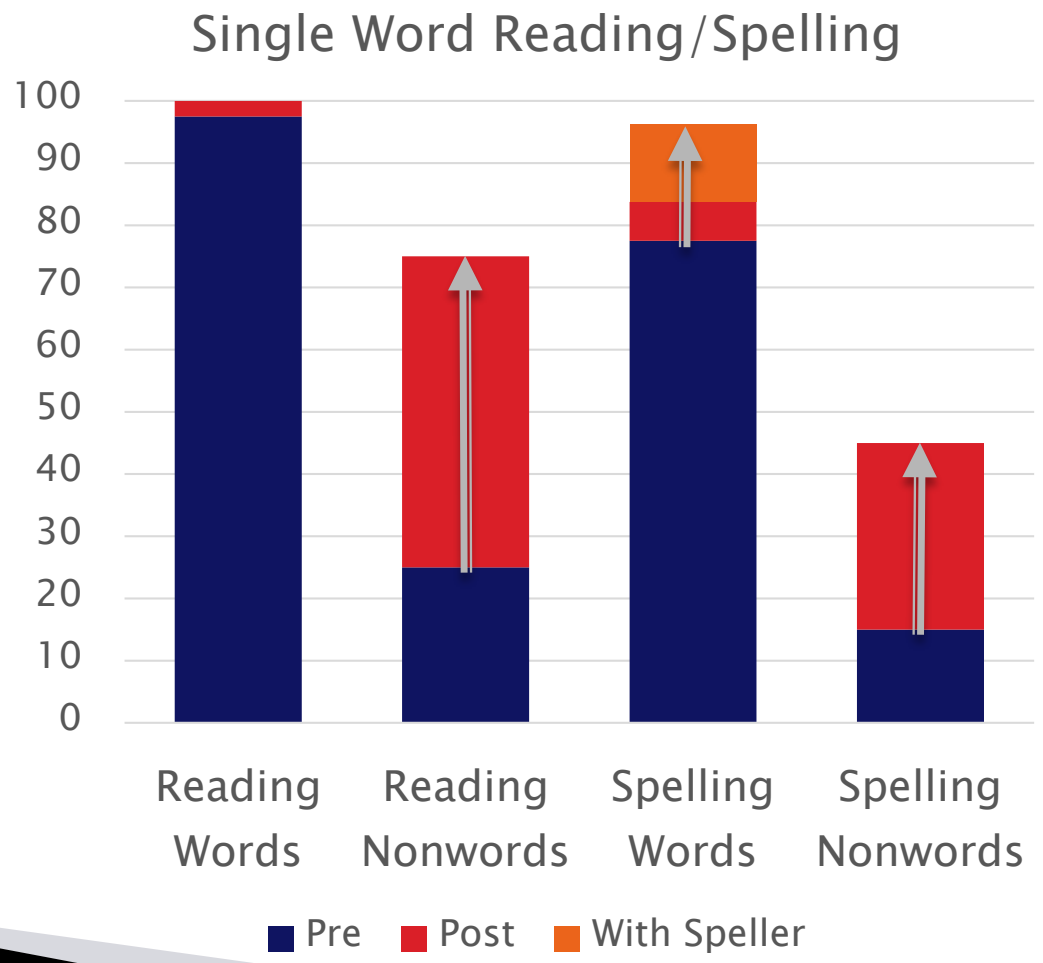
Phone

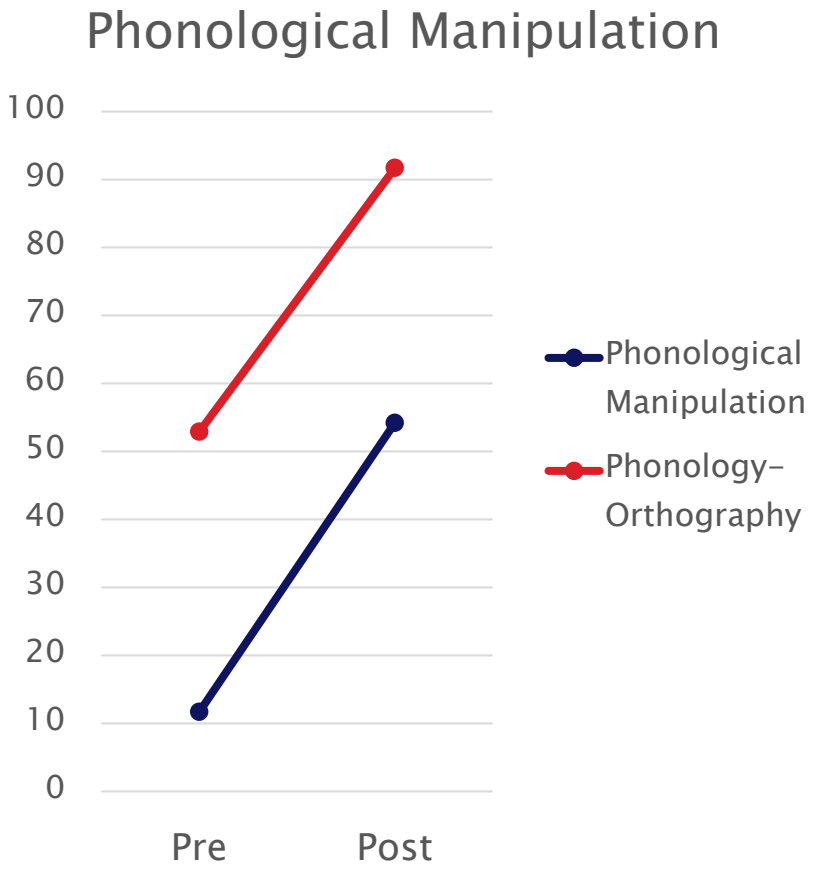


Example response to phonological and interactive treatment

Total treatment time:

- 16 weeks phonological
- 6 weeks interactive

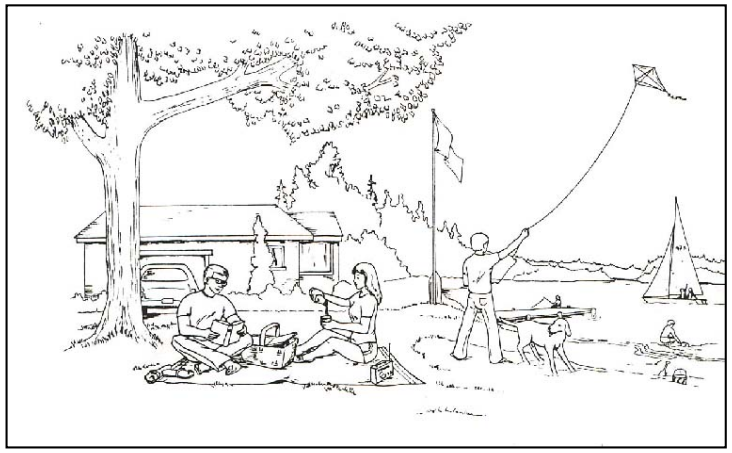




Response to Treatment: Text-level writing

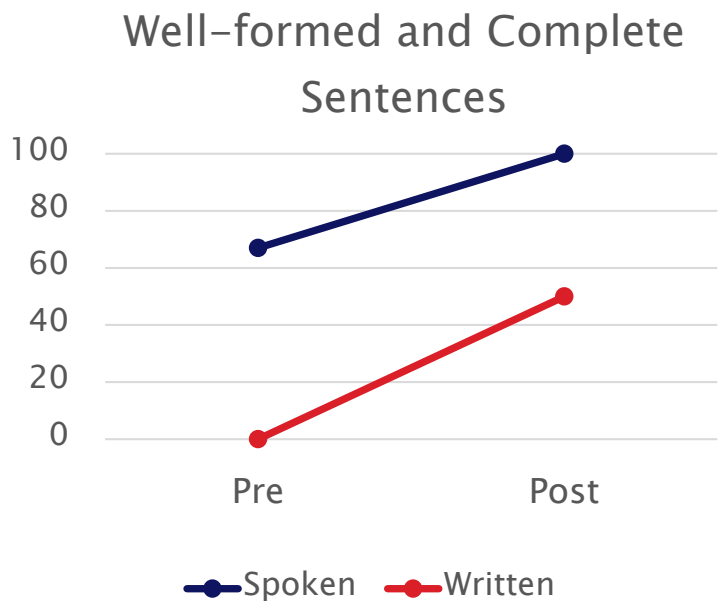
Before Tx

Dog is cuming
Man is fly kite
sailboat
lady & guy the picnic and book with wine

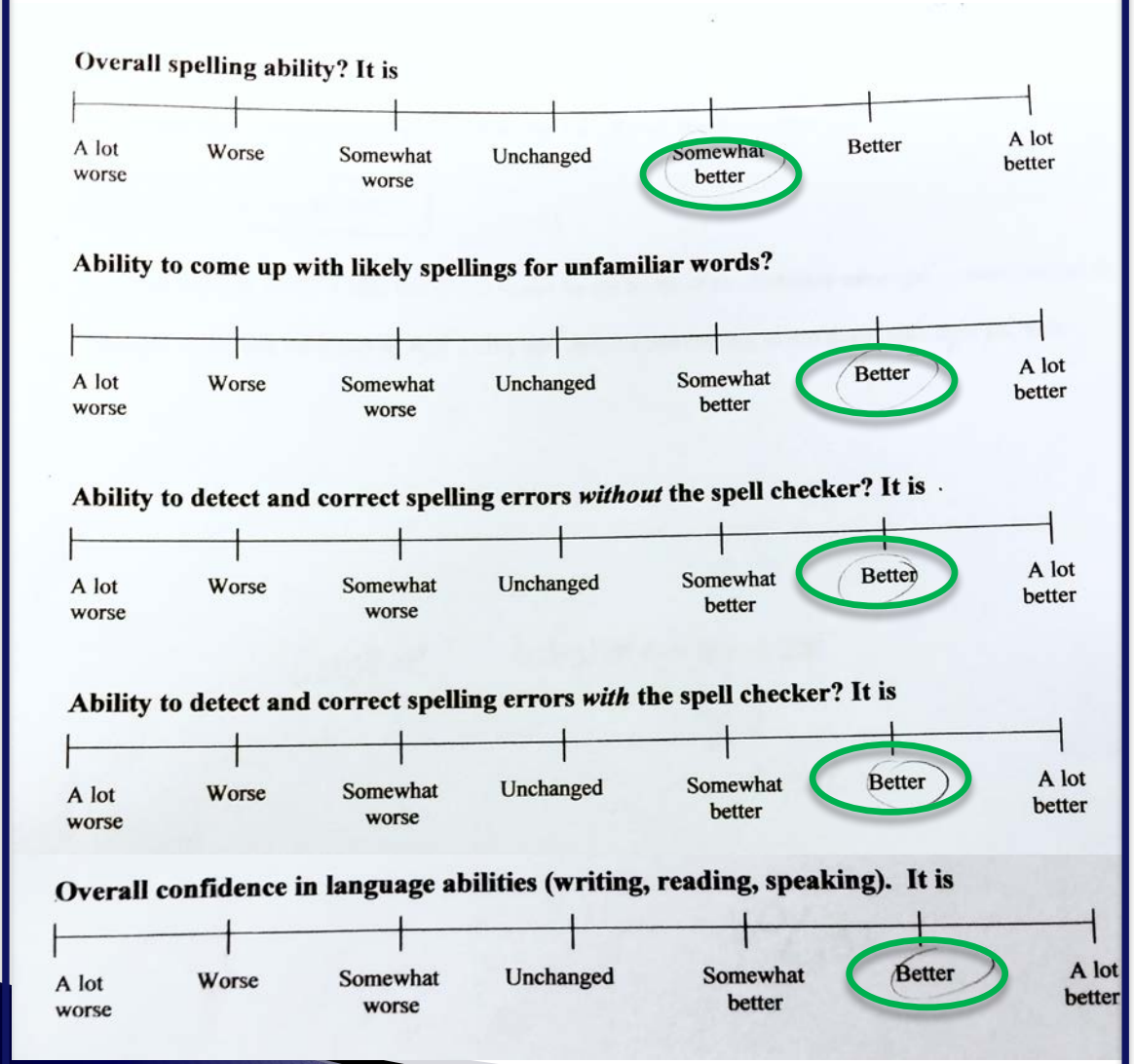


After Tx

The man a reading a book. The lady is pouring wine or soda. A differt man the flyer a kite, the dog help him. A man is fishing of a pier. A couple is sailing a boat.



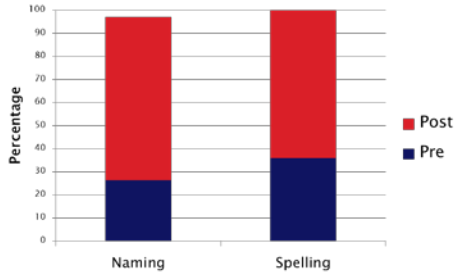
Patient perspective

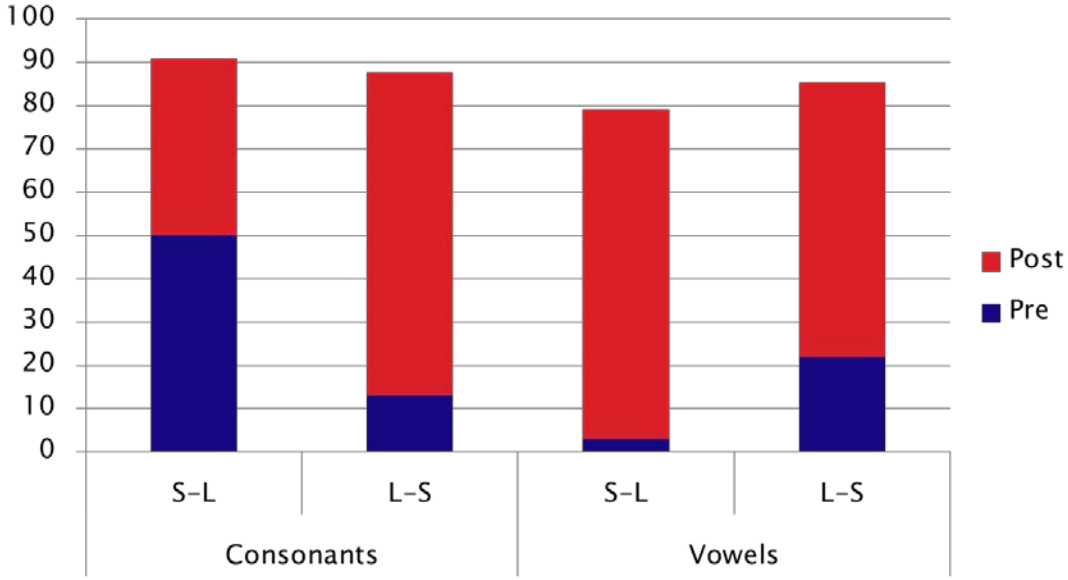


- Positive self-ratings after treatment
  - overall spelling ability:
    - "somewhat better"
  - Ability to use strategies (e.g., detect and correct spelling errors):
    - "better"
  - Overall confidence regarding written and spoken communication:
    - "better"
- Reported increased confidence writing e-mails to friends and family
- Was able to return to role as teaching assistant for Sunday school class

Phonological + Lexical Impairment

"Bobo … one … Bobo one … bye… bye"





"House…trees….
car…cars…boy…girls…wine"

Using orthography to cue phonology

Lexical→Phonological→Interactive→Lexical Retreival

"camp" …t .."tent"

trombone ---"t" "t" "trombone"

Orthography → Semantic self cue.

Orthography → Phonology: Phonemic self cue.

Wife's Thoughts on Treatment

"The writing has really helped because he has started like writing down a few letters and then the word will come right out. And while I'm at work, he'll call me. And then he starts talking, and I'm like, 'I don't know what you're saying.' And I'll say, 'Start to write it and put it in the spell checker and call me back with it.' That has amazingly helped…."
"It really made a world of difference."

Benefit of Treatment Sequences

Lexical → Phonological→ Interactive →Lexical Retrieval Tx

I better do this. [write] It's easier. tor-na-do

pliers

quail

Conduction aphasia: WAB AQ 49.5 at 1.3 years post stroke

Used written word to stabilize phonology for spoken production (decrease paraphasias)

Greater improvement in written than spoken language

WAB AQ 49.5 → 53.3

Treatment Benefit

Phonological → Interactive Treatment

Pre-Treatment

/d/-/I/-/g/ [dig]
/p/-/A/-/t/ [pat]

Regained phonological awareness skills.

Post-Treatment

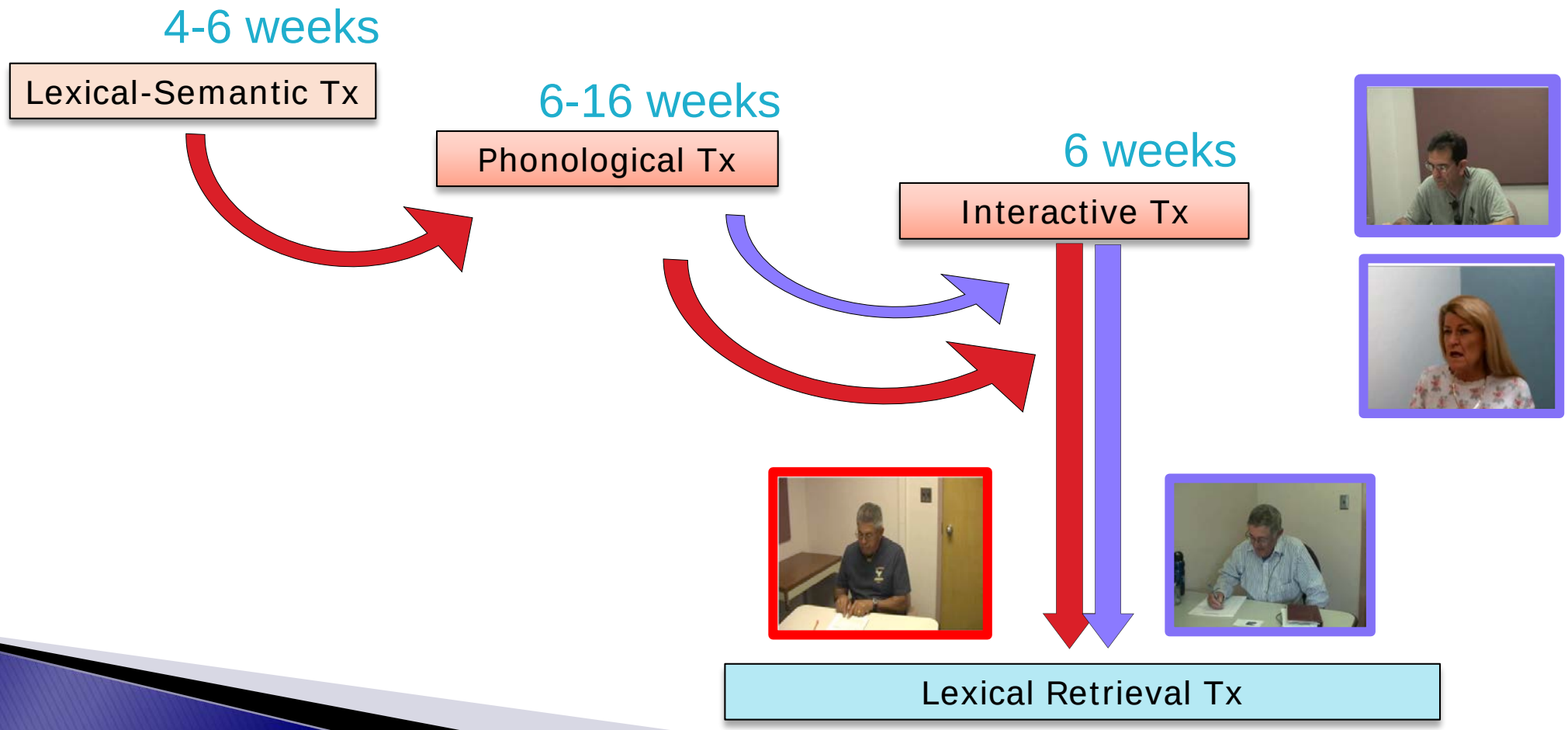
/d/-/I/-/g/ [dig]
/p/-/A/-/t/ [pat]
/b/-/oI/-/l/ [boil]
/p/-/a/-/t/ [pot]

Treatment Benefit

- Anomic aphasia
  - 1.9 years post onset when tx began
  - WAB Aphasia Quotient
    92.4 → 95.3
  - Boston Naming Test 48 → 52
  - Significant improvement phonological skills and spelling

How do we maximize recovery from aphasia?

- Remediate the core phonological deficit
- Implement treatment sequences that strengthen underlying skills and provide support to advance to next level



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Erin O'Bryan
Mara Goodman
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