The Benefit of Phonological Treatment in Aphasia: Getting at the Core Deficit

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Disclosure

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How do we maximize recovery from aphasia?

- Primary goal of our 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 to advance recovery
    - 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
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.
Phonological impairment is common following left perisylvian damage

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/-/l/-/g/  [dig]
/p/-/A/-/t/  [pat]
/b/-/oI/-/l/  [boil]
Impaired sound-letter correspondences

“Write the letter that goes with the sound.”
Phonological Alexia

Reading Words

Reading Nonwords

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

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

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

marked impairment of nonword spelling

Arizona Battery for Reading and Spelling (ABRS)
(http://www.aphasia.arizona.edu/)
Consider the cognitive processes

Lexical
Sub-lexical

Lexical
Sub-lexical

“apple”

Acoustic Analysis

Phonologic Lexicon

Phonemes

Speech Motor Programs

“apple”

Orthographic Lexicon

Graphemes

Graphic Motor Programs

Semantics

Visual Analysis

Apple

Consider the cognitive processes...
Phonological Impairment

Lexical
Sub-lexical

“apple”

Acoustic Analysis

Phonologic Lexicon

Phonemes

Speech Motor Programs

“apple”

Orthographic Lexicon

Graphemes

Graphic Motor Programs

Visual Analysis

Semantics

whole words

sound-letter

letter-sound
Testing phonological skills with nonword reading

Can’t use sublexical route to assist with reading

Can’t sound out words or nonwords

Phonological Alexia

Speech Motor Programs

“dust?”

Phonologic Lexicon

Orthographic Lexicon

Phonemes

Graphemes

Lexical

Sub-lexical

Visual Analysis

Semantics

whole words

sound-letter

letter-sound

reg irreg nonwords
Testing phonological skills with nonword spelling

Can’t use sublexical route to assist with spelling

Can’t sound out spellings for unfamiliar words or nonwords

Phonological Agraphia

Lexical
Sub-lexical

reg irreg nonwords
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.”

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

WAB = Western Aphasia Battery
BNT = Boston Naming Test
Phonological impairment has striking effect on sentence-level writing!

“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.”

Written picture description

Dog is coming
Man is fly kite
Sailboat
Lady & guy the picnic and book and with wine
Broca’s Aphasia with Alexia/Agraphia

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

“Bobo ... one ... Bobo one ... bye... bye”

Written picture description

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CAR TRUCK HOUSE WINS
KITE BOAT RAP "BOBO"
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Phonological plus Lexical Impairment

Global Alexia

Global Agraphia

Regular Words

- stop
- pillow

Irregular Words

- castle
- type

Nonwords

- flig
- hoach
- Home
Phonological Impairment

plus lexical-semantic and orthographic impairment

Lexical
Sub-lexical

Global Alexia/Agraphia

(< 30% correct)

Phonologic Lexicon

Orthographic Lexicon

Acoustic Analysis

Visual Analysis

Semantics

Phonemes

Graphemes

Speech Motor Programs

Graphic Motor Programs

“pill?”

“pill?”

pow
Two Profiles with Perisylvian Damage showing Phonological Impairment

**Global Agraphia**

*Lexical-Semantic & Phonological Impairment*  
(< 30% correct)

**Phonological Agraphia**

*Predominantly Phonological Impairment*

Both have impaired phonological skills.

Both warrant phonological treatment.

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* Arizona Battery for Reading and Spelling (ABRS)  ([http://www.aphasia.arizona.edu/](http://www.aphasia.arizona.edu/))
How common is phonological impairment after left perisylvian damage?
Aphasia Types
- 19 Anomic (many evolved)
- 13 Broca’s       1 Global
- 9 Conduction   5 Wernicke’s

mean   range
Age (yrs)  59.1   (22.5 – 77.7)
TPO (yrs)   2.5     (0.3 – 13.5)
WAB AQ    63.4   (16.7 – 96.4)
BNT         23.8   (0 – 55)
Assessment of Cognitive and Sensorimotor Processes

n = 47
Comprehensive assessment reveals marked underlying phonological impairment

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

Lesion overlap

n = 47
Comprehensive assessment reveals marked underlying phonological impairment

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

- **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 Cascade Tx
- train lexical retrieval strategies including semantic and phonological self-cuing
Treatment for Global Agraphia

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

retrain spellings for specific words
Lexical–Semantic Treatment

- **Purpose**
  - Strengthen written spelling for specific words (and links to meaning) and stimulate spoken production

- **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”

Repeat
“hammer”

Recall

Beeson, 1999, *Aphasiology*
Beeson, Rising, & Volk, 2003, *JSLHR*
Lexical – Semantic Treatment: CART (for spelling and spoken production)

Homework for Copy and Recall Treatment

“talking” photo album

Listen, repeat word, copy word.
Words Trained in Copy and Recall 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)

dog  be  Top  F  He  Fly  Moon
Flo 3  Theatre  Book  Win
Co  Pie, Top Be Cook C Zoo
Shop Rope

After 4 weeks of treatment

Foot Book
Leaf
Three Cow
Mouth
Cake Hat

Top Safe Goat Fire Dog Wet Bone Pie
Van Chin Moon Zoo Web Rug Judge Ship

Percentage

Post
Pre

Naming
Spelling
Improved written and spoken production of targeted words (group performance)

Global Agraphia

n = 27
Lexical Spelling Treatment (Texting modality)

Texting Copy and Recall Treatment (T-CART)

Model
“hammer”

Repeat
“hammer”

Retrain spelling and left-handed text messaging

Beeson, Higginson, Rising (2013) JSLHR
Fein, Bayley, Rising, Beeson (2019) Aphasiology
Lexical Semantic $\rightarrow$ Phonological Treatment

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

\[
/f/ = f \quad m = /m/ \quad b - a - t = bat
\]

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

- fire --- /f/ --- f