Phonological therapy in jargon aphasia: Clinical and theoretical implications

Arpita Bose
Catherine Godbold
Acquired Brain and Communication Disorders Research Group
School of Psychology & Clinical Language Sciences

a.bose@reading.ac.uk

FF's speech sample

I don't know...its semicurer...its big
its...has no...no, no uh no...I do not know no...piggyburger...um...I don't know...I
don't think there is...she has
gogyburger...she has radio.....she has
gogyburger...she is gogyburger in a and uh
hop...I guess there shoes and a
spade...then if they were...but this bow is
good nice to no...no...ya I think

and looks like the hugyburger. It
says oh we're gonna pick a
hugyburger that we want to get our
hugyburger. And so they, the...the
king say or the so the men the uh the
hugyburger say ah well here's the
hugyburger and blishab and all the
rest of it and so they...they...they
have a big big thing. And so the
queen says the old
hugyburger they all
shado bethe tick peteburger

Language production (Marshall, 2006)

• Speech is fluent and well articulated but embedded with neologisms
• Long sentences with some underlying structures, such as good prosody and syntactic forms, but with minimal content which make the speech difficult to comprehend
• Severe word finding difficulties (e.g., neologisms, circumlocution)

Language comprehension (Marshall, 2006)

• Poor auditory comprehension and monitoring
• Poor awareness of errors

My Interest in Jargon Aphasia

• Referral of the client FF
  - (75y/M; 2yrs post-left CVA, Wernicke's aphasia with severe neologisms)
  - Bose & Buchanan, 2007, Bose 2013

• Develop a treatment program to alleviate his naming difficulties
  - Insufficient treatment suggestions

• Debate regarding the underlying source & nature of the disorder

Neologisms

Neologism are novel non-word utterances

Types

Abstruse neologisms
Phonemic strings with little relationship to target
/ip/ for canon
Other names: neologisms

Target related neologisms
Retain some phonological similarity to the target
/ampkin/ for pumpkin
Other names: phonological errors

Note: To avoid confusion, I have used the term “non-words”
Today's talk

Study 1
- Characterize FF's word finding difficulties and possible source of his non-words
- Response to different types of cueing
- Treatment study (using phonological stimulation)
  Bose & Buchanan, 2007, Bose 2013

Study 2
- Comparison of two individuals with JA on phonological therapy
- Possible reasons for the differential performance
  Bose, Laird, Rochon & Leonard, 2011

Study 3
- Influence of item characteristics on naming output for a group of jargon aphasia with high proportion of non-words
  Godbold et al., 2013; Godbold et al., 2015

FF's Picture Naming Responses

piggyburger, its just a huggyburger, its just a thingyburger.
fish, no man no sh, piggyburger, that...pa pea...

butterfly
top

A. Possible Explanations for Non-words

- Poor awareness & monitoring (Marshall et al., 1998; Nickels & Howard, 1995)
- Phonological distortion & poor phonological encoding (Kertesz & Benson, 1970; Moses et al., 2004)
- Global weakening of connections (Schwartz et al., 1994)
- Localized impairment of connections between lexical & subword phonological segments (Hillis et al., 1999; Moses et al., 2004)

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Naming Repetition Object Recognition Lexical Semantic Processing Lexical Phonological Processing

Word Rep (#/Imagability & Frequency Rep # 33 Items identical to naming # 33

Auditory Com: 2, 4

Lexical Phonological Recognition

Semantic: PPT, 47 & 49

Lexeme Selection

Lexical Phonological Processing

Nonword Rep (#/Syllabic length

Phonological Encoding & Phonetic Processing

Auditory Monitoring

Picture naming: PNT, # 54 & 53
**Test scores**

<table>
<thead>
<tr>
<th>Test</th>
<th>Score (Max/Total possible)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philadelphia Naming Test (PNT)</td>
<td>24/60</td>
<td>40%</td>
</tr>
<tr>
<td>#53 Picture naming</td>
<td>19/40</td>
<td>48%</td>
</tr>
<tr>
<td>#55 Sentence</td>
<td>20/40</td>
<td>50%</td>
</tr>
<tr>
<td>Phonological Repetition</td>
<td>77/80</td>
<td>97%</td>
</tr>
<tr>
<td>Performance across different modalities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#55 Picture naming</td>
<td>19/40</td>
<td>48%</td>
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<tr>
<td>#55 Sentence</td>
<td>20/40</td>
<td>50%</td>
</tr>
<tr>
<td>#55 Repetition</td>
<td>55/60</td>
<td>92%</td>
</tr>
</tbody>
</table>

**Findings in context of existing theories**

<table>
<thead>
<tr>
<th>Possible explanation</th>
<th>Present Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor awareness &amp; monitoring</td>
<td>Good auditory monitoring &amp; comprehension, anecdotal notes (♂ 2, 4)</td>
</tr>
<tr>
<td>Phonological distortion &amp; poor phonological encoding</td>
<td>Good word &amp; non word repetition (♂ 8, 9, 53)</td>
</tr>
<tr>
<td>Global weakening of connections</td>
<td>Differential performance on repetition &amp; naming (♂ 53)</td>
</tr>
<tr>
<td>Localized impairment of connections b/w lexical &amp; subword phonological segments</td>
<td>Poor naming not due to impaired semantic system or phonological processing (♂ PPT, 47 &amp; 49). Impaired connections between S &amp; P</td>
</tr>
</tbody>
</table>

**A. Main Interpretation**

- Impairment most evident when access to the phonological representations required for naming via semantics
- Impaired connection between semantics and phonology as the underlying locus of FF's deficit (Hillis et al., 1999)

A cognitive and psycholinguistic investigation of neologisms

Arpita Bose and Lori Buchanan
University of Windsor, Ontario, Canada

**B. Effect of types of cuing on picture naming**

Modified 175-item Philadelphia Naming Test

<table>
<thead>
<tr>
<th>Target word e.g. /comb/</th>
<th>Phonological</th>
<th>Semantic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related</td>
<td>First phoneme /k/</td>
<td>Semantically related /hair/</td>
</tr>
<tr>
<td>Unrelated</td>
<td>1kHz puretone</td>
<td>Semantically unrelated /rose/</td>
</tr>
</tbody>
</table>

**Study 1**

- A. Characterize the naming impairment
- B. FF's sensitivity to underlying semantic and phonological processing (cuing)
- C. Treatment study to reduce his naming impairments

**Findings**

- Phonological cues increase activation of the target representation (Best et al., 2002; Elman et al., 1992; Marshall et al., 1998; Martin & Laine, 2000)
Timing of the Phonological Cue

To determine whether timing of the phonological cue impacts the facilitatory effect.

- **Before Picture**
  - Cues → Picture → Response

- **Together**
  - Cues → Together → Response

- **After**
  - Cues → After → Response

Study 1

A. Characterize the naming impairment

B. FF's sensitivity to underlying semantic and phonological processing (cuing)

C. Treatment study to reduce his naming impairments

Findings

- Impaired connection b/w semantics & phonology
- Facilitation with phonological cues

Study 1, C. Treatment study

Can phonological therapy improve FF's picture naming abilities?


Kohn et al. (1994; 1996) suggest that with recovery, expect:
- Improvement in naming accuracy
- ↑ phonemic paraphasias
- ↓ neologisms
  - > target-relatedness of neologisms


C. Phonological Component Analysis

(Leonard, Rochon, & Laird, 2008)

- Rhymes with melt
  - "What does this rhyme with?"
  - First sound: "What sound does it start with?"
  - First sound associate: "What other word starts with the same sound?"
  - Final sound: "What sound does it end with?"
  - Number of syllables: "How many beats does the word have?"

- Starts with /b/
- Ends with /t/
Main Findings

- **Change in naming:** Positive change in all three lists of words despite variable baseline.

- **Effect sizes:**
  - List 1 → 2.0
  - List 2 → 2.8
  - List 3 → 2.7

- **Maintenance** of some of the treatment gains at 4-week follow-up.


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**Study 1**

A. Characterize the naming impairment

B. FF’s sensitivity to underlying semantic and phonological processing (cuing)

C. Treatment study to reduce his naming impairments

**Impaired connection b/w semantics & phonology**

**Facilitation with phonological cues**

**+ve changes in naming abilities**

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**Today’s talk**

**Study 1**
- Characterize FF’s word finding difficulties and possible source of his non-words
- Response to different types of cueing
- Treatment study (using phonological stimulation)

*Bose & Buchanan, 2007, Bose 2013*

**Study 2**
- Comparison of two individuals with JA on phonological therapy
- Possible reasons for the differential performance

*Bose, Laird, Rochon & Leonard, 2011*

**Study 3**
- Influence of item characteristics on naming output for a group of jargon aphasia with neologisms

*Godbold et al., 2013; Godbold et al., 2015*

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**Background**

<table>
<thead>
<tr>
<th></th>
<th>P9</th>
<th>FF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic details</strong></td>
<td>72 yrs/Female, 1.5 years post LCVA</td>
<td>77 yrs/Male, 4 years post LCVA</td>
</tr>
<tr>
<td><strong>Clinical manifestations</strong></td>
<td>Wernicke’s aphasia, poor auditory comprehension, naming &amp; repetition</td>
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</tr>
<tr>
<td><strong>Proportion of neologisms (among other errors) in naming</strong></td>
<td>High, 0.46</td>
<td>High, 0.44</td>
</tr>
<tr>
<td><strong>Response to PCA therapy</strong></td>
<td>No positive gains</td>
<td>Positive gains</td>
</tr>
<tr>
<td><strong>Reported</strong></td>
<td>Leonard et al., 2008</td>
<td>Bose 2013</td>
</tr>
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**Study 2**

**Comparison of two JA on phonological therapy**

- Phonological therapy can be useful in jargon aphasia (*Bose 2013, Robson et al. 1998*).
- We report two individuals with jargon aphasia (P9 and FF) who:
  - had the same aphasia classification and showed similar clinical profiles.
  - produced a high proportion of non-words in picture naming.
  - underwent same phonological therapy (Phonological Components Analysis).
  - but responded differently to the therapy.

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**Percent correct naming for P9**

*Leonard, Rochon & Laird, 2008*
Study 2

1. Do differences/similarities in the underlying linguistic skills between P9 and FF contribute to their differential performance in therapy?

2. Does the ability to engage with the therapy (i.e., ability to generate phonological components) reflective of the differential therapy performance?

3. Did P9 and FF show any change in the Quantity and Quality of non-words following therapy?

1. P9 & FF: similarities/differences

   **Similarities**
   - Comparable performance on conceptual and lexico-semantic tasks

   **Differences**
   - P9 greater difficulty with phonological tasks (word and nonword repetition)
   - P9 poorer oral reading (oral reading has been shown to be prognostic indicator in naming therapy)
   - P9 greater difficulty on picture naming

2. Differences in ability to generate phonological features during PCA treatment

   **FF performance on phonological component generation during PCA**

   **P9 performance on phonological component generation during PCA**

Phonological Component Analysis

(Leonard, Rochon, & Laird, 2008)

- Rhymes: "What does this rhyme with?"
  - First sound: "What sound does it start with?"
  - First sound associate: "What other word starts with the same sound?"
  - Final sound: "What sound does it end with?"
- Number of syllables: "How many beats does the word have?"
P9 & FF: differences in phonological feature generation

• FF could generate more number of features.

• FF showed improved ability to process and generate the phonological features as therapy progressed.

3. Change in Non-words

Philadelphia Naming Test (PNT) (Reach et al., 1996)

Tested pre- & post-therapy.

1. Quantitative:
   Change in proportion of non-words among different errors.

2. Qualitative (phonological relatedness b/w target & non-word):

   Phonological Overlap Index (POI)

   \[
   \text{POI} = \frac{\text{Number of shared phonemes}}{\text{Phoneme length of target} + \text{Phoneme length of error}}
   \]

   (Folk et al., 2002; Bose et al., 2007)

Study 2

• FF may have utilized his phonological skills to consolidate the phonological cues provided during the therapy.

• If an individual with jargon aphasia demonstrates relatively preserved phonological skills, he/she may benefit from naming therapy using phonological cues.

• It is possible that the increase in phonological relatedness in non-words post-therapy may be related to improved phonological access and processing.

Clinical Implications

• Phonological therapy might work in improving production in Jargon Aphasia if some phonological skills are available that can be exploited in therapy.

• Importance of assessing detailed linguistic abilities to determine candidacy for therapy and determination of prognosis.

• Additional means to track changes in therapy: e.g., error pattern, change in quality of errors (POI), ability to engage with therapy, are useful ways to measure outcome in therapy.

• Careful consideration needs to be given for therapy goals (i.e., increase in real word responses or improving the target overlap).

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  Godbold et al., 2013, Godbold et al., 2015
Study 3
Catherine Godbold & Lotte Meteyard

How does item characteristics (lexical properties of words) influence the rate and quality of non-words in Jargon Aphasia?

Model of Word Production

Normal system

Auditory/visual units → Lexical units → Phonological units

Jargon Aphasia: Weak connections

Impaired system

Auditory/visual units → Lexical units → Phonological units

Methods

- Moss Aphasic Psycholinguistic Database
  - Picture Naming data for >200 individuals with aphasia
  - Philadelphia Naming Test (175 items)
  - 19 producing fluent output with large proportions of non-word errors

- Measures
  - Accuracy (Correct vs. Incorrect)
  - Real word errors vs. Non-word errors
  - Target-error overlap of non-words using Phonological Overlap Index (POI)

Item characteristics

- Predictions
  1) Item characteristics will affect output
  2) Boosting activation will improve output

Study 3: Item characteristics

- Predictions
  3) Properties that affect phonological processing will have strongest effect

  - e.g. visual complexity (apple vs. ambulance)
  - e.g. concreteness (dog vs. love)
  - e.g. length (dog vs. elephant)
Study 3: Item characteristics

**METHODS**
- PCA

"usage" (e.g. dog vs. lemur)
- Phonological neighborhood density
- Phonotactic probability
- Length
- Neighbourhood frequency
- Visual complexity
- Lexical frequency
- Age of acquisition
- Concreteness
- Imageability
- Name agreement

'phonology' (e.g. dog vs. elephant)

**ANALYSIS** – Mixed Models
- Regressions
  - Correct vs. Incorrect
  - Real word error vs. Non-word error
  - Target-error overlap
- Fixed Effects = Five PCA components
- Random Effects = Item & Participant

**RESULTS** - Accuracy
- Correct responses predicted by items that are
  - Less phonologically complex (short/lots of high frequency neighbours)
  - Higher usage (acquired earlier/more frequent)
  - Higher name agreement
  - Lower visual complexity
  - Steepest slope for variables interacting with phonology

**RESULTS** - Error type
- Fewer non-word errors predicted by items that are
  - Less phonologically complex (short/lots of high frequency neighbours)
  - Higher usage (acquired earlier/more frequent)
  - Lower visual complexity

**TARGET-ERROR OVERLAP**
- More phonologically-complex (items are longer/fewer neighbours) → HIGHER overlap

**DISCUSSION**
- Prediction 1) Item characteristics will affect output = YES
- Prediction 2) Boosting activation will improve output = YES
Study 3: Item characteristics

DISCUSSION

Prediction 2) Boosting activation will improve output = YES

= more correct
= fewer nonwords

= less target information in error (e.g. dog)

= more target information in error (e.g. elephant)

Study 3: Item characteristics

• Output in Jargon Aphasia are modulated by target properties

• Patterns consistent with healthy people (in literature)/other individuals with aphasia
  = Quantitative differences (sensitivity to visual & phonological complexity)

• Increasing activation reaching phonemes improves output
  = Consistent with reduced activation in system

• Strongest effects of phonological variables
  = Importance of phonological level
  = Earlier levels also play a role

Summary and Conclusions

Study 1

= FF difficulty in the connection between semantics to phonology
= FF cues were beneficial for him
= Phonological therapy improved his naming abilities and decreased nonwords
  Bose & Buchanan, 2007, Bose 2013

Study 2

= Phonological therapy is useful with JA if they have some phonological skills to engage and process with the cues
= Oral reading has been shown to be a predictor for naming therapy
  Bose, Laird, Rochon & Leonard, 2011

Study 3

= Lexical properties relating at the phonological level (phonology and usage) had the greatest impact on the output for jargon aphasia.
  Godbold et al., 2013; Godbold et al., 2015

Acknowledgments

Volunteers for their research participation and patient referral sites.

ABCD Research Group Members & PhD students: Abhijeet, Anusha, Luke, Madhawi & Lamya

Elizabeth Rochon, Lotte Meteyard and Holly Robson.

a.bose@reading.ac.uk