COMPLEXITY MATTERS: SEMANTIC AVAILABILITY OF CROATIAN BROCA’S APHASICS

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In aphasia, semantic processing is commonly assumed to be affected by impairment specific to language.

Imageability (HI or LI) has been argued to induce asymmetry in processing of nominal lexical units as this feature of the mental lexicon unit is sensitive to the stimulus modality and to the conceptual system.
• HI/concrete words
  - Richer semantic representations (Plaut and Shallice 1991; Nickels and Howard 1995)
  - Benefit from visual features in addition to semantic features (Paivio 1991)

• LI/abstract words
  - Only semantic representation modulated by language
  - One path to arrive at the understanding
Much previous research supports the idea that conceptual processes are modulated by word imageability:
- Shorter RT times
- Better recall and naming
- Learned earlier
- Patients better results on all tasks

Highly correlated to concreteness

Stress visual modality
Double modality of the representation of concrete nouns in the mental lexicon, verbal and non-verbal representation, contrasted with single, verbal, representation in abstract nouns (Paivio 1990, 2010), is argued to facilitate the processing of a concrete noun and slow down successful retrieval, access and any further processing of an abstract noun (Sabsevitz et al., 2005).
PARTICIPANTS: 30 aphasic participants (among them specifically 11 Broca’s and 11 anomic aphasics) and 30 paired neurologically healthy participants (gender, age, education, right/left handed) ; all native speakers of Croatian.

Behavioral classification for aphasic patients (clinical assessment) and CT scan data.
MATERIALS AND METHODS

• MATERIAL: Set of semantic tests of different complexity from the battery of tests Psycholinguistic Assessments of Language Processing in Aphasia (PALPA) adapted for Croatian (60 assessments).
  - PALPA:
    - Recognition, comprehension and production of spoken and written words and sentences
    - Modular approach to mind’s language system, assumption of selective impairment
    - Integrity of modules and pathways of communication between them

• TARGET TEST: Auditory and Written Synonym Judgments (PALPA 49 and 50)
  - designed to examine the processing of the lexical feature of imageability

• Two follow-up comprehension tests of lesser and higher processing complexity: Spoken and Written Word-Picture Matching (PALPA 47 and 48), and Word Semantic Association (PALPA 51).
1. To investigate the difference in semantic processing of HI and LI words in aphasic patients compared to healthy controls.
2. To compare accuracy of HI and LI words for Broca’s and anomic aphasics on semantic processing tasks of different complexity.
3. To investigate the correlation between the semantic processing of HI and LI words and the stimulus modality.
HYPOTHESIS

- **H1**: Activation of lexical mental representation depends on the imageability.
  - The accuracy is expected to be higher in the condition with higher imageability and lower in the condition with lower imageability.

- **H2**: Anomia is taken to be an impairment of the ability to retrieve words, and Broca’s aphasia is taken to be agrammatic aphasia, or the inability to understand and produce certain grammatical structures.
  - Broca's aphasics are expected to score higher than the anomic aphasics on semantic processing tasks of any complexity.
PALPA in Croatian

- Translation and adaptation
- Words matched for frequency

**PROBLEMS with PALPA and with Croatian:**
- PALPA overall – only descriptive statistical analysis (originally tested on 32 healthy subjects and 25 aphasics)
- Level of the lexical complexity for each task not explicit
- No normalization of imageability for Croatian yet
PALPA 49/50 AUDITORY/Written SYNonym JUDGMENT

- **TASK**: to judge whether two words are close in meaning (Q: Do they mean nearly the same thing?)
- **Binary Choice**
- **Two Sets** – HI and LI matched for frequency
- **DISTRACTORS**: not connected in meaning/NON-SYNONYMS

- **HI:**
  - + marriage – wedding; story – tale; joy – happiness (?)
  - - ship – tomb; tool - crowd
- **LI:**
  - + advice – counsel; lie – falsehood
  - - safety – truth; impotence - consent
# EXPERIMENT 1
**PALPA 49/50: AUDITORY/WRITTEN SYNONYM JUDGMENT**

## TTest HEALTHY vs APHASICS

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<thead>
<tr>
<th></th>
<th>HI</th>
<th>LI</th>
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<tr>
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<td>NON-SYNONYMS</td>
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## Synonyms BROCA

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<tr>
<th>TTest</th>
<th>Broca’s</th>
<th>Synonyms</th>
<th>Non-synonyms</th>
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<tbody>
<tr>
<td>HI</td>
<td>AUD vs WRITTEN</td>
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<td>LI</td>
<td>AUD vs WRITTEN</td>
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## Synonyms ANOMICS

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<th>Non-synonyms</th>
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<tr>
<td>HI</td>
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## BROCA’s vs ANOMICS

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## Synonyms LI (auditive+written)

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## Synonyms LI (auditive+written)

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## BROCA’s vs ANOMICS

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<tbody>
<tr>
<td>BROCA’s</td>
<td>0.0061</td>
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</table>
EXPERIMENT 1: PALPA 49/50

- HI SYNONYMS
- LI SYNONYMS
- HI NON-SYNONYMS
- LI NON-SYNONYMS

BROCA'S APHASIA
ANOMIC APHASIA
HEALTHY CONTROLS
EXPERIMENT 1: PALPA 49/50

- SD constantly higher in Broca’s than in anomics
- Greater range of variation altogether in Broca’s
- Anomics medians: 15, 15, 14, 15
EXPERIMENT 2: PALPA 47 and 48

PALPA 47 SPOKEN WORD-PICTURE MATCHING

PALPA 48 WRITTEN WORD-PICTURE MATCHING

One word, four pictures to choose from 40 words

Instructions: “Please listen to/read this word. Do not say what it is. Just think carefully and point to the picture which matches it. Be sure that you look at all the pictures.”

Overall results very high – aphasics 90%

- Close semantic distractor from the same superordinate category
- A more distant semantic distractor
- A visually similar distractor
- Unrelated distractor
- carrot – cabbage – lemon – saw – chisel
EXPERIMENT 3: PALPA 51

- PALPA 51 WORD SEMANTIC ASSOCIATIONS – HI AND LI WORDS
  - One word, four words to choose from
  - Instructions: “Look at this underlined word. Do not read it aloud. Here are four other words. Which one is the closest in meaning? Tick the one that is closest in meaning.”
  - ORGANIZATION: Stimulus - Target word - Semantically connected distractor - 2 semantically not connected distractors

- HI
  - 1. fog – dew – steam – screw – nail (low all)
  - 2. stove – oven – refrigerator – wax – soap (high all except Broca’s)

- LI
  - 1. alliance – pact – oath – idol – saint (high all)
  - 8. deceit – failure – guilt – disposal – habit (high all except Broca’s)
EXPERIMENT 3: PALPA 51 – OVERALL RESULTS

- HI
  - healthy –95% correct
  - anomia –90% correct
  - Broca’s –72% correct

- LI
  - healthy –95% correct
  - anomia –77% correct
  - Broca’s –56% correct
HI ASSOCIATIONS – CORRECT ANSWERS
LI ASSOCIATIONS – CORRECT ANSWERS
# EXPERIMENTS 2 and 3

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<td>Anomics</td>
<td>Mean</td>
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<tr>
<th>SPOKEN vs WRITTEN WORD-PICTURE MATCHING</th>
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<table>
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<th>WORD SEMANTIC ASSOCIATIONS (51)</th>
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<td>SD</td>
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<tr>
<td><strong>BROCA’s vs ANOMICS</strong></td>
<td>TTest</td>
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</tbody>
</table>

| HI Broca’s vs Anomics TTest | 0.0021 |
| LI Broca’s vs Anomics TTest | 0.0086 |
Revised H1: Activation of lexical mental representation depends on the imageability and on the complexity of the task.

- The accuracy is expected to be higher in a condition with lower complexity of the task and lower in the condition with higher complexity of the task.
REVISED H1: SIMPLICITY AND COMPLEXITY OF TASKS

- PALPA 49 and 50 (Auditory/Written Synonym Judgments) – comparing and establishing the relation of identity
  - Binary
  - Stimuli presented in the same modality (linguistic, spoken or written)

- PALPA 47 and 48 (Spoken/Written Word-Picture Matching) - comparing and establishing the relation of identity
  - COMPARING task with VISUAL PRIME – than MATCHING.
    - Illusion of comparing pictures.
    - Open question of SILENT NAMING.
| 23 |

**REvised H1: Simplicity And Complexity Of Tasks**

- **PALPA 51 (Semantic Associations – HI and LI words) – comparing and establishing a relation by association**
  - Stimulus, target and 3 distractors
  - Both stimuli and choices presented in the same modality (linguistic, written)
  - Semantically most complex task
DISCUSSION – H1: imageability

- As expected, aphasics as a group scored lower than the control group of healthy subjects on all measures, especially on LI words.
- Aphasics as a group scored higher on accuracy of HI words in the task of lower complexity than in the task of higher complexity.
- Also, aphasics as a group scored lower on the accuracy of LI than HI words in complex semantic processing task.
- Results suggest that imageability facilitates lexical activation, even in complex semantic processing.
DISCUSSION - H2: Broca’s vs. anomics

- Broca’s aphasics scored **lower** than anomic aphasics on all tests.
- There is a statistically significant difference between Broca’s and anomic aphasics in accuracy of HI and LI.
- While the overall performance of Broca’s aphasics was lower in comparison to anomic aphasics, it was **significantly lower** in processing highly complex semantic tasks.
CONCLUSION – Broca’s

- The most interesting result – the number of errors Broca’s patients performed in semantic processing increased with the increase of task complexity.

- Alongside with the available data on their syntactic impairment, this suggests that Broca’s aphasics might suffer not only from the impairment of specific module, than rather the complexity itself.
THANK YOU