Linguistic Impairment Profiles in Four Post-Stroke Aphasia Case Studies

Exploring the Role of Dialectal Micro-Variation

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In lieu of an outline

- Aphasia: a collection of language pathologies (affecting production/comprehension), that arise as the outcome of brain trauma

- Roughly subcategorised as Fluent and Non-Fluent

- N-Fl. aphasia especially affects verb production and retrieval and not nouns as much, while this dissociation is not found in Fl. Aphasias

- Verbal deficits in N-Fl. may be sensitive to Movement (Unacc.) and information integration at Syntax-Discourse (past reference)

Aphasia across languages

- Decades of research, but with heavy bias towards monolingual English speakers – with consequences for testing tools

- Work on SMG in recent decades
  - Main observation: Tense/Asp. differentially impaired
  - Hypotheses: Tree-pruning, Functional Features, Discourse-linking
  - e.g. Fyndanis, Arcara, Christidou, & Caplan, 2018; Fyndanis, Varlokosta, & Tsapkini, 2012; Nanousi, Masterson, Druks, & Atkinson, 2006; Tsapkini, Jarema, & Kehayia, 2001

- Some work in bilingual aphasia, e.g. Bilingual Aphasia Test in Cypriot Greek-English (Kambanaros & Grohmann, 2011)

- Less research in closely related varieties

The study

- *n=4* series of case studies:
  Efficacy of repetitive Transcranial Magnetic Stimulation in chronic post-Stroke aphasia rehabilitation

- My part: linguistic analysis of elicited continuous narrative using QPA (Saffran et al., 1989; Varkanitsa, 2012)

Participants

Participant	Sex	Age (years)	Handedness	Education (years)	Type of stroke	Months post stroke	Lesion site (left hemisphere)	Type of Aphasia	Severity of Aphasia	SLT prior to enrolment	Termination of SLT
1a	M	48	right	15	ischemic	11	IFG; internal capsule; insula; caudate nucleus; putamen	Broca's	moderate-severe	8 months – 4 times per week – 45 minutes	10 days before enrolment
2a	F	72	right	12	ischemic	50	Broca's and Wernicke's areas; arcuate fasciculus; insula	anomic	moderate-severe	24 months – 2 times per week – 45 min of SLT	2 years before enrolment
1b	M	55	right	17	ischemic	8	precentral gyrus; arcuate fasciculus; internal capsule; caudate nucleus; putamen	global	severe	4 months – 4 times per week – 45 minutes	10 days before enrolment
2b	M	26	right	16	ischemic	109	IFG; insula; basal ganglia; arcuate fasciculus; internal capsule; Wernicke's area	anomic	mild	10 months – 4 times per week – 45 minutes	7 years before enrolment

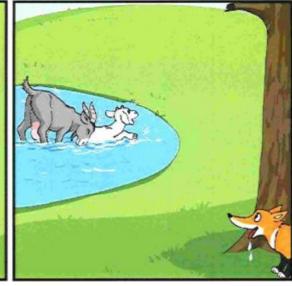*Key: PWA: people with aphasia; IFG: inferior frontal gyrus; SLT: speech-language therapy*
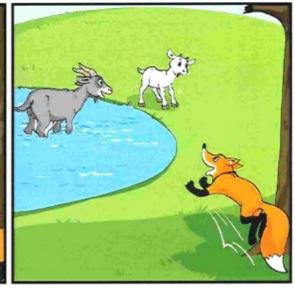
Methodology

- Protocol by Saffran, Berndt, & Schwartz (1989), modified by Varkanitsa (2012)

- Applied on an extended elicited narrative sample

- Hesitations, repaired segments, direct responses, stereotyped expressions, non-interpretable neologisms, and sentence coordinators are discarded

- Returns measures of well-formedness, complexity and elaboration indices, MLU, PoS proportions, error types

Narrative Samples

- 16 samples in total; 4 per participant (Pre-1, Pre-2, Post-treatment, Delayed Follow-up)

- Elicited with the Baby Goats stimulus from MAIN

- Transcription, normalisation, and annotation of the data

Narrative Sample - Transcription

- Το κατσικάκι επικίνδυνο τζιαι του είπεν η τάμπου τον λαλείς ο πατέ- η μάμμα σου η μητέρα σου επικίνδυνο. Φέφκει το το κατσικάκι σι- το νερόν να φέφκει να φύει το νερόν σου.

- to katsikáki epikínðino dže tu ípen i támbu ton lalís o paté- i mámma su i mitéra su epikínðino. Féfki to to katsikáki si- to nerón na féfki na fíi to nerón su.

Narrative Sample - Transcription

- The baby goat dangerous and what do you call him said to him the fath- your mum your mother dangerous. She removes it the baby goat s... the water to remove to be removed your water.

Narrative Sample - Normalisation

- To katsikáki epikínðino

- Tu ípen i mitéra su epikínðino

- Féfki to to katsikáki to nerón na fíi to nerón su

Narrative Sample - Annotation

- To **katsikáki** epikínðino
  The baby-goat dangerous

- *Tu* ípen i **mitéra** *su* epikínðino
  Your mother told him dangerous

- Féfki *to* to **katsikáki** to **nerón** na fíi to **nerón** *su*
  She removes it the baby-goat the water [in order to] remove your water

Pronoun **Noun** Adjective Verb
Other Closed Class

Measures (1)

- Number of narrative words
- MLU per trial per patient
- Prop. of well-formed sentences with verbs
- Part of Speech Proportion
- (Verb) Auxiliary Score

Measures (2)

- Embedding Score

- Elaboration Score

- Error-type Analysis

  - i) phonological,
    ii) morphosyntactic,
    iii) semantic,
    iv) lexical,
    v) uninterpretable neologisms, and
    vi) extended circumlocutions

QPA Results

- *Roughly* two distinct patterns of performance
  - Group 1 had higher Elaboration and Embedding Scores, more Nouns, longer MLU
  - Group 2 had more pronouns, more semantic errors, more variability

- Useful predictions / can be used for screening:
  - Group 1 → non-fluent aphasias
    Group 2 → fluent aphasia, but of varied severity (2b milder)

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Key: PWA: people with aphasia; IFG: inferior frontal gyrus; SLT: speech-language therapy

QPA Protocol	1a			2a			1b			2b		
	Avg Pre-Treatment	Post-Treatment	Follow Up	Avg Pre-Treatment	Post-Treatment	Follow Up	Avg Pre-Treatment	Post-Treatment	Follow Up	Avg Pre-Treatment	Post-Treatment	Follow Up
Lexical Selection												
% Closed Class	.32	.35	.35	.28	.38	.17	.28	.32	.31	.25	.20	.18
% Nouns	.26	.23	.21	.24	.29	.14	.24	.27	.27	.05	.04	.02
% Adjectives	.04	.09	.10	.05	.03	.00	.04	.01	.05	.09	.11	.07
% Prepositions	.08	.07	.11	.01	.01	.14	.07	.09	.07	.09	.06	.02
% Adverbs	.04	.03	.02	.02	.00	.00	.03	.00	.02	.04	.16	.09
% Pronouns	.06	.03	.03	.19	.09	.31	.09	.05	.07	.16	.14	.32
% Verbs	.21	.20	.19	.22	.18	.24	.25	.25	.21	.32	.30	.32
Sentence Productivity												
MLU (words)	6.28	9.67	8.83	3.75	4.86	3.23	5.89	6.42	5.35	3.49	3.40	3.17
Sentence Elaboration Index	3.13	4.17	1.83	1.95	1.64	1.60	2.61	2.67	2.25	1.40	1.21	1.53
Sentence Embedding Index	0.44	0.92	0.85	0.10	0.07	0.00	0.47	0.58	0.15	0.16	0.10	0.17
Discourse Productivity												
Number of Narrative Words	81.5	116	117	64	68	42	76	77	107	61	102	57
Grammatical Accuracy												
Sentences with Verbs	12	11	12	11.5	11	10	12.5	12	20	17	29	15
Utterances without Verbs	1	1	1	2.5	3	1	0.5	0	0	1	0	2
Single-word Utterances	0	0	0	2.5	0	2	0	0	0	0	1	1
% of Well-formed Sentences	.91	.73	.83	.38	.09	.50	.40	.75	.60	.85	.79	.33
Auxiliary Complexity Index	1.09	1.00	1.00	1.00	.90	1.00	1.04	1.17	1.05	1.06	1.00	1.00

Error Type Results

- No overarching pattern, except for 1b's apraxia:
  - Epíe na to **kxváli** (*fkáli*)
  - i mámma tu **efxasistúse** (*efxaristúse*)
    Aŋgakjastísasin (*aŋgaljastíkasin*)

Error-type Analysis	Avg Pre-Treat-ment	Post-Treat-ment	Follow Up	Avg Pre-Treat-ment	Post-Treat-ment	Follow Up	Avg Pre-Treat-ment	Post-Treat-ment	Follow Up	Avg Pre-Treat-ment	Post-Treat-ment	Follow Up
	1a			2a			1b			2b		
% Phonological	0.02	0.00	0.00	0.02	0.09	0.02	0.34	0.27	0.26	0.02	0.02	0.04
% Morphosyntactic	0.02	0.01	0.02	0.13	0.21	0.05	0.03	0.05	0.05	0.02	0.02	0.02
% Semantic	0.02	0.00	0.03	0.04	0.06	0.07	0.01	0.00	0.00	0.01	0.00	0.02
% Lexical	0.02	0.02	0.02	0.01	0.04	0.05	0.03	0.00	0.03	0.03	0.03	0.05
% Neologisms	0.00	0.00	0.00	0.02	0.00	0.02	0.05	0.00	0.00	0.00	0.00	0.00
% Circumlocution	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.02
% All Errors	0.08	0.03	0.07	0.21	0.41	0.21	0.45	0.32	0.36	0.08	0.07	0.14

Error Type Results

- ...and 2a's severe difficulties in all domains

  - Mbéni **ti katsikár' ti** meχáli **ti** mámma dže **vávχi** to katsikáki

    (Mbéni i katsíka i meχáli i mámma dže vχázi to katsikáki)
    The big goat, the mother, enters and takes the baby goat out

  - i **katsé'** dže to **aχór'** to **morá'i** tis mitéras dže to moró **su aχápi dže to meró**

    (i katsíka dže to aχóri to moráki tis mitéras ítan aχapiméni)
    The goat and the boy, her baby *and the baby love and the baby
    √ lived happily ever after (idiomatic)

Some points of interest

- Auxiliary Index: measure of verbal features marked on top of verb base form
  almost no sensitivity, unlike Varkanitsa's 2012 Greek results

Grammatical Accuracy	1a			2a			1b			2b		
Sentences with Verbs	12	11	12	11.5	11	10	12.5	12	20	17	29	15
Utterances without Verbs	1	1	1	2.5	3	1	0.5	0	0	1	0	2
Single-word Utterances	0	0	0	2.5	0	2	0	0	0	0	1	1
% of Well-formed Sentences	.91	.73	.83	.38	.09	.50	.40	.75	.60	.85	.79	.33
Auxiliary Complexity Index	1.09	1.00	1.00	1.00	.90	1.00	1.04	1.17	1.05	1.06	1.00	1.00

Proportion of utterances without verbs	0.17 (0.15)	0.28 (0.10)	0.19 (0.11)
Proportion of single-word utterances	0.03 (0.02)	0.20 (0.28)	0.00 (0.02)
Proportion of well-formed utterances	0.72 (0.10)*	0.43 (0.40)*	0.96 (0.65)
Auxiliary complexity index	0.18 (0.14)	0.20 (0.11)	0.30 (0.27)

* $P < 0.05$

Some points of interest

- Auxiliary Score (cont.): Very few relevant errors
  - Túton **fáfki** túton (_trói_): This eats that one
  - **Értiken** dže túton (_írten_): This one also came
  - **Ífen** to túton to katsikáki (éfien): It removed this small goat (Part. 2a)
- Extended periphrasis as compensation:
  - the crow **arrives at its destination** to catch the fox
  - Finally the bird went far away **from the scene where the fox was ready to capture the small one** (Part. 1a)
- Subject Elaboration Score: **low**
  - No participant produced Subject relative clauses

Some points of interest

- Semantic errors:
  - She gives birth to him (Part. 2b)
  - The bird has the meat & The bird had meat to the fox (Part. 2a)
  - There are three goats in the park (Part. 1b)

- Case assignment errors (ACC for NOM):
  - Mbéni **ti** katsikár' **ti** meχáli **ti** mámma (*i*)
    The big goat, the mother, enters
  - Firméni **ti** arepú na to fái (*i*)
    The fox, starving, (wanted to) eat it (Part. 1b)

Discussion

- The sample is too small to permit statistical treatment at this point

- Theoretical/Methodological concerns:
  - QPA, even after Varkanitsa's modifications, not fully adapted to Greek as seen in AUX score: salient marking, analytic-ness, dialect effect?
  - Simple story telling mode obscures grammatical competency in rarer constructions (esp. Subj. Sent.)
  - Study didn't account for bilectalism

Outlook

- Expansion of the participant base will allow safer interpretations of the preliminary patterns

- Tease apart Task effects from Variety effects
  - CG and SMG micro-differences in the T/Asp system: lack of/different sensitivity to Perfectivity less demanding, or simply obscured because ±Perf PAST it has no semantic consequence? – forced choice tasks
  - Assess impairment of relative clauses – direct elicitation
  - Control for Greek variety – ideally test both

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Follow-up

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How CG differs from SMG

Phonology (Arvaniti, 1999 and 2006; Nevins & Chitoran, 2008)

- **Consonantal repertoire**: gemination, post-alveolars, but no voicing distinction in plosives

- **Phonotactics**: intervocalic fricative elision, glide hardening

- **Suprasegmentals**: no secondary stress

- **Stress assignment**: nominal inflection patterns (interfaces with morphology?)

How CG differs from SMG

- **Morphology** (Hadjioannou, et al., 2011; Varella, 2006)

  - **Inflection**: preservation of older forms (*-sin*) and generalisation (*e-*), uniquely CG suffixes (*-uðes*), partial (reversed?) neutralisation of case distinction (GEN/ACC.PL)

  - **Determiners and Pronouns**: paradigms vary to different extents (tis→ tes, but afti → tuti)

How CG differs from SMG

- **Syntax**
  - **Clitics**: mixed placement: V-Cl. in Imperative, Declarative, Polar Q., free variation in some embedded clauses, Cl-V elsewhere. Strict IO>DO order.
  - **Case**: [+GEN] mono-transitive verbs
  - **Tense/Aspect**: Present Perfect A / Aorist-Perfect variation
  - **Left-periphery**: Wh-clefting & Focus-clefting