Measuring sentence production in primary progressive aphasia

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INTRODUCTION AND OBJECTIVES

The three clinical presentations of primary progressive aphasia (PPA) [non-fluent (nfvPPA), semantic (svPPA) and logopenic (lvPPA) variants] reflect heterogeneous neuropathological substrates that are difficult to be recognized *in vivo*.

The presence of agrammatism in the clinical profile has a high association with tauopathy and could be extremely helpful in the diagnostic procedure. However, grammatical competence is still difficult to be assessed in the clinical setting, mainly when patients have affected speech production.

In this study, we proposed a sentence anagram test (SAT), based on an adaptation of the Northwestern Anagram Test (NAT) for the Italian language. This test measures sentence production over patient speech disturbances.

Our aim was to assess the ability of SAT in differentiating nfvPPA and lvPPA which are difficult to be distinguished based on speech production albeit associated with different underneath pathology.
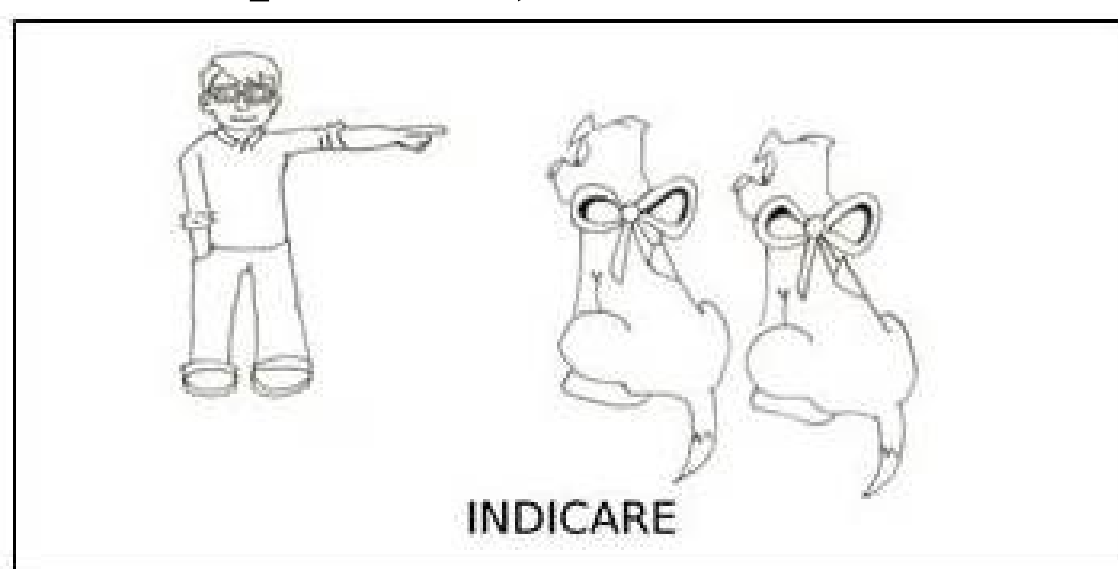
METHODS

Table 1. Sociodemographic, clinical and language features of patients

	nfvPPA	lvPPA	p	svPPA
N	13	9		4
Age	71.1±5.3	73.2±7.2	0.45	62.9±7.4
Gender, females	8 (62%)	5 (56%)	1.00	2 (50%)
Disease duration	2.5±1.3	3.8±1.4	0.04*	3.8±0.5
Education	10.3±5.7	14.4±2.7	0.06	8.5±3.3
MMSE	23.7±3.9	25±3.3	0.42	25.8±1.7
Confrontation naming, visual stimuli	44.3±3.3	40.9±6.1	0.15	20.8±6.4
Single word comprehension	48.0±0.0	47.9±0.4	0.30	39.8±9.2
Object Knowledge	49.1±3.4	49.8±2.1	0.64	31.0±8.5
Repetition, total score	129.5±28.9	128.1±10.1	0.90	140.8±3.8

Values denotes means±standard deviations (or frequencies). P values refer to t-test models or Fisher's exact test (svPPA were not included in the statistical analysis and were only used for a qualitative example of unaffected grammar performance). Abbreviations: lv=logopenic variant; MMSE=Mini Mental State Examination; nfv=non-fluent variant; PPA=primary progressive aphasia; sv=semantic variant. Neuropsychological batteries for specific domains: Confrontation naming and Single Word Comprehension=from CaGi; Object knowledge=Pyramids and Palm Trees Test, 52 items; Repetition=from Aachener Aphasie Test (AAT).

All patients underwent the SAT (see **Figure** below) which includes 44 items: canonical (8 simple and 16 complex active) and non-canonical (8 passive and 12 object-extracted question) sentences.

METHODS

Outcome measures
- SAT performance accuracy
- SAT time for completing total and sub-session items.
- Performances at the syntax comprehension test, useful for the differential diagnosis, were also included in the analysis.

Statistical Analysis
All neuropsychological features were compared between nfvPPA and lvPPA groups using t-test models. The four svPPA were not included in the statistical analysis and were only used for a qualitative example of unaffected grammar performance.

RESULTS

The group of patients took similar time to complete all the NAT sub-sessions and showed similar accuracy for canonical active sentences. Compared to lvPPA, nfvPPA showed worse accuracy for both canonical and non canonical sentences, specifically for complex active, passive and question sentences.

Likely due to initial comprehension deficits in lvPPA with longer disease duration, both groups of patients performed similarly in the syntax comprehension test.

As expected, svPPA qualitatively performed better than the other groups in all investigated domains.

Table 2. Performances of patients at the SAT and at the Syntax comprehension

	nfvPPA	lvPPA	p	svPPA
N	13	9		4
Sentence Anagram				
Simple active, score	6.5±1.5	7.6 ±0.9	0.05	8.0±0.0
Simple active, time	222.9±130.7	211.0±188.9	0.87	96.9±45.0
Passive, score	4.3±2.0	7.1±1.4	**0.001**	6.5±1.9
Passive, time	476.0±255.2	478.7±541.9	0.99	256.2±209.2
Complex active, score	5.3±5.0	13.6±4.4	**0.001**	10.6±3.5
Complex active, time	1529.3±764.2	1138.0±787.7	0.26	752.3±211.4
Questions, score	4.2±2.0	7.2±1.8	**0.002**	7.8±1.8
Questions, time	527.3±252.4	535.0±344.1	0.95	353.6±267.6
Canonical, score	11.9±6.1	21.2±5.3	**0.001**	18.6±3.5
Canonical, time	1752.2±867.0	1349.1±968.2	0.32	849.1±251.9
Non-canonical, score	8.5±3.4	14.3±2.6	**<0.001**	14.3±3.3
Non-canonical, time	1003.3±468.4	1013.7±864.7	0.97	609.7±344.0
SAT, total score	20.3±8.5	35.4±7.2	**<0.001**	32.9±6.8
SAT, total time	2755.5±1271.4	2362.7±1788.5	0.55	1458.9±582.8
Syntax comprehension				
Visual, score	37.7±7.2	41.4 ±3.7	0.23	42.3 ±2.2
Auditory, score	49.7±10.0	53.3±8.0	0.44	57.8 ±3.3

Values denotes means±standard deviations. P values refer to t-test models (svPPA were not included in the statistical analysis and were only used for a qualitative example of unaffected grammar performamce). 'Time' has been reported in terms of seconds. Abbreviations: lv=logopenic variant; nfv=non-fluent variant; PPA=primary progressive aphasia; SAT=Sentence Anagram Test; sv=semantic variant. Neuropsychological batteries for specific domains: Syntax comprehension=from BADA.

CONCLUSIONS

- The adaptation of NAT for the Italian language is powerful for distinguishing nfvPPA and lvPPA in vivo.
- Although some lvPPA had longer disease duration, the SAT was still able to detect the differences in the two variants.
- Future studies in larger samples should test the performance of these measures for a correct classification at the single subject level.