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EFFECTS OF PEDUNCULOPONTINE NUCLEUS AREA STIMULATION ON SPEECH PRODUCTION IN PARKINSON'S DISEASE

S. Pinto ¹, A. Maillet ², A. Ghio ¹, M. Ferraye ², V. Fraix ², R. Espesser ¹,
S. Chabardès ², E. Seigneuret ², A.L. Benabid ², B. Debû ², P. Pollak ²

¹ Laboratoire Parole et Langage (LPL), CNRS / Université Aix-Marseille, Aix-en-Provence, France
² Grenoble Institut des Neurosciences (GIN), INSERM U836, Université Joseph Fourier, Grenoble, France

BACKGROUND

Gait impairment, including freezing (FOG), is frequent in Parkinson's disease (PD) and responds poorly to classical pharmacological and surgical treatments. Freezing can also be seen for speech and since FOG may be improved by pedunculo pontine nucleus (PPN) area stimulation, it is of great interest to examine the PPN stimulation influence on speech.

The PPN is known to modulate locomotor activity. Its dysfunction in the context of PD, e.g., may be the origin of gait and postural impairments. This concept could be extended on the one hand to other movement disorders.

On the other hand, such influence of the PPN area on motor activity could also be expected in other kinds of movement, such as speech production. Actually, the brainstem represents an important convergence zone for orofacial motoneurons, which are in essence able to be affected by electrical diffusion within this area.

OBJECTIVE

To evaluate the effect of the PPN area stimulation on temporal speech parameters in PD

PATIENTS AND METHODS

PATIENTS AND SUBJECTS

7 patients with PD

| | 1 | 2 | 3 | 4 | 5 | 6 | Mean ± SD |
|---|------|-----|-----|------|-----|-----------------------|-------------|
| Sex | M | F | M | M | F | M | |
| Age at PD diagnosis | 55 | 50 | 49 | 44 | 31 | 27 | 42.7 ± 11.2 |
| Age at STN surgery | 64 | 64 | 65 | 53 | 53 | 47 | 57.7 ± 7.6 |
| Age at PPNa surgery | 68 | 68 | 72 | 57 | 59 | 56 | 63.3 ± 6.8 |
| Disease duration | 13 | 18 | 23 | 13 | 28 | 29 | 20.7 ± 7.1 |
| Levodopa equivalent daily dose (mg) (Lozano et al., 1995) | 1025 | 550 | 800 | 1170 | 400 | 0 | 675 |
| Improvement in the UPDRS motor score under levodopa off STN stimulation (%) | 55 | 23 | 23 | 44 | 46 | No levodopa treatment | |
| FOG (off med) | Yes | Yes | Yes | Yes | Yes | Yes | |
| Postural instability (off med) | Yes | Yes | Yes | no | Yes | no | |

Severe freezing of gait unresponsive to either L-dopa or bilateral STN stimulation

Bilateral PPN area stimulation

SPEECH PRODUCTION RECORDINGS

Carried out in addition to other clinical and gait evaluations (Ferraye et al., 2009, Brain), before and after surgery (5 times during one-year follow-up)

Performed with a digital voice recorder (Microtrack, M-Audio) connected with a head-mounted microphone (AKG4420)

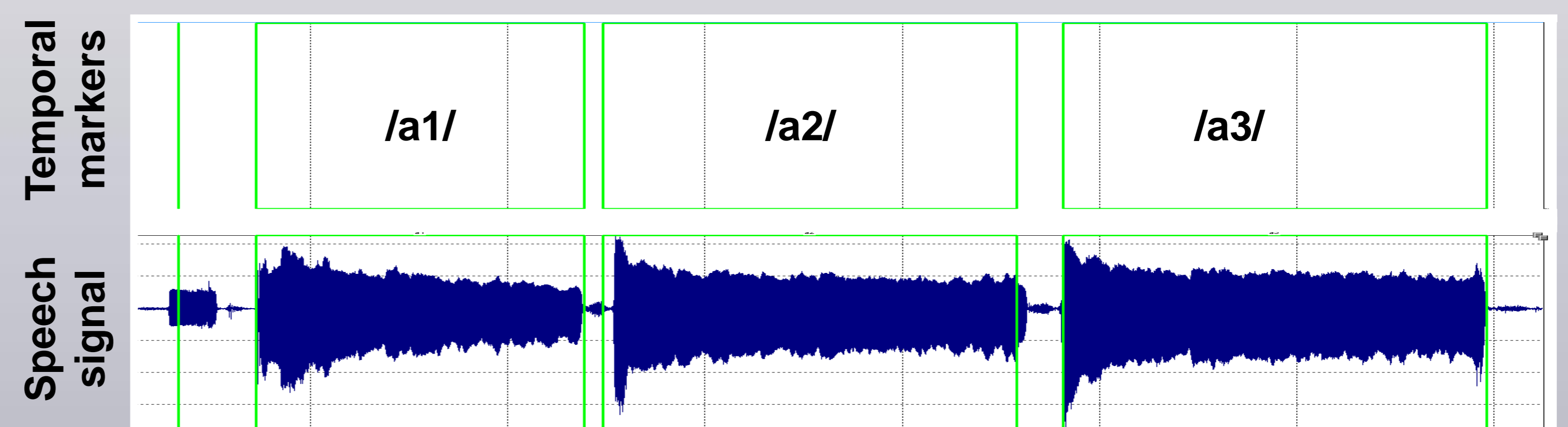
Analysis was performed using the **Phonedit** environment (Laboratoire Parole et Langage, Aix-en-Provence, France)

STATISTICAL ANALYSIS

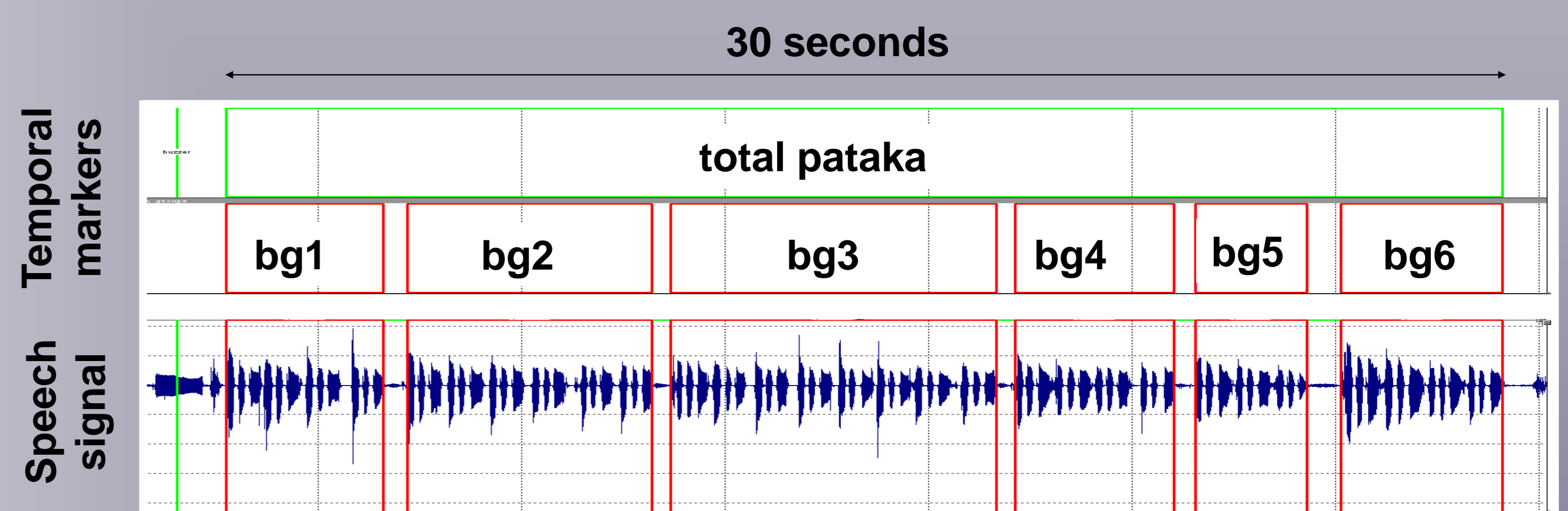
A linear mixed model was used (R software) for group analyses with patient as a random term, and treatment nature (L-dopa, STN stimulation, PPN stimulation) and state (off, on) as fixed effects.

SPEECH PRODUCTION TASKS

Three sustained vowel /a/ (/a1/, /a2/ and /a3/) were produced by every patient, in each of the therapeutical conditions. Temporal measurements were performed in order to assess the **Maximal Phonation Time** (MPT, in seconds) for the three vowels, which have been averaged.



A second speech task consisted in the repetition of the pseudo-word /pataka/ at normal speech rate, during 30 seconds. Temporal measurements were performed in order to assess the **breath group durations** (bg, in seconds) that have been needed for the completion of the task.



RESULTS

No effect of PPN stimulation, nor any interaction between L-dopa and PPN stimulation treatments ($p=0.3$; $N=231$ measures), when comparing postoperative data off vs. on PPN stimulation (on STN stimulation, off/on dopa). No modification of PPN stimulation effects from the first to the last postoperative evaluation ($p=0.3$; $N=126$).

Significant L-dopa deleterious effect ($p<0.001$; $N=231$), reducing the MPT up to 23% following dopaminergic administration (1). Comparison between preoperative and postoperative (last evaluation) data showed a negative synergistic effect of treatments: worst MPT were found on dopa/STN stimulation/PPN stimulation ($p<0.001$; $N=225$) whereas the best situation was off dopa/on STN stimulation/pre-PPN surgery (2).

Similar results were found for the /pataka/ task, either concerning the main effect of PPN stimulation (3) or the comparison between preoperative and postoperative states (4).

