Characterizing Verbal Fluency Declines Associated with Unilateral DBS for Parkinson Disease

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BACKGROUND

Verbal fluency performance following Deep Brain Stimulation (DBS) surgery for Parkinson's disease

- Declines in verbal fluency performance are commonly reported following DBS (Parsons et al, 2006; Voon et al, 2006, Okun et al., 2009).
- It is unclear whether these declines are due to the surgical procedure or to stimulation.

Clustering and Switching components of verbal fluency (Troyer et al., 1997)

Clustering
- Involves generation of contiguous words within a subcategory.
- Related to temporal lobe function.

Switching
- Requires disengaging from a prior sub-category and shifting to another.
- Relies on frontal-subcortical circuit integrity.

Previous Research
- Two studies noted declines in switching following DBS (Saint-Cyr et al., 2000, De Gaspari et al., 2006).
- This suggests that DBS may interfere with frontal-subcortical integrity. HOWEVER, neither study used a PD control group.
- No studies have investigated the impact of stimulation alone on component processes of verbal fluency.

AIMS of Study

AIM 1: To examine whether the decline in verbal fluency following DBS is due primarily to effects of surgery or of stimulation.

AIM 2: To investigate performance on component processes of verbal fluency (clustering, switching) both in response to the surgical procedure and to stimulation.

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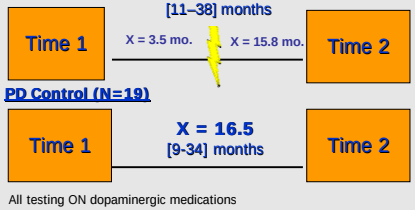
METHODS

Pre v. Post Comparison



All testing ON dopaminergic medications

	PD Controls *N* = 19	DBS *N* = 28
Age	64.1 (6.6)	60.5 (6.4)
Education	15.4 (3.0)	14.5 (2.5)
Male / Female	12/7	21/7
Motor		
Months with symptoms	*82.5 (69.5)*	*139.8 (60.9)**
Hoehn & Yahr Stage	*2.4 (0.4)*	*2.1 (0.2)**
UPDRS "*on*"	24.3 (8.3)	21.1 (8.2)
UPDRS "*off*"	*31.9 (8.9)*	*42.2 (11.0)**

*Indicates significant difference between groups, $p<0.05$.

ON v. OFF Comparison

- 36 unilateral DBS patients tested ON then OFF stimulation
- Order of testing counterbalanced
- Alternate forms (3 letters each) administered
- 12 hour withdrawal from dopaminergic medication

Letter fluency component measures

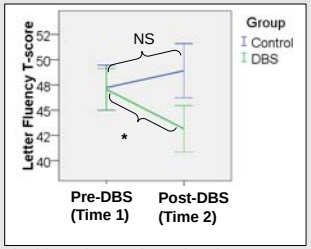
Clusters: Successively generated words that begin with the same first two letters (arm, art), rhyme (sand, stand), differ by only a vowel sound (seat, soot), or are homonyms (some, sum).

Switches: The number of transitions between clusters, between clusters and single words, and between single words.

RESULTS

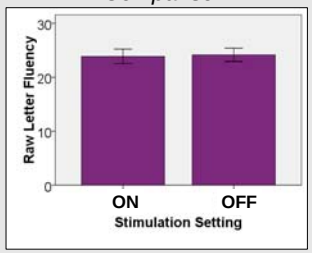
AIM 1: Are changes in overall letter fluency performance due to surgery or to stimulation?

Pre- vs Post-Surgery Comparison



Significant interaction: F(1,45)=5.43, p=0.024

On vs Off DBS Stimulation Comparison



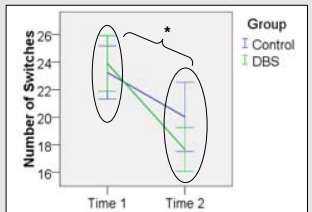
CONCLUSION 1: The declines in letter fluency following unilateral DBS cannot be attributed to the effects of stimulation per se. Rather, it raises the question of "surgical" lesion effects.

RESULTS cont.

AIM 2: Clustering and Switching Performance

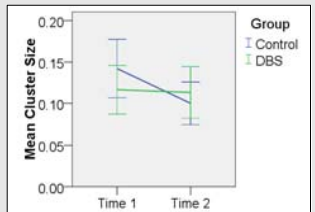
Pre- vs Post-surgery Comparison

SWITCHING



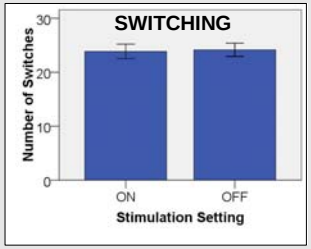
Time Main effect : F(1,38)=10.90, p=0.002
Non-significant interaction: p=0.786

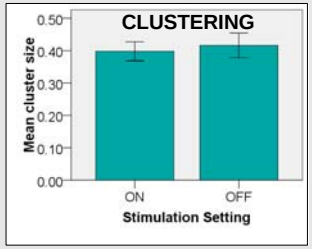
CLUSTERING



No significant main effect or interaction

On vs Off Stimulation Comparison





CONCLUSION 2: Both DBS and control PD patients exhibit decreased switching from Time 1 to Time 2. No other changes in clustering/switching performance are noted.

CONCLUSIONS

DBS-related declines in letter fluency cannot be attributed to stimulation.
- Future studies should investigate potential surgical factors (e.g., disruption of white matter pathways, lesion effects) that may influence verbal fluency.

DBS does not seem to selectively affect the switching process within verbal fluency as PD controls also showed a similar decline.
- It is important to use a PD control group when investigating DBS outcomes.
- It may be necessary to reconsider previous findings of decreased switching associated with DBS, because they did not include control groups.