Cortical-Subcortical Interaction in PD and Normal Speech

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Country

USA

Title of project or programme

Cortical-Subcortical Interaction in PD and Normal Speech

Source of funding information

NIH (NINDS)

Total sum awarded (Euro)

€ 2,011,479.82

Start date of award

01/07/2005

Total duration of award in years

1

The project/programme is most relevant to:

Parkinson's disease & PD-related disorders

Keywords

Deep Brain Stimulation, Speech, Parkinson Disease, Phonation, Cerebrovascular Circulation

Research Abstract

DESCRIPTION (provided by applicant): The proposed project will continue and extend our present studies on cortical-subcortical interactions during speech using the effects of PD and DBS to probe the neurological basis of motor speech control, and the effects of PD and DBS on

speech. Continuing our functional imaging with PET, we will add structural imaging, diffusion tensor imaging, and tractography using MRI. We will continue probing speech with a range of tasks incorporating reading, recitation, repetition, and spontaneous speech. We will evaluate intelligibility and perceptual ratings, using these results to inform acoustic analyses. We are adding expertise in statistical modeling and the application of MRI to the study of voice pathology. Our goal is to answer basic clinical and speech science questions. Several fundamental questions need to be addressed in this field. Clinically, we need a better estimate of how often DBS results in greater speech impairment, and when it occurs, how it can be characterized. We need to understand the extent to which DBS-related speech impairments result from changes in brain networks for speech, global brain effects, and/or stimulation of motor tracts adjacent to the subthalamic nucleus. From the speech science perspective, we need to characterize cortical-subcortical interactions for a range of speech tasks to better understand the role of the basal ganglia, cortical, and cerebellar regions in speech. We are approaching the goals of this project with a combination of well-controlled experimental studies, studies of special cases that may be especially informative, and an innovative approach to clinical survey studies. Our finding that DBS enhances some components of speech while retarding others provides an important step in understanding an inconsistent literature. Further, analysis of our PET data suggests that DBS changes the basic relationship between speech and cortical-subcortical interactions. Our major working hypotheses are that: cortical lateral asymmetry is associated with fluency; subcortical regions are strongly associated with phonation, particularly the first two formants, and these are shifted during DBS; when DBS strengthens phonation, an additional burden is placed on articulatory control; both brain and speech effects are task dependent, with the greatest difficulty observed during conversation. Our work also suggests that global blood flow is related to pausing during speech, with DBS on and off, and in PD subjects without DBS. This may reflect the integrity of the central nervous system in PD, and will be further examined with diffusion tensor imaging. In addition to the detailed imaging studies, we will conduct a broader, clinic-based study of conversational and repeated speech before and after DBS surgery. Taken together, these studies should provide a better understanding of the range and severity of speech changes following DBS, and the brain changes associated with these changes.

Lay Summary

Parkinson’s disease (PD) is a progressive movement disorder that impairs the ability to speak clearly. Deep brain stimulation (DBS) improves many of the motor symptoms of PD, but does not help and sometimes harms the ability to speak. This project seeks to understand the effects of PD and DBS on speech with the long-term goals of (1) modifying DBS to preserve or improve speech in PD and (2) improving our understanding of cortical-subcortical interactions during speech.

Further information available at:

Types:
Investments > €500k

Member States:
United States of America

Diseases:
Parkinson's disease & PD-related disorders

Years:
2016

Database Categories:
N/A

Database Tags:
N/A