INTRODUCTION

Recent functional neuroimaging studies in bi- and multi-lingualism converge on the observation that the same core set of brain regions subserves all languages, irrespective of proficiency and age of acquisition (Indefrey, 2006; Sebastian, Laird, & Kiran, 2011) but that language proficiency is a critical variable (Abutalebi, 2008; Hernandez & Li, 2007).

The nature of language networks in individuals with bilingual aphasia has been less studied (Abutalebi, et al., 2009; Sebastian, Sandberg, & Kiran, 2012) but has high potential for clinical impact.

OBJECTIVES

In this study, using fMRI and DCM, we examine language networks in normal Spanish-English bilinguals and in individuals with bilingual aphasia.

First, we examined patterns of activation on a word synonym task in English and in Spanish in both patients and controls.

• We hypothesized overlapping activation in language regions for both English and Spanish but also language specific activation foci.

Next, we examined effective connectivity (using DCM) in the two language networks.

• We hypothesized that patterns of connectivity will reflect BOLD signal changes, and differences in network connectivity will emerge for the two languages.

METHODS

Participants

• Four Spanish-English speaking non-brain damaged bilinguals (NBB) and four chronic bilingual adults with aphasia (BAA)

• Patients experienced a single, unilateral ischemic stroke in the distribution of the left middle cerebral artery.

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Stimuli/Task

• Word Triplet Judgment: 60 items in each language balanced for frequency, non-cognates and word-association in each language. Participants were required to match the target on the top to the word most similar in meaning from the bottom.

• Size Judgment: 60 stimulus triplets consisting of consonant letter strings were presented, and participants were required to match the target on the top most similar in size to two options at the bottom.

fMRI design

• MR images were acquired at Boston University’s Center for Biomedical Imaging on a 3T Philips scanner.

• T1 images were acquired with the following parameters: 140 sagittal slices, 1mm³ voxels, TR=8.2ms. BOLD images were collected using the following parameters: 31 axial slices, 3mm³ voxels, TR=2s.

• MR data was analyzed in SPM8. Structural images were coregistered to pre-processed functional images and both were normalized to the MNI template.

• Lesion masks were drawn in MRIcron on each patient's T1 image and were used in normalization to minimize deformities during warping (Bret et al.,

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EFFECTIVE CONNECTIVITY METHODS (DCM)

Voxel of interest (VOIs) created by constructing a 5mm sphere around the peak activation voxels

Exceedance Probability (q) for the best fit model using Bayesian Model Selection (BMS) for each model

Significant and connection parameters were extracted across each model

Bayesian Parameter Average (BPA) was computed for English and Spanish

Effective functional connectivity for each language

EFFECTIVE CONNECTIVITY RESULTS FOR PATIENTS

Red: English (ap) is significantly stronger than Spanish (ap), Blue: Spanish (ap) is significant stronger than English (ap), gray is non-significant

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No significant differences in connection for 24

CONCLUSIONS

1. Patients and controls both show overlapping activation for English and Spanish in LMTG only. More regions are activated for Spanish relative to English.

2. With regards to patients, 3 of the 4 patients were more proficient in Spanish pre and post-stroke. These patients show DCM results show stronger connections and input region parameters for English relative to Spanish.

3. The more diffuse BOLD signal activation in Spanish relative to English, but more modulation of networks for English relative to Spanish is an interesting paradox.

4. It raises the question of whether stronger connections are an indication of less efficiency.

REFERENCES
