#E43

fNIRS brain imaging investigation of bilingualism: A new view from Sign-Speech Bimodal Bilinguals

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Introduction

NEW QUESTION Are language-dedicated or cognitive-general mechanisms involved in bilingual language switching?

Bilingual language-switching refers to a bilinguals' ability to use both languages simultaneously or in rapid alternation, also known as the "Bilingual mode"[1,2]

Behavioral research has shown that bilingual language-switching or being in the "Bilingual mode"
- obeys complex linguistic rules of "code-switching"[3,4]
- employs general-cognitive mechanisms of attention and task-switching [5]

Brain imaging research has shown that bilingual language-switching or being in "bilingual mode"
- recruits brain structures dedicated to cognitive-general mechanisms of attention and task-switching [6]

NEW technology - **functional Near-Infrared Spectroscopy**
fNIRS measures changes in the components of brain's blood oxygen level density (BOLD), both deoxy- and oxy-hemoglobin (Hb & HbO_2 respectively)
An advantage of fNIRS is that the HbO_2 signal is a better predictor of neuronal activity than BOLD
Also, the fNIRS system is quiet, portable, child-friendly, & tolerates movement[7-9]

NEW population - **Bimodal Sign-Speech Bilinguals**

HYPOTHESIS Typical bilingualism: two spoken languages compete for both linguistic and speech planning, perception, production resources in a single sound-based modality. New Test: if the *competition* for "one mouth" is removed - via studying Speech-Sign bimodal bilinguals - the neural mechanisms that underlie the linguistic principles of bilingualism may become more revealed.

Methods

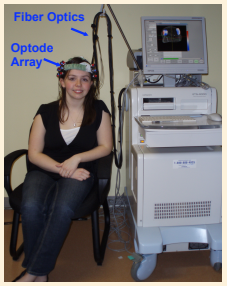
PARTICIPANTS

GROUPS (N=32)	MEAN AGE	AGE of EXPOSURE		PROFICIENCY	
		ASL	*English*	*ASL*	*English*
ASL-ENGLISH bilinguals	24	birth	birth	96%	98%
ASL monolinguals	26	birth-4		100%	
ENGLISH monolinguals	19		birth		96%

DATA ACQUISITION WITH fNEAR INFRARED

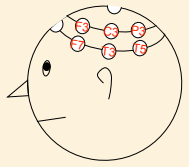
fNIRS signals were recorded using a **Hitachi 48 channel ETG-4000** with lasers set at 698nm and 830nm

Data were analyzed with a Matlab-based analysis package designed by Mark Shalinsky [10,11]



ANATOMICAL LOCALIZATION

3x5 Optode Array



10 x 20 Coordinates[12]

MRI co-registration

PICTURE NAMING TASK

Monolingual Mode[2] – name pictures in

A) ASL - only

B) English - only

Bilingual Mode – name pictures

A) simultaneously name pictures in ASL & English

&

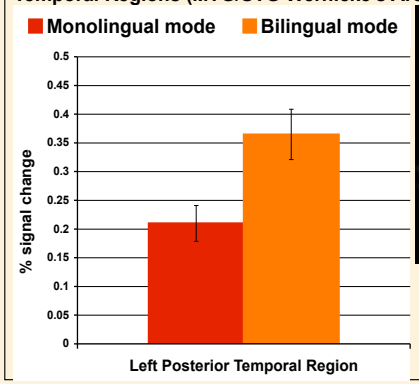
B) in **rapid alternation** between ASL or English, as cued by the background color of the picture

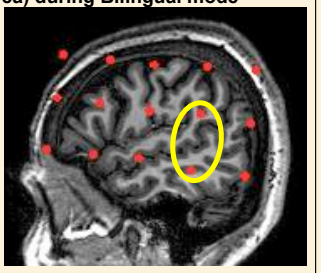
or

Results

BILINGUAL VS MONOLINGUAL MODES

ASL-English Bimodal bilinguals showed an increase in activation in **Left Posterior Temporal Regions (MTG/STG Wernicke's Area) during Bilingual mode**





Implications

ARE *LANGUAGE*-DEDICATED MECHANISMS INVOLVED IN BILINGUAL LANGUAGE SWITCHING? YES!

These findings provide new evidence that language-dedicated brain regions are indeed involved in the production of both languages simultaneously or in rapid alternation during Bilingual mode. Bilingual language switching involves **both** language-specific and cognitive-general brain mechanisms.

IS fNIRS AN EFFECTIVE BRAIN IMAGING METHOD? YES! Our fNIRS imaging and analysis methods were effective in obtaining meaningful brain imaging data. fNIRS is a technology here today that we can use to investigate higher cognitive and language functions, particularly during development in children.

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