The Effects of Bilingualism on Resistance to Proactive Interference and Brain Integrity Across the Adult Lifespan

Alessandra Macbeth[1], Eve Higby[2], Natsuki Atagi[3], & Christine Chiarello[1]

[1]University of California, Riverside, [2]California State University, East Bay, [3]California State University, Fullerton

UNIVERSITY OF CALIFORNIA **UC RIVERSIDE**

Cognitive Neuroscience Lab

Introduction

- Whether bilinguals have a domain-general inhibitory advantage - as a function of their need for language control - has been a subject of debate for nearly two decades.

- The two types of inhibition that have been studied most commonly in the studies that compare bilingual v. monolingual inhibitory abilities are prepotent response inhibition (e.g., a stop-signal or Stroop task) and perceptual distractor inhibition (e.g., a flanker task).

- A third type of inhibition, **resistance to proactive interference (PI)**, is the ability to inhibit access to previously learned material that has since become irrelevant (Friedman & Miyake, 2004), and has rarely been compared between mono- and bilinguals (e.g., Bialystok & Feng, 2009).

RESEARCH QUESTIONS

- Do bilinguals have an advantage in resistance to PI task performance?

- Do bilinguals have greater cortical integrity in brain regions that subserve inhibitory processes such as resistance to PI?

- Is there a relationship between measures of brain structure (e.g., grey matter volume and cortical thickness) and performance on resistance to PI tasks, and is this relationship stronger for bilinguals?

Method

PARTICIPANTS:

- 50 young adults (25 Spanish-English bilingual) aged 18-28 (M = 20.4 yrs)
- 32 older adults (16 Spanish-English bilingual) aged 58-84 (M = 68.9 yrs)

MATERIALS & PROCEDURE:

- Directed Forgetting Task
  - Participants studied a list of 40 words, presented one at a time
  - Immediately after each word, participants saw a cue to remember the word (RRRR) or forget the word (FFFF)
  - After a 3-minute distractor task, participants were asked to recall as many words as they could remember, regardless of whether they were to-be-remembered (TBR) or to-be-forgotten (TBF)
- Release From PI Task
  - Participants studied and recalled four lists of ten words each
  - Lists 1-3 consisted of words from the same semantic category (body parts or occupations), whereas List 4 contained words from a different semantic category (whichever category was not studied previously)
  - Measured number of correctly recalled word and intrusions per list
- Structural MRI Scan
  - Each participant was scanned on a 3T Siemens Prisma at UC Riverside
  - A whole-brain, T1-weighted MPRAGE was acquired; TR = 2400 ms, TE = 2.72 ms, FOV = 256 mm, FA = 8°, 208 slices, resolution = 0.8 mm^3
  - Cortical reconstruction and volumetric segmentation for participants was performed using the Freesurfer v 6.1 analysis suite (Fischl et al., 1999)
    - Used to extract grey matter volume and cortical thickness measures
  - **Regions of Interest:** bilateral ACC, IFG, and MFG

Results

Figure 1. Directed forgetting (A & B) and release from PI (C & D) task performance across our four groups. There were age effects, but no group differences between monolinguals and bilinguals for either task. *p < .05
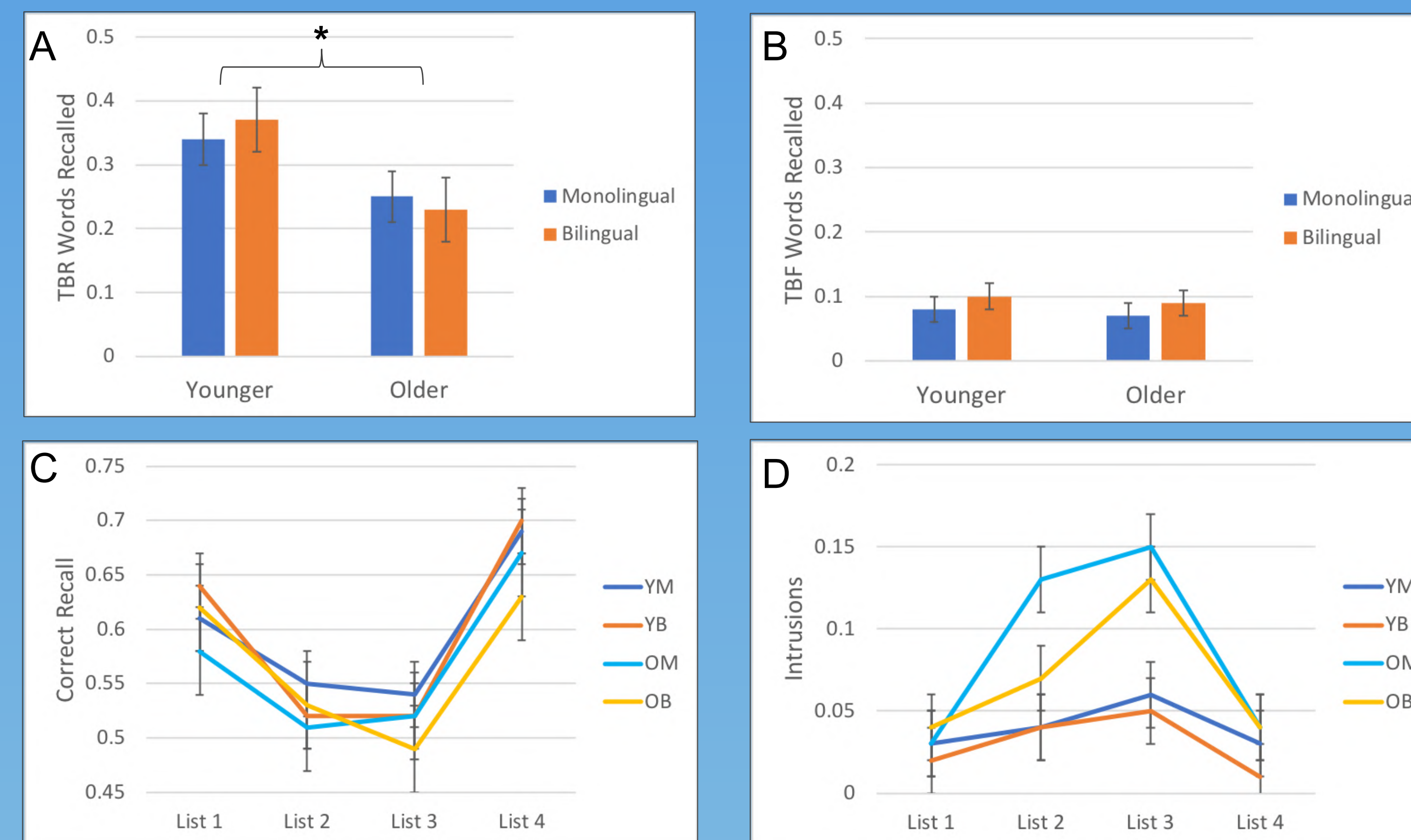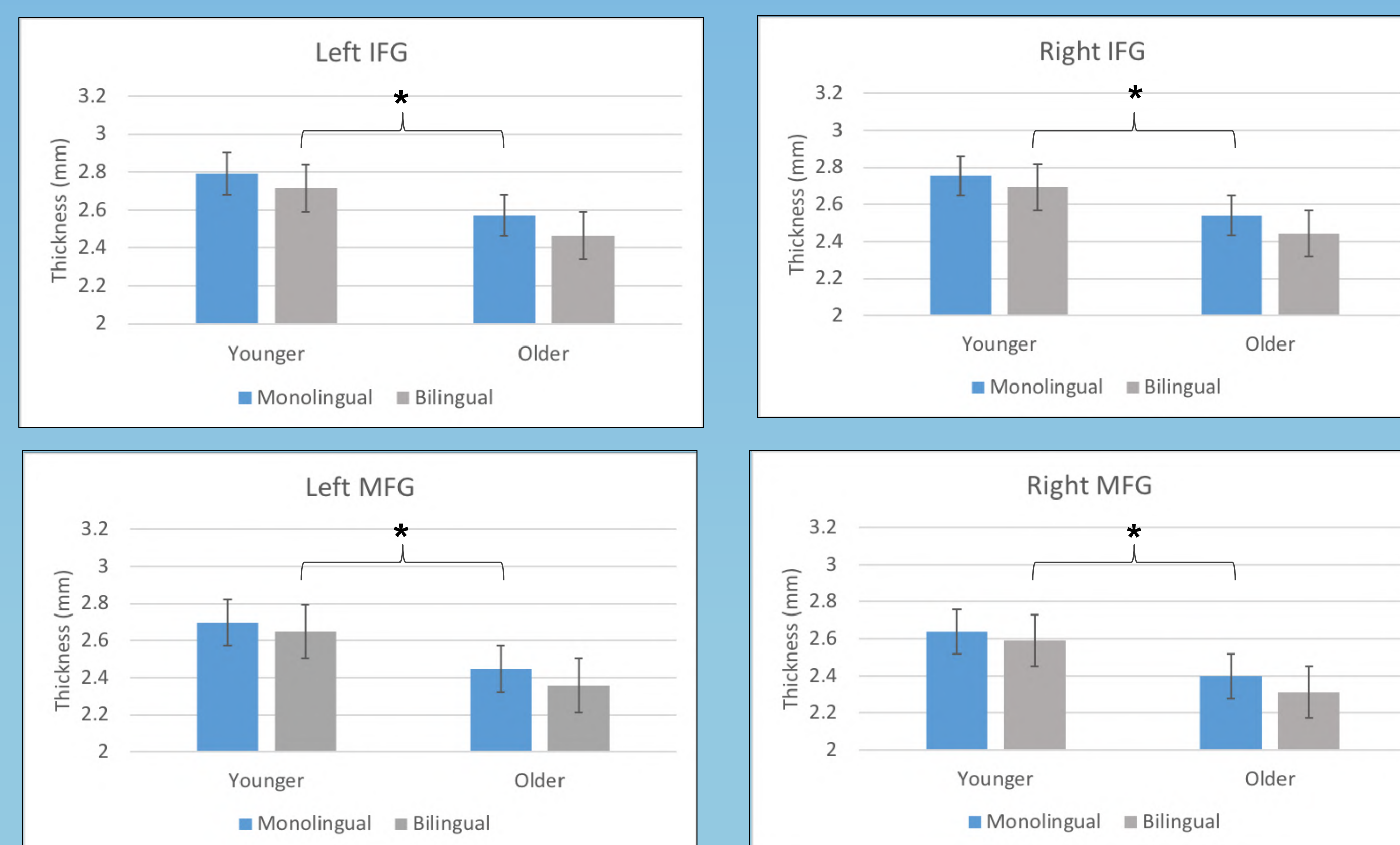

Figure 2. Cortical thickness in bilateral IFG and MFG across our four groups. Monolinguals displayed greater thickness than bilinguals. *p < .05

Figure 3. The relationship between grey matter volume and number of List 3 intrusions (a measure of interference), separated by language group. MFG volume predicted behavioral performance for bilinguals only.

Bilinguals: r(39) = -.42, p = .006   Bilinguals: r(39) = -.43, p = .005
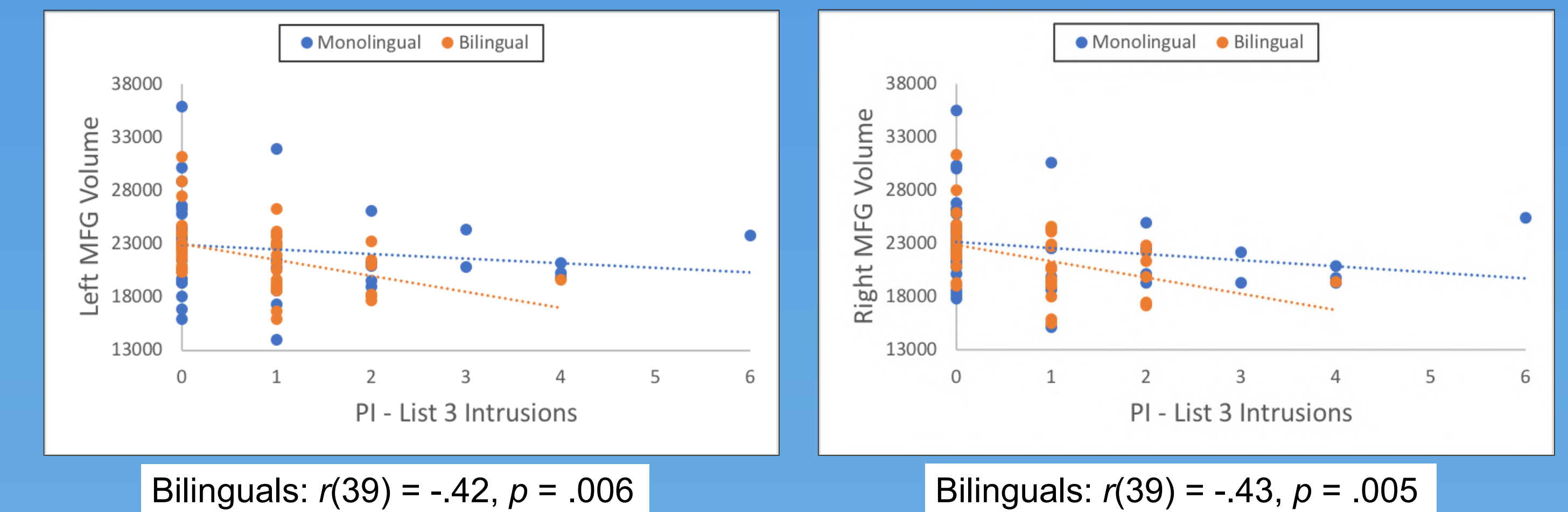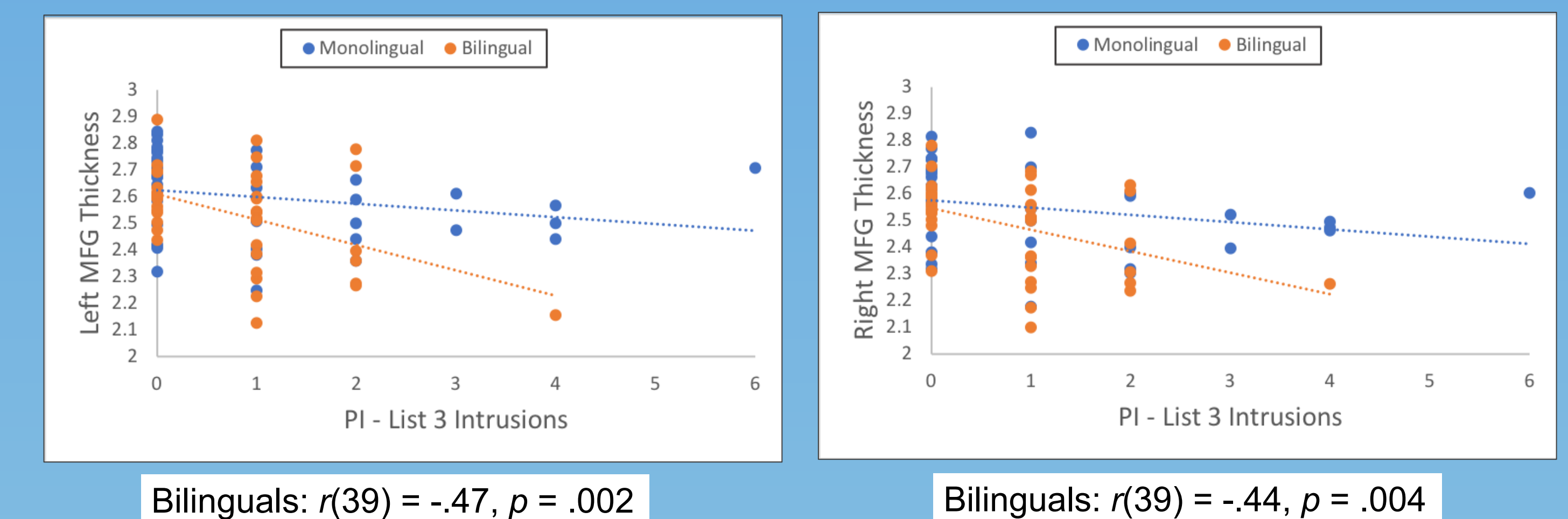
Figure 4. The relationship between cortical thickness and number of List 3 intrusions (a measure of interference), separated by language group. MFG thickness predicted behavioral performance for bilinguals only.

Bilinguals: r(39) = -.47, p = .002   Bilinguals: r(39) = -.44, p = .004

Conclusions

SUMMARY OF FINDINGS

- Bilinguals and monolinguals performed similarly on the two resistance to PI measures, with older adults performing worse overall on both directed forgetting (less TBR words remembered) and release from PI (more intrusions on Lists 2 and 3) tasks.

- In general, younger adults had thicker cortex in each of our cortical ROIs, and monolinguals also showed significantly greater cortical thickness in the IFG and MFG compared to bilinguals.

- Taken together, these findings suggest that bilinguals may be **compensating** by relying on different cortical organization in order to maintain comparable behavioral performance.

- Bilingual memory performance appears to be more dependent on brain structure than monolingual performance.

FUTURE DIRECTIONS

- Comparing bilingual v. monolingual performance on resistance to PI tasks involving working memory rather than long-term memory.

- Measuring resistance to PI abilities before and after intensive second language learning, among younger and older adults

References

Bialystok, E., & Feng, X. (2009). Language proficiency and executive control in proactive interference: Evidence from monolingual and bilingual children and adults. *Brain and Language, 109*, 93-100. doi:10.1016/j.bandl.2008.09.001

Fischl, B., Sereno, M. I., Tootell, R. B., & Dale, A. M. (1999). High-resolution inter-subject averaging and a coordinate system for the cortical surface. *Human Brain Mapping, 8*, 272-284.

Friedman, N. P., & Miyake, A. (2004). The relations among inhibition and interference control functions: A latent-variable analysis. *Journal of Experimental Psychology: General, 133*(1), 101-135. doi:10.1037/0096-3445.133.1.101

Cognitive Neuroscience Society Annual Meeting, Boston, March 2020; Contact: alessandramacbeth@gmail.com