

Multilingualism, Multiscriptalism and the Brain: A multicenter, multinational study of ACC sulcal gyration across culture, ethnicity and gender



Brendan Weekes

Laboratory for Communication Science, The University of Hong Kong
 Professorial Fellow, School of Psychological Sciences, University of Melbourne



SCIENCE OF LEARNING RESEARCH CENTRE

Highlights

- Cognitive control ability is related to ACC sulcal variability (Cachia et al. 2017)
- We found an interaction between ACC sulcation and bilingualism on control
- Sulcal variability predicts cognitive control in multilinguals and monolinguals
- Asymmetry in ACC sulcation (fixed in utero) has impact across the lifespan
- Early brain development interacts with effects of culture on cognitive control

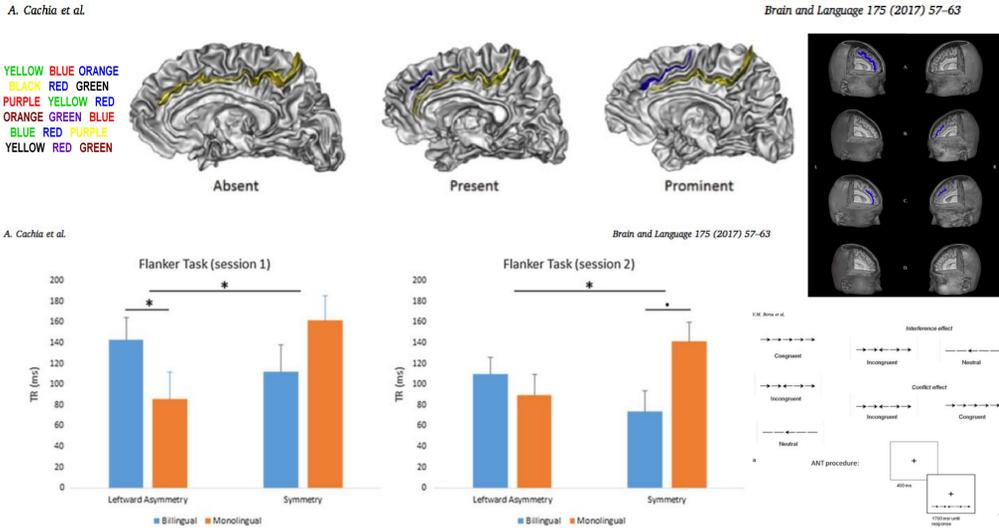
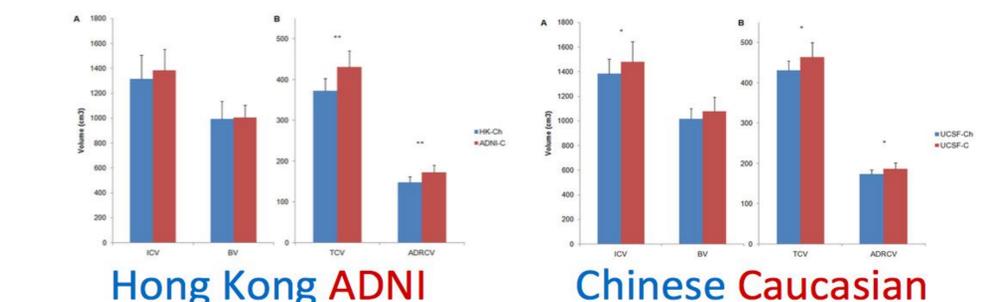
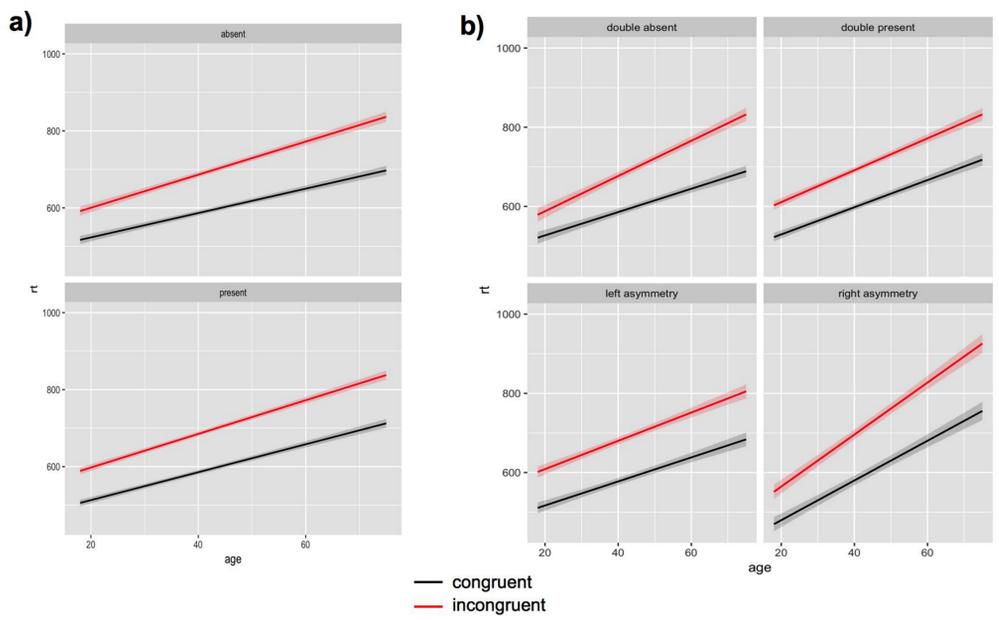


Fig. 2. Asymmetry of the anterior cingulate cortex (ACC) and cognitive control efficiency in bilinguals and monolinguals in Sessions 1 and 2. Conflict effect scores (differential RTs: Incongruent minus Congruent trials) in bilinguals and monolinguals with different ACC morphology. Error bars denote the standard error of the mean. * $p < 0.05$; ** $p < 0.1$.

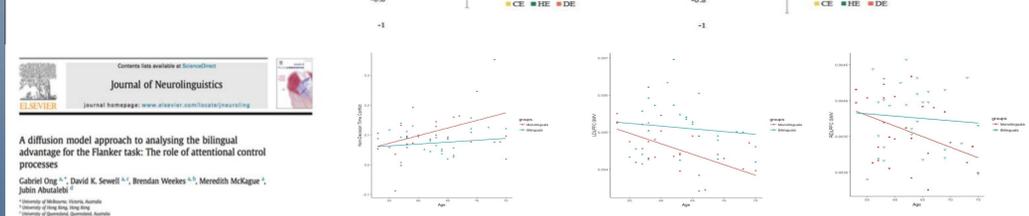
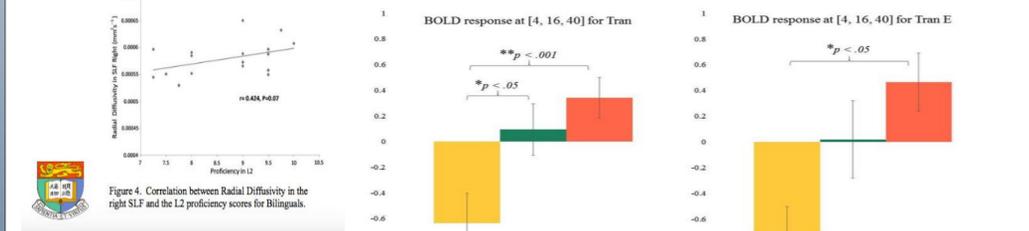
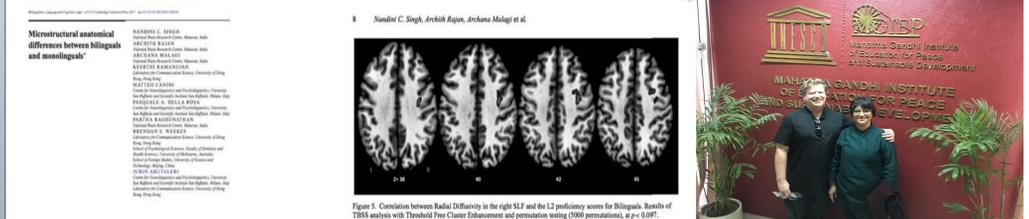
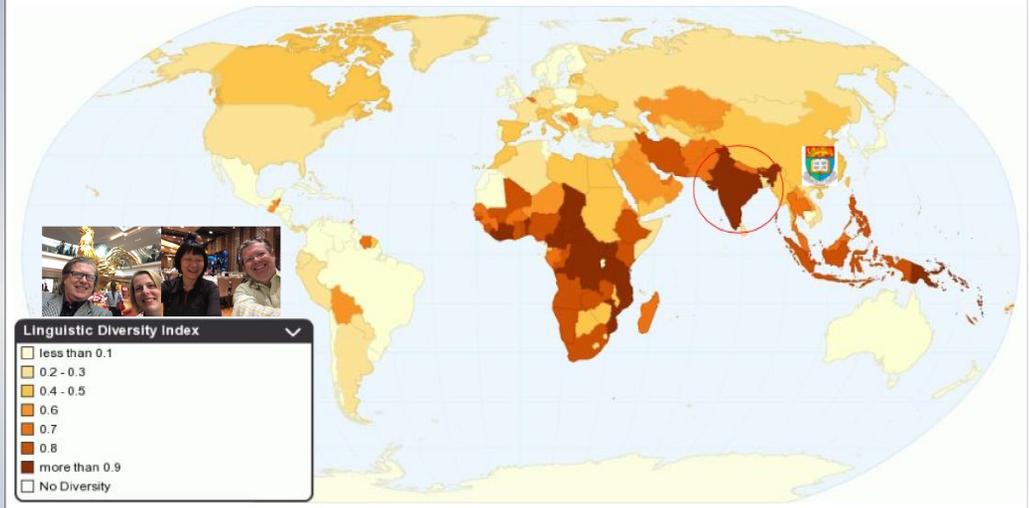
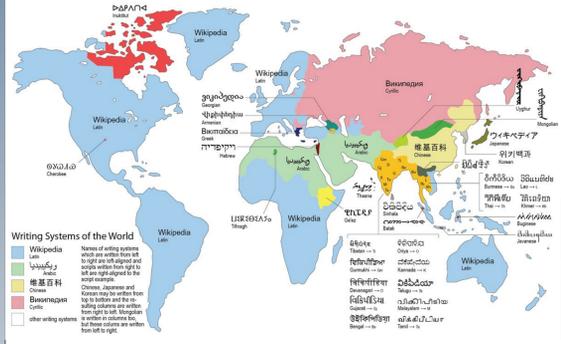
Preparatory Study

- We've completed a distribution analysis of the ACC sulcal pattern with $n=270$
- Subsample ($N=157$) Flanker Task across age 18-75 and education 5-26 years.
- Gender (152 F, 118 M), ethnicity (Caucasian = 130; South Asian = 43; East Asian = 97) and language experience (multilingual = 155; monolingual = 115).
- Prevalence of leftward ACC asymmetry unaffected by gender or ethnicity but conflict interacts with ACC sulcal symmetry in monolingual and multilinguals.

Results



UCSF
 University of California San Francisco



| Group | Mean Concentration (ms) | Reaction (ms) | p-value |
|----------------------|-------------------------|---------------|---------|
| [Cho] _{bil} | 1,042.19 | 0.961 | <0.05 |
| [Crl] _{bil} | 10,852.84 | 0.990 | <0.05 |
| [NAA] _{bil} | 17,463.14 | 0.917 | <0.05 |
| [ml] _{bil} | 9,712.89 | 0.987 | 0.140 |
| [Gib] _{bil} | 13,143.43 | 0.980 | <0.05 |

Abutalebi, J., Canini, M., Della Rosa, P.A., Sheng, L-P., Green, D.W., & Weekes, B.S.* (2014). Bilingualism protects anterior temporal lobe integrity in aging. *Neurobiology of Aging*, 35(9), 2126-2133.

Abutalebi, J., Guidi, L., Borsa, V., Canini, M., Della Rosa, P.A., Parris, B.A. & Weekes, B.S.* (2015). Bilingualism provides neural reserve. *Neuropsychologia*, 69, 201-210.

Abutalebi, J., Canini, M., Della Rosa, P.A., Green, D.W., & Weekes, B.S.* (2015). Neuroprotective effects of bilingualism upon the inferior parietal lobule: a structural neuroimaging study in Chinese bilinguals. *Journal of Neurolinguistics*, 33, 3-13.

Borsa, V., Canini, M., Della-Rosa, P., Guidi, L., Perani, D., Videsott, G., Weekes, B.S., & Abutalebi, J. (in press). Bilingualism and healthy aging: Aging effects and neural maintenance. *Neuropsychologia*.

Ong, G., Sewell, D.K., Weekes, B.S., & McKague, M., & Abutalebi, J. (2017). A diffusion model approach to analysing bilingual advantage: The role of attentional control processes. *Journal of Neurolinguistics*, 43, 28-38.

Singh, N., Rajan, A., Malagi, A., Ramanujan, K., Canini, M., Della Rosa, P., Raghunathan, P., Weekes, B. & Abutalebi, J.A. (2017). Mean diffusivity reveals microstructural anatomical differences between bilinguals and monolinguals. *Bilingualism:*