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Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 45(45)

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Publication Date
2023

Peer reviewed

Contrastive neural network reveals the structure of neuroanatomical variation within bilingualism

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Abstract

Bilingualism varies greatly in terms of language background, age of acquisition, and learning environment, making it complex to study the relationship between language and brain structure. Age of acquisition and linguistic proficiency are both crucial factors in language acquisition research and are closely related. To better understand the relationship between bilingualism and brain structure, we created a dataset of 2,000+ brain 3D images from bilinguals and monolinguals and trained a neural network (Contrastive Variational Autoencoder, CVAE) to distinguish bilingual-specific neuroanatomical variations from those shared by monolingual groups. The initial results reveal that the common variation (e.g. scanner and sex) in brain structure shared by two groups can be identified by CVAE. More importantly, CVAE disentangled linguistic proficiency from the common variation but not age of acquisition. It suggests that compared to age of acquisition, linguistic proficiency is more correlated with brain's structure.

In M. Goldwater, F. K. Anggoro, B. K. Hayes, & D. C. Ong (Eds.), *Proceedings of the 45th Annual Conference of the Cognitive Science Society.*