Gray matter volume and whole-brain pattern organization across lifespan and Alzheimer’s disease
Alexia Pichet Binette1, Julie Gonneaud1, Jüdes Poirier1, John C.S. Breitner1,2, Sylvia Villeneuve1,2, Étienne Vachon-Presseau1, Alzheimer’s Disease Neuroimaging Initiative, PREVENT-AD Research Group
1. McGill University, Montreal, QC, Canada 2. Douglas Mental Health Research Institute, Montreal, QC, Canada

BACKGROUND AND OBJECTIVES
Alzheimer’s disease (AD) and normal aging are both characterized by considerable atrophy. Because age is the main risk factor for AD, these two processes may be closely intertwined, and thus disentangling brain changes specific to aging versus AD has been a challenge (Jagust, 2013; Fjell et al., 2014). We sought further insight into this topic by examining grey matter (GM) changes across the lifespan and AD conjointly.

We applied independent component analysis (ICA) to GM maps from individual structural MRI of participants from a large, multi-cohort dataset spanning young adults, older adults with intact cognition and with AD dementia, to examine and characterize the GM changes across the lifespan and AD conjointly.

We investigated GM changes within these morphometric networks, along with changes in their intrinsic organization. GM changes were characterized according to three theoretical models, representing an effect of disease alone, aging alone, or an additive of age and disease.

STATISTICAL ANALYSES
We used binary logistic regression models with ten-fold cross-validation to classify: (1) Young adults vs. Older adults (effect of aging) and (2) Older adults vs. Alzheimer’s dementia (effect of disease) with different GM features (GM volume [left panel below]: whole-brain GM pattern [right panel below]) as input. We then used receiver operating characteristic (ROC) analyses and measured the area under the curve (AUC) to assess the model performance across the collated test sets.

We calculated the coefficient of variation (CV) of GM volume across the 30 morphometric networks in each group to evaluate how heterogeneity in GM volume changes with aging and AD.

In cognitively normal older adults, we evaluated whether measures of GM volume (in the most discriminative age- and AD-related morphometric network) or of whole-brain pattern were related to cognitive performance and clinical progression.

CONCLUSIONS
Investigating local and global GM changes in a large multi-cohort sample of young adults, cognitively normal older adults and patients with AD, we found that while atrophy occurred throughout aging and disease in an additive manner, GM volume loss was not specific to AD in any brain regions. Instead, AD compounds the effects of normal aging, but was specifically characterized by higher heterogeneity in both GM volume and whole-brain pattern signature, which was not the case in aging. Furthermore, in elderly with intact cognition, measures of whole-brain pattern were more related to cognition than GM volume.

A disruption of whole-brain GM pattern might be more related to future cognitive decline and AD than atrophy in specific regions, which might also be the case for other neurodegenerative diseases.

CONTACT : alexia.pichetbinette@mail.mcgill.ca
Poster downloadable @ villeneuvealab.com