Medical Xpress

A new machine learning model to isolate the effects of age in predicting dementia

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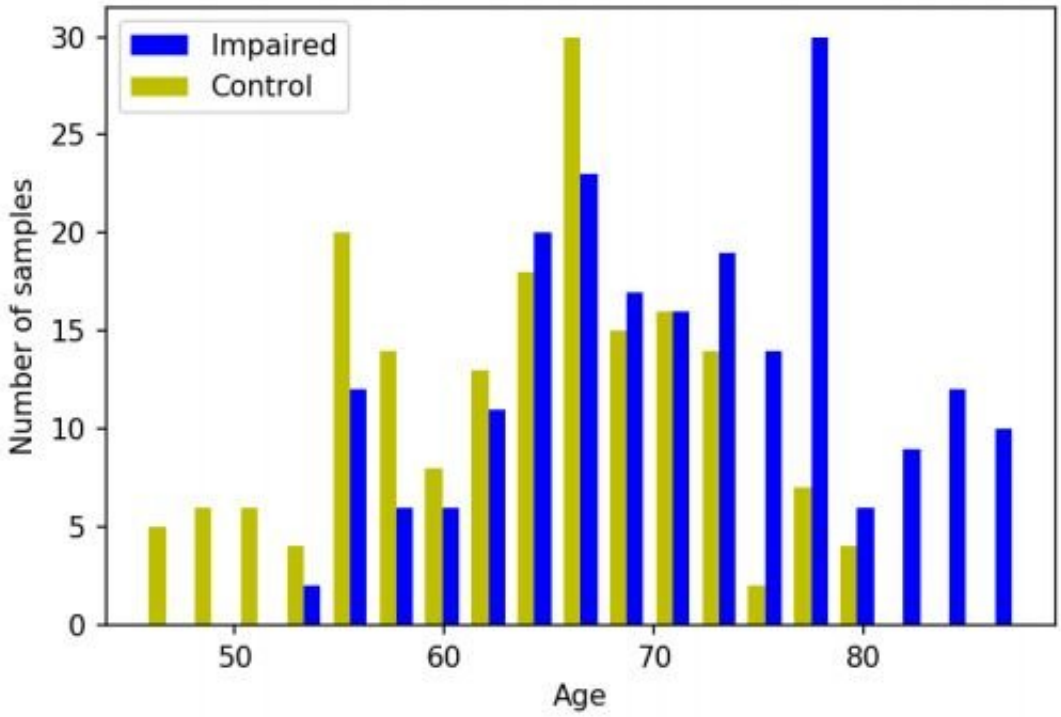
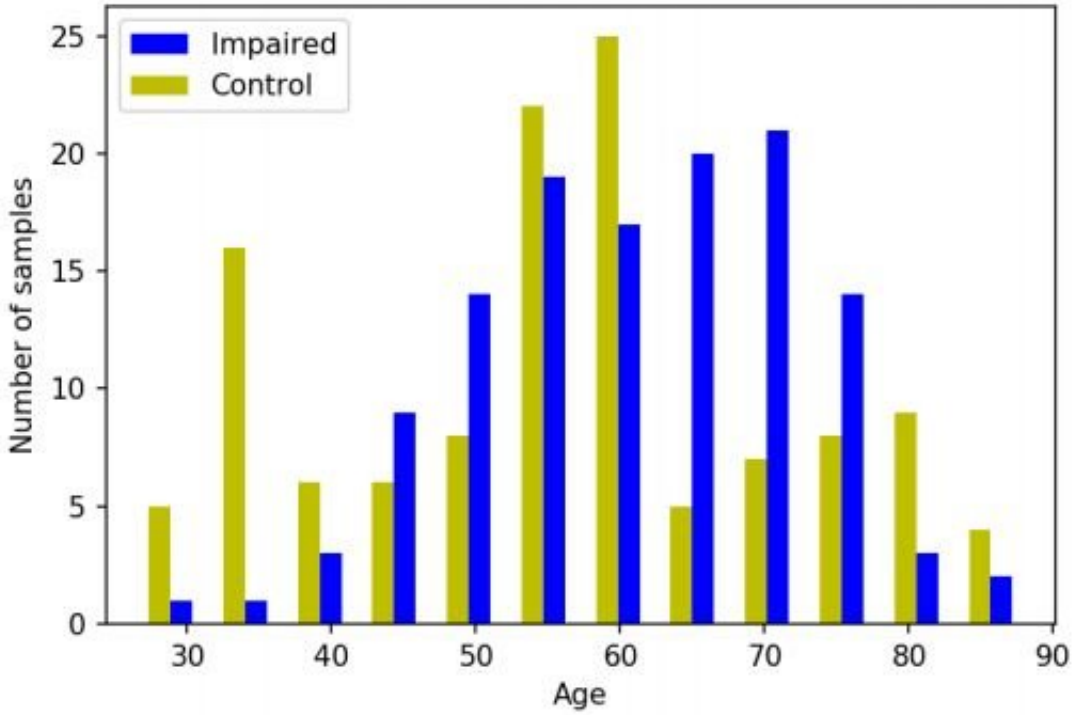


(a) Histogram plot for DementiaBank



Expository histogram plots for the ages of people in the impaired and control

groups. Credit: Frank Rudzicz et al.

Researchers at Toronto-based company WinterLight Labs have recently devised a machine learning method of predicting dementia that prioritizes particular variables when analyzing data, which could help to isolate the effects of potentially confounding factors.

Alzheimer's disease and other types of dementia are a major worldwide challenge, leading to the death of one out of three seniors in the U.S. alone. While the causes of these diseases have not yet been fully grasped, they can have detrimental effects on speech, memory, orientation and other important cognitive abilities.

WinterLight Labs is developing AI-based tools that could help detect and monitor Alzheimer's disease, aphasia, dementia, and other conditions that affect humans' cognitive abilities. The company has achieved very promising results, developing tools that can classify subtypes of aphasia with up to 100 percent accuracy and dementia with over 82 percent accuracy.

Their machine learning algorithms predict cognitive impairments and their severity by analyzing human speech and identifying distinctive patterns that are generally associated with dementia or other disorders. For instance, individuals affected by Alzheimer's tend to describe things more simply, using more pronouns than nouns, and taking longer pauses between words. However, detectable changes in speech or cognition are not always due to dementia or other cognitive impairments; they can also be a mere result of aging.

"We have been working with automatic, language-based assessment of dementia using artificial intelligence for several years," said Frank

Rudzicz, president of WinterLight Labs, associate professor at the University of Toronto, and faculty member of the Vector Institute, in an interview with Tech Xplore. "In this time, it has been increasingly important for us to identify changes to cognition that happen relatively early, so it became important to account for the effect of age on language, since age has a large effect on language generally."

In their recent study, Rudzicz and his colleagues used fair representation learning to devise a method that could help to prioritize certain factors over others when predicting dementia. Their method uses neural network classifiers that learn low-dimensional representations reflecting the impacts of dementia, which do not contain age-related information.

"We generally use several deep neural networks (including auto-encoders), although we introduce a new metric for measuring fairness and experiment with four models, including one motivated by categorical generative adversarial networks," Rudzicz explained.

The researchers tested their classifiers on two publicly available datasets, DementiaBank and Famous People, which include voice recordings and transcripts of people with dementia and others with no cognitive impairments. They found that their classifiers performed better than baseline deep neural network classifiers, disentangling results from age while compromising as little accuracy as 2.56 percent on DementiaBank and 2.25 percent on Famous People.

"Although we usually use age as an important covariate for predicting dementia, this paper shows that we can separate out those effects when predicting dementia," Rudzicz said. "This approach generalizes to other situations where multiple covariates may work together to give us our observed data, but where we're primarily interested in one of them."

In other words, despite the focus on age within the context of dementia

prediction, the models developed by Rudzicz and his colleagues could be applied to other cases in which researchers wish to isolate confounding variables.

"Part of the motivations behind our study come from recent discussions that confounding variables really confuse decision making (both of people and of AI), so we wanted to systematically and automatically get rid of their impacts," Zining Zhu, software engineer at WinterLight Labs told TechXplore. "This paper is about applying fair learning to isolating age effects, but it could be useful to remove effects of other factors as well, especially those lying in the causal chains between 'what we see' and 'what really happens'."

The researchers will now continue to explore ways of accurately detecting cognitive diseases, isolating the effects of age or other confounding variables.

"We still have a lot of work to do on disentangling the effects of age from the effects of pathological cognitive change, and this will likely continue," Rudzicz said. "We are interested in more interventional approaches, for example, and deeper integration with the healthcare system."

More information: Isolating effects of age with fair representation learning when assessing dementia, arXiv:180/.07217v1 [csLG]. arxiv.org/abs/1807.07217

Facts and Figures, Alzheimer's Association. www.alz.org/alzheimers-dementia/facts-figures