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Special Section: Are the rates of age- and amyloid β-associated cortical atrophy influenced by sustained exceptional cognitive functioning in older adults?

SuperAging: Current findings yield future challenges—A response to Rogalski and Goldberg

We thank Drs Goldberg and Rogalski for their thoughtful commentaries on issues related to the construct of SuperAging that arose from their consideration of our article entitled, "Rates of age- and amyloid β-associated cortical atrophy in older adults with superior memory performance". We agree that identifying biological factors that allow some older adults to maintain memory ability comparable to adults 20–30 years younger is important because such an understanding could provide clues to strategies for the elimination of age-associated neurodegenerative diseases. In this context, Rogalski and Goldberg identify important issues for consideration in empirical studies and theoretical development of the SuperAger construct. Both commentaries and our own work acknowledge that many different terms have been used to define older individuals with cognitive function superior to that of individuals of the same age [1]. While the present study focused on the SuperAger construct, the issues raised by Rogalski and Goldberg apply to all criteria developed to classify older adults with superior cognition.

Rogalski suggests that SuperAger classification should require a minimum age of 80 years, consistent with the Northwestern SuperAging Study criteria [2]. One foundation for this recommendation is that normative data for a list-learning test used to classify SuperAgers show that decline in test performance increases with aging: decline in performance from 60 to 80 years of age is much greater than that from 40 to 60 years. Thus, the preservation of youthful memory, defined as performance equal to or better than adults 20–30 years younger, becomes more impressive as individuals become older. However, we have suggested that enforcing a minimum age criterion in the definition of SuperAging might be limiting on a number of bases. First, biological age may be a better predictor of cognitive ability and overall health than chronological age [3]. Second, defining a single criterion value from continuous scales such as age will reduce the statistical power of investigations seeking biological or clinical correlates of SuperAging, as power is maximized when relevant samples are as large as possible and the variable of interest (e.g. age) is treated as a covariate in analyses [4,5]. Finally, studies of preclinical Alzheimer's disease suggest that existing normative data for many standardized neuropsychological tests will be negatively biased, particularly at older ages, because normative samples inadvertently include participants with preclinical dementia [6]. In fact, a recent study of cognitive aging showed that typical age-associated decline observed on standardized neuropsychological tests of memory is reduced when Aβ status is controlled statistically [7]. Therefore, our challenge is now to appreciate how chronological age should be treated in defining older adults with superior cognition.

Goldberg acknowledges that superior memory performance identified in the Australian Imaging, Biomarkers and Lifestyle Study of Ageing sample was not associated with reduced effects of aging or Aβ on cortical volume loss. However, he challenges these findings and recommends consideration into how older adults identified with superior memory came to have superior memory at all; this may be achieved by examining the role of genotypes such as *APOE* ε2 carriage or BDNF val66met val/val on preserving cognition [8–10]. He also suggests that lifestyle factors such as education may have been important [11]. Finally, because SuperAgers are classified on the basis of their neuropsychological performance, it is possible that their identification is a function of normal variability where individuals achieve superior scores due to chance. Thus, if classification of superior memory performance reflects the consequences of normal variability, then subsequent changes in performance on the same measure could reflect statistical phenomena such as regression to the mean. Goldberg also cautions that we need to be careful of performance improvements or practice effects that occur with repeated application of the same tests to cognitively normal older adults [12]. These practice effects can mask subtle cognitive decline and potentially explain why no age-associated memory decline was observed in Aβ− SuperAgers nor matched cognitively normal for age controls despite both groups displaying cortical and hippocampal atrophy over the same time period [13].

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These two thoughtful commentaries show that there still remains much work to do to refine and understand the Super-Ager construct. Together with our own work, we are sure that the challenges identified by Rogalski and Goldberg will provide a fertile area for future investigations of these older adults, like whom we all hope to become.

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