

Brief Report

The Continued Eclipse of Heterogeneity in Gerontological Research

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Abstract

Objectives: After a long history of neglect, diversity among older people and increasing heterogeneity with age are now familiar ideas in gerontological discourse. We take up the question of whether this increased attention is translating into the domain of empirical research. We replicate Nelson and Dannefer's (1992) review of the treatment of age-based variability in gerontological research, the most recent known assessment of the issue.

Method: A sample of empirical studies was drawn from six gerontological journals to determine (a) whether measures of within-age variability were reported and/or discussed and (b) if reported, the observed age-based pattern of variability in the outcome(s).

Results: The majority of studies neither reported nor discussed age-based variability. Among those that did report, the great majority indicated either stability or increasing variability with age. Observed patterns varied by outcome type. Although a majority of analyses of psychological and social outcomes suggested that variability was stable across age, half of the analyses of biological/health outcomes indicated increasing variability. Overall, very few (3%) of studies suggested decreasing variability.

Discussion: Consistent with earlier reports of studies, researchers continue to focus on average differences between age groups, yet key issues in social gerontology require attention to intra-age variability.

Keywords: Aging—Age-based variability—Heterogeneity—Measures of dispersion

The emphasis on diversity among older adults and the related idea that heterogeneity tends to increase over the life course have become familiar notions in gerontology. Long popular as a counterpoint to ageist stereotypes and simplistic generalizations about older people (e.g., Bass, Kutza, & Torres-Gil, 1989; Maddox & Douglass, 1974; Neugarten, 1983), an emphasis on heterogeneity among older people and the concomitant recognition of the limitations of relying on comparisons of average differences between age groups have become mainstays in gerontological discourse. During this same time, the field has witnessed a strong growth in interest in at least two broad theoretical

perspectives premised on the notion of increasing heterogeneity with age—successful aging (Rowe & Kahn, 1997) and cumulative dis/advantage (Crystal & Shea, 1990, 2002; Dannefer, 1987, 2003). More recently derived notions that imply increasing heterogeneity, such as cumulative inequality (Ferraro & Shippee, 2009) and weathering (Burton & Whitfield, 2005; Geronimus, 1992), also start from the premise that the increasing degree of variability in health and well-being in later life results from life-course processes rather than “normal” aging.

Given the wide applicability of explanatory frameworks that emphasize diversity and the age patterning of

variability as key aspects of cohort aging as well as the increasing availability of more advanced research designs and analytic tools, one would expect a commensurate expansion in attention to variability in empirical gerontological inquiry. If it indeed is the case that interindividual variability tends to increase as cohort members age, then sole reliance on averaged rates of change with age to characterize phenomena risks misunderstanding the actual patterning of phenomena over the life course and requires systematic attention to variability (Dannefer, 1987).

Systematic patterning in the age-variability relationship (e.g., increasing heterogeneity with age) is, of course, a research question that can be addressed explicitly in quantitative analysis. The neglect of this variability in empirical gerontological studies has long been noted as a concern (Bornstein & Smircina, 1982; Maddox & Douglass, 1974). In a widely cited study, Nelson and Dannefer (1992) examined whether and to what degree gerontological studies were reporting and discussing age-based variability. Using a sample of gerontological studies published between 1982 and 1986, their analysis yielded two important findings. First, few such studies reported or discussed the empirical patterning of variability with age. Second, among those who did report such data, the most common pattern observed across studies was a systematic increase in interindividual variability with age. In the two decades since this study was published, an acknowledgment of the importance of age-based heterogeneity has expanded across social gerontology and related fields (Crystal & Shea, 2002; Dannefer, 2003; Daatland & Biggs 2006; Ferraro & Kelley-Moore 2003; Kelley-Moore & Lin, 2011; Rowe & Kahn, 1997). This Brief Report assesses how, if at all, *research practices* in gerontological journals have changed in the last two decades. Our questions are as follows. In studies that examine age-related change and difference, is age-based variability reported and discussed more frequently than was reported two decades ago? And, to the extent that it is reported, do we observe a tendency for variability to increase with age?

Method

Selection Criteria and Sampling

Consistent with the study of Nelson and Dannefer (1992), we selected six established gerontological journals for study: *Journal of Gerontology* (all four divisions), *Psychology and Aging*, and *Research on Aging*. Although Nelson and Dannefer (1992) included a comparative analysis of developmental journals, we limit our study to gerontological research. We investigated a 6-year window (2005–2010), resulting in a total of 2,307 articles. Qualifying articles were identified by two coders using consensus coding where each article was coded independently, compared, and resolved. The abstract, methods, and results sections were used to determine whether the articles met the following three selection criteria: (a) empirical age-based comparisons are

presented in the article and are analyzed using descriptive or inferential statistics; (b) age is an independent variable in the analysis; and (c) the individual is the unit of analysis. The initial survey generated a sampling frame of 742 qualifying articles. From the sampling frame, we randomly selected 30% of qualifying studies, for a total of 231 articles (Table 1).

For descriptive purposes, we also recorded basic study features including outcome variables, age groups/age range examined, and sample size. Outcome variables were classified into three types: (a) biological/health (e.g., walking ability, weight, functional status), (b) cognitive/psychological (e.g., memory recall, mastery, depressive symptoms), and (c) social (e.g., socioeconomic status).

Coding and Classification

Each article was coded with respect to reporting and discussion of data on within-age variability. Articles were coded as reporting variability if any measure of dispersion in the outcome was reported based on age in the text, tables, or figures, whether the article included an explicit discussion of its age-based patterning. This included descriptive statistics by age group: standard deviations, interquartile range, or total range; or inferential statistics in multivariate models: standard error estimates of outcome by age coefficient, or estimated interindividual variance in age-based growth curves.

Discussions of age-based heterogeneity in the text were recorded if the author(s) explicitly interpreted the measures of dispersion with regard to age patterning. In a study that is exemplary in its attention to age-based variability, Karasik, Demissie, Cupples, and Kiel (2005) examined age differences in bone density. They stated in their results, “The variability of the score also increased with age [as measured by standard deviations (SDs) in each 3-year interval age group]” (p. 578). An example of reporting but not discussing is seen in Slessor, Laird, Phillips, Bull, & Filippou (2010), who report in a table a wider standard deviation of “gaze following” for older relative to younger adults but make no reference to this finding in the substantive discussion. Although explicit comparisons of variability are most typically seen in studies that compare age groups, even multivariate analyses

Table 1. Population and Sample Size by Journal

	Population	Sample
<i>JG: Biological Sciences</i>	34	16
<i>JG: Medical Sciences</i>	119	34
<i>JG: Psychological Sciences</i>	130	34
<i>JG: Social Sciences</i>	30	15
<i>Psychology and Aging</i>	360	109
<i>Research on Aging</i>	69	23
Total	742	231

that utilize a continuous age variable as a predictor of the outcome could explore the question of age-based patterns of variability (e.g., potential heteroskedasticity in the age effect on the outcome) and were included.

Based on these criteria, studies were classified into one of the following four categories: (1) measures of variability reported in tables or texts but not discussed with regard to the outcome under study; (2) measures of variability reported in text or tables and also discussed with regard to the outcome under study; (3) the issue of variability by age is discussed, but specific measures of variability in the outcome are not reported; and (4) neither report nor discussion of age-based variability in the outcome. Some studies presented measures of variability by age group in the form of box plots but did not provide exact values of the variance. These were classified as nonreportable and included in Category 4. Those studies that discussed but did not report measures of age-based variability (Category 3) were also excluded from further analysis.

Next, among those studies that reported sufficient information (Categories 1 and 2 earlier), we recorded the *pattern* of age-based variability in the outcome. Patterns of variability were classified as (a) stable with age; (b) increasing with age; (c) decreasing with age; and (d) fluctuating. For a more rigorous assessment of such patterns, we classified observed changes in variability by age based on whether the change is statistically significant ($\alpha = .05$), according to homogeneity of variance tests. For a given study, if no significant difference between ages (or age groups) was found, the pattern of variability was classified as *stable with age*. If the variances were significantly different, findings were classified as follows: increasing with age—in pairwise comparisons, variability is significantly larger in older age groups than in younger age groups; decreasing with age—in pairwise comparisons, variability is significantly smaller in older age groups than in younger age groups; fluctuating with age—variability changes but without a predominant pattern. Although a logical possibility, no study in our sample was classified as “fluctuating.”

Results

Report and Discussion of Age-Based Variability

Table 2 presents the categorization of studies based on their report and discussion of age-based variability. The majority of the studies reviewed (56%, 130 out of 231) neither reported nor discussed any age-based variability in the outcome under study (Category 4). The second largest group (38%, 88 out of 231) reported measures of variability yet did not discuss or interpret its substantive meanings (Category 1). Only 4% (10 out of 231) of the studies both reported *and* discussed age-based variability (Category 2). Those studies that discuss age-based variability but do not report measures account for 2% (3 out of 231) of all studies. Thus, in total, only 6% of the studies reviewed mention variability in their discussion of findings.

Table 2. Categories of Studies

Category	Percentage (<i>n</i>)
(1) Report only	38% (88)
(2) Report and discuss	4% (10)
(3) Discuss and no report	2% (3)
(4) Neither report nor discuss	56% (130)
Total	100% (231)

Observed Patterns of Age-Based Variability

Of all the studies examined, 98 studies reported measures of variability that can be used for our analysis of its age patterning. Because four studies have more than one outcome, we use outcomes rather than studies as the unit of analysis, resulting in an analytic sample of 102.

Table 3 presents the pattern of age-based variability by outcome type. For biological/health outcomes, the modal pattern was increasing variability with age (9 out of 18, or 50%). For cognitive/psychological outcomes, in contrast, stability with age was the modal outcome (55 out of 81, or 68%). Only three studies (two analyses of biological/health outcomes and one analysis of cognitive/psychological outcome) suggested decreasing variability with age. Fisher exact test confirmed that patterns of age-based variability reported differ significantly between these two types of outcomes ($p = .018$). Only three analyses examine social characteristics. Although they all suggest stability with age, there are too few such analyses to warrant a meaningful conclusion.

We also explored whether the observed pattern of age-based variability might vary by study characteristics, particularly sample size, age groups/age range being examined, and study design (i.e., cross-sectional or longitudinal; see Supplementary Appendix 1). For the most part, such factors seem to make little difference. However, we do note that of the studies with a longitudinal research design, 40% (4/10) report data supporting patterns of increasing variability, whereas only 32% of cross-sectional studies do so. The greater likelihood for longitudinal than cross-sectional analyses to report increasing variability was also found by Nelson and Dannefer (1992).

Discussion

Despite the growth in interest in theoretical perspectives for which heterogeneity is inherently relevant (e.g., successful aging, cumulative dis/advantage), scientists studying age appear to be continuing the traditional practice of relying on average differences between age groups to characterize the phenomenon under study and ignoring questions of age-based variability and inequality. Indeed, comparison of our findings with those of Nelson and Dannefer (1992) suggests little change in the proportion of studies reporting variability (43% in Nelson and Dannefer's analysis and 42% in the current analysis) and an actual *decrease* in the

Table 3. Patterns of Age-Based Variability by Outcome Type

	Biological/health	Cognitive/psychological	Social	Total
Increasing	50% (9)	31% (25)	0% (0)	33% (34)
Stable	39% (7)	68% (55)	100% (3)	64% (65)
Decreasing	11% (2)	1% (1)	0% (0)	3% (3)
Total	100% (18)	100% (81)	100% (3)	100% (102)

Note: Values are given as percentage (*n*).

proportion of articles discussing measures of age-based variability (39 out of 127 [31%] in Nelson and Dannefer's analysis and 13 out of 231 [6%] in the current analysis).

Turning to the question of patterns of variability observed in those studies that report measures of variability, we have seen that the great majority of studies report either stability or increasing variability with age. However, the pattern varies substantially among outcome types. Half of the biological studies report increasing variability, but only about a third of the psychological studies do so. Only three of the sampled studies dealt with outcomes considered social. Overall, the proportion of analyses suggesting increasing variability with age (34 out of 102 or 33%) is smaller than that reported by Nelson and Dannefer (1992; 35 out of 54 or 65%). This inconsistency is likely due to the present paper's application of a more stringent criterion for observed differences. Consistent with the observation of Nelson and Dannefer (1992), the predominant direction of change was toward increasing variability with age in our analysis. Yet our application of the homogeneity of variance test restricted our results only to those contrasts that exceeded the 95% confidence level.

Also consistent with Nelson and Dannefer (1992), it is notable that across cognitive, physical health, and social outcomes, there is virtually no evidence that variability *decreases* with age. The high percentage of stability in variance with age among cognitive and psychological measures suggests a potential disciplinary difference whereby scales may be deliberately constructed to minimize non-constant variation across age categories and other socially meaningful groups (Griffith et al., 2013). Future research that integrates systematic study of age patterning of variability should be mindful of measurement and how it may limit the ability to detect heterogeneity that exists in the population.

Overall, our findings suggest that the entrenched practice of relying on averages in characterizing age-related change remains resilient, despite both conceptual and methodological advances in the past two decades. Only 42% of the sampled studies report age-based variation in the outcome under study, and of those, only a handful make any reference to it in the text of their articles. Although one explanation for such a pattern includes habitualized research practices in testing and reporting, it is possible that such a trend may represent a problematic challenge in the field of gerontology: the implicit but resilient belief in the explanatory power of age per se for

a range of phenomena and, relatedly, the seductiveness of "normal aging" as a convenient and often interesting way to approach data. Inherent in such age-based comparisons is the continued entrenchment of chronological age as a chief explanans for the outcome under study, and the corresponding inclination to pay little attention to variability among age peers, which clearly tends to increase more than to diminish with age. Variability remains an empirical reality, but one that may be obscured altogether by the preference given to the central tendency depictions.

It is important that some of the studies in our sample exemplify the ways that scholars can empirically assess age-based patterns of variability and integrate such findings into the substantive questions (Allemand, Zimprich, & Martin, 2008; Charles & Almeida, 2007; Karasik et al., 2005; Krampe, Doumas, & Rapp, 2010; Neri et al., 2005; Schrauf & Sanchez 2008; Turcotte, Gagnon, & Poirier, 2005; Woledge, Birtles, & Newham, 2005). The advancement of theoretical perspectives positing increasing variability with age, in conjunction with the statistical tools to test it, provides a substantial foundation for future studies within the gerontological discourse. Now, it is a matter of researchers applying the explanatory frameworks that emphasize variability and its age patterning with the available empirical techniques.

Beyond these theoretical considerations, the issue of age-based variability has significant implications for the types of empirical questions under study and the statistical techniques used to answer them. Although space limits a full exposition of their potential for researchers, we suggest three directions for future studies. First, the outcome of interest may exhibit age patterning in its variance, which can be examined descriptively in both cross-sectional and longitudinal studies. Second, the relationship between a key independent variable and the outcome may be weaker at older ages, rendering the estimated regression line less precise. Third, when examining change in an outcome over time, there may be more interindividual variability in the rates of change at older ages compared with younger ages. In all three of the above examples, the statistical tools already exist to examine potential age-based patterns of variability, leaving it to the scientists to incorporate such questions explicitly into their study.

This study has several limitations. First, the sample of studies is limited in scope. The journals were selected because they are prime outlets for gerontological studies and to be

consistent with the 1992 study. We recognize that our sampling frame of six journals does not encompass all relevant research outlets for research on aging. Second, some of the age group comparisons, particularly when there were three or more age groups, were based on relatively small sample sizes so should be interpreted with caution. Third, we note that selective mortality and other cohort-level processes may introduce complexity with a net effect of decreasing observed increases in variability. In fact, variability may be greater at each age and increase faster with age if the effects of selective mortality were teased out from cross-sectional age comparisons (Dannefer, 1987; Markides, Timbers, & Osberg, 1984). Further exploration of selective mortality must remain beyond the scope of this Brief Report.

In sum, our results suggest that gerontological research has yet to recognize the implications of patterns of systematic change in variability over the life course. Despite the recent emphasis in gerontology on the importance of diversity and variability in how individuals age, the continuity of current research practices with those prevailing in the 1980s is remarkable. Recently, calls for increased attention to age-based variability have come from those who rely on advanced analytic techniques such as multilevel modeling and latent growth curves. Integrating systematic analysis of potential age-based patterns of variability could be critically informative in even descriptive analyses. Concerted attention to age-based variability, documented for many outcomes across studies, allows empirical findings to coalesce and provides opportunity to test conceptual frameworks that propose specific patterns. A solid base of evidence regarding age-based variability strengthens our ability to inform policy and programs that benefit persons of any age.

Supplementary Material

Please visit the article online at <http://psychsocgerontology.oxfordjournals.org/> to view supplementary material.

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