“Older Is Always Better”: Age-Related Differences in Vocabulary Scores Across 16 Years

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Cross-sectional studies of cognitive aging compare age groups at a certain time point. It is unclear from such studies whether age-related cognitive differences remain stable across time. We present a cross-sectional investigation of vocabulary scores of 2,000 younger and older adults collected across 16 years, using the same laboratory and protocol. We found a steady decrease with year of testing and an advantage for older adults. An additive relation between age group and year of testing implied that age-related differences in vocabulary are independent of changes over time, suggesting that younger and older adults are similarly affected by changes in word usage.

Keywords: aging, vocabulary, cognitive abilities, cohort, year of testing
meaning of the word (dual-representation theory of knowledge; Brainerd & Reyna, 1992; McGinnis & Zelinski, 2003).

Aging and Year of Testing

The general age-related advantage in vocabulary has been documented for over 50 years, with different scales (for a meta-analysis, see Verhaeghen, 2003). In 1995, Gold and colleagues found vocabulary scores to improve with age. The same pattern was noted in 2011 by Ben-David and colleagues (2011). Both studies compare performance between two groups of people in their 20s and 70s. The 1995 study compared participants born in the 1920s (older) and the 1970s (younger adults), and the 2011 one compared participants born in the 1940s (older) and the 1990s (younger). The question arises: Are these studies comparable? Did they capture the same stable age-related differences separated by 15 years, or do they reflect differences related to the year of testing?

The year of testing has an intricate effect on vocabulary scores, with some studies indicating a moderate increase (Gerstorf, Run, Hoppmann, Willis, & Schaie, 2011) and others indicating a moderate decrease in scores as years advance (Alwin, 1991; Glenn, 1994). Generally, these inconsistencies were attributed to the differential impact of the year of testing on items used in the specific tests (Bowles, Grimm, & McArdle, 2005; Wilson & Gove, 1999). The relationship between the effects of year of testing and age on vocabulary is also unclear. Uttl and Van Alstine (2003) reported an interaction of the two effects in a meta-analysis of 1965–1995 studies, whereas a meta-analysis of 1986–2001 studies failed to show such an interaction (Verhaeghen, 2003; see also Zelinski & Kennison, 2007). These inconsistencies may be due to a mediating effect of years of education.

Years of Education

Formal education (school, college, etc.) is one of the main predictors of performance on vocabulary tests (Kauffman, Reynolds, & McLean, 1989). However, the number of years of education may have less of an impact on younger than on older adults’ vocabulary, because the variability in years of education for younger adults is smaller than for seniors. Namely, younger participants usually comprise a rather homogenous group of undergraduates with at least 12 years of education (see Table 1 in Verhaeghen, 2003) who have not yet realized their full educational potential. However, older participants are more varied. After controlling for education, Uttl and Van Alstine (2003) found year of testing to affect age-related differences in vocabulary, and Wilson and Gove (1999) found age-related differences to remain stable over time. These inconsistencies call for a fresh examination.

The Current Study

The goal of the current study is to tease apart the effects of aging and year of testing on vocabulary scores. We analyzed data collected in the same lab using the same scale (aMH) across 16 years with over 2,000 younger and older participants, minimizing the contributions to error variance related to differences between labs, testing procedures and populations. As a first step, we showed that the aMH test provides equivalent results to the standardized vocabulary subscale of the WAIS–III. In the second step, we examined the data collected and aggregated across eight consecutive 2-year subgroups. We tested the main effects of age group (vocabulary changes across the life span) and year of testing (vocabulary changes over the years) as well as the interaction of the two (whether year of testing affects the vocabulary of younger and older adults differently), after controlling for the effect of education.

Experiment 1

The aMH has been widely used as a gauge of basic language skills (e.g., Ben-David, Tse, & Schneider, 2012). Sliwinski and Buschke (1997) found that scores on the aMH were correlated (r = .60) with scores on the standardized vocabulary subscale of the WAIS–R (Wechsler, 1981). Because the WAIS–R version of the test has been replaced by the WAIS–III, it was necessary in the current study to further validate the aMH test using the WAIS–III.

Method

Participants. One hundred and 70 younger adults (M = 19.2 years old, SD = 1.8), undergraduates at the University of Toronto Mississauga, participated in this study. They either received course credit or were paid $10 per hour. All participants were native English speakers (who learned English before the age of 5 years and have been speaking it ever since) and had visual acuity within the normal range on the Snellen test.

Materials and procedure. Participants completed the two vocabulary tests in the same session, separated by a short break, with the test order randomized across participants.

aMH vocabulary test. Participants were asked to match each of the 20 test items with its closest synonym by choosing one of six presented alternatives, with no time constraints. Individual scores were calculated as the number of correct responses out of 20.

WAIS–III Vocabulary subtest. The experimenter read aloud 33 words, each of which the participant was asked to verbally define. Responses receive 0, 1, or 2 points on the basis of their quality, such that the total score ranges from 0 to 66, and responses were coded by two independent experimenters. See the manual for a detailed description (Wechsler, 1997).

Results and discussion. The results of the WAIS–III vocabulary subtest in this study (M = 40.8, SD = 8.5) were similar (within interquartile boundaries) to those of 380 participants of the same age group in another study (M = 36.0, SD = 12.7; Ardila, 2007). Similarly, the average aMH score (M = 12.4, SD = 2.3) was within the range reported by our lab in the past 5 years (e.g., Ben-David & Schneider, 2010, M = 13, SD = 2.7; Ben-David et al., 2012, M = 12.8, SD = 2.8). The aMH in our sample was found to be reliable (Cronbach’s alpha = .57). Figure 1 shows that scores on the aMH test were significantly correlated with scores on the WAIS–III (r = .61, p < .01). This comparison replicates the results of Sliwinski and Buschke (1997) using a different version of the WAIS (WAIS–R).

Experiment 2

The results of Experiment 1 showed that the aMH can be used as a valid measure of vocabulary skill. In Experiment 2, aMH scores and the number of years of education of older and younger
adults were collected from the archives of the same laboratory across 16 years.

**Method.**

**Data collection.** Basic demographic information (age, gender, and years of education) and aMH scores were gathered for 2,036 older and younger participants, tested in the laboratory between 1995 and 2010, with measures implemented to verify transcription accuracy.

**Participants.** Data were collected from 1,299 younger adults (18–35 years old, $M = 21$ years old, $SD = 2.3$) and 737 older adults (60–94 years old, $M = 71.4$ years old, $SD = 5.9$). Participants to the lab were recruited through ads placed within the university and in the local media, through posters and brochures, or by word of mouth. Participants received either course credit or $10 per hour. Participants reporting health, sensory, or mobility issues were not recruited, and participants who learned to speak English after the age of 5 years were excluded from our analysis. The proportion of female participants in the older age group (62.0%) was slightly lower than in the younger group (69.7%), $X^2 = 12.2, p < .001$, but gender was not found to have a significant impact on aMH scores in our study and will not be further discussed. The average number of years of education for both age groups did not differ significantly ($F < 1$). The data were divided into 2-year subgroups on the basis of the year of testing. The average age of older participants did not change significantly as a function of year of testing, and the age of younger adults varied by no more than 1 year between consecutive 2-year subgroups.

**Results.** Table 1 presents the average aMH scores for each 2-year subgroup of older and younger adults. An examination of the table shows that aMH scores were higher for older adults on all eight 2-year subgroups, and that there was a gradual decline in aMH scores as the year of testing advanced. To check for any age by year of testing interaction, with respect to the contribution of education to aMH scores, we regressed aMH scores against years of education separately for each of the 16 combinations (2 ages × 8 testing years).

\[
\begin{align*}
\text{aMH}_{	ext{younger}} &= c_y + b_y \times \text{years of education} \\
\text{aMH}_{	ext{older}} &= c_o + b_o \times \text{years of education} \\
\end{align*}
\]

This 32-parameter model accounted for 24% of the variance in aMH scores (see the Appendix). Next, we showed that a model in which the intercepts of these functions declined in a linear fashion as a function of year of testing provided as good a fit as the full model. Namely, we could not reject the null hypothesis that the slope of the function relating aMH scores to years of education was the same for all year of testing subgroups (see the Appendix).

Hence, the 6-parameter model

\[
\begin{align*}
\text{aMH}_{	ext{younger}} &= c_y + a_y \times \text{years of education} \\
\text{aMH}_{	ext{older}} &= c_o + a_o \times \text{years of education} \\
\end{align*}
\]

provided almost as good a fit (23% of the variance) as the full model that allowed for Age × Year of Testing interactions with respect to the contribution of years of education to aMH score. Note that the parameters of this model are allowed to differ across the two age groups.

We then tested three null hypotheses with respect to this six-parameter model: (1) $c_y = c_o$; (2) $a_y = a_o$; and (3) $b_y = b_o$. The

<table>
<thead>
<tr>
<th>Year</th>
<th>$N$</th>
<th>Age</th>
<th>Years of education</th>
<th>aMH score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995–1996</td>
<td>43</td>
<td>22.0 (1.7)</td>
<td>15.5 (1.7)</td>
<td>14.5 (3)</td>
</tr>
<tr>
<td>1997–1998</td>
<td>55</td>
<td>21.8 (1.8)</td>
<td>15.1 (1.7)</td>
<td>14.2 (2)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>64</td>
<td>21.8 (2.4)</td>
<td>15.0 (2.0)</td>
<td>13.8 (2)</td>
</tr>
<tr>
<td>2001–2002</td>
<td>145</td>
<td>21.6 (2.3)</td>
<td>14.9 (1.7)</td>
<td>13.7 (2)</td>
</tr>
<tr>
<td>2003–2004</td>
<td>219</td>
<td>21.4 (2.6)</td>
<td>14.6 (2.2)</td>
<td>13.6 (2)</td>
</tr>
<tr>
<td>2005–2006</td>
<td>196</td>
<td>20.9 (2.1)</td>
<td>14.2 (1.8)</td>
<td>13.6 (2)</td>
</tr>
<tr>
<td>2007–2008</td>
<td>343</td>
<td>20.7 (2.2)</td>
<td>14.0 (1.8)</td>
<td>13.0 (1)</td>
</tr>
<tr>
<td>2009–2010</td>
<td>234</td>
<td>19.6 (1.9)</td>
<td>13.5 (1.3)</td>
<td>12.6 (2)</td>
</tr>
<tr>
<td>Sum</td>
<td>1299</td>
<td>20.9 (2.3)</td>
<td>14.3 (1.9)</td>
<td>13.2 (1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>$N$</th>
<th>Age</th>
<th>Years of education</th>
<th>aMH score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995–1996</td>
<td>57</td>
<td>71.1 (4.3)</td>
<td>15.0 (3.1)</td>
<td>16.1 (3)</td>
</tr>
<tr>
<td>1997–1998</td>
<td>49</td>
<td>72.1 (4.9)</td>
<td>14.7 (2.7)</td>
<td>15.9 (3)</td>
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<td>1999–2000</td>
<td>75</td>
<td>71.4 (5.5)</td>
<td>13.8 (3.2)</td>
<td>15.0 (2)</td>
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<tr>
<td>2001–2002</td>
<td>81</td>
<td>72.0 (5.8)</td>
<td>14.2 (3.1)</td>
<td>14.9 (2)</td>
</tr>
<tr>
<td>2003–2004</td>
<td>98</td>
<td>70.6 (5.3)</td>
<td>14.7 (3.3)</td>
<td>14.5 (3)</td>
</tr>
<tr>
<td>2005–2006</td>
<td>160</td>
<td>71.6 (6.4)</td>
<td>15.1 (3.0)</td>
<td>14.2 (2)</td>
</tr>
<tr>
<td>2007–2008</td>
<td>119</td>
<td>71.1 (6.2)</td>
<td>14.7 (3.5)</td>
<td>14.5 (2)</td>
</tr>
<tr>
<td>2009–2010</td>
<td>98</td>
<td>72.9 (6.9)</td>
<td>15.3 (3.6)</td>
<td>14.7 (3)</td>
</tr>
<tr>
<td>Sum</td>
<td>737</td>
<td>71.4 (5.9)</td>
<td>14.8 (3.3)</td>
<td>15.0 (1)</td>
</tr>
</tbody>
</table>

**Note.** Data are given as means with standard deviations in parentheses, when available. Age is given as years, and aMH as total score out of 20. AMH = Abbreviated Mill Hill (aMH) Vocabulary test.
first hypothesis (c₁ = c₂) was rejected, F(1, 2030) = 15.69, p < .0001, but the second (a₁ = a₂) and third (b₁ = b₂) hypotheses could not be rejected, F < 1 and F(1, 2030) = 2.79, p = .095, respectively. Hence, in Model 2, the relationships between aMH scores, years of education, and year of testing were assumed to be independent of age group. The null hypothesis that both b₁ = b₂ and a₁ = a₂ could not be rejected, F(2, 2030) = 1.52, p = .2. Namely, Model 3, depicted next, provided as good a fit to the data as Model 1.

\[
\begin{align*}
\text{aMH}_{\text{younger}} & = c₁ + a₁ \times \text{year subgroup} + b₁ \times \text{years of education} \\
\text{aMH}_{\text{older}} & = c₂ + a₂ \times \text{year subgroup} + b₂ \times \text{years of education}
\end{align*}
\] (3)

Two null hypotheses were tested and rejected with respect to Model 3: (1) b₁ = b₂ and (2) a₁ = a₂, F(1, 2032) = 195.86 and 52.77, respectively, p < .0001. Hence, we concluded that Model 3 is the minimum parameter model that provides as good a fit to the data (r² = .229) as the full model specified in Model 1 (r² = .320). Consequently, the relationships between aMH scores, years of education, and year of testing appear to be the same for both younger and older adults, but the aMH scores were consistently higher for older adults than for younger adults.

The best-fitting parameter values for Model 3 are

\[
\begin{align*}
\text{aMH}_{\text{younger}} & = 10.29 - .18 \times \text{year subgroup} + .27 \times \text{years of education} \\
\text{aMH}_{\text{older}} & = 11.86 - .18 \times \text{year subgroup} + .27 \times \text{years of education}
\end{align*}
\] (4)

The model describes three main trends: (1) an age-related advantage in aMH scores of about 1.6/20 points (means of 14.98/20 and 13.17/20, for older and younger adults, respectively), r(2031) = 7.14, p < .001, after controlling for the effects of year of testing and education; (2) a linear relationship between aMH scores and year of testing, with a decrease of 0.18/20 every 2 years, which does not differ between age groups; and (3) a significant effect of education, with an increase of 0.27/20 points for each additional year of education, in both age groups.

Figure 2 plots the linear regression lines described in Equation 4 for aMH scores as a function of 2-year subgroups (after removing the effect of years of education). In summary, our data show an additive effect of age group and year of testing on vocabulary scores, after controlling for education. The advantage of older over younger adults of 1.6/20 aMH points remained stable across 16 years, with a linear decrease in vocabulary scores for both groups. Note that the analysis did not involve adjustments to counteract the Flynn effect (Aghabani & Hiscock, 2013; Dickinson & Hiscock, 2010) because the effect typically does not involve crystallized intelligence factors such as vocabulary (Flynn, 1994).

**General Discussion**

This study investigated the influences of aging and year of testing on vocabulary knowledge as a measure of cognitive ability. Specifically, these variables were tested using scores on the aMH scale collected in a single laboratory, across 16 years, with over 2,000 younger and older adults. Analyses of the data led to several conclusions: First, there is an advantage in vocabulary scores for older adults over younger adults of about 1.5 out of 20 tested words. Second, vocabulary scores decreased steadily across these 16 years, with about 0.2 fewer words correctly identified for every 2 years that passed. Third, the two age groups had the same rate of decline as the year of testing advanced, indicating a stable age-related advantage across 16 years. Fourth, the number of years of education had a significant inflating effect on vocabulary scores.

**Age-Related Increase in Vocabulary**

An overall analysis of our data showed a significant advantage in aMH scores favoring older adults, after controlling for years of education (and year of testing). This age-related enhancement in performance is consistent with other findings (e.g., Gold et al., 1995; Schaie, 1996), suggesting that the lexicon improves from young adulthood to older age and counteracting the negative stereotype that all cognitive abilities decline in aging (Bell & Stanfield, 1973). Older adults are better than younger adults with respect to knowledge gained from past experience and accumulated with age (MacKay & Burke, 1990), such as vocabulary. In contrast, younger adults outperform older adults when tasks emphasize speed of processing or the inhibition of irrelevant information (Ben-David, Eidel, & Donkin, 2014; Ben-David et al., 2012; Schneider, Pichora-Fuller, & Daneman, 2010).

**A decline in vocabulary as year of testing advanced.**

Alongside the age-related increase in vocabulary, we found a steady decline in scores as the year of testing advanced, for both younger and older adults. This decline may involve environmental changes such as a gradual reduction in reading habits (Glenn, 1994) and in motivation and values (Alwin, 1991). Alternatively, the decline in scores with year of testing may merely reflect a change over time in the validity of the aMH itself. However, given the results of our study, this hypothesis does not seem likely. In Experiment 1, we found a strong and significant correlation (of .61) between the aMH and the highly validated WAIS–III vocabulary subscale. A high degree of correlation was also found in a 1997 study between the aMH and a previous version of the WAIS test by others (r = .60, Sliwinski & Buschke, 1997; WAIS–R).
As outlined earlier, the inconsistent evidence for changes in vocabulary as a function of year of testing may be due to a mediating effect of years of education (Uttl & Van Alstine, 2003). In line with this, our regression model found an effect of year of testing after removing the effect of years of education. We also note that the design of our study carefully controlled for other sources of error variance (scale, protocol, and population) that may have an impact on meta-analyses of studies.

**Additive effects of aging and year of testing.** In the 16-year span of data collection, there have been many changes that could have influenced older and younger adults’ vocabulary in different manners (Jensen, 1998). The most important finding in our study is the additive impact of age group and the year of testing on vocabulary scores. The same slope relating aMH scores to the year of testing was found for older and younger adults. That is, the advantage for older over younger adults in vocabulary was stable across the 16 years. This additive effect of year of testing and age group has practical implications. When aggregating information from younger–older comparisons of behavior across a 20-year span, do these comparisons reflect the same age-related cognitive effects, or different effects reflecting comparisons of different populations? Our study provides some support for the ability to accumulate results across years, as age-related differences on one such cognitive test (vocabulary scale) were found to be impervious to the year of testing.

From a broader viewpoint, this result shows that older adults are just as susceptible to changes in the environment as younger adults. Although the effect describes a decline in vocabulary as years advance, this result may demonstrate older adults’ sensitivity to the changes in the language spoken around them and their ability to adapt to these changes. This view is in line with Wister’s (1989) suggestion that older adults can accommodate to psychological and environmental changes that do not involve increased physical challenges. In other words, our data reflect an adaptive quality of older adults.

**Limitations**

One of the goals of our study was to test a homogeneous population of older and younger adults, across 16 years. These groups well represent the pool of participants in university studies (undergraduates and cognitively high-functioning older adults). This choice also presents a limitation of our study, as our conclusions might not be generalized to the population at large. We further acknowledge that our study includes a validation of the aMH against the WAIS vocabulary subscale only for younger adults. However, as Model 3 of Experiment 2 shows that different factors (year of testing and education) have the same effect on aMH scores for older and younger adults, the generalizability of Experiment 1’s data is supported. Future studies may wish to examine this link directly. Finally, we do not examine the environmental factors that lead to the decline in vocabulary with year of testing, and our study design cannot completely isolate the effects of education from those of aging. Our study calls for further investigations of the effects of education and year of testing on vocabulary in older and younger adults, considering other factors such as culture (see Icht & Ben-David, 2014).

**Summary**

In a cross-sectional investigation of vocabulary scores (aMH) of over 2,000 older and younger adults collected across 16 years, we found an advantage in vocabulary for older adults and a steady decline in scores with year of testing. Whereas the former is a common finding in the literature, the decline in scores as a function of the passage of time has been debated in the literature. The most important finding in our study is a clear additive relation between age group and year of testing, implying that age-related effects on the lexicon are independent of the effects of demographic changes over time. Our data also suggest that aggregating knowledge collected in cross-sectional studies over time will reflect age-related factors. Finally, it is notable that older adults appear to be affected by lexical changes in their environment just as much as younger adults, reflecting an adaptive quality in older age.

**References**


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proaches to language and aging. In T. Perfect & E. Maylor (Eds.), Models of cognitive aging (pp. 204–237). New York: Oxford University Press.


(Appendix follows)
Appendix

From a 32- to a 6-Parameter Model

To examine the relationship between aMH and years of education in a way that allowed us to test for interactions between the 2-year subgroups (1 ≤ i ≤ 8) and age groups (younger vs. older), we first fit separate linear functions to each combination of 2 age-groups × 8 year-of-testing subgroups according to the model

\[
\begin{align*}
\text{aMH}_{\text{younger}, i} &= c_{i, y} + b_{i, y} \cdot \text{years of education} \\
\text{aMH}_{\text{older}, i} &= c_{i, o} + b_{i, o} \cdot \text{years of education}
\end{align*}
\]  

(A1)

An examination of the intercept values of this 32-parameter model (which accounted for 24% of the variance in aMH scores) suggested that the intercept values in each group decreased as a function of year of testing in each group. Hence, we fit a reduced model that allowed for the intercept values to change as a linear function of year of testing but at different rates for younger and older participants in each of the eight 2-year subgroups, that is,

\[
\begin{align*}
\text{aMH}_{\text{younger}, i} &= c_{y} + a_{y} \cdot i + b_{y} \cdot \text{years of education} \\
\text{aMH}_{\text{older}, i} &= c_{o} + a_{o} \cdot i + b_{o} \cdot \text{years of education}
\end{align*}
\]  

(A2)

In this model the intercept for younger participants in 2-year subgroup \(i\) is given by \(c_{y} + a_{y} \cdot i\), whereas the intercept for older participants in 2-year subgroup \(i\) is given by \(c_{o} + a_{o} \cdot i\). Also note that this model allows separate slopes to be fitted to each combination of age and year of testing. We cannot reject the null hypothesis that this 20-parameter model provides as good a fit to the data, as does the 32-parameter model, \(F(12, 2004) = 1.34, p = .186\).

Next, we tested a further reduction of the number of parameters in the model in which we restricted the slope values for younger and older adults to be independent of year of testing, but allowed the slope values to differ between age groups, that is, \(b_{y} = b_{o}\). A test of the null hypothesis that this 6-parameter model provides as good a fit as the 20-parameter model specified in Equation A2 could not be rejected, \(F(14, 2016) = 1.68, p > .05\). In addition, this 6-parameter model accounts for almost as much of the variance in Mill Hill scores (23%) as does the 32-parameter model (24%).

Because this 6-parameter model (in which there is no interaction between age group and year of testing) provides almost as good a fit as the 32-parameter model (which allows for an Age Group × Year of Testing interaction), we conclude that there is very little evidence for an Age Group × Year of Testing interaction in the present data.

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