Performance on the Benton Visual Retention Test in an Educationally Diverse Elderly Population

Eun Hyun Seo,1 Dong Young Lee,2 Il Han Choo,2 Jong Choul Youn,3 Ki Woong Kim,4 Jin Hyeong Jhoo,5 Kwan Woo Suh,6 Yong Su Paek,7 Yong Ho Jun,7 and Jong Inn Woo2

1Interdisciplinary Program of Cognitive Science, Seoul National University, Seoul, Korea.
2Department of Neuropsychiatry, Seoul National University, Seoul, Korea.
3Department of Neuropsychiatry, Kyunggi Provincial Hospital for the Elderly, Yongin, Kyunggi, Korea.
4Department of Neuropsychiatry, Seoul National University Bundang Hospital, Seongnam, Kyunggi, Korea.
5Department of Neuropsychiatry, Kangwon National University Hospital, Chuncheon, Kangwon, Korea.
6Department of Psychiatry, Seoul Backjae Hospital, Seoul, Korea.
7Department of Psychiatry, Osan Mental Hospital, Osan, Kyunggi, Korea.

In this study, we investigated the effects of demographic variables on the performances of Administrations A and C of the Benton Visual Retention Test (BVRT) in a geriatric population with a wide range of educational achievement. We administered the test to 554 nondemented elders aged 60–90 years with an educational history of from zero to 25 years. Age and education significantly influenced Administrations A and C, although gender had no main effect. We observed significant Education x Gender interactions for Administrations A and C, Age x Gender interactions for Administration A, and Age x Education interactions for Administration C. Our results suggest that both nonverbal memory and constructional ability are influenced by age and education. Although there is no overall gender effect, men seem to outperform women in a poorly educated (for Administrations A and C) or relatively older (for Administration A) elderly population.

The Benton Visual Retention Test (BVRT) assesses visual perception, nonverbal memory, and constructional abilities (Sivan, 1992). Researchers have found that performance on the BVRT is related to demographic factors. The majority of studies have documented that older age and lower educational levels are related to poorer performance (Arenberg, 1982; Benton, Eslinger, & Damasio, 1981; Coman, Moses, Kraemer, Friedman, Benton, & Yesavage, 1999, 2002; Giambra, Arenberg, Zonderman, Kawasaki, & Costa, 1995; Youngjohn, Larrabee, & Crook, 1993). However, no gender effect on the BVRT has been identified (Coman et al., 1999; Youngjohn et al.). Some studies have also suggested a significant Age x Education interaction, indicating that age-associated decline may be more prominent for those individuals with a lower educational level (Coman et al., 2002).

A proper understanding of the effect of demographic variables is essential to the accurate interpretation of any cognitive test performance. However, previous studies on the demographic influences on the BVRT suffer from several limitations. First, the individuals included in such studies invariably had high educational levels, and thus the influence of demographic factors on BVRT performance in elderly individuals with a poorer educational background has not been well established. Second, little information is available on the performance of Administration C of the BVRT, which measures constructional ability; all previous studies dealt with Administration A, which measures nonverbal memory. As Benton (1962) indicated, one can discriminate pure nonverbal memory impairment from constructional failure by applying both administrations of the BVRT together. Third, previous reports have been based on relatively small samples of elderly individuals.

Therefore, in this study we examined the effect of age, education, gender, and the interactions among them on the performance of both Administrations A and C of the BVRT in a relatively large sample of elderly individuals with a wide educational range.

METHODS

Participants

We included 554 older adults in this study. We recruited study participants from the pool of elderly individuals who registered to participate in a community service program for the early detection and management of dementia at two public health centers (one dementia clinic located in Seoul and one in Kyunggi province, Korea) from January 2003 to April 2005. All subjects lived independently in the community, and we obtained informed consent from each participant in the manner prescribed by the institutional review boards at each center. Using the Korean version of the Consortium to Establish a Registry for Alzheimer’s Disease clinical assessment battery (Lee et al., 2002), we had a psychiatrist with advanced training in neuropsychiatry and dementia research individually examine all participants. We also interviewed reliable informants to acquire accurate information regarding cognitive and functional changes and the medical histories of subjects. A panel consisting of four psychiatrists made clinical decisions, which included diagnosing dementia.

All subjects in the present sample satisfied strict entry criteria. We excluded those individuals with dementia or other serious medical, psychiatric, or neurological disorders that could affect mental function. The psychiatrists made a diagnosis of dementia according to the criteria of the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994). All subjects possessed adequate vision and hearing, although many wore glasses and some required...
Materials and Procedures
We gave both Administrations A and C of the BVRT in this order, and we conducted the administrations according to the standard format described in the test manual (Sivan, 1992). We used the designs of both administrations from Form C. Under Administration A, participants viewed each of 10 cards for 10 seconds, and immediately reproduced the designs of each from memory. In Administration C, participants copied each of 10 designs while the designs remained in view. We measured the BVRT performance by using number-correct (NC) and number-error (NE) scores. For NC scores, we judged individuals’ reproductions of designs on an all-or-none basis. For NE scores, we recorded the numbers of errors for any less-than-perfect reproduction, and we classified errors into one of six major categories: omissions, distortions, perseverations, rotations, misplacements, and size errors.

Trained psychologists and nurses administered and scored the BVRT at each site. To evaluate interrater reliability, we had four examiners from each study site score the same 20 cases, we gave both Administrations A and C of the BVRT in this study to investigate the influences of demographic factors on Benton Visual Retention Test Administrations A and C.

Statistical Analysis
We performed a multiple linear regression analysis, considering age, education, gender, and two-way interactions between them simultaneously, to assess the relationship of these variables to test performance. We did not include the three-way interaction in the regression model because it is difficult to understand the clinical meaning of it. We entered age and education as continuous variables, and we coded gender as 0 for women and 1 for men.

RESULTS
Demographic Characteristics
The mean education period of 554 participants was 7.0 (SD = 5.0) years, and this ranged from 0 to 25 years. The mean subject age was 71.1 years (SD = 6.2), ranging 60 to 90 years. Although women comprised 62.3% of the overall sample, there were relatively more men in the 80–90 age group. The mean age and education of women were lower than those of men, at t(552) = 3.33, p < .01 for age and t(552) = 9.12, p < .001 for education. The mean score on the Mini-Mental State Examination for the entire sample was 24.6 (SD = 3.2).

Effects of Age, Education, Gender, and Their Interactions
Because correlations between NC and NE scores were very high (r = −.90, p < .001 for Administration A and r = −.97, p < .001 for Administration C), in this report we present the results only for the NC scores.

Discriminant analysis revealed that both education and age were significantly associated with NC_A and NC_C, respectively. When we compared standardized regression coefficients, we found that education contributed relatively more than age did to both NC_A and NC_C. However, we found no gender effect on NC_C or NC_A.

For NC_A, there was a significant Education × Gender interaction: the mean (SD) scores of the groups with 0–3 and ≥10 years of education were 3.9 (2.0) and 5.7 (1.5) for men versus 2.5 (1.7) and 5.8 (1.5) for women, respectively. There was also a significant Age × Gender interaction: the mean (SD) scores of the age groups of 60–69 and 80–90 years of age were 5.3 (2.2) and 4.3 (1.9) for men versus 4.8 (2.0) and 1.9 (1.2) for women, respectively. For NC_C, we also found a significant Education × Gender interaction: the mean (SD) scores of the groups with 0–3 and ≥10 years of education were 7.5 (1.9) and 9.5 (0.8) for men versus 6.8 (2.6) and 9.6 (1.1) for women, respectively. There was also a significant Education × Age interaction: the mean (SD) scores of the groups with 0–3 and ≥10 years of education were 7.5 (1.9) and 9.6 (0.8) for the age group of 60–69 years versus 5.2 (2.9) and 9.7 (0.5) for the age group of 80–90 years (see Table 1).

Table 1. Multiple Regression of Age, Education, and Gender on Benton Visual Retention Test Administrations A and C

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE (B)</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC_A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>−0.05</td>
<td>0.02</td>
<td>−0.17***</td>
</tr>
<tr>
<td>Education</td>
<td>0.54</td>
<td>0.19</td>
<td>1.29***</td>
</tr>
<tr>
<td>Gender</td>
<td>−3.80</td>
<td>2.04</td>
<td>−0.87</td>
</tr>
<tr>
<td>Age × Education</td>
<td>−0.04</td>
<td>0.00</td>
<td>−0.71</td>
</tr>
<tr>
<td>Age × Gender</td>
<td>0.07</td>
<td>0.03</td>
<td>1.10*</td>
</tr>
<tr>
<td>Education × Gender</td>
<td>−0.09</td>
<td>0.03</td>
<td>−0.24***</td>
</tr>
<tr>
<td>NC_C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>−0.09</td>
<td>0.02</td>
<td>−0.31***</td>
</tr>
<tr>
<td>Education</td>
<td>−0.42</td>
<td>0.17</td>
<td>−1.12**</td>
</tr>
<tr>
<td>Gender</td>
<td>1.05</td>
<td>1.83</td>
<td>0.27</td>
</tr>
<tr>
<td>Age × Education</td>
<td>0.09</td>
<td>0.00</td>
<td>1.75***</td>
</tr>
<tr>
<td>Age × Gender</td>
<td>0.07</td>
<td>0.02</td>
<td>0.13</td>
</tr>
<tr>
<td>Education × Gender</td>
<td>−0.14</td>
<td>0.03</td>
<td>−0.40***</td>
</tr>
</tbody>
</table>

Notes: NC_A = the number-correct score of Administration A (R² = 0.33); NC_C = the number-correct score of Administration C (R² = 0.32); B = regression coefficient; SE (B) = standard error of B; β = standardized regression coefficient. Age and education were entered as continuous variables, and gender was coded as 0 for a woman and 1 for a man.

*p < .05; **p < .01; ***p < .001.

As shown in Table 1, our multiple regression analysis revealed that both education and age were significantly associated with NC_A and NC_C, respectively. When we compared standardized regression coefficients, we found that education contributed relatively more than age did to both NC_A and NC_C. However, we found no gender effect on NC_C or NC_A.

We conducted the present study to examine the influence of age, education, and gender on the BVRT performance in a relatively large older sample with a wide educational background. To our knowledge, this is the first study to investigate the influences of demographic factors on the performance of Administration C in a geriatric population.

In terms of Administration A, our results indicated that both older age and lower educational level are associated with a poorer performance. These findings are consistent with those of previous studies (Arenberg, 1982; Coman et al., 1999, 2002; Youngjohn et al., 1993). However, the relative contributions of age and education observed in this study differ from those
reported in previous studies. Education was found to have a greater effect than age in this study, whereas age has been reported to have a greater effect than education in other studies (Coman et al., 1999; Youngjohn et al.). This difference is probably related to different distributions of educational attainment across study populations. In the present study, years in full-time education varied from zero to 25 years, with a mean of 7.0 years ($SD = 5.0$). In contrast, most participants in previous studies were in full-time education for more than 12 years. In the study by Youngjohn and colleagues, the range of educational level was from 12 to 25 years with a mean of 16.0 years. In the study by Coman and colleagues (1999), although the range of educational level was from 4 to 20 years, a large proportion of subjects (74%) were highly educated (i.e., more than 12 years in full-time education).

In our study, the relative influence of age might be smaller because our sample was restricted to an old population. The effect of age might be larger if the full adult age range were included. In addition, we found significant interactions between age and gender and between education and gender, indicating that the nonverbal memory of women declined more steeply than that of men with decreasing educational level and advancing age. This finding is different from that of Coman and colleagues (2002), who reported an interaction only between age and education. However, they did not even examine interactions with gender because the main effect of gender was insignificant.

As for Administration C, not only were there main effects of age and education but also a significant interaction between the two. The performance of Administration C remained stable with advancing age in individuals with higher educational levels, whereas ability significantly declined with advancing age in those with poorer educational attainment. Although not presented in the results, additional one-way analyses of variance and post hoc analyses performed separately for subdivided educational groups ($0–3$, $4–6$, $7–9$, and $10–10$ years) indicated that the negative influence of aging on constructional ability was significant only for those individuals with fewer than 4 years of education. However, because of the cross-sectional nature of our data, such findings should be interpreted cautiously. Further longitudinal studies are needed to clarify this issue. We also found a significant interaction between education and gender, indicating that the constructional ability declined more prominently in women than in men with decreasing educational attainment.

The better performance on the BVRT (both Administrations A and C) by poorly educated male elderly than female elderly individuals might be explained by differences in their social roles. Male elderly persons, even those with little formal education, were more likely to have learned occupationally associated subjects, whereas poorly educated female elderly persons, who are usually devoted to housework, have fewer opportunities for intellectual stimulation. Additional one-way analyses of variance and post hoc analyses performed separately for subdivided educational groups ($0–3$, $4–6$, $7–9$, and $10–10$ years) indicated that these gender differences are significant only for elderly individuals who received fewer than 4 years of education.

Whereas there were interactive influences of gender with other demographic variables on the performances, we did not find the main effect of gender itself on either Administration C or A. This is consistent with the results from previous studies on the BVRT (Coman et al., 1999, 2002; Youngjohn et al., 1993).

Although we tried to strictly exclude dementia and any other medical and psychiatric conditions that might affect mental function, some elders in our sample might have been in a borderline cognitive state such as mild cognitive impairment. In addition, the subjects of the present study were recruited through convenience sampling and thus their demographic characteristics might not be exactly the same as those of the general population. However, these possibilities do not appear to be serious because in our study we just tried to explore the effect of individual demographic variables on cognitive task performances; we did not aim to provide any normative information on the general population.

In conclusion, our results on the BVRT performances suggest that both nonverbal memory and constructional ability are influenced by age and education. However, contrary to previous reports, we found that the education effect is larger than the age effect among an elderly population with wide range of educational levels. Our findings also suggest that although there is no overall gender effect, men outperform women in poorly educated (for Administrations A and C) or relatively older (for Administration A) populations.

**ACKNOWLEDGMENTS**

This work was supported by Grant 04-2000-045 from the Seoul National University Hospital and Biotech 2000 (Grants 97-N1-02-03-A-12 and 98-N1-02-03-A-12) of the Ministry of Science and Technology of Korea.

**CORRESPONDENCE**

Address correspondence to Jong Inn Woo, Department of Neuropsychiatry, Seoul National University Hospital, 28 Yongon-dong, Chongno-gu, Seoul 110-744, Korea. E-mail: jiwoomd@plaza.snu.ac.kr

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Received April 3, 2006

Accepted November 21, 2006

Decision Editor: Thomas M. Hess, PhD