Differences in Cognitive Status between Healthy, Psychiatrically Ill, and Diffusely Brain-damaged Elderly Subjects

By DONALD C. KENDRICK and F. POST

INTRODUCTION

It has recently been pointed out by several authors that the psychometric assessment of the elderly patient has largely been geared to, or preoccupied with, the solution of diagnostic problems, measuring deterioration or discovering early dementia (Post, 1966; Inglis, 1962). Therefore, it appears that little attention has been paid to the use of psychometric tests in the broad area of prognosis. Often the psychiatric diagnosis of an elderly patient is quite clear, and in these circumstances it would be valuable to be able to discern reliable and significant changes in the cognitive status of such patients. For example, it may well prove quite significant, prognostically, to measure the rate of change in cognition of an elderly person suffering from a progressive cerebral disease. The rate of decline could be a prognostic indicator for the future disposal of the patient or for impending death. A variety of studies have shown that scores on measures of physical and cognitive abilities can predict death or discharge from hospital (Cosin et al., 1957; Inglis, 1959; Kleemeier, 1961; Kral, 1963). In the case of patients suffering from depressive “pseudo-dementia” (Post, 1965) it will probably be valuable to know if their cognitive status reflects changes in their clinical status. But probably the most important aspect of the psychometric assessment of the geriatric patient will be found to lie in measuring changes in function which may be the sequelae of treatment affecting brain function in general, i.e. anti-depressant preparations and electro-convulsive therapy.

The retest psychometric assessment of the elderly has largely been concerned with longitudinal studies. These studies indicate that intelligence tests have good reliability, but an important factor has been that the test-retest interval has been over a period of a year or more. These studies have led to the finding that the more intelligent person survives better than the less well-endowed (Jarvik and Falek, 1963; Riegal et al., 1963), and of course the reliabilities of the tests are being assessed on subjects with above average intelligence. One very recent study (Meer et al., 1965) however, has shown the reliability of four sub-tests of the WAIS to be as high as +.96 over a 24 hour test-retest interval for both men and women. But the literature contains little work on the stability or instability of cognitive status over short periods of time in elderly subjects, and this information is necessary if the psychometric assessment of the elderly psychiatric patient is going to be used in a manner that is not primarily concerned with diagnosis but change in functioning.

It was therefore decided to plan an investigation that would yield information necessary for the manner in which we intended to make use of the psychometric examination of the elderly psychiatric patient. In the three major areas of cognitive function known to change with advancing age, namely intelligence, short-term memory and sensori-motor speed, we wanted to know the effects produced upon these three abilities, as assessed by sequential testing, by the presence of chronic brain syndrome or treatment for an affective illness in comparison with the cognitive functioning of normal, healthy old people.

METHOD AND PROCEDURE

The tests used in this investigation were: (1)

The Mill Hill Vocabulary Scale, Form 1 Senior,
DIFFERENCES IN COGNITIVE STATUS BETWEEN ELDERLY SUBJECTS

synonym section only; (2) The WAIS Verbal Scale, omitting the Information sub-test; (3) Raven's Coloured Progressive Matrices; (4) The Synonym Learning Test (SLT); (5) The WAIS Performance Scale; (6) Inglis' Paired Associate Learning Test (IPALT), Forms A, B, and C, all administered as auditory recall tests; and (7) the Digit Copying Test (DCT). The administration and choice of these tests has been discussed in former articles (Kendrick, 1964, Kendrick, 1965, and Kendrick et al., 1965). The tests were all administered in the order shown above on three successive occasions with no deviation from that order.

It was decided that a test-retest plan over six weekly intervals would be most valuable for our purposes. To obtain the data required it was necessary that we tested four groups of subjects: (a) patients suffering from diffuse brain damage (chronic brain syndrome), (b) patients suffering from a depressive illness treated by E.C.T., (c) patients suffering from a depressive illness treated chemically (imipramine hydrochloride, Tofranil), and (d) a control group of normal elderly subjects. All the psychiatric diagnoses were to be unequivocal. All psychiatric subjects had been living in the community up to at the most three weeks before being tested.

The care with which the selection of patients was made has been described in detail in a former report (Kendrick et al., 1965). Depressed patients were randomly assigned to treatment. In the case of treatment with E.C.T., patients received eight shocks between initial testing and the first retesting, the retesting taking place 24 hours after the final treatment. Patients treated with Tofranil received dosages up to their individual maximum tolerance level, treatment being maintained for the whole 12 week period. Brain-damaged subjects received no treatment apart from general nursing care, attention to diet, and daytime sedation where necessary. All psychiatric subjects were given night sedation if required. It can be seen that subjects treated with E.C.T. received no treatment between their second and third testings whereas those treated with Tofranil maintained their treatment for the whole period. The reason for this was that the two treatments differ in their speed of action.

RESULTS

Ninety-seven psychiatric subjects were satisfactorily tested initially, of these, sixty-nine completed the tests over the twelve week period, as well as eleven normal subjects. The reasons for not completing the trials were: death, physical illness, too rapid improvement resulting in withdrawal of treatment before the allotted treatment time was completed or severe deterioration in clinical status resulting in change of treatment. In order to match the groups for mean age, education and socio-economic class the total number of subjects has been reduced by half. In matching the subjects one deliberate omission was made. In the initial test results of the depressed subjects, no patient was included that had obtained a score on the SLT that fell in the brain damaged range. We have made a detailed examination of those patients misclassified by the SLT and have come to the conclusion that they constitute a discrete section of depressed patients. They could be described as the depressive "pseudo-dementia" subjects. These subjects are characterized by low initial intelligence, delusional systems, complaints of perplexity, and poor knowledge of recent general events. Significant relationships have been demonstrated between these symptoms and poor scores on the SLT (Post, 1966). These facts have led us to concentrate on such cases in our cross-validation of the SLT (to be reported).

The four groups of subjects whose results are to be analysed each contain six females and four males. The groups are: (a) brain damaged subjects, (b) Tofranil-treated depressed patients, (c) E.C.T. treated depressed patients, and (d) normal, healthy subjects.

The mean scores on all tests over the three testing occasions were subjected to analyses of variance. There were no differences between the groups on mean age, education, or socio-economic class. The means and standard deviations on these measures for the 40 subjects are; Age, $\bar{X}=70.48$ years, $s=6.33$ years, Education, $\bar{X}=10.00$ years, $s=1.90$ years, Socio-economic class, $\bar{X}=3.05$, $s=1.01$. It was found also that there were no differences between the groups on mean IQ as measured...
by the synonym section of the Mill Hill Vocabulary Scale. It has already been shown that this form of the test gives a significantly better estimate of pre-morbid level in patients with chronic brain syndrome than does the WAIS Verbal Scale IQ (Kendrick, 1964). The present results show that the test is subject to significant practice effects, but this is not surprising as each subject has been taught the meanings of 30 words in the test as they form the basis of the SLT. There were no group x testing occasion effects, so all groups can be considered as responding in the same manner to this test. The relevant data for the 40 subjects on this test are: X_1 = 105.73, X_2 = 109.13, X_3 = 110.05, s_1 = 13.10, s_2 = 12.25, s_3 = 12.63, r_{12} = +.90, r_{23} = +.90, r_{13} = +.90. (The subscripts 1, 2 and 3 refer to testing occasion.)

Table I shows a summary of the results of the analyses of variance on the remaining tests. In these analyses of variance, as also with that carried out on the Mill Hill results, conservative tests of significance have been used because of the correlated nature of the data (Greenhouse and Geiser, 1959). Thus, where 3 and 36 dfs would normally be applied the conservative estimate uses only 1 and 12 dfs. Before discussing the results individually, it must be pointed out that where differences between the groups do occur, Tukey's method of comparisons among means was carried out on the results of the depressed groups and the normal controls with the result in every case that the depressed groups are undifferentiated from the normal group.

Table II therefore shows the means, standard deviations and retest reliabilities for the respective tests for the brain damaged group considered alone and the combined results of the other three groups.

A previous report has shown that the tests used in this study can be considered as measuring three aspects of cognitive ability, namely verbal-education, speed-performance, and short-term memory (Kendrick et al., 1965). The results therefore, will be taken under these three headings.

The verbal-education tests (Mill Hill and the WAIS Verbal Scale) do not in these analyses differentiate between the groups, but as has been already pointed out in a former analysis the Mill Hill IQ, based upon the synonym section of the test only is better for the assessment of premorbid ability than the WAIS Verbal Scale with diffusely brain damaged subjects (Kendrick, 1964). In the former analysis the groups were larger, and was based upon initial testing only. The analysis of the results of the WAIS Verbal Scale did not produce evidence of significant practice effects.

The WAIS Performance Scale and the DCT (tests measuring speed-performance) produce similar results. The brain damaged subjects are significantly worse than the other groups, and both tests show evidence of significant practice effects.

The two short-term memory tests also produce results similar to one another. The SLT and Inglis' PALT both differentiate the brain damaged patients from the normal and depressed subjects. Both tests also show an absence of significant practice effects, which indicates that the various retest versions of these tests can be taken as parallel forms.

The Coloured Progressive Matrices is a test that seems to be in the factor analytic wilderness, though it has many times been shown to differentiate brain damaged subjects from others (Evans and Marmorison, 1964). The results from this study replicate these results, and show also that there are no significant practice effects demonstrable with the test.

Probably the most important aspect of these analyses has been the absence of significant group x testing occasion interactions. This must imply that all groups have responded to sequential testing in a similar manner.

Because of the lack of differences between the two depressed groups and the normal controls, it was thought prudent to enlarge the sample of depressed patients and see if any significant differences emerged when the two groups were treated by themselves. Accordingly, a group of 20 patients assigned to E.C.T. were matched for mean age, education, and socio-economic class with 20 patients assigned to treatment by Tofranil. Each group contains 10 males and 10 females. The results of testing on the Mill Hill, WAIS Verbal and Performance Scales, the SLT, and the DCT were reworked and subjected...
### Table I

Summary of Analyses of Variance on the Results Obtained from the Four Groups. N = 40

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>WAIS. VS. IQ.</th>
<th>WAIS. PS. IQ.</th>
<th>Digit Copying Test</th>
<th>Synonym Test</th>
<th>Learning Test</th>
<th>Inglis Paired Ass. Learning Test</th>
<th>Coloured Progressive Matrices I.Q.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MSV</td>
<td>F</td>
<td>MSV</td>
<td>F</td>
<td>MSV</td>
<td>F</td>
<td>MSV</td>
</tr>
<tr>
<td>Groups (G)</td>
<td>3</td>
<td>1643.23</td>
<td>3.30</td>
<td>5970.42</td>
<td>15.92**</td>
<td>2011.74</td>
<td>13.52**</td>
<td>37491.92 79.32**</td>
</tr>
<tr>
<td>Occasions (O)</td>
<td>2</td>
<td>69.33</td>
<td>3.22</td>
<td>182.06</td>
<td>12.05**</td>
<td>993.48</td>
<td>5.26**</td>
<td>380.41 1.69</td>
</tr>
<tr>
<td>G x O</td>
<td>6</td>
<td>12.11</td>
<td>.55</td>
<td>32.48</td>
<td>2.15</td>
<td>357.38</td>
<td>1.89</td>
<td>108.83 .51</td>
</tr>
<tr>
<td>Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>within G.</td>
<td>36</td>
<td>497.53</td>
<td>23.14**</td>
<td>318.55</td>
<td>21.08**</td>
<td>1487.04</td>
<td>7.88**</td>
<td>471.39 2.21*</td>
</tr>
<tr>
<td>Residual</td>
<td>72</td>
<td>21.50</td>
<td>15.11</td>
<td>188.76</td>
<td>212.75</td>
<td>97.87</td>
<td>51.47</td>
<td>348.67 6.77**</td>
</tr>
<tr>
<td>Total</td>
<td>119</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Sig. at 5 per cent. level  ** Sig. at 1 per cent. level.
to analysis of variance techniques. No differ-
ences were found between the groups on mean
age, education, or socio-economic class. A
summary of the other analyses is shown in
Table III. Once again the results will be taken
under the three headings already described.

The two verbal-education tests do not
differentiate between the groups, but women
are significantly lower in ability on the Verbal
Scale of the WAIS than the men. Both tests
show significant practice effects. The group of
patients receiving E.C.T. do consistently worse
than the Tofranil group on the Performance
Scale of the WAIS. This is not related to the
effects of E.C.T., but it may be related to the fact
that patients of lower intelligence may respond
better to E.C.T. than to Tofranil. Although we
originally randomly assigned patients to either
treatment, natural selection may have taken
place after this point, and changes in treatment
may be related to initial level of ability. Once
again women are significantly poorer than men
on this section of the WAIS. As with the WAIS
Performance Scale the DCT shows significant
practice effects, but this test does not differen-
tiate groups or sexes. The SLT produced no
significant results at all.

Once more these results are characterized by
the lack of significant group x testing occasion
effects. As the groups are well matched, the
conclusion must be drawn that when elderly
depressed patients respond to either E.C.T. or
Tofranil, or at least get no worse, then no
differences in the effects these two treatments
produce on cognitive functioning can be demon-
strated. What little differences are found
between the analyses of the two groups and the
four groups may partly be explained by the fact
that in the second set of results, an equal
proportion of "pseudo-demented" patients had
Differences in Cognitive Status Between Elderly Subjects

Table III

Summary of Analyses of Variance on the Results obtained from Depressed Patients. N=40

<table>
<thead>
<tr>
<th>Source</th>
<th>Mill Hill IQ</th>
<th>WAIS. VS. IQ</th>
<th>WAIS. PS. IQ</th>
<th>Digit Copying Test</th>
<th>Synonym Learning Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MSV</td>
<td>F</td>
<td>MSV</td>
<td>F</td>
<td>MSV</td>
</tr>
<tr>
<td>Sex (S)</td>
<td>1333:34</td>
<td>3:31</td>
<td>2970:07</td>
<td>5:48**</td>
<td>4189:00</td>
</tr>
<tr>
<td>Group (G)</td>
<td>512:54</td>
<td>1:27</td>
<td>1408:42</td>
<td>2:60</td>
<td>1261:00</td>
</tr>
<tr>
<td>Occasion</td>
<td>1233:41</td>
<td>12:47**</td>
<td>122:24</td>
<td>6:43*</td>
<td>634:89</td>
</tr>
<tr>
<td>O x G</td>
<td>456:79</td>
<td>1:13</td>
<td>22:67</td>
<td>.42</td>
<td>1:42</td>
</tr>
<tr>
<td>S x O</td>
<td>11:05</td>
<td>.59</td>
<td>14:80</td>
<td>.78</td>
<td>39:45</td>
</tr>
<tr>
<td>G x O</td>
<td>10:60</td>
<td>.03</td>
<td>20:73</td>
<td>.38</td>
<td>4:24</td>
</tr>
<tr>
<td>Residual</td>
<td>72</td>
<td>18:72</td>
<td>19:02</td>
<td>18:05</td>
<td>292:30</td>
</tr>
</tbody>
</table>

Total 119

** sig. at 1 per cent. level.  * sig. at 5 per cent. level.

to be included between the two groups to allow the maximum total of subjects possible.

Discussion

The psychometric assessment of 40 subjects belonging to the same sample of the population, i.e. having the same mean age, education, socio-economic class, and IQ (Mill Hill), reveals that the 10 subjects suffering from chronic brain syndrome are clearly distinguished from the other subjects on tests of speed-performance and short-term memory. Klee-meier (1961) and others have pointed out that precipitous changes in psychological functions appear to coincide with the terminal or near terminal phase of the life span. The present data indicate that this precipitous change having occurred may remain at a stable level over relatively short periods of time. Any further deterioration from this level may indeed indicate that death is imminent. Too few of our brain-damaged subjects died during the three month test period for statistical evidence to be produced on this point.

The fact that there were no differences between the depressed and the normal subjects is rather surprising. Birren and his co-workers in their intensive study of 47 aged men found that although the presence of mild depressive symptoms had no effects on intellectual functioning, it did affect speed (Birren, 1963). Birren's method of measuring speed was very similar to that used in this study. The lack of differences was also surprising, since we expected at least that depressed patients recovering from the illness would show changes in cognitive level in the positive direction greater than found in normal subjects, since, owing to their depression, they had originally been functioning at a level much below their potential capacity. No evidence could be found to support such notions.

The literature on the effects of E.C.T. on psychological functions is confusing. Campbell has reviewed it extensively (1960). In this study we were concerned with establishing whether a series of E.C.T. interfered in any way with the pre-consolidation phase of memory. Thus the patients were required to learn new material 24 hours after treatment had been completed. The conclusion to be drawn from this study is that no deleterious effects of E.C.T. under these conditions can be demonstrated. Tofranil,
likewise, shows no deleterious effects, nor any
superiority over E.C.T. as far as effects on cognitive functioning go.

It is interesting to speculate upon the reasons for the differences in ability that occur between
males and females when drawn from the same sample of the population. Is it more difficult for
males to survive into the senium, and because of the intellect-survival correlation, are men
bound to be more intelligent than women in late life? Or do men exercise their intelligence more
up to late life than women, and women therefore appear less intelligent through lack of practice?
If it was the latter case it might have been expected that the women in this study should
have shown greater response to practice than the men.

**SUMMARY**

Comparisons have been made on psychometric tests administered three times over a
three month period at six weekly intervals between elderly subjects in normal health and
those suffering from a depressive illness or chronic brain syndrome. The results show that
the brain-damaged subjects are clearly differentiated from the other subjects. Normal and
depressed subjects are not differentiated by the tests, and no deleterious effects of E.C.T. or
Tofranil could be demonstrated.

**REFERENCES**


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