The differential effect of conation on intelligence test scores among brain-damaged and control subjects

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Abstract

Conation, or the ability to apply effective effort in completing a task over time, has been shown to be impaired in brain-damaged subjects. Various intelligence tests differ in the apparent extent to which they require conative ability. In this study we compared results earned by brain-damaged and control groups on three measures of intelligence: Wechsler Verbal IQ (VIQ), Wechsler Performance IQ (PIQ), and the Henmon–Nelson Test (HNT) of Mental Ability. Test scores were converted to T-score distributions for the combined groups in order to delete possible effects of differences in standardization procedures and the normative samples on which IQ scores were generated. The degree of impairment shown by the brain-damaged subjects was in direct relationship to the extent to which the three intelligence measures appear to require conation. The results support a generalization that intelligence tests that require a greater conative ability tend to produce lower scores for brain-damaged persons, as compared to controls, than do intelligence tests that are less demanding of conation.

Keywords: Conation; Intelligence test scores; Brain-damaged subjects

1. Introduction

Conation refers to purposeful striving toward and willing of task completion, and in terms of its relationship to performances on neuropsychological tests, would be represented by the ability to focus intellectual energy on the task and apply persistent effort in order to achieve the best possible performance.
In one sense, this ability may be thought of as the individual’s intellectual power or energy (Halstead, 1947; Reitan & Wolfson, 2000). Although conation, together with cognition and emotion, have been considered in the history of psychology to be the three primary elements of mental functioning (Anderson, 1934; Boring, 1929; Burt, 1960; Warren, 1931), conation has diminished in significance to the point that the term is not even included in Goodwin’s (1989) dictionary of neuropsychology and is rarely referenced to in the current literature. Nevertheless, if conation is significantly impaired in persons with brain damage, it could be a critically important aspect of the adequacy of their performances in practical situations and of direct significance in understanding and explaining instances in which there are disparities between a subject’s relatively adequate level-of-performance scores on neuropsychological tests and inadequate performances in everyday life.

We have previously reviewed definitions of conation and its role in the history of psychology (Reitan & Wolfson, 2000), but it may be of value to consider the concept with regard to cognition, emotion, motivation, and vigilance. Cognition refers to the processes involved in gaining knowledge. Conation has been reported to be relevant to the efficiency of cognition (Richardson, 1929; Wild, 1927, 1928). Emotion appears to be relatively distinct from conation, except that it is the area frequently implicated when relatively competent brain-damaged people perform poorly in practical situations. Motivation would seem to be closely related to conation, but differs insofar as motivation is concerned with need fulfillment and specific incentives which direct and drive behavior toward goal achievement. Vigilance, or maintenance of alertness over time as required by the task, shares with conation the temporal aspect of maintaining efficiency, but differs from conation insofar as vigilance is essentially a receptive (input) process whereas conation relates to an expressive (output) ability to persistently apply intellectual energy to the task as needed to achieve an optimal result.

In our previous study of conation (Reitan & Wolfson, 2000) we compared the performances of a non-brain-damaged control group and a heterogenous brain-damaged group on four measures selected to vary with regard to their dependence on conation.

Two of the tests that were used, the Information and Vocabulary subtests from the Wechsler Adult Intelligence Scale (Wechsler, 1955), are given an item at a time, and thus do not require persistent application of intellectual energy over time to solve the task presented. Another verbal test that was used (Speech-sounds Perception Test; Reitan & Wolfson, 1993) requires a degree of conation inasmuch as the subject must focus attention and make discriminative, though simple, judgments across a total of 60 items that are administered consecutively. Finally, a group intelligence test was used (the Henmon–Nelson Test of Mental Ability; Lamke & Nelson, 1957), even though it has never been proposed or evaluated as a measure that is sensitive to brain damage. The Henmon–Nelson Test (HNT) consists of 90 items that require a multiple-choice response and the subject is given 30 min to complete as many of the items as possible. Our hypothesis was that among these four measures, the HNT was most heavily dependent on conation since it required the subject to focus intellectual energy on the task and maintain productive effort over a fairly extended period of time.

Briefly recapitulated, Reitan and Wolfson (2000) found that the degree of impairment shown by the brain-damaged group, as compared to scores achieved by non-brain-damaged controls, corresponded closely with the test’s dependence on conation. The Vocabulary and Information
subtests were least impaired in the brain-damaged group, the Speech-sounds Perception Test was at an intermediate level, and the HNT was clearly the most impaired.

The present study compared the performances of a control group and a heterogeneous brain-damaged group on the WAIS Verbal IQ (VIQ), WAIS Performance IQ (PIQ), and the HNT. Our hypothesis, presuming that conation would be a determining influence, was that the intergroup differences would be least on VIQ, intermediate on PIQ, and greatest on the HNT. This hypothesis was based on the fact that the VIQ subtests are generally given one item at a time and probably do not require much persistent application of intellectual energy over an extended period of time. The PIQ subtest items range from short, discrete problems to tasks that require at least a brief period of focused effort and application of intellectual energy. The HNT requires 30 min of focused effort. Although other factors obviously may be of influence in determining the relative difficulty on these variables for brain-damaged as compared to control subjects, the above hypotheses presume an overriding influence of impaired conation in the brain-damaged group, as compared with the controls, in determining the magnitude of intergroup differences.

 Explicitly stated, the hypotheses were as follows: (1) If conation is a determining factor, the greatest difference between the brain-damaged and control groups should occur on the HNT, because this test requires the subject to apply himself/herself diligently to the task for 30 min. (2) A more striking disparity of the brain-damaged group, as compared with the controls, should occur on the PIQ than on the VIQ, because the PIQ contains some tasks that require a certain amount of time and persistent effort to complete, whereas most of the VIQ items are given one at a time. (3) Thus, the order of intergroup differences (smallest to largest), according to the influence of conative ability, would be VIQ, PIQ, and Henmon–Nelson IQ (HN IQ).

2. Method

2.1. Procedure

The tests were individually administered to each participant by trained technicians who had no direct knowledge of which group each participant belonged, nor the research purposes for which the data would be used.

2.2. Participants

The groups consisted of the same participants that had been used in an earlier study by Reitan and Wolfson (2000), and detailed description of the groups was previously presented. The brain-damaged group contained 25 persons with varied but definitive diagnoses of cerebral disease or tissue damage and had a mean age of 30.00 years (S.D., 8.19) and mean education of 11.40 years (S.D., 3.24). Diagnoses included closed head injury, 5; penetrating head injury, 1; cerebral vascular thrombosis, 4; multiple sclerosis, 5; intrinsic tumor, 4; cerebral abscess, 2; arteriovenous malformation, 2; and epilepsy, 2. Nine of the persons with brain disease or damage had progressive conditions; 12 had resolving conditions; and 4 had chronic conditions.
The control participants had a mean age of 30.48 years (S.D., 8.61), a mean education of 11.32 years (S.D., 3.53) and included 23 hospitalized persons with the following diagnoses: paraplegia, spinal disk herniation, peripheral nerve injury, panic attacks, paranoid reaction, and depression. There were two normally functioning participants. All of the control patients received neurological examinations and no evidence of past or present brain disease or damage was found, although these participants had many other problems associated with illness, hospitalization, etc. We sought out such patients for the control group (while being especially careful to rule out brain damage) because most of the brain-damaged participants had similar circumstantial problems. Twenty-three of the brain-damaged participants and 24 of the control subjects were male.

2.3. Statistical analyses

Since a major purpose of this study was to determine the comparative degree of deficit among subjects who had sustained brain damage and subjects who had no brain damage, it was necessary to transform raw scores into standard scores. Thus, the scores on each test for the combined groups were transformed to normalized $T$-scores, with a mean of 50 and a standard deviation of 10, and the $T$-scores for the 25 subjects in each group were used for statistical analyses. The first step was to compute $t$-ratios to determine the significance of mean differences between the two groups on the three variables. Since the greatest and most consistent differences between the groups occurred on the HNT, difference score distributions between Henmon–Nelson $T$-scores and $T$-scores for each of the other tests were obtained separately for the brain-damaged and the control groups.

Next, $t$-tests were done to determine whether the group with brain damage performed significantly more poorly on the HNT than on either of the other measures, and comparable $t$-tests were done for the control group. Finally, the data were analyzed to determine whether the intergroup differences shown on the various tests were significantly greater for some tests than others.

3. Results

Table 1 presents means and standard deviations for three measures of intelligence (WAIS VIQ and PIQ and HN IQ), and comparisons of distributions of scores for a brain-damaged versus a control (non-brain-damaged) group.

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<tr>
<th></th>
<th>Controls</th>
<th>Brain-damaged</th>
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<tbody>
<tr>
<td></td>
<td>Mean IQ</td>
<td>S.D.</td>
</tr>
<tr>
<td>WAIS Verbal IQ</td>
<td>109.24</td>
<td>15.73</td>
</tr>
<tr>
<td>WAIS Performance IQ</td>
<td>108.88</td>
<td>14.76</td>
</tr>
<tr>
<td>Henmon–Nelson IQ</td>
<td>103.96</td>
<td>8.74</td>
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</table>
Mean IQ values fell above average, but in the normal range, for the control group. While the mean IQ values for WAIS Verbal and Performance scores were in the normal range for the brain-damaged group, the mean score for the HN IQ was considerably lower. Intergroup comparisons indicated that WAIS VIQ was of borderline significance \( (P < .05) \). The brain-damaged group performed significantly more poorly than the controls on WAIS PIQ \( (P < .01) \), and especially poorly on the HN IQ \( (P < .001) \).

**Figure 1** supports further conclusions with regard to the hypotheses presented above.

The results presented in Table 1 are recapitulated (on a T-score scale) in Figure 1, but intergroup differences on the three IQ variables are also presented. These latter comparisons indicate that in the context of T-score transformations, the brain-damaged group performed better on the WAIS VIQ than the WAIS PIQ, better on the WAIS VIQ than the HN IQ, and better on the WAIS PIQ than on the HN IQ. However, the only difference among the three comparisons that reached statistical significance was the one in which the HN IQ was poorer than the WAIS VIQ \( (P < .03) \).

![Fig. 1. Mean T-scores for control and brain-damaged groups; probability levels in comparing differences between means for the two groups on the three IQ tests; and probability levels in comparing pairs of tests within each of the two groups.](image-url)
The comparisons in Figure 1 within the control group, in the context of T-score transformations, show that the reverse relationships among mean scores occurred among the three variables, but again, the only significant intergroup difference occurred in comparisons of the lower WAIS VIQ with the higher HN IQ (P < .005).

In summary, the results shown in Figure 1 reveal consistent findings in accordance with the hypotheses of this study: the WAIS VIQ showed the least differences between the brain-damaged and control groups, the WAIS PIQ occupied an intermediate position, and the HN IQ showed the greatest intergroup and intragroup differences.

The final step in data analysis, not represented in Table 1 or Figure 1 above, concerned the statistical significance of intergroup differences in difference score distributions among the three tests used. Figure 1 makes it quite clear that the direction of differences between the scores of the control and brain-damaged groups differed for each of the three tests, with the controls performing best in comparison with the brain-damaged group on the HN IQ, next best on the WAIS PIQ, and with a lesser intergroup difference on the WAIS VIQ. Thus, intergroup differences would be represented by the total (positive difference plus negative difference) difference score for each pair of variables. The results of this analysis yielded the following findings, comparing mean difference scores for pairs of groups: Control group versus brain-damaged group on mean differences between WAIS VIQ and WAIS PIQ, t = 1.15 (P < .30); WAIS PIQ and HN IQ, t = 1.41 (P < .20); and WAIS VIQ and HN IQ, t = 3.84 (P < .001).

Although the results were entirely consistent with hypotheses based on the influence of conative ability on the test scores, the differences that reached acceptable levels of statistical significance were found only in comparison of WAIS VIQ and HN IQ, with WAIS PIQ occupying an intermediate position.

4. Discussion

It must be recognized at the outset that the three measures of intelligence used in this study (WAIS VIQ, WAIS PIQ and HN IQ) differ greatly in both procedure and content. Thus, this factor was uncontrolled in the present study. Secondly, it should also be recognized that the Henmon–Nelson raw score–IQ score transformation was based on an entirely different database than the WAIS IQ's (Lamke & Nelson, 1957; Wechsler, 1955). Being aware of these possible contaminants, we used the actual performances of the subjects in our two groups as our basic data, performing T-score transformations based upon the combined distributions of scores, for each test, for the brain-damaged and control groups. The data analyses, therefore, were principally dependent upon intergroup and intragroup differences derived from a controlled distribution of total scores for each test. This procedure provided the opportunity to evaluate intergroup and intragroup differences in accordance with the extent to which each test required conative ability.

A question might be raised about the possible influence of malingering, or failure to put forth maximal effort, on the test results. Deliberate failure to exert maximal effort might be a factor in producing inadequate performances, but there is no apparent reason to expect more malingering on tests that require conation than on those that do not. Fatigue could well be a
factor, but mental fatigue might be considered to be closely related to, if not synonymous with, impaired conation.

The results were entirely consistent with the hypotheses of this study, which, in turn, were formulated with regard to the significance of conative ability and its possible impairment among brain-damaged persons.

The current findings are also entirely consistent with those reported in our earlier study of impairment of conation among brain-damaged persons (Reitan & Wolfson, 2000). While further controlled research is needed, it appears that conative ability may be a significant variable among the range of deficits resulting from brain damage, and perhaps a major determinant of ecological efficiency (or deficiency) among brain-damaged persons.

If this is true, conation is a variable that must be evaluated explicitly in assessing the consequences of brain injury. It is clearly inadequate to measure only ability levels without determining whether brain damage may have compromised the individual’s potential for applying those ability levels in a productive manner in practical situations. Thus, results of this study suggest that evaluation of conation may be an important aspect of overall ability evaluation in both a clinical and forensic context.

References