The Reliability of Patterns of Auditory Processing Deficits: Evidence from the Revised Token Test

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Numerous authors (Schuell, 1964 and 1974; Porch, 1970; Brookshire, 1972 and 1974) have described patterns of auditory processing deficits that occur in persons with aphasia. The patterns of auditory processing elicited by the Revised Token Test (RTT, McNeil and Prescott, 1978) include: (a) across item-within subtest patterns (intermittent, which is fluctuating performance across items; flat--unchanging performance across items; tuning-in--improving performance across items, and tuning-out--poorer performance across items), and (b) across subtest patterns (tuning-in--improving performance across subtests; tuning-out--poorer performance across subtests; intermittent--fluctuating performance across subtests; flat--unchanging performance across subtests;plus-length--improving performance with increasing stimulus length; minus-length--poorer performance with increasing stimulus length; and specific linguistic patterns--differential performance across different syntactic structures).

These patterns of auditory processing deficit occur with nearly equal frequency (as elicited by the RTT) across several different populations including right-hemisphere-brain-damaged nonaphasic listeners, left-hemisphere-brain-damaged aphasic listeners (McNeil and Hageman, 1979 and 1980), normal listeners in competing listening conditions (Hageman, 1980), stutterers (Greene, 1981), and recovering alcoholic listeners (Hageman and Rucci, 1981). That these patterns occur with such regularity across populations suggests that some stable underlying mechanism causing these patterns is shared by these groups. However, the ability of the RTT to elicit these patterns reliably has not yet been demonstrated.

Our purposes for undertaking this investigation were three. First, if treatment strategies are to be developed which will take patterns of auditory deficit into consideration, these patterns must be shown to occur reliably. Second, we wanted to assess the reliability of amplitude and frequency measures of within subtest variation. Third, we wanted to examine the consistency of individual production of these patterns.

METHOD

Subjects consisted of 13 left-hemisphere-brain-damaged persons with aphasia. They were heterogeneous with respect to etiology, site of lesion, age, sex, duration post-onset, and overall severity of aphasia. Two RTT tests were administered within two days of each other and were given at approximately the same time of day. Standard RTT testing procedures were followed. The examiners were reliable administrators of the test as defined by McNeil and Prescott (1978).

The method of pattern analysis was that described by McNeil and Hageman (1979). Pattern prevalence was computed for percentage of occurrence for each pattern and for percentage of subjects displaying each pattern. The Chi-square Goodness of Fit Test (Hopkins and Glass, 1978) was computed to determine if pattern prevalence and subject percentages were significantly different across test times. The method for obtaining amplitude of intermittent performance was to compute the standard deviation for item scores for each subtest for each test time. Pearson product-moment correlations (Hopkins and Glass, 1978) were computed for each subtest group (e.g., Subtest I, Test 1 with Subtest I, Test 2) to examine amplitude consistency. Frequency of item score changes was calculated by counting the number of item score changes of .20 or more within each subtest. Proportions were computed based on the total possible score changes (9) within a subtest. The proportions obtained for each test time were examined for statistically significant differences between test times by using the Chi-square procedure mentioned earlier. To examine the consistency of patterns produced by each individual, the number of pattern changes from Test 1 to Test 2 were counted for each individual, and a percentage of consistency was obtained based on the total number of possible pattern changes.

RESULTS

The percentages of pattern occurrence for across item-within subtest performance are shown in Table 1 for Test 1 and Test 2. Table 2 presents the percentage of subjects that demonstrated each across item-within subtest pattern for Tests 1 and 2. It can be seen that the percentages are nearly identical. The Chi-square test revealed no significant differences for percent of patterns or percent of subjects between Test 1 and Test 2 ($.90X^2_3 = 6.75$, $X^2 = .783$ for patterns and $X^2_3 = .123$ for subjects).

Table 1. Prevalence of across item-within subtest patterns for 13 left-hemisphere-brain-damaged aphasic listeners (percent).

Pattern	Intermittent	Flat	Tuning-in	Tuning-out
Test I	98	0.2	0	0
Test II	96	0.3	.08	0

Table 2. Percent of subtests showing each across item-within subtest pattern for 13 left-hemisphere-brain-damaged aphasic listeners.

Pattern	Intermittent	Tuning-out	Tuning-in	Flat
Test I	100	0	0	23
Test II	100	0.7%	0	30

The percentages of across subtest pattern occurrence are shown in Table 3 for Test 1 and Test 2. It is clear that these percentages are in close agreement, and the Chi-square test for significant difference was not significant ($.90X_3^2 = 10.6$, $X^2 = 1.90$). The percent of across subtest pattern occurrence represents the frequency with which each pattern occurs in the population being examined. In order to determine the relative importance of each across subtest pattern. a relative percent is calculated by dividing the plus-length and minus-length patterns by four and the specific linguistic patterns by six because there were four and six more possible occurrences for those patterns. Table 4 shows the relative percent contribution for each pattern for each test time. Again, the Chi-square test was not significant ($X^2 = 1.23$, $.90X_6^2 = 10.6$). Table 5 shows the percent of subjects displaying each across subtest pattern for each test time. The Chi-square test was not significant ($X^2 = 2.96$, $.90X_6^2 = 10$ showing that the percent of subjects does not change across test times.

Table 3. Prevalence of across subtest patterns for 13 left-hemisphere-brain-damaged aphasic listeners (percent).

Pattern	Tuning out	Tuning in	Intermittent	Flat	Minus Length	Plus Length	Specific Linguist
Test I	0	0	9.9	0	37	15	38
Test II	0	0	9.7	0	35	14.5	32

Table 4. Relative percent of occurrence of across subtest patterns for 13 left-hemisphere-brain-damaged aphasic listeners.

Pattern	Tuning out	Tuning in	Intermittent	Flat	Minus Length	Plus Length	Specific Linguist
Test I	0	0	9.9	0	9.25	3.75	6.33
Test II	0	0	9.7	0	8.75	3.6	5.33

Table 5. Percent of subjects showing each across subtest pattern for 13 left-hemisphere-brain-damaged aphasic listeners.

Pattern	Tuning out	Tuning in	Intermittent	Flat	Minus Length	Plus Length	Specific Linguist
Test I	0	0	54	0	85	69	85
Test II	0	0	46	0	92	53	62

The consistency of the amplitude of variation in item scores within each subtest for each test time was examined by computing Pearson product-moment correlations between Subtest I, Test 1, and Subtest II, Test 2, and so on. The correlations ranged from .69 to -.24, none of which were significant. These data do not suggest a reliable relationship for amplitude of item score change from one test administration to the next. However, a different picture emerged with regard to the frequency of item score variation. A Chi-square was calculated for each subject comparing the proportion of item score changes for each subtest at each test administration. No comparisons were significantly different. Thus, frequency of item score change appears to be consistent across test administrations.

Finally, the consistency of each individual's pattern production was examined. Across subtests the following changes were observed. For Subtest I to IV, only 46% of the patterns did not change from Test 1 to Test 2. This means, for example, that if a person showed a minus-length pattern on Test 1 across Subtest I to IV (meaning poorer performance with increasing stimulus length), he would be just as likely to show another pattern on Test 2--for example, plus-length across Subtests I to IV. The pattern displayed on Test 2 does not appear to be predictable from the pattern shown on Test 1. For specific linguistic patterns, 70% of the patterns remained constant from Test 1 to Test 2. Although the percentage of agreement for these patterns is somewhat higher, the patterns are still unpredictably changing. However, for within subtest across-item patterns, an entirely different picture emerged. Ninety-five percent of the patterns remained constant from Test 1 to Test 2. Intermittent performance appears to remain intermittent performance. These data would seem to suggest that across subtest patterns do not occur reliably for individuals, even though the percentages of patterns do remain constant from one test to the next for the group. Within subtest patterns, on the other hand, do remain consistent for individuals.

CONCLUSIONS

The following conclusions appear to be appropriate:

1. Across subtest patterns and across item-within subtest patterns of auditory comprehension deficit are elicited reliably by the Revised Token Test with respect to how the group performs.
2. Across item within-subtest patterns are elicited reliably by the RTT for individuals.
3. Across subtest patterns do not occur reliably for individuals even though they do for the group as a whole.
4. The frequency of item score change is a reliable measure of the frequency of intermittent behavior as elicited by the RTT.
5. The amplitude of item score change appears to change significantly from test to retest. It may be, however, that correlational analysis of this parameter is inappropriate.

Since the across subtest patterns of auditory comprehension have not been found to occur reliably for individuals, treatment strategies which attempt to make use of these patterns cannot be instituted with confidence. For example, the minus length pattern (poorer performance with increasing stimulus length) is thought to be a particularly important pattern revealing much about the limits of the auditory comprehension system of a patient. However, our subjects did not consistently produce minus-length patterns and, in fact, may change to a plus-length pattern on the next test. Thus, clinicians who are constructing treatment programs which attempt to utilize training material which systematically varies stimulus length cannot do so with confidence that the mechanism underlying this pattern of performance will not change radically from one day to the next. This finding is particularly striking when one notes that the RTT keeps stimuli and response modes constant across subtests of different lengths and difficulty.

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