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# REPORTS

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**A TIME-COMPRESSED SSW**

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## **RESPONSES ON A TIME COMPRESSED SSW TEST**

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### **ABSTRACT**

In this study we compared the performance of normal adults on natural and time compressed (5%) SSW test items. In order to produce errors in this group the presentation level of the test items was lowered to 15dB SL. The 20 college students (18-24 years of age) that were tested showed significantly more errors on the compressed test items than on the natural test items. A greater increase in the total number of errors was found in the right competing condition than in the left competing condition for the time compressed items. An increase in errors was observed on the second spondee under the time compressed condition as well. Also, a greater number of errors was noted in left ear first items in the time compressed condition. The results suggest that by time compressing the SSW test items they are made more sensitive to decoding errors.

### **INTRODUCTION**

For many years it has been noted that the Staggered Spondaic Word Test (SSW) is not equally sensitive to all auditory problems. For example, even among normal listeners there is a slight tendency toward poor performance in the left competing condition on left ear first items and on the first spondee. This same tendency is noted in groups that have central auditory processing problems. For example, in populations of learning disabled children it is common for those three features to be poorer than the right competing, right ear first, and second spondee conditions.

Generally, time altered speech has been used to assess central auditory problems (Beasley and Freeman, 1977), however, more recently it has been used to further sensitize central auditory processing tests. Bornstein (1994) studied the influence of speech time compression alone and "in the presence of competing babble" on the recognition of speech. By time compressing speech 60% Bornstein demonstrated significant decreases in speech recognition in both adults and children. Bornstein's study was conducted both monaurally and binaurally, showing a significant binaural advantage. His study suggested that time compressed speech may be diagnostically useful in audiology.

This brings us to the rationale behind the present study. The current SSW test seems to be slightly more sensitive to problems that are anterior in the central auditory system or areas that are often associated with short-term memory. One technique to manipulate the SSW and make it more sensitive to posterior central auditory problems, those areas associated with phonemic decoding, may be time compression. This study sought to determine whether 5% time compression would alter test performance. If so, would this signal change be likely to increase the decoding challenge or the memory challenge. Theoretically, we assumed that it would have a primary influence on decoding ability. Poor decoding of speech requires some additional time to process. By reducing the available time for processing the SSW items we have assumed that there should be an increase in decoding errors. Evidence of decoding problems are shown by an order effect Low/High (L/H). Therefore an increase of errors for the second spondee would suggest a greater decoding challenge. Other signs of decoding problems include poor performance in the right competing and left non-competing conditions as well as other qualitative indicators.

#### METHODS

A total of 20 subjects (10 males and 10 females) participated in the study. The subject group ranged in age from 18 to 24 years old with an average age of 21 years. All subjects involved in the study were attending college at the time of testing. Subjects were selected incidentally based on the following criteria: normal hearing sensitivity (20dB HL or better for the frequencies 500-4000Hz), the ability to respond verbally, English as their native language and no prior experience with the SSW Test. None of the members in the subject group were excluded because they all met the necessary requirements. A within-subjects design, that is, the subjects acted as their own control was utilized because with a small sample, one's own baseline performance would provide the most sensitive measure to demonstrate the effect of compression.

For several years, Katz has questioned whether a small amount of time compression, specifically 5%, would be sufficient to offset the tendency toward anterior signs. Through the good

offices of Melody Bricault, her husband Gary (an electrical engineer), volunteered to produce the necessary time compression of the SSW. The time compressed version was produced using computer software. Each test item on the original SSW test list EC was time compressed 5%. The method in which Bricault compressed the speech signal did not change the speech spectrum.

Puretone testing was conducted using either a GSI 10 or a GSI 16 audiometer. Word discrimination results were obtained using the Hirsh W-22 word lists from Technisonic. In order to provide complete data for both the normal and compressed versions of the SSW Test, two taped versions were produced. One began with two normal items and the other with two compressed items. Thus, every two subjects provided complete information for the equivalent of one natural SSW Test and one compressed test. Ordinarily, odd items would be compressed and even items would be natural speech or vice versa. However, on the SSW Test this would make all REF items time compressed and all LEF items natural speech. This would obviously confound test results. Therefore alternations were done in pairs, including one REF item and one LEF item.

It should also be noted that the level at which the SSW test items were presented to the subjects was also altered in the current study. It was clear to the researchers that if the test was administered at the standard 50dB SL that the normal subjects would make very few errors, with or without time compression. This would make it very difficult to see the influence of time compression. As most people who are familiar with the SSW Test know, "SSW Max" is 25-50dB SL. That is, we expect maximum performance on the SSW between 25 and 50dB above the 3 frequency speech average. For this reason a level 10dB below this range was chosen to insure a significant number of errors under normal conditions. This would provide a reasonable baseline from which we could assess the influence of time compression.

## RESULTS

The mean number of errors and the standard deviations for the four SSW conditions for both the natural and time compressed items are shown in Table 1. As can be seen by Figure 1, the subjects performed poorer on the time compressed version of the SSW test in each of the four conditions. However, it should be mentioned that for the right competing and left non-competing condition that the increase was greatest (more than twice as many errors) for the time compressed version.

A repeated measures ANOVA was computed for the four conditions for both natural and compressed presentations. The difference was statistically significant ( $F=10.93$ ,  $p<.002$ ).

Similar comparisons were made on two response biases: ear (Figure 2) and order effect (Figure 3). When items were presented

TABLE 1 : MEAN NUMBER OF ERRORS AND STANDARD DEVIATIONS  
FOR THE FOUR CONDITIONS (RNC, RC, LC, LNC)

	RNC	RC	LC	LNC
MEAN NORMAL	.8	1.4	2.5	.9
S.D. NORMAL	1.0	1.6	2.1	1.1
MEAN COMPRESSED	2.6	3.2	3.8	2.2
S.D. COMPRESSED	1.9	2.2	2.8	1.5

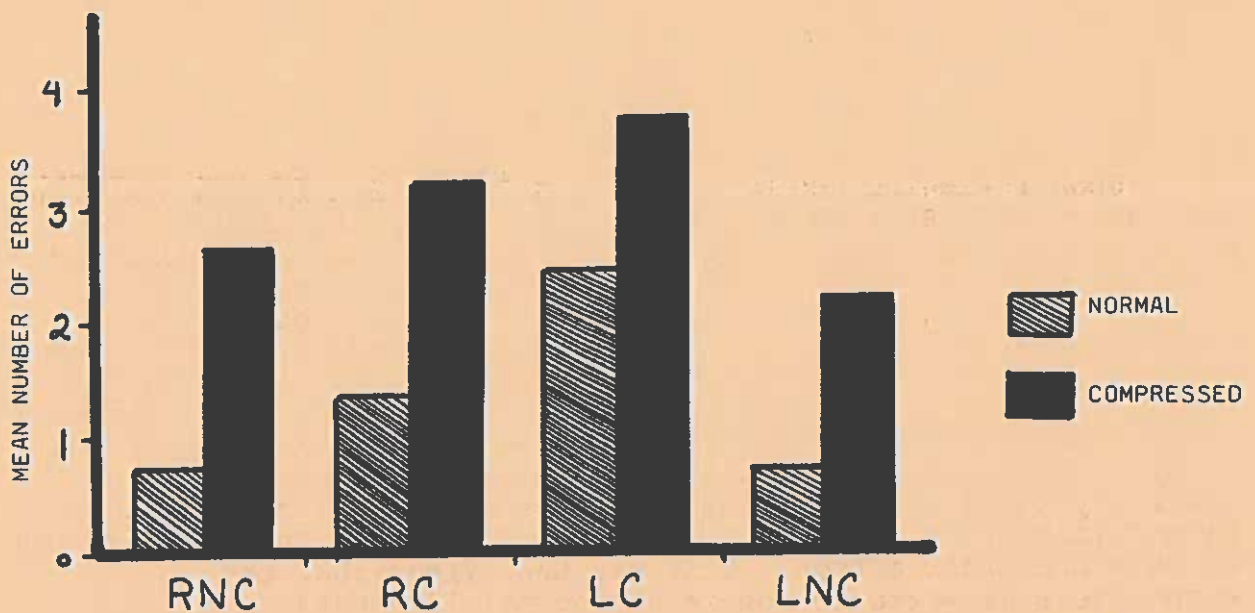


FIGURE 1: Mean number of errors on normal vs. compressed SSW test items for each of the four conditions

normally for REF and LEF items the mean difference was .75 favoring LEF. However, time compression increased the LEF errors more so than REF. This increased the difference to 2.3 between the two halves.

When comparing the first spondee under normal and compressed conditions there was not a significant difference. The same holds true for the second spondee.

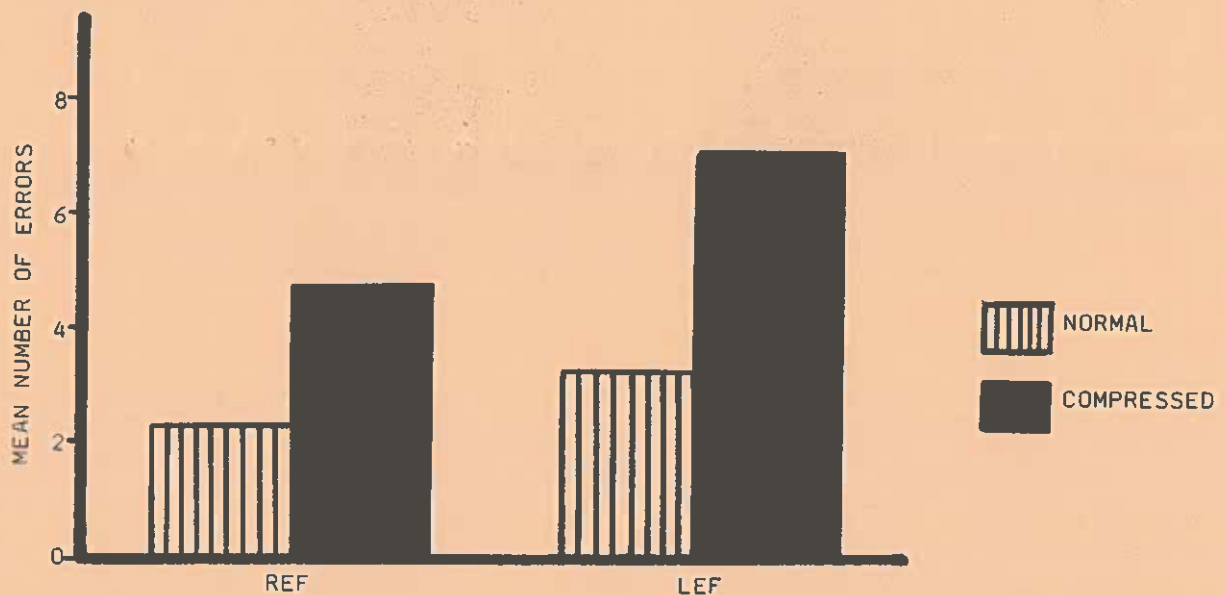


FIGURE 2: Right ear first vs. left ear first when comparing the mean number of errors for the normal vs. compressed conditions

### DISCUSSION

Upon reviewing the data it was evident that by administering the SSW at 15dB SL with a 5% compression rate, the task became more challenging for the normal listener. We were not surprised that the subjects demonstrated errors which indicated decoding difficulties because this coincides with Katz's theory. He suggests that subjects who have difficulty decoding would be more likely to make errors on the second spondee rather than the first whether natural or time compressed speech was used. This occurs because poor decoders concentrate on identifying the first spondee so by the time the second spondee is presented they are often still trying to interpret the first spondee. As a result, they have difficulties identifying the second spondee. This is referred to as a L/H order effect. This was the effect that the researchers expected to see in the normal listeners.

Many of the subjects also had delayed responses which is typical of poor decoders. Both quantitative and qualitative data

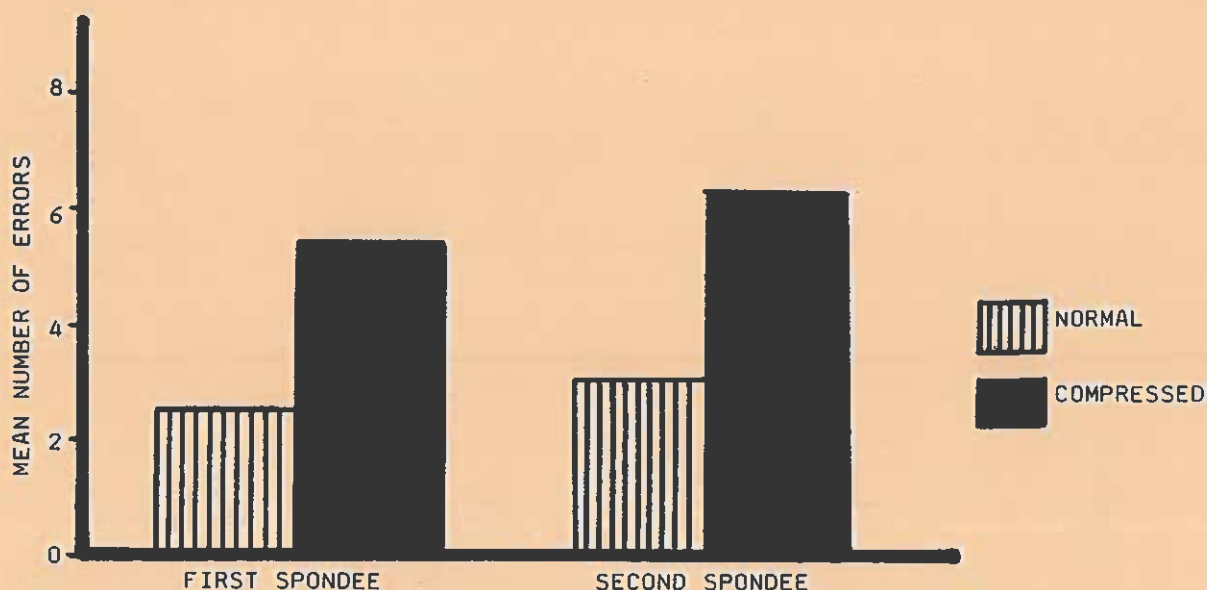


FIGURE 3: Mean number of errors for the first spondee vs. the second spondee for the normal vs. compressed conditions

revealed that time compressing the test items made the test less challenging of short term memory and more challenging of decoding.

This pilot study has provided suggestions for future research which may have clinical implications. For instance, researchers may carry out an experiment to evaluate individuals with known central auditory processing difficulties which show significant decoding signs that may have been insignificant when the natural speech SSW test was used. It would be interesting to see if these same individuals have a significant amount of decoding errors when the speech stimuli are presented in this slightly more rapid manner. Perhaps in the future norms may be obtained for the compressed version of the SSW test. This may aid in determining if an individual has decoding difficulties because it may not be detected from the normal version of the SSW Test due to the fact that it tends to be more sensitive to anterior signs.

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