

# EFFECTS OF ALCOHOL ON THE SPEECH OF ALCOHOLICS

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Speech disfluency resulting from alcohol intoxication was investigated in an experiment using established measures of nonfluency. Male alcoholic subjects ( $N = 16$ ) read a standardized passage into an audio recorder, once while sober and at two different degrees of intoxication. For each reading, the frequency of occurrence of 13 different operationally defined speech errors was scored. Subjects, when intoxicated, took a longer time to read the standardized passage; had increased interjections of words, phrases, and sounds; increased word omissions; increased word revisions; and increased broken suffixes at higher levels of intoxication (10 oz). Possible uses for a profile of disfluent speech of alcoholics are considered and suggestions for further investigations are discussed.

That alcohol intoxication produces changes in speech—often referred to as slurred speech—is generally accepted, but little meaningful work exploring characteristics of alcohol-induced disfluency has been reported. With some other drugs, the onset of nonfluent speech, identified by clinical observation, has been used as a measure of the beginning stage of consciousness impairment. In 1954, for instance, Shagass explored the effects of sodium amytal and related the clinically observed onset of slurring to the sedation threshold indicated by changes in the EEG pattern. Waskow (1966), however, noted that of the limited number of studies exploring the effects of drugs on speech, many have suffered from major methodological problems, particularly concerning the definition, adequacy, and reliability of dependent variable measures. In an extensive search of the literature, we found only one article which experimentally explored the effects of alcohol on verbal behavior (Zalmov, 1969). In that study, Zalmov measured the number of errors made by native Germans during spoken and written German dictation as a function of various degrees of alcohol inebriation.

Alcohol has been recognized pharmacologically as a progressive central nervous system depressant which produces both physical and mental impairment (Lienert and Traxel, 1959; Shagass, 1960; Bennett, 1966). Typically three types of criterion measures have been used to assess a given individual's

degree of alcohol intoxication: (1) direct chemical estimation of blood alcohol concentration (Harger, 1944), (2) clinical evaluation of the individual (McNamee, Mello, and Mendelson, 1968), and (3) performance on various psychomotor tests (Loomis and West, 1958, 1960; Young, 1970). Degree of speech disfluency may be considered as another measure of functional impairment resulting from alcohol inebriation, perhaps a subcategory of psychomotor performance. We are aware of no reported study which attempts to measure and assess the components characterizing disfluent speech caused by alcohol intoxication. This paper reports an experiment which used established measures of nonfluency to investigate the nature of alcohol-induced disfluent speech of alcoholics.

## METHOD

### *Subjects*

Male patients ( $N = 16$ ) who had voluntarily admitted themselves to Patton State Hospital for treatment of alcoholism and had volunteered for research studies served as subjects. No subject had consumed any alcohol for at least three weeks prior to the study. All subjects were medically cleared by a psychiatrist and showed no evidence of disturbed liver function, chronic brain syndrome, subnormal intelligence, or drug addiction. Every subject had previously experienced some withdrawal symptoms from alcohol. Additionally, subjects used no medication concurrent with the study, and all spoke and read English fluently.

### *Apparatus*

A Concord F-400 stereo tape recorder with automatic volume control was used to record the subjects' readings. During each recording session, a Concord voice-sensitive microphone was placed approximately 12 inches in front of the subject. Concord stereo headphones (H-Plo 8) were used by the experimenter to monitor and score speech errors in the subjects' readings.

### *Procedure*

A standard linguistic passage, 613 words long (McDavid and Muri, 1967), was read aloud and audio recorded during three separate sessions by each subject—once while mildly inebriated, once when moderately inebriated, and once when sober. A counterbalanced design was used for session order to allow analysis of any effects of practice. Subjects were randomly assigned to one of the four possible testing orders shown in Table 1 with the restriction that only four subjects were assigned to each testing order. All reading tests were separated by 48 hours. For sessions involving consumption of alcohol, subjects participated by pairs in three-hour drinking sessions conducted in an experi-

TABLE 1. Reading test orders used and degree of intoxication at time of testing.

| Test Session                     | Order of Testing |            |            |            |
|----------------------------------|------------------|------------|------------|------------|
|                                  | A (N = 4)        | B (N = 4)  | C (N = 4)  | D (N = 4)  |
| 48 hrs before drinking session 1 | no test          | no test    | sober test | sober test |
| Drinking session 1               | 5-oz test        | 10-oz test | 5-oz test  | 10-oz test |
| Drinking session 2               | 10-oz test       | 5-oz test  | 10-oz test | 5-oz test  |
| 48 hrs after drinking session 2  | sober test       | sober test | no test    | no test    |

mental bar setting previously described by Schaefer, Sobell, and Mills (1971). During those sessions they were allowed to consume up to 16 oz of 86-proof liquor or its equivalent in alcohol content. Subjects were tested once when sober (either 48 hours before or after the two drinking sessions), once after ingestion of 5 oz of 86-proof liquor or its equivalent in alcohol content, and once on a different occasion (determined by testing order) after ingestion of 10 oz of 86-proof liquor or its equivalent. Readings recorded while subjects were inebriated took place immediately after a subject had consumed either the fifth or tenth drink. All readings were recorded in the same acoustically isolated reading room with good overhead lighting.

Although a preferred procedure would have been to directly assess a subject's blood alcohol concentration (BAC) at the time of recording, circumstances did not permit such a determination. The relative degree of inebriation of subjects can be estimated, however. In most cases, subjects consumed 5 oz of 86-proof liquor or its equivalent in alcohol content within the first hour of a session. As no subject was of extraordinarily large physical structure, the expected BAC of each subject at the time of the recording test would be about 0.10 g/ml. Likewise, in all cases subjects consumed 10 oz of 86-proof liquor or its equivalent in alcohol content within the first two hours of their drinking sessions. This amount of alcohol consumed in such a short interval would result in an expected BAC of approximately 0.25 g/ml—more than twice the BAC needed to qualify as legally intoxicated in most states.

### Scoring Procedure

At the conclusion of the experiment, the senior author scored each speech sample for 13 different types of speech errors while carefully listening to the playback of the recording. In almost all cases, errors which occurred were clearly discernible and unambiguously met the criteria for scoring in only one of the scoring categories.

Seven established categories of disfluencies were used to score speech errors. These categories are thoroughly defined in Johnson et al. (1959). The following established disfluency scoring categories were used: (1) interjections—within this category three different types of interjections were scored independently—word interjections, phrase interjections, and sound/syllable interjections; (2) word repetitions; (3) phrase repetitions; (4) sound/syllable

repetitions; (5) revisions (single words); (6) incomplete phrases; (7) broken words—this category was also scored using three independent subtypes of speech errors—broken words—rhythm change, broken words—suffix change, and broken words—prefix change. The latter two divisions of the broken word category were not specifically defined by Johnson. However, our experience in previous pilot studies suggested that the inclusion of scoring categories of suffix change and prefix change would be valuable. Suffix and prefix change are defined as each word in the passage which was altered from its original context by omission, change, or addition of a suffix or prefix, respectively. Two additional scoring categories were also measured. They are defined as:

#### Time to Read Passage

The total number of seconds taken to read the passage aloud from beginning to end (including any pauses and hesitations).

#### Word Omissions

Each single word which was not verbalized although it appeared in the original passage. This does not include cases where another word or part of a word was substituted for the omitted word.

Following Johnson's scoring procedures for his derived categories, both the number or units and instances of nonfluency were scored for all categories of speech errors except time to read passage.

Only one judge was deemed necessary for the scoring because all error criteria were operationally defined, relatively independent, and clearly distinguishable on the audio tape recordings. Although the scoring categories were not totally independent, a given error could be scored in only one category. This procedure was preferred over the alternative of including a single error in more than one category.

A two-way repeated analysis of variance, using degree of inebriation as an independent measure and order of testing as a repeated measure (Winer, 1962), was calculated for each of the 13 scoring categories used.

## RESULTS

Mean scores for each of the 13 scoring categories are presented in Table 2 as a function of degree of intoxication. Degree of intoxication affected reading time ( $F = 14.32$ ;  $df = 2, 24$ ;  $p < 0.001$ ) and six of the 12 measures of fluency. The six direct indicators of fluency adversely affected were word interjections ( $F = 4.25$ ;  $df = 2, 24$ ;  $p < 0.05$ ), phrase interjections ( $F = 9.44$ ;  $df = 2, 24$ ;  $p < 0.001$ ), sound/syllable interjections ( $F = 5.19$ ;  $df = 2, 24$ ;  $p < 0.025$ ), word omissions ( $F = 7.40$ ;  $df = 2, 24$ ;  $p < 0.005$ ), revisions ( $F = 7.84$ ;  $df = 2, 24$ ;  $p < 0.005$ ), and broken words (suffix change) ( $F = 10.50$ ;  $df = 2, 24$ ;  $p < 0.001$ ). No significant differences were found for the remaining six measures of fluency.

Experimental order (Table 1) had a significant effect on only two of the

TABLE 2. Mean time to read passage and mean number of errors as a function of degree of intoxication for 16 alcoholic subjects (length of reading passage—613 words).

| <i>Error Category</i>             | <i>Sober</i> | <i>Degree of Intoxication</i> |                  |
|-----------------------------------|--------------|-------------------------------|------------------|
|                                   |              | <i>5 Ounces</i>               | <i>10 Ounces</i> |
| Mean time (sec) to read passage   | 233.50       | 243.62                        | 312.06           |
| Mean word interjections           | 5.81         | 7.31                          | 10.56            |
| Mean phrase interjections         | 0.31         | 0.38                          | 3.08             |
| Mean sound/syllable interjections | 0.56         | 1.38                          | 3.13             |
| Mean word omissions               | 2.86         | 3.25                          | 5.94             |
| Mean revisions                    | 3.48         | 3.38                          | 6.50             |
| Mean word repetitions             | 2.62         | 0.75                          | 0.88             |
| Mean phrase repetitions           | 0.38         | 0.19                          | 0.25             |
| Mean sound/syllable repetitions   | 1.31         | 0.86                          | 0.50             |
| Mean broken words—suffix change   | 2.81         | 3.50                          | 5.31             |
| Mean broken words—prefix change   | 0.00         | 0.00                          | 0.00             |
| Mean broken words—rhythm change   | 0.69         | 1.44                          | 1.50             |
| Mean incomplete phrases           | 0.00         | 0.00                          | 0.62             |

13 categories, revisions ( $F = 3.59$ ;  $df = 3, 12$ ;  $p < 0.05$ ) and broken words (rhythm change) ( $F = 3.71$ ;  $df = 3, 12$ ;  $p < 0.05$ ). In both cases, these significant order effects seemed to reflect a possible practice effect, in that more errors occurred for the experimental orders in which reading while intoxicated preceded reading while sober than for orders in which reading while sober preceded reading while intoxicated.

Only two interaction terms were statistically significant. For the interaction of phrase interjections and order ( $F = 3.75$ ;  $df = 6, 24$ ;  $p < 0.01$ ), an examination of the data suggested that this interaction was probably the result of subjects in Order C making more errors in the sober-reading condition than at the 5-oz intoxication level, while subjects in all other orders made fewer errors during the sober reading condition. The interaction of sound/syllable interjection and order ( $F = 4.25$ ;  $df = 6, 24$ ;  $p < 0.01$ ) is more difficult to interpret. It appears, however, to reflect the fact that subjects in Order A made their fewest errors in the 10-oz condition, while subjects in the other orders typically made their greatest number of errors in that condition.

While all categories (except time to read passage) were scored for units per instance (U/I, Johnson et al., 1959), an inspection of the data revealed that, with the exception of the category phrase interjections, there were few occasions where an instance of a disfluency error consisted of more than one unit. Therefore, U/I data will only be reported for the phrase interjections category. These errors occurred with a mean frequency of 2.20 U/I during the sober reading, 3.50 U/I during the 5-oz reading, and 4.96 U/I during the 10-oz reading.

## DISCUSSION

The results of this experiment make it possible to describe a profile of alcohol-induced disfluent speech of alcoholics. While this profile can only be

generalized to alcoholic subjects, it is reasonable to assume that persons who are not alcoholics will probably demonstrate the same general types of speech changes when inebriated, although the amount of alcohol consumption necessary to produce a similar amount of change might be considerably less than is necessary when individuals have developed a degree of physiological tolerance to alcohol. Unfortunately, the available facilities did not allow for monitoring BACs, and therefore the experiment reported here can only claim ordinal levels of intoxication. That is, 5 oz of consumed alcohol constituted greater inebriation than a sober state, and 10 oz of consumed alcohol represented an even higher level of intoxication.

With increasing inebriation, verbal behavior of alcoholics differs from their sober verbal behavior in at least the following characteristics:

1. The time to read a structured passage increases significantly. This finding might reflect an impairment of the ability to concentrate on an objective task, as has been suggested in various studies which investigated psychomotor task performance.
2. The incidence of word, phrase, and sound/syllable interjections increases significantly; that is, subjects introduce new words into the context of the passage, or words in the original passage are replaced by words either out of context or semantically similar (word interjections). The frequency of extraneous comments (phrase interjections) increases greatly with heavier intoxication. The data in Table 2 indicate that extraneous comments are seldom a concomitant of mild inebriation but appear quite frequently at greater levels (10 oz) of intoxication. Additionally, with increasing intoxication certain verbal pauses or sounds occur more frequently (sound/syllable interjections).
3. Word omissions increase; subjects omit words which are part of the reading passage.
4. Broken words-suffix changes increase in frequency; subjects either change or neglect to read the suffixes of some words.
5. The frequency of word revisions increases markedly with intoxication; subjects read words incorrectly, but correct those errors before finishing the passage.
6. Changes in none of the three repetition categories (sound/syllable, phrase, and word) vary as a function of increasing intoxication. In fact, this study indicates that there is less repetition at extreme levels of intoxication (10 oz) than when sober.
7. The categories of broken words-rhythm change, broken words-prefix change, and incomplete phrases do not vary as a function of increasing intoxication. In fact, for the last two categories respectively, only zero and one errors were made by all subjects combined for all readings.

This profile of alcohol-induced disfluency, interpreted within the limitations of the reported experiment, largely characterizes the phenomenon commonly

referred to as slurred speech. However, this profile is only for alcoholic subjects. An earlier pilot study produced results congruent with these showing increases in various speech error categories when subjects were intoxicated as compared to sober.

It is possible that changes in casual conversation which occur when a person is inebriated are different from those which occur in a structured reading of a prepared passage. For instance, although no significant effects were found for the repetition categories using a structured passage, this might not be the case in casual conversation or free-flowing speech where a person is forced to formulate his thoughts before speaking. Further investigation of the effects of alcohol on casual speech is needed to clarify any differences which exist. Our observation is that many professional actors and others imitating drunken speech make great use of the characteristic of repetition. The authors realize, of course, that speech which is popularly referred to as slurred speech is usually casual verbal interaction and not a structured verbal reading. However, it is much more difficult to construct measures to reliably quantify free speech changes than to measure changes which occur in structured readings. If such an investigation is successfully undertaken, probably certain verbal errors delineated in this report, such as suffix change, interjections, revisions, and word omissions, would probably still be found to occur.

One plausible explanation for the results reported here is that the errors found in drunken speech may possibly result from an increased lack of attention to the verbal reading task as a function of degree of intoxication. This interpretation is supported by a further analysis of the experimental data which revealed that very few of the word interjections occurring in drunken speech could be logically related to the sentence content. If the effect of alcohol intoxication were merely one of producing confusion, then a high frequency of semantic, rather than noncontextual interjections would be expected. Moreover, the relative lack of evidence for a pronounced practice effect suggests that the reading test was primarily one of competency of performance and depended very little on memory.

This experiment was purposely exploratory in nature. Future studies might emphasize determining phonemic and morphemic changes which occur with inebriation, differences between types of subjects, and changes which occur in speech other than in a standardized passage reading. If changes in speech occurring as a function of intoxication are found to be reliable and consistent across subjects, then it is possible that a refined form of speech sampling and analysis might someday be included with BAC and impairment of psychomotor skills as an observable measure of degree of alcohol intoxication.

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