SPEAKING WHILE INTOXICATED: PHONETIC AND FORENSIC ASPECTS

Angelika Braun

Landeskriminalamt Nordrhein-Westfalen,
Düsseldorf, Germany

ABSTRACT

Although there is a lot of everyday knowledge about the effect of alcohol on speech production, scientific studies on the subject are sparse. In the experiment reported on here 33 subjects read a given text in sober condition and in intoxicated condition. The results show a marked increase in speech errors, a decrease in readiness to correct errors, as well as a number of segmental effects, e.g. lengthening and (de)nasalization. The phonetic as well as forensic implications of the findings are discussed.

1. INTRODUCTION

It is common knowledge among ordinary people as well as phoneticians that the consumption of alcoholic beverages, especially in large quantities, affects the verbal behavior. Yet while the effect of alcohol on certain neurophysiological mechanisms has been subject to a large number of investigations, surprisingly little effort has been made among phoneticians and speech scientists to find out exactly what is the effect of alcohol on speech. One of the major shortcomings of the existing studies is that only very few of them have actually tried to measure the degree of intoxication. Instead, they often had to use the Widmark formula which only allows for a very rough estimate. Due to the difficulties in dealing with drunken subjects in an experimental situation, the number of subjects was usually very small, i.e. under 5 [e.g. 3,5]. Thus there is a number of very general findings indicating that speech produced under intoxication is slower, reduced in amplitude, and more error-prone than speech produced in sober condition [3], but we are still in need of precise descriptions.

The present study was motivated by this lack of data as well as the forensic application of phonetics, where the expert is often asked in court whether there is any indication of intoxication in a certain incriminating recording. One of the more recent spectacular cases in which the question of alcohol abuse was crucial concerned the Exxon Valdez oil spill. In cases like this it would not only be desirable to know exactly the effects of alcohol on speech production but also whether there is a correlation between the effects displayed and the amount of alcohol consumed. (This is of prime importance e.g. for the question of diminished responsibility).

2. EXPERIMENT

An experiment was carried out involving 33 male subjects who were 23 years old on the average (SD = 15 months). The task reported on here was the reading of a phonetically balanced text (The Northwind and the Sun) which was done in sober condition first. Subjects were then given 40% proof vodka. It was indicated to them that a blood alcohol concentration of between 0.1 and 0.2% was desirable for the purpose of the investigation and approximately how much vodka they would have to consume to achieve that, but there was no possibility to prescribe the exact amount they would have to drink. Thus, maximum alcohol levels of between 0.02% and 0.21% were actually achieved. The drinking time amounted to 90 minutes; 30 minutes later subjects were tested by means of a SIEMENS Alcomat breathalyser for their breath alcohol level (which has a close to perfect correlation to blood alcohol level [1]) and subsequently read the text.

3. METHOD

A number of parameters including rate of articulation, fundamental frequency, segmental features and speech errors were investigated, the former by means of a computer program specially designed for speech analysis, the latter by auditory analysis. This presentation will, for reasons of time, focus on speech errors and selected segmental features.

4. RESULTS

4.1. Segmental features

There are some descriptions about the effects of alcohol on certain speech sounds like /ts/, /n/, /l/, /r/ etc. (cf. e.g. [3, 5]), but in analysing our data we found that the segmental perspective was too narrow in order to explain some of the changes observed in the sense that a number of sounds are affected by certain general processes. I will thus try to outline some mechanisms which seem to be affected by alcohol intoxication.

4.1.1. Velar action

The preliminary auditory analysis of the data revealed a marked increase in denasalized articulation of the nasal consonants in intoxicated condition. A systematic evaluation of this phenomenon in relation to the maximum individual intoxication shows that even at very low levels of breath alcohol concentration (i.e below 0.08%), about 30 % of the subjects exhibit an increase in denasalazation of nasals; above 0.08% there is a drastic increase, and above 0.16% all subjects have denasal consonants. In view of this finding we also looked for the complementary effect, namely the nasalization of vowels as compared to the sober condition. Again, the correlation with the degree of alcohol intoxication is obvious, but vowel nasalization sets off at a later stage, i.e. above 0.08% BAL. (Fig. 1) It is important to note that the denasalization of vowels implies the nasalization of vowels, i.e. there is no case of consonant denasalization without vowel nasalization.

We explain these findings by a decrease in velar motility due to impaired motor control. A local effect on the mucosa seems highly improbable since INT-checkups conducted throughout the experiment revealed no effects on the laryngeal or pharyngeal mucosa.

4.1.2. Slurred Articulations

One of the most frequently mentioned effects of alcohol on speech is the so-called slurred or incomplete articulation of segments or clusters which are then "reduced", usually at the expense of the plosive element [2, 4]. The average number of incomplete articulations per person at the maximum individual BAL is increased even at low levels of intoxication as compared to the sober condition; it triples above a BAL of 0.8% and rises again drastically above 0,2%. (Fig. 2) (It has to be emphasized that only the changes compared to the sober condition were taken into account.)

As is shown by an in-depth analysis of the data, the sounds affected by incompleteness are mostly apico-alveolars of different manners of articulation, i.e. plosives, fricatives, nasals, and laterals. This indicates that the motor control of the tip of the tongue, which has to perform the most delicate articulatory movements, is impaired and thus these movements are not carried out completely.

4.1.3. Segment Lengthening

Segment lengthening forms one of the most commonly stated effects of alcohol [2]. The percentage of subjects showing vowel and consonant lengthening rises from 18% (vowels as well as consonants)

Nasalization and denasalization

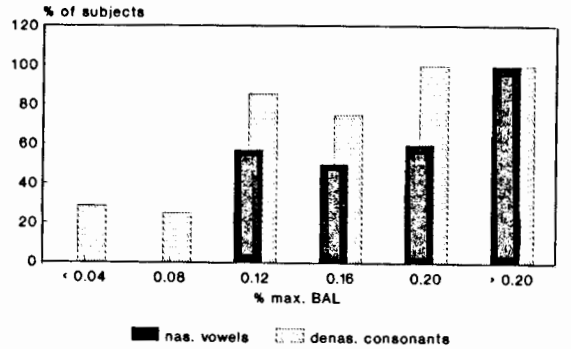

Figure 1

Number of incomplete articulations

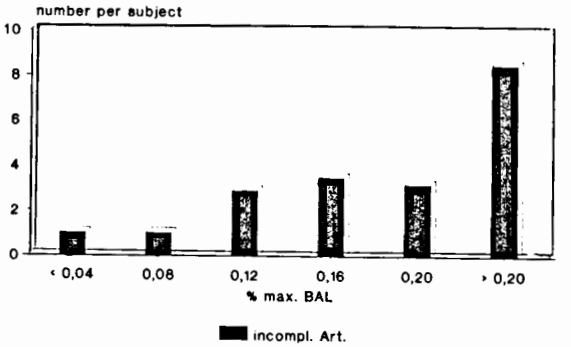

Figure 2

Number of speech errors per speaker

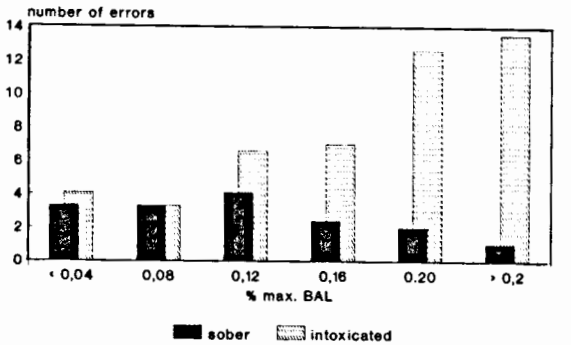

Figure 3

below 0.08% to 50% (consonants) and 81% (vowels) above 0.08% max. BAL. Thus the steady-state portions of certain sounds seem to be increased at the expense of the articulatory precision of others.

4.2. Production Errors

Speech errors have long been used as an indicator for mental processing; therefore we also analyzed them in two different respects: (a) the number of speech errors (slips of the tongue) in the read passage; (b) the readiness to correct the errors committed. There is a doubling of speech errors above a breath alcohol concentration of 0.08% and a drastic increase above 0.16% as compared to the sober condition. (Fig. 3) This means that even in a comparably simple task like reading a text which does not involve cognitive planning, there is a significant increase at 0.08% alcohol level. The readiness to correct these errors which is commonly viewed as an indication of an internal monitoring mechanism was greatly impaired (i. e. reduced to about 1/3) even at very low levels of intoxication. There is no significant change up to 0.2%, but above that BAL, there are hardly any attempts to correct the errors at all. Also, there is a growing percentage of false corrections at high BALs, which amounts to over 38% of all corrections at BALs of 0.16% and above.

5. DISCUSSION

Alcohol is known to be neurotoxic, i.e. to impair coordination and nerve transmission. In speech, this results in a reduced and/or imprecise movement of two articulators which require the most precise control mechanisms: the tongue tip and the velum, whereas other sounds are sustained for a longer period than in sober condition. With all of the parameters discussed here, the effect shows even at low BALs, but there is a marked increase above 0.08% and again at 0.16% (consonant denasalization; vowel length); or 0.20% (vowel nasalization; incomplete articulations). This seems to suggest that the effects of alcohol do not increase gradually but in steps.

The study also shows that even in a reading task, there is a significant increase in the number of speech errors paralleled by a decrease in the attempt to correct the errors. This suggests that not only production processes are impaired but also the reception and comprehension of texts.

From the forensic perspective it has to be pointed out that even though most effects of alcohol are generally very consistent, there is always a small number of subjects who do not show them. Thus, there is no one-to-one relationship between the consumption of alcohol and the effects on speech in the sense that the presence of one (or better: several) of the impairments mentioned here point to an intoxication of the speaker but their absence may not be taken to prove soberness.

6. REFERENCES

[1] ADRIAN, W. (1979), "Bestimmung des Alkoholgehaltes im menschlichen Körper über die Atemluft", *Der Sachbeweis im Strafverfahren, BKA-Vortragsreihe 24*, 99-103.

[2] LESTER, L. / SKOUSEN, R. (1974), "The Phonology of Drunkenness", *Papers from the Parasession on Natural Phonology*, Chicago, 233-239.

[3] PISONI, D. et al. (1986), "Effects of alcohol on the acoustic-phonetic properties of speech". *Alcohol, Accidents, and Injuries, (Society of Automotive Engineers, Warrendale, Pa.) Special Paper P-173*, p. 131-150.

[4] PISONI, D. / MARTIN, Chr. (1989), "Effects of Alcohol on the Acoustic-Phonetic Properties of Speech: Perceptual and Acoustic Analyses", *Alcoholism: Clinical and Experimental Research, 13*, 577-587.

[5] TROJAN, F. /KRYSPIN-EXNER, K. (1968), "The decay of articulation under the influence of alcohol and paraldehyde", *Folia phoniatrica, 20*, 217-238.