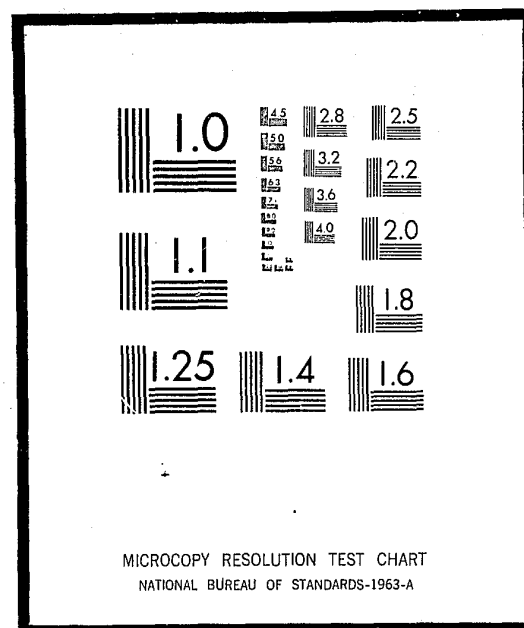


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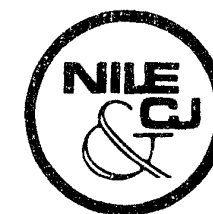
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WASHINGTON OPERATIONS

SPEAKER IDENTIFICATION THROUGH VOICE PRINTS: A BRIEF REVIEW

DECEMBER 1973

Equipment Systems Improvement Program Report
prepared for



U.S. DEPARTMENT OF JUSTICE
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION
NATIONAL INSTITUTE OF LAW ENFORCEMENT
AND CRIMINAL JUSTICE

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THE EQUIPMENT SYSTEMS IMPROVEMENT PROGRAM

Following a Congressional mandate* to develop new and improved techniques and equipment to strengthen law enforcement and criminal justice, the National Institute of Law Enforcement and Criminal Justice under the Law Enforcement Assistance Administration of the Department of Justice established the Equipment Systems Improvement Program. The objectives of the Program are to determine the priority needs of the criminal justice community to help in its fight against crime, and to mobilize industry to satisfy these needs. A close working relationship is maintained with operating agencies of the criminal justice community by assigning systems analysts to work directly within the operational departments of police, courts and corrections to conduct studies related to their operational objectives.

This document is a research report from this analytical effort. It is a product of studies performed by systems analysts of the MITRE Corporation, a not-for-profit Federal Contract Research Center retained by the National Institute to assist in the definition of equipment priorities. It is one of a continuing series of reports to support the program decisions of the Institute relative to equipment development, equipment standardization and application guidelines. Comments and recommendations for revision are invited. Suggestions should be addressed to the Director, Advanced Technology Division, National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, U. S. Department of Justice, Washington, D. C. 20530.

Gerald M. Caplan, Director
National Institute of Law
Enforcement and Criminal Justice

* Section 402(b) of the Omnibus Crime Control and Safe Streets Act of 1968, as amended.

THE MITRE CORPORATION

WESTGATE RESEARCH PARK
McLEAN, VIRGINIA 22101
(703) 790-6000

11 December 1973

SUBJECT: SPEAKER IDENTIFICATION THROUGH VOICE PRINTS:
A BRIEF REVIEW

REFERENCE: TGL-75

BACKGROUND

MITRE has reviewed the background and contemporary status of speaker identification through analysis of voiceprints. The objective of this short review was to document the rationale for the major Development Group project which is addressing three broad aspects of the subject: (1)

Voiceprint Technology Extension

Computer-Aided Voice Identification System

Voice Recording System

FINDINGS

This Analysis Group effort is considered part of the F-3 Subtask on Speaker Identification. The findings, in brief, are as follows:

1. The use of voiceprints as an aid to investigation encompasses a wide spectrum of crimes and is growing.
2. The value of a speaker identification system to criminal justice cannot be adequately quantified with available data, but growing use and the preponderance of informed, independent opinion indicate a high potential value.
3. Court acceptance of voiceprint identification (as differentiated from use for investigation only) is still strictly limited and is likely to remain so until voiceprint analysis gains general acceptance in the particular (scientific) field to which it belongs.

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4. General acceptance can probably be attained through controlled tests which improve and demonstrate the reliability of identification by voiceprints under the various conditions posed by legal challenges.

5. Further development of voiceprint technology may have significant collateral value in the related fields of mechanical speech recognition and speaker verification for security control, for example.

6. The focus of the Development Group project is generally consistent with priority needs expressed by the majority of those most familiar with the technical and legal status of voiceprint technology.

Based on the review and these findings, we recommend the following:

1. The Development Group project should include, at least in the planning stage, as many recognized authorities as possible to enhance the validity of the results through increased verification, thus providing earlier acceptance by the scientific community.

2. NILECJ should convene a conference of recognized experts, both technical and legal, to define the best detailed approach toward satisfying court requirements for acceptance of voiceprint identification. This should be done before contract proposals are requested.

3. LEAA should concurrently support improvement and wider use of empirical techniques, exemplified by the work of the Michigan State Police, while the analytic basis required by the courts emerges from the Development Group project.

DISCUSSION

The first reported case in which voiceprint evidence was introduced occurred in 1966.⁽²⁾ The Michigan State Police began operating their Voiceprint Identification Unit in 1967, and by the end of 1970 reported investigating a total of 291 cases⁽³⁾; the rate is now up to about 350 to 400 cases per year.⁽⁴⁾ Such growth is a reasonable indication that voiceprints have been found to be useful in solving certain crimes. Lt. Ernest Nash of the Michigan State Police, recognized by the courts as an expert in voiceprint identification, presented evidence admitted by the courts in 47 cases during calendar years 1971, 1972, and 1973 (24 cases in 1973 alone) as follows:⁽⁵⁾

- 12 False Bomb Threats
- 12 Extortions
- 7 Murders
- 5 Conspiracies

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3 Briberies

- 1 Each obscene call, real bomb threat, false fire alarm, burglary, robbery, narcotic sales

2 Other Crimes

The police have not estimated the additional investigation time which would have been necessary in these cases without voiceprints, or how strongly each prosecution or defense depended on the testimony of Lt. Nash. However, because voiceprints are still only provisionally acceptable, they tend to be used only when they are most needed.

Voiceprints are also used only for investigation in a large number of cases, helping police to concentrate on the correct suspect more quickly. Again, the value is difficult to measure. In one murder case, successive examinations over a 4 month period cleared 12 suspects before the 13th was positively identified. The time required to clear the 12 suspects (or whether the guilty person could have been found at all) by other means must remain unknown. The Michigan State Police unit has examined about 3300 different voices to date, producing 1920 definite eliminations of suspects and 519 positive identifications.⁽⁵⁾

The need will probably continue to grow with the increasing use of telephones for criminal purposes. After extensive reviews of the technical and legal status of the voiceprint identification process, one reviewer concluded that, "Its value as an investigative tool cannot be denied"⁽⁶⁾, and another that, "Undoubtedly, such a means of investigation, when properly developed, will be an invaluable aid in our fight against crime".⁽⁷⁾

It should be emphasized, however, that the major conclusions of both of the above reviewers were objections to the use of voiceprint evidence in court, which is in full accord with current guidelines of the Federal Bureau of Investigation as well. In the official opinion of the Bureau, "... the comparison of voiceprints is useful as an investigative guide but has not been proven sufficiently well authenticated to serve as a reliable basis for expert testimony as to identity, at this time".⁽⁸⁾

This wary attitude toward the admissibility of voiceprint evidence in court proceedings is buttressed by the cumulative record of court decisions on the matter. While lower courts are showing an increasing tendency to accept voiceprint evidence,⁽⁹⁾ apparently as a result of a study by Dr. Oscar Tosi,⁽¹⁰⁾ the highest court to rule since publication of Tosi's work (the Minnesota Supreme Court) dealt only with the sufficiency of proof to justify issuance of arrest and search warrants. Its decision to admit the evidence specifically stated that in such situations, police were "entitled to rely upon ... various ... factors which would not be admissible in evidence (at trial)".⁽¹¹⁾ The defense did not object to the introduction of voiceprint evidence at that trial.⁽¹²⁾

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One other appellate court has accepted voiceprint evidence since Tosi's work was published, but in that case the evidence was used to corroborate an identification made by other means. The decision of the Florida District Court of Appeals indicated that sufficient other evidence existed to sustain the conviction.(13)

Thus, while courts seem to accept the principle of identification by voiceprints, there is a distinct reluctance to grant the technique full confidence. Most jurisdictions rely on the 50-year-old Frye rule to govern acceptance of a new scientific technique.(14) It "must be sufficiently established to have gained general acceptance in the particular field in which it belongs."(15) Just what field is appropriate for voiceprint interpretations is still controversial, but if courts continue to rely on the Frye rule they will have difficulty ignoring the report of a Technical Committee of the Acoustical Society of America which concluded, after a study by six specialists, that "available results are inadequate to establish the reliability of voice identification by spectrograms. We believe this conclusion is shared by most scientists who are knowledgeable about speech; hence, many of them are deeply concerned about the use of spectrographic evidence in court."(16) The specialists reviewed their position after publication of the Tosi study mentioned above and, while complimenting the work as a valuable step forward, concluded that there is still insufficient data to evaluate the reliability of voiceprint identification.(17)

There is empirical evidence that the reliability can be developed and proven to a degree satisfactory to the courts: Major effects frequently cited in legal challenges -- the health of the speaker, room acoustics, aging, dialects, mimicry, recording medium, speech volume -- are amenable to testing and, although untested in the required controlled manner, some of these variables have been encountered by Lt. Nash in his daily work. He has developed sufficient ability to interpret the spectrograms so accurately that the Michigan State Police have a several-month backlog for a growing list of clients in other jurisdictions.

Limited court acceptance is also growing slowly. There is a considerable difference, however, between the talents of an experienced expert such as Lt. Nash and reproducible results of objective tests. If the technique is to be accorded the status of a science, it must be subjected to scientific tests; otherwise, it will remain an art. The work of the Michigan State Police provides empirical results which justify an analytic inquiry. It is the latter, however, which is essential to build a firm basis for eventual broad use of voiceprint techniques. A properly designed set of tests is difficult, but critical.(18) Not only must the tests counter the legal challenges to the reliability of voiceprint identification, but they must also provide the basis for developing standard identification criteria and standards for certifying expert analysts.(19)

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It is important to note that a better understanding of voiceprint technology will probably have considerable collateral value. Speech recognition (for voice-controlled machinery and automatic translation, for example) and speaker verification (for credit or access to restricted areas) are obvious and closely related uses. Voiceprints have also been used to recreate garbled messages from a flight recorder and to identify newborn babies. Medical uses to aid diagnosis of heart and respiratory ailments have been proposed.(20)

In conclusion, the focus of the Development Group project on speaker identification appears to be generally consistent with the priority needs expressed by the majority of those most familiar with the technical and legal status of voiceprint technology. Further tests are required to establish a scientific basis to the identification process, a key step in gaining judicial acceptance. Computer aids to voiceprint analysis will increase the speed, accessible data base, and objectivity. The third aspect of the Development Group project, recording systems, is a practical necessity. Standards for applicable equipment are necessary because, at this time, one of the most important factors in the analysis of a voiceprint is the quality of the recording from which it was made.(18) (19)

RECOMMENDATIONS

1. A stronger scientific basis for voiceprint identification is the key to greater acceptance by the courts. The effort to build such a basis will, at the same time, increase the reliability when voiceprints are used for investigation only. For those reasons, the subtask which addresses extension of voiceprint technology appears most important at this time. If the work is done by a single research group, however, the results are not likely to be "generally acceptable" until verified by other groups. This subtask should involve as many recognized experts, representing different established groups, as is practical.

2. Factors which must be considered in the effort to build a scientific basis are not especially controversial, but the program of experiments will offer much more opportunity for debate because it is not a straightforward task to design an acceptable set of tests. To avoid future disputes, the experimental program should be discussed and outlined by recognized experts possibly representing different points of view. NILECJ should convene a conference for this purpose, including as attendees, for example, Dr. Ladefoged of UCLA, Dr. Hecker of SRI, Lt. Nash of the Michigan State Police, prosecuting and defense attorneys and a judge. Proposals should not be requested of potential subcontractors until conference results can be incorporated in a Statement of Work.

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3. The empirical knowledge gained by members of the Michigan State Police Voiceprint Identification Unit is a unique asset which should provide a fundamental guide for the tests and interpretations to be done in the Development project. Although previously funded, the Michigan work is not supported by federal funds at this time.⁽⁴⁾ LEAA should support the Michigan work in order to assure that the Development Group project has the best available "real world" inputs. LEAA should also encourage wider use of the techniques which have already proven their investigative value.

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