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Words and the Intelligence Value of Conversations

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Increasing attention is being paid to the problem of automatic word recognition as a possibility to cope with vastly increased amounts of intercepted voice traffic. This article points to the need to develop an effective way to exploit the word recognizer and offers some suggestions.

When we succeed in developing a device that will recognize individual words in an intercepted conversation, we will have solved some incredibly difficult problems. But we will not yet be home free, for there remains the problem of how to employ such a device. Undoubtedly there will be a limit on the number of words it will recognize, and early models will likely be able to cope with only a small number indeed. The problem then is to select the best words for the purpose, for a task that involves recognition but not understanding.

It is not easy even to define what is meant by a word. In its written form, the word is easy to recognize: it has a space in front of it and another behind it. In its spoken form, however, there is no such simple solution. In rapid speech there may be no pause at all in a sentence of considerable length. At the other extreme, in slow-motion speech, it is possible to insert brief pauses between syllables. Words cannot be defined as the smallest units of meaning (Aristotle defined the word as "the smallest significant unit of speech"), for in most languages the word itself may be modified by adding on or inserting a plural meaning or a past-tense meaning, etc. This means that the word *door* has one meaning, the ending _____s has another, plural meaning, and the new word *doors* is the sum of the two meanings.

Even if we cannot offer a foolproof definition, we do know what words are. They are small units of meaning that can be manipulated, exchanged for one another, and, if chosen correctly, express precisely what the speaker had in mind.

We can communicate without words, of course, but not very satisfactorily or extensively. Laughing, crying, gesturing, signaling, etc., all can convey meanings, but to a very limited degree. Animals may *vocalize*, and the cow's moo at milking time is certainly expressive. But

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only humans verbalize. Only humans have developed a highly conventionalized system of verbal noises, with an almost limitless number of verbal symbols—words—to combine and order in any manner mutually agreed upon.

Language is an instrument developed by and for a group, sometimes referred to as the *speech community*. The group may be large or may conceivably have as few as two members, as is sometimes the case with identical twins, some of whom develop their own language which they use with each other while perfectly able to converse with the remainder of the family in "standard" language. Conventions in lexicon, grammar and phonology are the bone and sinew of a speech community, and mastery of these conventions pretty much guarantees intelligibility, unless the transmission channel is just too noisy. The boundaries of a speech community are not well defined in many cases. The English speech community certainly must cover the United States, Great Britain, Ireland, Canada and some smaller places, but then the Americans, British and Irish have their own speech communities as well, and the Scots may object to being lumped with the English into the British speech community.

One may think of speech communities as being distributed both horizontally and vertically. The horizontal distribution allows for dialect and language differences resulting from geographic separation. Vertical differentiation could result from any number of causes—education, social standing, type of occupation, etc. The individual is almost never a member of only one speech community; even schoolchildren quickly learn the language of the classroom and schoolyard, and employ language there that might sound strange and inappropriate at home.

Most occupations have their own jargon. It is likely that a speech community that is made up of practitioners of a trade or art will alter its speech only in its lexicon, leaving phonology and syntax pretty much alone. So although we complain when we enter a new field that we have to learn a "whole new language," we really mean only the words.

Lest the impression remain that the only movement we see in this area is toward a diversity of speech communities, it is worth noting that in the United States, among peoples highly diversified both racially and ethnically, a single language community was developed in a relatively short period of time. Pockets of non-English remain, but they are lost in the great expanse of common language on the continent. Many of the same forces for uniformity are still at work today, as they are in all speech communities. One of the best known societal behaviors toward language is standardization, or in the jargon of the

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sociologist, "the codification and acceptance, within a community of users, of a formal set of norms defining 'correct' usage."¹

With minimal effort, each of us could list a surprisingly large number of speech communities to which we belong. Some are open to all: one can be familiar with hundreds of highly specialized sports terms as a result of frequent and careful perusal of the sports pages of the newspaper. Think of all the words in golf, in baseball, in football, that are almost as familiar to the interested spectator as to the participant. Other speech communities are exclusive: the jargon of SIGINT is not likely to become common property outside the cryptologic community and authorized recipients of its product. Some societies have separate languages for men and for women, and each remains secret within the appropriate group. Some exclusiveness is tied to social level, and words and expressions that suit one group may be frowned upon as affected or at least inappropriate for another.

Some of the pet expressions of yesterday's teenager may only dimly resemble those used by the youngsters today. The language of the drug culture of the '60's undoubtedly influenced much of the young people's speech, so that "to crash by the side of the road" merely meant to pull off to the side to grab forty winks. And where there is a generation gap, it is probably accentuated by the differences in language. No one born about 1920 would use the phrase "23 Skiddoo" except derisively, and no one born after 1940 would be likely to say "It don't mean a thing if it ain't got that swing" under any circumstances.

All languages use words, but what passes for a word in one language may not make the grade in another. For example, a single word in Paiute, and American Indian language, is (according to Edward Sapir): "wii-to-kuchum-punku-rugani-yugni-va-nut-m(u)," which may be translated literally as "knife-black-buffalo-pet-cut up-sit (pl.) future-participle-animate plural." Translated more freely, it reads: "they who are going to sit and cut up with a knife a black bull or cow." There is a distressing number of other languages that also tack on prefixes and suffixes to a root in such a way as to express complex ideas with what is really only a single word.

In spite of the widely heard admonition, "Think before you speak," we tend to think in words most of the time, and unless we edit in advance, the thought and the spoken word are virtually simultaneous. In an attempt to discover the value of words in the thinking process, the Soviet psychologist Luria conducted an experiment in Leningrad in

¹Wm. A. Stewart, "A Sociolinguistics Typology for Describing National Multilingualism," in J. A. Fishman (ed.), *Readings in the Sociology of Language* (Mouton, The Hague, 1968), pp. 531-545.

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which children between one and 2½ years old were presented with small red and green boxes. The green ones were empty but the red ones contained candy. The children had trouble picking the right boxes, and the next day the correct choice had to be worked out all over again. The picture changed completely, however, when speech was introduced. Learning proved to be not only quicker and more permanent, but was also more readily transferred to situations in which different objects were used.² Another Soviet psychologist, Vygotsky, was so impressed with this experiment that he redefined word as "a microcosm of human consciousness."

Some words have independent meaning, while others have only structural functions. For example:

tree	} Independent Meaning	if	} Grammatical elements, useful only in con- junction with other words
sing		it	
blue		of	
gently		but	

Occasionally a *form* word, which has no independent existence, will change roles, depending on how it is used. The word "down"—most frequently an adverb—for example, may be transformed in phrases such as "to down one's tools," or "feel down," or "Down a drink." And often a single independent word, like the noun "stick," may trigger a host of verbal ideas, like waving, standing, hitting, poking, bending, and many others.³

Even within the same speech community, a word may acquire all sorts of special meanings. Take the word "partner," with a few of its varied meanings: business partner; marriage partner; partner-in-crime. Or words with special metaphorical meanings, as in: human body; heavenly body; body politic; automobile body; wine "with body." That a word may have many and very different meanings causes no surprise, but that mathematics might be helpful in analyzing this condition may seem odd. A novel approach was developed by Zipf, who claimed that "the number of different meanings of a word is equal to the square root of the frequency of usage of the word,"—Zipf's Law.⁴

In contrast with the variations in meaning acquired by a single word—*polysemy*—the matter is complicated, in the spoken language

²A. R. Luria, *The Role of Speech in the Regulation of Normal and Abnormal Behavior* (London, 1961), pp. 10-11.

³At the war crimes trials after WWII, a Japanese former prison camp guard was asked by the prosecutor whether he had beaten the prisoners with a *stick* or a *club*. The poor translator had a terrible time differentiating in Japanese. So "stick" carries yet another connotation, in English at least.

⁴George K. Zipf, *The Psycho-biology of Language* (Cambridge, Mass. 1965).

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by *homonyms* and *homophones*. Homonyms sound alike and are spelled in the same way, as in *bat* (flying mammal) and *bat* (stick used in baseball). Homophones sound the same but are spelled differently, as in *pear*, *pare*, *pair*. Although derived from different sources, unlike the case in polysemy, these words sound exactly alike.

What does all this mean for word-recognition as a tool for processing intercepted voice? Can the presence of a word, or a group of words, or a phrase, be used as a device for determining what a conversation is likely to be about? Can a *selection/rejection* system be built around automatic recognition of a limited number of spoken words? Is it possible to exercise selection in voice traffic without understanding the *content* of conversations but merely by determining whether or not certain words were spoken?

It is clear that each society contains speech communities employing specialized terminology, and this tendency to form such communities appears to be universal.

"Whenever social circumstances lead to the formation of a distinct group within the whole body of a society, or of distinct common characteristics and functions for a category of the population, the people involved will tend to develop, or deliberately devise, speech forms of their own."⁶

Here, surely, is an opening for the word-recognizer. Regardless of the specific subject discussed, it should be possible to surmise with some accuracy what speech community is represented. And if one accepts the idea that there are communities within communities, then it would not be unreasonable to expect that one could progress from identifying the speakers as:

Military → Ground Forces → Artillery, or
 Military → Air Force → High rank/low rank

In the last instance, why else would one of the parties in the conversation keep repeating, "Yes, sir," "No, sir," "I'll take care of it right away, sir"?

Subject matter and speech community may coincide and often do in industrial and technological contexts. Therefore, the very existence of certain types of words in a conversation should lead to the conclusion that there is a good likelihood that the speech community, and therefore the subject, represented by such words is present. The jargon of shipbuilding, of petrochemicals, of diplomacy—any of these would be a good lead if those were selection criteria. And conversely, if rejection

⁶Joyce O. Hertzler, *A Sociology of Language* (New York, 1965).

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of large masses of traffic is required, words characterizing speech communities that do not warrant listening to could provide the necessary leads.

It seems clear that each society may be expected to develop a large number of special languages corresponding roughly with social and educational stratification, multitudinous special interests, and the tendency to divide into functional specialties. The ever increasing and diversifying special categories of scientists, technicians, academics and bureaucrats must have specialized terminology to survive, although some may abuse this privilege and become obscurantist and ridiculous.

The potential of the word for identifying the speech community represented by the speakers in a conversation should not obscure the potential value of other clues to the nature and value of the conversation. Telephone numbers, whether dialed or spoken, speaker identification, intonation patterns, and a number of other features, external to the actual understanding of what is said, could also be of value. It may be expected, however, that vertical differences in speech communities will be largely, if not mostly, characterized by differences in word usage, and words may be our best clues as to the nature and therefore the probable intelligence value of any conversation.

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