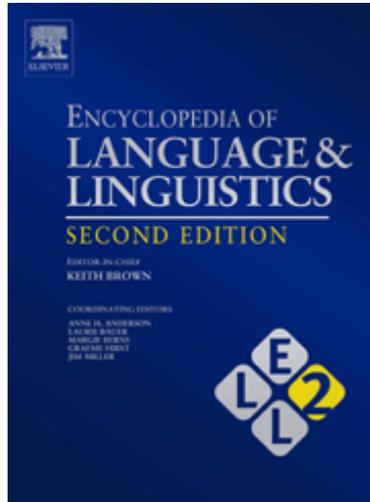


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with a full academic status” (Louw, 1991: 19). In his retirement years Westphal left linguistics to join his second wife in her efforts to save penguins that had been victimized by oil spills.

See also: Bantu Languages; Doke, Clement Martyn (1893–1980); Guthrie, Malcolm (1903–1872); Tucker, Archibald Norman (1904–1980).

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Whistled Speech and Whistled Languages

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Introduction

Several populations all over the world have naturally developed a whistled form of their local language in response to isolated conditions in their everyday life.

Whistled speech is a system of communication based on whistles modulated according to features in common with the spoken equivalent. Therefore, it is a vehicle for articulated language in the true sense of the word.

The fact that the information is quite unintelligible to untrained speakers long made whistled languages objects of mystery, even if their existence was reported since the treaty of the Tao in Asia (6th century B.C.) and since the 14th century in the island of La Gomera (Canary Islands). It is also the reason why so few researchers became interested in this alternative way of transmitting messages in a linguistic attitude.

The first scientific studies concerned mainly anthropological aspects (Quedenfeldt, 1887; Lajard, 1891; Labouret, 1923), and it is only in the last part of the 20th century that serious attempts of describing their phonetics and acoustics have been made (Cowan, 1948; Classe, 1956; Busnel *et al.*, 1962; Busnel and Classe, 1976). More recently an

international network of scientific researchers and local traditional authorities has been developed in a collaborative way (Meyer, 2004). This approach has emerged both from (a) the wish of some minority populations to revive, document, and transmit their threatened oral traditions and (b) the scientific assessment that these forms of communication provide significant information thanks to an alternative point of view of the phenomenon of language.

Diversity of Linguistic Production

Whistled forms of languages have been found in most of the main linguistic families. They rely mainly on a whistling technique and on a strategy of encoding, so every oral language may be whistled. Even some languages imported by waves of domination have been spontaneously adapted into a whistled equivalent, like Spanish Silbo of La Gomera, which evolved from a whistled form of a now extinct Berber language called Guanche.

Phonology and Phonetics

Linguists and acousticians noticed that two main ways of whistling a language have been developed. For tonal languages like Highland Mazateco, the pitch level of the main band of frequencies of the whistles characterizes the composition of the phonemes: in this case, whistles are focused on suprasegmental features and reproduce mainly the fundamental frequency of spoken

languages. For nontonal languages like Spanish or Turkish, the pure frequency of whistles reproduces mainly segmental features of the language: the vowels are emitted at different pitch levels (the whistled series [i e a o u] results in descending pitches whereas modulations of these pitches convey the consonantal information. These consonantal modulations, when represented on sonograms, have a strong resemblance to the second formant of the spoken equivalent (Brusis, 1972; Busnel and Classe, 1976). This has been explained in terms of articulation. The transitions of the consonants are influenced by the pitch of the neighboring vowels, their whistled loci being reported to another set of frequencies (Leroy, 1970). This similarity, which has been partially studied in Spanish Silbo and in Turkish, is not systematic, is obvious in occlusive transitions, and tends to disappear in rapid whistles.

The constraints imposed by whistling techniques when articulated affect the phonetics and phonology. The whistled forms of languages have therefore been identified as abridgments of speech that encode essential parts of human languages. For example, in nontonal languages, there is a reduction of the number of vowels (to three or four main bands of frequencies representing the vowels) and consonants. In most tonal languages, the whistles reproduce tones and glides but not vowel qualities.

Lexicon

The vocabulary of whistled forms of languages reflects the basic knowledge of the vocal spoken language and has potentially the same richness. Whistlers culturally use a preferential set of words that correspond to their everyday activities. As a result, the dictionaries of common whistled words that have been gathered by researchers (Moles, 1970; Busnel and Classe, 1976) appear to be more restricted than the spoken dictionaries (there are approximately 2000 common words in La Gomera).

Whistles as a Tool for Linguists

Many linguists use whistles in their fieldwork as a tool to help them to sharpen the tonal description of their phonological modeling (even if the language has no naturally developed whistled system). The whistles might be used to focus on tonal rules (Cowan, 1948; Rialland, 1980) but also to look for any tonal aspect in a language described as nontonal (Caughley, 1976).

Geographical and Social Environments

Whistled languages have naturally developed in response to the necessity for humans to communicate

in conditions of relative isolation (distance, night, noise) and specific activities (social information, shepherding, hunting or fishing, courtship, shamanism). Therefore, they are mostly related to places with mountains or dense forests. Southern China, Papua New Guinea, the Amazon forest, subsaharan Africa, Mexico, and Europe encompass most of these locations.

Native whistlers who have grown up in places where a whistled language was used daily do not remember when they began to control this aspect of the language. The learning process is the result of a phase when the person is immersed in a linguistic environment mixing whistled and spoken speech. Therefore, the whistled speech is locally simply seen as one of the multiple means of expressing the local language, like whispering, shouting, or singing.

Whistling Techniques

Many techniques have been described among the populations who whistle their language. The choice of a specific technique is first of all dependent on practical concerns. Bilabial and labiodental techniques are common for short and medium distance discussions (in a market, in the noise of a room, or for hunting); whereas the tongue retroflexed, one or two fingers introduced in the mouth, a blow concentrated at the junction between two fingers or the lower lip pulled while breathing in air are techniques used to reach high levels of power for long distance speaking. Each place has its favorite trend that depends on the most common use of the village and on the personal preferences of each whistler. Whistling with a leaf or a flute is often related to courtship or poetic expression (reported in the Kickapoo language in Mexico [Ritzenhaller and Peterson, 1954] and in the Hmong [Busnel *et al.*, 1989] and Akha [Meyer and Dentel, 2003] cultures in Asia). We may notice that the finger and the leaf can be seen as the first steps toward the use of an instrument (like jewharps, flutes, and drums to produce instrumentally played speech (Stern, 1957; Meyer, 2004).

Whistling techniques do not require the vibration of the vocal cords: they produce a shock effect of the compressed air stream inside the cavity of the mouth and/or of the hands. When the jaws are fixed by a finger, the size of the hole is stable. The air stream expelled makes vibrations at the edge of the mouth. The faster the air stream is expelled, the higher is the noise inside the cavities. If the hole (mouth) and the cavity (intra-oral volume) are well matched, the resonance is tuned, and the whistle is projected more loudly. The frequency of this bioacoustical phenomenon is modulated by the morphing of the

resonating cavity that can be, to a certain extent, related to the articulation of the equivalent spoken form.

Signal Characteristics and Audibility

The pitches of whistles are concentrated in a narrow bandwidth (1000 Hz to 3000 Hz) where the hearing in human beings is more sensitive and selective. The amplitude of whistled speech has reasonable limits in its dynamic range (less than 12 dB) whereas the range of spoken speech is more than 50 dB. In natural conditions the background noise is weak in high frequencies (except in windy weather) so the signal to noise ratio is better than 6 dB at 1 km and is enough to be clearly heard. Such properties explain the use of whistles in conditions of noise or long distance communication as they increase the resistance to background noise. Whistles are well carried in valleys, which form a natural guide. For example in La Gomera the signal remains understandable at 8 km (Busnel and Classe, 1976).

Intelligibility

One interesting and key aspect of whistled languages is their intelligibility. It is a principal functional parameter. Performance on recognition tests emphasizes the role of context (natural conditions of use) as an important aspect of the recognition task. Moreover, since the most common words are much more easily understood than others, there is a correlation between situational vocabulary and perception. The choice of words is targeted at phonetic clarity (in terms of whistled speech). At the same time, homophones between words are avoided, at least in the context of the topic.

Some perceptual tests, made on nontonal forms of whistled languages, have shown that good whistlers can recognize phonemes of their language in audio signals of other languages.

An early study in neuroscience has shown that the brain areas of production (*Broca*) and perception (*Wernicke*) of language are activated in well trained listeners (former whistlers), but not in untrained ones, when they are presented with *Silbo* (Carreiras *et al.*, 2005).

Comparison with Language Perception of Persons Whose Hearing Is Impaired

Similar remarks concerning intelligibility can be made with people whose hearing is impaired. They have only some perception in low frequencies (corresponding to the prosodic patterns carried by the

fundamental frequency and transposed in whistled speech) and use lip reading. To understand the meaning in a real time, their cognition task must test and verify many hypotheses in response to very poor phonetic cues (visual and auditory) in a strong context reinforced by many inputs such as: the topic (history, theme, and rhema), the situation (here and now), the relation with the talker (actual and past), and the feedback returned from the partner (well or not received).

Language Evolution and Whistled Language

Many aspects of whistled languages make them good candidates for the study of the evolution of languages. Their strong link with the ecological environment and their use in isolated conditions resulted in an adaptation to the performance of the hearing system and to the acoustical characteristics of both the producing system and the acoustical area. Their use in emergency situations or in contexts related to the local tradition has clear effects on lexical use. Moreover, a whistle is rich enough to transmit the essential aspect of the languages of the world without requiring the intervention of the vocal cords. The transfer of the whistling technique from one local language to another makes this practice resistant to language domination provided that the traditional way of life is maintained. In some locations, the whistles and some musical instruments are used both for transmitting messages of linguistic attitude and for traditional music. The careful analysis of the phonetic degradation of whistled and instrumentally played languages in the places where they are endangered is in progress (Meyer, 2004).

Bilingual Diversity Endangered

Whistled languages are a reliable human indicator of the vitality of the traditional way of life of the cultures that developed them. The gradual disappearance of activities like shepherding and the aging of rural populations are the main reasons for the extinction of an articulated whistled form in France (Aas). Most whistled languages are almost extinct due to the combined effects of the depreciation of the local culture and of the rural exodus. The gradual disappearance of whistled speech and its scientific interest underline the fact that linguistic biodiversity and cultural and scientific richness are both shrinking.

In some particular places, this tendency has already been reversed. For example, in the Canary Islands, the process of revitalization carried out by elders on a voluntary basis has recently been supported by local

education. In Mexico, some indigenous local councils have made the oral tradition one of their priorities, including local dances, traditional medicine, and whistled speech in their language.

See also: Cognitive Anthropology; Cognitive Linguistics; Endangered Languages; Limits of Language; Minorities and Language; Participatory Research and Advocacy; Semantics of Prosody.

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Whitney, William Dwight (1827–1894)

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Whitney was born in Northampton, Massachusetts, on February 9, 1827, and died in New Haven, Connecticut, on June 7, 1894. He is best known as a general linguist and Sanskrit scholar. He was the brother of the geologist Josiah Dwight Whitney (1819–1996), after whom the highest mountain in the United States (excluding Alaska), Mount Whitney, California, is named, and William Whitney's early interests lay in the natural sciences, notably ornithology and geology. It is therefore not surprising that he introduced into linguistic theory and practice notions derived from geology, which he had absorbed from Charles Lyell's

voluminous *Principles of geology* (1830–1833) and other scientific writings, notably the concept of 'uniformitarianism.' His education included a period at Williams College, New Haven, Connecticut (1842–1845), after which he devoted himself for three years to bird- and plant-collecting. Part of his collections subsequently went into the Peabody Museum of New Haven.

However, books on comparative philology, especially Sanskrit, which his elder brother had brought back from Europe, attracted his interest, and after another stint with the U. S. Geological Survey, he enrolled at Yale College in 1849. A year later, he left for Germany, studying at the University of Berlin with Franz Bopp, Carl-Richard Lepsius, and Albrecht Weber, and at Tübingen with Rudolf von Roth for almost three years (late 1850–July 1853). Whitney