SOUND SYMBOLISM IN !xóõ

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ABSTRACT

Studies in Sound Symbolism have showed that the phonetic characteristics of birds, fish and mammals names suggest the workings of universal sound-symbolic processes. This paper describes an experiment with !xóo data, a southern Khoisan language, to test these claims. Clicks are almost perfect objects for this kind of study because of their intrinsic acoustic properties. Results show that contrary to most studies showing that high frequency is the most important acoustic parameter to symbolize bird names, one must also take other factors into account, i.e. timing and intensity.

1. INTRODUCTION

Sound symbolism has been studied by a number of researchers in the past (Jespersen [1], Sapir [2], Wescott [3], Ultan [4], Jakobson and Waugh [5]) but recently there has been a number a new studies on the subject, such as Hinton et al. [6], Kawada [7] and Berlin [8], [9]. Berlin has shown, from studies in ethnozoological nomenclature, that in Huambisa (a North Central Peru language belonging to the Jivaroan language family) there is a strong correlation between bird names and segments having high frequencies in the acoustic spectrum of their first syllables. These segments are high front vowels having a high F2 and consonants having high frequency bursts. This claim is based on an experiment made with lexical data from bird and fish names. The experiment had the form of a basic word-matching test where pairs of terms from an unknown language were presented to subjects who were required to match them with words for familiar concepts in English. From the complete inventories of bird and fish names a representative sample of 50 pairs of words was produced, each pair comprising the name of a fish and the name of a bird, arranged in random order. Results and conclusions showed that the phonetic characteristics of the bird and fish names in Huambisa suggest the workings of universal sound-symbolic processes. Birds and fish names differ on the basis of the differential distribution of phonetic segments of high and low acoustic frequency. Bird names show a disproportionate number of segments that are of high acoustic frequency.

One of the main questions about Berlin's experiments is to know if these findings about universal sound-symbolic processes can be found in other cases and how these findings should be interpreted. One possible explanation has been elaborated by Ohala [10] who proposes a universal and innate cross-species "frequency code" where high Fo conveys the meaning of smallness and low Fo conveys the meaning of largeness.

Berlin's hypothesis has been tested in different ways, e.g. by Bettex and Demolin [11], but it seems that the almost ideal test for his hypothesis is to use clicks from Khoisan languages. Indeed, Traill [12] has shown that !xóõ clicks fall into two classes, depending on whether their burst noises are either abrupt and short or noisy and long. The former have very fast rise time of about 1 ms and are about 8ms long, whereas the latter have a crescendo-like onset of acoustic energy lasting about 25 ms. This allows to classify clicks according to the acoustic features of abruptness and spectral tilt (cf. table 1, figure 1 and figure 2).

	bilabial ʘ	dental ǀ	lateral ǁ	palatal ǂ	alveolar !
abrupt	-	-	-	+	+
high frequency	-	+	-	+	-

Table 1: click classification according to the burst.

Traill also mentions that although the two classes of abrupt and noisy clicks are almost always reliably distinguishable from one another, it is by no means obvious from the examination of acoustic spectra of particular tokens how all clicks are to be precisely distinguished on the frequency dimension. Another important point about clicks is made by Sands [13] who claims that they are immune to all forms of coarticulation except that of anticipatory rounding. The variability seen in the click spectra must therefore be internal to the articulation of the click itself. Thus the role of spectral emphasis is not trivial and makes clicks an ideal object to test Berlin's hypothesis.

2. MATERIAL AND METHOD

In order to test Berlin's hypothesis a list of bird and mammal names was collected in the Kalahari desert in Botswana, among the !xóõ San (Traill [14]). This inventory contains a list of 140 bird and mammal names. All names were pronounced by a !xóõ speaker and were recorded on a DAT tape. Then the names were arranged in random order. The experiment focused on clicks because of their salient word initial character. This fact makes clicks an almost perfect objet to test Berlin's hypothesis. Vowels are not taken into account in this study because the different types of vowels following clicks in the list are limited to three [a], [o], and [u]. Consonants also have no influence on the study because the consonantal environment of clicks is always velar or uvular. Consequently we can consider that consonantal environment is neutralized.

The distribution of clicks in the lexical list is made as follows: bird names have a majority of alveolar clicks (31.5%), followed by lateral clicks (29.3%), dental clicks (20.7%) and palatal clicks (18.5%). The bilabial click is absent of the inventory of bird names. Mammal names contain 33.3% of dental clicks, 23.3% of lateral clicks, 16.7% of palatal clicks and 13.3% of bilabial and alveolar clicks.

The 140 names were typed as a list and organized as a booklet of five pages. A standard spelling was used to represent all names, although clicks were represented by their IPA symbols. The instructions for the experiment appeared on the first page and read as follows: "The following list of words are terms for birds and mammals from a Khoisan language of the Kalahari desert. Please mark the word that you believe sounds like the name of a bird with O and the word that you believe sounds like the name of mammal with M". The test was administrated to 105 French-speaking students of the Université Libre de Bruxelles. When the booklets were distributed, the experimenter read the instructions and played the tape with !xóõ names. Each name was repeated twice. The whole experiment lasted approximately for ten minutes.

3. RESULTS

Results indicate that subjects have a 44.06% accuracy rate in correctly distinguishing (or identifying) bird names from mammal names. This level of accuracy is not very high, but is better than chance and is extremely statistically significant (p<.01). This statistical test is a normal test to approach the binomial.

48 of the 142 names were correctly identified. Among them there are 31.3% of bird names and 54.8% of mammal names. Recognition rates vary from 51.% to 94.3% (cf. table 2).

Recognized bird names		Recognized mammal names	
kâ qá̰le'ǁnā̰hn	51,43%	!ào-sè	53,33%
!'àa !'àa-sè	51,43%	ǂnṵ̂je	57,14%
ǁòa - ǁòa -sè	52,38%	ǁqhūũ	58,10%
!gúũ ǀhúũ	52,38%	!nâ̰la	59,05%
gūu kâ ká'ã	52,38%	ǂxūa	61,90%
qûje	53,33%	ǁûa	61,90%
!úluǀàhe-sè	54,29%	gùmi	62,86%
!âo ǂnúi	57,14%	dòõ-kà	64,76%
ǂā̰hi - ǂā̰hi	60%	'!nò̰ho	66,67%
ǀà̰hm !ūli	60%	gùmi à̰a	68,57%
qṵ̄hi	61,90%	ʘhán	70,48%
!ūũ kú !húũ	61,90%	!nūũ	71,43%
ǀ ɢùi	62,86%	ǂxàm	73,33%
tō̰ho - tí	63,81%	ts'àa-tê	73,33%
!àhã kú	66,67%	'ǀnùũ	74,29%
!nōhlo	68,57%	ǁgāhũ	75,24%
dzá̰ba ˥hi	68,57%	ǁgà'ã	78,10%
ǁ'ái- ǁ'ái-sè	68,57%	ǁgū'm	79,05%
!úbi lí !ái	71,43%	ǀxòo tsàhna	81,90%
ǁài	72,38%	!qāhũ	82,86%
qùi	78,10%	tsàhna	83,81%
q'àbi	79,05%	ǁnà̰hbe	86,67%
gūlu kūu gú'ũ	81,90%	gǀxá'm-bè	90,48%
kúu-kúu	90,48%		
ts'úli-ts'úli	94,29%		

Table 2. List of recognized bird and mammal names in !xóõ classified in term of their recognition rate.

Recognized bird names (cf. figure 3) contain a majority of alveolar clicks (48%). In addition they have 24% of lateral clicks, 16% of dental clicks and 12 of palatal clicks. The bilabial click is never recognized among bird names. Among recognized mammal names (cf. figure 4), there are 33.3% of lateral clicks, 22.2% of dental and alveolar clicks, 16.7% of palatal clicks and 5.6% of bilabial clicks.

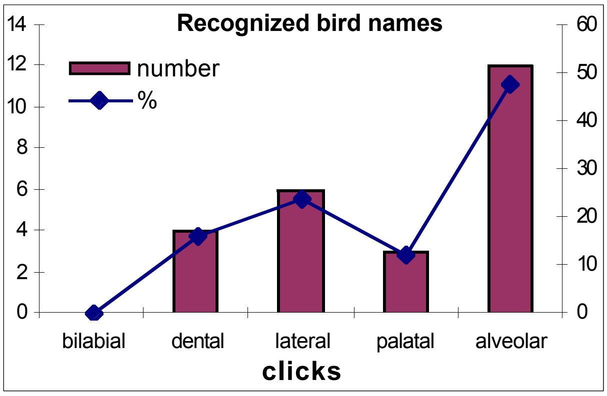

Figure 3. Distribution of clicks in recognized bird names.

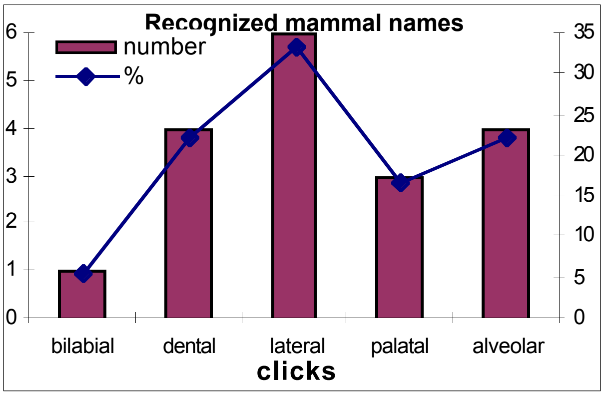

Figure 4. Distribution of clicks in recognized mammal names.

4. DISCUSSION

As mentioned above, Traill [12] has shown the main characteristics of the five !xóõ clicks in term of their acoustic properties of spectral tilt and abrupt onset. According to this classification two clicks are abrupt, the palatal [ǂ] and the dental [ǀ], while the bilabial [ʘ], alveolar [!] and lateral [ǁ] clicks are noisy. In addition the dental and palatal clicks have a high frequency spectral tilt.

If high frequencies characterize bird names, one would expect the two most frequent clicks for bird names to be the dental and the palatal, the latter the most frequent because it has both a high and abrupt frequency tilt. On the other end one would expect the lateral and the bilabial clicks to be the most recognized for mammal names. Indeed these last two clicks are neither abrupt nor produced with a high frequency spectral tilt.

The distribution of clicks in the list of recognized bird names confirms only partially Berlin's hypothesis. In fact, it is the alveolar click that is the most clearly associated with bird names, 48% in recognized names and 31.5% in the lexical list. In the case of mammals, as foreseen by the hypothesis, it is the lateral click that is the most recognized, with 33.3%. But in the lexical list it is the dental click that is the most frequent, with 33.3%. Note that the bilabial click, which is absent from the lexical list of bird names, is never identified with bird names in the experiment. In Traill's [12] perceptual experiments it is also the least recognized.

The main stake with these results is to know whether the acoustic characteristics of the alveolar click allow explaining why it is preferentially associated with bird names. The association of the alveolar click with bird names in the results of the experiment seems to go against what was expected from Berlin's hypothesis. Indeed if high frequencies are the main acoustic feature involved in bird name recognition, one would obtain more important identification rates for the dental and palatal clicks. As can be seen in figure 3, the only predominant click is the alveolar click. The other clicks obtain much weaker and comparable identification rates. Consequently it is possible to imagine that other features are involved in the perception and identification of the alveolar click. Results from the perceptual experiments made by Traill [12] indicate that there might be other parameters playing a part in the discrimination and identification of clicks. Traill himself notes that although the two different classes of clicks are almost always distinguishable from one another, it is not obvious at all to decide from acoustic spectra how these clicks are distinguished on the frequency dimension.

Traill's perceptual experiments in !xóo show interesting results. Indeed, one can observe that only the alveolar click is sensitive to a decrease of intensity. Traill's data show clearly that if the stimuli presented to the subjects of his experiments are decreased in intensity by 5dB steps, the margin of variation of the alveolar click is rather weak compared to that of the other clicks, a decrease of intensity almost never changing their identification. In the case of the alveolar click, a 20 dB decrease of the stimuli intensity turns the alveolar click into a palatal click. Therefore these results seem to suggest that the intensity of the clicks combined with their temporal realization, abrupt or noisy, are important parameters for the identification of clicks.

This suggests that the sound symbolism coding of bird names is not only made in terms of high or low frequency, but that temporal and intensity aspects must also be taken into account. It is the brief and intense aspect that seems to associate the alveolar click with bird names, and not only the frequency parameters that in this case seem to be less relevant.

5. CONCLUSION

An experiment on sound symbolism made in !xóõ partially confirms previous work made by Berlin [8], [9]. Results of the experiment allow to refine Berlin's hypothesis, which was focusing on frequency aspects, while results in !xoo suggests that other factors such as intensity and timing must also be taken into account, the latter parameters being as important as frequency.

In addition, Traill's work on the diachronic evolution of clicks brings a linguistic confirmation to this phenomenon. Indeed, his data show that when the alveolar click weakens, it changes into [k], i.e. precisely into the prototypical consonant underscored by other experiments in sound symbolism concerned with bird names, e.g. Berlin [8], [9] and Bettex and Demolin [11]. If one refers to the acoustic characteristics of the voiceless velar stop [k] (energy of the burst, intense and long, concentrated in a narrow band of the spectrum [15]), it is possible to say that in the change from [!] to [k], there is no weakening of the articulation but rather there is a preservation of the articulatory strength.

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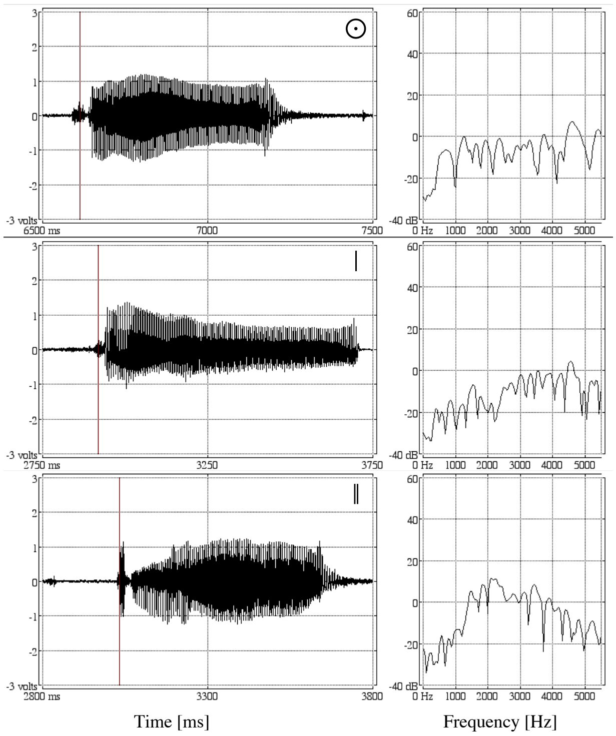

Figure 1. Waveform showing the three noisy clicks in three different !xóo words. The right side of the figure shows the spectra for the click taken at cursor position.

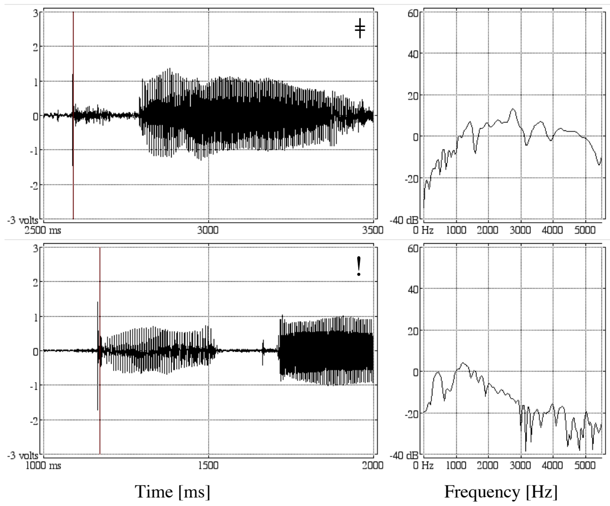

Figure 2. Waveform showing the two abrupt clicks in two different !xóo words. The right side of the figure shows the spectra for the click taken at cursor position.