Prelinguistic Vocalizations: Relations between Function and Pitch

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ABSTRACT
La présente étude explore les relations entre les fonctions communicatives des vocalisations pré-linguistiques et deux aspects prosodiques tels que le contour final de la fréquence fondamentale ainsi que son hauteur moyenne, minimale et maximale. Les productions vocales de dix enfants, âgés de 16 à 24 mois, ont été analysées. Les résultats définitifs confirment (1) la courbe descendante est le plus commun; (2) la courbe ascendante est relativement plus fréquentes dans le cas de certaines fonctions, telles que les demandes qui exigent une sorte de réaction de l'interlocuteur; (3) les fonctions basiques de communication peuvent être différenciées par leur hauteur moyenne, minimum et maximum, et finalement; (4) les vocalisations communicatives ne peuvent pas être différenciées de celles non communicatives par leur courbe intonative finale; et (5) il est possible de les distinguer en fonction de leur moyenne, minimale et maximale fréquence fondamentale.

1. INTRODUCTION

Prelinguistic vocalizations can be defined as infants’ vocal productions understandable by parents. These early productions may or may not have segmental content (phonologic) though they always suppose suprasegmental aspects, manifested by a prosodic group of variable duration [Lop05]. Based on this definition vocalizations comprehend—but are not limited to—productions such as infant babble.

Vocalizations have not received the attention one would expect, mainly, because of the difficulty their analyses and codification imply [Nat01]. This difficulty derives from the fact that these productions often lack a phonology susceptible of linguistic transcription and, also, from the secondary place that prosody has been relegated to for long.

Nevertheless, this early vocal production supposes a basic step in language progression since some of the elements that can already be observed in this primary stage are to be acknowledged later when the first words come into scene [Vih85]. Babbling, then, although somehow mistakenly defined as chaotic and discontinuous by Jakobson [Jak41] and which constitutes only one of the manifestations of prelinguistic vocalization, plays an essential role in the process of early language acquisition.

It is prosody that paths the way into communication. Pitch or intonation can be interpreted as the first association between form—a prosodic contour, for example—and meaning—a communicative or pragmatic intention. It is via prosody, then, that pragmatics or the basics of communication are to be acquired. This allows for the future development of the syntactic aspects of language.

In order to determine the relation between the prosodic aspects and the communicative function of a vocalization, one must, in the first place, establish what it takes for a vocalization to be regarded as communicative. Towards the end of the first year of life, infants increase the number of communicative intentions they are able to express using gestures or vocalizations or both combined. So by the time they start producing their first words, they have already been communicating intentionally for some time. The new communicative intentions that can now be expressed via words—and still vocalizations—add to the previous repertoire [Gib79].

In the present case, a vocalization is considered communicative based on parameters involving the child’s attitude and behaviour as well as the parent’s. Parent and child are interacting on a regular basis, which allows for them to share a common ground, some expectations and knowledge, which organize their communicative exchanges.

The parameters considered are also important when establishing the pragmatic or communicative function of the vocalization. On the child’s side, we looked for gaze direction, orientation of body—specially arms or hands—, persistence of the vocalization until the goal was achieved, and reformulation of the communicative behaviour if the child’s goal remained unreached. On the parent’s side, we paid special attention to the interpretation made of the child’s vocalization, manifested by his/her response to it. This was a very useful clue. Parents are the first interlocutors the child has. They not only interpret what the infant is trying to “tell” them but they may also reinforce the communicative efforts of their child in a specific direction, by giving some kind of reinforcement or, even, by failing to understand her sometimes, which results in the child’s goal being unsatisfied and the child being forced to try again in a different way.

Being prosody one of the first linguistic components to develop, it was expected to find early associations between final pitch contour and fundamental frequency measures, on one side, and communicative function, on the other.
2. Method

2.1. Participants
Ten children (7 boys and 3 girls), with ages ranging between 16 and 24 months (average=20 months), participated in this study, along with a close relative (mother, father, aunt). All infants were Spanish-speaking, living in Madrid, Spain. The initial sample of 12 subjects was reduced to 10 because of technical problems involving the recordings of 2 of the infants.

2.2. Data collection
The 10 infants were video recorded at their homes interacting with a close relative. Each child was recorded once for approximately 20 minutes.

Information regarding the contextual coordinates of each vocalization (what was the child doing before, during and after vocalizing, what was the adult’s reaction to this, and what was the child’s response to the adult’s reaction) was gathered from the observation of the videos.

3. Data analysis
196 minutes of recordings were analysed. This gave a total of 1733 vocalizations, of which 1601 were classified as communicative. The analysis unit employed was a pragmatic one: a unit or vocalization was identified with an infant’s production for a pragmatic purpose. In most cases, this pragmatic unit corresponded with a breath group, the portion comprehended between inspirations, most commonly manifested by pauses in the child’s speech [Kar03]. Laughter, crying and vegetative sounds were excluded from the final data sample.

3.1. Classification of vocalizations
The communicative vocalizations, which constitute our main database, were assigned a specific communicative function. From an original pool of 22 communicative functions, elaborated on the basis of the existing bibliography and the observation of these particular videos, 6 main functions were determined. (table 1)

<table>
<thead>
<tr>
<th>Function</th>
<th>Definition</th>
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<tr>
<td>Request</td>
<td>The infant seeks to achieve something from the adult, an object, an action, an answer or his attention.</td>
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<tr>
<td>Declarative</td>
<td>The infant seeks to direct the adult’s attention towards an object, action, person or character.</td>
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<tr>
<td>Personal expression</td>
<td>The infant seeks to express his emotional reaction or state (positive or negative), due to the adult’s initiative or an external event.</td>
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<tr>
<td>Mimicry</td>
<td>The infant reproduces, segmentally or suprasegmentally, the adult’s previous utterance, without reproducing its original function too. The vocalization has no other function but the reproduction itself.</td>
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<tr>
<td>Action guide</td>
<td>The infant vocalizes while performing an action in another function but the original function too. The vocalization has no other function but the reproduction itself.</td>
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Beside the final pitch contour, the other prosodic measures considered were the mean, minimum and maximum F0. The mean and minimum pitch of the vocalization proved useful to distinguish requests, declaratives and action guides. It also showed that personal expression and request vocalizations had almost the same mean and minimum pitch —with a difference of merely 5 Hertz between them (mean pitch F=8.75, p<0.001; minimum pitch F=9.43, p<0.001 ; maximum pitch F=2.71, p=0.019), (figure 1) Maximum pitch only allowed distinction between requests and conversational filling.

Non communicative vocalizations were, in this level, just labelled as such.

3.2. Acoustic analysis
Using the PRAAT programme, version 5.1.03, the orientation of the final pitch contour (rising, falling or neutral) and the mean, minimum and maximum fundamental frequency (Hertz) were determined in the case of each vocalization, communicative or non communicative.

4. Results
The request, declarative and personal expression functions together account for over 81% of the analysed infants’ vocalizations. These three functions can also be considered basic since they are the only ones occurring in all of the 10 infants studied.

Regarding the relation between communicative function and final pitch contour, the falling contour is by far the most common one, both globally and in the case of each individual function (x²=54.405, p<0.001). Nevertheless, the rising contour is relatively more frequent in the case of requests, action guides and conversational filling: the preference for the rising pitch is relatively higher in the case of these 3 functions when compared to the other three. (table 2)

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<tbody>
<tr>
<td>Falling</td>
<td>62.4</td>
<td>69.2</td>
<td>57.3</td>
<td>43.8</td>
<td>70.0</td>
<td>48.7</td>
<td>62.6</td>
</tr>
<tr>
<td>Rising</td>
<td>27.8</td>
<td>20.8</td>
<td>22.4</td>
<td>41</td>
<td>22.5</td>
<td>36.5</td>
<td>25.3</td>
</tr>
<tr>
<td>Neutral</td>
<td>9.8</td>
<td>10.0</td>
<td>20.3</td>
<td>15.2</td>
<td>7.5</td>
<td>14.8</td>
<td>12.1</td>
</tr>
<tr>
<td>Total %</td>
<td>100</td>
<td>100</td>
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Table 2: Relations between pitch contour and function.
The prelinguistic vocalizations of the 10 children studied here served 3 basic functions. All 10 children exhibited vocalizations with these 3 functions but not necessarily the other 3 (action guides, mimicry and conversational filling). Each and every one of the 10 infants was able, then, to produce declaratives, requests and express their own personalities via their vocal production. Infants were thus capable of carrying out referential acts oriented to objects, actions, persons or characters, mainly in the context of denomination dynamics motivated by their parents (for example, with the help of a coloring or story book). They were also capable of directing requests to their adult interlocutor, which allowed them to play a more active role in their social interactions in order to achieve their particular goals. It is important to remark that they not only request objects or actions but also attention from the adult, keeping him engaged in the interaction in course or starting a new one. Finally, they vocalized frequently as a way of expressing themselves, positively or negatively, in the face of an event or object introduced by the adult.

With regard to the relation between communicative function and final pitch contour, the falling pitch was observed to be the most common one, not only globally but in each functional category considered independently. All functions were marked then by a majority presence of the falling pitch contour. This could be explained by Lieberman’s [Lie84] theory, according to which the falling contour is the most natural one, because of the natural descent of subglottal pressure towards the end of the breath group.

However, a relative increase of rising final pitch contour was observed in the case of 3 functions: action guides, conversational filling, and requests. It is no surprise that requests present a relatively higher number of rising pitches: rising pitch is traditionally associated with the interpelative force of the locution and the function of a request is, precisely, to interpelate the adult in order to provoke his response. The case of action guides and conversational filling is, nevertheless, somehow obscure and remains to be explained in the future, after more specific research has been conducted. Although significative differences were found in the relations between communicative functions and final pitch contour, this last measure didn’t allow, at this evolutive moment in infancy, to differentiate the diverse functions of vocalizations: no function was performed using exclusively one final contour and no final contour was associated with a single function.

Besides the final pitch contour, 3 other acoustic measures were considered in the analysis: mean, minimum, and maximum pitch. Mean and minimum pitch proved useful to distinguish the 3 basic communicative functions and an additional one. Requests tend to have the highest mean pitch, followed by declaratives and finally by action guides. It is also important to notice that personal expression cannot be distinguished from requests based on mean pitch: they are the two functions with the highest mean pitch. It is traditionally acknowledged that requests tend to be associated with a higher mean pitch than declaratives, since requests seek to move the recipient to do something, while declaratives look to direct his attention towards something else [Mar87]. It seems reasonable for personal expression to share the highest mean pitch with requests since the former category includes such subcategories as protests or refusals, which are heavily charged with the will to move the recipient to do (or stop doing) something. The same scenario proves true when the minimum pitch is considered. However, when the maximum pitch is considered, only requests and conversational filling can be significantly differentiated: requests having the higher pitch and conversational filling the lowest one. It would seem, then, that when it comes to maximum pitch, almost all functions seem to blend in between the two extremes.

It seems pretty fair, then, to say that even in these young ages the request function tends to be associated with a higher pitch. This responds to the intention to direct the recipient’s action in a specific way. Even though when it comes to maximum pitch some differences fade away, when mean and minimum pitch are considered, requests are consistently higher pitched than declaratives and action guides, and practically the same as personal expression vocalizations.

Surprisingly, communicative and non communicative vocalizations can not be distinguished on the basis of their final pitch contour. This result could seem unexpected unless we assume non communicative vocalizations serve...
a rehearse or practise purpose, which would explain the result observed here [Wei62].

However, when the comparison was based on their mean, minimum and maximum pitch, communicative vocalizations turned out to be significantly different from non communicative ones. Communicative vocalizations exhibit a significantly higher pitch than non communicative ones (with the difference ranging between 23 and 29 Hertz). Interpolation, interlocution, seem to drive prelinguistic vocalizations in the direction of more elevated pitch [Pap06]. Parents would acknowledge and reinforce this early association between communication and higher pitch, reacting to this kind of productions interactively; but they would not engage with their infant when her vocalizations are marked by a lower, non communicative, pitch.

In conclusion, the infants studied here (16-24 months) were able to express a series of communicative intentions effectively to their adult interlocutors. Vocalizations, in which an intonational contour and a certain pitch —with or without phonologic content— serve to transmit a certain communicative intention, represent a very good and plausible starting point for the study of early language acquisition. Mastery of prosodic aspects introduces the child into major language control. It is the progressive control of his voice by intonation and tone that allows her, at this point, to be communicatively effective. This will eventually lead to a more complete phonological and, later on, syntactic learning.

The role of parents as interlocutors for the child can not be underrated. It is in the course of frequent interaction that frames of common ground emerge, in which certain routines and expectations become available for the child. It is in this context that infant’s vocal production acquires meaning and direction, and so progresses towards even more complex communicative achievements.

REFERENCES


