

Revision articles

Strategies for perception of mother tongue: from born to one year old

*Estratégias de percepção da língua materna:
do nascimento até um ano de vida*

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ABSTRACT

Very young babies show very refined language skills being able to perceive many features in adult speech. The perception of the mother tongue is essential to language acquisition. This literature review deals with speech perception skills from children under one year of age. Therefore a literature search was performed in 7 databases, in English, French, Portuguese and Spanish, in the period of 2003-2014. With this bibliographic research was possible to recognize how language acquisition occurs quickly, and that very young infants are able to use elaborate strategies to initiate such acquisition.

Keywords: Child Development; Infant; Cognition; Speech Perception

RESUMO

Bebês muito jovens demonstram habilidades linguísticas bastante refinadas, sendo capazes de perceber várias características na fala do adulto. A percepção da língua materna é, pois, imprescindível para a aquisição da linguagem. Esta revisão de literatura trata das habilidades de percepção de fala dos bebês a partir do nascimento até um ano de idade. Para tanto, foi realizada a busca bibliográfica em 7 bases de dados, nos idiomas inglês, francês, português e espanhol, no período de 2007 a 2014. Com esse levantamento bibliográfico foi possível reconhecer como a aquisição da linguagem ocorre de forma rápida e que bebês bem jovens são capazes de utilizar estratégias elaboradas para iniciar tal aquisição.

Descritores: Desenvolvimento Infantil; Lactente; Cognição; Percepção da Fala

INTRODUCTION

Recent studies demonstrate that, from a very early age, babies already show very refined linguistics abilities being able to many features in adult speech. Human newborn babies can discriminate phonetic contrasts and extract rhythm, prosodic information and elementary regularities of the utterance, which it is an essential perception for language acquisition.

By knowing better this acquisition process, the professional which works with children with difficulties to comprehend and acquire the language will be able to intervene precisely and effectively based on strategies which are observed in babies with typical development.

The objective of this article is present a review of the literature of the last 7 years, in English, French, Spanish, and Portuguese on perception of babies speech, since born up to their first year of life. During this period it is possible to observe an acquisition of motor, hearing and speaking skills; which will be essential to develop the language since it is from their perception of adult speech that babies develop skills to produce their own speech.

METHODS

In order to carry out this bibliographic review on the current research relative to language acquisition by babies until their first year of life, a database search was conducted in the following: MEDLINE/PubMed, Web of Science, Psycinfo, Embase, Scopus, Biblioteca Cochrane, BVS – LILACS, BDNF, INDEPSSI psicología, Index Psi teses, IBECS.

The search was in English, French, Portuguese, and Spanish and it was conducted in the period from 2007 to 2014.

The authors used to create the search strategies were “Hearing”, “Auditory Perception/physiology”, “Auditory Perception”, “Acoustic Stimulation” “Auditory Stimulation” “Language Development”, “Language” “Child Development”, “Child Language”, “Sign Language”, “Infant Development”, “Pattern Recognition, Physiological”, “Pattern Recognition, Visual”, “Recognition”, “Pattern Discrimination” “Familiarity”, “Infant” “Cognitive Process”, “Learning”, “Speech Development”, “lactente”, “Reconhecimento (Psicologia)”, “Reconhecimento Fisiológico de Modelo”, “Reconhecimento Visual de Modelos”, “Reconocimiento Visual de Modelos”, “Patrones de Reconocimiento Fisiológico”, “reconocimiento”, “reconhecimento”, “familiaridade”.

There have been found 4267 articles by these authors. The summary overviews of these articles were consulted so as to rule out those ones related to pathologies and group at risk, for this present article is about the ordinary development of babies. The articles on prematurity, lower birth weight, hearing loss, cochlear implant, deafness, sign language, visual maturation, otitis, and cleft palate problems were excluded. After this pre-selection, 302 articles remained. Out of these, 56 could be found in more than one database. And after ruling out the duplicated, a total of 262 articles were remaining. **Picture 1** depicts the number of articles that have been found in the respective databases and the remaining number after the first selection.

Database	Search result	Result after first selection
MEDLINE/ PubMed	2198	174
Web of Science	756	11
PsycINFO	752	9
EMBASE	342	37
SCOPUS	63	29
Biblioteca Cochrane/Library Cochrane	71	1
BVS – LILACS, BDNF, INDEPSSI psicología, Index Psi teses, IBECS	176	1
Total	4262	262

Picture 1. Number of articles per studied database, and the remaining number after first selection

After this pre-selection, the articles were examined again so that only the ones specifically related to the thesis would be included. Moreover, at this stage, the articles which had research on babies above age of 1 year were rejected, for they were out of the age-group predetermined, thus the search ends up with 39 articles.

REVIEW OF LITERATURE

The ontogeny of the linguistic functions of human brain remains uncertain and though some hearing abilities may be outlined during pregnancy, if and how such immature cortical circuits can process the speech is still under discussion¹.

It is possible to notice a great neural activity in the right frontal area, which can be stimulated by changes in syllables and alteration in the speaker's voice¹. This area also offers support to recognize the sequence of voices since the earliest stages of language acquisition².

Besides the frontal area, it is also possible to notice an activity in the front-temporal region of the left hemisphere as a result of linguistic hearing stimulus^{1,3}. Newborns show a gradual tendency to temporal processing from the early days and enhance this response over time with increase in age. At 22 days of chronological age, one can observe a successful processing⁴ and at 4 months of age, there is an activation of the left hemisphere during the rapid frequency change of the speech⁵. This neural activation made researchers conclude that human babies are born with superiority in their left hemisphere so that they can process specific properties of the utterance.

According to other study, the prenatal experience with the mother tongue affects the way the newborn's brain respond to language all over their cerebral regions responsive to the speech processing⁶, especially those areas related to memorization ability⁷.

The human brain is, therefore, committed to the properties of mother tongue. This fact explains this usual interest in the change of the development in the first year of life. Very young babies show skills to discriminate phonetic contrasts in both mother tongue and other languages. However, after a few months, most of the sounds that do not belong to their mother tongue cease to be recognized by the children, because they become very unintelligible for the children to recognize them. Studies have shown that throughout second semester of life, babies lose their skills relative to non-native sounds and they polish their sensibility to particular sounds of their mother tongue^{8,9},

and these neural representations are not substituted¹⁰; what makes a perceptual linguistic rearrange, implying that the perceptive system could be more and more strongly agree with the audiovisual correlations of mother tongue⁹.

It can be notice that the brain reacts to the diverse linguistic stimuli more and more mature as time goes by. The same reactions happen to voice recognition.

Studies carried out on babies in gestational stages, using MRI scan¹¹ and checking their heart rate¹², verified selective cortical processing what indicates the formation of neural network in the third quarter of pregnancy. These studies imply that babies prove to be able to recognize their mother's voice from an early age, and this fact can indicate that, therefore, there is learning as far back as the uterine life. In addition, it is unquestionable the caregiver's role in a baby's development considering that, according to search remarked herein, the caregiver's voice is processed differently by human brain, attracting the baby's attention and making it easier the interaction between the baby and the adult.

However, in order to comprehend the language to which human beings are exposed as far back as prenatal period, it is not enough to recognize voices or discriminate phonemes alone. There are still two great challenges that should be overcome precociously in order to make it possible to recognize a word. Infant needs to exceed the high degree of acoustical irrelevant variability in the utterance such as voice tone, diverse intonation, inter alia, and to reach the set of relevant lexical representations¹³. Besides, babies must be able to segment adult speech. According to Saussure¹⁴, language is composed of elements that occur one after another linearly, namely "in the speech chain" (p. 142), what requires from a child the ability to segment the flow of speech they hear because adults usually address to children by means of sentences. It is, therefore, necessary to understand the limits of the words in a sentence so that, little by little, one may learn their meaning.

Researchers have observed that ten-month children were able to segment words in a continuous speech utterance; they also could understand more words in the twelfth month, and produced more by the twenty-fourth month compared to those ten-month children that had not shown any response to segmentation¹⁵. Other specialists could also observe such data by doing research into seven-month babies, and afterwards into twenty-four-month babies¹⁶. These data show how

essential the segmentation abilities are in order to acquire the language, and they are truly associated with lexical development later on.

However, in order to enable the segmentation, babies must observe the acoustic track streams available being successful in the appropriation of language. There are several factors that can help in the segmentation conducted by babies. Initially they use many strategies all at once, but as the babies grow older, the way they segment also matures and the babies become able to comprehend specific audio signals, demanding less number of means to make the segmentation easier^{17,18}. Another important point is that according to their own linguistic experiences, babies can use different strategies to segment. A particular strategy can offer the child a clue to discover another way to segment, which benefits the apprentice in this task.

Some factors that can help babies carry out the segmentation of the utterance will be described henceforth. It can be listed, among others, being familiar with the word. For 7,5-month-old babies, the knowledge of a particular word has facilitated the segmentation of the utterance, however, in later date sentences, by the 10,5 months, children did not need to know words in order to do such task¹⁹. It was possible to verify that 10-month-olds show highly efficient linguistic skills to segment, and recognize spoken words; which allows them to face deftly the creation of a lexicon. This familiarity contributes yet to the children's overleaping phonetically similar words and their recognizing and segmenting the words with similar sounds in a fluent utterance²⁰.

And besides this familiarity, statistical standards have also been great predictors of segmentation. The child observes that some sounds of the language occur more frequently in a particular position of the word (beginning, middle, or end), and uses this information to segment utterances. There must be, however, recognition of isolated words in order to learn the statistical properties of the language and thus isolated words that were previously mastered support the child in the segmentation of new words as they appear in the discourse²¹. The responsibility of the brain with these patterns which are experienced at early age helps the acquisition of lexicon²². Studies on 11-month-olds²³ and 7 to 9-month-olds²⁴ have shown that these babies have an ability to use statistical information to extract words from the utterance.

Researchers could also observe that the segmentation may be influenced by phonotactic knowledge²⁵. Phonotactic patterns of the language involves the possible or non-possible combinations in the language, so when a child realizes that in their mother tongue there may not be, for instance, the sound /r/ as in "barata" at the beginning of a word, this serves as evidence for not segmenting the flow of the utterance in the middle of that word, facilitating the segmentation of the sentence appropriately.

Monitoring the prosody is another aspect that helps in the segmentation of utterances. The modulation of the adult speech while addressed to a child helps significantly the infant to perceive the utterance^{26,27}. When an adult use the child-directed speech, namely motherese, they overdo the intonation intuitively, use short clauses, reduce the speed rate, simplify the sentences, vary their pitch more often, and broaden the range of the prosody. These characteristics in speaking draw the child's attention, which makes it easier to perceive mother tongue from early years of life contributing, therefore, to the language appropriation.

One of the characteristics of motherese is the use of short clauses separated by pauses, and it has consequently more pauses than the adult-directed speech; therefore, it can help segmentation. It has been verified that 7,5-month-olds have a facility for recognizing words from the segmentation of the utterance since these words are located at the beginning or at the end of the sentence next to its pause²⁸.

In addition to this facility for segmentation, the child-directed speech with intonation favors bonds between babies and family members, and introduces the newcomer into an important social circle to the babies' development. Several studies have been carried out and all of them agree that motherese provides, very precociously, either newborns or some month of life babies with neural activation²⁹. Research has found activation of frontal brain area as a response to motherese^{30,31}. These observations indicate that motherese influences the cerebral functions of the babies, increasing the activities in these regions, drawing attention to potentially significant words.

Researchers have still been studying the support of the phonological sentences in the segmentation of spoken words. Phonological sentences are made of one or more content words, comprise four to seven syllables, are characterized by elongated pitch before the edge and a specific melodic group³². It is observed that the phrasal prosody can allow children to retrieve

some information on the syntactic structure of verbal utterance, even before having access to a wide lexicon³³, making it easier the sentence segmentation.

As children can make segmentation of the adult speech either by observing the pitch of the language, locating phonological phrases, recognizing the prosody or how frequently they occur in the speech, the children endow the words they hear with meaning. And though children start to produce words near their first year of age, they develop the ability to understand some months previously, recognizing the meaning of the most common words in their everyday life. Researchers have confirmed that there are faster neural pathways to familiar words³³.

A very familiar and importantly unquestionable word for the baby is their name. Studies have shown that 5 to 8-month-old babies are able to recognize their own names in a signal-to-noise ratio 10dB³⁴. Similarly, not only can 5-month-olds detect their own names, but they also use them as a social suggestion to direct their attention to events and objects in the world³⁵. A pilot study has observed even younger children and verified that 4 to 5-month-old babies can recognize their own names³⁶.

Babies are able to recognize other words between 6 to 9 months of age, demonstrating this ability as they look towards named images, which indicates they have understood the words they heard. This fact shows clearly that even young children can learn common words through everyday experience with language³⁷. 9-month-old babies are able to categorize visually,

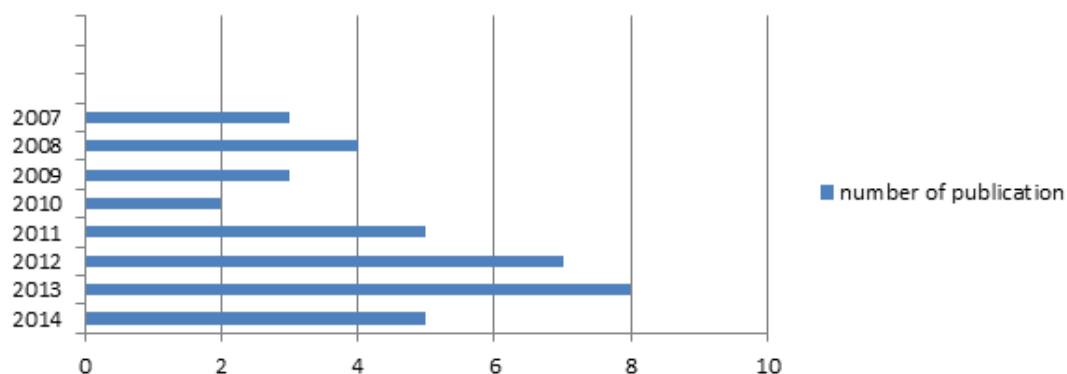
recognize and sketch words out, and all these three processes are crucial for the construction of vocabulary³⁸. Furthermore, 12-month-olds prefer words to other linguistic stimuli, which implies that by this age they have already developed knowledge of the nature in the form of sounds to name objects properly, and these babies will favor that form rather than the others³⁹.

It is thus observed that babies develop skills to perceive the speech, using many strategies and following a laborious pathway to the real recognition of the word. However, as the brain is extremely involved with this process, the task of appropriation of mother tongue is overcome in relatively short period of time.

From the selected articles, it is possible to observe that this thesis is considerably recent to which only in the last few years some researchers have given proper relevance. It can be determined from this research that there have been an increase in the production of articles over time, and an increase in the number of published works related to this thesis since 2011. This subject is undoubtedly significant especially because it focus on knowledge of, both babies' perception of the speech and cerebral responses, natural acquisition of mother tongue, which is target of interest of several areas of knowledge. This competence is indispensable for intervention in potential language disorders. **Picture 2** depicts the distribution of these surveys over the period 2007 to 2014.

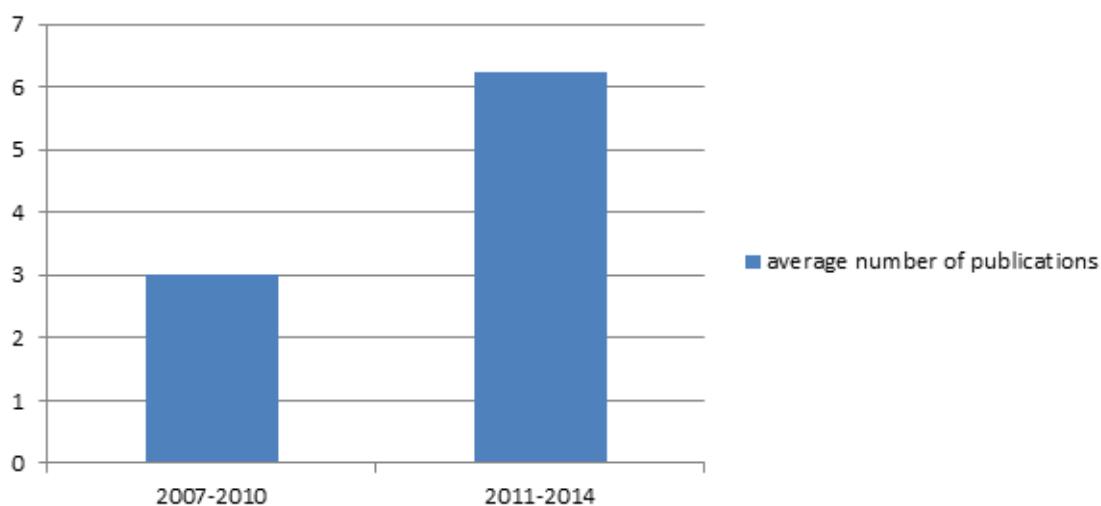
Picture 3 shows the average number of publishing on perception of mother tongue up to 1 year old between the years 2007 and 2014.

number of publication



Picture 2. Number of publications on perceptions of mother tongue up to 1 year old between 2003 and 2014

average number of publications



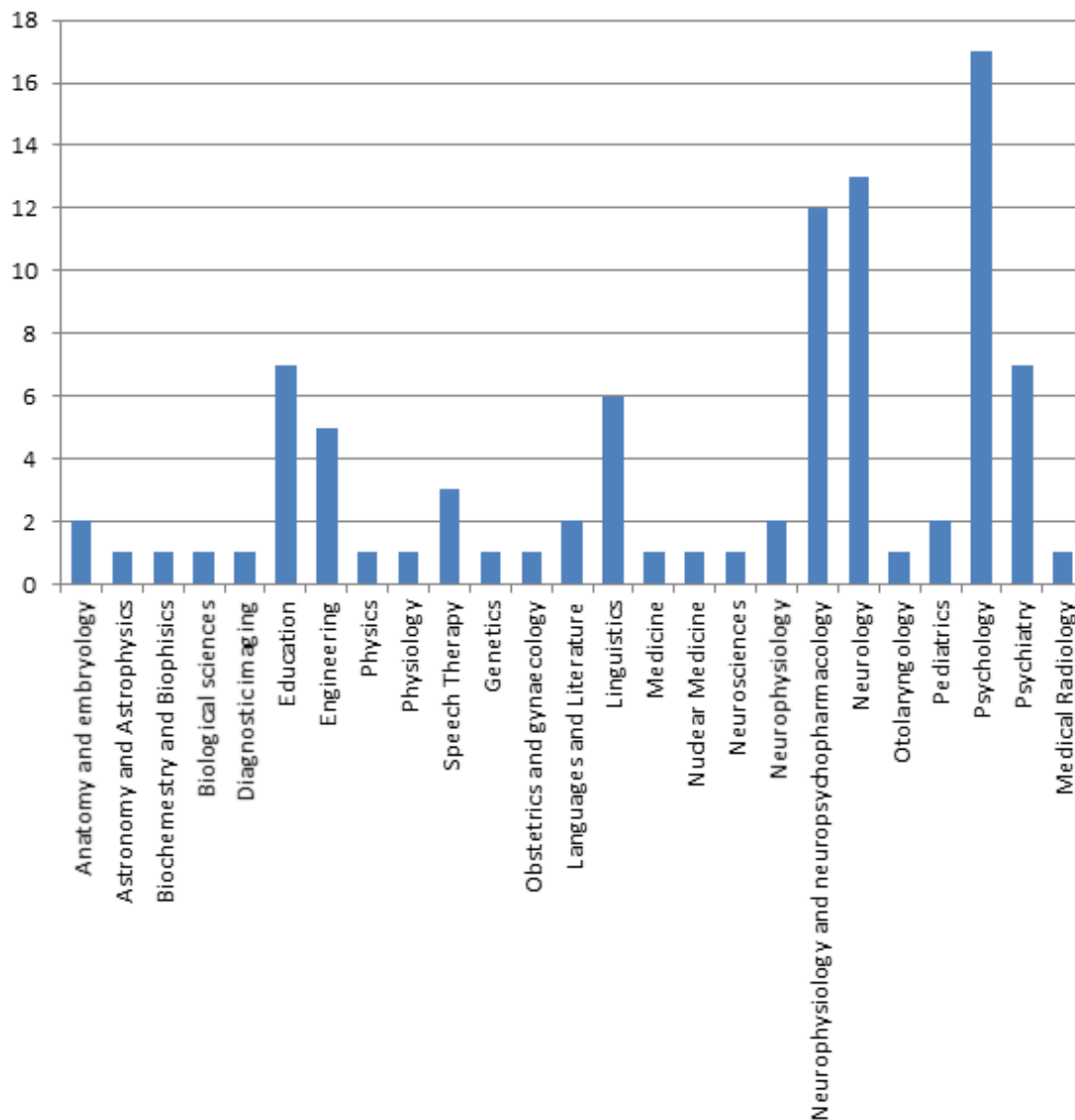
Picture 3. Average number of publications on perceptions of mother tongue up to 1 year old between 2007 and 2014

Most of the articles that compose this literature review were published in multidisciplinary journals. However, the fields with most occurrences are: education, linguistics, psychology, psychiatry, neurophysiology, neuropsychopharmacology, and neurology. Although this subject is interesting to several areas, it can be observed that most of the publishing were not made in journals directed to hearing care professionals, and pediatricians, among others, as target audience, who work with child development and communication. In

addition, in order to treat pathologies relative to this area, they need knowledge of typical development.

Picture 4 shows the number of published articles on perception of mother tongue up to 1 year old which were published in journals relative to several areas of knowledge. It should be stressed that the same journal can accept articles of more than one area of knowledge, therefore, the number of publications described in the following does not equal to the number of journals, but the several areas the journals may have.

number of articles per areas of knowledge



Picture 4. Number of articles on perception of mother tongue up to 1 year old in journals directed to several areas of knowledge

Another point that should be highlighted is the methodology of research. In order to study the subject, it can be observed that the methods which use devices are solely and exclusively to observe the performance of brain activation; among them, infrared, event-related potentials (ERP), monitoring of heart rate, electroencephalogram (EEG), magnetic resonance imaging (MRI), near infrared spectroscopy (NIRS). Such methods are very precise and minimally invasive, providing a valuable material for research and necessary comfort for the participants who, in turn, are babies and need as much care as possible.

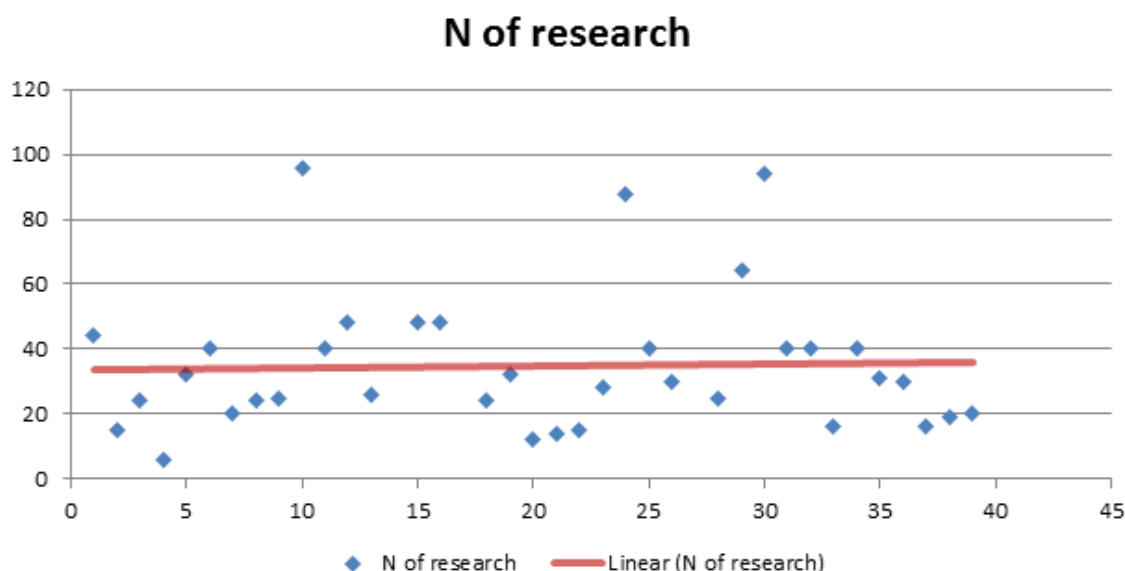
When the response was observed from the motor reaction of the studied child, especially observation of

speech recognition, it was used as a procedure the head movement, duration of staring, eye fixation, visual familiarity and duration of eye tracking. The studies altogether have very thorough methodological criteria and systematic bias deviation control; however, they are low-cost studies and do not need high-tech devices.

It was also observed that, in great part of the studies, the number of individuals were small. **Picture 5** depicts on the abscissa axis the number of studied articles, and on the ordinate axis the number of individuals who have participated in each study. The trend line shows that most of such studies were conducted on a number of participants below or equal to 35. Although this number seems to be small for research, studies in this

field encounter great difficulties to recruit participants. The following hypotheses can be raised: 1. probably due to the fact that these studies were carried out on healthy children, and most of the time parents cannot see how important their children's contribution can be for the research, because most of them do not have any immediate gain in the research; what does not

happen, for instance, to studies on syndromes, which offer, from the findings, some feedback direct to participants; 2. the young age and reduced natural immunity of this age group. Due to the immaturity of the system of protection against illnesses, parents tend to not leave home with their children, except if it is extremely necessary.



Picture 5. Number of participants of studies conducted on perception of mother tongue up to 1 year old analyzed in the literature review

CONCLUSION

It was observed from the review on perception of the speech by babies up to the age of one year old that such articles are published especially in journals for psychology and neurology fields, most of them with a number of individuals below 35, and that over the last years, there have been an increase in the number of publications, and most of the studies used simple and low-cost methodology, though very precise.

Researchers could observe that there have been since birth the reconnaissance of voices and activation of cerebral areas responsible for language, such as right frontal and left temporal. Moreover, it is observed that, although the great acoustic variety that babies found in the speaker voices, such as tone, intonation, inter alia, which are hindrances to understand the speech because they compete with the child's attention to relevant data of the language, babies from very early age are capable of creating strategies to recognize the

adult speech and little by little realize the words understanding their meaning.

Babies segment the utterance by means of prosody, familiarity with the word, and still, by means of statistical calculations, probabilities according to occurrence of syllabic combinations. Subsequently, in order to build a lexicon, babies categorize and sketch the words out. By doing so, they can comprehend their mother tongue; what can serve as a support to begin to utter first words.

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ERRATUM

In this article, "Strategies for perception of mother tongue: from born to one year old", with DOI number: 10.1590/1982-0216201618422715, published in the journal *Revista Cefac*, 18(4): 982-991, on page 982:

Where it was:

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