

How do children structure their initial mental lexicon?

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0. INTRODUCTION

How children structure their initial mental lexicon continues to be one of the main enigmas researchers are confronted with, since the infant must bridge the gap between inarticulateness and form, the latter relating phonoarticulatory gestures to meaning, since «a lexicon cannot be inborn – it must be acquired, on the basis of linguistic experience» (Cutler 1994,81). The innate ability of human cognitive and linguistic matrices, added to the way they mature and to the sociocultural interplay between caretakers and the child allow that, at a given point, generally around one year old, the first items emerge.

In this lecture we will examine some difficult problems we are faced with and will compare different explanations to overcome this enigma, deepening the analysis on questions that, from our point of view, have delayed a better understanding of how children begin to build their mental lexicon, namely:

- 1 – unilateral or prioritizing explanations, either emphasizing the role of syntax (Gleitman's syntactic bootstrapping, 1990), of specific semantic structuring (Clark's semantic feature theory, 1973, later on abandoned in favor of the lexical contrast theory 1983, 1987, 1990; of Kuczaj's prototype theory, 1982) ; of innate linguistic parametrizable properties (Meisel 1995; Mehler and Dupoux 1990); of cognitive-pragmatic factors (event representation theory, Nelson and Lucariello 1985); of social ecological factors (Zukow-Goldring, 1997); of function (Halliday, 1975) and so on. These unilateral explanations, although clarifying some aspects of the organization of the initial mental lexicon are unsatisfactory to answer some crucial questions:
- 2 – Why do children universally only begin producing their first utterances more or less at the age of one year?
- 3 – Why do they universally begin producing «one word at a time» (Bloom 1975) and not at minimum two related words, a condition of a syntactic structure?

Some recent approaches are more holistic like those which argue in favor of the probabilistic convergence of information from multiple sources (Kelly and Martin 1994) or in favor of a dynamic system (Thelen and Smith 1994). One property shared by developing biological and psychological systems is their «ability to abstract related patterns from temporally simultaneous but varied inputs» (Hirsh-Pasek and Michnick Golinkoff 1996, 7).

A holistic approach was already proposed by Slama-Cazacu (1961 [1959]) in her *Contextual dynamic method*.

Nevertheless, as Zukow-Goldring (*op.cit.*, 200) points out «No single existing theory, however, provides an adequate basis» for explaining «how infants come to know what everyone already knows.»

1. WHY DO CHILDREN UNIVERSALLY ONLY BEGIN PRODUCING THEIR FIRST UTTERANCES MORE OR LESS AT THE AGE OF ONE YEAR?

1.1. Biopsychological constraints

Our explanation to why children only begin producing their first utterances more or less at the age of one year is based fundamentally on that only then their neuropsychological maturity allows the expression of the verbal semiotic function, namely, adjusting their phonoarticulatory gestures to convey meaning.

Recent experimental research (Jaeger *et al.* 1996) demonstrates that very different amounts and areas of cortical activation are involved in structured circuits to account for verbal language processing and for the way lexical items, including regular and irregular verbs are stored. In addition, it must be pointed out that infants are not equipped by birth with those ready circuits. As Lecours states (1983,176) : «the process of brain maturation is expressed by numerous chemical, biological and anatomical changes». Explaining the myelinogenetic cycles, correlated to speech and language acquisition, the author suggests that babbling «constitute, in terms of speech development, the infant's global initiation to the motor use of his bucal, lingual, velar, pharyngeal and laryngeal muscles. At the time when babbling first occurs, relatively few neural structures have achieved an advanced degree of myelinogenetic maturity» (Lecours, *op.cit.* 180). The author makes a sharp difference between babbling and echolalia, which he defines as consisting «of specific imitative phonatory responses to specific acoustic stimuli» and «requires a relatively complex sensorimotor apparatus» (Lecours, *op.cit.* 182) since the child begins the process of mutual recalibration between proprioceptive and auditory feedback.

Great relevance must be attributed to the fact that pre-thalamic somaesthetic, post-thalamic somaesthetic and cortico and corticospinal pathways complete their process of myelinogenesis around the 12th month of the first year, considering that, the «somaesthetic receptors (*exteroceptive and proprioceptive*) are located in the skin, the tendons, the muscles. The stimuli are transformed into neural influx which is transmitted by sensory nerves; they merge at different levels to form the sensory components of the spinal nerves and of certain cranial nerves. Some of the latter, for example the *glossopharyngeal nerve*, thus convey influxes which inform the brain of the activity of the buccophonatory apparatus» (Lecours *op.cit.* 167), thus being essential for children's first attempt to control their phonoarticulatory gestures. Of no lesser importance is the fact that «certain specific and non-specific association areas of the cortex, as well as the axonal connections linking them together», play a major role on the semantic aspects of language reception and production, mainly the left inferior parietal lobule (Lecours *op.cit.* 184).

The fact that different spatiotemporal stages of morphological brain maturation, including myelinogenetic cycles relates with subsequent progressive organization of man's behavioral patterns, including language, dismiss the possibility of a rich innate repertoire of linguistic structures, even if they are thought of as abstract primitives like agent, event and object. What is certainly true is the compulsory trend beginning with conception that the human phoetus

mature in a specific species pre-programmed way which converges to man's main tool of surviving, specifically, ordering experience through the ability of building, recording, using and socially interchanging forms, which allows culture.

The adaptation mechanisms of the human species differ in a fundamental way from the other ones, in the sense that while among other species «The perception-response continuum is the simplest possible mechanism and implies an automatic and mechanical behavioral response to any given perception» which involves the determinacy of signal emission and an integrity of the perception-response continuum (D'Aquili 1972, 13), human communication, although also using concomitantly the perception-response continuum, is almost mediated by signs: higher mental functions interrupt the perception-response continuum.

3. FROM THE INARTICULATE TO THE ARTICULATE

It must be pointed out that the term *form* here used follows Saussure's concept: «La linguistique travaille donc sur le terrain limitrophe où les éléments des deux ordres se combinent; cette combinaison produit une forme, non une substance. (Saussure 1972,157). The same concept is deeply developed by Hjelmslev (1953). What must be emphasized is that the term *form* is here used not only to denote the representation of sounds or letters as it is predominantly used by American linguists and psycholinguists, or in its more naïve sense as synonym of sounds and letters, but also to cover meaning (*signifié*, in Saussure's terminology). Hjelmslev clarifies this point: «We thus recognize in the linguistic *content*, in its process, a specific *form*, the *content-form*, which is independent of, and stands in arbitrary relation to the *purport*, and forms it into a *content-substance*» (Hjelmslev *op.cit.*, 32). So, what is in contrast is form vs. substance, either the multiple and simultaneous flow of varied external and internal experiences (substance) which the child must depict and identify, attributing to them preliminary meanings (form) or to the multiple and continuous chain of sounds (substance) which the child must learn to segment reaching preliminary percepts (form) to anchor concepts. These two joint processes are possible and necessary due to the fact that the biopsychological human apparatus in a certain moment presents enough maturation of its brain pathways, allowing inter-modal processes, the building of complex percepts and the ability to selectively understand and respond to the caretakers' behavior.

There is still enormous debate concerning which are the bootstrapping factors that allow the emergence of the first lexical items. Although there is consensus about their production, around the end of the first year, since this is an overt kind of behavior, the same is not true concerning comprehension: explanations vary from attributing earlier complex linguistic structures inferred from the way the child behaves to a here-and-now grammar, the characteristics of which will be explained later. The debate is typically labeled with the terms continuity and discontinuity.

4. HOW DO CHILDREN BEGIN TO REIFY EXPERIENCE?

The first principle children must apply in order to reify internal or external experience is the discovery of the symbolic function, expressed in the Latin aphorism *aliquid stat pro aliquo*; in the words of Cassirer (1944, 169-70) with «the first understanding of the symbolism of speech a real revolution takes place in the life of the child». Practically they apply this principle whenever they are able to assign the same meaning to recurrent utterances in the same context of

use, which is more evident when they begin producing these same utterances having the same meaning in the same context of use. Nevertheless, in the case of comprehension, matters are not so transparent for asserting that children are really reifying, so early, as for instance at four months of age. It is more reasonable to admit that they are sensitive to some salient cues which, recurring in the same context of use, provoke similar responses. Those cues, however, are neither specifically linguistic nor exclusive of the chain speech he/she is hearing, but are multi-modal in character: children take advantage of whatever they can process in the here-and-now context.

Based on a more solid ground, it is possible to evidence the characteristics of the first items children produce, which are summarized below:

4.1. global items for each reference (reification of external and internal experiences) representing the child's immediate needs, which means contiguity to the here and now;

4.2. phonetic fluctuation of the same item, since the selection of the patterns which command the vocal gestures for a specific language is not firmly established;

4.3. absence of grammatical markers, either affixes, or free grammatical morphemes, or morphemes of order (tactemes);

4.4. following the preceding two items 4.1. and 4.3., absence of syntactic relations, since the child uses «one word at a time» (Bloom *op.cit.*);

4.5. private character of the child's variety: only the family group who interacts with him/her is able to understand his/her utterances.

5. INPUT

Two convergent inputs feed the production of the first lexical items: the surrounding utterances directed to the child (CDS) and his/her own productions, including babbling and echolalia.

It is necessary to make a distinction between what is said to the child and what she really perceives, since perception is drastically constrained by previous linguistic knowledge and maturation.

Nevertheless, excluding some few people who insist that there are no gross differences between the register used by adults when they speak to each other and the one used when they communicate with the child, most child language researchers agree that there is a universal knowledge commanding the way we must speak to children, be it called «baby talk» (Ferguson 1977), motherese (Bridges, Sinha and Walkerdine 1981, 123) or fine-tuning/child directed speech (SDC), (Snow, 1995).

Negating that there is the adult's adjustment to the cognitive, linguistic and perceptual child's constraints would mean ignoring the pragmatic and sociolinguistic principles that govern social editing and the well documented data evidencing the existence of different registers depending upon the addressee's conditions.

5.1. Characteristics of child directed speech

As Cutler (*op.cit.*, 85) points out «speech directed to the infant as a chosen listener exhibits a pattern which is systematic enough to warrant calling it a separate speech style».

Leaving aside some specific cultural and idiosyncratic differences, «in European languages, infant directed speech tends to be spoken at a slower rate, to have more frequent stresses, shorter continuous sequences and longer pauses and to be higher in pitch than adult-directed speech» and to show «a wider fundamental frequency range» (Cutler *op.cit.*, 85-6). Those characteristics suggest the adult's intuition about the child's processing constraints, like the temporal-space limitations of windows in short-term memory, difficulties towards units that are not perceptually salient and the absence of more complex syntactic relations embedded in longer sentences.

Authors do not agree on the major or minor frequency of distorting phonological transformations, if compared with those which adults practice when speaking to each other. Stoel-Gammon, for instance, found no difference between those showed when mothers speak to their children and when adults spontaneously speak to each other (Stoel-Gammon 1983).

A great enigma continues to be how children segment the chains they hear, beginning with whole units (the first lexical items) and subsequently cutting them down in minor segments in order to organize the phonological system of their native language, but no less intriguing is the concept the child chooses among many concurring possibilities when he/she hears an utterance (Quine 1960). Anyway, we dismiss that «knowing is a direct noticing of what the world affords for action» as Zukow-Goldring (*op.cit.*, 201) admits to be the position defended by ecological realism and mentioning J.J.Gibson's 1996, 1979 ideas. As it may be inferred, this position is epistemologically aligned with Aristotelian realism and is opposed to our belief that human knowledge, besides being fed by direct experience is mediated by symbolic systems, mainly, the linguistic one (Cassirer *op.cit.*, 172). Human beings do not directly notice: they dynamically build their ongoing percepts as a result of checking past experiences against multimodal encoded signals continuously arriving. But knowing is more than that and we cannot explain the ability to manage complex abstract relations only by «a noticing of what the world affords for action» .

5.2. THE CHILD'S OWN PRODUCTIONS

Maybe the structuring of sounds precedes the child's ability to depict meaning and prosody is really the bootstrapping that anchors his/her first concepts. The human's compulsion to order experience, as we signaled at the beginning of this lecture, in the case of the acoustic signal means, in its more basic form, the ability to perceive the regular distribution between sounds and silence and is favored by the fact that very precociously the phoetus is «exposed to gravitational (vestibular) stimuli generated primarily by its own body movements. It is also exposed to acoustic (cochlear) stimuli – sounds coming from the external world, sounds of the maternal life (heart beats, respiration, intestinal rumblings, etc.) – transmitted through the maternal walls and their amniotic sac which, on the other hand, remain impermeable to photic stimuli» (Lecours *op.cit.*, 179-180). The author also signals to «the precociousness and brevity of the myelogenetic cycle of the pathway linking the internal ear to the inferior colliculi and to the thalamus» ensuring their integration. This premature experience with rhythmic patterns explains why even two month old babies are sensitive to rhythmic groupings of tones (Demany et al.).

What is worthwhile emphasizing is the child's exposition to heart beats and respiration, which undoubtedly prepares to the rhythmic pattern of strong and weak syllables, no matter what is the specific parameter used by a specific language: stress, timing or mora, and is supported by experiments run by Mehler (1981) and Segui (1984). The natural rhythmic patterns conform to these linguistic preferences very soon and are recorded in prelinguistic productions of babbling (de Boysson-Bardies *et al.* 1984, Blake and de Boysson-Bardies 1992; Levitt and Wang 1991 and Levitt and Utman 1992. Cutler (*op.cit.* 99) concludes that «rhythm is also what allows infants to accomplish their *first* segmentation of speech» which is a fruitful hypothesis to be explored, as it was done by Mehler *et al.* (1990), but it does not mean, however that those segmentation coincide exactly with the adult's word boundaries due to crucial problems linked to closed external junctures, namely the phenomenon of sandhi linked to coarticulations and the existence of clitics. Klatt (1989) examined the opacity of word boundaries turning lexical access difficult and Scliar-Cabral (1993) listed and analyzed the difficulties an adult listener is faced with to segment the speech chain in its lexical components: distortions, pauses and hesitations for planning, sociolinguistic and phonetic variation, sandhi and coarticulation and new lexical items. There is a great difference between pauses delimiting sentential parsing, accompanied by rising or falling tones, which facilitate the child's task and pauses and hesitations of execution particularly those which disrupt the flow of a lexical item (Scliar-Cabral and Rodrigues (1993). The mentioned difficulties are magnified if we think of an infant attempting to link meaning to chunks of the speech chain.

In addition, the child, in his/her first attempts to segment the speech chain, lacks other crucial abilities, as, for instance, the one necessary for perceiving the weak units that usually convey grammatical meanings like affixes and, essentially, the ability for understanding such abstract categories. It must be pointed out that those affixes, either prefixes or suffixes delimit word boundaries. Of no minor importance is the fact that the child's mental lexicon is of a minimum size preceding the lexical explosion that occurs around 20 months of age: it has more or less 50 items and so, the process of segmentation cannot be handled by testing preliminary hypotheses matching some arriving chunks with what is already settled in his/her mental dictionary.

Syllabic reduplication as shown by Levitt and Utman (*op.cit.*) and also attested in the examples given by Jakobson in his pioneer and seminal article «Why mama and papa» (Jakobson 1971 [1959]), and in Brazilian Portuguese, where we find the reduplicated form CV'CV, demonstrates the importance of babbling total feedback to help children in their first attempts to use lexical items. CV'CV, as mentioned above, is a frequent reduplicated structure of the first lexical items in Brazilian Portuguese(examples: [ne'ne], [ma'ma]), although other very frequent monosyllabic examples may be found: [kɛ], [da].

6. CHARACTERISTICS OF THE FIRST LEXICAL ITEMS

In this section we will examine the characteristics of the first lexical items, beginning with reification, discussing some theoretical explanations to them.

6.1. Depicting meaning

«The continuity hypothesis is that the representational format is constant throughout development; that the child has innately the logical and conceptual resources to represent his or her world as do adults. The continuity

hypothesis denies stage changes of the sort envisioned by Piaget, denies changes in the child's linguistic representations such as the putative «semantic category/syntactic category shift posited some years ago.» (Carey 1994, 143).

Although disallowing sharp and compartmentalized divisions among stages, we admit a gradual development from the newborn inarticulate state up to the adults' knowledge of his/her language, marked by developmental shifts as, for instance, the one found when children leave the slow period of the 50 initial items beginning around 12 months and the vocabulary spurt or naming explosion, around 18 to 24 months, which attests a qualitative jump, since the vocabulary spurt coincides with the emergency of syntax. The gradual language development is coherent with the first proposition of this lecture that the process of brain maturation is expressed by numerous chemical, histological and anatomical changes and that the numerous pathways necessary for language storage and processing are not ready by birth, mainly those necessary for processing complex abstract categories referring to the internal meanings of language (grammar), such as morphosyntactic relations. This explains why the first child's utterances are global units which must be directly linked either to the situational context or to the immediate child's needs to be understood by their interlocutors, constituting what K.Buhler (1985, 124) designated as *demonstratio ad oculos*. Emphasizing the different character of these first items, researchers labeled them 'prelexical' (Nelson and Lucariello 1985); 'nonreferential and performative' (Snyder et al. 1981) and 'associative' (Lock 1980). Those labels call attention to some aspects, namely, that first items cannot be considered syntactic classes since they do neither occupy any slot in a syntactic marker as for instance, noun or verb nor contain any information that would allow the application of rules of subcategorization, unless the researcher assigns to the child a knowledge that he/she never shows in his/her first utterances (remember that Brent's (1994, 439-40) argument in favor of a precocious emergence of subcategorization frames was based on evidence of collected data from children not younger than 23 months, with MLUs which certainly attested that they were already using more than one item per utterance) . The only possibility of the child's categorizing those items as syntactic classes would be a semantic one, but there is no evidence that he/she uses such a criterion. When a Brazilian 12 month old utters [nane] (Eng. «banana»), pointing to the fruit, he/she may be trying to mean: «I want this banana», or while he/she is eating it, maybe he/she is trying to express «I am enjoying eating this banana» and so on.

Disagreeing with Clark's principle of conventionality, we defend the idea that it is not applied to the first child's items, since their meanings are not the same attributed by the linguistic community (de Saussure's (*op. cit.*, 104) meaning of conventionality). On the contrary, only the few members of the family group can understand them. The reason derives not only from the phonetic instability of its production, since the child's control of the phonoarticulatory gestures is not established, but also from the items' dependency to the individual child's experience shared only by his/her immediate social group. See, for instance the examples given by Stoel-Gammon and Dunn (1985, 24) for shoes: Daniel: [ʒ], [ʒa], [aʒ]; Sarah: [ʃ]; Will: [tʃɪs], [θɪl] («Shared mental structures are assumed to be constant across repeated categorizations of the same set of instances and different for other categorizations» (Keil 1994, 169).

The adultcentric and also the continuity position defend the idea that the child's representations have the same properties of the adults' concepts, a position not accepted either by Quine, or Piaget (Carey *op.cit.* 144); the adepts of a richly structured learning strategy (Williams 1994, 8) also reject the idea that complex abstract structures can be arrived at

through parameter setting. Quine proposed that the child develops from middle-sized, middle distanced objects (Quine *op.cit.*, 5) to 'divided reference' through the process of mastering quantifiers which in our point of view is only one of the possible strategies for developing concepts.

Carey (*op.cit.* 148) clearly argues that the fact that «babies have words in their lexicons that refer to object kinds in the adult lexicon tells us nothing of what these words mean to the babies» and cites those who defend the complexive character of the earliest words (Bowerman 1978; Dromi 1987 and Vygotsky 1962). More grounded conclusions about the way babies begin to organize their concepts come from experiments based on the selective looking paradigm (Carey *op.cit.*, 158): «under most circumstances babies will look longer at what is unfamiliar or unexpected compared to what is familiar or expected». Researchers use this fact to diagnose how the baby represents some situation especially what the baby considers surprising, given his or her current state of physical knowledge.» These were the bases for Spelke (1990) and her colleagues for establishing criteria of how babies individuate objects, namely «an object is a coherent, bounded, entity that maintains its coherence and boundaries as it moves through space.» Of course these criteria refer to sight seeing objects and do not account for the emergence of items that refer to the child's internal needs like «want» (port. [kɛ]); «no» (port. [nãw]) and so on, not to mention the further emergence of grammatical items.

Spelke's and also Baillargeon's (1990) research proved that babies use «two spatiotemporal principles to individuate and trace identity of objects: one object cannot be in two places at the same time and one object cannot go from one place to another without tracing a spatiotemporally continuous path» (the principle of «Discrimination of spatial and temporal ordering of stimuli» which is «the basis of the principles of identity and noncontradiction in formal logical» as formulated by d'Aquili (*op.cit.*, 8)).

As Keil (*op.cit.* 170-6) observes, there is no consensus about the hybrid character of word meanings, mixing two different sorts of contrasting relations: «(a) those involving domain-general tabulations of frequencies and correlation such as done by associative models and many connectionist systems and (b) those involving domain-specific patterns of explanation, usually of casual nature.» The debate continues, since the probabilistic approach defends the view that concepts reflect the real world correlational structure and feature frequency (Rosch and Mervis 1975) while the concept-in-theory view poses an initial problem of defining what is a theory.

Anyway, what is interesting to observe is how the age ascribed to when the infant begins to conceptualize has downgraded from five years old to 4 months as Spelke and her collaborators try to prove. But maybe there is some confusion between recognition and conceptualization because if a 4 month baby is effectively conceptualizing, the adepts of the view that thought precedes language would benefit with a strong argument as for instance the evidence from Spelke *et al.*'s experiments that children as young as 6 months can deal with belief-desire causality, as they are reported by Keil (*op.cit.*, 180): «If they observe events in which a six foot high cylinder rolls towards another, they expect that only physical contact can produce a movement in a second one. If the first cylinder stops, leaving a gap between it and the second one, and the second one then moves off as if launched without contact, the infants (and adults) find the event anomalous. If, however, the same events occur with human actor, the infants find launching of the second person without contact to be no more surprising than launching with contact». The concept of causality, according to d'Aquili (*op.cit.*, 8) derives from the baby's ability to perceive the interrelationship of structural units, resulting in the beginnings of an understanding of function. A stronger position is defended by Landau (1994, 259-96). She claims that non-linguistic knowledge constraints children's interpretations of the utterances

they hear based on what she proposes as being the spatial-cognitive system, which contains two separate converging components: one dedicated to representing objects (the 'what system') and the other to representing locations (the 'where system' (Landau *op.cit.*260).

7. CONCLUDING REMARKS

The primary principle children must apply in order to reify internal or external experience is discovering the symbolic function, but it is not reduced to recognizing by sight the identity of objects. After developing the ability to comprehend simple utterances thanks to the help of multimodal situational cues, around 12 months the child begins producing his/her first one word utterances, which are global items contiguous to the here and now, lacking grammatical markers and showing great phonetic variation. In addition, they are restricted to the family group who interacts with the child.

Two inputs feed the first lexical items: the surrounding utterances directed to the child (CDS) and his/her own productions, including babbling. The very different and sometimes conflicting approaches to explain how children structure their initial mental lexicon prove that bridging the gap between inarticulateness and form continues to be a great enigma and that for the moment there is not a satisfactory theory providing an adequate basis to explain it.

One of the reasons, as we have pointed out, is that unilateral explanations do not account for the convergence of three factors determining the emergence of language and, therefore, of the lexicon, namely, the innate ability of human cognitive and linguistic matrices, the way they mature and the sociocultural interplay between caretakers and the child. Very complex neural circuits must be structured and their pathways established to gradually allow the production of the first lexical items, then of morphosyntactic relations. There is no empirical evidence that corroborates the existence of syntactic structures in these first items.

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