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HOW CAN THE ABILITY OF SIX-MONTH-OLD INFANTS TO LEARN WORDS, MEANINGS, AND REFERENTIAL CATEGORIES BE EXPLAINED?

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According to the generally accepted Stern-Vygotsky paradigm, preverbal infants, while learning words, first learn concepts and names (phonetic complexes) separately. And then, in the second year of life, they associate the learned names with concepts, forming words "name + meaning (concept)". However, recent studies show that 6-month-old infants already know some common words, such as banana, mouth, and hand, indicating that they understand their referential uses. These and other results indicate that infants develop the associated pairs of "name + concept" from a very early age. This clearly contradicts the generally accepted paradigm. To explain how early words appear in infants, this article introduces a hypothesis, which states the innateness of the dual structure of the referential word in infants: "the sound template of the name + the conceptual template of the meaning", in which the name and the meaning are initially connected. As infants accrue speech experience, this structure is transformed into a referential word in two stages. First, by using the name template, infants isolate a specific name in an adult's phrase and form a specific word with an unknown meaning: "the specific name + the meaning template", and then, based on the referents of this word suggested by adults, infants form its meaning, thereby obtaining a referential word, that is, "the specific name + the specific meaning".

Keywords: innate knowledge, word structure, 6-month-old infant, referential words, referential relation

Language is sound with a meaning.
Aristotle

1. Introduction. The generally accepted paradigm of the child's vocabulary formation

The widely accepted paradigm in the 20th century (Vygotsky 1986, chap. 3, 4; Leddon et al. 2011) states that learn a new word, an infant must be able to perform at least three operations: a) select the sound form (phonetic com-



plex, hereafter referred to as the name) from the current flow of speech and store it in its memory, b) select the object corresponding to this name in the array of visible objects, and c) establish a referential relationship between the name and the object. And then, through repeated operations, the infant selects a concept stored in its memory that corresponds to the referents of the word and makes this concept the meaning of the word. As a result, a new word appears in the infant's memory – the pair “name (phonetic complex) + meaning (concept)”.

Clearly, the three listed operations present great difficulties for the child. Therefore, until very recently, researchers were convinced that the child's acquisition and understanding of words were possible only in the second year of life.

2. Linguistic knowledge of 6-month-old infants

However, over the past 15–20 years, some research results have appeared that contradict these ideas. Thus, Bergelson and Swingle (2012) obtained a completely unexpected result. It was found that as early as the age of 6 months, infants understand common words denoting foods and body parts. Thus, hearing from their mother the phrase *Look at the banana!*, infants choose with their eyes “banana” in the paired picture “banana – hair” or in a table scene with a banana, cookies, juice, and milk. Since the test pictures presented objects in different positions, and the study itself did not include any preliminary training, it follows that 6-month-old infants learn referential words based on their everyday experience. In what follows, we will call “referential words” nouns that name objects, making them their referents in accordance with their meaning.

Another unexpected result showed that sequential naming of a set of objects with a pseudo-word encourages infants to form a category of these objects. For example, in the experiment conducted by Fulkerson and Waxman (2007), 6-month-old infants were presented sequentially with eight images of objects from one category (eight images of dinosaurs). Each image was accompanied by two sequentially pronounced phrases with the pseudo-noun *toma*: *Look at the toma! Do you see the toma?* Then, all infants were presented with two test images in complete silence: another image of a dinosaur (the previous category) and an image of a fish (the new category). Infants looked much longer at the new object, the fish, demonstrating a robust preference for novelty. In the next experiment, each image was accompanied not by phrases but by a sequence of pure sound tones that exactly matched the phrases in average frequency, amplitude, duration, and length of pauses. In this case, when presented with test images (a dinosaur and a fish), infants did not show a preference for either of them. Therefore, the authors conclude, the pseudo-noun *toma*, when naming dinosaurs, contributes to the formation of the dinosaur category in 6-month-old infants, while monophonic sounds do not. Note that the authors assume by default that infants can extract the pseudo-word *toma* from the phrases they hear. Without going



into this issue any further, we refer to Shukla et al. (2011), who have shown that in some cases 6-month-old infants already know how to do this (see below for more details). Here, the importance of using a pseudo-noun in a naming phrase should be noted. As an earlier experiment (Waxman and Markow 1995) showed, if 12-month-olds heard the phrase *Do you see what's here?*, which did not contain a pseudo-noun, the category was not formed.

The immediate goal of this article is to explain both of the aforementioned linguistic phenomena: the emergence of referential words in infants and the formation of object categories prompted by an arbitrary pseudo-word.

Importantly, the aforementioned research, as well as some other experiments, has shown, directly or indirectly, that the infant's relation between a word and an object contains the most important features of a referential relation that does not arise as a result of repetitions, but on semantic grounds. For example, according to Friedrich and Friederici (2011), the connection between a word and identical objects in 6-month-old infants is established very quickly, sometimes after only four or five repetitions. In addition, the use of the event-related potential method (ERPs) revealed the presence of semantic priming in infants. The component of the brain potential associated with the event, known as the N400, indicated the semantic consistency of the word with the expected referent. Therefore, this connection is clearly not associative (the latter is formed much more slowly and purely statistically).

Taken together, the data accumulated to date indicate that 6-month-old infants have a good understanding of the mechanism of reference, i.e., they have full-fledged referential words and understand that others use words to realize their communicative and referential intentions (Vouloumanos et al. 2014; Neff and Martin 2023; Foushee, Srinivasan 2024).

To complete the picture, note some other recently found facts about infants' innate knowledge and early development. First, it is the striking ability of newborn infants to divide words (phonetic complexes) into "lexical" or meaningful words (sound forms of nouns, adjectives, adverbs and verbs) and "grammatical" or function words (sound forms of prepositions, conjunctions, pronouns, articles, etc.) (Shi et al. 1999; Shi and Werker 2003). It must be emphasized that this ability is universal and not related to the infant's prenatal speech experience (the mothers of half of the infants who categorically distinguished between types of English words in the experiment did not speak English). As has been shown, newborns base this division exclusively on the acoustic and phonological characteristics of sound complexes. Note that it is not about infants being able to isolate words from natural speech and then divide them into two classes. It is only argued that when infants are presented with individual words, they can categorically distinguish between lexical and grammatical words. In our discussion, we will assume that infants have an acoustic-phonological template for lexical words, primarily for names (phonetic complexes of nouns).

A natural question arises: why should a newborn infant know that the word it hears is lexical and has a meaning by means of which it relates to some objects, its referents? After all, the infant cannot yet isolate this heard



word from the flow of speech, nor find the referent of this word in the visible environment, nor, finally, learn its meaning. Some authors believe that this ability can help infants master the grammatical categories and syntactic structure of their native language in the future. In our opinion, this ability is caused by another, more urgent need. From birth, infants aim to learn the referential function of lexical words. And they master this complex skill gradually and in stages, as various brain structures (sensory, attention, memory, etc.) mature and experience (cognitive, speech, etc.) accumulates. For example, they may routinely encounter the simplest referential situations, when a word is pronounced separately, outside of a phrase, and there are one or two immediately observed candidate objects for the referent of the spoken word. In such situations, the infant can already practice the operations of linking a word with a referent and storing this pair in its memory, identifying the referent (choosing it from two objects), etc. (see the discussion of Saksida and Langus's (2024) article below).

This hypothesis is supported, though indirectly, by the results of another experiment: from 6 months onwards, infants prefer to listen to lexical words, i.e., names, rather than grammatical words (Shi and Werker 2003). The authors see the reason for this in the fact that lexical words are usually more noticeable and interesting in their acoustic and phonological forms than grammatical words. We believe that the reason is different: infants strive to maximally expand their initial lexicon of referential words, which they have already developed by 6 months, and therefore focus their attention primarily on lexical words. This tendency is confirmed by MacKenzie et al. (2012), who have shown that 12-month-old infants strive to associate lexical, but not grammatical words, with new objects.

Another innate property is infants' priority attention to native speech. As has recently become known, infants from birth demonstrate a species-specific preference for listening to the speech of others as opposed to other equally complex, but non-speech sound stimuli (Vouloumanos et al. 2010). Researchers explain this phenomenon in different ways. It seems natural to think that the reason for this attention is in infants' a priori knowledge of the referential function of lexical words.

3. The linguistic knowledge of 4-month-old infants

Although the remarkable success of 6-month-old infants in acquiring referential words is undeniable, it appears that the first very distinct stage of referential knowledge acquisition begins as early as 4 months. For example, a study by Marno et al. (2015) showed that 4-month-old infants are already aware of the referential function of the noun phrase and expect to see its referent. In Experiment 1, infants were shown 24 video clips. In the first 8 videos, they saw a woman's face on the display, who said: *Ciao bambina! Guarda! A gabato! (Hello, baby! Look! A gabato! (pseudo-word)* and then looked away to the left or right side of the screen. Then the face disappeared from the display, and immediately an object appeared in the direction of the woman's gaze. In the next 8 videos, the infants heard reversed speech, and in



the last 8 videos, they did not hear any sounds and saw only the movement of the speaker's lips. The infants found the referent significantly faster in the normal speech conditions than in the reversed speech or no speech conditions. In another experiment, it was shown that the speaker's gaze directed at the place where the referent appears is the second necessary condition (along with normal speech) for rapid referent detection. Thus, already at 4 months, the infant knows that a phrase containing a pseudo-noun names a referent and that to find it in the surrounding space, it is necessary to track the direction of the speaker's gaze.

Impressive evidence of early acquisition of referential properties of lexical words by infants has been obtained by Saksida and Langus (2024). Somewhat simplified, their Experiment 1 can be described as follows. 4-month-old infants were given a series of trials. Each trial began with a familiarization phase (900 ms) during which the infants were shown one of 8 black-and-white 2D figures like Tetris figures: "L", "T", etc., and during the demonstration, a word was pronounced — one of 8 disyllabic Italian pseudo-words (*nupi*, *zeno*, *vuda*, etc.). For example, the figure L and the pseudo-word *nupi* were given, and, after a pause of 1200 ms (blank screen), there followed a test phase in which the infants saw two figures: the previously shown L and a new one, for example, T, and they heard a pseudo-word that put them in a situation of referential uncertainty. In the first version of the test, the previously said word *nupi* was heard. On hearing this word, the infants chose the familiar figure L (they looked at it significantly longer). In the second version of the test, the infants heard the new word *zeno*. In this case, they chose the new figure T with their gaze. Thus, in both cases, they found the correct referent of the word. Similar tests with sine-wave speech, preserving the temporal structure, frequency, and amplitude variations of the original language stimuli while making the words unintelligible, did not produce such effects.

The presented results can be explained as follows. At the stage of familiarization, infants established a prereferential connection "+" between the word *nupi* and the visible object L, i.e., they formed a referent, a pair: "name *nupi* + object L (its mental representation)" and saved it in their memory. Therefore, when they saw two objects, L and T, in the first version of the test and heard the name *nupi*, the representation of object L was spontaneously activated in their mind by this name, and they began to look at it (activation of the name *nupi* in the mind automatically activated object L). When, in the second version of the test, infants, seeing the same two objects, heard a new pseudo-word, *zeno*, they did not establish a connection "+" between this word and object L, since, as can be assumed, the sight of this object activated its name *nupi* in their mind, and an object cannot have a second name (a priori referential knowledge). But the sight of the second object T did not activate any name in their memory, so it is an unnamed object, and the word *zeno* can refer to it. Therefore, the infants chose the object T for *zeno* and formed the referent of the new word — the pair "name *zeno* + object T".



From this analysis, it follows that the connection “+” has many features of a referential relation, linking a name and a referent. This connection a) arises after a single presentation of the pair “object–name” (it does not require repetitions and does not depend on them as an associative connection does)¹ and is retained in the infant’s memory for more than 1200 ms – the duration of the interval between the stages of familiarization and testing; b) cannot be between an object and two different names (the property of separateness of the referents of different words); c) is bidirectional: activation of the name (its sound) in the infant’s mind automatically activates the representation of its referent, and vice versa.

It can be assumed that the relation “+” forms protowords in 4-month-old infants. To become a referential relation, it only needs to acquire the feature of semantic correspondence: “the referent’s properties correspond to the meaning of the name” (Friedrich and Friederici 2017). It can be assumed that this feature is in the process of formation. According to Friedrich and Friederici (2011), the words of 6-month-old infants already have a referential relation. This is demonstrated by the semantic priming effect as observed in the N400 component of the brain potential. However, this priming effect occurs with a delay compared to a similar effect in 14-month-old children. This delay may be caused by the general factors of infant brain maturation, in particular, the stabilization of declarative memory structures (they ensure rapid – after one or several presentations – preservation of the “name + object” connection), and semantic priming interacts with declarative memory structures. At this time, the rapid formation of declarative memory begins: in 6-month-old infants, the “name + object” pairs are largely preserved after 1 day (Ibid.), while in 4-month-old infants they are not (which is what caused the short pause of 1200 ms between the familiarization and test phases); for a general overview, see Parise and Csibra (2012).

To conclude this brief survey, another manifestation of innate linguistic knowledge and abilities in 4-month-old infants should be mentioned: they already show the ability to form categories of named objects (Ferry et al. 2010), noted above in 6-month-old infants. Recall that the relationship between the name and the objects is of a linguistic (not associative) nature (Saksida and Langus 2024). An additional argument in favour of this claim is given by Novack et al. (2021): it has been shown that the same categorical effect is characteristic of the human language of a different modality, not speech, but gesture. Namely, the same categorization occurs in 4-month-old English-speaking hearing infants who are not familiar with sign languages. In a similar experiment, naming in speech (*Look at the toma! Do you see the toma?*) is replaced by its equivalent in American sign language, ASL, using a pseudo-sign (noun) instead of the word *toma*. If, however, only a pointing gesture and a glance are used instead of a gestural name, then categorization does not occur.

¹ This corresponds to everyday situations of speech use, when repeated coincidences of a spoken word and its visible referent is very rare.



4. Referential words

As noted above, the most important property of a referential word is its ability to have referents. The referent of a word is an object whose specific properties correspond to the general properties of the word's meaning (Lyons 1968, chap. 9; Koshelev 2019, pp. 36–39; Koshelev 2020, pp. 48–52). In this case, a referential relationship is established between the word and the object, and the object becomes the referent of the word, while the word becomes the name of the object. In psychophysiological terms, the referential relationship may be described as follows. On the one hand, the perception of a familiar word in a phrase automatically entails the activation of its meaning in the listener's mind (the typical shape and function of the referent, see below), and the desire to find its referent. On the other hand, the perception of a familiar object entails the activation (internal sounding) of its name, and then its meaning, i.e., the activation of the word. This bidirectionality of the referential relationship distinguishes it from the associative relationship (Kabdebon and Dehaene-Lambertz 2019). As has been shown by Saksida and Langus (2024), this bidirectionality is demonstrated already by 4-month-old infants.

To sum up, to a native speaker, the visible world is a set of objects with names, i.e., referents. It's just that the names of some objects are unknown. Similarly, in the world of sounds, phonetic complexes are not names but words – names with meanings and referents.

There is experimental evidence to support this claim. Native speakers spontaneously activate the names of objects they know when perceiving them (Meyer et al. 2007). The same is true for one-and-a-half-year-old children (Mani and Plunkett 2010). A similar effect was indirectly confirmed for 12-month-old infants by Gliga et al. (2010). Finally, Twomey and Westermann (2017) provide data that allow for the presence of this effect in 10-month-old infants. On the other hand, the meaning of a perceived word is activated in the listener's mind and is manifested, in particular, in the effect of semantic priming, i.e., in the consistency of the properties of the observed candidate referent with this meaning. This effect was found in adults (Noorman et al. 2018; Ostarek and Huettig 2017), as well as in 12-, 9-, and 6-month-old infants (Friedrich and Friederici 2010; 2011; Parise and Csibra 2012).

Another important property of a referent is that it cannot have a second name. In other words, the referent classes of different words are strictly separate.

Now, a few remarks about the meaning of the referent word. Its main lexical component is the basic-level concept, or, in short, the basic concept. The notion of basic concept emerged in the line of research conducted by Rosch et al. (1976), Mervis and Rosch (1981), Mervis (1987), Lakoff (1987), and others, and is illustrated by a generic term: “dog”, “tree”, “cup”, “chair”, etc. This is the “middle” level of classification (“animals” – “**dog**” – “fox ter-



rier"). It is called basic because, as noted by Rosch et al. (1976), basic concepts, among other things, are the first to be learned by children and the first to receive names and enter the child's language. Besides, interactions with different members of a basic category are physically similar.

Lakoff (1987, p. 36) gives the following general definition of a basic concept:

(1) Basic concept = overall shape of category members — typical physical interaction with them.

However, Mervis's (1987) definition seems to be much more adequate:

(2) Basic concept = overall shape of category members — their typical function.

(2a) Basic concept CUP = overall shape of cup — "used for drinking hot drinks".

Here the overall shape is an external characteristic, which we will interpret as a complete spatial volume (later it is presented to the child as a set of parts, or elementary volumes¹; for a cup, this is a set of the bottom, walls and handle), and the function is a purely internal characteristic as the result of typical physical interaction with objects.

Becoming the lexical meaning of a word, the basic concept defines the class of its referents, i.e., the class of objects whose properties correspond to the meaning of the word. Individual objects (their mental representations) have the same structure ("shape—function"). Thus, in a typical case, the expression "the properties of an object correspond to the meaning of a word" means that the object's shape corresponds to the overall shape of the referents, and its function corresponds to their typical function.

Children learn the overall shape of referents much faster than their function. For example, a two-year-old child can call a round piggy bank or a round candle a ball, without yet distinguishing their functions. Some cognitive and linguistic data indicate that a close connection between the name and the shape of referent objects appears very early. From 18 months, children believe that objects of the same shape should have the same name. Therefore, they extend the name they know to new objects of the same shape (Landau et al. 1988; Samuelson and Smith 1999; Noorman et al. 2018). At the same time, children also know that objects of different shapes should have different names (Dewar and Xu 2007).

Children's slower comprehension of the function of referents is due to the need to take into account the situational contexts of their typical use. However, the functional component also manifests itself from a very early

¹ The shape of an object is usually defined either as an integral ("holistic") volume, or as a configuration of several of its parts — elementary volumes (Pereira and Smith, 2009, p. 68).



age and is always present in the infant's representations of both objects and basic categories, and therefore must be taken into account (on the role of shape and function in categorization, see, for example, Booth et al. (2010); Ware and Booth, (2010)). According to Bergelson and Aslin (2017), 6-month-old infants were much more confident in recognizing the referent — for example, a banana — in paired object pictures if the second object (for example, hair) belonged to another functional area (not food, but body parts).

5. Inconsistency with the generally accepted paradigm of word formation by infants

To explain the emergence of referential words in 6-month-old infants, one cannot use the generally accepted paradigm, moving its onset to a significantly earlier age. True, at this age, infants are already able to isolate a name (phonetic complex) from a prosodically organized continuous phrase (Shukla et al. 2011). But this name does not receive the status of an independent sound complex (it is not stored in the infant's memory by itself). As Shukla et al. (2011) emphasize, infants isolate a name if it is on the border of the prosodic structure of a phrase, and simultaneously associate it with an object (referent). In other words, hearing a real phrase in natural conditions (with visible objects), infants isolate not a separate name in it, but directly the referential use of the word, the pair "*name* + object (referent)".

Yeung and Werker (2009) also testify to the holistic perception of pairs "*name* + object (referent)". They have shown that, when exploring the phonetic categories of names, infants rely not only on statistical analysis of auditory input, but also on the contrasting referents of these names. Thus, 9-month-old infants, who could not cope with the task of perceptually distinguishing phonetic complexes, began to distinguish them under natural conditions of perception, when these complexes were accompanied by their contrasting referents — dissimilar referents should have different names (Dewar and Xu 2007; Parise and Csibra 2012). Conversely, infants did not distinguish these complexes when their referents ceased to represent different categories.

Similarly, 6-month-old infants do not have independent concepts that could be linked to individual names to form words. According to Rosch et al. (1976), the concepts that first acquire names, i.e., basic-level concepts, or basic concepts, appear in children only in the second year of life, when children begin to interact with objects for their intended purpose: roll the car, rock the doll, etc.

Thus, there is an obvious inconsistency: on the one hand, in the mind of a 6-month-old infant, there are no independent phonetic complexes (names) and concepts — meanings for these names are postulated by the generally accepted paradigm. On the other hand, in their memory, there are already referential words — pairs "*name* + meaning (primary basic concept)"; the sign "+" here denotes a referential relation.



6. How do referential words appear in 6-month-old infants?

To resolve the inconsistency and explain such an early appearance of referential words in infants, we introduce a hypothesis about the elementary units of the infant's perception of reality.

As has been noted above, adult native speakers perceive a separate name (the phonetic complex of a noun) not on its own but together with the meaning, i.e., as a word that the speaker correlates, based on its meaning, with a suitable visible object. Similarly, adults perceive not a separate (familiar) object, but the object together with its name, i.e., the referent "object + name". Figuratively speaking, the perceived object "tells" the native speaker its name, and the word its meaning.

According to our hypothesis, structurally, an infant perceives reality similarly to an adult: the visible world as a set of named objects, i.e., referents, and the world of phonetic complexes not as names, but as words, i.e., names with meanings and referents. The only difference is that the infant does not yet know the names of visible objects and the meanings and referents of these names. And the infant's first desire is to learn them.

The hypothesis: We assume that the initial units of the infant's perception are not individual names (phonetic complexes) and objects, but generalized words and referents, i.e., pairs:

(3a) word = "acoustic template of name + conceptual template of meaning";

(3b) referent = "object + acoustic template of name",

where the acoustic template is a generalized acoustic-phonological complex that helps infants identify lexical words (Shi et al. 1999; Shi and Werker 2003), the conceptual template of meaning is the dual structure "unknown shape – unknown function", and the "+" sign denotes the referential relation.

Moreover, we believe that infants "understand" the essence of the referent word from birth and therefore know that 1) the referent of a word can only be an object whose properties (its shape and function) correspond to the meaning of the word, i.e., its overall shape and typical function; 2) an object can have only one name, but a word can have many referents; 3) all referents of a word form a category with a single common property, meaning.

In accordance with this hypothesis, as well as with other knowledge (about lexical words, their informational role, etc.), it can be assumed that infants see their main task in finding referents for the words they hear, in forming the meanings of these words based on their referents, and in recognizing the names of the objects they see. In solving these problems, they use their innate knowledge, as well as the referential uses of words by adults. According to recent studies (Marno et al. 2015; Saksida and Langus 2024), from a very early age, an infant choosing a referent for a heard word uses almost the same techniques as an adult: from the nameless candidates they



select the object indicated by the speaker's gaze, gesture, etc., exclude candidates with other names (the property of separateness of referents of different words), etc.

7. Formation of a referential word

Using a specific example, let us describe the process whereby a 6-month-old infant forms a referent word heard in its mother's phrases. To do this, the infant needs to solve three problems: a) identify the name of the word in the phrase heard; b) find the referent of this word; and c) begin or continue to form the meaning of the word.

Let us assume that the infant sees a table on which there are objects: a cup, a saucer, and a spoon. According to (3b), in its mind, each object is represented as a referent: cup – “name template + object cup”, etc. Let us assume that the infant hears the phrase *Look, it's a cup!* It cannot yet isolate words in a running phrase but assumes that the phrase contains a lexical word naming an object on the table. Therefore, the infant looks for this object using its knowledge (guided by the direction of the speaker's gaze, her pointing gesture, etc.) and, presumably, determines that this object is a cup. Further, from (3b), the infant receives an acoustic template of its name, by means of which it finds the appropriate phonetic complex *cup* (the name of the object cup) in the uttered phrase and puts it in place of the acoustic template in (3b). Referent 1 = “name *cup* + object cup 1” is stored in the infant's memory. At the same time, it begins to form a new word (3a) with the name *cup*, storing in memory the pair “*cup* + unknown meaning”. Now the infant moves on to form the meaning of this word. It knows that this is a referential word, so the word's referent corresponds in its properties to the word's meaning. Consequently, the infant can substitute the unknown meaning by this referent (its mental representation), and this is what it does. As a result, the word *cup* with its initial meaning and the first referent are stored in the infant's memory:

Word *cup* = *cup* + initial meaning (“cup 1”);
Referent 1 = *cup* (name) + “cup 1” (object).

Next, when in a similar situation, the infant hears the phrase *Where is the cup?*, this process is repeated. A second referent appears, i.e., a second object “cup 2” with the name *cup*. It must also correspond to the meaning; therefore, the infant forms a component-wise (in shape and function) generalization of these referents as the meaning of the word:

Word *cup* = *cup* + meaning (generalization of the objects “cup 1” and “cup 2”).

It is in this gradual manner that 6-month-old infants form in their memory the referential word *cup* with a specific meaning – a generalized representation of the referents encountered earlier.



Thus, the emergence of referential words in 6-month-old infants is explained. As shown above, the mechanism for the formation of such words does not require the presence of separate names (phonetic complexes) and concepts (their meanings).

Similarly, the categorical effect of a word (noun) is explained. Going back to Fulkerson and Waxman's (2007) experiment, in which 6-month-old infants were shown 8 pictures of dinosaurs in succession, accompanied by the phrases: *Look at the toma! Do you see the toma?*, we can see how the new word *toma* acquired a meaning — a generalized representation of these dinosaurs. Because of this, in the test task, the infants expectedly chose the picture of the fish (preference for novelty), rather than another picture of a dinosaur. Note that in this case, the infants' task was made easier by the fact that, firstly, there was only one referent (they did not have to look for it). Secondly, under the experimental conditions, the frequency of the phonetic complex *toma* for infants increased sharply over a short period of time, and, in addition, this complex appeared in two different speech contexts each time. All this also facilitated its identification using the template of the lexical name.

Understandably, this explanation is valid for 9- and 12-month-old infants (Fulkerson and Waxman 2007). It also holds for 4-month-old infants (Ferry et al. 2010), since they already know what a referent word is and how its meaning is related to its referents. Therefore, they will also form the meaning of the word *toma* based on its referents.

Thus, based on the introduced hypothesis, both linguistic phenomena are explained: the emergence of referential words and the formation of categories motivated by naming, discovered in 6-month-olds and clearly inconsistent with the generally accepted paradigm of word formation in infants (see section 2).

Note, in conclusion, that it is now possible to explain how children get the names and basic concepts separated from each other. After the age of 18 months, in the process of their cognitive-verbal development, children gradually begin to differentiate their fused word — pairs of "*name* + meaning (concept)" — into three relatively independent components: the name (phonetic complex), the meaning (basic concept), and the referential relation that connects them. These components are considered by many researchers to be elementary, initially inherent in infants.

8. New paradigm

The proposed hypothesis postulates a new paradigm alternative to the generally accepted one: thinking (concepts) and speech (names) in infants have not two different, but a single genetic root. This unity is embodied in the initial cognitive-linguistic units of infants (3a) and (3b).

Within the framework of the new paradigm, other problems discussed above are also easily explained. To illustrate this assertion, we will continue the analysis of infants' categories. We will assume the categories generated by the naming of objects to be referential, since the members of such categories — the referents of the word — are united by the word's meaning.



As is well known, the first categories of objects are formed in infants as early as 3 months of age, without any participation of verbal names and the object naming process (Oakes and Ribar 2005). The main basis for categorization is the external similarity of objects (Medin and Coley 1998; Rosch et al. 1976; Sloutsky 2003). Let us agree to call such categories perceptual. The introduced distinction between the two types of object categories allows us to solve another problem. As Chan et al. (2023) have shown, the category of dinosaurs arises in 6-month-old infants even without being named, in conditions of silence. Therefore, Chan and colleagues conclude, it is this (perceptual) category that is taken by Fulkerson and Waxman (2007) as a referential category generated by naming. We do not share this conclusion. According to Friedrich and Friederici (2011), the connection between a word and identical objects in 6-month-old infants occurs very quickly, sometimes after just four or five repetitions. Moreover, this connection is not associative (the latter being formed much more slowly), but referential. This was demonstrated by the presence of semantic priming (parameter N400, indicating the consistency of the meaning of a word with the expected referent). Consequently, in the situation of naming, infants formed a referential category of dinosaurs, and in the silence conditions, a perceptual one. The compositions of both categories coincide, but the reasons for combining their members are significantly different. The roles of these types of categories are also different. The domain of perceptual categorization is only obvious (and also universal) categories. Referential categorization gives rise to language-specific and ethnospecific categories, reflecting the uniqueness of the object taxonomy of a particular linguistic community.

The interaction between the two types of categories has been described in the literature (Althaus and Westermann 2016; Havy and Waxman 2016). The consensus is that referential categorization is dominant. In case of any discrepancies, it replaces perceptual categorization. Apparently, this fact indicates the prevalence of ethnospecific and language-specific classifications over universal (common human) ones.

An important result was obtained by Waxman and Braun (2005), who showed that if, for 12-month-old infants in the familiarization phase, objects are called not by the same but different words, the categorical effect does not arise (cf. LaTourrette et al. 2023). From the new perspective, this is easily explained: there is no word (it has not been formed) with a single meaning generalizing the objects (their mental representations), which specifies the referential category.

Let us now turn to the generally accepted explanation of the categorical effect of naming proposed by Waxman and her colleagues. Waxman and Markov (1995) formulated the following thesis (let us agree to call it the Waxman criterion): assigning the same name to objects emphasizes the common features between them, which otherwise might remain unnoticed. Waxman and Braun (2005) gave a more complete formulation, taking into account the negative effect of different names on categorization: assigning the same name to different objects emphasizes the similarity between them and



supports categorization, and assigning different names to individual objects emphasizes the uniqueness of each of them and supports the process of individualization of objects (Xu et al. 1999; LaTourrette et al. 2023).

This formulation leaves the following question unanswered: what property (general or individual) does the pseudo-name (a meaningless phonetic complex such as *dax*, *toma*, etc.) foreground when naming the first object in the familiarization phase? After all, there is no previous name with which it is compared. It is natural to assume that foregrounding the property of an object when naming it does not depend on the context (what name the previous object was called by). Suppose the second object is called by the name *gipi*, but we do not know what the first object was called. If it turns out that it was called by the same name *gipi*, then it means (according to Waxman's criterion) that a property common to the first object was foregrounded in the second object. If the first object was called by a different name, then it foregrounds an individual property in the second object. Consequently, the name foregrounds a property in the object that is both general and individual at the same time. But is this possible at all?

Apparently, it is, but only if this property is categorical, i.e., it specifies the category of objects. In such a case, it is, on the one hand, common to all objects of the category, and on the other hand, it differentiates (although does not individualize) them, separating them from the objects of other categories. One categorical property has already been discussed — the external similarity of objects that specifies the perceptual category. From what has been said above, it follows that this property is not appropriate. What is required here is a categorical property associated with a name. Since the first categorical properties that have names are specified by basic concepts, the property foregrounded by a word when naming an object is the meaning of the word, or the basic concept. In the perceptual part of the meaning, this is the overall shape of the referents (see section 2). And because, as noted above, shape is very early recognized by children as the main characteristic of the referent (they transfer the name of the object to other objects of the same shape), it can be assumed that shape is the property that, in accordance with Waxman's criterion, singles out the word in the object, naming it.

Note that Waxman's criterion explains the categorical effect in infants aged 6 months and above. However, Ferry et al. (2010) emphasize that in 3- and 4-month-old infants, the categorical effect is caused not by the word (according to them, at this age, infants are unable to identify a word in the speech flow and understand its meaning), but by human speech itself. It causes infants to pay increased attention to the environment, which facilitates categorization. This explanation is also supported by other research (Ferry and Guellai 2021; Perszyk and Waxman 2019). In this regard, and with reference to section 7 above, note that reliance on the new paradigm allows us to give a uniform explanation of the categorical effect, independent of the age of the infant.



9. Three types of object categories

The referential connection between the shape of an object and its name is characteristic primarily of solid objects. For them, shape plays an important categorical role, since it is directly related to their function. The shape of an object (spoon, knife, cup, chair, bicycle) predetermines the nature of physical interaction with it, since it is carried out primarily by hands and other parts of the body. As will be shown below, it is the typical function of the object that ultimately constitutes its main categorical property. In the case of an animal, its shape is not so categorically important (for example, a dog and a cat have a similar shape). Here, other properties that determine the category are more closely related to the name, such as the presence of eyes or the sounds made by the animal. Thus, according to Dewar and Xu (2009), 10-month-old infants expect that a name is more strongly related to the sound made by an object than to its shape. They believe that, regardless of shape, objects named by different nouns should make different sounds, and objects named by the same noun should make the same sounds.

In a series of studies analyzing the first few hundred nouns learned by English- and Japanese-speaking children (for a review, see Smith and Colunga 2012), three types of initial children's categories were identified: solids, animals, and substances, all with fundamentally different organizational structures. The review notes, in particular, that the ease with which 2- and 3-year-olds memorize the names of these different types suggests that children already at a very early age understand the different organizations of these types and know the connections between their naming and properties (see also Samuelson and Smith 1999; Rips and Hespos 2019). Thus, there are overarching universals in the distribution of names among children learning different languages: solids are usually named by their shape, substances by their material and colour, and animals by features suggesting animacy.

All of the above allows for a tentative assumption that infants' names are initially associated not with one type of perceptual component of meaning, as in (3a), but with three types of meaning (concept): for solid objects, it is shape, for substances — material and colour, and for living beings — signs of animacy. It is then reasonable to assume that substances and living beings correspond to two other acoustic templates of names, different from the template for objects in (3b). In this case, when forming a referential word, the infant, after hearing the phrase and finding its referent, first determines the type of referent (object, substance, or living being) by its appearance, and then determines (as in (3b)) the name template for the referent of this type. Next, using this template, the infant determines the name of the referent in the phrase. And then the infant forms a word with this name and meaning, generalizing its referents (see section 7).

10. On the main feature of the referential category

In the body of research discussed above, the main focus was on categories whose members were perceptually similar. At the same time, it remains unclear whether a referent category will emerge if one pseudo-word is used to name perceptually dissimilar objects (Yamauchi and Markman 2000). This



issue was addressed by Pomiechowska et al. (2024): in two separate experiments, adults and 9-month-old infants were introduced to several unfamiliar objects. The subjects manipulated them and heard the same unfamiliar word each time. Although the objects were specially selected to be visually dissimilar, both adults and infants combined them into a referential category. At the same time, adults, remembering the names of the category objects well, did not realize and could not explain what its members had in common. This proves that the combination of objects into a referential category does not depend on the degree of their perceptual similarity, and, in particular, on the commonality of their shape. This means that some other, implicit feature lies at the basis of the referential category. It is reasonable to assume that this feature is implied by the general mechanism of formation of the referent category (the naming of objects) and, therefore, is also present in all the referent categories discussed earlier. It is because of its implicitness that this feature was not discovered.

To understand what this feature is, it is necessary to recall the main property of the referential word: the category of its referents is based on the meaning of the word. Consequently, the sought-after feature is some component of this meaning. To identify it, let us return to the basic concept (2), which represents the meaning of the noun. Since the commonality of shape (the perceptual component) as the basis of the referent category turned out to be irrelevant, it remains to be acknowledged that the functional component, or the typical function of the referents, is relevant. In other words, the category of referents of a noun is determined by their common function. It is the main component of the meaning (for more details, see Koshelev 2020, pp. 20–27, 47–63).

Let us illustrate this conclusion using the example of “designer” chairs (Fig.). Their shape differs significantly from the typical shape of a chair. However, all of them can be named by the word *chair* in its direct (non-metaphorical) meaning; therefore, they belong to the referent category of chairs. The reason is that they all perform the function of a chair — “one person can sit on it, having support for the bottom, back, and legs (the floor)”. On the other hand, a papier-mâché chair that has a typical shape but cannot be used in a typical function does not belong to this category, as it can only be called a chair in a metaphorical sense. Thus, it is the function of the chair that defines the category of chairs. The role of the typical chair shape is different — to serve as a visual sign (manifestant) of the function. But this sign is validated each time, as in the case of the papier-mâché chair. Thus, the mechanism of reference is used by the child to learn the meanings of the mother-tongue words and the socially significant functions as constituents of these meanings. This learning occurs through situational acquaintance with the referents of words as the performers of these functions.



Figure. Chairs that are atypical in shape remain the referents of the word *chair*



So, the basis for a referential category is the functional component of the word's meaning. Clearly, neither an infant nor even an adult can determine this component only by observing the referents of an unfamiliar word. To do so, it is necessary to understand the general role of these referents in the cultural and everyday social setting. These referents are preserved in memory, and the knowledge that they are united by a certain socially significant function gives the infant a guideline for learning this function.

Let us elaborate on this a little. The object's function cannot be directly transferred to the infant. For this function to be acquired, it must be "discovered" by the infant. But the infant needs help with this. This is what the mechanism of reference does. By naming the referent, the word indicates to the infant that it is its function, its role in the observed situation that the infant must learn. Then the word names another referent in a different situation, but requires finding the same function, etc. Thus, by naming different referents in different situations, the referential word guides the infant in learning the single function of the word's referents. One of the main ways for an infant to understand the function of an object is through identifying a typical interaction with it. By following the actions of adults, infants gradually learn a typical interaction with referents, and through it, their function. Recall the definition (1) of the basic concept, which uses physical interaction instead of a function, an external expression of the function.

To summarize, the function is at the base of the category. Therefore, the name is directly related to the function, i.e., to the functional component of the meaning. At the same time, the role of the name itself as a symbolic marker, the "hook" of the function, becomes clear. After all, without a name, the function may not have another marker, since the category may not have a single prototype.

11. Conclusion

The obtained results have a number of general consequences. Some of them are highlighted below.

1. The structure of ethno-specific basic taxonomy has been revealed, defined by the vocabulary (nouns) of the language of the ethnic group. This taxonomy is defined by the matrix of the named functions — functional components of the meanings of nouns. These functions, projected onto the world of objects, divide them into referential categories of the performers of the functions. At the same time, the perceptual component of the meaning of each noun determines the typical appearance of these performers.

2. The classic question of where infants get their basic concepts from has been answered. Heretofore, three answers have been offered. J. Fodor believes that all specific concepts, including carburetor and trombone, are innate. Pinker and Wierzbicka hold a somewhat different view: only the simplest concepts are innate, and the rest are compositions of these simplest concepts (for more details, see Koshelev 2020, chap. 2). Finally, Chomsky and Berwick (2016, pp. 90–91) believe that no one knows the answer to this question.



However, the above considerations show that concepts arise in infants along with words (names), as their meanings. Infants form words using their a priori linguistic knowledge, as well as the names and referents of these words, perceived from adults. Basic concepts are gestalts and are not composed of simpler concepts (Lakoff 1987, p. xiv; Koshelev 2019, chap. 3).

It also follows from what has been said that in the purpose of language, one cannot single out any one function as the main one: the mental (Saussure, Chomsky) or communicative (Jackendoff, Mel'chuk), for more information, see (Koshelev 2019, p. 8–12). Initially, these language functions are inseparable.

3. The obtained results diverge from Chomsky's views as part of the previous paradigm, which separates thinking and speech. According to Berwick and Chomsky (2016, pp. 11–12, 66), language (inner language) is a tool for thinking that generates hierarchical mental expressions. The elementary units of these expressions are nameless "conceptual atoms" ("wordlike, but not words"). However, as shown above, concepts do not arise separately from their names. Consequently, there are no such things as Chomsky's conceptual atoms. Instead, infants directly develop words, concepts with names. In addition, according to Chomsky, externalization, or, in short, speech output of the generated mental expressions, is made possible by the sensorimotor system, which is separate from language and, evolutionarily, a much later development (Ibid., p. 87). But in that case, it would be natural to expect speech in infants also to arise separately from the conceptual system. However, according to the new paradigm, this is not the case. In this regard, Aristotle's definition: "Language is sound with a meaning" (cited in (Ibid., p. 66)), was a forerunner of the new paradigm.

4. The new paradigm sheds light on the issue of which components of language are innate and which are acquired through experience. For example, the innate components are the structures of the referent word (3a) and its referent (3b), as well as linguistic knowledge about them and the rules for their use, while the acquired components are concrete words, i.e., pairs of "concrete name + concrete meaning" and their referents. Thus, according to the proposed paradigm, human infants have completely new initial units (3a) and (3b), which are not present in non-human infants. It can be assumed that these units provided a decisive evolutionary advantage for *Homo sapiens*, allowing humans to learn and transfer new concepts and functions to conspecifics. Due to this, *Homo sapiens* was able to quickly adapt to various environmental conditions, gradually settling from South Africa around the world about 60,000 years ago (Berwick and Chomsky 2016, p. 150).

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КАК ОБЪЯСНИТЬ УСПЕХИ ШЕСТИМЕСЯЧНЫХ МЛАДЕНЦЕВ В ИЗУЧЕНИИ СЛОВ, ЗНАЧЕНИЙ И РЕФЕРЕНЦИАЛЬНЫХ КАТЕГОРИЙ?

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Согласно недавним исследованиям, уже в возрасте 6 месяцев младенцы знают некоторые распространенные референциальные слова («банан», «рот», «рука» и т.д.). Эти и другие результаты свидетельствуют о том, что с самого раннего возраста в сознании младенцев появляются ассоциативные пары: «имя + значение (понятие)», что явно противоречит общепринятой парадигме. Чтобы объяснить столь раннее появление у младенцев слов, в статье выдвигается гипотеза о врожденности у младен-



цев дуальной структуры референциального слова «звуковой шаблон имени + концептуальный шаблон значения», в которой имя и значение изначально связаны. Показываются, что с ее помощью удается объяснить столь ранние успехи младенцев.

Ключевые слова: врожденные знания, референциальные слова, структура слова, шестимесячный младенец

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