# 1. Delimiting the Areas and Research Procedures of Cognitive Linguistics

Keywords: *cognitive sciences, cognition, language, mental conditions, methods of research*

## 1.1 Introduction

Cognitive linguistics (CL) is a discipline of the cognitive sciences that deals with description and explaining of mental structures and processes connected with language knowledge. Cognitive linguistics is more like some kind of flexible framework of various language theories rather than one widely accepted theory.

It constitutes space for coexistence of various approaches and explanations of language phenomenon, which partially overlap themselves. Interdisciplinary character of CL is also reflected by methodological collection that is used in the research of language knowledge structures. It ranges from philosophical language analyses that are based on inductive and deductive reasoning, through drafting of empirically testable hypotheses, to various types of experiments within the psycholinguistic and neurolinguistic theories.

## 1.2 Subject of Cognitive–linguistic Research

Cognitive linguistics belongs to the system of cognitive sciences with the main subject of research being mental knowledge structures and processes. The research aims of cognitive sciences are empirically testable theories that explain structural and processual aspects of human cognition. Cognitive processes include not only ability to think and use language, but also process of perception, learning, and memory. Behavioristic approach restricted its attention only to inputs (impulses) and outputs (reactions) of organism, while the whole process of internal processing was left alone. Mental conditions and processes were labelled under this apprehension as directly scientifically unobservable, hence as incognizable. They became "black box" phenomena. By pointing out the inability of explaining language on the grounds of relations between impulses and reactions, N. Chomsky provoked paradigmatic change in the explanation of cognitive processes. This turning point is called "cognitive revolution" and is characterized by several features:

1. It accepts *real existence of mental conditions and processes.*
2. Conclusion of this postulate is not a dualistic version of mind and body relation. It sees possibility of solving the ancient philosophical problem of coexistence of the mental and the physical in perceiving human being as an information processing system that is similar to computing device. We can distinguish two levels within — software and hardware. The software level is based on a certain code type, on information sequence of computing character. Hence we deal with algorithm. The hardware level is material basis that executes algorithm — a set of rules for conducting certain operations. The problem of relation between mental and material is in its cognitive research, conceptualized on the basis of the mentioned *computer metaphor*.
3. In the context of A. Turing's works concerned with computational mechanisms, cognitive processes are understood as internal

algorithms that operate with mental representations. Intelligent behaviour is explained by specific manipulations and exactly structured symbols. Mental conditions are thus perceived as informational conditions. Algorithm of information processing represents a collection of exactly defined operations with a set of mental representations. This concept of explaining cognitive processes is called *representative–computational.*

4. Determining criterion for qualifying adequacy of cognitive theory is the *criterion of psychological plausibility.* Theory has to explain the observed characteristics of cognitive system; it has to correspond with psychological reality. Equally important is the area of neurophysiologic findings. Hypotheses in cognitive research thus have to be potentially empirically falsifiable by observable psychological and neurophysical facts.

Cognitive turn or cognitive revolution hence meant transfer from description of cognitive abilities to their explanation. Chomsky's theory of generative grammar represented passage from systemic description of language to cognitive explanation that meets all listed characteristics (Chomsky, 1988). Language is examined as a specific cognitive human capacity that is included in the system of other cognitive competencies. Language study is always a part of cognition research. Hence language is understood as a special knowledge subsystem, which is needed to be scrutinized in the context of other subsystems of cognitive system.

Language ability is generated in structural and functional constitutions of human brain. Language as a cognitive system can be described independently of its neurobiological substratum, so as a mental phenomenon with its own structures and patterns. From the philosophical perspective we can ask a question about the character of such examination. Are we dealing with functionalist thesis about assessment of system elements on the basis of their position and relations in subsystem, while physical substratum of this system is irrelevant? Or is possible to understand cognitive explanation of language as a physical explanation that is focused on specifying of neuronal structures of brain connected with language? "Cognitive linguistics is focused neither physicalisticly nor strictly functionalisticly, but it integrates certain aspects of both perspectives in order to affect neuropsychological language reality." (Schwarzová, 2009, p. 33). At the same time cognitive–linguistic research postulates mental characteristic of language, thus it is mentalistic. Language ability has to be analyzed structurally (as a system of mental representations) and processually (as a specific sequence of information processing). *Theoretical linguistics* is focused on exposing structures of language knowledge. The manner of learning language competencies, functioning of language memory and a process of its activation is the subject matter of psycholinguistics. Neuronal structures mechanisms that are basis of language representations and operations with them are examined by *neurolinguistics*. Cognitive linguistics hence acts as an integrating scientific discipline that tries to find connections among structures of mental representations, their processing, and neuronal substratum. Above all it asks these questions: 1. What is the basis of our language competency? 2. How do we learn language? 3. How is language connected with thinking? 4. How is language structure (morphological, lexical, syntactic, semantic, phonological) reflected in a structure of language representation? 5. How do we use our language knowledge? 6. What is the neuronal substratum of representation, learning, and usage of language? Cognitive linguistics scrutinizes primarily possibilities of modelling the learning process, language reception and production, while its fundamental effort is to create complex theory about cohesion of structural and procedural aspects of language knowledge.

Cognitive linguistics understands language as a tool for organizing, processing, and delivering information. Processing and storing of information are the determining characteristics of language abilities. Despite the beginnings of cognitive–linguistic research that preferred explanation of syntactic language knowledge structures (Chomsky's Universal Grammar), today's linguistics

understands language as primarily semantic — it bears certain meaning. Language has some characteristic traits: a) it is perspectivist — language is not only a reflection of objective state of things, but it is a constituent of this state (Wittgenstein talks about language as a condition of world existence), b) it is dynamic and flexible — it is a reflection of the ever–changing environment we live in, hence new terms and meanings originate in the language as a reflections of our new experience, c) it is encyclopaedic and non–autonomous — also social and cultural contexts reflect in language, and it is formed by other cognitive abilities, d) it is conditioned by usage and experience (Geeraerts, 2006).

In the field of cognitive science two opposite approaches to explanation of language knowledge dominate — modular and holistic. Modular stream characterizes language as an autonomous module, separated from modules of other cognitive abilities. Chomsky's theory about generative grammar or Fodor's language of thinking hypothesis serves as an example. Holistic approach rejects conceptualization of language as an autonomous module and it postulates explanation of language knowledge only as a part of general conceptualistic processes and categorization principles. Language structures and operations are thus inseparable parts of cognitive abilities.

Another dichotomic pair is computational and connectionist approach. These approaches differentiate in an explanation of mental processes character and operations with mental representations. Classic computational model is based on a principle of algorithm as a set of modified rules that control variation of some state. This algorithm performs in series; next operation is commenced after previous operation is finished. Connectionist models perform on a principle of mutually interconnected network of units — nodes and parallel processing of information. This model mostly stems from neurophysiologic findings concerned with behaviour of human brain.

## 1.2 Research Procedures in Cognitive Linguistics

Research procedures are given by its interdisciplinary character. Apart from classical rationalistic approaches of inductive and deductive assuming, plenty of empirical observational methods are used in the field of cognitive linguistics. We have already mentioned a criterion of psychological and neurophysiologic plausibility of cognitive theories and their empirical character. That is why the method of experiment is one of the most important methods; it allows direct contact with neuropsychological reality. It is a controlled observation of human behaviour during experiment, where experimentalist interferes with the course of experiment by specific instructions. On the basis of the observed behavioural change of tested subjects he tries to state some causal connections. Experiment then serves as a confirmation or as a disproval of given hypothesis. We distinguish two basic types of experiments — so–called off–line and on–line experiments.

Off–line approaches detect the ability to store the provided information. We talk, for example, about a method of free or bound reproduction. In case of free reproduction, an individual is to repeat provided information, while time interval between reception of information and its reproduction may vary. In case of bound reproduction, the experimentalist provides key phrases to the tested individual, which should help to achieve more precise reproduction of given information. Under this reproduction, significant influence of long–term memory knowledge is shown, when tested subjects insert information that were not given into their descriptions. Influence of individual experience on perception and processing of given information is evident. However, it is not clear if activation of knowledge stored in long–term memory happens at reception or at reproduction of information. The off–line method is hence appropriate for detecting structural aspect of language knowledge, while sequence of its processing is hardly apprehensible this way.

In case of on–line methods we intervene directly into the action of information processing, so it is suitable mainly for detecting processual character of cognition. It is, for example, priming method that examines influence of knowledge structures stored in the long–term memory on operations with lexical units. Tested subject is firstly presented a word with certain meaning, then another — so–called final word. The task of the tested subject is to determine if the final word has meaning or if it is only a random cluster of syllables. This approach leads to finding that time needed for determining if a word is meaningful is proportionally shortened by the fact whether the initial word has semantic relation to the final word. Hence semantically related words are activated together in long–term memory. Another type of on–line method is the measurement of speed by which language units are processed. Under this approach, connections between the length of information processing and complexity of undergoing cognitive processes are investigated.

Next group of methods, which cognitive–linguistic research is based on, are neuropsychological methods that look for connections between mental and physiologic processes. These methods include computer imaging methods that trace various biochemical brain activities (for example, processing of glucose in particular brain areas) or blood flow through certain brain regions. Cognitive science gains much knowledge about interconnection of mental and neuronal structures from the study of various pathologic cases and by disassociations method. Disassociations method determines dependency or autonomy of certain cognitive capacities of patient, who suffers from specific neuronal defect. It, for example, investigates if face recognition malfunction (prosopagnosis) is connected with some other memory disorder.

# 2. Language as a System

Keywords: *language system, phonology, phonetics, morphology, syntax, semantics, language sign*

## 2.1 Introduction

Linguistics as a science was constituted at the beginning of the 20th century mainly by introducing its systematic character in the work of F. de Saussure. Basics of systemic linguistics were also co–constituted by the Copenhagen (L. Hjelmslev), American (L. Bloomfield), and Prague schools (R. Jakobson). The main aim was to outline the linguistic analysis subject. Saussure introduced difference between internal and external linguistics. External linguistics reflected language as a socio–cultural phenomenon in relation to geographical, ethnologic, or historical explanation. Internal linguistics could then focus on examining language as a system. Classical philology understands language as a tool, not as a target (Dolník, 1999). Language says a lot about user's personality. As a social phenomenon it can also outline certain characteristics of nations. In the systemic linguistics, phenomenon of language is examined as a scientifically explicable occurrence and it is the subject of explanation of a number of empirically tested linguistic hypotheses.

## 2.2 Systemic Linguistics

Systemic linguistics is based on two basic postulates: 1. language is explained as a system — it is the unit of structurally organized basic units that directly or indirectly affect each other, 2. language units have character of signs — sign character is explained by semiotics (or semiology) — science about signs.

Saussure divided systemic linguistic language into *langue* — language and *parole* — utterance, speech (according to Copenhagen school it was dichotomy between system and process). N. Chomsky classified language knowledge in a similar manner — into competency and performance, or I–language and E–language. Saussure also introduced third, the most general term — *langage* — oration that stands for common ability to realize language communication. He compares language to a game of chess — it is also certain system with strictly given rules and positions of individual pieces (language — langue). A specific chess game in progress with specific position of figurines matches the language — parole. Human ability to play chess and understand its rules is parallel to language — langage.

"Language as a langue is an abstract language units system of sign character and rules of its usage, including norms and models (templates, patterns, schemes) of this usage." (Čermák, 2009, p.81). In this content, the character of language is: 1. collective and conventional, 2. abstract, 3. Neurobiological (it is stored in brain memory centres), 4. historically conditioned (it is the product of past development), 5. normative — it is source of patterns for carrying out language communication, 6. independent of its physical realization (language is independent of the existence of letters). Language system structure consists of hierarchized network of

relations of its basic components. Language units are defined by position they have in the system. Principle of their arrangement is relation of opposition. Differences among units are important; they are arranged and distinguished from other units according to those differences. Thus every unit is determined by its opposition to other units that is what differentiates it, forms it at the same time. Oppositely arranged language units create network of relations. Network of units, which are mutually broadly equivalent, are called paradigm. Every paradigm has its rate of abstraction and complexity, on their basis paradigms are arranged hierarchically (according to the principle of hyponymy). An example is the chain of paradigms — animal — mammal — canine — etc. Language units are fully defined in the language system, which is why they have arbitrary character in relation to their physical realizations. In the language system, lexical units are classified into categories — abstract functional classes — which are one of the criteria of language expression distinctiveness. Their function is next classification (for example nouns), followed by classification that creates alternatives (active or passive voice), or further definition of relation (plural, first person, third case).

Language system can be classified on the vertical line into collocations (regular word sequences), vocabulary, morphology (flexion and derivation), and a phonology. The number of units of particular subsystems decreases in the given order from millions (collocations) to tenths (phonemes)[1].

Realizations of abstract possibilities enabled by language — langue are the area of communication, utterance — language of paroles. These realizations can be performed in verbal form (factual discourse) or in written form (text). The characteristic of language — parole is concrete, individual and up–to–date. Particular utterances have clearly delimited content, linear character and they exist (in contrary to language — langue) here and now (in praesentia). Speech is a domain of individual creativity of speaker and hence is the source of names in the language — langue. Units in the language — parole have suffix –tic (e.g. phonetic), units in the language — langue have suffix –emic (e.g. phonemic). Language — parole is a specific linear chain of units, on the other hand language — langue is an abstract, hierarchically organized model of basic units.

1) For tracing the usage frequency of lexical units in the native language, so–called frequency dictionaries are created. In Slovak language the mostly used words, according to J. Mistrík, are the words and, be, in, on, and reflexive pronoun. The most frequently used colour in Slovak is black, while in French it is blue. From the oppositional pairs like healthy — sick, wise — stupid, poor — rich, etc. the more frequently used after positive words with the exception of pair happy — sad where more frequent term is the word sad. (Mistrík, 1969)

Language study is divided into several systematically organized disciplines. They examine basic parts of language on various structural levels.

*Phonology* is concerned with the study of language phonemes in their particular language realizations. *Phonetics* is focused on the study of systemic acoustic units from their functional point of view. It divides phones into vowels and consonants according to their origin, which may be tone or noise. Phones create strings in the following sequence: syllable — cycle (combination of syllables with one stress) — sentence section (part of sentence separated by pause) — sentence. Grammar represents summary of language system rules that determines manner of creation and organisation of sentences and word forms. It pertains to that part of language that determines ways of combining language units (syntactic structure of language). It is classified into *morphology* and *syntax*. Morphology is focused on the character of morphemes — parts of a word with certain factual or grammatical meaning. It is a minimal language sign that always has meaning or grammatical function.

Morphology in narrow sense deals with flexion hence declination (flexion of nouns) and with conjugation (flexion of verbs). Flexion serves as an expression of syntactic relations in word, mainly with the help of suffixes and prefixes. Word classes have various categories that determine their syntactic relations (nouns are determined by number, gender, case, possession, etc., verbs by person, number, tense, mood, etc.,) Morphology in broad sense deals with word creation. Every word has certain structure. For example the word "nezničiteľného" consists of prefixes ne– (defines negation) and –z– (defines perfective aspect), the root word –nič– (bearer of the basic lexical meaning), grammatical morpheme –it– (defines infinitive), suffixes –teľ– (defines substantivation) and –n– (defines adjectivization) and the ending –ého (defines case, gender, and number) (Černý, 2008).

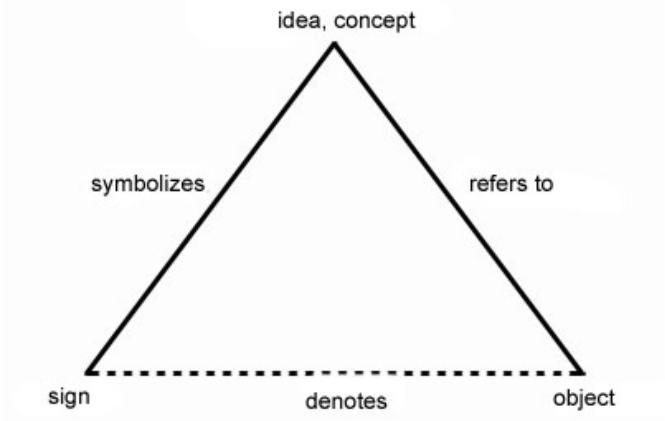
Another grammar discipline — *syntax* examines and defines rules, ways, and combinations of words connected with creation of sentences or texts. Sentence is the basic structural, systemic unit of language — langue. It is a verbal expression of thought and has a linear character. While constructing a sentence, individual signs cannot be organized in another way than one after another. Every language has its own specific word order rules. Syntactic character of language is a prerequisite for computational explanation of language in cognitive linguistics. Proposition is a simple declarative sentence, which has the character of a meaningful unit based on certain declaration (predication). A syntactic string usually has this structure: subject — predicate — object — attribute — adverbial. Sentences connect into compound sentences, which may consist of either two main clauses (there is a relation of coordination the between clauses) or one main clause and one subordinate clause (relation of subordination). Next important systemic linguistics discipline is lexicology and lexicography. *Lexicology* examines language signs inventory (expressions, words, and collocations) and it systemizes vocabulary in terms of its organization, words origin, ratio of root words to derived words, it inquires ways of creation of new words, foreign words usage and their influence on native language vocabulary. *Lexicography* applies this knowledge in compiling various types of dictionaries. *Semantics* is teaching that deals with the meaning of language signs.

## 2.3 Language Sign and its Character

Language is a system of signs. The basic characteristic of a sign is its representative function.

The nature of sign character comes from the era of scholastic philosophy: something that stands for something (lat. aliquid stat pro aliquo). An organized system of signs composes a code. The sign has certain meaning, it is the bearer of some information. Which language elements are signs? In a broad sense, the word acts as a sign or if you like as a lexical unit (a sign may be composed of more words, for example to be thirsty). A sentence is not a sign; a phoneme is not a sign either. Multi–word name is a sign only if it is an idiom.

The sign structure is given by its function: to stand for something, represent something. It is usually exemplified by a semiotic triangle:



A sign or a form may have graphic or phonic character. The relation between a sign and an object/referent is representative — a sign represents something. The relation between a sign and an idea is denotative — a sign symbolizes meaning. The relation between a meaning and an object is referential — the meaning refers to object, it points at the object.

We may interpret a semiotic triangle by language of existential logic. The sign is replaced by the term individual name, meaning by intensity of individual concept, and object by individual (it represents extension of individual name and concept). Then we can describe semiotic triangle as follows: an individual name denotes an individual. "Denotation is a semantic relation between some language expressions and extralinguistic objects, which has the ability to assign one extralinguistic object at most to every distinct expression as his denotation." (Cmorej, 2001). Denotation of expression (individual's name) is its extension. Another part of a triangle is the relation between individual name and individual concept — it is signification. It is a different way of language expressions reference than denotation. In case of signification we deal with relation between expression and intensity (we can identify it with the meaning of expression). Intensity of expression is its signifier. Last side of triangle is relation between intensity of an individual name and object of extralinguistic reality (an individual). It is the relation of determination — an individual is determined by individual concept (intensity of individual's name). The object of extralinguistic reality is hence extension of its concept and name it denotes. From the existential logic point of view, we can explain the function of sign as a relation among individual name, its signifier (name intensity), and denotation (extension of name and concept). Two names with different denotation necessarily signify different intensity. The same relations apply to predicates that assign certain attributes to individuals or state that individuals are in certain relation.

Systemic linguistics distincts a number of defining characteristics of a language sign: a) it is of an arbitrary character (it is defined conventionally), b) confidentiality and linearity (a language sign has a fixed shape and range, and has one–dimensional character), c) semanticity (a sign always has relation to meaning), d) relative exchangeability and wide acceptance (signs are accustomed and the same for everyone), e) negativity and contrariness (a sign always stands in contrary to another sign, it is negatively delimited), f) a sign is portable in time and space, and among cultures (a sign is learnable) (Čermák, 2009).

Pursuant to the theory of Ch. S. Pierce, we distinct three types of signs: indexes — their principle is to point at objects (e.g. language expressions here, there, tomorrow, later), icons — signs based on a relation of similarity and labelling of object (for example, imitative words or metaphors), and symbols — signs that are based on arbitrary relation to the object of extralinguistic reality.

The discipline that deals with language sign research is called semiotics (Saussure uses the term semiology). Semiotics analyses three types of relations — syntactic (relations among signs), semantic (relations among signs and objects), and pragmatic (relations of signs to their user).

## Recommended Literature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# 3. Language Learning Problem

Keywords: *native language, predisposition, phases of development, symbolic function*

## 3.1 Introduction

The rate of language competencies innateness is the research subject of a number of cognitive–linguistic theories. Noam Chomsky — the initiator of nativism discourse — postulates the existence of so–called LAD (language acquisition device).

It is a kind of an organ of language communication we come to this world with. This organ subordinates to individual's ontogenesis in the same way as other human organs. It matures similarly to our neural system. According to Chomsky, the ability of language communication is innate similar to the ability to perceive certain colour spectrum or certain sound frequencies.

Today's cognitive theories recognize the role of innate factors that influence learning of a language. However, the question of magnitude of their influence in proportion to the influence of outer conditions still stays open.

Do we have to learn language by everyday practice, or does our language competency simply develop on its own? In current effort to find answer to this question, the focus is aimed on the process of learning the language by children. Language development is examined on the level of phonetics, lexicology, and grammar. Many linguists even consider explanation of children language competency as a central problem of linguistic theories. Because children are the only living beings that are able to master a complicated language system in such a short time period and on the basis of such a limited sample.

## 3.2 Phases of Development and Crucial Stages in the Language Learning Process

Even a newborn inclines to the native language, since it has had the hearing experience with it since the period of intrauterine development (internal ear develops in the second half of pregnancy). A child hence prefers not only mother's voice, but also the language she speaks. (Kráľ, 2005).

Approximately at the age of two months, children enter the phase of the first phones articulation (e.g. "ááá", "óóó", and other vowels). A child tries to imitate sounds of mother's voice. This development phase is called "cooing" and it lasts about until the sixth to eighth month. Then the second phase called babbling steps in, it is characterized by duplicate pronouncing of phonemes (e.g. "mamama", "tatata", "bababa"). This development is characteristic for acquisition of any world language; even in case children who learn the language are deaf. At the age of nine months a child understands a number of words, while the first spoken words usually appear between the twelfth and fourteenth month. They are usually names of individuals ("mama", "tata", "dedo") and objects ("auto", "bábo"), next are names of substances ("voda"), animals ("havo"), demonstrative pronouns ("toto"), greetings ("papa"), and expressions of agreeing and disagreeing. In this development phase verbs,

adverbs, and prepositions are absent. Words are uttered in form of sentences (so–called one word sentences), while new expressions are added approximately twice or three times a week. Gradually the pace of acquisition of new words increases, while verbs, adverbs, and functional morphemes (they mark past tense of verbs, etc.) are being added at a continually bigger rate. In this phase of ontogenesis syntax gets in. Children combine words into strings according to a language pattern they are exposed to. The first sentences are assembled in a pattern subject — verb — object. They are sometimes called telegraphic sentences, because there are not any functional morphemes (sentences have very simple character, words are not flexed). Children adopt basic sentence structure around the age of four. An interesting finding is that children much sooner than they are able to produce multiword sentences themselves, understand syntax (thus they understand the importance of word position in a sentence at generation of sentence meaning). Experiment when children heard a sentence that corresponded to only one of the two suggested pictures, showed that children who were not able to compose two–word sentences understood the difference between: "Big Bird tickles Cookie Monster." "Cookie Monster tickles Big Bird." (Hirsh–Pasek and Golinkoff 1996). This finding points at basic understanding of semantic implications of a sentence structure at an early age. Syntactic understanding is being developed up until the phase of adolescence.

Around the age of three, telegraphic sentences phase ends and absence of functional morphemes is replaced by hyperregulatory tendency (e.g. in case of past tense of irregular verb go — went, children use "goed", or "wented"). Also the phenomenon of creating new verbs from nouns appears (e.g. instead of "to make giggle" new term "to giggle") (Bowerman 1982). In connection with using grammar rules we observe interesting occurrence that is described as U–curve. Its usual course has the shape of the letter U and describes manner the children learn, for example, rules of forming past tenses of verbs or plural of nouns. In the first phase of learning, children make relatively small amount of errors, because they learn irregular forms by heart as new words. In the second phase, they gradually learn and understand how rules work, and that is why they have a tendency to apply the principle of rules to exceptions and irregular forms (e.g. ryža — ryžoto, plavky — plavka, ľudia — ľud, and so on). That is why this phase in gradual development of language competency is ironically the phase of "decline" or increased number of errors. It lasts approximately from the age of two to seven. Only in the third phase of learning the number of errors decreases again and a child is able to correctly identify the area of applying rules and allocate group of irregular forms, pluralia tantum, or other exceptions. This occurrence is observed in every language.

At the age of six, a child knows approximately 13 to 15 thousand words, while an adult understands approximately 65 thousand words (systematically educated man may understand up to 120 thousand words).

In the process of language learning, a number of critical phases occur.

The first critical phase of learning phonetic–phonologic system around the age of eight months, when as if the ability of learning new phonemes ends. For example, in Japanese and Korean there are no distinct sounds for phones "r" and "l", children with these native languages cannot distinguish phonemes "r" and "l" after eight month of age. Next critical phase in learning semantic aspect of language is after the fourth year of age. There are cases when thanks to external intervention (implantation of neural–prosthetic that electrically stimulates acusticus) originally deaf–born children learn to speak. But when cochlear apparatus is implanted in adulthood, it is not possible to use it for verbal communication, not

even in case of serious and systemic learning. Significantly slower understanding of speech is already noticeable after passing the age of four (Kráľ, 2005). Auditory cortex of the brain develops depending upon the existence and the quality of sound stimuli.

Another critical phase is the stage of learning grammar and development of specific neural apparatus on which correct usage of grammar rules depends. Interesting findings about the ways of creating grammar knowledge come from the records about the origin of pseudo–language — so–called pidgin. This type of language appeared among slaves dragged to America, who descended from various countries (Mauritius, Seychelles, Hawaii, and others). For the purpose of simple communication, they created a specific language characterized by simple grammar and lexicon consisting of words of particular native languages of slaves. An interesting discovery is that the next generation of users was constantly and spontaneously developing and enriching this primitive grammar. The result was the creation of so–called creole languages that worked on the principle of largely semi–finished grammar — "authorial contribution" of diverse user community. Also based on these facts, Noam Chomsky presumed innateness of ability to create syntactic structures (so–called universal grammar that we learn thanks to LAD — language acquisition device). Acquisition of grammar competencies happens relatively early and much sooner than, for example, acquisition of logical–mathematical abilities. According to number of authors, ability of creating syntactic language structure is determined biologically and is connected with continuous development of our body. Critical stage connected with grammar efficiency lasts approximately up to the beginning of puberty (Kráľ, 2005). At this age, plasticity of neural verbal centres diminishes.

Other evidence on the existence of critical stages of human language communication ability are provided by the cases of so–called wolf children. This term denotes extreme cases of children that for various reasons did not grow up amid day–to–day language practice but in a total isolation from human community. Due to the lack of language experience, wolf children after passing the age of 7 — 12 cannot learn to communicate by articulated language, since brain centres for language at this stage have already taken over other functions. Development of brain centres specialized in language knowledge is closely connected to external impulses of environment (while significance of these impulses decreases disproportionately with increasing age).

Based on the mentioned examples we can observe dual conditionality of learning language competency — external and internal. On one hand, language is the result of neurobiological predisposition of specific human language centres and on the other hand, it is the outcome of cultural influence of communicating human community. Both conditions — specific neural apparatus and early experience with language practice are necessary prerequisites for language competency. We can also state that the richer and more information loaded external inputs of language experience are, the less the child has to engage its "pre–programmed" inductive capacity as a kind of internal supplementary apparatus. Also universal cognitive principles (such as analogy, transfer, systematism) intervene into the process of language learning and by significant rate influence level of language acquisitions.

A child is not only a passive recipient of language but also its creative producer. An interesting example of innate skill for grammar principles is a simple test of creating plurals of nouns — so–called wug test. If a child is given a task to create plural of a made–up word (this word is heard for the first time), it will not hesitate and on the basis of principles of analogy and systematism it will create plural of this word. The American experimenter Berk–Gleason used the word Wug (to name a specifically looking bird) in her experiment. When she asked children participants to the experiment (at the age of at least four) to name two of those birds, they automatically created new word: Wugs (in English, plural of regular nouns is created by adding suffix –s). This example is a proof that a child is not only a passive imitator of the observed

grammar rules, but it also directly possesses innate apparatus of implicit rules which he applies automatically without explicitly understanding them. An interesting discovery is the relative complexity of explication and reasoning of language rules in the phase of learning native language at elementary school. In this phase, it is relatively difficult for a child to understand grammar structure and make analysis of a sentence, even though it has already been systematically creating grammatically correct sentences in the spoken language for few years. It is possible to observe interconnection of higher cognitive functions with learning process of grammar rules on the example of composites (compound words) creation. The four–year old child is not able to create a compound word as an author. Composite creation namely requires perception and finding of connections among events, for which developed associative thinking is important.

### 3.3 Piaget's Theory of Symbolic Function Development as a Condition of Language Skill

Jean Piaget's concept presents an interesting explanation of language acquisitions. Piaget explains language intelligence in broader framework of general intelligence as the ability of symbolic function. It arises from the foundations of developed sensorimotor intelligence at the age of approximately two. It lies in the ability to represent, imagine something, to create conceptual schemes. The basic principle of symbolic function is determined by the existence of difference between labelling and being labelled. Developed representing (semiotic or symbolic) function is a condition to the possibility of language, emergence of figurative concept, symbolic gesture.

A child in sensorimotor period does not yet operate with images. But gradual onset of new cognitive functions at the beginning of second year of life presumes the existence of the concept of object and subsequently the ability to evoke this concept as some kind of "substitute" for the absent object. Symbolic function passes through the stages of so–called deferred imitation (e.g. imitative gesture), symbolic or fictive play (e.g. pretence of sleep), drawing or graphic representation (which represents transition between a play and a figurative concept), the figurative concept (in terms of internalised imitation), until the development is finished with the emergence of a language symbol. Concept is in the early stages expressed through movement; the imitation act is gradually getting separated from the current context and becomes a generalized labelling symbol — concept in mind. Figurative concept is at first the child's own conceptualisation (it has thus the nature of individual construct); only later it becomes some kind of a copy of the perceived object (it is formed according to the intersubjective validity criterion). Therefore, the transition from concept expressed through an act to mental concept, stimulated by symbolic play and drawing, is determining for the possibility of child's language competence. The mental concept is separated from outer acts and through its generalising and formal nature it becomes the basis for development of higher cognitive functions. The language skill in this process represents a certain culmination of development of symbolic function.

During the period of developing symbolic function, figurative concepts are rather subject to the laws of own conceptualization than the laws of perception. It turned out that up until the age of eight or nine child's drawing is mainly the representation of what the child knows about the object and not what it sees in front of it. Only in the period of the so–called intellectual realism (approximately from the age of nine), the drawing represents qualities of the model, regardless of the visual perspective. The same as with drawing, also the figurative concept is developing — first in form of own conceptualisations, later as internal copy of perceived object (Piaget, 2010). These findings could be important in explaining the semantic nature of linguistic knowledge.

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# 4. Modular Concepts of Linguistic Knowledge

Keywords: *modularity, transducer, mandatoriness, neuronal topology*

## 4.1 Introduction

The modularity theory is one of the broadly accepted methods of explaining linguistic knowledge in the contemporary cognitive linguistics. Modular linguistics postulates the system of linguistic knowledge as an autonomous module of neurophysiologic nature.

## 4.2 Modular Approach

The foundations of modular approach were laid by N. Chomsky, who understood language as an independent module separated from other cognitive systems: "...it seems that we should consider the knowledge of language ... as a certain differentiable capacity of mind, linguistic capacity, with its specific properties, structure and organisation, as a "module of mind" (Chomsky, 1986, p. 5). Since the times of P. Broca's discovery who localised the third frontal gyrus of left brain hemisphere as the area of linguistic knowledge, various forms of modular theories are emerging. At the turn of the eighteenth and nineteenth century a theory emerged that connected specific mental functions with different parts of brain. This so–called phrenological theory (from the combination of words "phreno" — mind, spirit and "logy" — science) was, however, later condemned as pseudo–science, but the basic idea that human

cognitive capacity is composed of various abilities that are independent domains and have foundation in physiological constitution of our brain, remained inspiring.

N. Chomsky's concept of modularity focuses mainly on the explanation of functioning of language as universal, genetically generated system of syntactic linguistic competences. The American cognitive psychologist J. Fodor elaborated the idea of modular organisation of human cognition in more detail. He rejects the horizontal structure of cognitive abilities that leads to separation of judgement from observation, perception from memory, will from imagination, and so on. Instead of that, he proposes vertical division of elements of these cognitive processes and postulates independent units of mind — modules. These are representing some kind of cross–section of individual horizontal abilities. A module is therefore an autonomous unit of mind, which is as if an independent device for processing specific information. It communicates with other modules on the input and output level only. Processing of precisely structured input information itself is running according to module's unique algorithm. The module operates with own data set not accessible to other modules, whereas it is also true that there is information accessible to at least some cognitive processes and not accessible to the module (Fodor, 1985). Fodor therefore introduces the fundamental difference between "lower" level of perception and "higher" cognitive processes. His concept of functional organisation of mind has three levels: sensory transducers, input systems and central cognitive systems, which have different functional tasks. The modular nature applies to input systems that fulfil intermediary function between the level of sensory transducers and levels of central systems. Input systems are vertically organised abilities. The modular nature of input systems is related to their computational properties. They are as if a certain type of autonomous computing device working with symbols. The result of computation of information that are entering the input systems through sensory transducers, are mental representations. Module input systems are therefore responsible for provision of information about organism's outer environment. The computationally processed information is in form of mental symbols. In this form, they are accessible by central cognitive systems that can further work with them. Therefore, the procedure of information processing by cognitive system is as follows: sensory transducers record changes in the environment; these are subsequently computationally processed by modularly organised input systems. The result of this processing is symbolic representations of the environment, which become the only available and "eligible" material for central cognitive processors. The task of perception modules is thus to represent changes in the environment to thought and to intermediate contact of cognitive system with the outside world in this way. The task of sensory transducers is, on the other hand, to analyse environmental stimuli and to transform them to such types of signals that are subject to computational operations of input systems, without loss of their informational content. In case of language, the information processing is happening as follows: the respective input system for linguistic knowledge processes the regularity of sound waves created through speech and landing on hearing sensor — eardrum and creates a linguistic representation. Differentiation between perception and cognition becomes essential here. Emergence of mental representations is bound to the activity of modularly organised perception and therefore does not fall under the domain of cognitive processes. On the other hand, formation of beliefs about certain state of affairs is not a result of input modules' representation but is related to activity of central systems. In case of formation of beliefs, we are in fact considering: "to what extent is the sight reliable or to what extent is the source reliable. Formation of beliefs is exactly what I had in mind as a typical central process." (Fodor, 1983, p. 46).

Fodor specifies the set of modules' attributes. Typical is their domain specificity. The module is always adapted to certain type of information inputs. That is, he receives signals from certain

type of sensory transducers only. For example, in relation to auditory perceptions, the differentiation of melodic or rhythmic structures or recognition of voices is modularly organised. In case of visual perception, it is the independent computational processing of colour data or three–dimensional spatial objects. Another feature of a module is mandatoriness (i.e. boundedness, directness). A sentence in mother tongue cannot be perceived as a meaningless sequence of noisy sounds. In fact, the input systems process information from transducers into the form of mental linguistic representations, which we therefore inevitably perceive as connected with certain meaning. Also another feature of modules — limited access of central modules to mental representations of input modules, is related to it. The ability to realize something is indeed the matter of central cognitive processes that are working in a different "regime". Modular constitution is characterized by very fast and efficient processing, which automatically executes a specific set of operations. This fact becomes very useful in life–threatening situations, when it is necessary to act immediately. One of the most important attributes of modules is their informational reclusiveness. Modules operate autonomously and have no access to information from cognitive operations. It is the so–called information encapsulation of module. Modular organisation is of neurophysiologic nature and therefore it is possible to create a fixed neuronal architecture of input systems. However, this does not apply to central cognitive systems, because these are (unlike input systems) very demanding in terms of information, are not operating on the basis of automatic algorithms, but are providing flexibility and possible adaptation of the organism. Also the many times empirically determined fact that the damage to certain part of brain is accompanied by disruption of certain psychical function, whereas this disruption is usually isolated and other functions remain intact, speaks in favour of fixed neuronal topology. An example is the so–called Williams syndrome, in which certain cognitive abilities (e.g. the ability to count or to solve simple spatial tasks) are selectively disrupted, but linguistic knowledge remains almost intact. A similar case is the so–called prosopagnosia (disorder of face recognition), in case of which the remaining cognitive processes are functioning normally. This would speak in favour of the theory of modular organization of input systems. Also in case of aphasia (language disorder) it is the case of disruption of vertical organisation of cognitive abilities rather than reduction of horizontal abilities (of memory, perception, attention) as a whole.

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# 5. Holistic Concepts of Linguistic Knowledge

Keywords: *holism, symbol, cognitive grammar, conceptual metaphor*

## 5.1 Introduction

Holistic approach rejects the existence of autonomous language module. The carrier of linguistic competence is the whole cognitive system. The representatives of holistic concept are blaming the modular explanation for excessive level of idealisation and formalisation of language abilities, which lead to postulate the language as a closed system and do not allow explaining the cognitive purposefulness of language.

## 5.2 Holistic Approach

Holistic approach explains the linguistic competence as a part of a set of universal principles, such as creation of concepts, categorisation, recognition of structures, creation of meaning, creation of metaphors and others. These universal principles are in the same extent the foundation of all mental abilities. Holistic explanation of language is being developed mainly in the concepts of cognitive grammar (R. Langacker, L. Talmy) and in the cognitive metaphor theory (G. Lakoff).

The basic feature of grammar is its symbolic nature: "... cognitive grammar claims that grammar is inherently symbolic and exists only depending on semantic and phonological structure... whereas lexicon, morphology and syntax create a continuum of symbolic structures only arbitrarily divided to separate elements" (Langacker, 1988, p. 5). Another important postulate is the primacy of meaning in language (unlike formal syntactic structure, preferred by modular approach). In short, the basic tendency of thought can be formulated like this: language is meaning and meaning is conceptualization (formation of concepts) (Geeraerts, 2006). Grammar consists of symbolic units that are the conventional joining of form and meaning. They are more abstract than lexical items. Langacker claims that the language cannot be described without basic reference to cognitive processing. The effort to analyse grammatical units regardless of their semantic value can be likened to writing a vocabulary, where the meaning of lexical items is not mentioned. Langacker also objects to formal semantics, based on defining conditions for validity that should be an adequate description of meaning of linguistic expressions. Semantic structures are in fact characterized by their dependence on cognitive system that is primarily open. Meaning is given through the process of conceptualization. Linguistic semantics must therefore be concerned with structural analysis and explicit description of abstract entities, such as ideas and concepts. The term conceptualisation includes creation of new concepts, as well as the already fixed concepts, sensory, kinetic and emotional experiences, recognition of social, physical or linguistic context and other cognitive activities. Meaning of lexical items is adequately expressed through semantic nets, within which many nodes with regular meaning of lexical items exist.

Semantic structures are bound to cognitive domains. Semantic description of expression is derived from the comprehensive notion of encyclopaedic scope. In fact, certain expressions anticipate other, already established expressions, which make it possible to characterise them. For example, the concept hypotenuse is characterised on the basis of the concept of right triangle. This concept allows attaching certain meaning to the concept hypotenuse; therefore, the concept of right triangle is cognitive domain for the

concept hypotenuse. Similarly, the concept arm is the cognitive domain of the concept elbow, the concept April is conditioned by the existence of certain, more or less same, parts of a calendar year, i.e. by the concept of months. Therefore, if we wanted to provide full and comprehensive characteristic of language's semantic structure, we would have to describe all relevant cognitive domains, which are ordered hierarchically — from fundamental domains up to derived domains.

The basic statement in Lakoff's theory of conceptual metaphor is postulating a metaphor as a way of thinking. Metaphor is therefore concerned primarily not only with linguistic expression, but also with thought processes. "Metaphors are empirical questions, not poetic linguistic expressions." (Lakoff, 2006, p. 185). Principles of poetic metaphoric expressions are not of linguistic, but of thought nature. They govern universal mapping across conceptual domains. So the conceptual metaphor theory can be shortly characterised as cross–domain mapping in conceptual system. Lakoff argues that metaphor is the central principle of natural language's semantics. The principle of metaphoric generation of meaning means thousands of cross–domain mappings executed every day. Metaphoric thinking is to the great extent foundation of language's structure. For example, concepts such as "cause" or "purpose" are of metaphoric nature, too. Metaphoric understanding comes always when we traverse to the area of abstractions or emotions. Lakoff objects against traditional explanations of metaphoric expression as an opposite to everyday language. Language is often interpreted as literal understanding of meanings, because only such literal comprehension allows to determined conditions of validity.

Lakoff illustrates his concept of cognitive metaphor on the example of *"love is a journey"* metaphor. There are many expressions in everyday language that support this metaphor. They are phrases like: "See, how far we have come", "We have found ourselves on the crossroads", "Our relationship is heading nowhere", "Maybe we should go separate ways", "There is no way back", "Our relationship is at dead end" and others. Lakoff seeks a universal rule that determines the method how these linguistic expressions about a journey are used to characterise love. Another example of metaphorical nature of linguistic knowledge: argumentation as war ("to defeat someone in discussion", "to hold own positions", "to give in to arguments"), thoughts as live beings ("an idea was born in his head", "prolific thought), life as a hazardous game ("it is a big stake", "hold all trumps", "life defeat"), mental conditions as vessels or forms of something ("to be on the spot", "fall into depression", "be in mood")(George Lakoff — Mark Johnson, 2002). The analysis of metaphoric expressions leads to the exclusion of certain fundamental characteristics of metaphorical nature of language competence: *systematicness* — metaphor is not accidental, but grasps the structural similarity between two different areas (source and target), *constructiveness* — metaphors create new realities, new meanings emerge by structuring target areas according to the source areas (e.g. measurement is the result of metaphorisation of measured quantity through space — up, down, left, right), *physical conditionality* — the source of metaphor is direct physical experience (we comprehend abstract expressions on the basis of visualisation of certain sensory experience — e.g. love as a journey, argument as a war, etc.). The metaphor's experience base does not have to be exclusively a set of physical and material experiences, but can have the shape of socio–cultural experience. A metaphor is usually one–way — a known and non–problematic expression is a key to comprehension of unknown and hard–to–grasp expression.

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# 6. Symbolic and Connectionist Paradigm of Linguistic Knowledge Modelling

Keywords: *computation, symbol, algorithm, artificial neuronal network, weight connections, sub–symbolic level*

## 6.1 Introduction

The foundation of computational representational theory of cognitive processes is: 1. Explanation of mental state as representing states. The implementation of mental states are states of brain that are understood as representing or acting states of other systems — e.g. of outer world or organism's internal environment. 2. Transitions between states are explained as computational operations on representations.

In the 1950s and 1960s, connectionist models of cognitive functions started to emerge. The hardware element of these models is represented by networks consisting of great amount of densely interconnected units — nodes that correspond with concepts or properties. It is the so–called parallel distributed processing (PDP). The cognitive process is modelled by parallel processing of sub–symbolic information.

## 6.2 Symbolic Paradigm

Computational operations are the principle of abstract device known as Turing machine. It is based on sequential states and rules that determine changes of these states. Each precisely defined function can therefore be executed by this machine in a sequence of steps, which are governed by a simple syntactically structured rule: "if state S gets input V, it performs step Q". Turing machine consists of a control unit, tape, reading and writing head. The control unit is at every time defined by certain state that changes in precisely established way on the basis of information coming from reading and writing head. Tape in this abstract machine is an infinite linearly arranged sequence of units bearing symbols from a finite set of symbols. These constitute the input alphabet that codes the computing algorithm of Turing machine (TM). The TM head always reads one unit on the tape, the one which it is currently above. Apart from reading, it can also overwrite the unit or move by one unit to the right or left. TM is therefore able to perform certain function (go from the initial state p to desired state q) on the basis of a set sequence of manipulation steps with symbols established in advance. TM is based on an algorithm that is a specific guide for solving tasks. An algorithm is a set of rules, defined in finite way, for performing data processing procedures. The result is the transformation of one state of the device (machine, computer) to another. This finite set of operations is formulated as a symbolic code. The code is implemented into the device on the basis of its formal sequence due to its syntactic characteristics. It has several definition properties: a) it is finite (it is made up of finite number of instructions, whereas each of it is performed in finite time), b) its confidentiality is connected with it (it is made up of discreet, separable units — instructions), c) is sequential (the next operation can commence only after the last one was finished), d) is determined (the sequence of operations is precisely set), e) has mass character (e.g. the algorithm of addition is applied to any pair of number), f)

is resultant (it reaches final state within finite time). The attribute "computational" is therefore connected with the characteristics of a special type of cognitive architecture — serial algorithmic systems working with relatively fixed, explicit and discreet representations. Also neurobiological data indicate the similarity of brain with TM, because also on the level of neurons it concerns procedures of information processing on the basis of the mechanism "input — processing procedure — output" (MIT, 2001). In this formal understanding, the brain is truly an equivalent to Turing machine.

Chomsky's understanding of linguistic knowledge has also the nature of computational operations on symbols. The knowledge of language is in his case connected to commanding the algorithm of manipulation with symbols — therefore with commanding syntactic rules. Such formal explanation of language has sufficient explanation force also in case of such language properties, such as productivity and systematicness (mental representation — symbols are compositional and can appear in infinite number of language sentences), or generative nature (generation of unlimited amount of language sentences following given grammatical rules). As if two computational "devices" existed in Chomsky's understanding of linguistic knowledge: the articulatory–perceptory system, operating the production and perception of sounds and the conceptual–intentional system that is determining interpretation of propositional properties of symbols. Computations therefore run on two types of representations: phonetic and logical.

Symbolic models serve for explication of such cognitive functions, such as memory, language comprehension or task solving. Disadvantage of these models is their inability to explain the process of learning (new piece of knowledge must indeed be entered into the system externally by a new algorithm) and also the absence of similarity with neuronal networks as biologic substrate of cognitive functions. A problem arises also with explaining semantic properties of a language. These in fact cannot be grasped "once" in form or abstract variables (e.g. in case of more or less synonymous words with little shades of meaning — nice, handsome, comely, bonny, etc.) Syntactic rules are too rigid to be able to explain also such phenomena, such as comprehension of garbled words or grammatically incorrect sentences.

### 6.3 Connectionist Paradigm

Connectionist models, also called artificial neuronal networks, are more similar to the constitution of our neuronal system than computational–representative models. The difference between hardware and software or neuronal and mental level is not that noticeable as in the case of symbolic models, because the programme is directly related to network's physical constitution and is implemented within it. Units of the connectionist model are analogous to biological neurons and communicate with each other through weight connections. These are analogous to synaptic connections of neurons. Connections between units have certain weight coefficients that determine intensity of their connection. Coefficients can have negative or positive value. In the first case it is an inhibitive connection, in the second one an exhibitive one. Functioning of neuronal network depends on its architecture and on weight coefficients of nodes. The basic difference between symbolic and connectionist paradigm is in their approach to explaining cognitive functions. Connectionist models are characterised by their bottom–up approach. Units of artificial neuronal network do not have representing function. Each neuron has internal potential, based on which it then produces certain output. Neurons communicate with each other on sub–symbolic level that has numeric nature (outputs are impulses with different frequency). An idea or a concept has in the connectionist network shape of an intricate pattern of node activity, which presents a distributed representation. "It is reasonable to expect that distributed representation has such internal characteristic that two concepts similar in meaning are represented by similar pattern of activities. Because the

representation is expressed through patterns of neural activities, we can quite easily introduce a relation of similarity between representations as mathematical similarity between given patterns."

(www2.fiit.stuba.sk/~kvasnicka/CognitiveScience/1.../1.prednaska.pdf) Unlike this, the symbolic paradigm assumes a symbolic representation, firmly localised in memory. Distributed representations are therefore suitable for representing the diversity of semantic properties, making the model of cognitive linguistic system more robust and more adequate to everyday language practice. Each word is understood as a symbol that has several elements within the connectionist model: visual, acoustic and semantic. Each is represented separately and in different ways.

The architecture of neuronal networks determines its potential. There are two basic types of connectionist networks: forward and recurrent. In the forward network, the information proceeds only in one way from input to output. The recurrent neuronal networks contain also feedbacks from the layer of so–called hidden neurons. This network layer produces outputs that return to previous level as contextual inputs for other computing operations. Contextual inputs can serve as memory. Recurrent networks thus become suitable for modelling spatio–temporal tasks (e.g. in case of generating language sentences). Neuronal networks can thus have several layers, whereas the number of hidden neurons determines the complexity of the model.

The learning process can be explained, in case of computational representational models, only with an outside intervention. On the other hand, the connectionist models can successfully simulate also the ability to learn on the basis of a change in node weights. These changes are executed by implementing the learning algorithm, which causes the change in weights considering the required output. A typical example of connectionist network learning is the neuronal network model for creation of past tenses of English verbs, created by Rumelhart and McClelland. The acquisition of creation of past tense of verbs in English takes place in three phases. In the first phase, the past tense creation is based on memorising learned verbs, whereas independent use of the rule for creation of regular and irregular forms of past tense is absent. In the second phase, children learn the rule for conjugation of regular verbs and use it also in case of irregular verbs (they apply the rule of –ed ending to all verbs), which lowers their linguistic competence (the "overregularization" phase). Finally, children learn to distinguish between the method of creation of past tense of regular and irregular verbs. The learning process is called U–shaped learning due to this characteristic three–phase course (Farkaš, 2005). Pinker and Price objected to connectionist models, stating that they are learning rules that cannot be found in any human language, that they cannot explain morphological and phonological regularities and cannot find explanation of the U–shaped learning, including the overregularization phase (Pinker, Prince, 1988). The proponents of symbolic paradigm have indeed pointed out the fact that no model of artificial neuronal network can simulate correct generalisation, if the occurrence of rule is not frequent enough and if the category of words to which the rule applies, is less numerous (as is also in case of English regular verbs that are less frequent in the language than irregular verbs. Some of these comments were taken into account in creation of further models and multi–layer forward networks, which could apply the rule of creation of English regular verbs' past tense (the –ed ending) also in cases when the class of these verbs presented a minority in training set, were created. The recurrent neuronal networks today are able to recognize grammar structures in sentences, e.g. they can harmonize the person and number of nouns with verb endings and also recognize members.

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# 7. Language Skill Development and its Neuronal Correlates

Keywords: *development of language, neuronal correlates of language, imaging methods, language perception models, language processing models*

## 7.1. Introduction

Phylogenetical aspects of linguistic knowledge are being discussed. Some scientists hold the opinion that language did not emerge as a result of natural selection, but as a "by–product" of brain's development and growth. To support such explanation, they show, for example, the non–existence of genetic variability of biological specialization for language grammar, whereas its transitional forms are not known (Gould, 1987). On the other hand, S. Pinker (1990) or R. Jackendoff (2002) are convinced that the language competence is a type of complex adaptation and developed on the basis of natural selection. "The past experience of scientists showed explanation of the origin of our language to be much harder than tracking down the origin of the skull, pelvis, or the first instruments (all of this could have been maintained, explored, dated, but the spoken word disappears immediately)." (Kišoňová, 2013). The basic step of language evolution is the transition from non–syntactic to syntactic communication.

## 7.2. Language Skill Development

In order to explain the development of language skills, it is necessary to find answers to three basic questions: 1. How will we define language and which of its aspects will we consider to be the key ones? 2. Is human language as a communication system unique by its nature or is it just one of the types of communication systems of the animal kingdom? 3. Did the evolution of language occur continuously or discretely — in certain leaps?

D. Hauser (2002) thinks about the evolution of language in terms of broader and narrower understanding of language cognition: 1. language talent in broader sense includes: sensorimotor system, system of concepts and intents, algorithm for recursion (when it is possible to create an unlimited number of meaningful sentences from a finite set of expressions), 2. narrower understanding applies only to the existence of recursive rules in language. Hauser believes that the broader definition of language is comparable, or even homologous with communication tools of other species. Narrower definition, stemming from characterisation of human language as primarily syntactic recursive, is a typical human aspect of language talent that evolved in recent times.

The first form was the so–called proto–language that could be compared to pidgin language or language of small children or anthropoids. A basic feature is the modest amount of word without any syntactic connection.

The assumed user of this language was Homo erectus. Proto–language was the basis of primitive language (vocal proto–language).

Distinctive leap in development was the transfer of meaning of gesture into the meaning of abstract sounds.

It happened in following steps: grasp — development of a system of mirror neurons enabling imitation of grasps on the basis of repeated exposure (from simple imitation to more and more complex and complicated) — development of proto–symbols within the manual communication system — development of proto–language within the increase in flexibility of voice apparatus. Proto–language is already the result of primarily cultural evolutions (cf. Koukolík, 2006).

## 7.3. Neuronal Correlates of Language Skill

The cognitive science research is based on certain set of methods, through which we gather information about processes in our organism. In case of cognitive linguistic, imaging methods used in neuroscience are an important source of information about language skills. They allow us to discover neural structures in brain that are active during language symbol processing, perception of phonetic side of speech, processing of semantic side of language and in speech production.

The computer axial tomography (known as CT) allows investigating density of brain tissue by measuring the X–ray absorption, which is evaluated by a computer programme. In this way it is possible to detect regions of brain that have different density and display them in real spatial relations. With this method, it is possible to discover various brain injuries, tumours, increase in brain volume and other pathological processes. After introducing a contrast

substance into brain's bloodstream it is possible to monitor the flow and volume of blood in brain and brain metabolism (the so–called PET — positron emission tomography operates on the principle of radioactive decay of substances administered intravenously). The functional magnetic resonance imaging (fMRI) uses, analogous to PET, change of blood supply in tissues due to their activation. Another method of brain examination is nuclear magnetic resonance imaging, based on using magnetic properties of hydrogen nuclei in human body's tissues. The differentiation between grey and white brain mass and better imaging of certain brain structures (e.g. of thalamus or basal ganglia) can be obtained in this way. The known and quite long used method is also the electroencephalography (EEG). It focuses on discovering brain activity through measuring difference in electric potential between two electrodes, placed on the surface of head (it belongs to non–invasive methods). Electric current created through the brain activity, is recorded in multiple magnification in form of a curve. An important source of knowledge about the functioning of brain is also neurological studies on lesions. Through this method, basic features of different speech disorders, such as aphasias (disorders of the comprehension and formulation of language), dyslexias (reading disorders) or dysarthrias (articulation disorders).

On the basis of facts gathered by these methods, models of neuronal correlates of language are emerging. It is a vastly complex cognitive ability, conditioned by many others (e.g. memory or consciousness). Therefore, all models that are trying today to provide a description of perception and processing of language, are inevitably incomplete and partially based on individual assumptions of scientists. We will proceed from basic model of Andrej Kráľ (Kráľ, 2005). He assumes a hierarchical organisation of brain, where the input to cerebral cortex is done through projections from thalamus. Primary sensory areas are activated, whereas for these cortical–thalamic connections, the reciprocal projections back to thalamus are characteristic. Primary areas send signals further to secondary (association) areas and these then to tertiary (association) areas. The result of activation of association areas is the excitement of multisensory (multimodal) and amodal areas. From there, the signal is spread to planning, pre–frontal and pre–motoric areas.

The model of language processing by nervous system would therefore look probably like this: speech signal activates auditory areas (mainly areas responsible for identification of speech signal), which leads to abstraction of phones from the speech stream. This process is probably located in auditory areas (BA21 and BA22, which is the so–called Wernicky area). Phonetic analysis is completed in posterior BA22, containing phonological representations. The whole process takes place in approximately first 200 ms after speech impulse. The result is an abstract representation of speech signal in the form of phonological representation. Involvement of other areas (BA39, BA40, gyrus temporalis medius, anterior inferior temporal areas), containing amodal representations and cooperation with explicit memory leads to complex representation of language symbol. Also the involvement of language and communication context is necessary through prefrontal areas and BA22, BA39 and BA40. At this level of language representation processing, we run into the problem of semantic and conceptual side of language, which we are not able to describe precisely yet. It always remains the "hardest nut to crack".

In case of written language expression, the visual cortex is activated, whereas the identification of writing happens in association visual cortex. Convergence of visual and acoustic signals (in areas BA39 and BA40) follows, whereas the involvement of higher auditory areas is necessary mainly in case of so–called silent reading.

The participation of muscle apparatus is necessary in speech generation. Therefore preparation and planning of speech are connected with activation of prefrontal and premotoric cortex. Primary importance in the process of speech production has mainly the area BA 44 — 47 (the so–called Broca area). In fact, right here the connection with areas receiving and processing the language representation

occurs. Broca area is therefore the bridge between thinking and speech production. With regard to time, in brain, first the phonetic–phonological analysis of speech runs (it happens 100 to 200 ms after the impulse), the morphological analysis follows (200 to 300 ms after the impulse) and finally, the analysis of semantic side of language representation is executed (400 to 600 ms after the impulse).

There are many researches that confirm certain level of asymmetry between the right and left hemisphere. The hemisphere dominance are determined by such methods, involving sending a different information to left and right ear or, left or right ear and subsequently, the perceptions of tested person are being mapped (there are tests of dichotic stimulation and bisectional visual field tests). On the basis of these tests, the higher rate of correct answers when stimulating right ear, in case of verbal stimuli, was found. In case of non–verbal stimuli, the tested persons answered correctly, if the input was introduced into the left ear.

D. Kimura (Kimura, 1973) proposed a model of auditory circuits leading to inner ear: contralateral circuit, leading to auditory area in temporal lobe of the hemisphere opposite to stimulated auditory apparatus and ipsilateral circuit, leading to auditory area of temporal lobe of the hemisphere on the side of stimulated auditory apparatus. The contralateral path contains more nerve fibres and is considered more powerful path, either inhibiting or blocking signals travelling through ipsilateral way.

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# 8. Chomsky's Theory of Generative Grammar


Keywords: *mentalism, generative grammar, language acquisitions, poverty of stimulus, parameterization of language competences*


## 8.1 Introduction

Chomsky's position on the field of linguistic research is determined by radical rejection of behaviouristic explanation of mental phenomena. His understanding of the content and methods of cognitive science research was a strong impulse of the so–called cognitive revolution at the end of 1960s (Chomsky 1965, 1970). Chomsky focused on formulating "questions about the nature and source of knowledge" and on "integrating the study of language into the corpus of natural sciences" (Chomsky, 1987, p. 511). He describes his position as a frank adherence to mentalism (ibid.). He is convinced that primary focus in explaining linguistic knowledge and processes should be give to the very thing the behavioural psychology was rejecting — mental states.

## 8.2. Chomsky's Understanding of Cognitive Research and the Nature of Language

Mentalism of his cognitive science programme is nothing mystical, does not lead to dualistic understanding of psychophysical problem. Even modern science, according to Chomsky, works with many constructs and hypothetical particles, whose existence has

not been empirically documented yet (existence of certain elementary particle, graviton, is assumed, which would be linked to transmission of gravitational force), which however does not imply their immaterial nature. The foundation of research in cognitive sciences is the understanding of mind/brain as information processing system, whose operations with abstract representations are of computational nature. Language behaviour is based on the system of representations of linguistic knowledge and operations with them. Linguistic theories are formulated as empirical hypotheses, whereas mainly their explanatory force (i.e. extent, to which is the theory able to explain empirical facts) is important. Data essential for confirmation or rejection of hypothesis are provided by sentences of the natural language.

In Chomsky's linguistic theory, transition from description of language structure to explanation of linguistic knowledge as (literally) essentially related to construction and way of operation of human mind, is obvious.

How is then the relation of language and cognitive processes and structures? Is there in mind/brain an independent "operating programme" for creation and processing of language competences, which could be an adequate topic of cognitive linguistic explanation?

The linguistic knowledge system is a system consisting of components of phonology, morphology, syntax and semantics.

Chomsky's linguistic theory works with the hypothesis of modular organisation of mind/brain. Linguistic knowledge is determined primarily by the activity of two autonomous modules. On one hand, it is the module of universal grammar structures and vocabulary units, generating sentences as structural descriptions. These include and incorporate information about auditory and meaning part of sentences. Second is the performance module that determines realization (performance) of structural descriptions, i.e. articulation, interpretation and intentionality of sentences.

It concerns two types of performance systems: articulatory–perceptory, participating in production and perception of sounds and conceptual–intentional system, controlling interpretation, understanding of structural descriptions generated by the first module. Language skills are the result of cooperation of these two modules. Chomsky therefore distinguishes between I–language and E–language. E–language is external language, concerned mainly with speech products. I–language is internal code of our language representations. It is concerned with mental structures and processes connected with language skills. Chomsky's concept is characterized by prioritizing syntactic competence in language. As a proponent of rationalist tradition in philosophic thinking, he concentrates on examination of grammar knowledge that represents within cooperating systems of different linguistic knowledge (lexical, morphological, semantic, pragmatic and others)a sort of an internal mental base of constitutive operations and specific language principles, which emerge as a condition of human ability to acquire natural language. For Chomsky, the organisation of linguistic knowledge system is the most important. The assumption of existence of autonomous module of syntactic operations implies the possibility to explain the nature of language competence and describe its functioning.

Chomsky comes with the concept of generative grammar, which bases its explanation on postulating autonomous module working

with grammar categories and rules that cannot be derived from any other knowledge system. Grammar knowledge is implicit, intuitive or unconscious or "tacit" knowledge (Chomsky, 1980). Users of natural language do not know in any way that they have knowledge about syntactic linguistic rules. Usually, they follow them automatically and it is quite difficult for them to describe or explain these rules. An important thesis of generative theory is that to dispose with certain grammar knowledge means to be in certain mental state: "Knowledge of language L is the property of person P..., that P knows language L means that P's mind/brain is in certain state... (Chomsky, 1986, p.8). The assumption of mentalist cognitive structure of mind/brain obviously follows from the above.

### 8.3. Language Acquisition and Universal Grammar

We have mentioned that the database for verification of linguistic hypotheses is sentences of natural language. Other facts necessary for confirmation of explanatory force of linguistic theory are provided by the language acquisition process. This question is at the heart of Chomsky's attention. If we watch how children acquire their language competences, we will come to interesting findings. Children usually acquire the mother tongue spontaneously, fast and very efficiently. At the age of four, a child has in fact already developed language competence, i.e. ability to distinguish between grammatically correct and incorrect sentences (Rybár, 2005). But the child is confronted within these four years with quite limited sample of language sentences, whereas it comes into contact with almost exclusively positive examples. Parents in fact correct children mainly in terms of the correct use of words, but not in terms of grammar rules of sentence creation (Takáč, 2005). These facts are jointly labelled as the poverty of stimulus. Another important finding is that a child is able to independently produce even sentences it has not heard before. We can compare this situation to the person who wants to learn rules of chess (which he knows nothing about) exclusively by watching certain limited number of chess games. The comparison of the amount of data we have during learning of a language, with intricacy and complexity of language system lead Chomsky to postulation of hypothesis of universal grammar. Also in case of acquisition of competence of other cognitive systems (e.g. perceptory), it is rather about development of innate abilities than about acquisition of new information (in terms of empiricism). According to this theory, the child is able to acquire language on the basis of innate cognitive structures that generate certain "condition of the option" of any language competence. Universal grammar is therefore an innate symbolic language code, which is universal and has syntactic nature. It is genetically determined language ability. The ability to linguistically represent the reality is therefore a part of our gene equipment.

Chomsky returns with the theory on innateness of the universal grammar to innate ideas, postulated by Descartes. He goes even further, to Plato's dialogue Meno, in which Socrates leads a randomly chosen uneducated slave to that state the Pythagorean theorem. Chomsky sees the opportunity to explain our ability to represent the world in certain way right in the concept of innate cognitive structures. Why will a child say, when looking at an object of distorted shape, that it sees a triangle, when the given object fails to meet requirements of classical Euclid triangle? Descartes justifies this fact with the statement that mind during stimulation creates a representation of the triangle, because the mechanisms of mind are based on Euclidean geometry. Its geometric shapes become forms or models of cognitive processes of perception or learning. "We should adopt something like a Cartesian idea of innate ideas as tendencies and dispositions, biologically conditioned attributes of mind/brain, which would provide a frame for constructing mental representations." (Chomsky, 1987)

The universal grammar narrows the field of all logically possible grammars to the area of biologically possible grammars, i.e. those natural to us. The process of language competence acquisition is

made quite easier by limiting possibilities. "Even mathematical and logical research (Osherson et al., 1984) leads to the conclusion that the language acquisition ability assumes such specification of acquisition mechanism that "sets" it for limited number of grammars. The ability to acquire implies finite number of languages and this is guaranteed by universal principles that determine common structural properties of natural languages." (Dolník, 2005, p.51). Chomsky compares the genetically coded language disposition to a "mental organ"; it is a certain type of "device" for language acquisition — the so–called LAD (language acquisition device). This mental organ is developing similar to other organs of the human body. In the figurative sense, we could say that our ability to interpret and produce language "grows" and improves to such extent, to which we use the language actively. The language competence depends on the cooperation of "AD — innate universal language principles and parameters and PLD — primary language data, which we process and evaluate.

But how to explain such diversity of grammars of natural languages by a universal genetically determined code? Chomsky specifies the theory of universal grammar as the parameterization theory. Why, for example, in standard Slovak sentence (i.e. a sentence created according to syntactic rules defining the phrase structure in Slovak language) the subject does not have to be expressed? For example in English, sentence without subject would lack meaning (compare: It rains. Prší.) These differences are precisely the expression of existence of connection between LAD and PLD. The universal grammar represents sort of an abstract structure of language representations, which gets specified by the stimulus of primary language data. Some potential structures are eliminated, some are expanded. Therefore, it would be a mistake to picture the universal grammar as equivalent to mother tongue. Like in the case of Fodor's language of thought that is not equivalent to the language used. Both the universal grammar and the language of thought are conditions of the possibility of language abilities. They are "prototypes" of a kind, founding the possibility of their subsequent diverse implementation.

In 1981, Chomsky published Lectures on Government and Biding, in which he specified the method of language competence parameterisation. Generative grammar is based on the principle of constructing complex language structures on the basis of given rules. Within the sentence structure, Chomsky distinguishes deep and surface structure. The sentence's surface structure is the current organisation of words in the sentence, derived from deep structure. The deep structure of sentence is constituted by several grammar subsystems (e.g. X–bar theory, theta theory, lexicon theory). It presents formal–syntactic structure and is also called phrase structure grammar. If we investigating deep structure of sentence, we are investigating how is the sentence compiled from basic elements (syntactic categories) according to basic rules (phrase structure rules). We can distinguish two levels within the syntactic categories — lexical and phrasal. The first group includes, for example, nouns (nomen — N), verbs (verbum — V), adjectives (adjectivum — A), prepositions (praepositiones — P). Phrase categories presents structures from which a sentence is constituted. Lexical category has certain inflectional form (i.e. way of word inflexion) and certain complement (e.g. certain verb is connected with certain case and certain preposition). A phrase category arises from connection of these elements. The element that is determining for given phrase, is the head of phrase. For example the verb to "to offend" is connected either with the complement "someone/something" or the complement "take offence". Without these additions, the verb has no meaning in the sentence. Therefore, a VP — verbal phrase category is constructed, because its head is the verb "to offend". It consists of the verb V ("to offend") and the noun N ("someone/something"). In case of the verb "to forget", apart from the complement "someone/something", also the complement "about" can be added. The collocation "to forget about someone/something" is again a verbal phrase that consists of the verb V ("to

forget") and PP, i.e. preposition phrase compiled from the preposition P ("about") and the noun N ("something/someone"). The head of phrase, i.e. the determining component is here again the verb V, from which the whole phrase is derived. Grammar of phrase structure has hierarchical arrangement. By adding another component, for example an adverb "completely", we will create a more complex phrase structure of higher level of complexity: "to completely forget about something/someone". This principle governs creation of the meaningful sentences in all natural languages. The definition that phrase category has only one head is among the human innate language equipment; it is one of the principles of universal grammar.

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# 9. Jerry Fodor's Representational Computational Theory of Cognitive Architecture of Mind


Keywords: *mental representation, propositional attitude, language of thought, representational computational theory, cognitive architecture*


## 9.1. Introduction


Fodor's theory of cognitive architecture of brain is determined by two fundamental theses. The first thesis is concerned with plausibility of explanation of popular psychology and legitimacy of causal role of mental states. The second thesis is rejection of all versions of dualistic explanations of mind and body and formulation of materialistic cognitive linguistic theory.


In examining our ability to mentally and linguistically represent events and phenomena we are discovering many connections and common characteristics. Fodor perceives this fact within the theory of language of thought.

## 9.2. Nature of Mental Representations and Hypothesis of the Language of Thought

A popular psychology explains human behaviour referring to intentionality of mental state as the cause of certain type of behaviour

or action. Intentionality means the focus of mental state on something "outside" of this state, it is the ability to represent things and events in the world, which are not mental (e.g. house, tree, bank account). In other words, to be intentional means to be "about something", to refer to something (else). This property of mental state is exceptional in the whole of physical reality. An example of intentionality of mental state is the so–called propositional attitude, through which we express our beliefs, wishes, hopes and convictions. If we believe, we must necessarily believe in something, if we wish, we must necessarily believe in something if we hope, it is hope for something, etc. Propositional attitude refers to certain "object" that stands outside the frame of our mental state. If we believe in the power of human character and hope for justice of our legal system, with this propositional attitude we represent something that is an intentional object of our beliefs and hopes. The basic proposition of popular psychology is the postulate on convictions, wishes and other propositional attitudes as causes of our and other people's behaviour. Fodor maintains the position that such causal explanations of popular psychology are the best and most successful model of explaining the mind. One of the pillars of his theory of human mind is therefore postulating the real existence of propositional structure of mental states and causal effects of such structured mental states. Hence, if we want to explain the cause of our behaviour, we have to refer to propositionally structured mental representation. Despite that many cognitive scientists do not agree with the postulation of causal role of propositional attitudes, Fodor is convinced that rejection of intentions could be one of the biggest intellectual catastrophes in the history of a mankind (Fodor, 1987). Because if we reject intentionality of our mental states, many scientific fields lose the option of scientific explanations (e.g. in case of social sciences and humanities).

The second pillar of Fodor's cognitive architecture is rejection of dualistic explanation of mind/brain relationship. Scientific psychology must be materialistic psychology. Therefore, Fodor tries to formulate his hypotheses as empirically falsifiable assumptions. Mental representations thus must be of material nature, they cannot be ideas from the "world" of res cogitans.

On one hand, Fodor postulates real existence of mental representations, which are structured propositionally, on the other hand he recognizes exclusively material nature of these representations. How can the concurrently intentional and material nature of mental representation be explained? How can my mental state of wish to get up and leave be the cause of physical movements of my body? Or in other words: how can the change in mental state cause the change in physical state?

Unification of these two positions, which are usually seen as mutually contradictory, required new fundamental theory of cognitive states and processes — theory of thought of language (Fodor, 1975). This theory postulates many statements that are still topics of polemic discussions. The hypothesis of language of thought is in fact based on mentalistic approach in cognitive scientific explanation and holds the nativistic thesis about mental contents.

The mental representation in Fodor's explanation does not have the character of an image or impression (as was understood, for example, in theories of classical logical positivists), but has the quality of a sentence. Therefore, it concerns the linguistic and propositional model of mental representation (Fodor, 1993). Thought and language have many comparable properties — are independent of direct stimulus, could also be fallacious, misinterpret reality, can refer to fictive things. Another common feature is their infinite complexity; they are very efficient and flexible representational systems. Every language consists of words (or morphemes) that are bearers of certain content and sentences structuring this system. According to Fodor, we can find similar pattern also in case of thought. Here we can single out terms as bearers of meaning and also certain syntactic rules of higher complexity, which present structural elements in thought process.

If we develop the idea of linguistic model of mental representation, we will come to two basic features the mental representation has to meet: 1. it has to be a carrier of certain content, because it has (in accordance with popular psychology) intentional nature. Mental representation is therefore a certain type of symbol, like the language representation. 2. it has to have syntactic, i.e. constitutive structure. The difference between mental representations is therefore given not only by different content but also by different syntactic form, whereas their intentional objects remain the same. A classic example is the difference between mental representation of the planet Venus as Morning Star and mental representation of the same object as Evening Star (Kanovský, 2005). The very syntactic form of mental representation is the carrier of its causal role: "As a result, it must be possible to tell the whole story of mental causality (...) without referring to intentional properties of mental states" (Fodor 1987, p. 139). Mental states are therefore a certain specific way of representing objects, events, phenomena. It is a symbolic code that operates on the basis of said dual property of mental representation — semantic and syntactic.

Similarly, also the language can be understood as propositionally structured symbolic representational system. The analogy between language and thought is not accidental, according to Fodor. This connection is fundamental, because thought is constructed like language. Language of thought, sometimes even called "mentalese", is a type of cognitive representational system, where concepts are, similarly to words in sentence, organised in more complex structures. The meaning of these complex representations depends on their structural organisation and on the content of elementary parts, from which they are made up. The result is a structured syntactic string of mental representations similar to a sentence of language, which is also a structure set of symbols.

Fodor maintains the position that to explain cognitive states and processes, it is crucial to postulate the language of thought as a language–like internal symbolic code. For us to be able to acquire concepts in the process of learning there must be some sort of internal language, by which we are representing the concepts. Likewise for thinking about possible realities, if we consider scale of our possible actions and their impacts, we need a sufficiently rich representational system, in which we formulate our hypotheses. The language of thought is semantically rich, full of basic semantic units — concepts. This "stock" of semantic units is innate. Our basic concepts do not stem from experience. Concept acquisition is more like development of certain innate ability than learning something new. Language of thought is therefore primary and determining in relation to natural language and is independent of natural language. Quite the contrary, the representational force of language is dependent on representational force of language of thought. Language of thought is therefore not learnt, because it is not, unlike natural language, a conventional system. Language of thought is a condition for the option to represent the content and express it in natural language. "Thought and natural language act as engines, whose driving mechanism and foundation is the symbolic system." (Preti, Velarde–Mayol, 2005).

### 9.3. Computational Nature of Cognitive Processes

We explained in the previous chapter the representational nature of mental processes, which is explicitly elaborated in Fodor's theory of language of thought. We described the dual nature of mental representation — semantic (corresponding to intentional property) and syntactic (corresponding to formal property). Mental representation assumes the causal role in human behaviour in its syntactic determinateness. In the thesis of computational nature of cognitive processes, Fodor focuses on explication of their procedural nature and on formulating empirically based model of physical realization of language of thought.

In formulating the computational theory, Fodor proceeds from the classic model of Turing algorithm (Turing, 1950). An algorithm

is a set of rules, defined in final way, for performing data processing procedures. The result is the transformation of one state of the device (machine, computer) to another. This finite set of operations is formulated as a symbolic code. The code is implemented into the device on the basis of its formal sequence due to its syntactic characteristics. These data processing rules are recursive, i.e. they can be subsequently applied in infinite sequence all by themselves.

Cognitive processes are, according to Fodor, computational processes. They are causal operations with mental representations that create a "programme", language of thought, with their syntactic structure, i.e. structured syntactic string of mental representations. Semantic content is coded in sequences of symbols of this algorithm. Information coded in this way complies with the characteristics of intentionality — they represent events and phenomena of external environment. The device, in which this "programme" is implemented, is the brain. The algorithm proceeds in sequence of operations that must be executed in precise order. Next task will not be stared unless the previous one was finished. Classical algorithm, from which also Fodor proceeds, therefore processes the information serially (operation by operation). On the other hand, connectionist models of cognitive processes are based on interaction between nodes with parallel processing.

Fodor's explanation of the nature of mental states and processes has the form of representational computational theory. Cognitive processes represent syntactic operations with mental representations that cause change in the state of the system — i.e. human brain. Postulation of propositional nature of mental representations, whose intentional content is connected with their formal structure, allows the explanation of cognitive processes as specific computations.

In this way, Fodor succeed to connect the postulate of intentional realism (i.e. the notion that mental representations as propositional attitude are causes of observable behaviour) with the doctrine on materialistic nature of cognitive psychology. Language of thought is the only type of representational system that meets the said criteria. Computational explanation of cognitive operations makes it possible to explain the physical execution of mental states in the brain. According to Fodor, the symbolic code model reflects also in the nature of rationality. It is in fact based on inferential connections between propositions, it is the ability to transform in a certain, precisely set way one proposition to another, while maintaining their semantic connection.

To support his computational representational model of language of thought, Fodor quotes two characteristic features of thought and language: production and systematicness. Productivity of thought means that we are able to create infinite number of thoughts and sentences out of finite number of concepts or words. Systematicness of language and thought refers to their structural properties, to the existence of a sum of syntactic operations that enable systematic joining of individual ideas or sentence into a coherent unit.

Fodor's notion of cognitive architecture of human mind is characterised by three fundamental properties: 1. it is representational, 2. representations have composite structure corresponding to the structure of proposition (intentional content), 3. operations on representations have computational nature, whereas with these operations only the form of representations that is the carrier of their causal role and enables their material implementation is applied.

Fodor's hypothesis of language of thought evoked many critical reactions. Questions, to what extent the mental representational system corresponds to the language system, arose. What should be considered as complex mental structure with intentional content? Concept or some simpler structure (in terms of language morpheme)? Daniel Dennett objects against joining the propositional attitude with causal roles in explaining our behaviour. Connectionist models of cognitive processes present real and respected alternative to postulating the need for language of thought within computational models.

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# 10. Philosophical Issues of Cognitive Linguistic

Keywords: *meaning, speech act, abstract object, subjectivity*

## 10.1 Introduction

One of the basic questions of philosophy of language is: How words represent (refer to) things?

Related questions are: How is the relation between what I mean when I say something and what that word means (either expressed or not)? What makes a string of words meaningful? What is the criterion of validity or invalidity of language statements?

Essentially, we can distinguish between three types of statements with regard to the world: 1. true statements, 2. false statements and 3. meaningless statements.

The relation between statement on one hand and object to which it refers on the other hand is the key.

A problematic situation arises when the referenced object is not "physically present", when it is not possible to point a finger at it. In that case we are talking about the so–called abstract objects (self, soul, mental state, centre of gravity, etc.)

The question of meaning of language expressions that are related to such abstract objects is since the times of ancient philosophising one of the most important questions of the philosophy of language.

### 10.2. Meaning as Opinion and Recognition in the Concept of J. Searle

According to J. Searle, the language communication functions as a bridge between two shores — shore on the side of speaker and shore on the side of receiver. Such bridge is constituted through several rules: 1. To understand a sentence means to know its meaning. 2. The meaning of sentence is determined by dual rules — rules for expression of sentence and rules for understanding (deciphering) of this expression. 3. Expressing a sentence implies certain meaning, which is understood as the intention to bring the listener to be able to recognize certain state of things on the basis of rules in item (1). 4. The sentence then acts as certain conventional means enabling to achieve the intent to invoke certain effect in listener. To understand the meaning of sentence is therefore to comprehend this intent on the basis of understanding of certain rules for expressing sentences and language expressions. (Searle 2007). In Searle's understanding, to speak means to get involved in certain form of behaviour, regulated by rules, to perform certain speech acts: "Speech is the performance of acts according to rules." (Searle 2007, p. 39). Searle uses the term illocutionary acts that lie in stating language expression in certain context, under certain conditions and with certain intent. They are, for example, statements, asking a question, giving orders, giving promises, warning, apologizing, etc. The impact of intent to invoke certain understanding on the listener's side is described by the so–called perlocutionary acts.

### 10.3 The Term "Self" in the Concept of L. Wittgenstein and D. Dennett

A type of abstract object that has its name in the language is, for example, the concept of "self". The basic feature of such object is that it does not have any material shape. We cannot find it and point our finger at it. It is a bit absurd thought, because from the context of everyday life it seems clear to us that exactly this is the deepest essence of the term "self" — that we can point a finger at it, namely when we are pointing it at ourselves. Our "self" is something dearly known to us, the carrier of value of our life, necessary condition of our existence in this world. In the context of everyday existence, the term "self" is indisputably connected with the term "is", thus it necessarily has its real existence, and it is event the centre, the centrepiece of all existence. We could go even further and together with sophists say that human — i.e. every specific self — is the measure of existence of all things, existing, that they exist and non–existing, that they do not exists. In what sense can the "self" be an abstract object without real existence?

In Dennett's concept, the "self" is a fictional term in terms of fictionality of the term centre of gravity of objects in the physical description of the world. In this context we can say that the introduction of the term "self" was a very effective step. Damasio sees advantage of this strategy in achieving the most possible unity that is the key from the survival of organism's point of view, its effective and efficient decision–making. Dennett's explanation is firstly a functional one — as is the introduction of the centre of gravity very contributive to predicting the behaviour of objects of physical world, also the introduction of the "self function" as a final reference "point" (but a fictional one) of our whole internal world of experience is a very fruitful act. This explanation strategy has, however, one substantial condition — we should not want to search for its real existence: "If you still want to know what *self* truly is, you are committing a categorical fault." (Dennett 2008, p. 31). Also

*Gilbert Ryle* points this problem out when he speaks about some sort of "systematic elusiveness of the concept of Self" (Ryle 1990, p. 178). He summarized it concisely in one sentence: "Self sounds mystical." (ibid.).

Also *Ludwig Wittgenstein* defines the term self functionally and relationally: " "Self" does not describe any person, "here" does not describe any place, "this" is no name. But they are in relation to names. Names are explained through them." (Wittgenstein 1998, s. 154).

The term "self" is analysable in concepts of these thinkers only within the context of language and communication. Other than the language form of the existence of "self" is questioned. The term "self" acts here as a personal pronoun, serving to point out to certain being, which we could describe in more details by saying or writing its own name. "Self" is a form that is filled with content only in the context of situation, in which it is expressed. Personal pronouns I, you, he can all refer to the same person. A person with initials P.T. can be describing in one context as I, in another as you, in yet another as he. It is not "self" that is changing, but only certain relations, bringing turn in the point of view. The same way as Sunday, December 14, does not change with being once labelled with the adverb today and another time with the word yesterday or the day before yesterday. We are always talking about the same day. Ryle states that "Self" is not an extra name for extra being; when I say or write it, I label the same individual that can be also called with its own name "Gilbert Ryle". "Self" is not another name for "Gilbert Ryle"; it labels the person named by "Gilbert Ryle" when "Gilbert Ryle" uses "Self" (Ryle, 1990).

This analysis seems to be logically consistent, non–contradictory. Despite that it leaves us with a feeling of unresolvedness, excessive (or unacceptable?) simplification of such explication. Can we really "demystify" the "self" completely with the statement that it is just an empty form with variable content set by context? But Wittgenstein goes in the analysis of the function of the first person in language communication even further. He points out to strange relationship between the content and subject of statement. The subject is indeed always implicitly present in all our expressions.[2] But it does not act in it as a specific subject but as a "carrier" of action. We can see this relationship on the example of the statement "I am in pain". According to Wittgenstein we are not focusing on the statement who is in pain: ... I am not saying that this and this person is in pain but that "I am"... When I say "I am in pain" I am not pointing with it to any specific person being in pain, because in a sense I do not really know, *who* is in pain." (Wittgenstein 1998, p. 153). We are not concerned with directing the focus on certain specific person. "No, I want to direct it to myself." (ibid.). Here, "self" has not only the function of one of many labels for person. Sentences containing "self" create a group of sentences of specific type. They always implicitly contain this subject. Nevertheless, it is not concerned with any specific "self" but with assumption of subjective attitude. *In this sense, "self" has a specific function of indicating subjective point of view.* This attitude applies mainly to mental states. Here, the subjective point of view is the most obvious. As a classical example of a meaningless sentence, Wittgenstein shows the sentence: "I don't know if it is me in pain or the other one." (ibid.). In sentences of "subjective type", distinguishing, defining, specifying the person who is the bearer of action is not important: "But with the words "I am..." you want to distinguish between you and the other person. — Can it be said in all cases? Even simply to walls? And also even if "I want to distinguish" between myself and the other one — do I want to distinguish with it between persons L.W. and N.N.?" (Wittgenstein 1998, p. 153).

The task of the first person in such sentences is obvious: it indicates the transition to distinctive reality, to the area of living the reality. "Self" is a sort of a "spokesperson" of subjectivity. Here, we

2) In the Slovak language it is implicitly present to such extent that we do not even have to express it, unlike in English or German, with a subject. In our language it is sufficient if the subject is defined by the ending of conjugated verb.

are therefore considering subjectivity without having to take into account a specific actual bearer of it. It is an important finding. The subjectivity reveals in the most intensified form in sentences that predicates certain mental states, feelings, moods, states. Firstly, we have to look here for the main role of "self" — as a function of subjectivity.

**Recommended Literature:**


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