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DYNAMICS OF JUNIOR AND SENIOR ADOLESCENTS’ COGNITIVE STRUCTURES IN ORAL SPONTANEOUS RECALLS

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Abstract. This work analyzes dynamics in manifestation of cognitive structures in junior and senior adolescents. The data were obtained experimentally through oral recalls of educational texts on social studies. The purpose of the study is to identify cognitive sphere development that is reflected in the propositional and semantic elements of oral recalls produced by adolescents of different ages. The cognitive structures were detected within the cognitive-and-discursive paradigm with the help of psychological and psycholinguistic diagnostic approaches. Special functional syntax methods of predicate-and-actant elements of utterances analysis were used. It has been found out that the denotative maps of oral recalls performed by junior and senior adolescents demonstrate cognitive structures advancement, which is manifested in the evolution of thinking, consciousness, memory and language skills. As a teenager grows up, the actant-predicate relations in the logical scheme of recalls become more complex, in particular, there is an increase in number of complex semantic structures with connectors, taxis relations, the use of predicates with abstract and aspectual properties like resultative, procedural, dynamic, terminal, and statal. This article offers an insight into the work of adolescent’s cognitive system. The findings can be used in corpus and empirical studies.

Key words: cognitive structures, junior adolescents, senior adolescents, oral recalls, propositions.

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РАЗВИТИЕ КОГНИТИВНЫХ СТРУКТУР МЛАДШИХ И СТАРШИХ ПОДРОСТКОВ В УСТНЫХ СПОНТАННЫХ ПЕРЕСКАЗАХ

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Аннотация. В работе анализируются динамические процессы, связанные с манифестацией когнитивных структур младших и старших подростков. Материалом послужили устные пересказы учебных текстов по обществознанию, полученные экспериментальным путем. Цель исследования – определить направления развития когнитивной сферы подростков разных возрастов, отображенной в пропозициональных и семантических элементах устных пересказов. Детекция когнитивных структур осуществлена в рамках когнитивно-дискурсивной парадигмы с применением диагностических психологических и психолингвистических подходов и методов функционального синтаксиса для анализа предикатно-актантных элементов высказывания. В результате исследования показано, что когнитивные структуры манифестируются в денотативных картах устных пересказов младших и старших подростков. Установлено, что в основе развития таких структур лежит взаимодействие мышления, сознания, памяти и языка подростка. Динамика этого процесса выражается в усложнении актантно-предикатных отношений в логической схеме пересказов старших подростков, развитии сложных семантических структур с коннекторными, таксисными отношениями, расширении употребления предикатов с абстрактными и аспектуальными свойствами: результативными, процессуальными, динамическими, терминальными и статуальными. Материал и результаты работы расширяют представление о когнитивной системе подростков и могут применяться в корпусных и эмпирических исследованиях.

Ключевые слова: когнитивная структура, младшие подростки, старшие подростки, устный пересказ, пропозиция.

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Introduction

Cognitive approach has demonstrated its high efficiency in psychology, cognitive linguistics, ontolinguistics, pedagogy and psycholinguistics. Cognitive structures are relatively stable psychological systems employed in extracting and analyzing current information [Chuprikova, 1997, pp. 380-382]. Besides, cognitive structures provide basis for dynamic processes such as analysis, synthesis, abstraction and generalization [Kholodnaya, 2002, pp. 64-84]. They are also considered to be organizational constituents of mental experience, which predetermine human behavior [Kholodnaya, 2002, pp. 84]. The features of cognitive structures are: verbality, efficiency, digestibility, and adaptability (Babenko (ed.)).

Our article is aimed at exploring cognitive structures development in junior and senior adolescents. We assume that the ontogenetic dynamics of these cognitive structures should be best studied through the analysis of spontaneous oral recalls of educational texts in social studies.

The research questions are as follows:

1. Is it possible to trace the cognitive structures dynamics in junior and senior adolescents by analyzing their spontaneous oral recalls?

2. Does functional syntax in the semantic structures of denotative maps of oral recalls reflect peculiarities of adolescent's cognitive sphere?

3. Do predicate-actant structures in oral recalls undergo changes with adolescent's maturation?

Hypothesis. In unprepared oral narratives of junior and senior adolescents there are some features that are typical to each stage of ontogenesis. These features are determined by the ontogenetic, psychological, and cognitive development of an individual.

Theoretical considerations

Cognitive structures are also known as structural knowledge [Jonassen, Beissner, Yacci, 1993, pp. 125-131]. They help an individual to arrange facts, concepts, propositions, theories, and raw data at any point in time [Taber, Keith, 2000, p. 405]. As well, they help to organize the relationships of concepts in memory [Shavelson, 1972, p. 226]. It is assumed that the order in which information is retrieved from long-term memory reflects in part individual cognitive structure within and between concepts. Hence, an individual's cognitive structure is made up of various schemata and mental models that can be embedded within one another within a hierarchy. Cognitive structures can also be viewed as conceptual knowledge which transcends the mere storage of declarative knowledge [Ifenthaler, Masduki, Seel, 2011, p. 43].

There is a fairly large number of empirical works devoted to the analysis of cognitive

structures parameters, their cognitive complexity and simplicity. However, such analysis is limited mainly to the sphere of communication [Druzhinin, 2024]. There are no works at all devoted to the *cognitive development* that is revealed in the speech products of adolescents who are involved into the interpretation of educational texts. The dynamics of cognitive complexity indicators over a certain age period and its relationship with intellectual functions also remains a poorly studied issue. As a person develops, there is a restructuring of cognitively representative structures, which are responsible for the solution of a wide range of tasks [Chuprikova, Ratanova, 1995, p. 105].

Cognitive structures development is accompanied by the growth of their systemic hierarchical organization [Chuprikova, Ratanova, 1995]. The system gets organized, which results in formation of hierarchically ordered cognitive structures, that means evolution of former syncretic, poorly differentiated structures. Therefore, it is in adolescence that a significant shift occurs in the cognitive and mental activity of a child [Kalinkina, Poyarova, Yablokova, 2021, p. 328].

In early adolescence, the cognitive system is characterized by low levels of cognitive differentiation and integration. However, the mechanism of cognitive differentiation and integration starts its development namely at this stage. The skills to search for similarities and differences between objects and phenomena are being shaped. The qualitative composition of the constructs used by adolescents undergoes serious changes throughout maturation [Kelly, 1991]. For example, junior adolescents tend to use more specific characteristics that describe visual signs, people's attitudes towards somebody or something.

As far as senior adolescence is concerned, they start operating with attributes that describe personalities. Their simplified cognitive structure disintegrates, and a new, more complex system undergoes development to hierarchize at a higher level [Kalinkina, Poyarova, Yablokova, 2021, p. 331]. Senior adolescents demonstrate a large number of constructs that are more specified. It means that in the process of perception, teenagers of this age group have at their disposal more characteristics for objects classification than junior adolescents. Cognitive integration is also dynamic and undergoes changes. Cognitive complexity increases due to extension in cognitive differentiation and cognitive integration. Cognitive complexity is aligned with the categories that are identified by a person and are integrated with each other. In other words, there is a clearly-cut connection between the categories used by an individual. Thus, cognitive complexity makes it possible to take into account both cognitive differentiation and cognitive integration of an individual's consciousness [Kalinkina, Poyarova, Yablokova, 2021, p. 329].

Cognitive structures act as constructs for assessing knowledge organization, assimilation, and accommodation. The scientists are of opinion that the main task is to identify reliable and valid tools that may help to elicit the external representation of internal structures with subsequent analysis [Ifenthaler, Seel, 2005, p. 321]. However, as it is not possible to measure cognitive structures directly, individuals have to elicit or externalize them before researchers can analyze and interpret them [Ifenthaler, 2008, pp. 43-44]. As for elicitation of cognitive structures, a variety of techniques have been developed referring either to natural language or graphical approaches. Natural language-based techniques utilize the most automated and natural means by which humans externalize their cognitive structures. It is argued that natural language approaches are less biased than graphical ones, because natural language is more trained and highly automated [Ifenthaler, Masduki, Seel, 2011, p. 44].

The authors of this article suggest an original approach of their own. We are making an attempt to demonstrate the dynamics of adolescents' cognitive structures development within the framework of functional syntax. This method scrutinizes propositions and semantics of oral recalls, as well as their cognitive structures functioning.

Methodology

We advance the hypothesis that cognitive structure is a relatively stable and developing psychological system of knowledge representation, which can be studied experimentally with cognitive and psychologic diagnostic approaches (N.I. Chuprikov, D. Ifenthaler, T.A. Ratanova), as well as psycholinguistics and cognitive science.

There are a number of researches that describe the components of the semantic structure (predicates, actants, constants), identify types of

propositions, and consider them from the standpoint of actual discourse (S.V. Gusarenko, A. Mustajoki, E.V. Paducheva). We draw on the inventory of functional syntax and semantic structures developed for the Russian language by Arto Mustajoki [Mustajoki, 2006]. We agree that a proposition is a stable component, which is independent of the surface structure composition of an utterance. Proposition is shaped during the cognitive processing of an utterance. Hence, it is of primary importance to consider the interaction of the proposition with other cognitive-semantic structures involved in the cognitive processing of utterances [Gusarenko, 2021]. Our analysis of oral recalls is based on I.A. Zimnyaya's model of utterances generation, which includes the phases of meaning formation and meaning formulation. Mechanisms of word choice are activated when articulation program "clothes" thoughts into words and language structures [Zimnyaya, 2001].

Material and methods

The material for this study was collected in the course of mass experiments, which were conducted in several secondary schools of the Republic of Tatarstan almost three years ago. The participants were school students from Kazan and some schools located in rural areas. All in all, there were interviews with more than four hundred students of the fifth-grade level of 11–12 years old and senior adolescents of the ninth-grade level of 15 to 16 years old. Boys and girls were interviewed in almost equal proportions. So, gender and social indices of the respondents were rather relevant. The corpus of oral spontaneous recalls comprises of 297 texts. All these recalls were obtained empirically and used by us as the ***material*** for current research.

Linguistic parameters of source and secondary texts were identified with the help of RuLingva automatic text complexity analyzer (https://rulingva.kpfu.ru) developed by the "Text Analytics" Research Laboratory of Kazan Federal University. The linguistic parameters of the source text and its recalls were calculated with the help of the automated analysis program RuLingva (https://rulingva.kpfu.ru/) based on the Russian Language Educational Corpus (Certificate No. 2020622254). The parameters were identified for each of the investigated texts, and they included: the average number of words in a sentence, the average number of syllables in a word, FKG mod SIS index, abstractness index, lexical diversity (TTR), and narrativity index.

Sentence length happens to be one of the most significant parameters as far as the assessment of text complexity and text readability is concerned. Long sentences with sophisticated logical connections impede overall comprehension. The sentence length in 11–12 words is believed to be optimal for educational texts in Russian. The word length also affects text comprehension: the longer a word, the more time it takes to understand it and to retain it in short-term memory [Mikk, 1981]. In addition, it has been found out that long words with three or more syllables traditionally have a lower frequency [Krioni, Nikin, Filippova, 2008].

The Flesch-Kincaid index is one of the most valid formulas for text readability identification. This index shows the number of years of education required to understand the analyzed text and is calculated by the formula: $FKG\ mod\ SIS = 0.36 \times ASL + 5.76 \times ASW - 11.97$, where ASL is the average number of words in a sentence; ASW is the average number of syllables in a word [Solovyev, Ivanov, Solnyshkina, 2018]. The lexical diversity index is calculated as the ratio of unique lexical units to the total number of words. It ranges from 0 to 1 and the highest values point to the vocabulary richness of a text [Templin, 1957]. A high level of lexical diversity (TTR) presupposes that a reader knows a lot of words. This parameter may be an indicator of the number of terms in a text as well.

Text narrativity is calculated as the ratio of the total number of nouns to the total number of verbs [Biber, Conrad, Reppen, 1998]. If the final score is high, it means that the level of narrativity is low. The scientific style of speech with a noticeable dominance of nouns over verbs may illustrate the fairness of this statement. Experts in this area have proven that narrative texts with familiar structure are easier for students to perceive [Kraal, Koornneef, Broek, 2018]. Abstractness can be calculated with the help of the concreteness-abstractness scale or by the number of words with abstract suffixes in one text [Mikk, 1981]. Numerous studies have revealed that the texts which contain a large number of abstract words are more difficult for understanding [Solnyshkina, Kazachkova, Ismaeva, 2019]. Children's thinking is characterized by particularity (concreteness) and abstract concepts are out of touch with reality.

Results and discussion

Linguistic parameters and the description of the text "On Differences in the Work of Animals and Humans" (fifth-grade level)

According to RuLingva, the text has: number of words – 226; social science terms – 20; nouns – 62; verbs – 51; the average number of nouns in a sentence is 2.82; the average number of verbs in a sentence is 2.32; ratio of verbs to nouns – 0.82; abstract words – 65, among which, for example, there are such as: *text*, *speech*, *difference*, *work*, *animal*, *person*, *trait*, *activity*, *means*, *conclusion*; frequent abstract words: *person* – 9, *animal* – 8; total number of propositions (main and sub) – 129. The respondents perceived the source text through reading, and after that, they were asked to reproduce it orally with as many details as possible.

Description of the source text. This text represents a story about a man, his work, and the differences between human and animals' work. There are two semantic centers in the text. First, the "imaginative" center with the stimulus "let's imagine". It has a passive observer and predicates "to imagine", "to observe". The imaginary scene includes imaginary agents and their actions which are described by action predicates. The second semantic center represents a comparative reflection about the actions of animals and humans. The actions of an abstract agent are described with predicates of intellectual, creative, and social activities, including such verbs as *to create*, *to plan*, *to think*, *to study*, *to work*. Two semantic centers are connected indirectly with each other through an agent that performs logical operations. Noteworthy, the first semantic center refers to a specific real world with the real actions of living beings in it, and the second semantic center requires logical interpretation of animals' and human actions. Logical and event-logical propositions with a small inclusion of existential (event) propositions prevail in the text. The level of abstraction is fairly high – 2.49. Hence, it is not always possible to determine the agent-doer and the background sign of his actions. At this stage of ontogenesis, abstract thinking, reflection, imagination, self-esteem and self-concept are still evolving. That is why abstract text comprehension causes troubles and provokes the appearance of modifications of the actant-propositional structures in secondary oral narratives [Petrova et al., 2023, p. 923].

Linguistic parameters and the description of the text "On Leadership" (ninth-grade level)

According to RuLingva, the text has: number of words – 251; social science terms – 16; nouns – 114; verbs – 33; the average number of nouns in a sentence is 6.71; the average number of verbs in a sentence is 1.94; ratio of verbs to nouns – 0.29; abstract words – 109, among which, for example, are: *leadership*, *process*, *attitude*, *group*, *position*, *position*, *decision*, *task*, *achievement*, *goal*, *action*, *ability*, *experience*; frequently used abstract words 43: leader – 10, leadership – 4, group – 7, role – 7. The total number of propositions (main and sub) is 82. The method of perception and reproduction was the same as in junior adolescents' group: the respondents perceived the source text through reading, and then, they were asked to reproduce it orally with as many details as possible.

Description of the source text. This is at story about leadership, leadership qualities, leaders and their actions in a group. The text "On Leadership" can be divided into three semantic blocks: 1) leader and leadership roles; 2) new types of leaders; 3) leadership processes [Petrova, Solnyshkina, 2021, p. 230]. The relationship with a specific referent goes through the reference group and environment.

There are sentences with a wide range of such referents as "role", "group". For example: *The first* ***role*** *includes actions aimed at organizing the group to achieve the goal of the activity and at solving the task assigned to the group*. As seen, the referent is hidden in the descriptions that make up the reference groups and form the referent environment. To identify a specific referent, it is necessary to carry out a number of cognitive and logical operations that move from the leader to his types, roles and functions. The text is full of the predicates of communicative-semantic spheres: social relationship, activity, characteristics, existence, identification and classification. Most of the predicates are gerunds what explains the low narrativity of the text. Physical actions are poorly reflected and represented by participles, participial phrases, or

by some verbs in the passive voice. The above-mentioned features have caused difficulties in the actual agent identification.

So, both source texts are characterized by high abstractness indices: 2.49 – for the fifth-grade level and 2.8 – for the ninth-grade level. High abstractness is also revealed in abstract words such as "leadership", "labor", etc.

Linguistic parameters of the sources texts and recalls are presented in Tables 1, 2.

Having compared two educational texts and deep level predicates, we arrived to the conclusion that in the source text about labour differences, there are predicates of intellectual, creative and social activities; whereas in the text about leadership, there are predicates of social relationship, activity, existence, identification and classification.

According to psychologists (A.A. Leskova, T.V. Sklyarova, L.A. Semchuk) 10–12 years-old adolescents demonstrate ***the following tendencies*** in their ***theoretical and practical thinking development*:**

1) transition from a concrete type of thinking with specific ideas to theoretical thinking;

Table 1. **Linguistic parameters of the source text "On Leadership" and the recalls of senior adolescents**

Parameter	Source: L.N. Bogolyubov "Social Studies. Tenth-Grade Level" (Bogolyubov, 2009)	Recalls				
		1. Respondent K9004	2. Respondent K9089	3. Respondent K9074	4.Respondent K9126	5. Respondent K9A01
Average number of words per sentence	12	5,67	9,8	13,2	15,3	9,9
Average number of syllables per word	3,04	2,5	2,55	2,33	2,35	2,46
Index FKG mod SIS	9,84	4,47	6,25	6,22	7,9	5,79
Abstractness index	2,8	2,63	3,07	2,68	2,48	2,84
Lexical diversity (TTR)	0,81	0,85	0,71	0,74	0,7	0,6
Narrativity	2,88 (49:17)	2,5 (10:4)	2,5 (15:6)	2,75 (22:8)	1,59 (43:27)	1 (23:23)

Table 2. **Linguistic parameters of the source text "On Differences in the Work of Animals and Humans" and the recalls of junior adolescents**

Parameter	Source: L.N. Bogolyubov "Social Studies. Fifth-Grade Level" (Bogolyubov, 2013)	Recalls				
		1. Respondent K5A17	2. Respondent K5A18	3. Respondent K5A20	4. Respondent K5B01	5. Respondent K5B16
Average number of words per sentence	10,27	8,38	11,88	9,2	11,43	12,71
Average number of syllables per word	2,25	2,09	2,17	2,15	1,91	2,27
Index FKG mod SIS	4,68	3,1	4,8	3,74	3,16	5,68
Abstractness index	2,49	2,49	2,61	2,56	2,24	2,33
Lexical diversity (TTR)	0,64	0,71	0,51	0,52	0,49	0,65
Narrativity	1,21 (62:51)	1,2 (30:25)	0,75 (18:24)	0,87 (29:33)	1,19 (25:21)	1 (26:26)

2) restructuring of a concrete type of thinking;

3) development of operational thinking, concepts comparison, and consecutive evolvement of thoughts;

4) development of independent thinking, reasoning, comparing, drawing relatively deep conclusions and generalizations;

5) development of abstract and critical thinking (younger teenagers imagine objects and relationships between them, whereas older teenagers produce ideas).

Adolescents aged 13–14 progress a lot in mastering such operations as classification, analogy, generalization. The abilities to analyze intellectual operations and to solve problems are shaped. The dialogical nature of imagination evolves. Older teenagers gain the ability to individually change, develop, and add images. Image integrity unites separate parts and makes the subject of imagination indivisible. Thinking dynamics start to be in close connection with the dynamics of other cognitive systems such as memory, perception, attention and speech. It affects written text perception, its understanding and interpretation. As result, these changes are reflected in spontaneous recalls of junior and senior adolescents.

In early adolescence, cognitive structures dynamics is manifested in the prevalence of poly-subjective position of imagination. As children grow older, their "I-concept" is being evolved along with the elements of interpretation, reasoning, and opinion expression. A large number of epistemic modality modifiers (Modep), speech function (Func), phase, causation (Caus) and authorization (Aut) are recorded on deep levels [Mustajoki, 2006, p. 287]. Senior adolescents employ abstract concepts, evolve the ability to see logical links and to defend one's point of view. Junior adolescents demonstrate personal involvement and the involvement of other participants in the situations described in the text. The tetrad of personal pronouns «я-ты-мы-вы» ("I-you (singular)-we-you (plural)") appears in the superficial structure of their oral recalls. The situation is interpreted from the point of view of an observer who identifies himself with the reference group and accepts the attitudes of this group [Privalova, Petrova, 2023].

An abstract situation is turned into a concrete one that is why more predicates of creative activity start to appear. Besides, restructuring may cause the increase in number of modifiers, qualifiers, or immersion elements. On the other hand, one may notice the fragmentation of propositions along with the elimination of actants of the source text and the loss of lexical diversity in recalls. Macro-propositions with the most general meaning appear, although they are not general nominations like keywords.

In our previous studies [Petrova et al., 2023], we identified semantic milestones, predicate links and text elements subordinated to the dominants of the narrative. Additionally, the referential or referenced type of connections between text elements was indicated. In the referential type, there is a relationship with a specific referent. In the referenced type there is a relationship with a reference group or through a reference environment. In the referenced type, the reader needs to carry out a number of cognitive and logical operations in order to establish connections between co-referent names [Petrova, Solnyshkina, 2021, p. 231].

We have divided the total amount of oral recalls of senior adolescents into four groups according to the invariability of propositional structures. In the first group, there are the recalls with the smallest number of preserved propositions and a false display of the denotative map (8 propositions; 10%). In the second group, there are recalls with a few preserved propositions and weak display of the denotative map of the text (10 propositions; 13%). In the third group, one can see a larger number of propositions and adequate display of the denotative map (33 propositions; 51%). In the fourth group, there is a big number of propositions and successful displays of the denotative map (105 propositions; 26%) [Petrova, Solnyshkina, 2021, p. 231]. Oral recalls of younger adolescents were divided into 3 groups according to the outcome of conveying propositional structures and the main idea. In the first group, there are recalls with a few propositions and a weak display of the denotative map of the text (18–30 propositions; 15%). The second group has a large number of propositions and adequate display of the denotative map of the text (31–50 propositions; 41%). In the third group, there is a big number of propositions and successful displays of the denotative maps (51–82 propositions; 44%) [Petrova et al., 2023].

Interestingly enough, we have not recorded a low number of propositions and false denotative maps in younger adolescents recalls. It may happen due to the specifics of the fifth-grade level subjects. Another reason for stable propositions is the nature of the source text. The proposition indicators should not be confused with the indicator of the number of words (Tokens) in RuLingva. A long story with a lot of words does not mean a successful recall, since the same words can be repeated many times without rendering any meaningful information. That is why we assume that the propositional structures displayed in denotative maps represent a relevant content of oral recalls.

There is one more issue that is necessary to raise, specifically, adolescents' intentions to collapse propositions into macrostructures during spontaneous recalls. From a psycholinguistic point of view, such operations require time-consuming periphrasis-transformations. One of the extreme types of periphrases-convolutions is a set of keywords. It may happen if there is an instruction to produce a recall using only keywords with the possibility to record these keywords. Meanwhile, there were no such instructions and, as a result, there were no oral spontaneous recalls like: "Night. Street. Flashlight. Pharmacy".

Descriptions of semantic structures in the recalls of junior adolescents

The analysis of spontaneous oral recalls resulted in distinguishing several features that were seen as verbalized in adolescents recalls: inclusion of non-existent agents into the semantic structure; occurrence of specifiers in the semantic structure, zoonymic diminutives; introduction of complex semantic structures by some models; creation of the reference field of the agent-person; appearance of optional modal phase modifiers with modal metalexemes "possibly". Below there goes explanations on the features enumerated above, samples of the texts with reactions of the adolescents, taken from our collection.

1. Inclusion of non-existent agents into the semantic structure. Considering oneself as a participant of the situations; virtual creation of another participant to whom a specific case is described; appearance of the personal pronouns tetrad "I-you-we-you" in the surface structure of oral retellings. Examples:

(1) условный или безусловный рефлекс, с которым **ты** познакомишься в биологии (K5B24) [1] (a conditioned or unconditioned reflex, which you will become familiar with in biology) [2];

(2) **скажешь**, они же все трудятся (K5G03) (**you'll say**, they're all working);

(3) **думаю,** вывод этот будет неверный (K5G07) (**I think** this conclusion will be incorrect);

(4) **не забывай**, что только человек может невиданное, неиспробованное (KC 513) (**don't forget** that only man can do the unprecedented, the untried);

(5) **мы** можем узнать то, что животные не могут трудиться (K5G11) (**we can find out** that animals cannot work).

In plus, we have noticed mandatory modifiers of the speech Function (Func) [Mustajoki, 2006, p. 418] with metaverbs "to inform", "to advise"; optional modal phase modifiers (ModPhase) with modal metalexemes "maybe"; optional modifiers of Authorization (Aut) with the metaverb "to count" and epistemic modality (Modep) with moderate confidence (medium degree of probability) [Mustajoki, 2006, p. 287]. In approximately 20% of recalls, epistemic modality (Modep) covers semantic elements that indicate a speaker's attitude towards some affairs. Senior schoolchildren have abilities to master abstract concepts, to see logical connections and to defend their point of view [Petrova et al., 2023]. The agent represented with personal pronouns *I*, *you* may be skipped in denotative maps. The semantic structure includes predicates of the communicative-semantic sphere of intellectual activity: "to think", "to forget". Such predicates reflect situations of thinking and include combined semantic models with the situations of previous experience.

2. Occurrence of specifiers in the semantic structure. Specifiers describe certain properties of the predicate or its actants. The main qualifier Negation (Neg) has been recorded in the totality of our respondents' recall. In speech, the statement is not specifically expressed and is perceived by default. As for oral retellings, negation refers to the predicate and thus to the entire core of the semantic structure [Mustajoki, 2006, p. 421]. Examples:

(6) получается, животные **не планируют**, **не думают** (K5P14) (it turns out that animals **don't plan, don't think**);

(7) они **не совершенствуют, не ставят цели и не облегчают** свою работу (K5G03) (they **do not improve**, **do not set goals** and do not **make** their work **easie**r).

3. Appearance of complex semantic structures with the model "simple semantic $structure_1$ + **meta-conjunction** + simple semantic $structure_2$ or extended (simple) semantic $structure_3$":

(8) и делать что-то, **чтобы** ему было легче делать это дело (K5P14) (and do something **to** make it easier for him to do this thing);

(9) этот ответ был бы неверный, **потому что** только человек может раздумывать (K5P14) (this answer would be incorrect, **because** only a person can think).

4. Appearance of zoonymic diminutives with meliorative emotional assessment. In 30% of oral retellings, there has been noted a replacement of the lexeme «птицы/птица» → «птички/птичка», «муравей» → «муравьишки», «птенцы» → «птеньчики» ("a birds/bird" → "a little bird/little birds", "an ant" → "little ants", "a chick" → "little chicks"). They are zoonymic diminutives with meliorative emotional assessment:

(10) **муравьишки** берут соломинку и тащат в дом (KS510) (**the little ants** take a straw and drag it into the house);

(11) и **птичка** идет кормить своих животных, своих **птенчиков** (K5B16) (and **the little bird** goes to feed its animals, **its chicks**);

(12) вы видите, как маленькая **птичка** несет э... к своим детям в гнездо еду (K5A06) (you see, how **a little bird** carries uh... food to its children in the nest).

5. Creation of the reference field of the agent-person, who acts as a beneficiary. Introduction of additional specifiers "Image" and "Method of Action" (Man) into the semantic structure [Mustajoki, 2006, p. 424]. Actants shape the agent's reference field. They are focused on the actions of an agent receiving preferences and benefits. Also, actants may characterize agent's actions. On the surface structure, actants are verbalized by adverbs or possessive and personal pronouns in indirect cases. They may change actant vectors, replace or include new predicates in the deep structure. Besides, they can add to the agent a new role of possessor:

(13) человек может придумывать что-то новое **для себя** или **облегчить свою работу** (K5A20) (a person can come up with something new **for himself** or make **his work easier**);

(14) это то, что человек иногда совершенствует **свои** достигнутые **цели** (K5P06) (it is that a person sometimes improves **his** achieved goals);

(15) но люди умеют ставить **себе** цели (K5G01) (but people know how to set goals **for themselves**).

6. Appearance of optional modal phase modifiers (ModPhase) with modal metalexemes "possibly". They help to describe physical and intellectual abilities of living creatures, specifically, the ability to do something, to achieve results. The agent in these cases does not always directly control the modal phase, although he acts as a potential agent of the semantic structure:

(16) человек совершает новые открытия, а животное это **не может, может** только человек (K5G16) (a person makes new discoveries, but an animal **cannot do** this, only a person **can**);

(17) Только человек **может** добиваться своих **целей** (K5P06) (Only man **can** achieve his **goals**).

Besides, we have noticed the semantic structure development with optional modifiers and modal phase modifiers. They characterize both agent and performed actions.

Descriptions of semantic structures in the recalls of senior adolescents

The comparison of senior adolescents' speech performance with the junior adolescents' above revealed some development in spontaneous oral recalls.

1. Replacement of the subject-agent by a new one along with the inclusion of non-existent agents into the semantic structure. Occasional inclusion of non-existent agents depends on the topic and characteristics of the source text. Let us explain this assumption referring to the source text about leadership. The vague idea of leadership forces schoolchildren to introduce such agents as *руководитель*, *директор*, *начальник* (*manager*, *director*, *chief*) that are absent in the source text. It can be viewed as an attempt to replace a logical proposition with an abstract agent-theme "leadership" → "manager, director, chief" according to the principle of hyponymic replacement:

(18) формальный лидер это тот, который... выбирается по должности, допустим тот же самый **руководитель, директор и начальник** (K189B11)

(the formal leader is the one who... is selected by position, for example the same **leader, director and boss**).

2. Mandatory use of modifiers of the Speech function (Func) [Mustajoki, 2006, p. 418] with metaverbs "to inform", "to advise". The use of optional modifiers of the modal phase (ModPhase) with modal metalexemes "possible", "allowed", "impossible", "prohibited"; optional modifiers of Authorization (Aut) with the metaverb "to count" and Causation (Caus):

(19) **Им запрещено** законно наказывать либо поощрять своих подданных (K189B11 OT92) (They are **prohibited** to punish legally or encourage their subordinates).

Interestingly enough, a causation agent never acts as a subject actant. The agent of causation influences events more or less directly.

3. Deep predicates can indicate an action, and a change in intellectual or in emotional state:

(20) инструментальный лидер – это тот лидер, который **наставляет** группу на нужный путь, **указывает** свои, **какие решения делать, принимать, помогать и достижению целей** и других потребностей группы (K189V11 OT92) (an instrumental leader is the leader who **guides** the group on the right path, **indicates** what **decisions to make**, **help and achieve goals** and other needs of the group).

There are also Modal Phase modifiers (ModPhase):

(21) нет, права-то у него есть, но официальных их нет, и он **не может ни поощрять, ни наказывать** (K189) (no, he has rights, but there are no official ones, and he **can neither reward nor punish**).

4. Authorization (Aut) provides additional characteristic to the author's statement. The metaverb "to consider" is neutral since it does not indicate author's attitude towards the state of affairs. The information expressed by the core of the semantic structure is clarified with the help of authorization through an indication of someone's point of view [Mustajoki, 2006, p. 284]:

(22) еще **один ученый подразумевает** собой **три качества** лидерства, а **его ученики еще два** (K189B12 OT92) (**another scientist implies three qualities** of leadership, and **his students two more**).

5. The use of complex semantic structures with the model "simple semantic structure$_1$ + **meta-conjunction** + simple semantic structure$_2$ or extended (simple) semantic structure$_3$":

(23) формальное лидерство заключается **в том, что** сам лидер обладает полномочиями, **чтобы** влиять на группу (K189A01 OT92) (formal leadership **is that** the leader himself has the authority **to** influence the group);

(24) Они найдут всегда время на какую-то беседу, который нужно, **если** кому-то надо помочь (K189) (They will always find time for some kind of conversation, which is necessary **if** someone needs help).

6. The use of nuclear semantic structures with identifications and characteristics:

(25) именно **инструментальный лидер** обладает такими качествами, как очень **трудоспособный** и очень **целеустремленный** (K189B11) (it is **the instrumental leader** who has such qualities as being very **hard-working** and very **purposeful**);

(26) что касается эмоционального лидерства, это **лидер**, **который** передает настроение что-либо делать (K9A01) (as for emotional leadership, it is **a leader who** conveys the mood to do something).

7. Reference fields of the agent "leader/ leaders" and the actant "group" is shaped. This group acts as beneficiary at which the agent's activity is directed:

(27) **они** всегда, а эмоционально **поддерживают группу**. ...С ними **поговорить, решить их проблемы** (K189V11 OT92) (**they** always emotionally support the group. **...Talk to them, solve their problems**).

8. Development of taxis relations of non-simultaneity [Mustajoki, 2006, p. 361]. Non-simultaneity is typical in successive states of affairs that are terminal, effective, or momentary. Also, it is typical to the neutral state of affairs with the meta-union "and then":

(28) **позже** отечественный психолог Уманский выделил еще несколько типов; **а** и **потом** еще выделили, его уже ученики выделили такое, как лидер-организатор и лидер-дезорганизатор (K189B) (**later**, the domestic psychologist Umansky identified several more types; **and then** they also singled him out, his students already singled him out as an organizer leader and a disorganizer leader) .

Having compared the recalls in younger and senior adolescents, we noted the following:

1. The educational text on social studies for senior adolescents gets complicated through the introduction of abstract terms and situations. Presumably, this complication results in ignoring the pronoun "oneself" in the recalls produced from the point of view of an observer. These recalls look like narratives with analogies, generalizations, and polemics. Noteworthy, in recalls of junior adolescents, the personal pronoun "oneself" occurs on regular basis and different types of generalizations are rare.

2. In senior adolescents, the system of optional modifiers of the modal phase (ModPhase) becomes more complex in the nuclear semantic structure. There appear the lexemes that were not previously observed: *возможно*, *разрешено*, *невозможно*, *запрещено* (*possibly*, *allowed*, *impossible*, *prohibited*). Authorization types of semantic structure are enriched with the opinion of another person.

3. In senior adolescence, complex semantic structures with connectors, taxis, logical relations and immersions are improved. The development of taxis relations is associated with the expansion of action predicates. These predicates indicate states of affairs that are different from the point of view of aspectual properties [Mustajoki, 2006, p. 209]: procedural, dynamic (a process with an unachieved goal), terminal (a process with an achieved goal), effective (transition to a new state), resultative-statistic (a new state with a previous change in the state of affairs).

4. In senior adolescents' recalls, diminutives disappear. It happens since diminutives in perception and production are characteristic mainly of children of preschool and primary school age [Vvedenskaya, 2021, p. 19].

5. In junior adolescents' recalls, the vector of the action is directed at the subject. As teenagers get older, the vector of orientation becomes multidirectional. Specifically, in cases with beneficiary – the participant whose interests are affected by the situation and who benefits from it.

All in all, younger adolescents most often use compact articulated or monolithic constructs. It causes difficulties in the situations where it is necessary to take a look at a subject from different points of view. For this reason, their perception may be one-sided, partial, and not entirely consistent with the surrounding reality. As for senior adolescents, they reach a high level of intellectualization in perception, convergent and divergent thinking. They master generalization, which is the most complex mental operation. Integration of a large number of disparate parts and their ordering is achieved thanks to generalization. Senior adolescents use a large number of inter-connected categories for comparison when they perceive phenomena and things of the surrounding world. Gradually, the cognitive structure turns into a complex network of concepts in which classes are distinguished and their hierarchy is formed. The structure of this hierarchy is predetermined by the most important properties of concepts.

Conclusion

Summing up, a precise and stepwise diagnosis of cognitive structures helps us to better understand the differences between junior and older adolescents' mode of thinking as they develop over time. This will enable us to identify the most appropriate instructional materials to be provided at suitable times during the learning process. We also have some important directions for future research, specifically, to carry out the diagnosis of developing cognitive structures in different subject domains in order to detect variations in terms of how cognitive structures develop between different content areas.

NOTES

[1] Here and after these numbers stand for the cipher code of an experiment participant.

[2] Here and below the reactions are translated by the authors.

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