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ABOUT THE MAIN IDEAS OF THE DIRECT FORMAL-LOGIKAL DESCRIPTION OF THE GEORGIAN NATURAL LANGUAGE SYSTEM THOUGHT ONE EXAMPLE

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1. Introduction

Earlier we offered (4) the general principles and ideas of the Direct Formal-Logical or Frege's type or word-by-word Description (DFLD) of the Georgian Natural Language System (GNLS). The DFLD is understood as Frege's type since any word of the GNLS, according to the DFLD turns out to be Frege's type symbol. Thus, it has been proved by the DFLD that any word of the GNLS can be described through Frege's mathematical theory of sign. - Therefore GNLS is Frege's type language system. Further, the DFLD of GNLS is understood as the word-by-word description because of the fact that unlike Montague, we have no necessity for the DFLD of the GNLS to get Chomsky-Montague's S or t type as the basic one. The morphologically realized syntactic properties of the words of GNLS enables us to make their direct formal-logical description. Thus, we have no necessity of using Church's λ-abstractor and sentences to understand the formal logical nature of the words.

In the paper the examples from [1] will be analysed to show the possibility of constructing of the natural-formal deductions in the natural set-theoretical model of the GNLS. This model is obtained from the GNLS by DFLD and is based on Montague's set-theoretic aprouches.

2. Main Part

We shall use an example constructed in accordance with the example 3.15 from [1] to illustratic our approaches.

Example:

(E1) (Some (p̣atients)')' like (all (doctors)')' = t
(G1) (zogiert (p̣acienṭs)^c)^v [uq̣vars] (q̣vela (ekimi)^c)^v = t
(E2) No (patient)' likes any quack = t
(G2) (arcert (p̣acienṭs^c)^v) [ar [uq̣vars]] (arcerti (ekimbaši$^{\mathrm{c}}$)$^{\mathrm{v}}$) = t

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(E3) No doctor is a quack = t?
(G3)(arcerti (ekimi$^{\mathrm{c}}$)$^{\mathrm{v}}$) [ar [aris]] (ekimbaši$^{\mathrm{v}}$) = t?

It's implied that the sentences above the line are the true ones and we have to resolve the truth of the sentence below the line.

According to the DFLD of the GNLS, the subjective name type words (i.e. the names of the subject of judgement) are the basic type words. Therefore the subjective name type is the main grounding type of the formalism obtained by the DFLD of GNLS. This formalism is called Formal Georgian Natural Language System (FGNLS). In the GNLS as well as in the FGNLS we have three formally different subjective name types, in particular, N-i, N-ma and N-s subjective name types are obtained respectively by generalization of the words in the Georgian Nom., Erg., and Dat. cases (see Table 1).

Table 1.

English forms	Nom.	Erg.	Dat.
patient	p̣acienṭ − i	p̣acienṭ − ma	p̣acienṭ − s
doctor	Ekim-i	Ekim-ma	Ekim-s
quack	ekimbaš − i	ekimbaš − ma	ekimbaš − s

Thus, in the above described alphabet the second (third) (fourth) column is the column of the N-i (N-ma) (N-s) type subjective words, i.e. nouns. In the GNLS any N subjective name type word represents some set of entities (subjects) and this really existent sets is denoted by $^{e}\{N\}$, e.g. the set, which is represented by '$p̣acienṭs'$('$ekimi'$)('$ekimbaši'$) is denoted by $^{e}\{p̣acienṭ\}$ ($^{e}\{ekimi\}$)($^{e}\{ekimbaši\}$). To make it clear, in the ENLS the set $^{e}\{p̣acienṭi\}$ $=^{e}$ $\{p̣acienṭma\}$ $=^{e}$ $\{p̣acienṭs\}$ must be denoted as {patient}, in so far as in the ENLS we have the only one general case for subjective name type words. The nouns in the English possesive case are not the subjective name type words. Further, the question arises: how has the GNLS understood the sets: '$\{p̣acienṭs\}$','$\{p̣acienṭi\}$'and '$\{p̣acienṭma\}$'- Or, in general, how has the GNLS understood the sets of the '$\{N-s\}$', '$\{N-i\}$' and '$\{N-ma\}$' types? It is clear that they are the different sets on the language level, but they represent one and the same set on the under-language mental-subjective level. Thus, the words '$\{p̣acienṭs\}'$, '$\{ekimi\}$' and '$\{ekimbaši\}$' represent the both level set. Besides, the word in the GNLS contextually represents constant or variable type symbol, the area of definition (domain) of which is the sets '$\{p̣acienṭs\}$', '$\{ekimi\}$'and '$\{ekimbaši\}$'. Thus, in the GNLS any subjective name type word is the constant (c) or variable (v) type symbol, the domain of which is defined by itself.

Now we shall consider the next sentence:

(GI) ($p̣acienṭs^{c}$) [uq̣vars] ($ekimi^{c}$) = t

(EI) ($a/the\ patient^{c}$) [likes] ($a/the\ doctor^{c}$) = t

here 'uq̣vars-likes' is $V\{N-i, N-s\}$-type verb. It means that 'uq̣vars-likes' is a predicate defined on a certain $\{N-i\}$ and $\{N-s\}$ type sets. In our case the 'uq̣vars-likes' is defined on the sets $\{p̣acienṭs\}$ and $\{ekimi\}$. Thus, according to the classical point of view 'uq̣vars-likes' is the set of ordered pairs and this set of pairs is a subset of the Descartian multiplication of the sets $\{patient\}$ and $\{doctor\}$, i.e. a subset of $^{e}\{p̣acienṭs\}\times^{e}_{D}\{ekimi\}$, where $\times_{D}$ denotes the Descart's sets multiplication operation. But in the GNLS the '$uq_{.}vars - likes$' is understood as follows: 'uq.vars-likes'$\subseteq \{p_{.}acient_{.}s\} \times_F \{ekimi\} = \{ekimi\} \times_F \{p_{.}acient_{.}s\}$, where $\times_F$ denotes the free multiplication operation of the sets.

Definition: If A and B are sets, then $A \times_F B = \{\{a, b\}, a \in A \wedge b \in B\}$.

If in ENLS the 'likes' as a predicate is a subset of the $\{patient\} \times_D \{doctor\}$, then in the GNLS the '$uq_{.}vars$' is a subset of the $\{p_{.}acient_{.}s\} \times_F \{ekimi\}$. As we've mentioned,in the GNLS' $uq_{.}vars$' is $V\{N-s, N-i\}$-type basic predicate type word (i.e. verb). The morpfologically realized property of this verb enables us to understand it as a binary predicate, but in GNLS we can also understand it as 0-ary (0-place) word(verb) and according to this understanding, N-i, N-ma and N-s type words, by virtue of their morphologically realized properties are left-or-right unary operators operating on (0)-ary verbs and this simplification gives us the most perfect and simple formalism for GNLS. Because of that on the simple sentence level we have only two formal type words, (0)-ary words, or verbs, and unary words. It is the first reason and, besides, there is the second one: the verbs form the so-colled under- operational logical space of the GNLS. It means that any simple statement, i.e. any non-composed logical type expression of the GNLS is obtained by operating on some verb with N-i or N-ma or N-s type noun phrases and the sense of this formal operation is the concretization of the before existed general understanding: e.g. in the GNLS '$uq_{.}vars' - $'$likes$' is the general logical understanding (concept) and '$pacient_{.}suq_{.}vars$'- 'a patient likes' is its concretization by operating from the left on '$uq_{.}vars - likes$' with '$p_{.}acient_{.}s - patients$'. Analogously, '$p_{.}acient_{.}s\ uq_{.}varsekimi$' - 'a patient likes a doctor' is obtained by operating from the right on $[p_{.}acient_{.}suq_{.}vars]$ with 'ekimi'. Thus, in the GNLS the verbs represent a complex concept including both above-mentioned understandings: First - not 0-ary or predicated symbols with arety, and second - 0-ary symbols, i.e. as the basic elements of the under-operational logical space. Our further judgement is based on the second understanding.

As for the (G1) statement: 'uq.vars-likes' as the basic element of the under-operational logical space is $V\{N^c - s, N^c - i\}$ type transitive verb, and because of this the 'p.acient.s-patient' and 'ekimi- doctor' in the (G1) are the c-type or constant type symbols. This is indicated by the upper index c inside brackets. 'zogiert-some' according to the DFLD of the GNLS is right unary quantifier type word-operator and the type of this 'right-one-place', i.e. the area of definition of this right-one place includes the word 'p.acient.s', therefore, by operating of the word 'zogiert-some' on the word 'p.acient.s' we have got the quantified-N-s type noun-phrase. It means that '$\{zogiert(p_{.}acient_{.}s)\}$- {some (patients)}' is a N-s type set, moreover, from the logical properties of the word 'zogiert-some' follows that $\{zogiert(p_{.}acient_{.}s)\} \subseteq \{p_{.}acient_{.}s\}$. In the (G1) the upper index v indicates that the noun-phrase $(zogiert(p_{.}acient_{.}s))^v$ is understood on the set $\{zogiert(pacients)\}$ as variable symbol. To our mind, this ability to transform a constant type symbol into the variable type is the main feature of the word-operator of the quantifier type. The same situation is noted with quantified N-i-type noun phrase $(q_{.}vela(ekimi)^c)^v$. Therefore from $(G1) = t$ we conclude that $\{uq_{.}vars\} = \{q_{.}vela(ekimi)\} \times_F \{zogiert(p_{.}acient_{.}s)\}$

As for the semantic of operating on 'uq.vars-likes' by $(zogiert(p_{.}acient_{.}s)^c)^v$, formally, according to Herbrands strong formal approaches, the resultant expression is

$(zogiert(p_{\cdot}acient_{\cdot}s)^c)^v$ [uq.vars] (1), the set-semantic interpretation of which is certain N-i-type set. In our case (1) = $\{(q_{\cdot}vela(ekimi)\}$. Thus, we can conclude: the noun phrases of GNLS represent some N-i or N-ma or N-s type quantified or non-quantified sets and the transitive verb phrases of GNLS can be described as the transformers of one type sets into the other ones, i.e. through the operating on the transformers with some type of noun phrase the set represented by this noun phrase is transformed into the other corresponding type set. So, if 'zogiert ($p_{\cdot}acient_{\cdot}s$)' is N-s-type quantified noun phrase and 'q.vela (ekimi)' - N-i-type quantified noun phrase, then (zogiert (p.acient.s)) [uq.vars] is the verb-N-i type noun phrase and [uq.vars] (q.vela (ekimi)) - the verb-N-s-type noun phrase. Thus, (1) is an alternative name of the set $\{q_{\cdot}vela(ekimi)\}$ and nothing else. Analogously, the linguistic expression [uq.vars] (q.vela (ekimi)) is the second name of the set zogiert (p?acient?s). Now we may construct the following deduction:

$(G1, E1) = t \rightarrow \{(zogiert(p_{\cdot}acient_{\cdot}s^c)^v)[uq_{\cdot}vars]\} = \{(qvela(ekimi`))'\}$ (I)

(G2, E2) = t $\rightarrow \{(arcert(p_{\cdot}acient_{\cdot}s^c)^v)[ar[uq_{\cdot}vars]]\} = \{(arcerti(ekimba\check{s}i^c)^v\}$ (II)

Due to the natural logical properties of the Georgian words 'uqvars - likes', 'zogiert - some' 'arcerti - no', 'q.vela - all' and 'ar - not'

$\{(q_{\cdot}vela(ekimi^c))^v\} = \{ekimi\}$ (III)

$\{(arcerti(ekimba\check{s}i^c)^v\} = \{ekimba\check{s}i\}$ (IV)

$\{(zogiert(p_{\cdot}acient_{\cdot}s^c)^v)[uq_{\cdot}vars]\} \cap \{[(arcert(p_{\cdot}acient_{\cdot}s^c)^v)[ar[uq_{\cdot}vars]]\} = \oslash$ (V)

$(I) \wedge (II) \wedge (III) \wedge (IV) \wedge (V) \rightarrow \{ekimi\} \cap \{ekimba\check{s}i\} = \oslash \rightarrow ((G3), (E3)) = t$

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