Stratificational Approach to Language Description

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Basic Idea

- every language comprises a restricted number of structural layers or strata,
- strata hierarchically related in such a way that
  - units or combinations of units on one stratum realize units or combinations of units of the next higher stratum
  - *strata are linearly ordered*
Basic Idea

• every language comprises a restricted number of structural layers or strata,
• strata hierarchically related in such a way that
  • units or combinations of units on one stratum realize units or combinations of units of the next higher stratum
  • strata are linearly ordered

• the number of strata vary from (linguistic) theory to theory
  • semantics, constituted by
    – sememic stratal system (deep structure)
  • grammar, constituted by
    – lexemic stratal system and
    – morphemic stratal system (surface structure)
  • phonology, constituted by
    – phonemic system

• grammar relates to semantics and phonology in a same way as the lexemic and the morphemic stratal systems within the grammar
vs. Noam Chomsky's
*Aspects of the Theory of Syntax* (1965)
- system of three components (syntax, semantics, phonology)
- three types of rules (phrase-structure, transformational, morphophonemic)
Stratificational Approaches

- Sydney M. Lamb … *Outline of Stratificational Grammar* (1966)
  - Berkeley, follower of glossematic school
  - four necessary levels of sentence analysis:
    - the sememic stratum … structure of clauses and sentences
    - the lexemic stratum … structure of phrases
    - the morphemic stratum … structure of word forms
    - the phonemic stratum … syllable structure
- each stratum has its elementary units
- each stratum has its own combinatorial pattern
- strata are hierarchically related
  - each “realized” by the elements in the level structurally beneath it
  - without making use of rules that convert one entity into another

- Functional Generative Description (FGD)
- Meaning ⇔ Text Theory (MTT)
Basic characteristics of FGD

- motivation: machine translation

Diagram:

```
abstraction

'interlingua'  

language independent representation

source language target language

sentence ~ string of graphemes/phonemes
```
Basic characteristics of FGD

• motivation: machine translation

![Diagram]

- ‘interlingua’
- language independent representation
- language meaning ... transfer
- sentence ~ string of graphemes/phonemes

Dependency Grammars and Treebanks – Stratificational Approach
Basic characteristics of FGD (cont.)

'classical' version of FGD:

• dependency framework
  • formal description
  • suitable mathematical formalism
Basic characteristics of FGD (cont.)

'classical' version of FGD:
- dependency framework
- stratificational approach

Diagram:
- Language meaning ~ function
- String of graphemes/phonemes ~ form
- Synonymy
- Ambiguity
Basic characteristics of FGD (cont.)

'classical' version of FGD:
• dependency framework
• stratificational approach
• relation between a form and its function / a function and its form
Basic characteristics of FGD (cont.)

'classical' version of FGD:
• dependency framework
• stratificational approach
• relation between a form and its function / a function and its form

functional

structural linguistics:
• language meaning (not cognitive content)
• language as a system ~ langue vs. individual utterances ~ parol
• stress on testable criteria for distinguishing lang. phenomena
Two components of FGD

• generative component
  ~ to define all formally correct meaning representations
  (of possible sentences of a given language)
• formalism: 1) phrase rules, phrase structure trees + functors
  2) dependency trees
• push-down automaton

→ generative
Two components of FGD

- generative component
  ~ to define all formally correct meaning representations
  (of possible sentences of a given language)
- formalism: 1) phrase rules, phrase structure trees + functors
  2) dependency trees
- push-down automaton

- translation component
  ~ translating meaning representations to lower layers
- sequence of push-down transducers plus finite-state automaton
System of layers in FGD

meaning

expression

deep / underlying syntax
tectogrammar

surface syntax

morphematics

morphonology

phonology/phonetics
System of layers in FGD (cont.)

sentence … full representation on each layer of description

each layer ~ set of descriptions for all possible sentences
  • finite set of elementary units
  • finite set of operations and relations \(\rightarrow\) set of complex units
  • finite set of relations between sentence representations on a particular layer and its representations on adjacent layers
System of layers in FGD (cont.)

sentence … full representation on each layer of description

each layer ~ set of descriptions for all possible sentences
- finite set of elementary units
- finite set of operations and relations → set of complex units
- finite set of relations between sentence representations on a particular layer and its representations on adjacent layers

\[ \begin{align*}
  n + 1 & \quad \rightarrow \quad \text{function} \\
  R & \quad \uparrow \quad C \\
  n & \quad \rightarrow \quad \text{form} \\
  C & \quad \downarrow \quad C
\end{align*} \]

type C relations (composition): elementary units constitute complex units
  i.e., relations between units of the same layer

type R relations (representation): form-function relation
  i.e., relation between adjacent layers
System of layers in FGD (cont.)

**Layer of phonetics**
- distinctive features ... elementary units
- phones (~ a speech sound) ... complex units
- suprasegmental units ... prosody, intonation

**Layer of phonology**
- distinctive features ... elementary units
- phonemes (~ ‘smallest’ units that distinguish meaning) ... complex units
  - asymmetry ... allophones ~ variants of a single phoneme
  - language dependent (sing vs. sin)
System of layers in FGD (cont.)

**layer of morphonology**

morphoneme ~ set of phoneme variants  
  e.g. k|c|č|k in "matka"

morph ~ string of morphonemes
  lexical variants (matk, matc, matč, mat.k)  ...  4 allomorphs
  mat(k|c|č|k)  ...  1 morph

  lexical variants (foot, feet)  ...  2 allomorphs
  f(oo|ee)t  ...  1 morph

Dependency Grammars and Treebanks – Stratificational Approach
System of layers in FGD (cont.)

layer of morphematics

- morpheme ~ the smallest component that has semantic meaning
- lexical morpheme
  - roots
    e.g. lex. morpheme for *matka* consists of 4 allomorphs (*matk, matc, matč, mat.k*);
    for *to write* (*writ, wrot*); for *leaf* (*leaf, leav*)
  - derivational morphemes (affixes: prefixes, infixes, suffixes, … )
    *il*-* (as in illegal), *non-* (as in nonproblematic)
    *-ly* (as in legally), *-ess* (as in actress)

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System of layers in FGD (cont.)

layer of morphematics

• morpheme ~ the smallest component that has semantic meaning
• lexical morpheme
• grammatical morpheme
  • inflectional affixes  e.g. Cz: suffixes  nouns: case, gender, number, …
    verbs: gender, number, tense, voice,
  Eng: suffixes  nouns: plural -s
    verbs: past tense -ed , continuous –ing
System of layers in FGD (cont.)

layer of morphematics

- morpheme ~ the smallest component that has semantic meaning
- lexical morpheme
- grammatical morpheme
  - inflectional affixes e.g. Cz: suffixes
    - nouns: case, gender, number, …
    - verbs: gender, number, tense, voice, …
  - Eng: suffixes
    - nouns: plural -s
    - verbs: past tense -ed, continuous –ing
  - e.g. matk + a  koup + il
  - boy + s  play + ed

- sema … a combination of grammatical morphemes that characterize
  a lexical morpheme (or strings of lexical morphemes)
System of layers in FGD (cont.)

layer of morphematics

- morpheme ~ the smallest component that has semantic meaning
- lexical morpheme
- grammatical morpheme
- formeme:
  sequence of morphs realizing a single tagmeme / sentence member
  lexical f., case f. (i.e., prep+case), conjunction formemes (i.e., conj+verb mood)

Cz: vysok+á škol+a; lamp+a; na+laví+i; chod+i; bud+e+chod+it
Eng: white-collar; lamp; on+ table; walk+s; will+be+walk+ing
System of layers in FGD (cont.)

morpheme ~ the smallest component that has semantic meaning

Czech ... (inflection language):

\[ \text{nejneobhospodařovatelnější} \]

most-non- cultivate - [iter]- [adj] - [super]-[sg+nom+fem | sg+acc+neutr | ... pl+voc+masc]

23 combinations ("meanings")

grammatical morphemes
System of layers in FGD (cont.)

morpheme ~ the smallest component that has semantic meaning

Hungarian (agglutinative language):

fi-ú boy
fi-a his/her son fi-a-i his/her sons
fi-á-é his/her son's (singular object) fi-a-i-é his/her sons' (singular object)
fi-á-é-i his/her son's (plural object) fi-a-i-é-i his/her sons' (plural object)

Turkish (agglutinative language):

Dilbilimcileştiremeyebileceğizmiydiniz?
Dilbilim-ç-leş-tir-e-me-yebil-ecek-ler-i-miz-den-mi-ydi-niz

Were you one of those whom we would not be able to transform into a linguist?
System of layers in FGD

two layers of syntax
• tree-based dependency structure
  • nodes for tagmemes / sememes (complex symbols)
  • edges labeled with a type of a respective syntactic relation
The layer of **surface syntax**

*My brother often sleeps in his study.*

Po babiččině příjezdu půjdou rodiče do divadla.  
[After grandma's arrival the parents will go to the theatre.]
The layer of **surface syntax**

**surface syntactic tree**
- ~ nodes for formemes  $\rightarrow$ **tagmemes** / sentence members  
  (cz school syntax: větné členy)
- ~ edges for syntactic relations

+ surface word order … linear ordering of tree nodes
The layer of **surface syntax**

**surface syntactic tree**
- ~ nodes for formemes ➞ **tagmemes** / sentence members (cz school syntax: větné členy)
- ~ edges for syntactic relations

**Surface word order** … linear ordering of tree nodes

3 types of elementary units:
- lexical: units from a dictionary
- morphological: set of morphological features ~ **tags**
  (a pair of) trousers … sema - plural
- syntactic: subject, object, attribute, adverbial, complement,…
The layer of **deep syntax**

~ meaning of a sentence:

*semantemes*: lexical (autosemantic) words, their lexical and morphological features and mutual relations

terminology: deep / underlying / tectogrammatical representation (TR)
The layer of deep syntax

meaning of a sentence:

semantemes: lexical (autosemantic) words, their lexical and morphological features and mutual relations

terminology: deep / underlying / tectogrammatical representation (TR)

3 basic types of elementary units:

- lexical: units from a (tectogrammatical) dictionary
- morphological: grammatemes

  meaning of individual morphological categories
  (a pair of) trousers … singular
  denominating (pojmenovávací)

  vs. correlating (usouvztažňující) categories

- syntactic: types of relation, functors and subfunctors

  Actor, Patient, Addressee, … local, temporal modifications …
The layer of **deep syntax**

~ meaning of a sentence:

**semantemes**: lexical (autosemantic) words, their lexical and morphological features and mutual relations

terminology: deep / underlying / tectogrammatical representation (TR)

3 basic types of elementary units:

- lexical, grammatemes, functors

**deep word order**

- increasing communicative dynamism:
  word order reflects "relative degree of importance in comparison with other expressions in the sentence […]"

- topic focus articulation

condition of **projectivity** !!!
The layer of **deep syntax**

Po babiččině příjezdu půjdou rodiče do divadla.
[After grandma's arrival the parents will go to the theatre.]

Dependency Grammars and Treebanks – Stratificational Approach
The layers of **surface** vs. **deep** syntax

- different sets of elementary units
  - 'morphological' lemma vs. tectogrammatical lemma
  - morphological categories vs. grammatemes
  - surface sentence members vs. functors

- different sets of complex units
  - tagmeme vs. semanteme

- deep word order
  - projective trees
  - increasing communicative dynamism
The layers of **surface vs. deep syntax**

- **only autosemantic / lexical words** as nodes at deep layer
  - modal verbs
    
  Peter **wants** to attend the concert. [to attend + volitive]
  Charles **has to** pass the exam. [to pass + debitive]

- nominalization
  
  After grandma's **arrival** ... → [to arrive]

- active / passive verbs → [active form]
  
  Tato krásná kniha **byla vydána nakladatelstvím Albatros.**
  [This beautiful book was published by the Albatros publishing house.]

- **completeness of the representation**

  - (surface) ellipses are restored
  - omitted surface subject, object, comparison ...


  Spanish: ¿Ves este tronco? [(Do) you see this log? ]
Meaning↔Text Theory (MTT) vs. FGD

- **meaning**
  - semantic representation
  - deep-syntactic representation
  - surface-syntactic representation
  - deep-morphological representation
  - surface-morphological representation
  - deep-phonological representation
  - surface-phonological representation
  - tectogrammatical representation
  - surface-syntactic representation
  - morphematic representation
  - morphonological representation
  - phonological representation

- **text/sound**

Dependency Grammars and Treebanks – Stratificational Approach
References

• Sgall, P. (1967) Generativní popis jazyka a česká deklinace. Academia, Praha
• https://www.britannica.com/science/linguistics/Stratificational-grammar

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