TORE NESSET

# Second-Order Schemas and Active Subschemas: Vowel Reduction in Cognitive Grammar

Any linguistic model with pretensions of being a theory of phonology must address neutralization. In this paper I explore phonological neutralization in Cognitive Grammar on the basis of a case study of vowel reduction in Contemporary Standard Russian. I shall make two points. First, we shall see that generalizations about neutralization can be stated in Cognitive Grammar as what I call "second-order schemas". Second, it will be shown that we are in a position to accommodate the interaction of conflicting schemas if what I refer to as "active subschemas" are granted a role in the grammar. The analysis I propose has theoretical implications in that it provides an empirical argument in favor of one of the fundamental ideas in cognitive linguistics, viz. that grammars are organized in a bottom-up fashion. After a presentation of the relevant data in section 1, I discuss second-order schemas in section 2 and active subschemas in section 3, before the contribution of the paper is summarized in section 4.

## 1. Vowel Reduction in Contemporary Standard Russian

Russian dialects display several complicated patterns of neutralization in unstressed vowels. In this paper, however, I shall limit myself to the vocalism of Contemporary Standard Russian, which suffices to illustrate the theoretical problems I wish to address. The data are well known from the literature, but a brief presentation is nevertheless in order.

Most researchers assume five contrastive vowels (/i, e, a, o, u/), but as shown in Table 1 some of the oppositions are neutralized in unstressed syllables. This phenomenon is traditionally referred to as "vowel reduction". Table 1 concerns vowel reduction in environments where the relevant vowels are not preceded by a palatal(ized) consonant. It is necessary to distinguish between two unstressed positions, because [á, ó] alternate with [ʌ] in the syllable preceding the stressed syllable, but with [ə] elsewhere. Crosswhite (2001:61 and 106f.) suggests that the stressed syllable and the syllable immediately before it each have a mora, while other syllables do not. Detailed discussion of this proposal (and the notion of "mora") is well beyond the scope of this article. Suffice it to say, that Crosswhite's proposal facilitates a three-way distinction between syllables with stress and mora ($\acute{\sigma}_\mu$), syllables with a mora, but no stress ($\sigma_\mu$), and syllables with neither stress nor mora ($\sigma$).[1]

| | $\acute{\sigma}_\mu$: | | $\sigma_\mu$: | | $\sigma$: | | Gloss: |
|---|---|---|---|---|---|---|---|
| /i/: | [ɨ]: | [sɨ́rə] | [ɨ]: | [sɨrój] | [ɨ]: | [sɨrʌváto] | 'moist' |
| /e/: | [e]: | [z̪émtʃʲuk] | [ɨ]: | [z̪ɨmtʃʲúz̪ɨna] | [ɨ]: | [z̪ɨmtʃʲugá] | 'pearl' |
| /a/: | [a]: | [stárɨj] | [ʌ]: | [stʌrʲík] | [ə]: | [stərʲitʃʲók] | 'old' |
| /o/: | [o]: | [góləvu] | [ʌ]: | [gʌlóf] | [ə]: | [gəlʌvám] | 'head' |
| /u/: | [u]: | [pust] | [u]: | [pustój] | [u]: | [pustʌtá] | 'empty' |

**Table 1: Vowel reduction—the basic pattern**

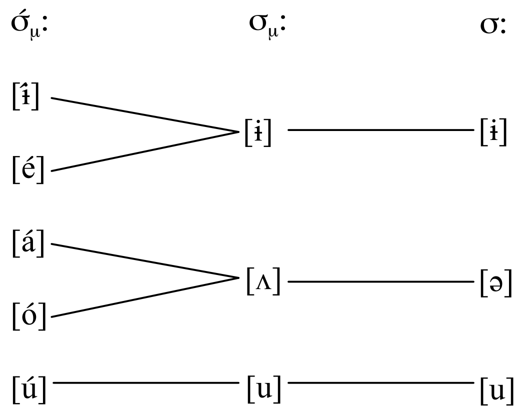


**Figure 1: Vowel reduction as neutralization**

Figure 1 offers an overview of the basic neutralization patterns. However, this is not the whole story, because vowel reduction interact with fronting and raising of vowels preceded by palatal(ized) consonants.

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[1] Notice that in word-initial position, we have [ʌ], not [ə], as in the nominative plural form [ʌkərʌká] of [ókərək] 'hamhock'. This suggests that word-initial vowels are moraic (cf. Crosswhite 2001:74f.).

The data in Table 2 and the diagram in Figure 2 show that mid and low vowels neutralize to [i] after palatal(ized) consonants.

| | $\acute{\sigma}_\mu$: | | $\sigma_\mu$: | | $\sigma$: | | Gloss: |
|---|---|---|---|---|---|---|---|
| /i/: | [i] | [tʃʲist] | [ɪ] | [tʃʲɪstá] | [ɪ] | [tʃʲɪstʌtá] | ‘pure’ |
| /e/: | [e] | [lʲes] | [ɪ] | [lʲɪsnʲík] | [ɪ] | [lʲɪsnʲɪtʃʲók] | ‘forest’ |
| /a/: | [a] | [pʲátɨj] | [ɪ] | [pʲɪták] | [ɪ] | [pʲɪtʌtʃʲók] | ‘five’ |
| /o/: | [o] | [zʲórnə] | [ɪ] | [zʲɪrnó] | [ɪ] | [zʲɪrnʌvój] | ‘grain’ |
| /u/: | [u] | [lʲúbʲit] | [u] | [lʲubʲítʲ] | [u] | [lʲubʌvátʲsə] | ‘love’ |

**Table 2: Vowel reduction after palatal(ized) consonant**

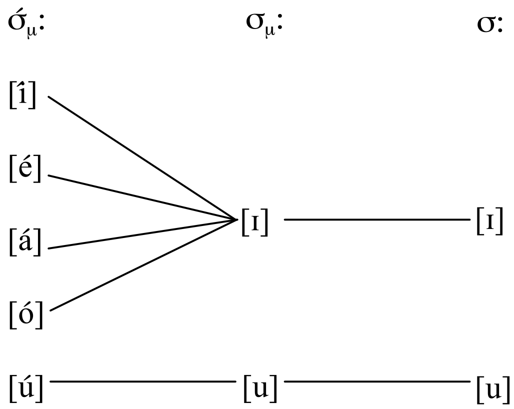


**Figure 2: Vowel reduction after palatal(ized) consonant as neutralization**

Summarizing the situation, we may state the following descriptive generalizations:

(1) a. Stressed high vowels alternate with high vowels in unstressed syllables.
b. Stressed mid and low vowels alternate with [ə] in unstressed syllables.
c. Stressed mid and low vowels alternate with [ʌ] in moraic unstressed syllables.
d. [é] alternates with [ɨ] in unstressed syllables.
e. Stressed mid and low vowels alternate with [i] in unstressed positions when preceded by palatal(ized) consonants.

The statement in (1a) sums up the somewhat trivial, but nevertheless important generalization that /i/ and /u/ maintain essentially the same quality in unstressed syllables, whereas mid and low vowels are involved in more complicated alternations described in (1b-d). (1b) is the default pattern concerning the majority of mid and low vowels (/a, o/) in the majority of environments (all unstressed syllables without a mora). It is overridden by (1c) for mid and low vowels in moraic unstressed syllables, and by (1d) for /e/ in all unstressed syllables.[2] The statement in (6e) captures the raising and fronting effect observed after palatal(ized) consonants.

## 2. Second-order Schemas

Is it possible to accommodate the generalizations in (1) in Cognitive Grammar? A fundamental assumption in Cognitive Grammar (and cognitive linguistics in general) is that language is an integral part of cognition. As Janda (2000:4) puts it, “for a cognitive linguist, linguistic cognition is simply cognition”. There are no clear-cut boundaries between language and other cognitive abilities, and cognitive linguists seek to analyze language by means of theoretical constructs that are based on and compatible with insights from other disciplines in cognitive science. Central concepts are schemas and categorizing relationships. Imagine listening to a cover version of Lennon and McCartney’s “Yesterday” performed by a female singer without the accompanying string quartet. You will most likely find yourself comparing the cover version with the Beatles’ original recording. Doing this, you are connecting your mental representations of the two versions by means of categorizing relationships. Despite the differences, you are able to extract enough elements recurring in both versions that you perceive them as versions of the same song. You have formed a schema for the song.

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[2] Historically, the behavior of /e/ is different due to a fronting effect, because in the native vocabulary /e/ is only attested after non-palatalized consonants that were formerly palatalized. However, as pointed out by Crosswhite (2001:106f.), such an analysis is not viable for Contemporary Standard Russian, since [é] alternates with [ɨ] in vowel-inital syllables too, where no fronting effect due to a preceding consonant can be assumed.

The mental activity involved in listening to music does not necessarily have anything to do with language, but the notions of schema and categorizing relationships are relevant for language too—including Russian vowels. Is it possible to account for vowel reduction in terms of schemas and categorizing relationships? Being exposed to Russian speech, language users may identify recurring elements among the vowels and establish schemas for vowels in various environments. The language users may furthermore compare vowels in stressed and unstressed syllables and connect them by means of categorizing relationships. If such comparisons occur on a regular basis, the language users may form schemas covering the systematic relationships between stressed and unstressed vowels in Russian.

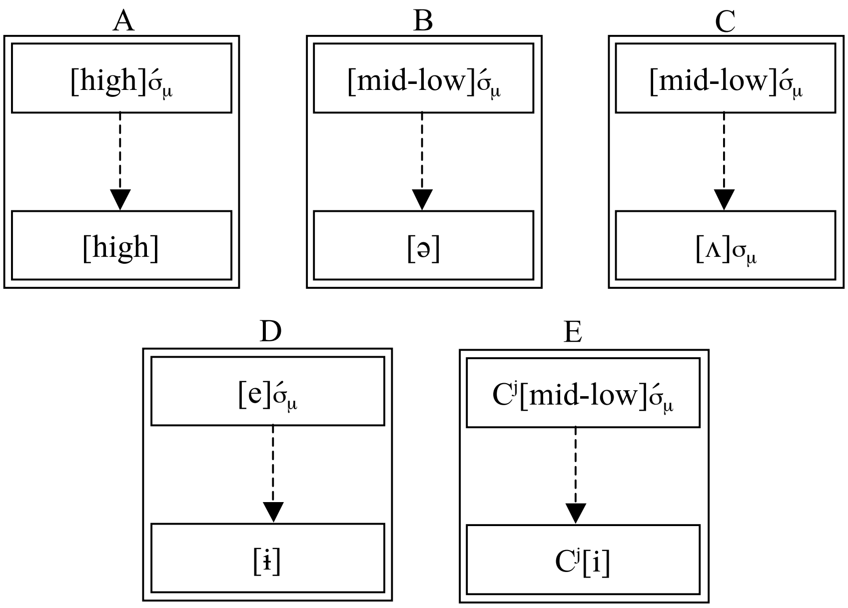


**Figure 3: Neutralization as second-order schemas**

The five schemas in Figure 3 are of this type. The upper box in each schema represents stressed vowels. They are connected with boxes for unstressed vowels by means of dashed arrows. The arrows symbolize categorizing relationships of the type Langacker (1987) calls "extension", which connect structures that are partially comaptible. Schema A captures generalization (1a) that high vowels alternate with high vowels, while schemas B and C accommodate the behavior of mid and low vowels in (1b-c). Notice, that I use the feature specification [mid-low] instead of the traditional [-high]. Schemas are generalizations over structures actually occurring in utterances, and since the absence of something never occurs in utterances, the absence of something cannot be part of a schema. In view of this, I avoid negative feature specifications. Mid and low vowels occupy a continuous portion of the vowel space that can be positively specified as involving a relative high degree of openness. Schema D captures generalization (1d) about the [e] ~ [ɨ] alternation, and schema E accounts for the behavior after palatal(ized) consonants, which are represented as $C^j$ in the schema.

All the schemas in Figure 3 are complex; they are schemas over schemas that are connected by extension relations. Schemas of this sort have occasionally been proposed in the literature (Langacker 1987:442ff., Nesset 2005 and Tuggy 2005), but no generally accepted term has been coined. I suggest referring to them as "second-order schemas". Terminological issues aside, Figure 3 shows that Cognitive Grammar provides a straightforward account of the neutralization patterns observed in Russian unstressed vowels. No ad hoc machinery is invoked—categorizing relationships and (second-order) schemas are all we need.

## 3. Subschemas and "Bottom up" Organization of the Grammar

Although the second-order schemas advanced in section 2 enable us to accommodate the generalizations from section 1, the analysis is not complete until we have specified how the schemas interact. This is not a trivial question, because some of the schemas are in conflict with each other. For instance, schema B states that mid and low vowels alternate with schwa. The vowel [e] is mid, so it is compatible with the schema. However, at the same time schema D applies to [e], for which it predicts an alternation with [ɨ]. How can conflicts between schemas be resolved? Langacker (1999:106), who takes connectionism as his point of departure, argues that schemas containing specific information take precedence over general schemas. In other words, if schema X applies to a subset of the structures compatible with schema Y, schema X wins out. As shown in the Venn diagram to the left in Figure 4, a subset relation holds between schemas B and D. The vowel [e] is a subset of all mid and low vowels, so we expect the more specific schema D to take precedence. This prediction is borne out by the facts, insofar as [e] in Russian alternates with [ɨ], as shown in Table 1.

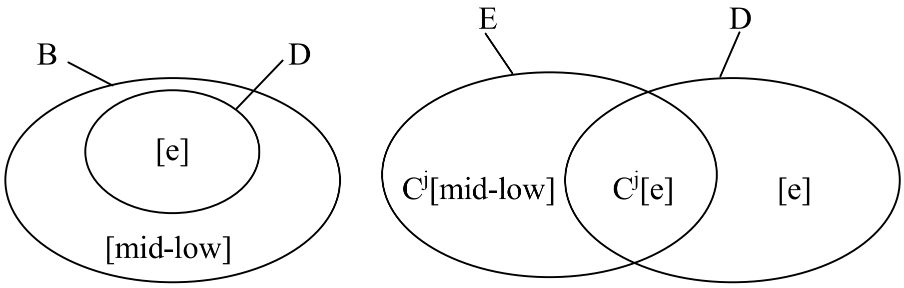


**Figure 4: Conflicting schemas**

However, not all conflicts are of this type. Schemas D and E illustrate this. Schema D applies to [e], while schema E covers all mid and low vowels. This suggests that D is more specific, but schema E applies after palatal(ized) consonants only, while schema D does not involve any specifications of the environment. In other words, schema D provides the more specific characterization of the relevant vowels, but schema E gives a more specific description of the environment surrounding the vowels. For this reason, the sets of structures compatible with the two schemas intersect, but neither set is a subset of the other. The situation is illustrated in the Venn diagram to the right in Figure 4.

How can we account for schema interaction where no subset relations hold? In addition to the specificity principle explored above, Langacker (1999:105) discusses a second principle of schema interaction, according to which more entrenched schemas take precedence over less entrenched schemas. Entrenchment can be thought of as a function of frequency; every time a structure is activated it becomes more entrenched in the mental grammar. This principle facilitates an account of frequency effects, which are no doubt pervasive in language (cf. e.g. Bybee 2001, Dąbrowska 2004). However, in the examples at hand, I am not aware of any evidence indicating differences in entrenchment among the relevant schemas. In other words, Langacker's entrenchment principle is not of any help in this particular case.

Instead I would like to propose an account in terms of what I call "active subschemas". A fundamental assumption in Cognitive Grammar is the idea that grammars consist of networks of schemas. The grammar is organized in a “bottom-up” fashion. Language users form “local” schemas over small sets of data. These schemas are connected by means of categorizing relationships, and “global” schemas covering large classes may or may not be formed. The schemas in Figure 3 are of the “global” type; they capture generalizations about large sets of data. It is important to remember that such schemas do not exist in a vacuum, but rather represent generalizations over several subschemas. This point is made explicit in Figure 5, where schema E generalizes over different subschemas for different mid and low vowels. The schemas are connected by solid arrows indicating that the schemas in the lower portion are fully compatible with the topmost schema.

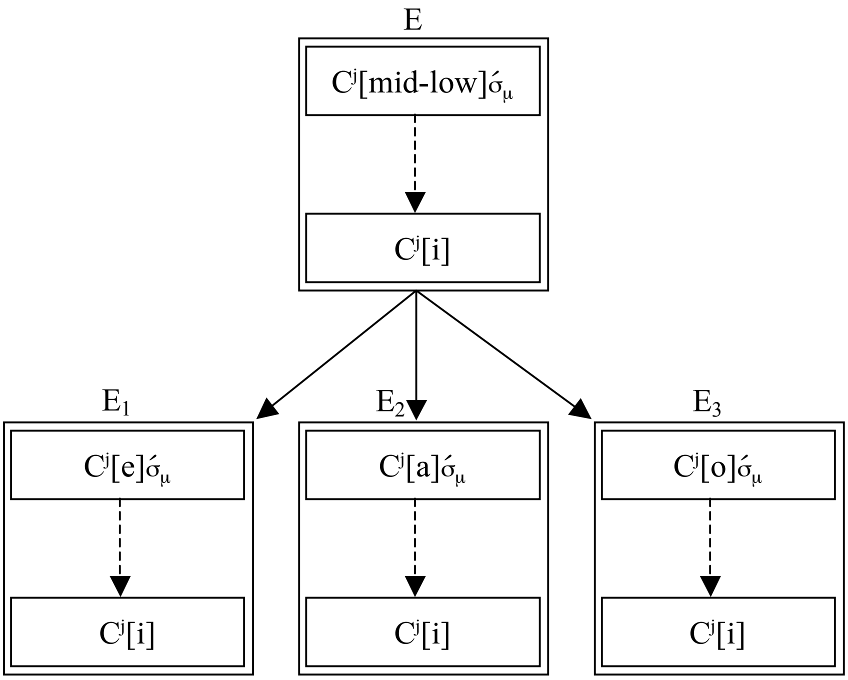


**Figure 5: Schema with subschemas**

Let us now return to the problematic conflict between schemas D and E. As shown in Figure 5, schema E is just the tip of the iceberg. What I would like to propose is that schema E does not interact directly with schema D, but rather participates in the interaction via subschema $E_1$. Subschema $E_1$ is more specific than schema E, in that the former refers to

[e], while the latter covers all mid and low vowels. Importantly, a subset relationship also holds between schemas $E_1$ and D. Schema $E_1$ applies to [e] preceded by a palatal(ized) consonant, whereas schema D covers [e] regardless of the segmental environment. On the basis of Langacker's specificity principle we predict that schema $E_1$ takes precedence over schema D. This prediction is borne out by the facts; as shown in Table 2, [e] alternates with [i], not [ɨ], when preceded by a palatal(ized) consonant.

The analysis with the "active" subschema $E_1$—simple as it is—has interesting theoretical implications. It provides an empirical argument in favor of one of the fundamental assumptions in Cognitive Grammar, viz. the idea grammars are organized in a bottom-up fashion. In order to account for the interaction between conflicting schemas we need subschemas. Although global schemas are useful insofar as they enable us to capture generalizations over large classes of items, we have seen that we cannot do without more specific subschemas. The subschemas may involve redundant information, but they nevertheless do important work for us—for instance accounting for schema interaction as we have seen in the present study of vowel reduction in Russian.

## 4. Conclusion

In this short paper, I have provided an analysis of vowel neutralization in unstressed syllables from the perspective of Cognitive Grammar. Two concepts have been important: second-order schemas and active subschemas. Second-order schemas enable us to capture broad generalizations over the neutralization patterns observed in Russian vowels. Active subschemas are necessary in order to accommodate the interaction between conflicting schemas. Illustrating the important role of subschemas, the proposed analysis lends support to one of the fundamental ideas in Cognitive Grammar, viz. that grammars are organized in a bottom-up fashion.

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*E-mail: tore.nesset@hum.uit.no*