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Modeling Grammaticalization Based on Reanalysis and Analogy

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Grammaticalization is a phenomenon of language change, in which content words such as nouns and verbs change into function words such as auxiliaries and prepositions. New functional categories, tense, mood, and so forth, can emerge in a language structure through grammaticalization. Then structure and lexicon of a language can become complex and rich. It is important to understand the process of and the cognitive abilities necessary for grammaticalization in the context of origin and evolution of language. The constractive examination is effective to clarify these abilities. In this thesis, we first analyze how conventional studies of grammaticalizaiton can be interpreted to our cognitive aspects. Based on the analysis, we construct a computational model using an extent model of language evolution.

In theoretical linguistics, grammaticalization has been thought to consist of two processes, called reanalysis and analogy. Reanalysis is a structural change without observable changes in forms. This occurs when a hearer understands a form to have a structure and a meaning differently from that of a speaker. Analogy is to apply a grammatical rule to forms in which the rule was not applied properly. We redefine them as cognitive abilities to cause grammaticalization. We define that the ability to cause the process of analogy as a linguistic-specific ability called the "linguistic analogy".

Also we define the cognitive ability which instantiates the linguistic ability as the "cognitive analogy"; it finds analogy among situations and among forms. Reanalysis is a cognitive ability which is also based on the cognitive analogy.

Then, we investigate whether these cognitive abilities can be related to Simon Kirby's compositionality model. More specifically, we investigate the relationship between the learning mechanisms in the model and the underlying mechanisms for grammaticalization in order to develop a model of grammaticalization based on reanalysis and analogy. In Kirby's model, a language learner acquiring his own grammar performs three operations to generalize his grammar: *chunk*, *merge* and *replace*. Reanalysis is partly realized in the *chunk* opration, since a learner can analyze utterances in different way from a speaker's by the *chunk* operation. An important feature of the linguistic analogy is expressed in the *merge* operation and the *replace* operation; a learner extensively applies a grammatical rule, which was used for only an instance, to all members in a category to which the instance belongs. We also find that these two operations are so strong that one instance triggers complete integration of different categories. The cognitive analogy is instantiated in all operations (chunk, merge, and replace) of Kirby's model. Consequently, it is recognized that reanalysis and analogy are premised in these three operations:

1. All operations are based on the cognitive analogy.

2. In addition, the *chunk* operation requires reanalysis.

3. In addition, the *merge* operation requires the linguistic analogy.

4. In addition, the *replace* operation requires reanalysis and the linguistic analogy.

Actually, the phenomenon of meaning change is observed where a form for a noun was to be used commonly for various verbs in simulations of Kirby's model. But Kirby's original model is not be able to express a functional meaning. In our model of grammaticalization, we set an additional argument for tense as function meaning. Then we design the relationship among these arguments in the meaning space as follows:

1. A meaning category indicated by the forms of '*go*' overlaps with that indicated by forms of other meanings.

2. Sentences including the meaning of '*go*' often have the meaning of '*future*' also.

We observe that the result of the model is actually comparable to gramaticalizations in the real world. The structural design of the meaning space described in 1 contributes that '*go*' more likely changes into other meanings, while that of the meaning space described in 2 makes '*go*' change to '*future*'.

These results strongly suggest that the followings are the sufficient conditions to cause directional grammaticalizations observed in natural language:

1. One must have the ability to find the common feature according to the situation and the form.

2. She must have the ability to punctuate the sentence voluntarily based on 1.

3. She must have the ability to extend new knowledge he discovered by 1 and 2 to other knowledge.

4. The meaning category indicated by an original content word overlaps with that indicated by another function word.

5. The meaning of an original content word frequently appears with the meaning of another function word.

Moreover, in the simulation grammaticalization occurs through the following steps:

1. There are two forms for one meaning. (synonym)

2. Both of the forms happen to appear in a same utterance.

3. A learner analyzes one of them as an original content word and the other as a part of a form for another meaning.

4. The original content word's form does not have to express its original meaning, as the synonym now covers the role of the original content word.

5. The original content word's form becomes a meaningless morpheme.

6. The original content word's form obtains the meaning of the target functional meaning.

We suggest that some of our grammaticalization processes can be triggerd by the existance of synonsyms and follow the steps given above.