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Exemplars supersede abstractions: Presenting an exemplar theory of grammatical constructions

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This paper presents a radically memory-based theory of grammatical constructions, named *Exemplar-based Construction Grammar* (EBCG). EBCG assumes that 1) we human memorize all the exemplars of sentences previously heard/read; 2) when processing an input sentence we *associate* those concrete exemplars with the input; 3) then we transfer and superpose meanings (and perhaps, forms) of associated exemplars to the input. This means that EBCG is not based on abstract entities, but based on concrete exemplars (hence *exemplar-based*). This attitude against abstractness is in fact radical, but in many respects there are advantages for exemplar-based view over abstraction-based one: 1) it can do with fewer assumptions; 2) it can avoid most of overgeneralizations; 3) it can provide an integrated model of grammatical representation and sentence processing.

1 Introduction

This paper presents a radically memory-based theory of grammatical constructions, named *Exemplar-based Construction Grammar* (EBCG). EBCG is, as the name shows, a version of a linguistic theory called *Construction Grammar* (e.g., Goldberg 1995), which can be characterized as a monostratal, declarative approach to grammar. In Construction Grammar the knowledge of language is assumed to be composed of various kinds of *constructions*, i.e., stored symbols of form-meaning pairs, with varying size and degree of abstractness, from morphemes to syntactic frames (e.g., [Subject Verb Object_1 Object_2]), which are considered to be connected into a vast network.

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This attitude against abstractness is in fact radical, but in many respects there are advantages for exemplar-based view over abstraction-based one: 1) it can do with fewer assumptions; 2) it can avoid most of overgeneralizations; 3) it can provide an integrated model of grammatical representation and sentence processing.

Before going to the main part, the following sections provide the theoretical background of this paper, that is, exemplar models and Construction Grammar.

2 Background

2.1 Exemplar models

What can be called exemplar model or exemplar-based model can be found in literatures in as early as 1980s, such as Hintzman (1984). Most of them are in the field of cognitive psychology and aim at explaining categorization behaviors through simulation. More specifically they explain how humans judge a novel item as a member of some category based on similarity between the item and stored exemplars.

In Hintzman's model (1984) an exemplar is coded as a point of multi-dimensional space, or a feature

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vector, whose values are either -1 (negative), 0 (missing), or $+1$ (positive). His model named MINERVA2 computes similarity as a degree of activation using the inner product between a target item called a *probe* and an exemplar and then the activation value is multiplied by the exemplar vector. After that each of the feature values is summed to one and averaged, resulting in a new vector, called an *echo*. The echo gives the probe a content lacking in it including features coding category labels, which is considered as the process of category judgment (see Fig. 1).

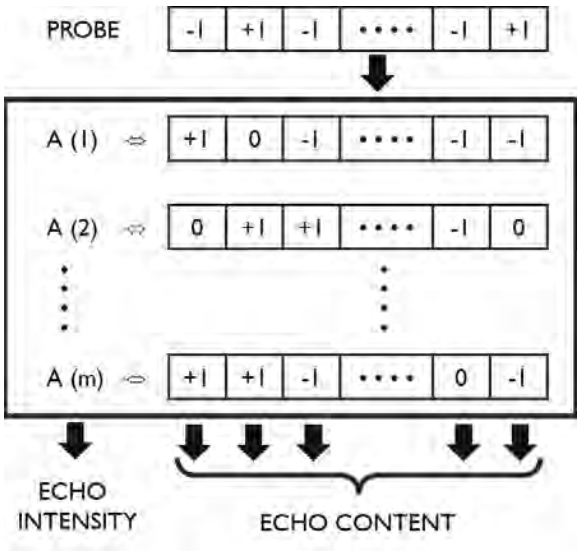

Fig. 1 MINERVA2 (based on Figure 1 and Figure 2 in Hintzman 1986:413–414)

As for language, there are not so many models based on exemplars. Of them phonetic and phonological ones are famous, such as Johnson (1997) and Pierrehumbert (2001), because auditory processing can be discussed within the framework of categorical judgment. These models assume that every specific and concrete auditory experience is stored in memory with some kind of labels such as phoneme-like alphabetical ones and the sequence of them, e.g., a word or a morpheme, and the auditory details themselves are utilized when processing input data (see Fig. 2).

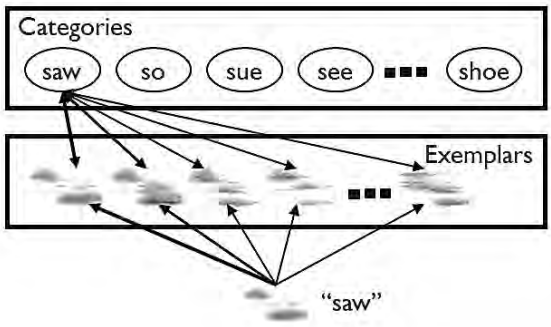

Fig. 2 Schematic illustration of an exemplar-resonance model by Johnson
(adapted from Fig. 5 in Johnson 2006:493 with slight modifications)

When it comes to syntax or semantics, there is almost no established model based on exemplars. Notable exceptions are works by Rens Bod and his colleagues such as Bod (2009) and Borensztajn and Zuidema (2011). They present a model which can be characterized as an exemplar-based model of syntax, coupled with a framework of sentence processing called *Data-Oriented Parsing* (DOP) Their model, especially Borensztajn and Zuidema's (2011), is highly similar to the model proposed in this paper, i.e., EBCG, but in some non-trivial respects differs from EBCG.

Borensztajn and Zuidema's model (2011) is called *Episodic Grammar*, which assumes that every sentence is processed based on the history of previous experiences or episodes of derivation. Derivation in their model is the process in which the internal structure of a sentence is analyzed, resulting in providing a tree structure with syntactic labels such as N (= Noun) and VP (= Verb Phrase).

This model is a probabilistic model which utilizes probabilities of derivations given a sequence of words, i.e., a sentence, and the most probable derivation is selected as "the best parse" and applied to the sentence. In this respect the model is somewhat different from phonetic/phonological ones given above.

The common feature shared by those models is the co-existence and interaction of exemplars and abstract properties or labels. The models are indeed exemplar-based, but exemplars alone do not suffice. Input stimuli are first processed based on concrete properties which navigate to abstract properties or labels and hence categorizations or analyses result.

2.2 *Construction Grammar*

Construction Grammar (CG) is a theory of grammar which can be characterized as a monostratal, declarative approach to grammar. By monostratal it is meant that the theory only assumes one level of structural representation, that is, it does not assume any kind of derivation. By declarative it is meant that the components of the theory are static, that is, no rule-like operations are assumed.

This character marks a sharp contrast with that of rather classical theories of grammar, especially a family of theories known as *Generative Grammar*, which assume that the elementary part of grammar is a set of rules which operate some kinds of items such as syntactic categories (e.g., *Sentence*, *Verb Phrase*, and *Noun*) and words.[*1] Most of those traditional theories regard a verb as the core or the *head* of a sentence, that is, a sentence is, say, considered to be an instance of a verb. Therefore, the structure of a sentence is assumed to be determined by the properties of the verb contained by the sentence.

For example, the structures of following sentences are thought to be determined by the verbs, *sleep*, *break*, *hit*, and *make*:

(1) a. Louis slept well. (Intransitive)
b. Judy hit the ball. (Transitive)
c. Freddy gave me the globe. (Ditransitive)
d. Sarah made him happy. (Causative)

This assumption is made probably because in those theories the meaning and structure of a sentence is thought to come only from the component parts, that is, words included in it and syntactic categories, and

[*1] Although details cannot be presented due to the limitations of space, there was an intermediate case between rule-based and template-based theory of grammar, known as *Government and Binding Theory* (Chomsky 1993). The theory assumes that the structure of a sentence is composed of syntactic schemas called $\bar{X}$ *schemas* (Jackendoff 1977), which provide a template of canonical phrases such as a verb phrase and a noun phrase. The theory, however, also has derivation rules which transform the templates into somewhat different configurations, hence intermediate between rule-based and template-based.

not from elsewhere.

However, there are many verbs which can be used in various structures, or more precisely, *argument structures*. For example, the verb *kick* can be used in at least following eight argument structures:

(2) a. Pat kicked the wall.
b. Pat kicked Bob black and blue.
c. Pat kicked the football into the stadium.
d. Pat kicked at the football.
e. Pat kicked his foot against the chair.
f. Pat kicked Bob the football.
g. The horse kicks.
h. Pat kicked his way out of the operating room. (Goldberg 1995:11)

In order to explain this fact, verb-centered theories should assume that verbs of this kind have as many meanings and potential structures as they occur in different structures. This, obviously, leads to a circularity (Goldberg 1995:10–12).

What is more, the meanings of the whole sentence vary systematically according to the argument structure in which the verb is embedded. This fact suggests that, contrary to the assumption of the generative theories, there can be sources of the meaning of a sentence other than component parts of the sentence.

In this connection, CG assumes that an argument structure also has its own meaning and is a kind of *construction*, a pair of form and meaning. Construction *C* is defined as follows:

(3) *C* is a CONSTRUCTION iff$_{\text{def}}$ *C* is a form-meaning pair, $\langle F_i, S_i \rangle$ such that some aspect of F_i or some aspect of S_i is not strictly predictable from *C*'s component parts or from other previously established constructions. (Goldberg 1995:4, with slight modifications)

This allows us to assume that the meaning of a verb differs according to argument structures it occurs in because, although the verb is or can be monosemous, structures themselves have their own meanings. In other words, argument structures are assumed to be *objects* in their own rights, not composed or constructed from smaller parts such as words in it.[*2]

Further, CG enables us to account for somewhat anomalous or novel uses of verbs such as follows:

(4) He sneezed the napkin off the table. (Goldberg 1995:9)

In this example the verb *sneeze* is unusually used transitively taking an object "the napkin." In order to account for this fact verb-centered theory should assume the verb *sneeze* has a subsense and a substructure of its own which enable it to be used transitively, but this is hardly the case. CG, in contrast, can easily explain this: the semantic and syntactic properties of the verb *sneeze* can be *fused* with that of the argument structure construction, namely *Caused-Motion Construction* whose structure is [Subject Verb Object Oblique] and meaning, [X causes Y to move Z] (Goldberg 1995:5).

Fig. 3 graphically displays how the argument strucure construction and the verb are fused. Argument structure constructions and verbs are thought to have their own sets of *semantic roles* such as ⟨`cause, goal, theme`⟩ and ⟨`sneezer`⟩. Fusion succeeds when and only when the roles specified by the construction

[*2] Note that according to the definition, morpheme is also regarded as a construction, because the form and meaning of it cannot be predicted by its component part, i.e., phonemes.

and the verb correspond each other and are fully compatible (Goldberg 1995:50–52).[*3]

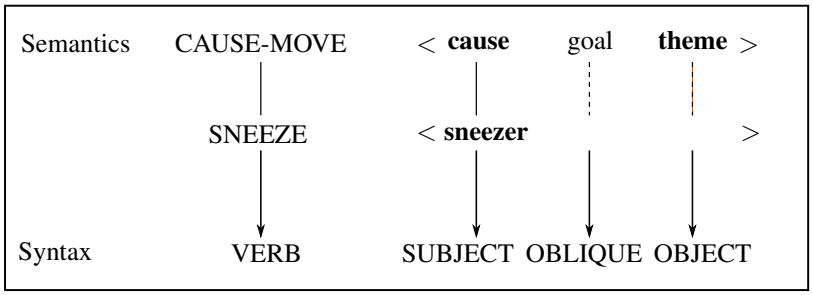

Fig. 3 "Fusion" of Caused-Motion Construction with the verb *sneeze*
(adapted from Figure 2.10 in Goldberg 1995:54 with modifications)

Note here that the definition of construction was later modified or extended to include kinds of *predictable* units of form-meaning pairs, if they are frequently enough and assumable to be *stored* in memory (Goldberg 2006:5).

3 *Exemplar-based Construction Grammar*

Taking exemplar-based view, the theory of construction should be modified radically, because its assumptions are, for now, based on highly abstract notions such as argument structure constructions as presented in the previous section. In this section, therefore, a radically revised version of CG named *Exemplar-based Construction Grammar* (EBCG) is presented.

In the remaining of this section, first, the overview of EBCG is briefly displayed (3.1), then, secondly, its basic assumptions are presented one by one (3.2), thirdly the methodology of EBCG is introduced (3.3), and fourthly limitations of EBCG are provided.

3.1 Overview

EBCG is a theory of sentence grammar radically based on exemplars. In this theory a sentence is assumed to be produced and comprehended by means of transferring and superposing sentential exemplars stored in memory. For instance, a novel sentence such as (5) is considered to be processed by transferring exemplars similar to it, e.g., *She sent me a photo*, *She emailed me a photo*, and so on.

(5) She skyped me a photo.

In terms of this assumption EBCG marks a sharp contrast with the traditional theory of construction in that in the traditional one the sentence is considered to be processed with abstract template called argument structure construction, specifically in this case, Ditransitive Construction. In this sense the traditional version of CG can be called *Abstraction-based Construction Grammar*, hence hereafter referred to as ABCG.

3.2 Basic assumptions

The definition of construction In the tradition of CG a construction, as mentioned above, has been defined as the stored unit of form-meaning pair, but exemplar-based view does not concern whether a unit is

[*3] See Goldberg (1995) for details.

stored in memory or not, because all the units once hear/read are assumed to be stored (Bybee 2010:24). EBCG, therefore, declines the very assumption of construction and instead assumes that construction is only a phenomenon, that is, *construction effect*.

Construction effect Construction effect is a kind of *completion effect* in which given some input the input is interpreted as parts of a structure as a whole and hence some nonpresent parts are completed (Kuroda 1997). In the case of the example given in (5), for example, the discontiguous sequence *She . . . me a photo* can be thought to evoke a whole such as *She sent me a photo* and therefore the part "sent" would be completed.

Exemplar transferring and superposition When completion occurs the meanings and in some cases the forms of associated exemplars are transferred to the given input, e.g., (5). In other words, the input is interpreted via associated exemplars. In transferring, the mismatched parts, e.g., ⟨skyped, sent⟩, are *superposed*, that is, their meanings are composed or unified into one.

(6) *She* skyped *me a photo.*
⇑ superposotion ⟩ transferring ⇒ completion
She **sent** *me a photo.*

Note on exemplar An exemplar is defined as follows: *the least abstract* and *the most specific* entity of memory. That is to say, exemplars are not totally *concrete*, because our brain cannot encode every physical detail of input stimulus. Input stimuli or experienced episodes are, in this sense, *parameterized* to some degree based on innately equipped perceptive features and those obtained via previous experiences (Cf. Goldberg 2006:46).

3.3 Methodology

In EBCG the sources of construction effects are investigated. In order to achieve this, EBCG adopts a *form-based* approach. Specifically, 1) seeking one or more *surface patterns*, i.e., contiguous or discontiguous sequences of word forms, which is assumed to be effective to identify a certain construction; 2) based on the specified patterns, collecting tokens actually employed in linguistic database, or *corpus*; 3) checking whether the collected data can actually be regarded as instances of the construction.

For example, the English *Ditransitive Construction* (e.g., *Freddy gave me the globe*), a famous argument structure construction frequently discussed in linguistics, can be identified at least partially by means of a pattern [will __ me a __] as in *You will give me a kiss*.*4

At the same time, however, tokens which cannot be considered as instances of this construction may also be found using the pattern, such as *You will miss me a lot*. If the number of those tokens are rather small, they are regarded as exceptions, but that is not all: then other factors which make them exceptional should be investigated. As for the "miss you" example above the pattern [__ miss __ a lot] may play this role.

3.4 Limitations

Note that the model currently focuses mainly on the process of comprehension, as opposed to production, of a sentence. Therefore, it may be pointed out that solely with the proposed model the production process of a sentence cannot be explained in a principled way.

*4 This pattern can be obtained given the properties of typical instances (see Gries 2003 for details).

4 Advantages of EBCG over ABCG

EBCG has at least three advantages over ABCG: 1) it has less theoretical constructs than ABCG; 2) it can easily deal with the polysemy of a construction which enables us to avoid overgeneralization; 3) it enables us to discuss matters on representation and processing at one time, while ABCG does not. In the remaining of this section those advantages are discussed in some details one by one in this order.

4.1 Fewer assumptions

The first advantage relates to a principle in philosophy of science, namely what is called *Occam's razor*, which is the principle of fewest assumptions: other things being equal, hypothesis with fewer assumptions are better. Wherever there is a construction there also is a construction effect. Consequently, a theory without assuming constructions as objects can be said as better.

4.2 Avoidance of overgeneralization

There is a situation in which a single argument structure construction has two or more similar but distinctive senses. This is called *constructional polysemy*, discussed in ABCG (e.g., Goldberg 1995:32–39). For example, Goldberg (1995:75) provides six senses in Ditransitive Construction and explains how they are related:

(7) a. 'X CAUSES Y TO RECEIVE Z' (e.g., Joe gave Sally the ball.)
b. Conditions of satisfaction imply 'X CAUSES Y TO RECEIVE Z' (e.g., Joe promised Bob a car.)
c. 'X ENABLES Y TO RECEIVE Z' (e.g., Joe permitted Chris an apple.)
d. 'X CAUSES Y NOT TO RECEIVE Z' (e.g., Joe refused Bob a cookie.)
e. 'X INTENDS TO CAUSE Y TO RECEIVE Z' (e.g., Joe baked Bob a cake.)
f. 'X ACTS TO CAUSE Y TO RECEIVE Z at some future point in time' (e.g., Joe bequeathed Bob a fortune.)

However, it can be pointed out that the constructional polysemy is caused possibly by a kind of overgeneralization, that is, the assumption of the argument structure construction as an object. In contrast, if the exemplar-based view is taken there is no need to discuss the polysemy, because the argument structure construction is considered as phenomenal and its meaning is assumed to come from associated exemplars.[*5]

4.3 Integration of representational and processing matters

ABCG assumes that a sentence is processed by fusing an argument structure construction with a verb, as explained above. However, it has to be said that under ABCG's assumption the *recognition* of construction can hardly be explained, without appealing some kind of external devices. How can we recognize a given input sentence as an instance of such and such an argument structure construction?

In contrast, EBCG can easily explain how a sentence, especially a novel one, is processed. Rather, it may be better to say that EBCG is a model both of representation and processing in the first place, while ABCG is that only of the former. This obviously is a strongly advantageous point in EBCG.

[*5] As for this topic, see Yoshikawa (2010) for detailed discussions.

5 Concluding remarks

This paper presents a new theory of grammar named Exemplar-based Construction Grammar (EBCG) and displays how advantageous it is compared with the prevailing theories. For now, to be honest, EBCG is only provisional, but it surely has a huge possibility of future breakthrough in the theory of grammar.

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