

INTRODUCING FLUID CONSTRUCTION GRAMMAR

Fluid Construction Grammar (FCG) is a formalism to represent, learn, and apply lexical and grammatical inventories. FCG has been mainly developed to support research on the origins and evolution of language through computational and robotic experiments in which artificial agents evolve a shared communication system along the lines sketched in [11]. However, FCG is useful for studying issues in natural language and language acquisition in general, and cognitive linguistics in particular. There is a fully operational version implemented in Common LISP that is freely offered to the community and downloadable from <http://arti.vub.ac.be/FCG>. Several large-scale experiments have already been carried out using this platform. The paper surveys the objectives of FCG, the main design principles, and their motivation. It does not focus on implementation details but on FCG as a potential tool for linguists and researchers in cognitive science.

The main motivation behind the development of FCG is to have a framework to model the parsing and interpretation as well as the production and conceptualisation of grounded language by artificial agents. Grounded means that the language can be about the real world as experienced by an embodied agent through his sensori-motor apparatus. The framework adopts the viewpoint of procedural semantics, similar to earlier AI work [12] and Montague grammar [8], although the primitive semantic operations are motivated by cognitive realism rather than logical correctness or computational utility. The meaning of an utterance is a (constraint) program that achieves some communicative goal like: identifying an object in the environment or checking whether a description is true for a recent event. Conceptualisation by the speaker thus becomes a planning process that assembles into a constraint program more primitive cognitive operations such as categorial perception, analogical mapping, filtering a set with a prototype, taking the intersection of two sets, etc. Interpretation by the hearer consists of running the constraint program that was parsed from language input in order to achieve the communicative goal. Both conceptualisation and interpretation make use of each agent's situation model that is grounded through perception and action systems in the world. This is therefore how agents can 'step out of the Chinese Room' and become able to dialogue about real world situations.

The constraint program produced by conceptualisation takes the form of a list of predicate-argument clauses where the predicates are constraints (such as 'filter the set of objects in the context with the prototype for [BLOCK]') and the arguments are either objects in the domain of discourse or meta-objects (like prototypes, exemplars, categories, set-theoretic operators, functions), as well as variables ranging over these two types. The constraint program (further called 'the meaning') then needs to be mapped onto an utterance based on the speaker's inventory of lexical and grammatical constructions and the utterance needs to be mapped back onto a constraint program using the hearer's inventory. It follows that parsing means more than deriving the constituent structure or any other kind of syntactic structure. The parser must reconstruct the meaning to be used in interpretation. Also production means more than generating a well-formed utterance that satisfies the syntactic constraints of the language. Production must take the 'raw' meaning and perform the necessary semantic re-categorisation (for example decide whether a particular predicate-argument relation is of type agent) in order to fit

with the semantic case frame implied by a construction.

We follow the basic tenets of construction grammar [5] to achieve this mapping, dubbed 'Vanilla Construction Grammar' by [3]: (1) Lexical and grammatical inventories consist of constructions, that is, pairings of form and meaning. The constructions are not derivational but they express constraints on mapping meaning to form or form to meaning. The same constructions are therefore applicable both for parsing and production. Due to the tight coupling of semantic and syntactic constraints, no step neither in parsing nor in production is possible without considering both aspects. (2) Lexical or grammatical constructions have the same structure so that there is in fact a continuum between the two. Lexical constructions map directly bits of meaning to lexical items and grammatical constructions employ syntactic and semantic categories. Typically, the semantic side of a grammatical construction is similar to a case frame [4] and the syntactic side to a usage pattern, in the sense of [6]. (3) The inventory of constructions is structured. Syntactic and semantic categories form taxonomies and constructions hierarchies with some constructions perhaps only pertaining to a single case and others being much more abstract in the sense of covering a wide range of usage events. There is no sharp distinction between idiomatic and general constructions.

FCG makes as few theoretical assumptions as possible. It is not married to any specific set of syntactic or semantic categories nor does it prescribe any particular type of syntactic analysis, except that it must fit broadly within a constructional framework. FCG also strives for some additional features so that the grammar becomes 'fluid', in other words open-ended and able to cope with change. (1) The formalism is intended to be used in situated dialogues where the linguistic inventory changes with every interaction (as indeed confirmed by investigations of natural dialogue [9]). Consequently every element in the inventory (categories, constructions) must be able to undergo change at any time and it must be possible to add new elements or remove them. (2) The linguistic inventory must also be applicable in a flexible way, in the sense that even if an utterance is ungrammatical, the parser should try to go as far as possible in reconstructing a set of plausible meanings, and if inventory is missing, the production process should nevertheless try to construct a partial utterance that covers as well as possible the meaning. The aim is not grammaticality but communicative success. (3) The formalism must also support the fact that conventionalisation is seldom complete and fixed. There are constructions which are accepted by some part of the population but not yet by others. Lexicalisation and grammaticalisation processes can gradually change the usage of certain words or syntactic structures for expressing (new) meaning.

FCG has been implemented as a unification-based formalism using typed feature structures [7] [2], both for the syntactic and semantic structures being built and for the templates which implement constructions. This approach has also been used for other formalisations of construction grammar [1] and is indeed widely used today in other linguistic approaches, in particular HPSG [10]. More details and their justification will be given in the paper.

References

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