COLING 82, J. Horecký (ed.)
North-Holland Publishing Company

The Anatomy of a Systemic Choice

William C. Mann
USC Information Sciences Institute
4676 Admiralty Way
Marina del Rey, CA 90291
USA

1 Scope and Purpose[1]

Choice is one of the most prominent organizing concepts in systemic linguistics. Languages are described in terms of the choices available to the speaker and the relationships of those choices to each other and to the language produced.

This paper addresses the problems of ***characterizing processes of choosing in a systemic framework and creating a corresponding notation.*** Focus on notation is necessary at this point since development of notation must to some extent precede development of corresponding content. Although these developments are part of an investigation of computer text production, their significance is not confined to that enterprise; they are as significant in linguistics as in computer science.

This paper focuses on the perspective of choice as a speaker's action. We hope that by exploring the nature of systemic choices, several kinds of interests in language will be served:

Interest in Grammar as Language Description

- Describing choices can yield a richer understanding of the alternatives offered, and how one system of choices differs from another.

Interest in Semantic Descriptions

- Choice descriptions can be a direct extension of present systemic frameworks in the direction of more explicit semantics.

Interest in Describing Communication

- Choice descriptions are helpful as parts of descriptions of how particular intentions to communicate can be satisfied. They can be a component in a description of how a speaker can use language in order to do things, to use the functionality of language.

Interest in Constructive Models

- Choice descriptions can be used as parts of constructive models of the expressive communicative process, models which can perform this process instead of describing it. Our current research is aimed at building such a model as a computer program.

Interest in Applications

- Teaching English: choice descriptions can be used to convey the ways that syntactic constructs are used.

- Comprehensible Computation: In making computers communicate effectively with people, choice processes can be part of a process that creates text for computer users.

The paper is intended to convey primarily the skeletal framework for choice description, a set of well-motivated devices for describing choice processes. To be useful it will have to be complemented by a physiology, an account of how choice processes can interact to produce intended effects.

2 Choice and Intent

People build grammars for different purposes, so it is appropriate to apply differing criteria to their products [Halliday 64]. Although we feel that the work in this paper serves a broad range of purposes, we should still identify ours. We would like to create an account of **how one may generate text that is appropriate for satisfying particular intentions to communicate.** In other words, given something particular to say, we would like to be able to bring that intention to an existing description of how to seek to satisfy intentions to communicate, apply the description to the intention, and see at some level of detail that appropriate language is generated.

By introducing a communicative purpose we immediately raise an issue of whether that purpose, or the potential of all purposes, should be regarded as within the grammar or outside of it. To include purposes as formal objects within systemic grammars would be a major extension of scope beyond the dominant tradition. In contrast to Fawcett [Fawcett 80] (pp. 75-78), we treat the development of a particular intention to speak as outside of the grammar. We agree with Fawcett that the intention deserves theoretical treatment in conjunction with its grammatical realization, but we do not propose to derive it systemically.

So the grammar has a definite boundary, with communicative purposes residing outside.

The grammar is composed of ***systems*** (hence the name Systemic) which are collections of alternatives. Each alternative is named; the names are called ***grammatical features***. Each system has an ***entry condition*** (a boolean expression of grammatical features), which specifies when the alternatives are offered. For example the Number system offers the alternatives Singular and Plural. Its entry condition is simply Count, i.e. the alternative Count must have been chosen in some other system before the alternatives of Number are offered. The act of offering the alternatives is called ***entering*** the system.

The grammar also includes the methods of choosing among alternatives, the "choice experts" to be developed below.

3 Things to Know about a Choice

Since the grammar is to generate in conformity to a given intention to communicate, and since the language which is generated depends entirely on the grammar's choices,[2] the central problem is as follows:

> ***How can the choice in each system entered be made to conform to a given intention to communicate?***

It is helpful at this point to introduce the notion of a **choice expert** for a system. Following our intention to view choice as action, we define a choice expert as a process that interacts with the environment and determines what choice in the system conforms to the given intention. Choice experts follow these conventions:

- Each system has a distinct choice expert that operates independently of the other choice experts of the grammar.

- All of the interaction between choice experts is in the connectivity of the grammar, the entry conditions of systems.

- A choice expert does not function until the entry conditions of its system are fully satisfied.

We give each choice expert the potential for two kinds of interaction with the environment: one in which the expert asks questions of the environment, and one in which it receives responses. In its work, there are two things a choice expert can do:

1. It can ask a question of the environment.

2. It can make one of the choices offered by its system.

If it makes a choice, then its work is finished. If it asks a question, then by further convention it waits for the answer from the environment, inspects it, and proceeds in a way that is somehow conditioned by that answer.

The following become the central issues in describing each choice expert:

1. What questions must be asked of the environment in order to choose according to the intent?

2. What must the environment contain in order to answer the questions correctly?

3. How do answers condition asking further questions?

4. How do answers condition making choices?

The sections below deal with three primary aspects of choosing: asking questions of the environment, answering, and choosing. These three are systematically incomplete because they do not deal with the subject matter of the questions. Later sections extend the discussion in order to make the subject matter explicit.

4 Asking, Answering and Choosing

The Nigel grammar which this paper represents contains over 200 systems, each raising relatively specific issues[3]. There are some strong patterns in the sets of questions which Nigel's choice experts address to its environment. Three kinds of questions are particularly influential in determining what is generated:

1. Some questions are used to determine whether information of a certain character is ***available,*** such as the location or duration of an event. These are generally used just before other questions that seek to characterize information.

2. Some questions try to categorize or characterize available information. These questions used for ***information characterization*** are the most numerous. They are used to subcategorize, and also to discover relations of inclusion, identity, precedence, adjacency, and attributes of manner, number, completeness, intended emphasis, identifiability to the reader, decomposability, gender, hypotheticality, extensionality, and many other sorts.

3. Several questions about ***preference*** are concerned with whether available information should be expressed.

Note that for each of these kinds of questions, the set of possible answers is closed, since it is fixed by the inquiry and predictable in advance.

Because in this model there is a definite boundary between the grammar and its environment, and knowledge of the world and the intended communication belong to the environment, we could put a particular grammar in very different environments, and as long as the questions received the same answers, the generated units would be the same. This leads to two basic observations about answering:

1. The method which the environment uses to determine its answer is not part of the grammar. A description of the grammar can therefore omit these methods.

2. The range of possible answers must not vary from one environment to another; rather it must be controlled (definitionally) by the grammar, and so a description of the grammar must include them.

Since the answers given to each choice expert have a predictable range, the response of the choice expert can be completely determined in advance. For each of the possible answers, there is a next action, either a question to ask or a choice to make.

The questions, answers and choices therefore form a Decision Tree.

5 The Incompletness of Asking, Answering And Choosing

The account of choice experts above is defective in that it does not adequately identify the subject matter of the choice expert's questions.[4] The environment is not required to remember anything about the ongoing "conversation" with the grammar, so the grammar must provide all continuity by identifying, remembering and asking about items in its environment.

We call an item in the environment a *hub*, by analogy to the hub of a spoked wheel, partly because in a network representation of knowledge such items tend to have a well-identified central structure with connections to surrounding structures.

The grammar's memory of entities in the environment is creted by

1. Getting the environment to supply symbols to represent its entities.

2. Associating these symbols with grammatical funciton symbols,

3. Writing questions (in choice experts) in terms of these grammatical function symbols,

4. Translating questions (at presentation time) to include hubs instead of the associated grammatical function symbols, using a process called the ***Mediator***.)

The first step, getting the environment to supply symbols, requires that the choice experts employ a second class of questions. They differ from the ones presented above in that the allowable answers are drawn from open sets, and the questions do not correspond to branch points in the decision trees of the choice experts.

The interface between grammar and environment is a two-layer boundary, with the Mediator process between the boundaries performing the inquiry translations. It is a simple substitution process that uses a table of the existing associations between grammatical functions and hubs. The environment's responses are not translated.

The mediator isolates the grammar from the symbol system of the environment. The grammar is written in terms of grammatical functions; no symbols from the environment are written into the grammar. Conversely, the environment does not encounter grammatical function symbols in questions. It sees only the question symbols of questions and hub names it has itself supplied.

The most important consequence of this arrangement is that ***the grammar can operate without any particular sensitivity to how knowledge is represented in the environment.***

6 Creating Function Associations

Associations between grammatical function symbols and hubs provide the continuity in the grammar's interaction with its environment. These associations are an extension of the notion of a function symbol, since we can now ask of a function symbol what concept it represents and also what linguistic realization it has.

This extension seems particularly natural where reference is being performed. Function symbols such as ACTOR and BENEFICIARY are already in the grammar, and in satisfying intentions to communicate, ACTOR will be associated with hubs for actors, BENEFICIARY with hubs for beneficiaries, and so forth.

This use of function symbols is an extension in another way. Some function symbols will be associated with hubs but will not correspond to constituents in the generated structure. In Nigel the function symbols EVENTTIME and RELEVANTTIME are used in the reasoning about tense, but do not have their own distinct constituents in clauses. The function symbols SPEAKER and HEARER are used in reasoning about pronouns, and the symbol SPEECHACT is used in reasoning about mood.

These various uses of function symbols are compatible: the way of identifying the hub to be associated with a function does not depend on whether that function will be inserted into the structure. Several functions are inserted in some instances but not others, and yet they carry the same hub information in each case. (For example, AGENT would carry the same hub symbol for either "Someone closed the door" or "The door was closed," but it would be inserted only in the second case.)

Associations between function symbols and hubs are created by the method used to present an open-set question to the environment. Part of the specification of such a question is the function symbol with which the environment's response will be associated. That symbol must not have an existing association when the question is asked. Associations therefore cannot be changed, once made.

7 Conclusions

We have presented a new way of thinking about choices, representing them, identifying their content, and progressively making the notion of grammatical choice more explicit. The key conceptual elements are the distinctness of the grammar and its environment, the metaphor of a choice expert who asks questions, closed sets of question and answer symbols, open sets of hubs and hub identifiers, association of hubs with grammatical function symbols and choice expert processes as decision trees. This conception is compatible with the systemic framework and contributes to it. At the same time, it simplifies talking about how systemic grammars fit with various concepts of text and communication, and since it helps relate text to intentions to communicate, it contributes directly to the art of computer text generation.

Footnotes

[1]This work would not have been possible without the active participation of Christian Matthiessen and Michael A. K. Halliday [Halliday 76], [Halliday 61], [Matthiessen 81]. It is part of an ongoing research project in computer text generation.

This research was supported by the Air Force Office of Scientific Research contract No. F49620-79-C-0181. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of the Air Force Office of Scientific Research of the U.S. Government.

[2]except for the possibility of underspecification of order, which we will ignore,

[3]See [Mann 82].

[4]It also does not describe the three-way interaction between choice experts, the environment, and the lexicon. The extension of these ideas to the interaction with the lexicon is outside the scope of this paper. However, see [Matthiessen 81] for a description of how the lexicon, grammar, and knowledge representation of the environment might be suitably related.

References

[Fawcett 80] Fawcett, R. P., *Exeter Linguistic Studies.* Volume 3: *Cognitive Linguistics and Social Interaction,* Julius Groos Verlag Heidelberg and Exeter University, 1980.

[Halliday 61] Halliday, M. A. K., "Categories of the theory of grammar," *Word* 17, 1961.

[Halliday 64] Halliday, Michael A. K., "Syntax and the consumer," in C.I.J.M. Stuart (ed.), *Monograph Series in Languages & Linguistics.* Volume 17: *Report of the Fifteenth Annual (First International) Round Table Meeting on Linguistics and Language Study*, pp. 11-24, Georgetown University Press, Washington, D.C., 1964.

[Halliday 76] Halliday, M. A. K., *System and Function in Language,* Oxford University Press, London, 1976.

[Mann 82] Mann, William C., Generating Text: The Grammar's Demands, 1982. Manuscript

[Matthiessen 81] Matthiessen, C. M. I. M., "A grammar and a lexicon for a text-production system," in *The Nineteenth Annual Meeting of the Association for Computational Linguistics*, Sperry Univac, 1981.