Generating Adjectives to Express the Speaker's Argumentative Intent

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Abstract

We address the problem of generating adjectives in a text generation system. We distinguish between usages of adjectives informing the hearer of a property of an object and usages expressing an intention of the speaker, or an argumentative orientation. For such argumentative usages, we claim that a generator cannot simply map from information in the knowledge base to adjectives. Instead, we identify various knowledge sources necessary to decide whether to use an adjective, what adjective should be selected and what syntactic function it should have. We show how these decisions interact with lexical properties of adjectives and the syntax of the clause. We propose a mechanism for adjective selection and illustrate it in the context of the explanation component of the ADVISOR expert system. We describe an implementation of adjective selection using a version of Functional Unification Grammars.

Introduction

Traditionally, an adjective is defined as ''serving as a modifier of a noun to denote a quality of the thing named, to indicate its quantity or extent, or to specify a thing as distinct from something else'' (Webster, 1963). Analysis of human conversations however shows that adjectives often loosely relate to actual properties of the objects being modified but are used to express a speaker's intention or argumentative orientation. The work we present here is developed in the context of the explanation component of the ADVISOR expert system (McKeown *et al*, 1985, McKeown, 1988), a question answering system advising university students which courses to select. In this context, when an academic advisor tells a student that a *course is very hard*, he often does not refer to a property of the course, but rather expresses his evaluation of the course.

This creates problems for text generation. The first problem we face is that the information needed to choose whether to use an adjective playing an argumentative role cannot be found directly in a knowledge-base describing objects of the domain. Instead, the decisions must be based on the speaker's goals, a hearer model and the object being modified. In addition, these decisions interact with the lexical properties of adjectives, the syntax of the clause and other factors like collocations. In this paper we therefore address the following two questions: What should be the input to a generator capable of producing argumentative usages of adjectives? And how should the generator combine the many interacting factors constraining the selection of an adjective?

After reviewing previous work related to these questions, we present the linguistic data upon which we base our approach and the conclusions we draw from its analysis. We then present and justify the input we require to properly select adjectives and discuss how adjective selection is constrained by the lexical properties of adjectives and interacts with other surface decisions. The paper illustrates the key features of our implementation of adjective selection in the context of the ADVISOR explanation component.

Previous Work

In previous work in generation, adjectives have been studied as a tool for producing descriptions of objects. It is important to distinguish usages of descriptive noun-phrases to either refer to objects or to attribute a property to objects (Donnellan, 1966, Kronfeld, 1981, Searle, 1979). In a referential usage, a noun-phrase is used when the speaker wants the hearer to identify some object. In this case, adjectives are used to contrast the target object from other potential referents. The proper adjectives are chosen based on their discriminatory power. For example, in a background containing blocks of different forms and colors, the generator will pick a combination of form and color that can be used to uniquely identify the referent and differentiate it from all other blocks in the background. Different mechanisms for such a selection are presented in (Dale, 1988, pp.249-262) for the EPICURE system, (Appelt, 1985) for the KAMP system and in (Reiter, 1990).

In attributive usages, the goal of the speaker is to inform the hearer of some property of an object. In (McKeown, 1985) and (Appelt, 1985) for example, adjectives are used to perform `inform` speech-acts. In this case, the generator

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simply maps from the information in the knowledge-base describing the object to an adjective denoting the property being attributed. Note that in KAMP (Appelt, 1985), the notion of *action subsumption* was introduced to account for cases where a particular noun-phrase simultaneously served as a referring and attributive expression and the adjective was selected both because of its contrastive value and of its informative value.

Other works have studied usages that are neither attributive nor referential in the sense discussed above. With PAULINE, Hovy (Hovy, 1988) discussed the use of adjectives to satisfy pragmatic constraints. For example, the generator could produce a sentence like *poor John was severely beaten by the police* where *poor* does not denote any information about John but rather expresses the orientation of the speaker. Hovy covered many different linguistic devices satisfying pragmatic constraints and as a result provides only a very superficial treatment of adjective selection (he devotes a single paragraph to its discussion).

In (Bruxelles *et al*, 1989) and (Bruxelles & Raccah, 1991), a model for describing the argumentative potential of lexical items is introduced. This model aims at explaining how adjectives like *courageous* express both a property of the modified object and an argumentative orientation of the speaker (a favorable evaluation of the object), whereas adjectives like *intrepid* or *bold* while conveying roughly the same information also convey a different orientation. The reported work is still at early stages and is oriented towards interpretation. We use here many concepts derived from this work and examine its implications on generation.

In earlier work, we have studied the problem of generating certain connectives like *but*, *although*, *because* or *since* (McKeown & Elhadad, 1991, Elhadad & McKeown, 1990). We identified a set of pragmatic features necessary to distinguish between these connectives, including argumentative features. In this paper, we refine this work and identify features to adequately select a certain class of adjectives.

The Problem: Data and Motivation

Originally, our task was to extend the linguistic coverage of the generator for the explanation component of the ADVISOR expert system to select adjectives based on general principles. ADVISOR is a system that assists university students select courses and plan their semester (McKeown, 1988).

We performed an analysis of a corpus of 40,000 words containing transcripts of recordings of advising sessions with human academic advisors. In this corpus, we identified approximately 700 occurrences of 150 distinct adjectives. We focused our analysis on all occurrences of adjectives modifying a course, in both predicative and attributive positions. We found 69 such occurrences, of 26 distinct adjectives. Figure 1 shows a break down of these occurrences in semantic classes.

Of the 69 occurrences listed in Figure 1, 58 express a property of a course that one cannot reasonably expect to find in the knowledge-base describing courses. For example, it is problematic to describe a course as *good* or *hard* in absolute terms. For most of the occurrences therefore, the technique of mapping from a semantic property in the knowledge-base to an adjective, as used in previous generation systems to produce attributive noun-phrases, would not be applicable. Most of the usages of adjectives in the corpus correspond to an argumentative usage. For

Semantic class	Adjective	Occurrences
Difficulty [24]	advanced	1
	basic	1
	challenging	1
	difficult	4
	easy	5
	hard	11
	high-level	1
Domain [8]	mathematical	2
	programming	4
	theory	1
	computing	1

Semantic class	Adjective	Occurrences
Importance [24]	important	10
	needed	1
	recommended	5
	required	5
	suggested	1
	useful	1
	valuable	1
Evaluative [10]	interesting	4
	perfect	1
	good	5
Misc [3]	traditional	1
	new	1
	interdisciplinary	1

Figure 1: Adjectives modifying courses in corpus

example, the advisor qualifies a course as *hard* when he wants to discourage a student from taking it. The selection of *hard* in this context is related to the underlying goal of the advisor in addition to the objective properties of the course and to the level of the student as evaluated by the advisor (the same course is not hard for all students).

What Information is Needed to Choose an Adjective

We therefore cannot expect the input to the surface generator to simply be *attribute the property P to a course* if we want to be able to generate adjectives in argumentative contexts. We examine in this section what information needs to be provided to a generator to adequately select an adjective in such contexts.

Consider the difference between the adjectives *hard* and *difficult*. In our corpus, *hard* was consistently used in contexts where the advisor was discouraging the student from taking a course, as in the following examples:[2]

> *Data Structure is probably the* ***hardest*** *course and you would want to make sure that you could handle it.*

> *There is no law against taking Data Structures without having ... [pause] but it is a very* ***hard*** *course.*

In contrast, *difficult* was used in more neutral contexts, where the advisor did not commit to a particular evaluation of the course:

> *I really can't tell you how* ***difficult*** *or easy they are.*

> *I think they're both at the same level and I don't think there's much difference in terms of what's easier and more* ***difficult****.*

Hard and *difficult* convey a very similar information on the course. However, *hard* is argumentatively marked, while *difficult* is neutral. If we want our generator to be capable of distinguishing between these two adjectives, we need to provide the argumentative intent of the speaker in the input.

The description of this intent needs to be *scalar* and *relative* to a background. Adjectives in argumentative usages are used in comparative constructs and with intensifiers. These factors point to the *scalar* nature of the argumentative moves realized by adjectives. We therefore use a notion of scale in our representation of the argumentative intent of the speaker (cf (McKeown & Elhadad, 1991, Elhadad & McKeown, 1990) for details on scales).

In addition, many linguists have distinguished between *absolute* and *relative* adjectives (Bartsch, 1989, Huebler, 1983, p.37). The meaning of relative adjectives depends on the object being modified (a *small* elephant is a *big* animal) whereas absolute adjectives keep the same denotation for all objects they modify (a *red* box is as *red* as a *red* book). For relative adjectives, an evaluation norm needs to be identified. This norm can be explicitly stated as in *Data Structures is the hardest* ***of the undergrad courses*** or *this course would be perfect* ***for you.*** But it can also be left implicit as in *this course is fairly advanced* where the evaluation norm determining what is *advanced* depends on the model the speaker has of the student. In the ADVISOR domain, we have found that relative adjectives depend not only on the object being modified (a *good* course is not good in the same sense as a *good* meal) but also depend on a model of the hearer: a *challenging* course for an undergrad could be easy for a graduate student, a programming project could be very difficult for a student lacking programming experience.

A Formal Representation for Argumentative Intent

We need a way to represent the argumentative orientation of a speaker in a way that captures both its scalar nature and its relativity. We now present a representation using the FUG notation that satisfies these requirements

Notation: The notation used is that of *functional descriptions* (FDs) used in Functional Unification Grammars (FUGs) (Kay, 1979, Elhadad, 1990a). Figures 2 and 3 illustrate the notation. Each attribute in a complex FD can be described by an embedded FD. In the pair (`focus {ao scope attribute}`), the `{}` notation indicates that `focus` is a pointer to the value of the `attribute` of the `scope` of the `ao` in the FD. When such a pointer is used, the two attributes actually share a unique value. The `cat` attribute identifies the type of the denoted objects. Note that FUF, the version of FUG we have developed is *typed* (Elhadad, 1990b) and values like `course` and `student` are actually part of a type lattice. For example, `undergrad-student` is a specialization of the type `student`.

Input specifying the argumentation for
AI is hard (for a course)

```
(...
 ;; Arg orientation of the utterance
 (ao
  ((scope
     ((process-type attributive)
      (carrier ((cat course)
                (name AI)))
      (attribute nil)))
    (focus {ao scope attribute})
    (scale difficulty)
    (orientation +)
    (reference-variable
      ((constraint {ao scope carrier})
       (range ((cat course)))))))
```

Figure 2: Input with argumentative specifications

[2] All examples in the paper are taken from our corpus unless otherwise mentioned.

An argumentative orientation (AO) is a representation *in intension* of a partially ordered set of propositions. We use 6 features to represent an AO. Intuitively, the AO specifies that a certain proposition is a stronger argument for a certain class of conclusions than all the propositions defined in this set. A logical notation for the set denoted by Figure 2 is:

$$AO=\{\text{attributive}(C,A) | A \in \mathit{Scale\text{–}difficulty} \wedge C \in \mathit{Courses}\}$$

where *Scale–difficulty* denotes the set of all degrees on the scale of difficulty and *Courses* denotes the set of all courses. In our notation, the pattern common to all elements of the set AO is represented by the `scope` feature. The elements of the set AO are ordered by first projecting each proposition on the role pointed to by the `focus` feature. Intuitively, the notion of focus is best illustrated by comparing the sentences: *even John came* and *John even came*. In the first one, *John* is the focus of the argument, whereas in the second one *came* is the focus. The projections are degrees of the set denoted by the `scale` feature and the `orientation` feature indicates what ordering relation is used to compare them. This technique of comparing complex propositions is similar to the techniques used in (Cresswell, 1976) and (Kay, 1987).

The role of the last two features `reference-variable` and `reference-set` is to constrain the range of the variable C in a way similar to how the focus variable A is constrained by the quantification over the scale. For example, Figure 3 can be represented by the following logical formula:

$$AO=\{\text{attributive}(C,A) | A \in \mathit{Scale\text{–}difficulty} \wedge C \in \mathit{Ref}\}$$
$$\mathit{Ref}=\{X | \exists S, \text{undergrad-student}(S) \wedge \text{take}(S,X)\}$$

Intuitively, we limit the values of the `carrier` of the `scope` to be within the range of courses that `undergrad-students` can take. The AO specification can therefore be read as *AI is hard compared to the courses that undergrad students take*. The input specification in Figure 3 can be derived from the simpler one in Figure 2 by the addition of information from a user model.

This formalism is general enough to capture the relativity of argumentation both in terms of the object being modified and in terms of information found in a user-model. We refer the reader to (Elhadad, 1990c) for a discussion of the semantics of scales and how they capture the scalar nature of argumentation.

Input for `AI is hard for an undergrad`

```
(...
 (ao
  ((scope
     ((process-type attributive)
      (carrier ((cat course)
                (name AI)))
      (attribute nil)))
   (focus {ao scope attribute})
   (scale difficulty)
   (orientation +)
   (reference-variable
     ((constraint {ao scope carrier})
      (range {ao reference-set medium})))
   (reference-set
     ((process-type action)
      (process take)
      (agent ((cat undergrad-student)))
      (medium ((cat course))))))))
```

Figure 3: AO relative to the user-model

Lexical Representation of Adjectives

In the previous section, we have identified the information needed in the input in order to select an adjective and we have presented a representation for this information. We now turn to the information that needs to be present in the lexicon to describe adjectives. Linguistic studies have identified many different classes of adjectives, based on their semantic or syntactic behavior. We focus on lexical properties that constrain how adjectives can be used to convey an argumentative meaning and show the type of lexical representation we use for adjectives.

In general adjectives can occur in either attributive or predicative position (Quirk *et al*, 1972, p.231). Certain adjectives however can only be used in predicative position (*e.g.*, *mere*), only in attributive position or can have a different meaning if used in predicative or attributive position.[3] Such properties need to be encoded in the lexicon.

In (Bolinger, 1972, p.21), Bolinger distinguishes between *degree* and *non-degree* adjectives. In our domain, *required* is an example of non-degree adjective (there is an official legal definition of what a required course is for the major), whereas *important*, *hard* or *interesting* are all degree adjectives. Non-degree adjectives cannot be used with intensifiers like *very* and cannot be used in comparative forms. This lexical classification limits the range of adjectives capable of being used for argumentative purposes.

Using different terms, linguists in (Givon, 1970), (Rusiecki, 1985, p.13 *ff*) and (Huebler, 1983, p.38) have distinguished between *marked* and *neutral* adjectives. In our domain, this distinction is illustrated by the difference between *hard* and *difficult*. Note however that while *difficult* tends to be used as a neutral adjective, it can be marked if it is intensified (like in *it is a very difficult class*). This lexical property distinguishes among adjectives conveying the same information those that can be used to convey an argumentative meaning.

Certain adjectives can be presented as *absolute* in surface. For example, *interesting* was consistently used in our corpus without any qualification or complement:

What is that course? It looked very interesting

[3]For example *old* in *an old friend* is the opposite of *new*, whereas in *My friend is old* it is the opposite of *young*.

It would be an interesting course. I mean, I think Mathematical Logic is pretty [pause] interesting.

In contrast, *good* was always used with a complement explicitly relativizing its meaning:

So that might be a good class for you to take next semester if you take AI this semester.

If you're good at math - that might be a good course to take.

Note that this distinction is only at the surface: there is good reason to consider *interesting* as a relative adjective in the semantic sense introduced above and many semantically relative adjectives do not require or prohibit an explicit complement at the surface. This property of *good* and *interesting* is therefore unpredictable from their semantics. But it constrains the way these adjectives can be used.

At the semantic level, the lexicon specifies the mapping from semantic scales to the adjectives that can express them. In addition, it specifies what objects can be modified by what scales.

Similar to these selection restrictions but at the lexical level, lexical affinities or collocations (Smadja, 1991) can constrain what words can be used along with adjectives. For example, a course can be *strongly recommended* or *very important* (Bolinger, 1972, pp21-57). The choice of the intensifier is constrained by the adjective. Such lexical affinities need to be captured in the lexicon for the adjectives to be properly used.

Figure 4 shows an example of lexical entry for the adjective *hard*. We do not discuss here how all lexical entries are organized and indexed into a large lexicon. For the semantic section of this entry, the `object` feature contains the semantic class of the object being modified. The `alt` construct (the disjunction operator in FUG) lists the semantic classes compatible with the adjective. For each type of object, the argumentative scale triggered by *hard* is different. For *hard*, the Webster dictionary lists 13 different meanings corresponding roughly to different scales. This semantic description needs to be adapted to different domains.

```
((cat adjective)
 (lex "hard")
 ;; Compatible semantic classes
 ;; that can be modified
 (object ((alt (((cat course))
                ((cat material))
                ((cat liquor))
                ...))))

 ;; Depending on semantic class of
 ;; object, semantic scale triggered
 ;; by the adjective
 (alt (
   ((object ((cat course)))
    (ao ((scale difficulty)
         (orientation +))))
   ((object ((cat material)))
    (ao ((scale pressure-resilience)
         (orientation +))))
   ...))

  ;; No collocation constraints
  ;; on intensifier: use default
  (intensifier nil)

  (degree yes)
  (marked yes)
  (relative yes)
  (require-complement no)

  ;; can be used both in predicative
  ;; and attributive position
  (predicative yes)
  (attributive yes))
```

Figure 4: Fragment of the lexicon

Interaction with other Surface Decisions

The selection of adjectives is only one of many choices made when generating a clause. We discuss in this section some syntactic factors that determine whether to use an adjective at all to satisfy an argumentative intent and constrain what adjective can be used when necessary.

Consider the following examples:

I struggled with AI. (I took AI + I found AI hard.)

I enjoyed AI. (I took AI + I found AI interesting.)

In these two sentences, the verb lexically carries an argumentative evaluation of its object. In these cases, there is no need to use an adjective, a semantically rich verb can express both the information that the course was taken and the speaker's evaluation of the course.

In contrast, consider the following example where the advisor is asked what course follows *Introduction* in the curriculum:

Data structures follows Intro, and it is a very difficult course.

Since there is no verb that can express both the notion of succession and the evaluation of the course, the generator must resort to using an adjective in this case.

These examples illustrate how the argumentative orientation constraint specified in the input can be realized at different levels in the syntactic structure of the clause. This explains why we represent the `AO` feature in the input as a top level feature and not embedded under the description of the object it modifies. The non-locality of the argumentative constraint presents interesting challenges to a text generator in terms of control. We explain in (Elhadad & Robin, 1991) how FUF has been extended to handle this type of choice.

The decision of using an adjective also interacts with the choice of the head of the noun phrase being modified. For example, proper nouns cannot be pre-modified by adjectives, and require the grammar to choose either a relative clause, an apposition or a predicative construct. The decision to use the adjective in predicative or attributive position also depends on the lexical properties of the adjective.

Finally, the decision to explicitly express the relativity of the adjectival modification (does the generator produce *AI is hard* or *AI is hard for an undergrad course*) depends on what information is encoded in the `reference variable` and `reference-set` features and the lexical properties of the adjective (whether it requires a complement and what forms of complements it can support).

The Grammar: Combining all the Constraints

The grammar we use encodes both the lexicon and the syntactic resources. Its function is to combine all the constraints specified in the input, the lexicon and the syntax into a single consistent clause.

The mechanism of constraint combination is handled by unification. Because the grammar must express many different constraints, coming from many different sources (lexical properties of the verb, of the adjective, of the modified noun, position of the adjective, use of a connective etc) we found the FUG formalism particularly well adapted to the problem. It is indeed possible to express each source of constraints independently and the constraint satisfaction mechanism of FUG takes care of the interactions that can exist between them (cf (McKeown & Elhadad, 1991) for a discussion and a comparison of FUG with other formalisms).

We have used the grammar that we developed earlier for the COMET system (McKeown et al, 1990) and extended it to include treatment of adjectives. The flow of control used to traverse the grammar is described in details in (Elhadad & Robin, 1991). The main challenge we met when developing the grammar was the non-structural nature of the argumentative constraint in the input, and it required the development of new control tools implemented in our implementation FUG, FUF (Elhadad, 1990a).

Conclusion and Future Work

We have shown that adjectives are often used to convey the argumentative intent of the speaker in addition to conveying information about objects. We have proposed a formal representation of the argumentative orientation of an utterance, that can serve as an input to a surface generator to decide whether to use an adjective and what adjective to select. We have listed what lexical information is required to describe adjectives for the generator and some aspects of the clause generation that interact with the decision to use an adjective serving an argumentative function. The lexical properties of adjectives, when not readily accessible in dictionaries, can be found by analyzing corpora of existing conversations. We have analyzed such a corpus of 40,000 words, and derived a characterization of 26 distinct adjectives in our domain. In order to extend the coverage of our system, we plan on analyzing larger corpora.

The model we have presented is partially implemented in the explanation component of the ADVISOR expert system, using FUF, our implementation of FUGs. We are currently pursuing this implementation in several directions. A deep generator is being developed to produce the inputs we have described, taking a user model into account. We are investigating circumstances under which intensifiers are used and what pragmatic effects are produced when a complement is added to an adjective (a construct like *hard for an undergrad* presupposes something about undergrads).

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References

Appelt, D.E. (1985). *Planning English Sentences*. Studies in Natural Language Processing. Cambridge, England: Cambridge University Press.

Bartsch, R. (1989). *Semantics and Contextual Expression*. Dordrecht, Holland; Providence, RI: Foris Publications.

Bolinger, D. (1972). *Degree Words*. The Hague: Mouton.

Bruxelles, S. and Raccah P.Y. (1991). Argumentation et Semantique: le parti-pris du lexique. In *Actes du Colloque 'Enonciation et parti-pris'*. Forthcoming.

Bruxelles, S., Carcagno, D. and Fournier, C. (1989). Vers une construction automatique des topoi a partir du lexique. *CC AI - Journal for the integrated study of Artificial Intelligence cognitive science and applied epistemology*, *6*(4), 309-328.

Cresswell, M.J. (1976). The semantics of degree. In Partee, B.H. (Ed.), *Montague Grammar*. New York: Academic Press.

Dale, R. (1988). *Generating referring expressions in a domain of objects and processes*. Doctoral dissertation, University of Edinburgh.

Donnellan, K.S. (1966). Reference and Definite Description. *Philosophical Review*, *75*, 281-304.

Elhadad, M. (June 1990). *The FUF Functional Unifier: User's manual (Version 3.0)* (Tech. Rep. CUCS-012-91)). Columbia University.

Elhadad, M. (1990). Types in Functional Unification

Grammars. *Proceedings of 28th Meeting of the ACL (ACL'90)*. Pittsburgh.

Elhadad, M. (1990). *Constraint-based Text Generation: Using local Constraints and Argumentation to Generate a Turn in Conversation* (Tech. Rep. CUCS-003-90)). Columbia University.

Elhadad, M. and K.R. McKeown. (1990). Generating Connectives. *Proceedings of COLING'90 (Volume 3)*. Helsinki, Finland.

Elhadad, M. and Robin, J. (1991). *Control in Functional Unification Grammars for Text Generation* (Tech. Rep. CUCS-020-91)). Columbia University, Dept of Computer Science.

Givon, T. (1970). Notes on the semantic structure of English adjectives. *Language*, *46*(4), 816-837.

Hovy, E.H. (1988). *Generating natural language under pragmatic constraints*. Hillsdale, N.J.: L. Erlbaum Associates. Based on the author's thesis (doctoral--Yale University, 1987).

Huebler, A. (1983). *Pragmatics and Beyond*. Vol. IV:6: *Understatements and Hedges in English*. Amsterdam: John Benjamins Publishing Company.

Kay, M. (1979). Functional Grammar. *Proceedings of the 5th meeting of the Berkeley Linguistics Society*. Berkeley Linguistics Society.

Kay, Paul. (July 1987). *Even* (Tech. Rep.)). University of California, Berkeley. To appear in Linguistics and Philosophy.

Kronfeld, A. (1981). *The Referential-Attributive distinction and the Conceptual-Descriptive Theory of Reference*. Doctoral dissertation, University of California, Berkeley.

McKeown, K.R. (1985). *Text Generation: Using Discourse Strategies and Focus Constraints to Generate Natural Language Text*. Studies in Natural Language Processing. Cambridge, England: Cambridge University Press.

McKeown, K.R. (1988). Generating Goal Oriented Explanations. *International Journal of Expert Systems*, *1*(4), 377-395.

McKeown, K. and M. Elhadad. (1991). A Contrastive Evaluation of Functional Unification Grammar for Surface Language Generators: A Case Study in Choice of Connectives. In C. Paris et al (Eds.), *Natural Language Generation in AI and Computational Linguistics*. Kluwer Academic Publishers.

McKeown, K.R., Wish, M., and Matthews, K. (1985). Tailoring Explanations for the User. *Proceedings of the IJCAI*. IJCAI.

McKeown, K., Elhadad, M., Fukumoto, Y., Lim, J., Lombardi, C., Robin, J. and Smadja, F. (1990). Language Generation in COMET. In Mellish, C. and Dale, R. and Zock, M. (Ed.), *Current Research in Language Generation*. London, UK: Academic Press.

Quirk, R. *et al*. (1972). *A Grammar of Contemporary English*. Longman.

Reiter, E. (June 1990). The Computational complexity of Avoiding Conversational Implicatures. *Proceedings of the 28th meeting of the Association for Computational Linguistics (ACL'90)*. University of Pittsburgh, Pittsburgh, PA: ACL.

Rusiecki, J. (1985). *Adjectives and Comparison in English: a semantic study*. England: Longman. (Longman Linguistics Library).

Searle, J. (1979). Referential and Attributive. In *Expression and Meaning: Studies in the Theory of Speech-Acts*. Cambridge: Cambridge University Press.

Smadja, F. (February 1991). *Retrieving Collocational Knowledge from Textual Corpora. An Application: Language Generation.*. Doctoral dissertation, Computer Science Department, Columbia University.

Merriam Webster. (1963). *Webster's Seventh New Collegiate Dictionary* (1963 ed.). Springfield, MA: Merriam Webster.