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Extraction of Pragmatic Information in a CALL System

NLP-m Project Report
1993\textsuperscript{12}\textsuperscript{20}

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1 Introduction

1.1 The Problem

Diagnosing pragmatic ill-formedness in a computer-assisted instruction system is not a straightforward task. Since pragmatic information can be expressed at different linguistic levels, such as in the lexicon or in syntactic structure, a simple matching of parsed output does not lead to a good error-detecting strategy. For example, uncertainty of the speaker can be expressed with a sentential adverb such as maybe or perhaps, or a modal auxiliary such as may or might, by embedding the proposition inside / think that... or / assume that..., or by attaching a tag question at the end of the proposition. A system which relies only on the f-structure, which is the output from the syntactic parser, would have no way of knowing that those structures actually convey very similar information, and that sentences with different syntactic structures conveyed the same prepositional and pragmatic content.

If pragmatic information can be extracted from the output of a syntactic parser, and if it can represented in a systematic way, a computer assisted instruction system benefits in two ways. One is that the system will be able to give students flexibility to express propositions in different ways, since the system can recognize the similar pragmatic information expressed in different structures and accept them. The second advantage is that the system will be able to detect errors and give finer feedback on pragmatic usage of the language based on the information systematically represented and stored.

1.2 A Solution: P-STRUCTURE

As a solution to the problem described above, constructing a p-structure, which represents pragmatic content as feature-value sets scoping over the prepositional content of a sentence, is proposed. This requires a mapping program which converts f-structures into p-structures.

The motivation for constructing this program is based on the hypothesis that syntactic structures are able to convey meanings outside the basic semantic predicate-argument structures [Fillmore et al., 1988] [Levin and Nirenburg, 1992]. The program thus needs to be able to recognize and extract pragmatic information which is embedded not only at the lexical level but also at the constructional level in f-structure. This p-structure mapping program enables us to obtain a detailed pragmatic representation, and to compare propositional content of more than one sentence independently from its syntactic structures or pragmatic content.

In this project such a mapping program was implemented and integrated with the existing Japanese tutorial system ALICE-chan. In the ALICE-chan system, a teacher is able to construct an exercise by simply typing in a correct sentence and defining a blank around it. The system automatically sends the sentence to the natural language processing component for analysis. The students' input sentence is also analyzed in exactly the same way as the teacher's input. The result is then sent to the matching program, which compares the teacher's and the student's predicate-argument structures and returns appropriate feedback.
The new p-structure mapping program involves the neutralization of syntactic structures. This raise the question of when and which syntactic information to throw away in processing of the input. For example, different constructions which express the same pragmatic content contain different subcategorization frames that are crucial for building a predicate-argument structure. Such construction-specific information should be retained until a predicate-argument structure is built, but then be dropped in the syntactically neutralized p-structure. For this reason, the new p-structure mapping program is placed between the grammatical-function assignment program and the matcher. The integration of the mapping program into system thus involves the modification of the matcher as well as the design of appropriate feedback for the pragmatic usages of the language. This project focuses on two phenomena in Japanese: constructions to express evidentiality (or speaker's uncertainty), and expressions of request.
2  The Original ALICE-chan System

2.1  Overview

ALICE-chan is a computer assisted language learning environment for Japanese language instruction, developed in the Laboratory for Computational Linguistics and at the Center for Machine Translation at Carnegie Mellon University. The system uses natural language processing (NLP) methods both for authoring exercises and for evaluating students’ responses.

The analysis of the author’s model answer is stored as part of the exercise and is later compared to the analysis of the student’s answer during error detection, where mismatches are pointed out to the student. The system can thus assist the author in getting better result with less work, since the author does not have to specify possible wrong answers and feedback for each exercise. Furthermore, by optionally allowing the author to edit the analysis to increase or restrict the range of student answers that should be accepted, the system gives the author some control over the NLP-based error detection mechanism without having to understand the internals of the NLP components.

Unlike in some other CALL systems which only rely on string matching for error detection [REFERENCE??], in the ALICE-chan system the NLP-based analysis makes it possible to recognize a wide range of responses as right or wrong without requiring an exhaustive list. (This includes sentences that differ in word order.) Using the rich information from the analysis, the system can not only find the location of errors but also explain the error in terms of linguistic relations.

2.2  Lexical and Morphological Analyzer

The NLP lexicon contains information for the system to recognize words in all of their morphological variants and to identify syntactic and semantic features of the word. Each lexical entry consists of two main parts:

- A list of three different orthographic representations of the word.
- A list of syntactic and semantic features and possible continuation of the morpheme.

The morphological processor takes the form of a finite state machine whose transitions are morphemes. The processor finds a sequence of morphemes that can travel from an initial state (possible beginning of a word) to a final state (possible ending of a word), while accumulating feature-value pairs from each morpheme entry. The output of the morphological analysis is a feature structure which identifies the morphemes that comprise the input word and their inflectional and semantic features.

2.3  Syntactic Analyzer

The ALICE-chan system uses the same syntactic analyzer during both exercise authoring and student exercises. In exercise authoring, the correct answers from the author are analyzed so that
3 Background

3.1 Linguistic Analysis of Pragmatic Information Encoding

3.1.1 Speech Act Theory and Linguistic Politeness

The concept of speech act was introduced by [Austin, 1962] to be actions that are performed by saying certain utterances in the right context. Austin also proposed the concept of felicity conditions, which need to be satisfied in order for an utterance to function as a particular speech act. While Austin's speech act was limited to explicit performatives, [Searle, 1975] extends the idea and develops the theory of indirect speech acts, which can be expressed in various linguistic structures. Searle classifies speech acts into five general categories (listed below) and defines the felicity conditions for each act:

1. **Representatives.** Statements about the world that can be judged as true or false, such as assertions and conclusions.
2. **Directives.** Attempts of the speaker to change the hearer's intentions or behavior, such as request, beg, suggest, and command.
3. **Commissives.** Commitments of the speaker to some intention or behavior, such as promise and threat.
4. **Expressives.** Expressions of the speaker's psychological state, such as apologize and thank.
5. **Declaratives.** Executions of some act by the use of language, such as quit, fire, marry, and resign.

Grice's theory of communication [Grice, 1971, Grice, 1975] has been basis for many studies of indirect speech acts and linguistic politeness. Grice argues that only when the speaker's intention to communicate is recognized by the addressee, that the communication is considered to be achieved. He proposes maxims to calculate the intended meaning of an utterance from the expressed proposition based on the cooperative principle observed among interlocutors.

Brown and Levinson develop a theory of politeness [Brown and Levinson, 1978] and [Brown and Levinson, 1987] in order to provide an explanation for discrepancies between Grice's maxims and observed conversations. They postulate the idea of "face", which has two aspects, "negative face" and "positive face". Negative face is defined as "the want of every 'competent adult member' that his action be unimpeded by others", and positive face is defined as "the want of every member that his wants be desirable to at least some others" [Brown and Levinson, 1978] p. 68. Based on this concept of 'face,' five major politeness strategies are formulated and claimed to be universals:

1. Without redressive action, boldly.
2. Positive politeness.
3. Negative politeness.

4. Off record.

5. Avoid the Face Threatening Act.

While Brown and Levinson's work and Grice's are based solely on the propositional content of an utterance, [Matsumoto, 1989] and [Ide, 1989] observe another type of politeness which is encoded in linguistic structures but falls outside of propositional content. Ide calls it the *discernment* aspect which is

... oriented mainly toward the wants to acknowledge thb ascribed positions or roles of the participants as well as to accommodate to the prescribed norms of the formality of particular settings. [Matsumoto, 1989], p. 231.

While some languages allow the expression of discernment to be optionally encoded in a neutral utterance, a language like Japanese does not have a neutral form and thus requires the encoding of discernment information in every utterance. Matsumoto points out that a speaker of Japanese has to be constantly choosing the appropriate speech level according to the formality of the setting and the relationship among the interlocutors. The speaker's use of an unexpected encoding may trigger what Matsumoto calls "interactional implicatures" which then invoke inferences even when other aspects of the utterance such as relevance and quality of information are perfectly appropriate.

These studies suggest that the representation of linguistic politeness will require at least two separate scales: discernment and volition (employment of verbal strategies, etc.) Both aspects are points on a continuum, and a single utterance thus usually contains the both aspects interacting each other in expressing politeness. [Matsumoto, 1989] p. 218 presents an interesting example of the interaction of the two aspects in the following two utterances:

(a) kore-o morattemo ii? (Matsumoto's (11))
   this-ACC receive even though O.K.
   'Is it O.K. to have(get) this from you?'

(b) kore-o kudasai. (Matsumoto's (12))
   this-ACC give-me-Imperative-polite
   'Please give this to me.'

Although (a) is less imposing (less "face-threatening" in Brown and Levinson's term) than (b), (a) is generally perceived less polite because of its informal speech level, unless uttered to a close friend of the speaker's.

The interaction of the two aspects becomes more distinct when we take a close look at a large number of expressions with the same propositional content. The following are lists of expressions collected in the quantitative study conducted by [Hill et al., 1986]. 30 Japanese and 30 American
students were asked to list all expressions they use in borrowing a pen in their native language. The students were then asked to rate the politeness of each expression on a 5-point scale.

**Ranking of politeness of request forms in Japanese:**

(4-5) okarisitemo yorosiidesyoo ka
kasiteitatadakitaindesu keredo
kasiteitatadakemasuka
okaridekimasuka
kasiteitatadakemasenka
kasitekusumasenka

(3-4) kasitekuremasenka
iidesuka
kasitekusasai

(2-3) kasitehosiindakedo
kariteii
kasitekureru

(1-2) tukatteii
kasiteyo
kariruyo
ii
kasite
pen
aru

**Ranking of politeness of request forms in American English:**

(4-5) May I borrow
Would you mind if I borrowed
Would it be all right if I borrowed
I was wondering if I could borrow

(3-4) Do you think I might borrow
Do you mind if I borrow
I wonder if I could borrow
Is it all right if I borrow
Do you have a pen I can use
Can I bother you for a pen
Would you lend me
Could I borrow
Could you lend me
Can you lend me
Although some expressions in these lists require large amount of inference in order to function as a request and thus are out of scope of this project, the lists and ranking provide us some insight about the encoding of linguistic politeness in requests. It is striking that all the Japanese expressions over scale 3 contain predicate with the formal ending, whereas the ones under 3 do not. In addition, we can recognize that the distinction between honorific and non-honorific verbs is also contributing the difference in the degree of politeness. For example, \textit{kasite itadakemasen ka} is ranked higher than \textit{kasite moraemasen ka}, and \textit{kasite kudasaimasen ka} is ranked higher than \textit{kasite kuremasen ka}, where the only difference between the pairs is in the auxiliary verbs (\textit{itadaku} versus \textit{mora}, \textit{kudasaru} versus \textit{kure}). It implies that the discernment aspect has a consistent effect on the perceived degree of politeness.

The authors of this quantitative study claim that the imposition factor is kept constant since the study deals only with the requests in borrowing a pen. I believe, however, that the rankings are clearly affected by the degree of imposition expressed in each utterance. The uses of negative forms, interrogative forms, the past-tense form of auxiliary verbs (\textit{could} or \textit{would}), and hedging (\textit{Do you think... or would you mind if...} in English,... \textit{temo iidesuka} or... \textit{kedo} in Japanese) can all be considered verbal strategies to reduce the degree of imposition, and they do contribute to the higher degree of perceived politeness in the ranking. It is thus very important to decompose the different aspects of politeness expressed through various linguistic forms and represent them in a systematic way, in order to capture pragmatic information accurately.

The study by Hill et al. also found that Japanese forms are distributed more evenly and within a longer span of the scale than American English forms. Furthermore, the study also investigated the relative frequency with which specific request forms are used toward specific categories of addressees in typical situations. It found that the Japanese subjects show a stronger correlation between particular person/situation features and the form of a request than American subjects. The result of this study implies that different languages assign different weight to the various factors subsumed under the discernment aspect and the volition aspect, although they follow the same overall model of polite use of language.

### 3.1.2 Expression of Evidentially in Japanese

Evidentiality is another kind of pragmatic information which is not fully grammaticized but encoded by various word of morpheme classes in the Japanese language. [Kamio, 1975] analyzes
Japanese evidentials in terms of "territory of information". He claims that certain sentence-final forms (the bare verbal form, sentence-particle yo and the extended predicate) can be used only when the given proposition is held exclusively by the speaker, that is when the information belongs to the speaker's 'territory of information.' Following is some examples of such forms.

(a) Taroo wa byooki da. (Kamio's (2))
(Taroo is ill.)

(b) Usuzan ga mata hunkasita-yo. (Kamio's (4))
(Mt. Usu erupted once again.)

(c) Soori-wa moosugu intaisuru-n-da. (Kamio's (5))
(It is that the Prime Minister will soon retire.)

On the other hand, when the information does not belong to the speaker's territory of information, sentences such as (a), (b) and (c) are not appropriate. Instead, different forms such as (d), (e) and (f) are generally used:

(d) Taroo wa byooki da tte. (Kamio's (3))
(It's said Taro is ill.)

(e) Usuzan-ga mata hunkasita yoo da-na. (Kamio's (8))
(It appears that Mt. Usu erupted once again, doesn't it?)

(f) Usuzan-ga mata hunkasita soo da-ne. (Kamio's (8))
(It is said that Mt. Usu erupted once again, isn't it?)

While Taro's father is likely to use (a) to utter to one of his son's friend, if the friend in turn wants to convey the same information, (d) is more natural.

Although Kamio's idea of "territory of information" playing an important role in Japanese evidentials is very insightful, to categorize the evidentials into only two (inside and outside of the speaker's territory) seems too simple-minded. For example, sentence (d) can take sentential particles such as 'ne' and 'yo' to express different connotations:

(d') Taroo wa byooki da tte ne.

(d'') Taroo wa byooki da tte yo.

Since the sentences above still contain the hearsay marker tte, the information does not belong to the speaker's territory according to Aoki's analysis. However, (d'') is used only when the speaker believes the addressee has not heard the news yet, whereas (d') is used when the speaker assumes that the addressee has already heard the news. Therefore, there are at least two separate aspects in evidentiality expressed in Japanese. One is the speaker's belief or assumption about the addressee's
knowledge on the particular piece of information. The other is the source of information, i.e. how
the speaker has obtained it.

**The speaker's belief about the addressee's knowledge.** When the speaker believes the
addressee does not know the proposition, s/he uses the forms such as (a), (b) and (c) above (the
bare-verbal form, sentential particle *yo' and the extended predicate). On the other hand, if the
speaker believes the addressee has also had an access to the information, s/he uses sentential particle
*ne' or the tentative form of the predicate with rising intonation. In fact, as Kamio points out, a
statement about the weather can be extremely strange without such a marker since both of the
interlocuters have an access to the information:

(g) Ii tenki desu-ne. (Kamio's (29))
(It's very fine, isn't it?)

(g') *Ii tenki desu_. (Kamio's (30)).

**The source of information.** The direct form (the bare predicate) is used when the speaker has
a direct access to the information. The speaker's perceptual content or the speaker's interpretation
based on his/her perception is a typical instance of such kind of information. Especially in the
Japanese language the speaker's own perception and a third person's are clearly distinguished
because one is not considered able to access any perception or inner feelings of anyone else other
than his/her own. Therefore an expression of perception or feelings with the bare form such as
(h) below is always considered the speaker's own, whereas some evidential marker is required to
express someone else's perception or feelings as in (i) and (j):

(h) Sabisii.
lonely
(I'm lonely.)

(h') *Kare wa sabisii.
he T.M. lonely
(He is lonely.)

(i) Kare wa sabisii no da.
he T.M. lonely COP
(He is lonely.)

(j) Kare wa sabisi -gatteiru.
he T.M. lonely
(He is showing signs of being lonely.)

The extended predicate used in (i) turns the proposition into a statement of fact, whereas -gatteiru
in (j) is a verb meaning 'showing signs of...' implying the speaker's inference based on his/her
perception of the signs.

When the speaker expresses the information which has been obtained by hearing from someone, one of the hearsay markers which may be translated as they say, I hear or it is said. The typical hearsay markers in Japanese are soo plus a copula and the more colloquial –tte as in examples (d) and (f). In this way, the speaker is able to express that the source of the information is someone else but without having to specify the source.

There are also other evidentials to imply an indirect source of information. The detailed analysis of such markers is presented by [Aoki, 1986]. The evidentials such as the one used in (e) are inferential forms translated as seem, look like, and appear. According to Aoki, –yoo da is used “when the speaker has some visible, tangible, or audible evidence collected through his own senses to make an inference” [Aoki, 1986] p. 231. He gives the following example to illustrate this point:

(k) Soreni omae no yoosu o mi -reba doomo sima
    further you P.M. behavior O.M. see -when at all island
    e iku no o kunisi -te-i -nai -yoo da.
    to go NOM. O.M. be troubled -PROG -NEG
    (Besides, as I watch you I get the feeling that you are
    not at all bothered by the prospect of exile.)

(Aoki’s (41))

The second inferential marker –rasi –i is used “when the evidence is circumstantial or gathered through sources other than one’s own senses” [Aoki, 1986] p. 231. This observation is based on the fact that one can utter (1), a sentence with rasi, not when looking at the clear sky, but when unable to see the sky and merely making a guess based on the factors such as the brightness of the room.

(1) Hare te-i-ru rasi -i. (Aoki’s (42))
    clear result
    (It seems to be clear.)

Aoki also points out that soo da as an inference marker (attached to the pre-masu form rather than the plain form of a verb) expresses the speaker’s belief of the proposition being true. Therefore (m) is ungrammatical.

(m) *Ame ga huri soo da ga hur -ru to wa omowa -na -i.
    rain S.M. fall but fall -NP Q.M. T.M. think -NEG -NP
    (It seems that it is going to rain but I don’t think it will.)
    (Aoki’s (48))

Other evidentials in Japanese. There is a subclass of adverbs which deals with the speaker’s attitude toward the truth value of a proposition. They express evidentiality either alone or in
combination with other evidential elements in the predicate. Those adverbs can be classified into three major classes:

1. Adverbs that express the speaker's conviction or certainty.
2. Adverbs that express the speaker's doubt.
3. Adverbs that express the speaker's negative conviction.

The first class of adverbs includes matigainaku (unmistakably), utagainaku (undoubtedly), tasikani (certainly), kanarazu (infallibly), kitto and sazo (surely). Adverbs in this class do not necessarily require other evidential markers in the predicate. The second class of adverbs includes tabun, osoraku, dooyara, which can all be translated as probably. Adverbs which express a greater degree of doubt such as mosikasitara or hyottosite (possibly) often require the predicate indicate a corresponding degree of certainty, as Aoki points out in the following examples:

(n) Dooyara kare wa hon o yon-de-iru rasi -i. (Aoki's (60))
likely he T.M. book O.M. read-PROG
(He seems to be reading the book.)

(n') *Dooyara kare wa hon o yon-de-iru. (Aoki's (61))
likely he T.M book O.M. read-PROG
(He is likely to be reading a book.)

The third class of adverbs such as masaka (surely not) usually requires both inferential and negative element present in the same sentence:

(o) Masaka kare wa sono hon o yon-de-i -nai daroo.
surely he T.M. the book O.M. read-PROG -NEG TENTATIVE
(I doubt that he is reading the book.) (Aoki's (64))

(o') *Masaka kare wa sono hon o yon-de-iru. (Aoki's (62))
(He could not possibly be reading the book.)

(o'') *Masaka kare wa sono hon o yon-de-iru rasi-i. (Aoki's (63))
(He could not possibly be reading the book.)

We should also note that those evidentials are used not only as a marker of the speaker's attitude toward the addressee's knowledge or toward the proposition, but also as a verbal strategy to express politeness. For example, the speaker may use sentential particle ne as one of "positive politeness strategies" in Brown and Levinson's sense by expressing the sense of shared knowledge. The evidentials to express the speaker's doubt or uncertainty can often be used to soften the effect of asserting a proposition, even when the speaker is certain about its truth value. This use of evidential can be considered one of the "negative politeness strategies" which reduce the Face Threatening effect of some speech act.
3.2 Representation of Pragmatic Information in Computational Systems

In the PENMAN text generation project based on the Nigel grammar developed at the University of Southern California [Bateman et al., 1990], textual meaning is represented in the "upper model", a hierarchical property-inheritance network of concepts. The upper model consists of four subhierarchy: the process hierarchy, the object subhierarchy, the quality subhierarchy and the interpersonal attitude subhierarchy. Pragmatic information is represented under the interpersonal subhierarchy in the model. The interpersonal subhierarchy, however, includes only polarity and speech acts. Furthermore, the speech acts that this model handles are limited to the ones which can be directly translated from certain syntactic structures. That is, there are only four kinds of speech acts — question, command, assertion and answer, which result in a surface form interrogative clause, imperative clause and indicative clause and an elliptical form functioning as an answer, respectively.

[Nirenburg and Defrise, 1992] have developed a model of text-meaning representation which consists of the following:

1. T: textual meaning.
2. G: an agent's active set of goals and plans.
3. S: the setting of the communication situation.

In their model, the speaker's attitudes (epistemic, evaluative, deontic, volition, etc.) are represented in T (textual meaning) on a 0, 1 scale scoping over part of the text. On the other hand, pragmatic factors such as formality, directness and respect are represented in S (the setting of the communication situation). This way of representation makes it possible to capture and represent the meaning of multi-clause sentences, where the scope of the speaker's attitude is limited to one proposition, namely one clause, whereas other pragmatic factors scope over the whole sentence or the whole discourse.

ATR's speech translation system [Kogure et al., 1988, Kurematsu, 1993] uses the intention translation method in which two different representations, prepositional content and the speaker's intention, are translated separately. Whereas prepositional contents are represented by recursively defined relationships which are language-dependent, intentional contents such as request, promise, greetings, etc. are passed through the transfer process.

3.3 Extraction of Pragmatic Information in Computational Systems

In interpreting speakers' intentions and attitudes in natural language processing systems, the most well-known approach is based on plan recognition [Perrault and Allen, 1980, Sidner and D. J, 1981, Allen, 1983], where a speech act is recognized as part of the speaker's plan. The system uses beliefs of each individual agent and shared knowledge which are explicitly stored in the database and other beliefs derived from them to recognizes plans.

The plan-based system is able to recognize the intended meaning of sentences by searching through the interlocutors' beliefs and also preconditions and effects of each action appeared in a
In order to perform this recognition process successfully, the system need not only to have beliefs of each individual agent and knowledge shared by the interlocutors stored systematically, but also to be able to derive other relevant beliefs based on the information in the database. Thus, this process can be computationally very expensive. Furthermore, it fails to use language specific information, such as the fact that some semantically equivalent structures may not be pragmatically equivalent; for example, *Can you pass the salt?* is often used as a request whereas *Are you able to pass the salt?* is not.

In more recent systems [Allen and Hinkelman, 1989], therefore, the plan-based approach is combined with structural processing. The linguistic component of the system uses a set of language-specific rules to identify words or structures which might indicate certain speech-act in some context. The mapping between those linguistic features and corresponding speech acts are, however, highly ambiguous. Unlike true idioms, their literal and non-literal readings do interact with each other at the surface level. In their system, therefore, the linguistic component produces the range of possible interpretations rather than a unique speech act type. The plan recognition component is then used to resolve the ambiguities in context and return a single interpretation.

This combined approach has been used in other areas of natural language systems. For example, in ATR's Japanese to English speech translation system [Kogure et al., 1990b, Kogure et al., 1988], a typed feature rewriting system is used to derive a set of candidate speech act types, which are then filtered using a dialogue plan recognition system. On the other hand, in a limited, goal-oriented dialogue domain such as the NADINE system's [Kogure et al., 1990a] it has been found that a plan recognition component is not crucial for correct translation. Analyzing pragmatic felicity conditions in addition to syntactic and semantic information of the input sentence makes it possible to resolve ambiguities and ellipses [Yoshimoto, 1988].

Another notable computational system that deals with pragmatic information is the work by [Bateman, 1988] who extended the NIGEL grammar. The grammar has a system called "inquiry semantics" which formulates questions to the database and obtains information necessary to construct appropriate grammatical structures in the process of text generation. Bateman has extended the interpersonal subhierarchy of the NIGEL grammar to handle politeness features in Japanese. The system asks all the questions related to the aspect of the social relationships of the interlocutors and the speech situations, and makes appropriate selection of grammatical features based on the information. One of the problem Bateman faced is that pragmatic information and its linguistic encoding do not have one-to-one correspondence. By making the choosers in the system to be able to make any number of selections of grammatical features in the network, he has succeeded in handling a minimal alternation of politeness which can result in radically different grammatical structures that differ by many syntactic features.

### 3.4 State of the Art of NLP in CALL systems

An intelligent computer assisted language instruction (ICALI) system requires a sophisticated natural language processing component which understands the student input and generates system
responses. Most of the existing ICALI systems use a syntactic parser first to obtain structural information of the input and then pass the information to semantic routines for validation.

In open-ended text processing systems and grammar exercise programs, using such natural language processing techniques, can handle significant syntactic problems foreign language learners face, such as subject-verb agreement and inflection of verbs, although the levels of sophistication in terms of number and type of errors they can detect vary across the systems [Catt, 1988].

When it comes to error-detection beyond syntactic level, it is only possible in more restricted domain such as microworld systems. Microworld systems implement a conversation with students on some very constrained world. Since it is easy to represent knowledge in such a restricted world, those systems are capable of understanding and reacting to student input and detecting semantically incoherent input as well as syntactic errors. Examples of experimental microworld implementations include the LINGO system developed in MIT as part of the Athena Language Learning Project [Morgenstern, 1986] whose microworld consists of a dormitory room. The student is to tell the character (a poltergeist) to move things one place to another to mess up the room. The system can understand the student input and display the outcome of each action in pre-stored graphic image as well as produce responses dictated by conversational strategies. Another microworld implementation is the Foreign Language Adventure Game for Latin and French developed in University of Delaware [Mulford, 1989], where the student is an adventurer who explores the objects around him/her and discovers the plot of the drama s/he is involved. This system does not use graphics but produces utterances to inform the student the outcome of the action, and it can handle more types of actions than the LINGO system.

In both of the two microworld systems, due to their highly controlled text, the vocabulary and structures to be encountered are highly predictable and leave little room for pragmatic exercise. For example, since both programs expect the student to give commands to the system, plain imperative forms are highly expected whereas more subtle ways of expressing requests are unlikely to appear. The student's command then has to be mapped onto one of the operators defined in the program to perform the action, the additional information that the student's lexical choice might have contained will be discarded. (For example, *hurry, sneak* and *creep* are all reduced to the operator *go* in the Adventure Game) The systems thus cannot give feedback on the appropriateness of the manner of the action (or choice of lexical items) in the given context.

A notable effort to detect more than syntactic errors in less restricted domain can be found in STASEL, a style analyzer developed in University of Toronto [Payette, 1990]. The system is capable of giving feedback on stylistic features such as vagueness, wordiness or unbalanced coordinations by passing the parser output to the "syntactic style analyzer" and then to the "goal-directed style analyzer." However, a rhetoric and pragmatics module that assesses the input sentence according to the writer's intention or purpose is yet to be implemented.
4 Data and Linguistic Analysis

4.1 Speaker's Uncertainty

The major linguistic features which can express the speaker's uncertainty and should be handled in this project are as follows:

1. tentative, susi-o taberu darou.
2. think, susi-o taberu to omou.
3. double-negative, susi-o tabenai n zya nai.
4. adverb, mosikasitara susi-o taberu.
5. evidential-na, susi-o taberu mitai da.
6. evidential-adj, susi-o taberu kamosirenai.
7. evidential-stem, susi-o tabe-soo da.
8. hearsay, susi-o taberu soo da.
9. sentential-particle, susi-o taberu ne.
10. extended-predicate, susi-o taberu to omou n da.
11. negative, susi-o tabenai ka to omou.
12. negative-extended-predicate, susi-o taberu n zyanai ka.
13. interrogative, susi-o taberu ka to omou.
14. conjunction, susi-o taberu to omou ga.
15. interrogative-spart, susi-o taberu kasira to omou.

When those sentences above are uttered as a mere statement of a fact, the features to express the speaker's uncertainty can be viewed as devices to reduce the speaker's conviction about the truth of the proposition. This view is based on the assumption that one of the felicity conditions [Searle, 1975] for speech act "providing information" to be successfully carried out is:

belief: speaker S believes that proposition P is true

An affirmative sentence can be used to carry out speech acts other than "providing information". For example, if a person utters one of the sentences above in reply to a question Would you like to go to an Italian restaurant with me?, the intended speech act might be "rejection". In that case, the features to express the speaker's uncertainty is functioning as a device to weaken one of the
felicity conditions for speech act "rejection" (i.e. the person's unavailability), and as a result the face-threatening effect of "rejection" is reduced.

In this project, therefore, those above mentioned features are treated as "reducing-factors" for felicity conditions of any speech act.

4.2 Requestives

Since only one sentence at a time can be sent to the analyzer, structures that require inferences beyond sentence level in order to carry out an indirect speech act are not considered within the scope of this project. This restriction is reasonable in this stage, because the interpretation of a given sentence can be constrained by the context/speech situation which the author can specify within the exercise when s/he authors it.

The list of linguistic structures that should be processed as request by the system is as follows:

1. imperative,  
   (Write a letter.)

2. give-favor-inward-imperative,  
   (Give me a favor of writing a letter.)

3. potential-interrogative,  
   (Can you write a letter?)

4. give-favor-inward-interrogative,  
   (Will you give me a favor of writing a letter?)

5. want,  
   (I want you to write a letter.)

6. receive-favor-desiderative,  
   (I want to receive a favor of writing a letter.)

7. receive-favor-potential-interrogative,  
   (Can I receive a favor of writing a letter?)

Here felicity conditions for speech acts "requesting action" are assumed as:

- **propositional content**: future act A of hearer H
- **belief**: speaker S believes that H can do A
- **desire**: S wants H to do A
- **expectation**: S expects H to do A

When each requestive form in the data is closely examined, it is found that a particular one of these felicity conditions is usually evoked in a sentence; either the condition is stated or questioned. For example, in sentence 3 tegami-o kakemasu ka. the belief condition (S believes that H can do A) is questioned, and in sentence 5 tegami-o kaite hosii. the desire condition (S wants H to do A) is expressed straightforwardly.

If the linguistic features to express speaker's uncertainty is used with a requestive, they are interpreted as "reducing factor" for the felicity condition each sentence evokes. For example in
tegami-o kaite hosii to omou n desu ga features such as omou (think), the extended predicate and negative conjunction ga can be viewed as devices to weaken the speaker’s desire for the addressee to perform the action of writing a letter.

While similar grammatical structures seem to carry out the same speech act across languages, some linguistic features to express certain speech act are language-specific. For example, Can you do X cannot function as a requestive [Searle, 1975] whereas You want to do X is a common form of request in Hebrew [Allen and Hinkelman, 1989]. The constructions with giving-receiving auxiliary verbs for requestives are certainly specific to Japanese. The Japanese language has seven verbs in common usage which correspond to the English give and receive. These verbs differ according to the relative social positions of the participants in the giving event and the direction of the giving action. When they function as auxiliary verbs attached to another verb, they will add meaning of “give (receive) a favor of doing X”. In this project, whenever an appropriate giving-receiving auxiliary verb is used in a requestive, it is interpreted that the expectation condition (the speaker expects the addressee to do the action) is evoked.

4.3 The Design of P-structure

Based on the approach described above, a p-structure is designed so that pragmatic features are represented in terms of felicity conditions and their reducing factors.

There are, however, other pragmatic features that do not affect the felicity conditions of the intended speech act. One is speaker’s perception of the speech situation. In Japanese, it is obligatory to express the formality of the speech form in every predicate. The choice of formal/informal form of the predicate expresses mere the speaker’s perception of the speech situation in some cases, and can imply the speaker’s respect/disrespect or distance/closeness toward the addressee in other cases. Another pragmatic feature encoded in a sentence is speaker’s perception of the position of the addressee. By using or not using the honorific form of a verb, the speaker expresses that s/he perceives the addressee socially lower, higher or equal to herself/himself. In the p-structure designed here, therefore, has slots “speech situation” and “placement of addressee” at the top level scoping over the propositional content.

Below is the basic structure of a p-structure designed and used in this project.

```
<p-structure> ::= <requesting-action>
   <requesting-information>
   <providing-information>

<requesting-action> ::= ((speech-act requesting-action)
   (syntactic-feature SYNTACTIC-FEATURE)
   (action <clause>)
   (belief <felicity-condition>)
   (desire <felicity-condition>)
   (expectation <felicity-condition>))
```
(placement-of-addressee PLACE)
(speech-situation SPEECH-SITUATION))

:requesting-information> ::= ((speech-act requesting-information)
(proposition <clause>)
(reducing-factor REDUCING-FACTOR)
(speech-situation SPEECH-SITUATION))

:providing-information> ::= ((speech-act providing information)
(proposition <clause>)
(reducing-factor REDUCING-FACTOR)
(placement-of-addressee PLACE)
(speech-situation SPEECH-SITUATION))

:clause> ::= (predicate-argument-structure)

:clause> ::= (predicate-argument-structure)

:clause> ::= (predicate-argument-structure)

:felicity-condition> ::= ((feature SYNTACTIC-FEATURE)
(reducing-factor REDUCING-FACTOR))

SYNTACTIC-FEATURE ::= elliptical
    give-favor-imperative
    give-favor-inward
    imperative
    potential
    receive-favor-desiderative
    receive-favor-potential

REDUCING-FACTOR ::= extended-predicate
    conjunction
    favor
    adverb
    double-negative
    evidential-na
    evidential-adj
    evidential-stem
    hearsay
    interrogative
    negative
    negative-extended-predicate
    sentence-particle
    tentative
    think
PLACE ::= higher/lower

SPEECH-SITUATION ::= formal/informal
5 Implementation

5.1 Extension and Revision of the Syntactic and Semantic Analyzer

In order to process all the structures in the data described in the previous section, the grammar coverage for both the syntactic analyzer and the semantic mapper has been extended. The newly covered constructions include:

- causative
- passive
- desiderative
- potential
- giving-receiving auxiliary verbs
- combination of above

As a next step, the mapping process has been integrated into the parser so that the grammatical function/semantic role assignment of input sentences with complex predicates can be done more effectively. The process is now split into subprocesses and called from the parser at different stages of parsing.

Subprocess 1: Subcategorization the frame. Since the morphological analyzer has a very simple data structure and cannot change the value of the features during the process, the subcategorization information of each lexical entry is limited to minimum feature-value pairs. The presence or absence of each feature-value pair indicates specific subcategorization frame that the predicate requires. For example, the lexical entry of "taberu" (to eat) contain only one pair "wo-patient +" concerning its subcategorization frame.

An complete subcategorization frame for the base form of the predicate is build when the predicate, processed by the morphological analyzer, enters the parser. The frame also specifies semantic restriction of each role based on the information from the feature-value pair in the predicate. For the above mentioned verb "taberu", the function constructs the following frame:

```plaintext
{(subcat ((ga ((actor animate))))
  (wa ((actor animate)))
  (actee any))
(mo ((actor animate))
  (actee any))
(wo ((actee any)))
(ni ((time-at time-ni)))
(to ((accompaniment animate)))
(de ((location place)))
(kara ((time-from time)))
(made ((time-to time))))}
```
For each particle/case marker, all the possible semantic roles are listed with their semantic restriction. Since any argument NP can be dropped in Japanese, both argument and adjunct roles are treated in exactly the same way.

**Subprocess 2: Revising the subcategorization frame.** In the next step, the parser checks if there is any additional syntactic feature which can affect the subcategorization frame such as passive or causative. If any of those features are recognized, the frame is sent to another mapping function for a further revision. For example, if the feature "passive" exists, the frame above is revised into the one below:

```
((subcat ((ga ((actee any)))
    ((affected animate)))
  (wa ((actor animate))
    (actee any)))
  (mo ((actor animate))
    (actee any)))
  (wo ((actee any)))
  (ni ((actor animate))
    (goal any))
    ((time-at time-ni))
  (to ((accompaniment animate)))
  (de ((location place)))
  (kara ((time-from time)))
  (made ((time-to time))))
```

Note that the mapping program reverses the roles "actor" and "actee" between "ga" and "ni", while keeping the semantic restrictions of each role as defined. It is also clear from the frame that the semantic roles and case-markers do not have one-to-one correspondence: more than one particle can mark the same semantic role, and the same particle can mark more than one semantic roles. This is the reason why some semantic roles can not be deterministically assigned as soon as a noun phrase is recognized during parsing, since it depends on the assignments of other noun phrases/semantic roles in the sentence.

**Subprocess 3: Make a list of all possible roles for each noun phrase.** When a noun phrase is recognized in the input sentence by the parser, its particle and semantic features are compared with the subcategorization frame, and a list of possible roles it can fill is inserted into the feature structure of the noun phrase. For example, a noun phrase *tanakasan-wa* (Mr.Tanaka) will have the following feature structure when combined with the verb *taberu*:

```
((s "Tanaka-family name") (cat noun) (title +) (proper +) (part wa)
  (roles (*MULTIPLE* affected actor actee)))
```

The "roles" feature above indicates that this noun phrase can fill one of the three semantic roles: affected, actor, or actee.
Subprocess 4: Assigning semantic roles to each noun phrase. After a whole clause is processed by the parser, it is finally sent to the mapping program for the assignment. The mapping program tries all possible combinations in which all the noun phrases in the input sentence are mapped onto some roles and each role filled by no more than one noun phrase. In order to map all the noun phrases efficiently, noun phrases with restrictive particles (i.e., ones do not mark more than one role) are mapped first, and then noun phrases with less restrictive particles are mapped onto the slots which are still empty. There are some special restrictions that need to be considered during mapping.

1. **Noun phrases with mo.** More than one noun phrases marked by particle *mo* can be mapped onto the same role as long as they are adjacent to one another.

2. **Precedence.** If role "affected" and "actee" are both present in the parse, "affected" has to precede "actee".

3. **Role conflict.** Two roles cannot be filled by two *ga* marked noun phrases in one clause.

### 5.2 Use of Information from the Author's Parse

The second major revision in the system is to separate the processing of author's input and the processing of student's input. By doing so, the efficiency of both of the processings are improved:

1. The parser does not have to consider the possibility of the input being ill-formed when parsing author's input.

2. The processing of student's input can be guided by information from the author's parse, which can reduce the ambiguities in the analysis.

After the author's input is analyzed, some information is extracted from the template and inserted into student's feature structure to guide the parsing/mapping. While case-marking of each noun phrase is crucial in determining its grammatical functions and/or semantic roles in Japanese since noun phrases can be almost freely scrambled, case-marking is one of the most frequent error sources made by students of the language. The mapper, therefore, if the meaning of a noun phrase in the student's input and the meaning of one of the noun phrases in author's parse match, automatically assigns them the same semantic role regardless of the particle the student used or not used with the noun phrase. Using this mapping strategy, the feedback to the student can be improved significantly. For example, when a student types *susi-ni watasi-ga tabemasita* intending *I ate sushi*, *susi-ni* would be assigned "extra" using the original mapping strategy, since the subcategorization of the frame does not allow a ni-marked noun phrase to be mapped onto "actee":

```
TEACHER: watasi ga susi wo tabemasita.
I sushi eat-PAST
<actor> <actee>
```
Therefore, the feedback used to be:

I cannot identify the function of "susi-ni" in your sentence.
You left out an actee phrase with the following feature:
meaning sushi.

Using the new mapping strategies, the system can correctly recognize that the student used "susi
ni" as an actee phrase and made a particle error. The new feedback should be:

You seem to have used the wrong particle on the actee phrase "susi-ni".

5.3 The P-structure Mapping Program for Authoring

The new p-structure mapping program is implemented between the syntactic/semantic analyzer
and the disambiguator. As in the new syntactic/semantic analyzer, the p-structure mapping program
also processes author's input and student's input in different ways.

This program, taking the output from the parser, performs two major tasks:

1. Strip off those syntactic features that function as reducing factors and identify the propositional
   content of the given input.

2. Identify the indirect speech act of the given sentence and build a "p-structure" accordingly.

During both of these tasks, the analyzer will encounter many ambiguities. For example, one
particular syntactic construction such as /think that... can be either a reducing factor for the
embedded proposition or an actual part of the proposition. Therefore it is important for the system
to preserve these ambiguities and leave it to the author to select an appropriate interpretation.

The first step in the pragmatic mapper is to identify some special forms of the predicate such as
the imperatives (...kake.) and the elliptical requestives (...kaite.), which are recognized as a form
of "requesting action" speech act. If the input sentence has none of those special form of predicate,
then the pragmatic mapper tries to strip off all the reducing factors until it reaches the propositional
content. At the same time it identifies possible speech act types and build p-structures for each one.
For example, if the input sentence is tegami-wo kaite itadakenai darou ka to omou n desu ga., it
goes through the following processes in the pragmatic mapping program:

Input (output from the parser):

COMPLEMENT
1. <teacher-p-mapping>

Is it an imperative or an elliptical requestive?

No. (==> nonimperative-mapping)

2. <nonimperative-mapping>

Is it an interrogative?

No. (==> declarative-mapping)

3. <declarative-mapping>

Identify reducing factors for declaratives and put them under REDUCING-FACTOR.

Result:

COMPLEMENT

FAVOR ACTEE 手紙を(tegami-wo)
SENSE 'letter'
書いて(kaite)
SENSE 'write'
頂けない(itadakenai)
SENSE 'receive'

thought (omou)
EXTENDED-PREDICATE

んです(n desu)
CONJUNCTION

が(ga)
POTENTIAL +
NEGATIVE +
TENTATIVE tfh 5 (darou)
QPART tf* (ka)
COMPLEMENTIZER t (to)

55 (omou)
REDUCING-FACTOR
EXTENDED-PREDICATE At=£ n desu
CONJUNCTION 7^ (ga)

Does 'S5' present in the input?

Yes. (==> (1) the whole sentence goes into nonimperative2-mapping)
(==> (2) only the complement goes into nonimperative2-mapping
and "JS5" goes under REDUCING-FACTOR)

Interpretation (1):

FAVOR
ACTEE tPšt (tegami-wo)
SENSE 'letter'

Itwc (kaite)
SENSE 'write'

Ecftvs (itadakenai)
SENSE 'receive'

POTENTIAL +
NEGATIVE +
TENTATIVE /t*v 5 (darou)
QPART fa (ka)
COMPLEMENTIZER t (to)

65 (omou)
REDUCING-FACTOR

EXTENDED-PREDICATE AsX"£ n desu
CONJUNCTION # (ga)

Interpretation (2):

FAVOR
ACTEE 3^K£ (tegami-wo)
SENSE 'letter'

It^T (kaite)
SENSE 'write'
5. <nonimperative2-mapping>

Is it an interrogative?

(1) No. (==> declarative2-mapping)
(2) Yes. (==> interrogative1-mapping)

6. <declarative2-mapping>

Identify reducing factors for declaratives and put them under REDUCING-FACTOR.

Does any RECEIVE feature present?
No. (==> affirmative-mapping)

7. <affirmative-mapping>

Identify evidential markers and put them under REDUCING-FACTOR.

Build a p-structure for speech act of 'providing-information'.

Interpretation (1):

SPEECH-ACT providing-information
PROPOSITION
COMPLEMENT

FAVOR ACTEE ^ftf (tegami-wo)
SENSE 'letter''
ff\^C(kaite)
SENSE 'write''
IRtf&v^ (itadakenai)
SENSE 'receive''

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8. <interrogative1-mapping>
Identify reducing factors for interrogatives and put them under REDUCING-FACTOR.

Interpretation (2):

FAVOR

ACTEE  ^&fc* (tegami-wo)
SENSE   "letter"
H^T (kaite)
SENSE   "write"
B|l't^ (itadakenai)
SENSE   "receive"

POTENTIAL +
REDDUCING-FACTOR

EXTENDED-PREDICATE  k~Qir (n desu)
CONJUNCTION   fa   (ga)

THINK
S5 (omou)

COMPLEMENTIZER 

NEGATIVE +
TENTATIVE #3 5 (darou)
INTERROGATIVE   fa   (ka)

Are any of the features for requestives present?
Yes.  (==> (2.1) interrogative2-mapping)
        (==> (2.2) receive-potential-mapping)

9. <interrogative2-mapping>
Identify evidential markers and put them under REDUCING-FACTOR.
Build a p-structure for speech act of "requesting-information."
Interpretation (2.1):

SPEECH-ACT  requesting-information
PROPOSITION
FAVOR  ACTEE  ?&$,* (tegami-wo)
SENSE  'letter'
it^T (kaite)
SENSE  "write"
Mtf*:^ (itadakenai)
SENSE  "receive"
POTENTIAL  +

REDUCING-FACTOR
EXTENDED-PREDICATE  AsX"t (n desu)
CONJUNCTION  # (ga)
THINK  ,B5 (omou)
COMPLEMENTIZER  t (to)
NEGATIVE  +
TENTATIVE  tf">.* (darou)
INTERROGATIVE  fa (ka)

SPEECH-SITUATION  formal

10. <receive-potential-mapping>

Build a p-structure for speech act of 'requesting-action.'

Interpretation (2.2):

SPEECH-ACT  requesting-action
FEATURE  receive-favor-potential
ACTION  ACTEE  ?&ft (tegami-wo)
SENSE  'letter'
S^T (kaite)
SENSE  "write"

BELIEF
DESIRE
EXPECTATION
FEATURE  receive-favor-potential

REDUCING-FACTOR
EXTENDED-PREDICATE  hr^T (n desu)
CONJUNCTION  ^ (ga)
THINK  ,B5 (omou)
As shown in the above example, the pragmatic mapper is always aware of the possibility of certain syntactic features being a part of propositional content as well as being a part of reducing factor or speech act. Thus, it preserves necessary ambiguities and often produces more than one output. In the example above, there are three p-structures (1), (2.1) and (2.2) produced by the pragmatic mapper.

5.4 The Disambiguator

The disambiguator searches the output of the pragmatic mapper for certain types of ambiguities and engages the user in disambiguation dialogs to resolve the ambiguities. The first thing the disambiguator looks for is SPEECH-ACT feature. In a case like the example above, the three output p-structures can be disambiguated by asking the user which speech act was intended.

What type of speech act did you intend? Double-click on the appropriate answer, or defer:

REQUESTING-ACTION
PROVIDING-INFORMATION
REQUESTING-INFORMATION

defer this question until later

Sometimes the disambiguator asks the range of the propositional content of the given sentence.

What is the appropriate bracketing for the requested or provided information (if any)? Double-click on the appropriate answer, or defer:

主人は ms [jiaoc ff<] t と思います
主人は [WB MMK ff<] t と思います
[主人は 明日 東京に ff<] i と思います
[主人は 明日 東京に 行く]
defer this question until later

5.5 The Author's Template

After disambiguation, the result of the natural language processing is displayed in the author's template, which the teacher is able to edit in order to control the range of students' answers to be accepted by the system. The template for output(2.2) will look like this:

speech-act REQUESTING-ACTION
syntactic-feature RECEIVE-FAVOR-POTENTIAL REQ
            ELLIPTICAL - ILL
            GIVE-FAVOR-IMPERATIVE ILL
            GIVE-FAVOR-INWARD ILL
            IMPERATIVE ILL
            POTENTIAL ILL
            RECEIVE-FAVOR-DESIDERATIVE ILL

action tfv>"C (kaite) REQ
meaning WRITE
thing_acted_on ^|ft(tegami) REQ
particle f (wo) REQ
meaning LETTER
dictionary-form ISK (kaku) expectation REQ

feature RECEIVE-FAVOR-POTENTIAL REQ
reducing-factor
            INTERROGATIVE fa (ka) REQ
            FAVOR H< (itadaku) REQ
            meaning RECEIVE-FAVOR
            EXTENDED-PREDICATE a/tf (n desu) REQ
            NEGATIVE REQ
            CONJUNCTION # (ga) REQ
            INTERROGATIVE-SPART ^ (ka) REQ
            TENTATIVE fch 5 (darou) REQ
            THINK B5 (omou)
            COMPLEMENTIZER
            t (to) REQ
ADVERB ILL
DOUBLE-NEGATIVE ILL
EVIDENTIAL-NA ILL
EVIDENTIAL-ADJ ILL
EVIDENTIAL-STEM ILL

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Each feature present in the teacher’s output is displayed with REQ (required) feature, which means the feature is expected to be found in the student’s output. The author can click on REQ button and change it into either OPT (optional) or ILL (illegal). The author can also type in additional word, morpheme or feature to be accepted by the system. This template is stored to be used by the matcher.

5.6 The P-structure Mapping Program for Student Exercise

When processing student’s input, the pragmatic mapper uses the information extracted from the author’s template as a guide. In this way, the analyzer is able to accept ill-formed input while avoiding an enormous number of ambiguities. The available information from the author’s parse includes:

- speech act type
- main predicate of the proposition
- meaning of each argument noun phrase
- required and allowed reducing factors

Whereas the author p-mapping program tries to identify all possible speech act types the input sentence can carry out, the student p-mapping program starts with the given speech act type from the author to limit the search. By doing so, even when student fails to use certain linguistic feature to mark particular speech act, the system can recognize the student’s attempt and give an appropriate feedback.

For example, in an exercise where the example sentence above is authored, if a student types in a sentence “tegami-wo kaite sashiagerarenai darou ka to omou n desu ga” using the giving-receiving verb with the wrong direction, it will go through the following processes:

Input (output from the parser):

{COMPLEMENT
    FAVOR
    ACTEE tegami-wo
    SENSE ‘letter’
    kaite
    SENSE ‘write’
    sasiagenai

    HIGHER
    REQ
    speech-situation FORMAL
    REQ

    ILL
    NEGATIVE-EXTENDED-PREDICATE ILL
    SENTENTIAL-PARTICLE ILL

    HEARSAY

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SENSE  ' 'give' '
POTENTIAL +
NEGATIVE +
TENTATIVE +
QPART ka
COMPLEMENTIZER to

omou
EXTENDED-PREDICATE
n desu
CONJUNCTION -

ga

1. <student-p-mapping>

Is the author's speech act type ''providing-information''? No.

Is the author's speech act type ''requesting-information''? No.

Is the author's speech act type ''requesting-action''? Yes. (=> student-request-mapping)

2. <student-request-mapping>

Is it an imperative or an elliptical requestive? No. (=> nonimperative-request-mapping)

3. <nonimperative-request-mapping>

Is the top-level predicate identical to the author's predicate? No. (=> nonimperative-request1-mapping)

4. <nonimperative-request1-mapping>

Is there a lower-level clause embedded in the ''omou'' construction? Yes. (=> embedded-nonimperative-request-mapping)

5. <embedded-nonimperative-request-mapping>

Strip off the top level construction and put all the reducing factor at that level under REDUCING-FACTOR
Result:

FAVOR  ACTEE  tegami-wo
       SENSE  'letter'
   kaite
       SENSE  'write'

sasiagenai
SENSE  'give'
POTENTIAL +
NEGATIVE +
TENTATIVE +
QPART  ka

REDUCING-FACTOR
    THINK  omou
    COMPLEMENTIZER  to
EXTENDED-PREDICATE  n  desu
CONJUNCTION  ga

Is the new top-level predicate identical to the author's predicate? No. (=> nonimperative-request2-mapping)

6. <nonimperative-request2-mapping>

Is the feature FAVOR present at the top-level? Yes. (=> student-favor-request-mapping)

7. <student-favor-request-mapping>

Is the predicate 'give' or 'receive'? 'give'. (=> student-give-request-mapping)

8. <student-give-request-mapping>

Build a p-structure for speech-act of 'requesting-action'.

Result:
SPEECH-ACT  requesting-action
FEATURE  give-favor-potential
ACTION  ACTEE  tegami-wo
       SENSE  'letter'
   kaite
       SENSE  'write'

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BELIEF
DESIRE
EXPECTATION
FEATURE give-favor-potential
REDUCING-FACTOR
THINK omou
COMPLEMENTIZER to
EXTENDED-PREDICATE n desu
CONJUNCTION ga
FAVOR sasiagenai'
NEGATIVE +
TENTATIVE darou
QPART ka
PLACEMENT-OF-ADDRESSEE higher
SPEECH-SITUATION formal

Is the direction of the giving verb inward or outward?
outward ==> add error-feature 'give-direction-error-out'

5.7 The Matcher

As in the original ALICE-chan system, the matcher compares the analysis of the student input sentence with the author's template and report any features that are missing or different from each other. It also finds error features that are inserted during the analysis and formulate appropriate feedback sentences from them. For example, the in the student's input described above contains error feature "give-direction-error-out". So the system will say You seem to have used the giving verb with the wrong direction. You should have used the verb with inward direction.

The system can detect the following types of errors in addition to syntactic/semantic errors:

1. Wrong degree of imposition.
2. Wrong degree of uncertainty.
3. Wrong direction of auxiliary giving-neceiving verbs.
4. Unmatched honorifics.
5. Inappropriate formality.

In addition to the student's errors, the outline of the system's analysis of the input sentence is also presented, in order to help students to understand the error messages. The information that the system can present includes:

38
- The speech act type the system used for the interpretation.
- The main feature that marks the particular speech act.
- The main predicate of the sentence.

See the Appendix for example exercises, list of acceptable answers and feedback.
6 Conclusion

In this project, I have succeeded in separating the pragmatic information that is encoded in a sentence from the prepositional content of the sentence. The extracted pragmatic information is classified and represented in a "p-structure". The program, implemented in a Computer Assisted Language Learning system, can help students to learn and practice different ways of expressing certain indirect speech act, and use the target language appropriately in the given situation.

The system with the new pragmatic mapping program is able to recognize various sentences with the same prepositional content, even if their syntactic structures are not identical. It is thus able to allow students to express a certain proposition more freely without burdening the author with the task of typing in all possible correct answers and incorrect answers with appropriate feedback.

In the p-structure, the pragmatic information is represented in terms of the speech-situation, the speaker's attitude toward the addressee, and the felicity conditions for the intended speech act. Linguistic features that express the speaker's uncertainty are interpreted as reducing factors that weaken felicity conditions of the intended speech act of the sentence.

While this mapping program has succeeded in extracting and representing pragmatic informations, it has not been able to come up with a reliable way of measuring the effect of the individual and combined pragmatic features. For instance, a certain reducing factor seems to weaken the speaker's conviction more than another, but it is difficult to measure reducing forces of each feature with respect to every other feature. It becomes even more difficult when two or more reducing factors are combined. This problem causes some difficulties in authoring and matching in the system: when the author wants to allow certain range of indirectness, the system provides no easier way than going through every possible feature and specify the status whether it is required, optional or illegal. More detailed and broad linguistic analysis is necessary in order to build a system that can provide a simpler way of recognize the range of pragmatic forces.

The other possible direction of improvement is to extend the analysis ability beyond the sentence level. This will require an implementation of an inference system that can recognize the speaker's intention based on the contextual information and world knowledge. The system then will be able to recognize a broader range of pragmatic forces and help student to understand and use the language appropriately in realistic speech situations.
A Examples of Declarative F-Structures and P-Structures

1. "Susi-o tabemasu"

<table>
<thead>
<tr>
<th>f-structure</th>
<th>p-structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTEE PRED &quot;susi&quot;</td>
<td>SPEECH-ACT providing-information</td>
</tr>
<tr>
<td>SENSE sushi</td>
<td>PROPOSITION</td>
</tr>
<tr>
<td>PART wo</td>
<td>ACTEE PRED &quot;susi&quot;</td>
</tr>
<tr>
<td>PRED &quot;taberu&quot;</td>
<td>SENSE sushi</td>
</tr>
<tr>
<td>SENSE eat</td>
<td>PRED &quot;taberu&quot;</td>
</tr>
<tr>
<td>STYLE formal</td>
<td>TENSE present</td>
</tr>
<tr>
<td>TENSE present</td>
<td>REDUCING-FACTOR</td>
</tr>
<tr>
<td>CERTAINTY-FACTOR</td>
<td>SITUATION formal</td>
</tr>
</tbody>
</table>

2. "Mosikasitara susi-o taberu kamosirenai n zyanai darou ka
   to omou n desu ga"

<table>
<thead>
<tr>
<th>f-structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPLEMENT</td>
</tr>
<tr>
<td>ADJP-MODIFIER</td>
</tr>
<tr>
<td>ACTEE PRED &quot;susi&quot;</td>
</tr>
<tr>
<td>SENSE sushi</td>
</tr>
<tr>
<td>PRED &quot;taberu&quot;</td>
</tr>
<tr>
<td>SENSE eat</td>
</tr>
<tr>
<td>PRED &quot;kamosirenai&quot;</td>
</tr>
<tr>
<td>SENSE maybe</td>
</tr>
<tr>
<td>TENSE present</td>
</tr>
<tr>
<td>NEGATIVE-EXTENDED-PREDICATE +</td>
</tr>
<tr>
<td>TENATIVE +</td>
</tr>
<tr>
<td>INTERROGATIVE +</td>
</tr>
<tr>
<td>QPART PRED &quot;ka&quot;</td>
</tr>
<tr>
<td>CERTAINTY-ADVERBIAL</td>
</tr>
<tr>
<td>PRED &quot;mosikasitara&quot;</td>
</tr>
<tr>
<td>SENSE by any chance</td>
</tr>
<tr>
<td>PRED &quot;omou&quot;</td>
</tr>
<tr>
<td>SENSE think</td>
</tr>
</tbody>
</table>

41
<table>
<thead>
<tr>
<th>TENSE</th>
<th>present</th>
</tr>
</thead>
<tbody>
<tr>
<td>STYLE</td>
<td>formal</td>
</tr>
<tr>
<td>EXTENDED-PREDICATE</td>
<td>+</td>
</tr>
<tr>
<td>CONJUNCTION</td>
<td>PRED</td>
</tr>
</tbody>
</table>

p-structure

<table>
<thead>
<tr>
<th>SPEECH-ACT</th>
<th>providing-information</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROPOSITION</td>
<td></td>
</tr>
<tr>
<td>ACTEE</td>
<td>PRED</td>
</tr>
<tr>
<td>SENSE</td>
<td>sushi</td>
</tr>
<tr>
<td>PRED</td>
<td>&quot;taberu&quot;</td>
</tr>
<tr>
<td>SENSE</td>
<td>eat</td>
</tr>
<tr>
<td>TENSE</td>
<td>present</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REDICING-FACTOR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONJUNCTION</td>
<td>&quot;ga&quot;</td>
</tr>
<tr>
<td>EXTENDED-PREDICATE</td>
<td>+</td>
</tr>
<tr>
<td>THINK</td>
<td>PRED</td>
</tr>
<tr>
<td>SENSE</td>
<td>think</td>
</tr>
<tr>
<td>INTERROGATIVE</td>
<td>+</td>
</tr>
<tr>
<td>TENTATIVE</td>
<td>+</td>
</tr>
<tr>
<td>NEGATIVE-EXTENDED-PREDICATE</td>
<td>+</td>
</tr>
<tr>
<td>ADJ-EVIDENTIAL</td>
<td>PRED</td>
</tr>
<tr>
<td>SENSE</td>
<td>maybe</td>
</tr>
<tr>
<td>ADVERB</td>
<td>PRED</td>
</tr>
<tr>
<td>SENSE</td>
<td>by any chance</td>
</tr>
</tbody>
</table>

| SPEECH-SITUATION | formal |

42
B Examples of Request F-Structures and P-Structures

1. "Tegami-o kake"

<table>
<thead>
<tr>
<th>f-structure</th>
<th>p-structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTEE</td>
<td>SPEECH-ACT</td>
</tr>
<tr>
<td>PRED</td>
<td>requesting-action</td>
</tr>
<tr>
<td>&quot;tegami&quot;</td>
<td>FEATURE</td>
</tr>
<tr>
<td>SENSE letter</td>
<td>imperative</td>
</tr>
<tr>
<td>PART wo</td>
<td>ACTION</td>
</tr>
<tr>
<td>PRED &quot;kaku&quot;</td>
<td>SENSE write</td>
</tr>
<tr>
<td>SENSE write</td>
<td>ACTEE PRED</td>
</tr>
<tr>
<td>IMPERATIVE +</td>
<td>&quot;tegami&quot;</td>
</tr>
<tr>
<td></td>
<td>SENSE letter</td>
</tr>
<tr>
<td></td>
<td>DESIRE FEATURE</td>
</tr>
<tr>
<td></td>
<td>REDUCING-FACTOR</td>
</tr>
<tr>
<td></td>
<td>BELIEF FEATURE</td>
</tr>
<tr>
<td></td>
<td>REDUCING-FACTOR</td>
</tr>
<tr>
<td></td>
<td>EXPECTATION FEATURE</td>
</tr>
<tr>
<td></td>
<td>REDUCING-FACTOR</td>
</tr>
<tr>
<td></td>
<td>PLACEMENT-OF-ADDRESEE lower</td>
</tr>
<tr>
<td></td>
<td>SPEECH-SITUATION</td>
</tr>
</tbody>
</table>

2. "Tegami-o kaite itadake nai darou ka to omou n desu ga"

<table>
<thead>
<tr>
<th>f-structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPLEMENT</td>
</tr>
<tr>
<td>COMPLEMENTIZER</td>
</tr>
<tr>
<td>PRED &quot;to&quot;</td>
</tr>
<tr>
<td>PRED &quot;itadaku&quot;</td>
</tr>
<tr>
<td>SENSE receive-favor</td>
</tr>
<tr>
<td>FAVOR PRED &quot;kaku&quot;</td>
</tr>
<tr>
<td>SENSE write</td>
</tr>
<tr>
<td>ACTEE PRED &quot;tegami&quot;</td>
</tr>
<tr>
<td>SENSE letter</td>
</tr>
<tr>
<td>PART wo</td>
</tr>
<tr>
<td>POTENTIAL +</td>
</tr>
<tr>
<td>TENTATIVE +</td>
</tr>
<tr>
<td>NEGATIVE +</td>
</tr>
<tr>
<td>INTERROGATIVE +</td>
</tr>
<tr>
<td>PRED &quot;omou&quot;</td>
</tr>
<tr>
<td>SENSE think</td>
</tr>
<tr>
<td>STYLE formal</td>
</tr>
<tr>
<td>EXTENDED-PREDICATE +</td>
</tr>
<tr>
<td>CONJUNCTION PRED &quot;ga&quot;</td>
</tr>
</tbody>
</table>

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p-structure

SPEECH-ACT request
FEATURE receive-favor-potential
ACTION PRED "kaku"
SENSE write
ACTEE PRED "tegami"
SENSE letter

DESIRE FEATURE
BELIEF FEATURE
EXPECTATION FEATURE receive-favor-potential
REDUCING-FACTOR

CONJUNCTION "ga"
EXTENDED-PREDICATE +
THINK "omou"
INTERROGATIVE +
TENTATIVE +
NEGATIVE +
FAVOR +

PLACEMENT-OF-ADDRESEE higher
SITUATION formal
C Original AucE-chan System.
D New AucE-chan System

lexical and morphological analyzer
syntactic parser
semantic mapper
pragmatic mapper
disambiguator
matcher

input sentence

expected answer

IT

feedback
error messages

Student's, p-structure.

Student

Teacher

teacher's p-structure
ROLE: a general manager of ABC corporation
SITUATION: Your son is now a junior high school student and wants to learn English conversation. You are looking for a good teacher. Lee-san is your subordinate and is a very nice man. You call Lee-san to your office.

Politely tell him that you want him to teach English conversation to your son.

息子に英会話を教えてもらいたいんだが。

speech-act  REQUESTING-ACTION
syntactic-feature  RECEIVE-FAVOR-DESIDERATIVE  OPT
    ELLIPTICAL  ILL
    GIVE-FAVOR-IMPERATIVE  ILL
    GIVE-FAVOR-INWARD  OPT
    IMPERATIVE  ILL
    POTENTIAL  ILL
    RECEIVE-FAVOR-POTENTIAL  OPT
action  U^T
    GOAL  f&rjr
    particle  iZ
    meaning  SON
    HUMAN
    ANIMATE
thing_acted_on  3^fcis
ROLE: a housewife

SITUATION: You are talking with one of your husband's friends on the phone. He asks if your husband will be available tomorrow to help him move to his new house. You know that your husband does not want to help him tomorrow.

Tell him indirectly that your husband will not available by saying that perhaps your husband will go to Tokyo tomorrow.

たぶん主人は明日東京に行くと思います。
G Acceptable Answers and Feedback for Exercise 1

role: a general manager of ABC corporation
situation: Your son is now a junior high school student and wants
to learn English conversation. You are looking for a
good teacher. Lee-san is your subordinate and is a very
nice man. You call Lee-san to your office.

Politely tell him that you want him to teach English
conversation to your son.

<author's sentence>

"musuko-ni eikaiwa-wo osiete yatte moraitai n da ga"

<author's template>

syntactic-feature RECEIVE-FAVOR-DESIDERATIVE OPT
ELLIPtical ILL
GIVE-FAVOR-IMPERATIVE ILL
GIVE-FAVOR-INWARD OPT
IMPERATIVE ILL
POTENTIAL ILL
RECEIVE-FAVOR-POTENTIAL OPT

action |££_"C
meaning TEACH/TELL
GOAL M=f-
particle K
meaning SON
HUMAN REQ
ANIMATE REQ
thing-acted-on 3£^i&
particle £
meaning ENGLISH CONVERSATION

reducing-factor
EXTENDED-PREDICATE hfi OPT
CONJUNCTION i£ OPT
meaning ALTHOUGH
FAVOR * hV*ftW
meaning GIVE-FAVOR
TAI-FORM OPT
ADVERB ILL
DOUBLE-NEGATIVE ILL
EVIDENTIAL-NA ILL
EVIDENTIAL-ADJ ILL
EVIDENTIAL-STEM ILL
HEARSAY ILL
INTERROGATIVE OPT
INTERROGATIVE-SPART ILL
NEGATIVE OPT
NEGATIVE-EXTENDED-PREDICATE ILL
SENTENTIAL-PARTICLE ILL
TENTATIVE ILL
THINK ILL

feature RECEIVE-FAVOR-DESIERATIVE OPT
placement-of-addressee LOWER REQ
speech-situation INFORMAL OPT

<acceptable answers>

"musuko-ni eikaiwa-wo osiete yatte moraitai n da ga"
(exact match)

"musuko-ni eikaiwa-wo osiete yatte moraitai n desu ga"
(speech-situation formal)

"musuko-ni eikaiwa-wo osiete yatte moraeru ka"
(syntactic-feature receive-favor-potential)
(reducing-factor interrogative)

"musuko-ni eikaiwa-wo osiete yatte moraenai ka"
(syntactic-feature receive-favor-potential)
(reducing-factor negative, interrogative)

"musuko-ni eikaiwa-wo osiete yatte moraemasu ka"
(speech-situation formal)
(syntactic-feature receive-favor-potential)
(reducing-factor interrogative)

"musuko-ni eikaiwa-wo osiete yatte moraemasen ka"
"musuko-ni eikaiwa-wo osiete yatte moraenai desu ka"
(speech-situation formal)
(syntactic-feature receive-favor-potential)
(reducing-factor negative interrogative)

"musuko-ni eikaiwa-wo osiete yatte kurenai ka"
(syntactic-feature give-favor-inward)
"musuko-ni eikaiwa-wo osiete yatte kuremasen ka"
"musuko-ni eikaiwa-wo osiete yatte kurenai desu ka"
(speech-situation formal)
(reducing-factor negative interrogative)
(syntactic-feature give-favor-inward)

<errors and feedback>

"musuko-san-ni eikaiwa-wo osiete yatte itadakitai n da ga"
"musuko-san-ni eikaiwa-wo osiete yatte itadakitai n desu ga"
"musuko-san-ni eikaiwa-wo osiete yatte itadakeru ka"
"musuko-san-ni eikaiwa-wo osiete yatte itadakemasu ka"
"musuko-san-ni eikaiwa-wo osiete yatte itadakenai ka"
"musuko-san-ni eikaiwa-wo osiete yatte itadakemasen ka"
"musuko-san-ni eikaiwa-wo osiete yatte itadakenai desu ka"

(feedback: You used honorific verb to place the addressee higher, which is not appropriate in this speech situation.

"musuko-ni eikaiwa-wo osiete yatte kuretai n da ga"
"musuko-ni eikaiwa-wo osiete yatte kuretai n desu ga"

(wrong direction of giving-receiving verb)

(feedback: You used "kureru," a inward-giving verb in desiderative form. You can either use a receiving verb in desiderative form or use a inward-giving verb in question form in order to make a request.

"musuko-ni eikaiwa-wo osiete yatte agetai n da ga"
"musuko-ni eikaiwa-wo osiete yatte agetai n desu ga"

(wrong direction of giving-receiving verb)

(feedback: You used "ageru," a outward-giving verb in desiderative form. You can either use a receiving verb in desiderative form or use a inward-giving verb in question form in order to make a request.

"musuko-ni eikaiwa-wo osiete yatte agerareru ka"
"musuko-ni eikaiwa-wo osiete yatte agerarenai ka"
"musuko-ni eikaiwa-wo osiete yatte ageraremashu ka"
"musuko-ni eikaiwa-wo osiete yatte ageraremashen ka"

(wrong direction of giving-receiving verb)

(feedback: You used "ageru," a outward-giving verb in the
potential interrogative form. You should have used a receiving verb in the potential form to make a request.

"musuko-ni eikaiwa-wo osiete yatte agenai ka"
"musuko-ni eikaiwa-wo osiete yatte agemasen ka"
"Ittei'oko-ni-eikaiwa-wo-osiete-yatte-'agenai-desu-ka"
(wrong direction of giving-receiving verb)
feedback: You used "ageru," a outward-giving verb in the interrogative form.
You should have used a receiving verb in the interrogative form to make a request.

"musuko-ni eikaiwa-wo osiete yatte kure"
"musuko-ni eikaiwa-wo osiete yatte kudasai"
"musuko-ni eikaiwa-wo osiete yatte"
"musuko-ni eikaiwa-wo osiete yare"
(lack of reducing factors)
feedback: Your sentence seems to be too indirect for this context. Try to be a little more indirect.
For your sentence 「たぶん主人は明日東京に行くと思います」 in Blank #A:
What is the appropriate bracketing for the requested or provided information (if any)? Double-click on the appropriate answer, or defer:

たぶん 主人は 明日 【東京-に 行く】 と 思います
たぶん 【主人は 明日 東京-に 行く】 と 思います
たぶん 主人は 【明日 東京-に 行く】 と 思います
たぶん 【主人は 明日 東京-に 行く】 と 思います
【たぶん 主人は 明日 東京-に 行く】 と 思います
【たぶん 主人は 明日 東京-に 行く】 と 思います

defer this question until later

For your sentence 「手紙を書いてもらえますか」 in Blank #A:
What type of speech act did you intend? Double-click on the appropriate answer, or defer:

REQUESTING-ACTION
PROVIDING-INFORMATION
REQUESTING-INFORMATION

defer this question until later
I Example Feedback

In blank # A: Error Your sentence seems to be too direct for this context. Try to be a little more indirect. Your sentence is interpreted as expressing a speech act of PROVIDING-INFORMATION. The predicate of the proposition is interpreted as いきます meaning "GO".

In blank # A: Error Your sentence seems to be too direct for this context. Try to be a little more indirect. Your sentence is interpreted as expressing a speech act of REQUESTING-ACTION. You used a RECEIVE-FAVOR-DESIDERATIVE to make a request The requested action is interpreted as TEACH/TELL-.
J References


