Ambiguities in Task-oriented Dialogues

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Introduction

Ambiguity in language has received attention from a variety of sources. Linguists use ambiguity as one way to ascertain the validity of their theoretical accounts of language structure; psychologists use it as a means to gain understanding of the cognitive processes involved in language understanding. In the field of computer-human interaction, in which the computer serves either as knowledge source for data retrieval or as mediator in translation tasks, ambiguities can be critical snags in the flow of information; computers are not *a priori* equipped to deal with linguistic ambiguities. This, it is crucial to look at ambiguities themselves in order to determine the mechanisms by which they can be resolved. These mechanisms can then be built into an automatic disambiguation system or exploited in an interactive one.

We will address only a small part of this much larger question here. In the course of the work with multimedia interfaces for machine translation conducted at ATR, we have collected a corpus of spontaneous dialogues, some of which are monolingual conversations and some of which are bilingual, interpreted conversations. In order to determine what kinds of ambiguities actually occur in spontaneous dialogue, we examined these conversations and made a rough catalogue of the ambiguities they contain. By better understanding actually occurring ambiguities, it may be possible to anticipate more accurately the nature of the difficulties that ambiguity presents to language processing systems.

In addition, because of a peculiarity of one of the experiments, we were also able to examine speakers' corrections of their utterances, including utterances containing ambiguities. This raises the question: will speakers spontaneously correct their own ambiguities if given the chance? If speakers do disambiguate their own utterances with minimal prompting or instruction, this could significantly affect the way that we approach dealing with the presence of ambiguities in language processing input.

Right from the start, several words of caution are in order. First of all, these ambiguities were collated by hand. This means that the recognition of these ambiguities is prey to the same subtle cognitive processes that allow humans to "automatically" disambiguate the vast majority of ambiguities they encounter in everyday language interactions. When one person tells another that she "is going to the bank," there is rarely a reason to ask if she means "the side of a river" or "a financial institution." Thus, while we made every effort to uncover all possible ambiguities, there is no guarantee that our own cognitive disambiguation processes did not kick in and prevent us from discovering all of them.

Second, in the context of automatic language processing, the definition of "ambiguity" is itself unclear. We would prefer to define an ambiguity as a linguistic item (word, phrase, utterance, or sentence) for which a parser returns more than one analysis. However, this approach is fraught with difficulties. There are many reasons why parsers return more than one analysis for a structure and in many cases these analyses may be equivalent from the practical point of view of rendering a translation or otherwise processing the utterance. (The extreme of this situation is the case in which an ambiguous word (or phrase) in one language can be translated into a similarly ambiguous word (or phrase) in the other.)

In addition, we are far from the stage in which we have a parser useful for defining ambiguous expressions, let alone from the point at which we can distinguish trivial "ambiguities" from significant ones. It is for this reason, of course, that we extracted the ambiguities in our corpus by hand. However, as we did so, we tried to be guided by our concept of what a fairly straightforward linguistic analysis of each utterance would yield, and whether an analysis that did not have extensive access to some "world knowledge" or "context" database would be able to "decide" upon a unique representation for an utterance. Where it seemed that a fairly simple-minded approach to parsing would yield more than one (substantively different) analysis, we selected the utterance as an ambiguous one.

Below we describe the nature and occurrence of these ambiguities. We then examine the issue of whether speakers naturally disambiguate their own utterances..

The corpus

In order to test a multimedia interface for machine translation developed at the Interpreting Telecommunications Research Laboratories at ATR in Japan, we conducted three experiments to record spontaneous conversation using the system. In the first experiment, subjects acting as "Clients" were instructed that their task was to get directions to the site of a conference they were "attending" by engaging in a cooperative dialogue with the "conference Agents." In this first experiment, the subjects, both "Clients" and "Agents," were native speakers of American English, and their interaction was human-human. In two further experiments, native American English-speaking Clients interacted with Japanese-speaking Agents, both to get directions and to make hotel reservations. In one of these experiments, each conversation was mediated by one

human Interpreter (translating both English-to-Japanese and Japanese-to-English); in the other, by a simulated automatic machine translation system utilizing two interpreters; one English-to-Japanese and one Japanese-to-English ("Wizard of Oz" style; see (Fais and Loken-Kim, 1995) and (Fais *et al.*, 1995) for further details concerning these last two experiments). We will refer to this latter setting as the "machine-interpreted" setting, or as "human-machine interaction," and to the interpreters in this setting as "Wizards;" keep in mind, however, that translation was actually done by trained interpreters mimicking a computer-based system. The "Wizard-of-Oz" style introduced some complexity into the interaction that allowed us to examine whether speakers self-disambiguate, and will be discussed below. In each of the three experiments, subjects also interacted in two modes: via a standard telephone, and via a computer-based, multimedia environment in which subjects could interact by voice, text, and drawing (Loken-Kim *et al.*, 1993). Descriptive statistics for all three experiments appear in Table I. The experimental configurations are shown in Figure 1.

Ambiguity corpus

Once the conversations had been collected and transcribed, we examined the transcriptions for ambiguities. A representative list of the ambiguities found appears in Appendix A. Particularly in the case of polysemous ambiguity, there were numerous instances of the same type of ambiguity; only one or two typical instances are listed in the Appendix. Indeterminacy of pronoun reference was not included in our list of ambiguities, although a few examples did occur in the data, nor were ambiguities due to ellipsis.

We used the classification system modified from Blanchon (1994) to label types of ambiguities.

These categories were motivated by the need for structurally stable patterns for automatic recognition of ambiguities. The mechanism for this process is discussed in Blanchon (this volume). These categories are also used in the experimental data reported in Blanchon and Fais (this volume). Table II gives the list of syntactic types, their abbreviations as found in Figure 3 below and in the Appendices, a short explanation, and an example.

We have alluded above to the ability of speakers to "automatically" resolve ambiguities such that they do not form an obstacle to communication. It may be interesting to note as an aside, the actual cases in the data in which misunderstanding *did* arise between the conversants, and to examine whether ambiguous expressions were involved. There were three such cases, one in each of the three experiments, as it turned out. The first turns on a combination of a syntactic class ambiguity involving "stop" and a mishearing of the word "does." When the Client asks the agent "where **does** the bus **stop**...?" the Agent hears it as "where **is** the bus **stop**," and a lengthy discussion is required to clear up the misunderstanding[1]:

C(lient): OK and out of curiosity where does the bus stop (on) on this map {is it} closer than the [train] station
A(gent): {/breath intake/} the bus stop is actually down this way (it's) it's a little bit off the map to the south
C: [oh] the number five bus
A: yes (number) and thi [uh] number five bus makes its first stop at thi International Conference Center
C: [oh] but what I mean is the bus stop for the conference center is closer to the conference center than Keage station {where}
A: {no} the bus stop is off the map

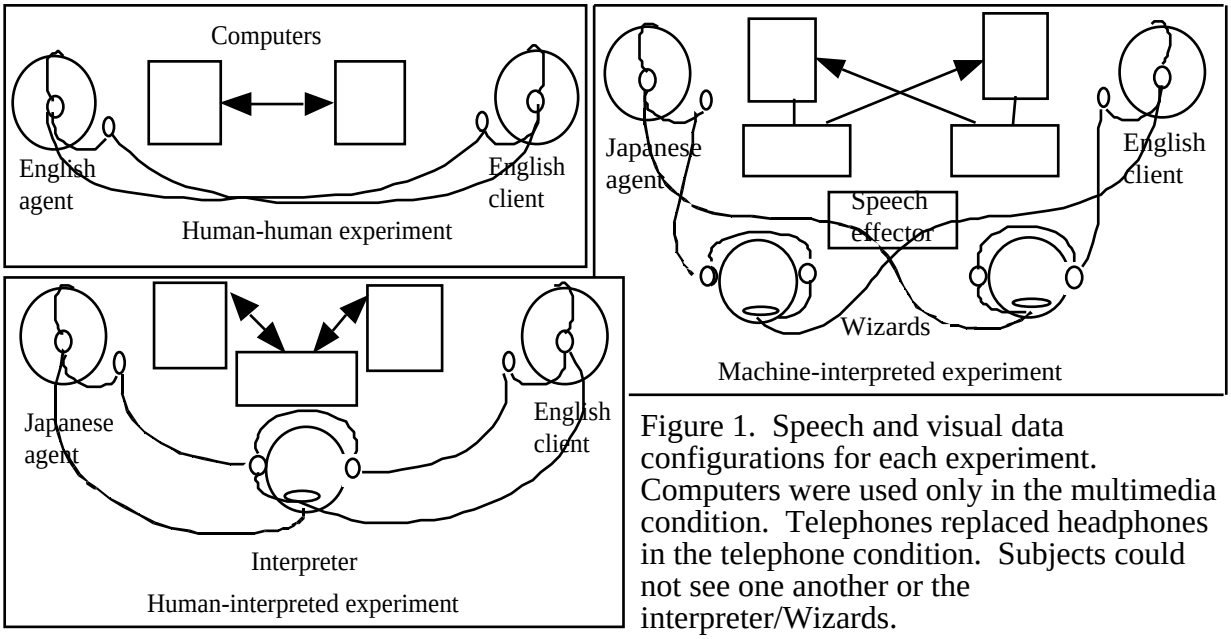

Figure 1. Speech and visual data configurations for each experiment. Computers were used only in the multimedia condition. Telephones replaced headphones in the telephone condition. Subjects could not see one another or the interpreter/Wizards.

	English subjects	Japanese subjects	Task	# Words English
Human/human	12	0	direction-finding	12,342
Human-interpreted	9	5	direction-finding; hotel reservation	9,513
Machine-interpreted	10	10	direction-finding; hotel reservation	12,636

Table I. Description of the three experimental settings.

C: +oh+
A: +off the+ map
C: so I'd have to walk that far
A: yes {(if yu)}
C: {after the bus}
A: yes
C: so there isn't a bus that stops on that road
A: well the [ah] bus number five will take you all the way to thi International Conference Center (is
{is that})
C: {right in fr}ont of it
A: yes it will stop at the {Conference Center}
C: {oh right tha}t's what I +meant+
A: +will take+ you {right to} the conference center
C: {right} oh +OK right+
A: +that's correct+

The ambiguity involved in the misunderstanding in the human-interpreted experiment is a "classic" subordination ambiguity:

Interpreter: [ah] You have to go to **number five bus stop** number five
C : Bus stop number five or bus number five

The misunderstanding in the machine-interpreted experiment arose from an ellipsis, which we are not treating here:

C: [um] How much by bus?
Wizard: Five hundred yen
C: No, no, no, how much time by bus?

Of course, compared to the actual incidence of ambiguities which we discovered in the corpus, the instances in which true misunderstanding arose are rare. However, these conversations all involved human speakers, bringing to bear not only linguistic but also world knowledge. In the case of automatic machine translation, on the other hand, not only is the contribution of outside knowledge limited, but also, the translation may crucially depend upon distinguishing among ambiguous possibilities which humans resolve easily. Thus, "machines" will of course encounter many more difficulties than humans in processing ambiguities.

Results

Figure 2 shows the average number of ambiguities per 100 words in each experimental setting. A few comments can be made concerning these results. The highest frequency of ambiguity occurred in the human-human setting, while the human-interpreted and machine-interpreted settings were both significantly lower ($p < 0.007$). This could be similar to the trend seen for disfluencies, in which speakers tend to "clean up" their speech in a machine interaction (Suhm *et al.*, 1994). That is, speakers faced with a communication channel complicated by interpretation might attempt to speak more clearly, including avoiding phrases that could be ambiguous. However, this is simply conjecture; there is no way to determine from these data whether speakers were actively eliminating ambiguity in these settings or not.

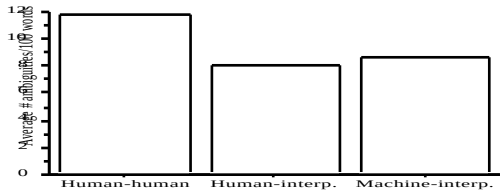

Figure 2. Ambiguities per 100 words for each experimental setting.

Coord. CO	Coordination	Interpretation of conjoined phrases as in "Medieval food and drink." – medieval drink, – not medieval drink.
Decor D	Decoration	Problem with the function of a phrase as in "You should go **by** the highway" – go next to the highway, – go via the highway.
Phr. verb PH	Phrasal Verb	Interpretation of a phrasal verb as in "**Take** it **from** me." – remove it from me, – believe me.
Poly. P	Polysemy	A word with several senses such as "**bank**." – river side, – financial institution
Subord. S	Subordination not involving the verb	Subordination of phrases not involving a verbal phrase as in "He is a **thin film technologist**." – thin film, – thin technologist
Subord./verb SV	Subordination involving the verb	The complementation of the verb is not certain as in "He brought a bottle of wine **from France**." – a bottle of French wine, – a bottle, brought from France, of wine
Synt.class SC	Syntactic class	Ambiguity of syntactic class as in "She washes her face and **dresses**." – She washes her dresses, – She dresses.

Table II. Categories of ambiguities, their abbreviations, descriptions, and examples.

While these results reveal the general picture, a breakdown of the frequency of ambiguities by type for each setting yields some interesting differences (Figure 3).

The general trend, that is, a greater number of ambiguities in the human-human setting and fewer in each of the interpreted settings, holds for most categories, with the clear exception of subordination. The frequencies for the subordination type of ambiguity are inflated by the disproportionately frequent use of the phrase "International Conference Office," which is the goal of the direction-finding task and a subordination ambiguity. That phrase alone makes up 66% of the subordination ambiguities for the human-human setting; 47% for the human-interpreted setting, and 62% for the machine-interpreted setting. However, even with these phrases excluded from consideration, the human-human setting still has an atypically low rate of subordination ambiguities (Figure 4).

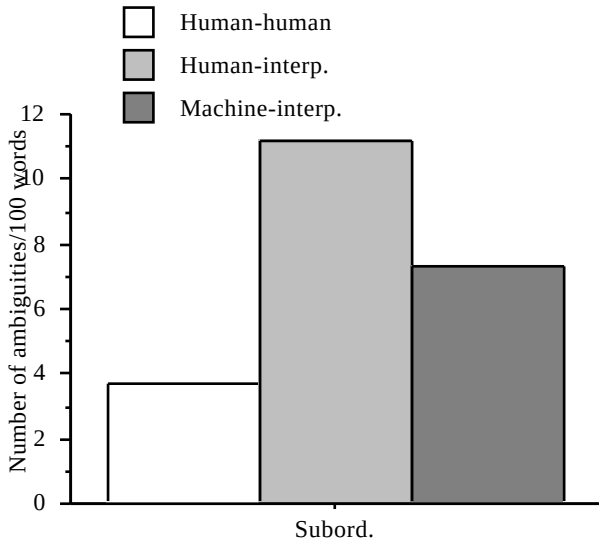

Figure 4. Number of subordination ambiguities in each experimental setting.

This seems to be a byproduct of the nature of the tasks in these experiments. In the two interpreted settings, but not in the human-human setting, subjects made hotel reservations in addition to getting directions. A disproportionate number of the subordination ambiguities found in the data from the two intepreted settings has to do with the hotel reservation task (see Appendix A for examples.)

Some recommendations suggested by these results

A rough examination of the types of ambiguities encountered in the corpus leads to some suggestions for reducing the frequency of certain types of ambiguities. The high frequency of particular phrases involving ambiguities suggests that any automatic disambiguation system should be customizable. In this case, users should have the option of determining early on in the interaction the preferred sense of "International Conference Center," for example (and possibly other examples like "Japanese style hotel," which also occurred quite frequently inthe interpreted experiments), so that they are not prompted for its meaning each time they use the phrase. The preferred sense for certain polysemous words, also, can be determined early on; "**check in** to the hotel" is one example in this corpus.

In addition, the use of context could help to resolve some examples of syntactic class ambiguity, such [1]:

[1] Interpreter: Would you prefer to go by bus or taxi
Client: **Taxi** (SC)

Reference to the previous utterance allows us to choose between "noun" and "verb" for the part of speech of the single word utterance "Taxi."

These suggestions may reduce the frequency of two of the three most frequent classes of ambiguities: subordination ambiguities and polysemy (see Figure 3). The third most frequent class, however, is the set of subordination ambiguities involving the verb. These strategies would

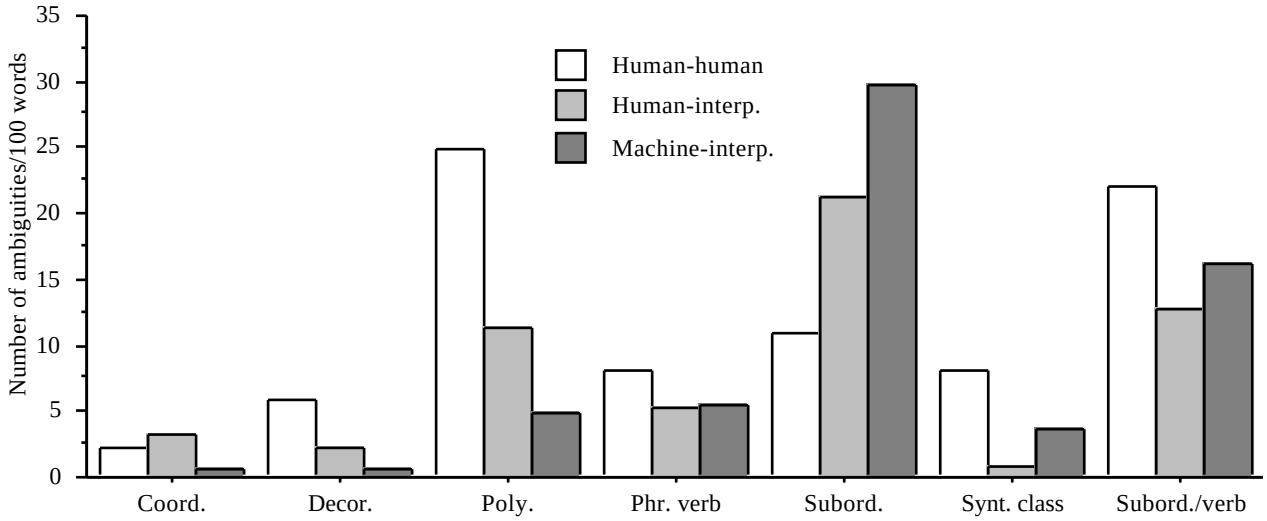

Figure 3. Number of ambiguities in each experimental setting, by category.

have no effect on this set, which is recognized as one of the most difficult types of ambiguity to resolve. It seems clear that for this and other types of ambiguity, it is necessary to consult the speaker of the utterance in an interactive context in order to fully disambiguate it.

Simple repetition as a disambiguation strategy

Recall that the machine-interpreted experiment involved a Wizard-of-Oz style setting. As part of our attempt to make our subjects believe they were interacting with an actual machine translation system, we instructed the "Wizards" to simulate lack of understanding if the subject's utterance was too long, disfluent or complex. In these situations, the Wizard asked the subject to "please repeat." Subjects used a wide range of strategies to clarify their utterances (Fais *et al.*, 1995); here we will focus on those utterances which included ambiguous expressions.

In the data for the machine-interpreted setting, there were a total of 161 requests by the Wizards for clarification. Of these, 42, or approximately 26%, involved ambiguities. These are listed in Appendix B. There were 44 ambiguities in these 42 contexts (two repetition contexts involved two ambiguities each). In 22 cases (50%), the ambiguities were eliminated in the clarification utterance. On the other hand, in 17 cases (39%), the ambiguity either remained (15 cases; 34%) or was changed to a different ambiguity (2 cases; 5%). There were also instances in which utterances *before* repetition requests did *not* include ambiguities, while the clarification utterances did. That is, in these instances, subjects introduced ambiguities in their clarification utterances. There were five such examples in the data (11% of the requests for repetition).

We would not suggest that ambiguity be clarified simply by asking the speaker to repeat his/her utterance. Subjects expressed frustration at being asked to repeat their utterances even at the low rate of repetition request found in the corpus (1.7 requests for repetition per 10 turns); if they had been asked to repeat every utterance that contained an ambiguity, they may not have even completed the task. There were six ambiguities per 10 turns in this experimental setting; asking for repetition of every utterance containing an ambiguity would have resulted in asking for repetition of approximately every other utterance. However, as a "last resort," simple clarification may be a somewhat useful strategy. It is encouraging that simply requesting repetition resulted in the elimination of the ambiguity in 50% of the cases.

However, this may simply be a random strategy. That is, there is no evidence that subjects recognized that the "machine's" difficulty in understanding their utterance stemmed from an ambiguity and thus took steps to correct it. At best, in some examples, it seems that the subject understood that there was something wrong with the wording of the utterance and thus made major changes in the wording which also eliminated the ambiguity. Whether subjects knew that an ambiguity was present or whether they thought that the "machine" could not understand the structure or vocabulary they used is not at all clear. Examples [2] through [4] illustrate this type of clarification:

[2] C: Yes, so **one single room** from October [um] twenty-fourth through the twenty-eighth
WOZ: Please repeat (S)
C: OK, [um] yes, a single room for one person

[3] C: [ah] (I) I think I'll **pass on** breakfast
WOZ: Please repeat (PH)
C: [um] [ah] (no) No thank you, (I) I don't want breakfast

[4] C: [ah] (is it thi) Is it a straight walk or should I take a taxi or **bus**? (SC)
WOZ: Please repeat
C: (what's the) What's the best way to get there?

On the other hand, there are certain ambiguous expressions which are also standard for the context of the conversation; subjects would not voluntarily change these expressions unless it were specifically brought to their attention that they were ambiguous. These expressions include the "International Conference Center" and "check in." In fact, one subject *introduced* an ambiguity into her clarification utterance by using "International Conference Center;" she probably thought that, in fact, she was making her utterance clearer by being more specific in her reference:

[5] C: {I;I;I} am at Kyoto Station and I need to get some directions to a conference in Kyoto. Can you help me?
WOZ: Please repeat
C: Hello, /ls/ I want to find out how to get to thi **International Conference Center in Kyoto** (S)

Another subject created exactly the same situation with "check in":

[6] C: [ah] When [ah] can I check in? (it's [ah]) It's morning now
WOZ: Please repeat
C: When can I **check in** to the hotel, what time? (PH)
WOZ: Please repeat
C: What time can I **check in** to the hotel? (PH)

Subjects tended to cut out unnecessary expressions (or sometimes even necessary ones) in their clarification utterances; this tendency toward simplification was the dominant clarification strategy (Fais *et al.*, 1995). Sometimes, ambiguities were eliminated as a consequence of this simplifying:

[7] C: [ah] Yeah I'd like to **check out** October thirtieth (PH)
WOZ: Please speak slowly
C: [ah] Until the thirtieth

And, occasionally, subjects would change utterances altogether, and the change would eliminate an ambiguity:

[8] C: But that **says** Keage. Is Keage Keitsu? Are they the same? (P)
WOZ: Please repeat
C: [um] I don't see Keitsu on the window. Where is Keitsu? (can you sh)

Thus, the strategies used by subjects to clarify utterances sometimes have the effect of eliminating ambiguities. Some of those cases in which they tend to introduce ambiguities are also those which we suggested above should be "pre-set" by the speaker ("International Conference Center," and "check in," for example). If that is possible, then simple clarification may be a somewhat useful last resort for ambiguity resolution.

Summary

We have examined in some detail the occurrence of ambiguities in three different corpora of spontaneous, task-oriented dialogues. It is encouraging to note that subjects seemed to utter fewer ambiguities in interpreted contexts, whether the interpreters were human or machine. Further, it is possible to single out some domain-specific examples which would benefit from the capability to set pre-determined interpretations for certain ambiguities. Likewise, the use of contextual clues may have a beneficial effect on ambiguity resolution.

We were able to explore also, the question of whether speakers would automatically eliminate ambiguities if simply asked to clarify their utterances. In fact, they did so in 50% of the cases examined, though they also introduced ambiguities in a small number of cases. However, it is not clear that the elimination of ambiguities was a conscious strategy; at best, the fear of ambiguity may have motivated *some* changes made by the speakers, at worst, the elimination of ambiguity was a fortuitous outcome of the simplification strategies widely employed in clarification. In either case, however, we conclude that, while not by any means a solution to the problem of disambiguation, request for clarification is useful enough to be used as a last resort in an interactive disambiguation context.

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Appendix A: List of Ambiguities

Each example is prefaced by abbreviations which locate it in our corpus. "MM" refers to the multimedia setting; "TL" to the telephone setting. The initials following those letters are those of the subject acting as the Client in the experiment. A following "C" signifies that it was a Client utterance; an "A" signifies an Agent utterance.

The fact that the list of ambiguities for the last set (machine-interpreted experiment) is the shortest, does not reflect a necessarily smaller number of ambiguities; rather it reflects the fact that that experiment contained repetitions of ambiguities already listed for previous experiments which were excluded from the list for the machine-interpreted experiment.

Human-to-human setting; same language

CO	TL	BL	A	...you can just [uh] tell him that you're trying to get to thi International Conference Center and it should be about a twenty minute ride
D	MM	EW	A	...you've come in **on** thi second platform so we're right about here
D	MM	MS	A	...you can pay for it **right** on the bus
D	TL	AM	C	oh hello I'm calling **for information**
D	TL	BM	C	{/breath intake/} hi I **just** arrived in Kyoto
D	TL	FP	A	you'll {want} to leave **by** exit number six
D, P	TL	AM	A	...that will be east if you **just** walk **right** out of the main doors of the sta{tion}
P	MM	AM	A	yes bus five should **leave** every half hour
P	MM	AM	C	right OK (so) and it's one hundred yen including the **change**
P	MM	BL	A	and **change** subways to thi Keihen-Kyotsu Line
P	MM	BL	A	and then I'll show you the **blow up** of thi station
P	MM	BL	A	so let me **go** to thi station and
P	MM	BL	A	so you can [ah] **catch** the subway
P	MM	BL	A	you're going to **take** the [n] subway north
P	MM	EM	A	you're at Kyoto station and you can travel a number of different **ways**
P	MM	EM	C	OK and how **long** will the ride be
P	MM	JL	A	...there you can **pick up** a taxi
P	MM	MS	C	...do they **make** change on the bus
P	MM	MS	C	{[umm] I} am on the first floor and that's about all I can **tell**
P	TL	AA	C	{(how mu}ch) how much is the **bus**
P	TL	AM	C	How many **stories**
P	TL	BL	A	thi [uh] **taxi** costs ten thousand yen
P, PH	MM	AA	A	OK let me **call up** a map here and this will help you OK you're at Kyoto station I will **draw up** [th] map of Kyoto station
PH	MM	BL	A	{([z])} do you [ah] wanna **go over** that again or
PH	MM	EW	A	well it's difficult to **get out of** Kyoto station
PH	TL	EW	C	OK thats fine I thi{nk} I **got** it +**straight**+
S	TL	BL	A	..that is where the **main ticket office** is
S	TL	BL	C	/breath/ yes I'm trying to find my way to thi **International Conference Center**
S	TL	EW	A	{theres} only one platform and the trains are **only** going in one direction
S	TL	MS	A	{[uhuhn]} yes [ah] this is an English speaking agent (English law professor)
S, SV	MM	MS	C	...I'm trying to figure out how to get to thi International Conference Center...where [um] the conference is **I believe**
SC	MM	AA	A	Good morning **conference office**
SC	MM	AM	A	/ls/ the bus ride is **about** five hundred yen
SC	MM	BM	A	OK the quickest route would really be taking a taxi
SC	TL	BM	A	{line} and you can catch that at the second **level** floor platform
SC	TL	EW	C	{OK} (and that so that) I take **that** [um] one stop
SC, SC	TL	AM	A	Let me get those maps out OK [ah] you can travel by **subway bus** or **taxi**
SV	MM	AA	A	OK Kyoto station is located in the south part of the map **right here**
SV	MM	AA	A	OK [ah] so you can cross the street **from the station**
SV	MM	AM	A	...going to go directly across the street **to the middle** of the bus station
SV	MM	BL	A	...we can [ah] show you where you are **in relation to transportation**
SV	MM	BL	C	[um] yes I'm calling about thi [ah] International Symposium on Interpreting Telecommunications **right now**
SV	MM	BM	A	and thi taxi stand is located to the north of the train station [ah] **to thi [ah] east of the bus stop**

SV	MM	EM	C	OK [umm] where can I catch a taxi {**from Kyoto Station**}
SV	TL	AA	C	I think subway sounds like the best way **to me**
SV	TL	BL	A	that's where you can pick up a taxi **as well**
SV	TL	MS	A	{/breath/} OK let me pull up my maps **to help you here**
SV	TL	MS	C	...{it} says here **on my flyer**
SV, P	MM	BL	A	OK I'm going to [ah] tell you **roughly** how you're gonna go

Human-interpreted setting; bilingual

In this list, "C" refers to the Client; "I" refers to the Interpreter.

CO	MM	JB	I	So as I said there's a swimmin pool and also the gym that you can go and train
CO	MM	KK	C	[ah] (is) Is that like an international hotel they're going to have like regular western beds and regular western toilets and stuff
CO	MM	WW	I	All right then can I ask you to please type in your name and the telephone number
CO	TL	GH	C	OK if possible I'd like a room with a large double or queen size bed
CO	TL	KS	C	OK but is there like a restaurant or something in the hotel or nearby where I'll be able to eat
CO	TL	RC	I	K [um] so if you standing at outside a gate you should be able to see the sign saying exit whatever maybe the number or the name
CO	TL	WW	C	is there a train or bus or something from here
CO	TL	WW	I	Well there are many temples and castles like kinkaguchi temple or nijojo castle
CO,	MM	KS	I	K could I ask you to type in your full name and your telephone number either at your office or home
CO,S, SV	MM	KK	C	...am I going to be eating like a *Japanese style breakfast* **with fish** and stuff
D	MM	BB	C	Can you spell **that** for me
D	TL	WW	C	{I;(he);I} Hello is this reservations **for** hotels
D, SV	TL	KK	C	Yeah [um] my name is [ah] Tex and I'm **stuck down** here at Kyoto Station
D, SV	TL	KS	C	OK so I go **straight up** the stairs **in front of me** [uh]
D, SV	TL	KS	I	Yes [ah] **go out from** the gate ten **where you are**
D,SV	MM	KS	I	If we could [ah] we like to be [ah] making such arrangement **for you also**
S	MM	GH	I	They should have **Japanese style rooms**
S	MM	JB	I	July the seventh through fourteenth for two **in one twin room**
S	TL	EB	I	{C1;You;C1} should tell him the name of the temple **which is nanzenji**
S	TL	EG	C	is it possible to get a room in a hotel **close to the conference center**
S	TL	JB	I	K fifteen thousand per night **including breakfast**
S	TL	JB	I	[ah] Five minutes [ah] by taxi **from the [ah] conference center**
S	TL	KK	I	[ah] Then a **double bed room** will be fine
S	TL	KS	C	OK so this is like at the bottom of the stairs there's a gate **on the left**
S	TL	KS	C	Yeah that's right I'd like to do some sightseeing the day after the conference **before I leave**
S	TL	WW	I	[ah] You have to go to **number five bus stop** number five
S,SV	MM	JB	C	I'm calling from the Kyoto Station and I'm looking for a hotel reservation **near** the **International Conference Center**
SC	MM	BB	C	[um] I'll go by bus and **train**
SV	MM	GH	I	...you should be able to enjoy jogging **around there**
SV	MM	KK	I	You will see many taxis **waiting** there so you can get on the taxi there
SV	MM	KS	C	OK yeah I can see the top of the stairs **there**
SV	MM	WW	I	All right then I'll make sure you will have your reservation **at the Royal Hotel**
SV	MM	WW	I	Do you know where you can **get on** a taxi at the Kyoto Station
SV	MM	WW	I	{C1;But;C1} [ah] the Royal Hotel will be more convenient for the transportation because you can get on the Keihan Line **from the hotel**
SV	TL	GH	C	K [um] if you are staying in a room **with one large bed**
SV	TL	GH	I	Well it has a very good environment and we're sure that you'll [um] enjoy some sightseeing **around there too**
SV	TL	KS	I	And when you come to the end of the overpass [ah] you see the stairs to go down **on your right hand** side
SV	TL	KS	I	{C;And;C} I'm sure that you'll be able to find some good Japanese restaurants **also**
SV	TL	KS.	I	[ah] Could you exit **out from** [ah] the shinkansen

SV	TL	WW	I	That's right yes that's where you **get on** the bus
SV, D	MM	WW	C	OK let me give you my number **here then**[ah]
SV, S	TL	DF	C	...I'd [ah] like to make a reservation at a hotel **nearby if possible**

"Machine"-interpreted; bilingual

In this list, "C" refers to the Client; "W" refers to the "Wizard."

D	TL	ER	C	OK, [um] should I make a [um] deposit **with** my credit card? (p 86)
S	MM	AC	C	/breath/ OK, do I wait for bus number three at the **sightseeing bus stop**
S	MM	SS	W	Yes, OK **adult single room**
S, CO	MM	AC	C	I would like a **small Japanese style hotel** near shops and restaurants| please
SC	MM	RD	C	Can I do it **all over** again?!
SC	TL	LF	C	[ah] **Taxi**
SC	TL	NO	W	You can **go in** about twenty minutes
SC	TL	RG	W	Will you come by bus or **taxi**?
SC	TL	RP	C	OK, [ah] that's **all right**.
SV	MM	AC	C	Can you please draw the directions **on your map**?
SV	MM	AC	C	Can you see my location **now**?
SV	MM	DP	C	OK, can you book me a room **for three nights**, starting tonight?
SV	MM	DP	C	OK, [ahum] what do I tell them, where do I tell the taxi to go?
SV	MM	RG	C	/ls/ Yes, I see the map, so you want me to follow thi arrow **into (thi) this taxi stop**?
SV	MM	RG	C	I'm standing at thi mark **near thi Kintetsu Line**
SV	MM	RP	C	[ah] How much does a taxi cost **to thi Conference Center**?
SV	TL	AN	C	...so how long would it take from the station **here**? (cf p 74)
SV	TL	NO	W	Yes, please ride bus five **to Sanjo Keihan Station**
SV,S	MM	SS	C	/ls/ So, also I need information about a hotel **for the weekend**

Appendix B Ambiguities in requests for repetition

The first column describes the ambiguity present and the effect of clarification. For example, "SV->Ø" signifies that a subordination ambiguity involving the verb has been eliminated in the clarification utterance. Likewise, "Ø->D" means that an utterance containing no ambiguity was "clarified" into an uuterance containing a decoration ambiguity. "P->P" means that a case of polysemy remained even after clarification. The other abbreviations are as in Appendix A.

SC->Ø	TL	AC	C: Is that M Y A K O, **Myako** WOZ: Please repeat C: How do you spell Miyako?
Ø->PH-> PH	TL	AC	C: [ah] When [ah] can I check in? (it's [ah]) It's morning now WOZ: Please repeat C: When can I **check in** to the hotel, what time? WOZ: Please repeat C: What time can I **check in** to the hotel?
SC->Ø	TL	AC	C: **One** hyphen, four zero two hyphen, seven seven two hyphen, six three nine eight WOZ: Please repeat C: One, four o six, four zero, pardon me, I'll begin again. One, four zero six,
PH->PH	TL	AC	C: All right, I would like to **check in** to the hotel on October twenty-fifth and I would like to check out of the hotel on October twenty-seventh WOZ: Please repeat C: I would like to **check in** to the hotel on October twenty-fifth and I would like to check out of the hotel on October twenty-seventh
SV-> SV-> Ø->Ø	MM	DP	C: OK, [um] what do I tell them, **where** do I tell the taxi to go? WOZ: Please repeat C: OK, when I take the taxi, **where** do I tell the taxi to go? ![oh] that one, OK! WOZ: Please repeat C: /laugh/ [hum] /ls/ OK, I see which taxi stand. [um] (what) Which building do I say to the taxi driver? WOZ: Please repeat C: [um] /ls/ When I'm in the taxi, (how) [ah] where does the taxi go to?

SV->SV, SV->Ø	MM	DP	C: OK, can you book me a room **for three nights**, **starting tonight**? WOZ: Please repeat C: OK, I need a room **for three nights**. Can you book?
PH->Ø	TL	DP	C: That's correct. Does it **come with** meals, /ls/ how many meals? WOZ: Please repeat C: /ls/ That's correct. How many meals a day are included in the price?
P->Ø->Ø	MM	NO	C: But that **says** Keage. Is Keage Keitsu? Are they the same? WOZ: Please repeat C: [um] I don't see Keitsu on the window. Where is Keitsu? (can you sh) WOZ: Please repeat C: [um] Where is the Keitsu Line? Can you show me on the window?
Ø->D	MM	NO	C: OK, great. Thank you. [um] I want to rent a hotel room. [ah] Can you help me get a hotel room? WOZ: Please repeat C: [ah] Can you help me **with** a hotel reservation?
S, S->Ø->S	MM	NO	C: [um] Actually (I would) I would like a **traditional Japanese hotel**, a **traditional Japanese inn**. Is there one available? WOZ: Please repeat C: OK. [um] I would like to stay in a Japanese inn if possible WOZ: Please repeat C: [um] I want to stay in a **traditional Japanese hotel**
CO->Ø->Ø	MM	NO	C: [um] (is it OK if I) Can I arrive and leave my luggage (in the) in the lobby? WOZ: Please repeat C: [ah] Can I drop off my luggage so I don't have to carry it around all day? WOZ: Please repeat C: [ah] Can I bring my suitcase before three o'clock?
SC->Ø	TL	NO	C: [ah] (is it thi) Is it a straight walk or should I take a taxi or **bus**? WOZ: Please repeat C: (what's the) What's the best way to get there?
Ø->SV	MM	RG	C: I'm at thi Kintetsu Line. I'm putting a mark where I'm standing WOZ: Please repeat C: I'm standing at thi mark **near the Kintetsu Line**
SV->Ø	MM	RG	C: /ls/ Yes, I see the map, so you want me to follow the arrow **into (thi) this taxi stop**? WOZ: Please repeat C: I can follow this line **to the taxi stop**?
SV->S, SV	MM	SS	C: {I;I;I} am at Kyoto Station and I need to get some directions to a conference **in Kyoto**. Can you help me? WOZ: Please repeat C: Hello, /ls/ I want to find out how to get to thi **International Conference Center in Kyoto**
PH->PH	MM	SS	C: OK, so I will **check out** October twenty-seventh (a) at ten a.m. WOZ: Please repeat C: I will **check out** October twenty-seventh at ten a.m.
SV->SV	MM	SS	C: So I have a reservation October twenty-fifth and twenty-sixth **at the Miyako Hotel.** Is that correct? WOZ: Please repeat C: I have a reservation October twenty-fifth and twenty-sixth **at Miyako Hotel**. Is that correct?
P (3 senses) -> P (2 senses)	TL	SS	C: Walk twenty meters, turn **right** at the gas station, and then I will see the Conference Center? WOZ: Please repeat C: After I turn **right**, where do I go?
D->Ø	MM	AN	C: [um] OK, (I) I also need to [um] book a hotel room. Can you please advise me **on** a hotel room? WOZ: Please repeat C: Can you please advise me **on** a hotel room reservation?
SV->D->SV	MM	AN	C: [um] /ls/ OK, that sounds good, (I) I see where it is. [uh] Can you please make a reservation **for me**? WOZ: Please speak slowly C: Yeah, (I'd like to like) I'd like to make a reservation there **then** WOZ: Please repeat C: I would like to make a reservation **for that hotel**

D->Ø, SV->SV	TL	AN	C: [ah]OK, [um] [um] (kay) (I I'd, I'd I'd also) I also need to book a hotel room. Can you please [ah] advise me **on** a hotel room **near the Conference Center**? WOZ: Please repeat C: [ah] (I need a) I need to book a hotel room **near the Conference Center**. Can you help me? WOZ: Yes, there is thi Kyoto Royal Hotel
SV->SV	TL	AN	C: [um] OK, (can) Can you please make a reservation for me **for five nights** please WOZ: Please repeat C: Can you please make a reservation for me **for five nights**?
SV->Ø	TL	AN	C: [um] [well] [ah] /ls/ I'd like to go there now, so how long would it take from the station **here**? WOZ: Please repeat C: [ah] How long would it take to get there from the station?
S->S	MM	ER	C: So, [um] what is thi address of thi **International Conference Center**? WOZ: Please repeat C: What is thi address of the **International Conference Center**?
S->S (but less compli-cated)	MM	ER	C: Actually, I would like to stay in a **very traditional Japanese style hotel**. Can you recommend one? WOZ: Please repeat C: I would like to stay in a **traditional Japanese hotel**
S->Ø	TL	ER	C: Yes, so **one single room** from October [um] twenty-fourth through the twenty-eighth WOZ: Please repeat C: OK, [um] yes, a single room for one person
SV->Ø	MM	RP	C: OK, yeah, that's good. Yeah, please [ah] book me a room **for four nights** WOZ: Please speak slowly C: [ah] Yeah, that's good
PH->Ø	MM	RP	C: [ah] Yeah I'd like to **check out** October thirtieth WOZ: Please speak slowly C: [ah] Until the thirtieth
SV->Ø	TL	RP	C: (e) Excuse me, change lines **to where**? WOZ: Please repeat C: [ah] (do where) Where do you want me to change, at Keihan Station I get off the bus and then what do I do?
SV-> Ø->Ø	TL	RP	C: So (I) I would like to [um] spend [ah] maybe one hundred dollars **a night** {I2;if possible;I2} WOZ: {C2;Please speak;C2} slowly C: [ah] Yes, I'm looking for a place, maybe [ah] about one hundred dollars a night WOZ: Please speak slowly C: [ah] Yes, I would like a hotel that costs about one hundred dollars a night
SV-> SV->SV	TL	RP	C: OK, [ah] very good. [ah] Can you please book me a room for tonight, [ah] let's see, (tomo) tonight, [ah] and **for the next three nights**? WOZ: Please repeat C: [ah] Yes, (I would like to book a room in the Kyo) I would like you to book me a room in thi Kyoto Hotel **for tonight** through the {I;night of;I} WOZ: {C;Please speak;C} slowly C: OK, [ah] yes, please book a room **from October twenty-fifth to October twenty-ninth**
PH->Ø	TL	RP	C: [ah] (I) I think I'll **pass on** breakfast WOZ: Please repeat C: [um] [ah] (no) No thank you, (I) I don't want breakfast
SV->SV	MM	RD	C: I would like to find out how I can get to the Conference Center **from Kyoto Station** please WOZ: Please repeat C: I would like some information about how to get to the Conference Center **from Kyoto Station** please