Processing Customer Requests: An Analysis of the Estonian Dialogue Corpus

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Abstract

This paper describes the processing of customer requests by an information operator. The study is based on the Estonian dialogue corpus. Our future goal is to develop a dialogue system which would interact with a user in Estonian and process user requests automatically. The corpus analysis demonstrates that a number of linguistic cues can be found which can be used for automatic recognition of requests. Once a request is recognised, a frame corresponding to the given request can be filled in by the dialogue system, and a semantic grammar can be used for giving information to the customer, or for initiating a subdialogue.

1. Introduction

Several spoken dialogue systems (DS) exist that interact with a user in a natural language [1], e.g. flight reservation systems worked out in the USA, flight and train schedule systems developed in Europe, the Verbmobil meeting agreement system in Germany, a help desk and bus schedule system developed in Finland within the Interact project, etc.

Our goal is to build a DS which would give information in Estonian and follow the norms and rules of human-human communication. The main part of a conversation with such a DS is formed by questions and answers, requests and grants. In order to find out how humans use questions and requests, and how the formal features of these questions and requests depend on a specific language and culture, it is necessary to analyze naturally occurring dialogues. The acquired knowledge can then be used for automatic recognition.

In a previous paper [2] we analyzed Estonian information dialogues in order to determine the linguistic features that can be used in automatic recognition of various types of questions. We considered information questions (i.e. the questions that are used for requesting information) and the questions that initiate the dialogue where communication problems are solved. The study showed which structural types of questions (wh-question, open and closed yes/no question, question that offers answer, alternative question) were preferred in each case.

In this paper we consider requests, which we distinguish from questions. Our aim is to design a processing cycle of requests which can be implemented in a DS.

The computational models of dialogue act interpretation can be divided into two main classes [3]. The first class has been called cue-based or probabilistic. The idea is that the listener uses different cues (lexical, collocational, syntactic, prosodic, or conversational-structure cues) of the utterance to help them decide how to build an interpretation. The second class of models implements the inferential approach. Such models are based on belief logics and use logical inference to reason about the speaker's intentions.

In this paper, we combine the two approaches: first, we use linguistic cues for dialogue act recognition, and then, a frame corresponding to the act is activated and filled in, in order to interpret (understand) the recognized act, and to generate an appropriate grant.

This paper is organized as follows. In section 2 we give a brief overview of the empirical material and the method of analysis. Section 3 explains the difference between the notions of request and question. In section 4, we first discuss some linguistic cues of requests that we found as a result of our corpus analysis, and then we determine a frame of request. Section 5 investigates the structure of a dialogue which begins with a customer request. Section 6 discusses a dialogue model. Finally, we present our conclusions.

2. Empirical material

Our study is based on the Estonian dialogue corpus, EDiC[1]. The corpus contains about 800 human-human spoken

[1] http://www.cs.ut.ee/~koit/Dialoog/EDiC

dialogues. Over seven hundred of them are phone calls. The dialogue acts in EDiC are annotated using a typology which is based on the conversation analysis. This is basically a DAMSL-like dialogue act set, with minor variations [4]. There are about 120 different dialogue acts in our typology[2]. Each dialogue was annotated separately by two different persons (the total number of annotators was 8), and then the results were unified. Currently, a software tool (workbench) is being worked out with the aim of simplifying the corpus analysis [5]. The tool allows the user to choose a subcorpus and search it for specific words or dialogue acts, according to any combination of constraints from both the transcribed dialogue text and dialogue acts' annotations. Statistical reports can be generated for an entire dialogue corpus or for any subset. EDiC is accessible on the Internet via the workbench, but it is password-protected.

For the purposes of this paper, 144 phone calls (total 19,938 tokens) were selected from EDiC. Four situational groups are represented in the dialogues:

- 60 directory inquiries (phone numbers, addresses, etc)
- 36 calls to travel agencies
- 26 calls to outpatients' offices
- 22 calls for taxi.

Table 1 gives an overview of our empirical material.

Table 1. Overview of the corpus

Dialogue type	Number of dialogues	Number of tokens	Number of customer's requests
Directory inquiries	60	4,384	56
Travel agency	36	12,104	33
Outpatients' office	26	2,422	22
Taxi	22	1,028	20
Total	144	19,938	131

3. What is a request?

There are several dialogue act typologies; the best-known is DAMSL [6]. Our typology differs from DAMSL to some extent [4]. Crucially, in this paper we draw a line between directives and questions [7]. The main difference between the two categories lies in formal features. Questions make use of explicit formal features in Estonian (interrogative words, intonation, specific word order), whilst directives do not. Other information-requests (and directive-actions in the sense of DAMSL) are viewed as directives. For example, *Can you give me the phone of X?* is formally an open yes/no question (an indirect act where the simple answer 'yes' is insufficient), but *Give me the phone of X* is a directive.

Some other typologies, implemented for other languages, do not differentiate between questions and directives. For example, yes/no questions like *Could you help me?* have been viewed as requests in English and Finnish [8-11].

Why do we distinguish requests from questions? An argument for differentiating between them lies in the fact that it is harder for the addressee to refuse to perform a directive than answer *no* to a question. Thus, the speaker uses a directive if he expects the addressee to fulfil it. By asking a question, the speaker mitigates her request. Communicative goals of the speaker are different in either case. "The most common mitigation strategy in English is to be indirect, for example by posing the request in the form of the modal question (*can you, would you*). This […] allows an interlocutor the chance to choose to reply to the literal meaning and ignore the intended force. Many of these indirect forms are so conventionalized that the interrogative form makes only a small token gesture towards the hearer." [12]

We divide requests into two groups on the basis of the reaction expected from the addressee. The first group is formed by information requests – a customer needs a certain piece of information, e.g. a phone number. The other group comprises requests that presume an action by the addressee (to make an appointment with a doctor, to send a taxi).

In our corpus, customer requests are represented by information requests in directory inquiries and phone calls to travel agencies (e.g *ma paluks filo'soofiateaduskonna 'dekanaadi 'numbrit.*[3] */ I would like to ask for the phone number of the dean's office of the faculty of philosophy).* The requests that presume an action occur in calls to an outpatients' office or for taxi (*ma palun `taksot `Ringtee `kuuskend kaheksa `bee. / I ask for (request) a taxi to Ringtee sixty eight B).* At the same time, the action is accompanied by giving information: the operator informs the customer about her ability to perform the requested action, or about the successful completion of it (*jaa, takso tuleb teile / yes, a taxi comes to you*). If a customer calling to an outpatients' office or taxi service needs information, then she usually forms a question rather than using a request (*kas teil 'nihukest taksot 'ka on kuhu 'viis inimest peale mahuks. / do you have a taxi for five people?).*

4. Interpretation of requests

The goal of dialogue act interpretation is to determine the specific dialogue act that a given utterance realizes. In some cases, it is possible to classify the act by its lexical or syntactic form. For example, some questions in English begin with *wh*-words, commands have imperative syntax, etc. [8]

There are two main classes of computational models for dialogue act interpretation [3]. The first class has been called cue-based or probabilistic. It is motivated by intuitions on microgrammar [13]. The cue-based models consider interpretation as a classification task, which is solved by training statistical classifiers on labeled examples of dialogue acts. The second class of models implements the inferential approach.

[2] The acts are divided into two big groups – adjacency pair (AP) acts (e.g. question–answer) and single (non-AP) acts (e.g. continuer). Names of dialogue acts consist of two parts separated by a colon: the first two letters give abbreviation of the name of act-group, e.g. DI – directives, FR – free reactions; the third letter is used only for AP acts – the first (F) or second (S) part of an AP act; 2) full name of the act, for example, DIF: REQUEST, DIS: GIVING INFORMATION, FR: CONTINUER. The act names are originally in Estonian.

[3] Transcription of conversation analysis is used in examples, cf. http://www.cs.ut.ee/~koit/Dialoog/EDiC.

In this paper, we will propose a combination of the cue-based and the inferential approach. We use a cue-based model in order to determine the dialogue act type of an utterance, and then implement an inferential model to interpret the act.

4.1. Linguistic cues of requests

Our first aim is to determine which lexical and syntactic cues are used in requests in Estonian spoken dialogues. Estonian language belongs to the Finnic group of the Finno-Ugric language family. Estonian is an agglutinating language, but more fusional and analytic than the languages which belong to the northern branch of the Finnic languages. The word order is relatively free. A detailed description of the grammatical system of Estonian is provided by [14].

In the fraction of EDiC that we analyzed, most of the requests (88%) contained a verb. Therefore, we examined the verbs that were used in requests.

Table 2. Number of verbs and their features in requests

Verb	Mode			Total
	indicative	conditional	imperative	
soovima 'to wish'	2	33		35
paluma 'to ask'	12	13		25
tahtma 'to want'	3	7		10
ütlema 'to tell'			8	8
võtma 'to take'		6		6
vaja olema 'to be needed'		5		5
huvitama 'to interest'	1	3		4
panema 'to put'	1	1	2	4
teada tahtma 'to want to know'		3		3
andma 'to give'			2	2
huvitatud olema 'to be interested'	2			2

As our corpus analysis demonstrated, only a limited number of verbs (18) occurred in customer requests (cf. Table 2). The most frequent ones were *soovima 'to wish'* and *paluma 'to ask'* – 60 occurrences (46% of the requests which contain a verb). In addition, *tahtma 'to want'* and *ütlema 'to tell'* were used in 18 cases. These four verbs corresponded to 60% of usages. Five more verbs were used 3-6 times (altogether 22 times, or 17%). The remaining 9 verbs were used in 1-2 cases.

Certain modes and persons of a verb can be used in order to express a request, while others cannot. Some verbs cannot be used in institutional dialogues, because they represent too strong commands.

The verbs can be divided into two groups. In the first group, the imperative form is used in order to express a request (*ütle 'tell', pane 'put', anna 'give', vaata 'look'*). 14 requests (11%) in the corpus were expressed by the imperative form of those verbs. The indicative form of the same verbs can (only) be used in order to express a wish in a yes/no question (*kas te (ei) vaataks /annaks /paneks /ütleks 'would you (not) look /give /put /tell'*). However, questions are excluded from the current analysis.

In the second group of verbs, the first person of the conditional or indicative is used (*ma soovin /tahan /palun /võtan 'I wish /want /ask /take'*). 99 requests in the corpus were formed this way. 75 requests (75%) appeared in the conditional. The conditional has a special morphological feature *(-ks-)* in Estonian, which can be used as a cue for automatic recognition. The remaining 22 requests contained an indicative verb form.

The conditional in general is related to a request: it adds politeness. At the same time, some requests include an indicative verb form. Now there is the problem of determining the conditions which allow one to use an indicative verb form. The indicative is the universal form for declarative acts. In all the analyzed cases, it could have been used instead of the conditional, except in *huvitatud olema 'to be interested (in)'* (2 cases; cf. [14], [8]).

The indicative is the prevalent choice only in the case of the verb *paluma 'to ask' (*here: *'please')*. This word is also used as a politeness formula in Estonian, therefore its meaning already includes politeness and it functions as a mitigater in an utterance. Other usages of the indicative represent specific (exceptional) cases.

The position of a verb in an utterance is another cue for recognizing a request. In our analysis a verb started an utterance in 44 cases (40%). Another big group was formed by the utterances which begin with the pronoun *m(in)a 'I'* (38 cases). In addition, 21 utterances began with a particle, conjunction or adverb: *ku(u)le 'hear'* (in the imperative singular), *et 'that', aga 'but', äkki 'suddenly', palun '[I] ask' (*here: *please)*, followed by a verb. The verb takes the second position in the utterance, however, the preceding words do not belong to the sentence as a grammatical unit.

A conclusion can be drawn that certain cues exist in Estonian which can be used for representing requests:

- certain verbs
- certain forms – the conditional and imperative.

Verb semantics determines whether a verb can be used in a request. Formulas are used in certain situations:

- *palun/paluks '[I] ask /would ask', öelge 'tell', sooviks '[I] would wish'* in directory inquiries;
- *palun '[I] ask', sooviks '[I] would wish'* ordering a taxi;
- *sooviks '[I] would wish'* in calls to an outpatients' office.

Certain word forms are used in order to start a new topic, at the beginning of an utterance or after the pronoun *I*. Particles, adverbs and conjunctions can start an utterance.

4.2. Frame of request and semantic grammar

Once the type of a dialogue act is determined, the frame which corresponds to the act can be activated. The next task of the DS is to fill in the slots in the frame. In the case of a request, this means specifying the action *D* which the DS is expected to perform (cf. Fig. 1). In the descriptions of dialogue acts we represent two types of knowledge: the structure of the act (the static part), and the procedures that constitute the reasoning processes which underlie the generation and the interpretation of the act (the dynamic part).

Request (*A; B, D*)
I. Static part
Precondition: A believes that *B* is able to do *D*
Goal: B knows that *A* wants that *B* does *D*
Body: A informs *B* that *A* wants that *B* does *D*
Consequence: B knows that *A* wants that *B* does *D*
II. Dynamic part
Generation procedures (implemented by *A*):
Inform *B* that *A* wants that *B* does *D*
Interpretation-generation procedures (implemented by *B*):
(1) (to do *D*+) give information
(2) inform *A* that *D* cannot be done (+ argument)

Figure 1. Frame of request (*A* – author, *B* – addressee, *D* – action)

The reaction expected from the addressee can either be giving information or performing a physical action (which is accompanied with giving information about its results). The idea of adjacency pairs of dialogue acts is implemented in the frame: if the first part of an AP is a request (by *A*), then the second part will be giving information (maybe after an action was performed, e.g. a taxi was sent), or informing the partner that it is impossible to perform the request (by *B*).

Semantic grammars can help the DS to understand which action is expected (cf. [15]). For example, if the DS plays the role of a taxi operator then the semantic grammar can be represented as a frame which includes the slots 'address', 'customer's name', 'time', etc. In the case of a receptionist of an outpatients' office, it is necessary to fill in the slots 'patient's name', 'his/her ID code', 'doctor's specialty', 'doctor's name', 'reception time', etc.

5. How to grant a request?

Let us go back to the corpus analysis. In the following, we will consider only such dialogues which start with a customer request (after an introductory part). The number of such dialogues was 96 (from 144) in our analyzed corpus (Table 3). The remaining dialogues (those that start with a question) will not be considered here. However, some questions are quite similar to requests (e.g. *ma uurin millised oleks reisivõimalused Inglismaale 'I investigate which possibilities there are to travel to England'*), but an interrogative *millised 'which'* helps the DS to determine that it is a question{} rather than a request.

Table 3. Dialogues which start with a customer's request

Type of dialogue	Number of dialogues which start with a customer request
Directory inquiries	46
Travel agency	20
Outpatients' office	13
Taxi	17
Total	96

There are three possible continuations to the dialogue after a customer request: (1) the operator grants it immediately, (2) the operator initiates an information-sharing subdialogue, (3) the customer herself initiates a subdialogue. The first continuation is typical in directory inquiries and when ordering taxi – the needed action was performed and information was given immediately in 29 and 12 cases respectively (Ex. 1).

(1)
C(ustomer): (0.5) `öelge mulle palun `Tartus=õ (.) < `täiskasvanute `gümnaasiumi (0.5) number (.) `Veerikul. >
DIF: REQUEST
tell me please the number of the adults gymnasium in Tartu
(0.5)
O(perator): jah,
yes
(.) üks hetk?
a moment
(1.0) .hh `number on seitse neli kuus?
DIS: GIVING INFORMATION
the number is seven four six
(.)
C: jah?
yes?
O: üks seitse? (.) viis üks.
DIS: GIVING INFORMATION
one seven five one

In contrast, all the calls to an outpatients' office are of type (2) – the operator always initiates a subdialogue asking several bits of data about the patient (name – 9 cases, ID code – 5 cases, time – 9 cases, etc., Ex. 2).

(2)
C: sooviksin ikka siis järgmiseks nädalaks (.) sinna `neuroloogi juurde.
DIF: REQUEST
I would like to go to a neurologist the next week
(..)
O: ee (.) `Pohlamoosile jah?
to Pohlamoos, yes?
C: jah
yes
(..)
O: `isikukoodi öelge palun.
ID code please

In the phone calls to a travel agency, the customer gets an answer immediately if her goal cannot be achieved (6 cases, Ex. 3).

(3)
C: (.) sooviks `Norrasse sõita.
DIF: REQUEST
I'd like to travel to Norway
(.)
O: ää=ee
C: `jõu-lude ajal.
in advent
O: ei, kahjuks meie ei=tee sinna (.) sellel=ajal `reise.
DIS: MISSING INFORMATION
no, unfortunately, we do not organize trips there at this time

The operator started a subdialogue in 10 cases, and the customer herself did it in 8 cases (after the operator's acknowledgement *jah? 'yes'* which signals that she is expecting an adjustment, specification of the request).

Different information is required by the operator. In calls to an outpatients' office, the name, the specialty of the doctor,

the reception time, and personal data of the patient are needed, while in travel agency dialogues, the number and the age of travelers, the time and the duration of the trip are required.

It is quite typical of travel agency dialogues that a customer starts with a general request (*I would like to take a trip to England*), and then proceeds with a question-answer subdialogue specifying her request. She asks different questions about the trip (date, duration, price, accommodation, abatements etc.). This way, her initial (too general) request will not be granted by the operator directly, however, a sequence of answers to her questions can be considered as a grant.

Besides information-sharing subdialogues, clarification (or error correction) subdialogues can be found in our corpus. In conversation analysis, these correction subdialogues are called *repairs* [16]. A repair typically begins with a question that offers answer, and its function is clarification or reformulation [17] (Ex. 4).

(4)
O: ja sis=ee et=e kas (.) £ > kas=on võimalik teile programmi < `saata kuhugile.
is it possible to send you the programme?
(0.5) `emaili{ga} või `faksiga. £ | with e-mail or fax
C: ee on `küll võimalik [jah.]
it is possible, yes
O: [jaa?]
yes?
(1.0)
C: see=oleks=sis=ee `Berta=h? nõrga `beega,
it would be berta with b
(.)
O: * ahah *
eh
(.)
C: `punkt=`taru?
dot taru
(1.0)
O: jaa?
yes?
C: `ät `mail `punkt=`e-`ee.
at mail dot ee(3.8)
O: # `Berta? (.) `punkt `Aru? #
RPF: CLARIFICATION
berta dot aru?
(0.5)
C: `Taru, `teega. RPS: REPAIR
taru, with t
O: `Taru=jah?
taru yes?

Table 4 gives an overview of typical subdialogues. However, both *A* and *B* may initiate both kinds of subdialogues in several positions of a dialogue.

Table 4. Subdialogues of a dialogue

A: request *B: information-sharing* *A:* *B*: grant	*A*: request *B*: grant *A: clarification/ (error) correction* *B:*

6. Discussion

The results of the corpus analysis suggest that the regular grammar on Fig. 2 can be taken as the basis of interaction by a DS (cf [15]).

dialogue ::= conventional_beginning (**request (information-sharing)* grant (clarification)*)**$^{+}$ conventional_ending
grant ::= giving_information | missing_information | other
conventional_beginning ::= greeting greeting
conventional_ending ::= leave-taking leave-taking
information_sharing ::= question answer
clarification ::= question answer

Figure 2. Dialogue grammar

The DS recognizes a user's act on the basis of linguistic cues found in an utterance. Then it activates a frame corresponding to the dialogue act and fills in its slots. The act frame predicts how to generate its own utterance. The dialogue grammar provides the possible ways of dialogue processing and is also used for dialogue management. It is important for the dialogue manager to be ready to initiate subdialogues. For example, a user-friendly DS should be ready to start with the analysis of a user's general request, and then ask adjusting questions in order to explain her exact needs. As our analysis demonstrates, in calls to an outpatients' office, a customer tends to start with a general request, after which the operator asks questions in order to acquire the data which are needed for granting the request. In addition, such behavior gives an opportunity to the DS to reduce the problems of speech recognition.

Some experiments in automatic recognition of dialogue acts have been made at the University of Tartu. Neural networks have been tested by Mark Fishel [18] and decision trees by Taavet Kikas. Margus Treumuth has been implementing two simple web-based dialogue systems which interact with a user in Estonian[4] in cooperation with researches at the Institute of Cybernetics at the Tallinn University of Technology and the Institute of Estonian Language. The first of them gives information on flights which depart from the Tallinn Airport, and the second – of theater performances. Text-to-speech synthesis has been incorporated into the first DS, and both speech recognition and synthesis into the second. The results of the present analysis have not been implemented so far.

7. Conclusions

We have analyzed Estonian human-human spoken dialogues with the aim of designing a dialogue system. We have chosen 144 institutional dialogues (phone calls) from the Estonian dialogue corpus. Four situational groups are represented in the dialogues: 1) directory inquiries (phone numbers, addresses etc. have been asked), 2) to travel agencies, 3) to outpatients' offices, 4) ordering a taxi. In this paper we have concentrated on the processing of customer requests.

There are certain lexical and syntactic cues in Estonian which can be used for representation and automatic recognition of requests:

[4] http://www.dialoogid.ee/

- certain verbs
- certain forms – the conditional and imperative.

Verb semantics determines whether a verb can occur in a request. Formulas are used in certain situations:

- *palun/paluks '[I] ask, [I]would ask', öelge 'tell', sooviks '[I] would want'* in calls for information;
- *palun '[I] ask', sooviks '[I] would wish'* ordering a taxi;
- *sooviks '[I] would wish'* in calls to an outpatients' office.

Certain verb forms are used in order to start a new topic, at the beginning of an utterance, or after the pronoun *I*.

Particles, adverbs and conjunctions can start an utterance which represents a request.

After the DS has recognized a user request, it can activate a frame corresponding to the request and fill in the slots. This way, in our DS, we try to combine the two well-known methods of automatic interpretation of dialogue acts: the cue-based and the inference-based method.

The corpus analysis suggests that a simple regular grammar which includes subdialogues of two types can be used for dialogue management. When initiating a subdialogue, the DS activates a domain frame, and asks questions from the user, in order to fill in the slots in the frame. After this, the DS is probably able to grant the user request.

Our next aims are 1) to test the linguistic cues found in the corpus analysis in a system of automatic recognition of dialogue acts (using decision trees), 2) to test the suggested combination of cue-based and inference-based methods.

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