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Using large multi-purpose corpora for specific research questions: discourse phenomena related to wh-questions in the Spoken Dutch Corpus

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Abstract
In this paper, we investigate whether a dataset derived from a multi-purpose corpus such as the Spoken Dutch Corpus may be considered appropriate for developing a taxonomy of wh-questions, and a model of the way in which these questions are integrated in spoken discourse. We compare the results obtained from the Spoken Dutch Corpus with a similar analysis of a large random collection of FAQs from the internet. We find substantial differences between the questions in spoken discourse and FAQs. Therefore, it may not be trivial to use a general purpose corpus as a starting point for developing models for human-computer interaction.

1. Introduction
Over the past years the issue of data sparseness has received a great deal of attention. The almost insatiable need for data arose from the field of linguistic engineering as much as from the field of speech technology. Thus, a great many projects were initiated that were directed at compiling large collections of data. Since the compilation of corpora throughout the years has continued to be costly, both in terms of time investment and manpower, the creation of multi-purpose corpora has prevailed. Examples of corpora that have resulted from this approach are the British National Corpus (BNC; Aston & Burnard 1998) and the American National Corpus (ANC; http://americanationalcorpus.org/), while also the Spoken Dutch Corpus (Corpus Gesproken Nederlands, CGN; Oostdijk 2000) − although much smaller in size − fits this description. As in recent years it has been the availability and more specifically the quantity of data that has been at the centre of attention, the question whether the data are appropriate for the specific purposes for which they are employed has often been neglected. In the present paper, we report the results of a case study that was conducted and which aimed to address this issue. In this study it was investigated whether a dataset derived from a large multi-purpose corpus such as the Spoken Dutch Corpus may be considered appropriate for developing a taxonomy of wh-questions and a model of their discourse structure. Since the final goal of our work is the development of interactive spoken question answering, we report the results with an analysis of a corpus of questions obtained from a number of FAQ websites.

2. Background and motivation
Before we could even begin to try and answer the question raised above, it was clear that we needed to establish what kinds of question one would expect to find in the context of spoken QA. Unfortunately, there was no ready answer to this question. Given the present state of the art in the field of question-answering, current QA systems generally are directed towards handling written language input. Moreover, when we consider the nature of the questions that are being asked, it appears that they are mostly stand-alone factoid questions asking about who, what, where, when and how. One of the more recent developments here is that systems are required to handle series of related questions, where answers given by the system trigger follow-up questions, or where the system asks clarification questions before even attempting to find answers. Knowledge acquired in dealing with previous questions must then be employed in order to handle the current query. For the development of future interactive QA one might greatly benefit from a better understanding of how questions are embedded in spoken discourse. The question we address in this paper is whether a general purpose corpus such as CGN can be used for this highly specific type of discourse analysis. At the same time we aim at making an inventory of the spoken language phenomena that distinguish questions in spontaneous dialogues and conversations from those in interactions by means of a keyboard and screen. In this paper, we limit ourselves to the analysis of wh-questions.

3. Data collections
For the present investigation two data collections were used, viz. a subset of data from the CGN and a set of data collected from the internet. These are described in sections 3.1 and 3.2 respectively.

3.1. Data from the Spoken Dutch Corpus
Since the final release of the CGN was not yet available, we used the sixth intermediate release (CGN R6). From the data available in this release only the northern Dutch data were included in our present investigation. By means of the COREX exploitation software we first extracted all questions. This yielded an initial set of 38,101 instances. Through manual selection this set was reduced to include only wh-questions. This set was further delimited by requiring that questions should display the unmarked word order normally found in independent wh-questions. Thus included were questions like [1]-[2], while excluding instances like [3].

[1] wat betekent botanisch precies?
[2] (nu kun je zeggen van) hoeveel zouden d'r waarschijnlijk zitten aan Serven?

[3] wat betekent botanisch precies?
[2] (nu kun je zeggen van) hoeveel zouden d'r waarschijnlijk zitten aan Serven?

1 In order to maximize the number of questions that could be obtained and also to allow us to study how in spoken discourse questions are embedded, we decided to include not only independent questions but also dependent ones. However, only those dependent questions were included that answered to the word order criterion.
are the most frequent types of and hoe
r (77x241) these in reply to a question prompt like:
[77x252]declaratives. Characteristically, one would expect to find
[77x272]were in fact not questions in the form of an interrogative
[77x283]exploration it became apparent that a number of FAQs
[77x293]sites representing a variety of domains. From an initial
[77x303]from the FAQs sections of a random set of 104 internet
[77x314]questions one would expect to find in an IR/IE context,
[77x334]naturally spoken questions encountered in the CGN and
[77x358]3.2. Internet data
[91x345]In order to allow for a comparison between the
[91x194]
[91x90]daarvan vergroten?
[110x231]What seems to be problem?
[117x700]wh
[123x64]wh
[124x396]-questions in
[124x385]-questions like instances that were excluded
[210x473]35,246 93
[214x231](cf. exs. [6]-[7]).
[229x397]-questions
[236x241]How may I help
[240x397]-questions
[239x513]), and wie
[320x168]total 10,033 2,584 100.00 100.00
[320x276]Type of w
[320x376]wie:
[320x386]welk(e):
[320x397]gewat
[320x408]wat:
[320x418]wanneer:
[320x429]waarom:
[320x440]waarvan, waarvandaan, waarvoor, waarzo
[320x461]waarheen, waarin, waarlangs, waarnaar, waarnaartoe,
[320x482].
[320x524]), wannee
[320x596]-question as described in the
[320x596]literature (eg Donaldson 1997; Haeseryn et al. 1997; de
[320x609]Frequency and distribution

The prototypical wh-question as described in the
literature (eg Donaldson 1997; Haeseryn et al. 1997; de
Vries 2001) is introduced by a wh-element. The
wh-element is either an interrogative pronoun or an
interrogative adverb. In Dutch, wh-elements (pronomins
and adverbs) take on a variety of forms. We decided to
classify these in 7 major types: hoe (how), waar (where),
waarom (why), wanneer (when), wat (what), welk(e) (which),
and wie (who). Figure 1 gives an overview.

![Figure 1. Types of wh-question](image)

The distribution of question types is roughly the same
for the two datasets (cf. Table 2) and across various types
of speech: wat and hoe are the most frequent types of
question (cf. Table 3). Compound questions involving
more than one wh-element were classified as multiple.

<table>
<thead>
<tr>
<th>Type of wh-question</th>
<th>Absolute freq.</th>
<th>Relative freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CGN</td>
<td>WWW</td>
</tr>
<tr>
<td>hoe</td>
<td>2,792</td>
<td>1,014</td>
</tr>
<tr>
<td>waar</td>
<td>985</td>
<td>196</td>
</tr>
<tr>
<td>waarom</td>
<td>972</td>
<td>201</td>
</tr>
<tr>
<td>wanneer</td>
<td>307</td>
<td>80</td>
</tr>
<tr>
<td>wat</td>
<td>3,797</td>
<td>811</td>
</tr>
<tr>
<td>welk(e)</td>
<td>411</td>
<td>185</td>
</tr>
<tr>
<td>wie</td>
<td>672</td>
<td>51</td>
</tr>
<tr>
<td>multiple</td>
<td>97</td>
<td>46</td>
</tr>
<tr>
<td>total</td>
<td>10,033</td>
<td>2,584</td>
</tr>
</tbody>
</table>

Table 2. Frequency and distribution of question types across the two datasets

2 More accurately, a wh-element or a constituent (usually a
prepositional phrase) containing such an element. Deviant
structures may occur as a result of, for example, topicalisation
or the initial placement of conditional clauses.

3 Table 3 gives the relative frequencies for the four major text
types (components 1, 3, 5 and 14 in the CGN dataset
respectively; cf. Table 1).
4.2. Reduced questions

What goes undetected in the presentation of the frequency and distribution information as presented in Tables 2 and 3 is the role played by reduced wh-questions, ie questions in which essentially only the wh-element remains, while the verb and possibly other constituents are omitted. Examples are [10]-[12].

[10] in welk opzicht?
[12] naar wat voor quiz?

Such questions typically serve the purpose of obtaining clarification from the interlocutor for something that was introduced earlier on in the discourse. It is therefore no surprise that reduced questions occur most frequently in the more interactive text types of speech. In naturally spoken language, wh-questions are commonly embedded by means of the connective hoezo.

4.3. Introductory elements

In naturally spoken language, wh-questions are commonly introduced by one or more introductory elements that precede the wh-element. Figure 2 gives an overview of the main categories and the elements they comprise.6

Figure 2. Introductory elements

In all, 3,906 questions in the CGN contain one or more introductory elements. Table 5 lists the frequencies of the 10 most frequent single introductory items, which together account for 1,731 instances.7

Table 3. Frequency and distribution of question types across different types of speech

<table>
<thead>
<tr>
<th>Type of wh-question</th>
<th>Relative freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoe</td>
<td>28.78</td>
</tr>
<tr>
<td>Waar</td>
<td>9.77</td>
</tr>
<tr>
<td>Waarom</td>
<td>7.80</td>
</tr>
<tr>
<td>Wanneer</td>
<td>3.28</td>
</tr>
<tr>
<td>Wat</td>
<td>37.44</td>
</tr>
<tr>
<td>Welk(e)</td>
<td>5.00</td>
</tr>
<tr>
<td>Wie</td>
<td>7.15</td>
</tr>
<tr>
<td>Multiple</td>
<td>0.79</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Table 4. Frequency and distribution of reduced questions across different types of speech

<table>
<thead>
<tr>
<th>Type of wh-question</th>
<th>CGN-1</th>
<th>CGN-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoe</td>
<td>196</td>
<td>35</td>
</tr>
<tr>
<td>Waar</td>
<td>63</td>
<td>17</td>
</tr>
<tr>
<td>Waarom</td>
<td>164</td>
<td>65</td>
</tr>
<tr>
<td>Wanneer</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Wat</td>
<td>307</td>
<td>73</td>
</tr>
<tr>
<td>Welk(e)</td>
<td>29</td>
<td>17</td>
</tr>
<tr>
<td>Wie</td>
<td>79</td>
<td>15</td>
</tr>
<tr>
<td>Multiple</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>913</td>
<td>228</td>
</tr>
</tbody>
</table>

Table 5. The 10 most frequent introductory elements in the CGN dataset

<table>
<thead>
<tr>
<th>Item</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>En</td>
<td>664</td>
</tr>
<tr>
<td>Maar</td>
<td>411</td>
</tr>
<tr>
<td>Ja</td>
<td>236</td>
</tr>
<tr>
<td>Uh/uhm</td>
<td>144</td>
</tr>
<tr>
<td>Nee</td>
<td>66</td>
</tr>
</tbody>
</table>

6 In this context it is worth mentioning that some full questions are in fact formulaic and can serve the same purpose. These include wat/hoe zeg/zei je? and wat/hoe zeg/zei u? In informal conversation they are commonly reduced to wat? and hoe?

7 Interestingly, a very large proportion of reduced hoe questions (viz. 204 out of 297 or 68.69%) contains the wh-element hoezo (hoezo, hoezo dan, hoezo niet) which is roughly equivalent to how’s that or why.

Note worthy is that in the internet data no introductory elements were encountered.

5 Dependent wh-questions are commonly embedded by means of the connective von or of, or a reporting clause.

Table 5. The 10 most frequent introductory elements in the CGN dataset

<table>
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</tr>
<tr>
<td>Nee</td>
<td>66</td>
</tr>
</tbody>
</table>

Note worthy is that in the internet data no introductory elements were encountered.
4.4. Answer prompts

Another phenomenon found in our material exclusively with the naturally spoken data is that questions may already contain a candidate answer. Consider exs. [15]-[17].

[15] wat uh Van Dale?
[16] en waar komt ie vandaan Leiden Amsterdam?
[17] of ja wat zei ik net De Nederlandse Bank?

Such questions characteristically are used with the intention of verifying information. Judging from our data, their frequency is extremely low.

4.5. Reference

As mentioned before, in the internet data two groups of questions can be distinguished: the full independent questions that occur by themselves, and the sometimes reduced questions that follow a statement. Questions in the first group are usually self-contained. The questions in the second group, however, almost invariably require anaphora resolution (cf. exs. [18]-[19]).

[18] Ik kan mijn password niet wijzigen. Hoe kan dit?
[19] Reizigers in besmette gebieden worden gescroond op SARS. Wat is dat?

In the spoken data, the picture is rather different. A large proportion of full independent questions require anaphora resolution. However, with our present dataset it is impossible to determine whether the referent is to be found in a preceding utterance produced by the present speaker or in an utterance produced by the interlocutor.

With regard to the matter of reference, two further observations can be reported. One relates to the phenomenon of topicalisation (cf. ex. [20]). Although topicalisation is generally assumed to be characteristic of spoken rather than written language, the number of topicalised questions in the spoken data is negligible: in all we counted 91 instances. The other observation concerns the use of cataphoric reference (cf. exs. [21]-[22]). This, again, is a phenomenon found in our datasets exclusively in the spoken data and even then, it occurs very rarely.

[20] en sinussen wat zijn dat precies voor dingen?
[21] waar door wordt dat veroorzaakt die temperatuurstijging?
[22] waar ligt dat dan Oorschot?

5. Discussion and conclusion

A comparison of the two datasets has brought to light a number of differences – quantitatively and qualitatively – that may be considered relevant when contemplating the issue of whether a dataset derived from a large multipurpose corpus such as the Spoken Dutch Corpus may be considered appropriate for developing an NLP system that can support natural interaction in a spoken QA system.

Our analysis leads us to conclude that in principle CGN data are appropriate for developing a model of the (wh-)questions that people will use in interactive QA. CGN constitutes a very rich source both in terms of the number of questions as well as in terms of the (structural) variation that is encountered. All possible (likely) variants are represented in the data and the coverage of a language model that has been developed on the basis of these data will appear to be adequate for handling all sorts of spoken wh-questions. The data also make it possible to model a number of phenomena that appear to be characteristic of naturally spoken questions. Here it is useful to distinguish phenomena that are unique in human-human interaction (eg vocatives, formulaic questions, reaction signals, expletives), while other phenomena are found in both human-human and human-machine interaction (eg connectives, hesitations, false starts). In deriving a dataset for modeling questions in spoken QA it seems a good idea to create the equivalent of a stop list for formulaic questions (wat zeg je?, hoe bedoel je?, hoezo? hoe gaat het?).

However, we should add a word of caution. As was pointed out before, the present study has been limited to wh-questions. On the basis of what we have seen in the internet data, it would appear that this limitation can not be upheld. Imposing on people that they should use only wh-questions might prove to be too severe a limitation to a QA system that is intended to handle natural interaction. Therefore, further research is necessary into alternative ways of asking for information that the user is likely to use. Other issues that future research should address include the following: Can we distinguish between (the types of) questions that are likely to be asked by the user of a QA system, and questions that the system may generate? And related to that How can we distinguish between a starter question and follow-up questions?

In the present paper, deriving a dataset from the CGN was said to be a case study. Before we can generalize the findings of the present research to other corpora and other languages, similar studies should be undertaken with aim of corroborating the present findings.

6. Acknowledgement

Thanks are due to Johan de Veth who raised the question addressed here and thus put us onto the research reported on in this paper.

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7. References


TREC. http://trec.nist.gov/