Experiences from the Spoken Dutch Corpus Project


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Abstract

This paper provides an overview of the ongoing development of a large corpus of spoken Dutch in Flanders and the Netherlands. We outline the design of this corpus and the various layers of annotation with which the speech signal is enriched. Special attention is paid to the problems we have encountered, and to the tools and protocols developed for obtaining consistent and reliable annotations. We also discuss the outcome of a recent external evaluation of our project by an international committee of experts.

1. Introduction

The Spoken Dutch Corpus (Corpus Gesproken Nederlands; CGN) project aims to develop a corpus of 1,000 hours of speech originating from adult speakers of standard Dutch. The corpus is to serve as a resource for Dutch, for use in a number of widely different fields of interest, including linguistics, language and speech technology, and education. Therefore, its design must anticipate the various research interests arising from these fields and provide for them, while the different transcriptions and annotations should be as sophisticated as possible given the present state-of-the-art. Moreover, in its construction we conform to national and international standards where available, or else follow recommendations and guidelines or adopt best practice as it has emerged from other projects. Finally, in devising protocols and procedures that will ensure the highest possible degree of accuracy and consistency we intend to contribute to setting a standard for future corpora.

All data will be orthographically transcribed, lemmatized and annotated with part-of-speech information. For part of the corpus, additional transcriptions and annotations will be available. These include an auditorily verified broad phonetic transcription, a syntactic annotation and a prosodic annotation. The corpus will be distributed together with the audio files containing the speech recordings. Within the project, exploration software is being developed that will make it possible not only to browse the data, but also to conduct potentially complex searches involving multiple annotation layers, while including a rich set of meta-data. Since all transcriptions and annotations will — directly or indirectly — be aligned with the audio files, the user will be able to access the recordings from any point in the corpus (Oostdijk, 2000).

In the process of constructing the corpus, extensive use is made of tools for quality control. They include tools that support the creation of transcriptions and annotations; tools for the automatic alignment of various transcriptions and annotations; tools for checking the consistency within and across various transcription and annotation layers; and tools for validating the format of each type of transcription and annotation.

Now that the Spoken Dutch Corpus Project is approaching its fifth and final year, it seems appropriate to take stock of what has been achieved so far. In this paper we present an account of the experiences gained in the process of compiling and annotating the corpus, together with the results of the mid-term evaluation that was carried out by an international committee of experts.

2. Corpus design and data collection

The design of the Spoken Dutch Corpus was guided by a number of considerations. First, the corpus should consti-
tute a plausible sample of contemporary standard Dutch as spoken by speakers in the Netherlands and Flanders, that would serve the interests of rather different user groups. Second, the corpus should constitute a resource for Dutch that should hold up to international standards. With 1,000 hours of speech (approximately ten million words), the corpus will be comparable in size to, for example, the spoken component of the British National Corpus (Aston and Burnard, 1998). Third, because of the time, financial, and legal constraints under which the project must operate, but also for practical reasons, it is impossible to include all possible types of speech and compromises are inevitable.

In order to be able to accommodate a great many different types of user, a highly flexible design was adopted. Thus, in determining the overall structure of the corpus, the principal parameter has been the socio-situational setting in which speech occurs. As a result, the corpus comprises a number of components (ranging from spontaneous conversations to read-aloud text), each of which can be characterized in terms of its situational characteristics such as communicative goal, medium, and number of interlocutors. The specification of each of the components is given in terms of sample sizes, total number of speakers, range of topics, etc. Where this is considered to be of particular interest, speaker characteristics such as gender, age, geographical region, and socio-economic class are used as (demographic) sampling criteria; otherwise they are merely recorded as part of the meta-data.

The meta-data are included in the text and participant headers that are available for each of the samples in the corpus. The design of the headers has been inspired by the guidelines of the Text Encoding Initiative (Spierberg-McQueen and Burnard, 1994) and the Corpus Encoding Standard (Ide, 1996). Integration in the corpus exploration software (COREX) involving a conversion to the IMDI (http://www.mpi.nl/IMDI) set has enabled effective access to the meta-data so that these can be used in browsing as well as in searching the corpus.

The collection and acquisition of data has appeared to be more problematic than anticipated, owing to a number of causes. Thus, while it was intended to collect parallel samples for Flanders and the Netherlands, cultural differences make it virtually impossible to collect the same kind of speech in similar situations. For example, spontaneous conversations between family members or friends in Flanders are not commonly conducted in standard Dutch, whereas in the Netherlands in such contexts standard Dutch is used predominantly. Moreover, the fact that for all recordings permission must be obtained before the data can be digitized and sampled and transcription and annotation can be begun, has appeared to be an unsettling factor which has made it impossible to obey any firm production scheme. Finally, unforeseen technical complications have delayed the project considerably where the collection of telephone conversations is concerned.

2.1 Transcriptions and annotations

2.2 Orthographic transcription

The orthographic transcription layer is the first annotation layer of the Spoken Dutch Corpus. It is of great importance that the quality of the orthographic transcriptions is high since all other annotation layers added to the speech samples rely on it. The orthographic layer is also very essential for the users of the corpus because they will use it as their primary means for searching the corpus and accessing the speech samples: The symbolic orthographic representation of the speech samples is much easier to handle than the audio files themselves.

The orthographic transcription layer consists of several tiers, one tier for every speaker. The tiers are divided into chunks. Every chunk points to a particular position in an audio file and contains the transcription of the corresponding speech. The average length of the chunks is about 2 seconds and 95% is less than 4 seconds long (99% is shorter than 6.5 seconds).

The transcription rules are formalized in The Protocol for Orthographic Transcription. These rules are (as much as possible) in line with the international standards for large spoken language corpora. The final orthographic transcription aspires to be an excellent starting point for a wide range of researchers (speech and language technologists, linguists, lexicologists, phoneticians, etc.), taking into account the financial constraints.

The orthographic transcription is a verbatim transcription. The utterances are interpreted as little as possible. There is no correction of grammatical errors, no completion of truncated words, etc. The transcription also conforms as much as possible to the spelling conventions of standard written Dutch. Common articulation phenomena (acceptable deletions, insertions and substitutions of sounds) are not indicated; normalized word forms are used.

However, there are some spoken language phenomena that are indicated with a non-normalized form or by means of a mark-up symbol. The protocol contains a limited list of reduced word forms (like <'k>, <'ns>, <'d'r>, <'z'n>, etc.) and pronunciation variants (like <goeie>, <ik snij>, etc.) and also a list of mark-up symbols. We use *z for standard Dutch words that are heavily regionally accented (non-acceptable deletions, insertions and substitutions of sounds). Dialectic forms and constructions are indicated by *d. There are also symbols for truncated words (*a), intentional or non-intentional mispronunciations and onomatopoeia (*u), new interjections (*t), foreign words (*v) and hardly-intelligible words (*x) just as symbols for non-linguistic speaker sounds such as coughing, laughing, etc. (ggg), unintelligible words (xxx) and unintelligible proper names (Xxx).

Some other deviations of the conventional spelling are the restriction of the punctuations to full stops (.), question marks (?) and continuations (...). The absence of upper case letters in the beginning of sentences and the use of upper case letters as a mark-up for proper names, titles and abbreviations in a more systematic way than in the standard spelling conventions.

The orthographic transcription also includes the description of clearly audible or meaningful background noises. The transcribers are allowed to comment on the acoustic characteristics of the recordings as a whole.

In general, an orthographic transcription is produced from scratch by one student or freelance worker and is
subsequently verified by someone else. Following additional verification with a separate software tool that checks for illegal sequences and executes or sometimes suggests some substitutions, the orthographic transcription is ready as a starting point for the next annotation layers. Based on the feedback of the other annotation layers and the lexicon group many of the remaining errors and inconsistencies are subsequently corrected. This feedback can lead to substitution rules that can be applied to all the orthographic transcriptions, the current ones as well as future transcriptions. Some of these substitution rules can be applied automatically others need some human interaction.

2.3. POS tagging and lemmatization

The first layers of linguistic annotation concern the assignment of a lemma and a tag to each of the ten million tokens. The lemma is the base form of a word; for most words it is identified with the stem, i.e. the word without inflectional affixes; for verbs, however, it is identified with the infinitive. A tag consists of a part of speech and a number of morphosyntactic features which are associated with that part of speech, such as number for nouns, tense for verbs, and degree for adjectives. For the part of speech distinction we employ the classical classification into ten parts of speech, which is also used in the standard reference grammar for Dutch ‘Algemene Nederlandse Spraakkunst’ (Hae-seryn et al., 1997). For the addition of extra features, we follow the recommendations of EAGLES, the Expert Advisory Group on Language Engineering Standards. Adapting them to the specifics of the Dutch language, we have defined a tagset with a relatively high degree of granularity, consisting of 316 different tags. A full description of the tagset and the guidelines for lemmatization is provided in Van Eynde (2001).

For the assignment of tags to tokens we adopt the following principles. First, the units to which the tags are assigned coincide with the units of the orthographic transcription. The two words in ‘ter plaatse’ (at-the-DATIVE place-DATIVE), for instance, are each assigned one tag, preposition and noun respectively. Conversely, a form such as ‘daarlangs’ (there-along) is treated as a single word and is not further analysed as an adverbial pronoun followed by a postposition. Second, the assignment of the tags is governed by formal and morphological criteria, rather than by functional or semantic ones. For instance, due to its morphological characteristics and its distribution, the word ‘maandag’ (Monday) is invariably tagged as a noun, also when it occurs in an adverbial position, as in ‘ik ga maandag naar Leuven’ (litt. I go Monday to Leuven). Third, for all words which are potentially ambiguous with respect to the tagset, we only assign the tag which is relevant in context.

Given the size of the corpus and the limited resources, it is not possible to carry out the tagging and lemmatization in a purely manual way. Therefore, we undertook an evaluation of publicly available tools for automatic tagging and lemmatization, see Zavrel and Daelemans (2001). This led to the selection of MBMA (Memory Based Morphological Analyser) for lemmatization. For tagging, we adopted a system which combines the results of four individual taggers, i.e., the HMM-based TnT tagger, a memory based tagger, a maximum entropy tagger and a Brill tagger. The results of the automatic tagging and lemmatization, which takes place in Tilburg, are manually checked and — if necessary — corrected. This is done in Nijmegen for the Dutch data and in Leuven for the Flemish data. Both centers recruit student-assistants to prepare the data for the half-yearly releases under supervision of local co-ordinators.

The corrected data are not only used for dissemination, but also for retraining the tagger. Table 1, provided by Antal van den Bosch, shows the effect of this retraining on the performance of the individual taggers and the combitagger. A summary of the tagset, the guidelines for lemmatization, and the evaluation of automatic taggers and lemmatisers can be found in Van Eynde et al. (2000).

2.4. Lexicon coupling for multi-word units

For the assignment of lemmata we adopt the same word-for-word principle as for the tags. This means that the units to which the lemmata are assigned coincide with the units of orthographic transcription. However, do not always coincide with what are intuitively felt to be lexical units. For this reason, we add another layer of annotation in which multi-word expressions can be treated as single lexical units. Since it is not always clear which multi-word expressions qualify as lexical units, we limit the identification to three clear-cut cases. First, discontinuous combinations of a verb and a particle, as in ‘hij belt je op’ (litt. he calls you up), are identified with a single verb, i.e. ‘ophellen’. Second, names which consist of two or more words, such as ‘Den Haag’ and ‘Gaston Van Den Bergh’, are treated as single units. Third, the same applies to combinations which entirely consist of foreign words, such as ‘chili con carne’ and ‘ad hoc’.

The identification of these multi-word units will be done for the entire corpus. The Dutch data will be processed in Nijmegen and the Flemish data in Leuven. Since it is more efficient to do this in one go for all the data, rather than for each release separately, the work on this task has so far been of a preparatory nature.

2.5. Further enrichments

For about one million words, four additional annotations, namely a broad phonetic transcription, a manually checked word segmentation, a prosodic annotation and a syntactic analysis will be provided.

2.5.1. Syntactic annotation

Syntactic annotation is carried out by the CCL-group in Leuven for the Flemish data and by the Utrecht OTS-group for the Dutch part. The annotation provides two types of information: categorial information at the level of syntactic constituency, and dependency information to capture the semantic connections between constituents. The annotation format uses datastructures expressive enough to naturally encode dependency relations, also where they are at odds with syntactic constituent structure.

Formally, the annotation structures are directed acyclic graphs (DAGs). The vertices are decorated with a syntactic category label: a POS label for the leaves, a phrasal label...
for the internal nodes. The edges carry dependency labels. They capture the grammatical function of the immediate constituents of a phrase, distinguishing head, complements and adjuncts.

The CGN tagset tries to strike a balance between informativity and practical usability. It uses 25 phrasal category labels and 34 dependency labels. Conciseness is obtained by giving the labels a context-sensitive interpretation. The MOD label, for example, denotes adverbial modification in verbal domains, but adnominal adjuncts in noun phrases. Levels of granularity that are bound to lead to inter-annotator discrepancies (such as the twenty kinds of adverbial phrases distinguished in the ANS grammar) are avoided. The rich POS tagset (with over 300 labels) is reduced to some 50 distinctions relevant for the dependency annotation. On the other hand, special provisions are made for the annotation of phenomena typical of spoken language. The category label DU (discourse unit) for example, allows for an articulation in terms of dependency notions such as nucleus versus satellite, tags or discourse links. An overview of the tagset can be found in Hoekstra et al. (2001), the full annotation manual is in Moortgat et al. (2001).

The annotation makes full use of the expressivity of DAGs as compared to trees. Discontinuous dependencies result in crossing branches that would be problematic in a conventional syntactic constituent structure format. Allowing items to simultaneously carry multiple dependency roles results in a simple annotation schema for phenomena that would require 'movement' or similar devices in tree-based theoretical frameworks. Finally, annotation graphs with disconnected components are useful to provide partial analyses for interrupted phrases, interpolations and the like.

The syntactic annotation procedure, which like the POS tagging is performed semi-automatically, uses the interactive annotation environment developed within the German NEGRA project (http://www.coli.uni sb.de/sfb378/negra-corpus/negra-corpus-.html). A simple visualisation tool for the annotation graphs is freely available from the Utrecht CGN site (http://cg.n.let.uu.nl). In a later phase of the project, the CGN exploitation software will provide more advanced display and search facilities for the syntactic annotation.

2.5.2. Phonetic transcription

Table 1: The effect of retraining on the performance of the individual taggers and the combi-tagger.

<table>
<thead>
<tr>
<th>date</th>
<th>26/11/99</th>
<th>06/02/00</th>
<th>08/03/00</th>
<th>12/07/00</th>
<th>23/01/01</th>
<th>08/02/02</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of words</td>
<td>10802</td>
<td>21475</td>
<td>39304</td>
<td>95246</td>
<td>553226</td>
<td>2762712</td>
</tr>
<tr>
<td>TrIT</td>
<td>89.1</td>
<td>91.6</td>
<td>92.7</td>
<td>93.9</td>
<td>95.3</td>
<td>96.2</td>
</tr>
<tr>
<td>MBT</td>
<td>86.5</td>
<td>89.4</td>
<td>91.2</td>
<td>92.0</td>
<td>94.3</td>
<td>95.6</td>
</tr>
<tr>
<td>maxent</td>
<td>83.6</td>
<td>89.4</td>
<td>90.1</td>
<td>92.6</td>
<td>95.2</td>
<td>-</td>
</tr>
<tr>
<td>Brill</td>
<td>83.3</td>
<td>86.3</td>
<td>87.9</td>
<td>89.9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Timbl combiner</td>
<td>94.2</td>
<td>94.3</td>
<td>94.3</td>
<td>95.6</td>
<td>96.2</td>
<td>96.6</td>
</tr>
</tbody>
</table>

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A combination of budgetary and scientific considerations has resulted in the decision to restrict the phonetic transcription of the CGN to a broad phonemic level. Starting point for the transcriptions is the phonemic representation of the orthographic transcription that is generated fully automatically. Work is under way to develop automatic transcription procedures that maximise the 'quality' of the automatic transcription. For approximately one million words the automatic transcription will be checked by phoneticians. The procedure for this manual production of phonemic transcriptions is defined in a detailed protocol (that is presently only available in Dutch, cf. http://www.elis.rug.ac.be/cgn/). The set of symbols that can be used in the transcriptions is derived from the SAMPA set. The set does not contain diacritics, so that the transcription is truly limited to the broad phonemic level.

The design of the internal data structures of the CGN are completely based on the concept of words as units delimited by blank spaces. This principle was carried over to the level of phonemic transcription. However, it is well known that cross-word assimilations and degeminations abound in continuous speech. To retain the one-to-one correspondence between the orthographic words and the phonemic transcriptions, a special notation had to be developed for cross-word degemination. For example, the word sequence 'op pad' [on the way] in Dutch is likely to be pronounced as /OpAt/. To restore the link with the orthographic level the notation in the CGN is /Op.pAt/. The /p/ notation stands for a single phoneme /p/, of which it is impossible to say whether it is the word final phoneme of the first, or
the word initial phoneme of the second word. Phoneme insertion at word boundaries is handled in the same way: Underscores are used to link the inserted phone to both its left and right neighbour word.

It has taken extensive and lengthy discussions to reach agreement on a protocol that is at the same time sufficiently detailed as well as practical. However, the resulting protocol has now been in use for over one year, and our experience is very positive. Transcribers encounter few problems, and if problems do occur, supervisors find it easy to arbitrate.

Evidently, one would want to have a precise estimate of the ‘quality’ of the manual phonemic transcriptions (and, of course, also of the part of the transcriptions that are made fully automatically). However, as yet there are no generally agreed procedures for a formal evaluation of the quality of phonetic transcriptions. It remains to be seen whether such procedures become available before the end of the CGN project.

2.5.3. Word segmentation

The goal of the word segmentation is to introduce time-markers delimiting the words. For linguistically oriented users, the word segmentation can offer easy access to the enormous amount of speech material brought together in the CGN. By means of various queries on, e.g., a specific linguistic phenomenon, users will be able to retrieve and to listen to the relevant words and their context. Speech technologists may use manually verified word segmentations to obtain a good time-alignment for bootstrapping the training of an acoustic model in automatic speech recognition (ASR) development. Or, they can use it for prosodic training of an acoustic model in automatic speech recognition.

During the production of the manually checked word segmentation (MWS), the human transcriber is given an automatic word segmentation (AWS) which he is allowed to correct. The automatic word segmentation system actually generates an automatic phonetic segmentation (APS) which is then converted to the desired AWS. A full description of our efforts to produce the best possible AWS can be found in another paper in the present proceedings (Martens et al., 2002). Here it suffices to highlight three important elements which have facilitated the creation of an accurate AWS.

1. The protocol for orthographic transcription (Goedertier et al., 2000) of the CGN stipulates that long speech files have to be cut into short chunks (2 to 6 seconds) separated by audible pauzes between words, before starting the transcription. I.e., the AWS can be obtained chunk by chunk.

2. The APS can be derived from what is generally considered the best possible input, namely a manually verified broad phonetic transcription (see previous section).

3. The APS to AWS transformation is made trivial by the fact that the broad phonetic transcription was kept consistent and synchronized with the word transcription.

Although this cannot be achieved for very short words, the main goal of the word alignment is to create word segments that are easy to recognize as words when made audible. So as to achieve this goal and as to produce something that is also useful for, e.g., prosodic research, we propose a methodology which deviates to some extent from common practice as adopted in the development of mainly technologically oriented corpora such as Switchboard (LDC, 1994) and Verbmobil (http://verbmobil.dfki.de/).

1. We decided not only to delimit linguistic words, but also to delimit clear pauzes between these words. This feature has actually enabled us to partly automate the prosodic annotation discussed in the next section.

2. In continuous speech, it often happens that two words share a phoneme. When this is the case, one could put the word boundary in the middle of that phoneme. This strategy works well as long as the shared phoneme is not a plosive (e.g., /p/, /t/, /k/, /b/, /d/ and /g/). A plosive cannot be split up into two parts such that it sounds acoustically acceptable in both words that share it. As described above when discussing the phonetic transcription, it was therefore decided to treat a shared plosive as a separate segment, marked with an underscore. When making either of the two words audible, this separate segment has to be considered as part of that word. I.e., words sharing a plosive are realized in overlapping time segments.

3. It also happens that a phoneme is inserted between two words (e.g., a /j/ between the Dutch words /drie/ (three) and /vier/ (four)). These phonemes do not have an orthographic equivalent but they do appear in the phonetic transcription. Thus, in order to maintain consistency between the AWS and the phonetic transcription, they should also appear in the AWS. We have experienced that both words sound acceptable if the word boundary is put in the middle of this phoneme. The inserted phoneme is then transcribed in both word segments, and also marked with a hyphenation mark.

During the manual checking stage, the human transcribers (students) use the program Praat (http://www.praat.org). On the screen they see an image of the signal. For each speaker in the recording, two text tiers with time markers are shown. These tiers show the orthographic and the phonetic transcriptions or the words between the time-markers.

In order to retain as much as possible the internal consistency implied in the AWS, the human transcribers are instructed to leave the AWS as it is, unless moving a time marker clearly improves the audible impression of the surrounding words.

The actual version of the protocol for manual checking of the AWS has been used to check about a hundred thousand words of broadband speech. Human transcribers seem quite capable of performing their task as prescribed in the
protocol. A systematic comparison of the automatic and the manual segmentations revealed that about 20% of the automatically generated word boundaries were altered by the human transcribers. There are no systematic measurements available about the time it takes to verify one minute of speech, but a restricted experiment on a few thousand words yielded a figure of about 20 minutes work per minute of speech.

To conclude this section on word alignment, we want to mention that apart from the MWS of one million words, there will also be an automatically generated word segmentation for most of the remaining nine million words. At the start of the CGN project it was investigated whether the quality of this automatic alignment could be improved if the results of two different alignment systems were combined. To that end a fusion system was built that obtains its input from a conventional Hidden Markov Model system and a Speech Segment Model based system. It appeared that the output of the fusion system was virtually identical to one of its inputs, in this case the input of HMM based system. Therefore, it was decided to proceed with just the output of the HMM aligner, and omit the SSM based system and the fusion. Note that since the AWS will have to be automatically inferred from the orthography, it may be much less accurate than the AWS computed starting from a phonetic transcription that was automatically generated word boundaries were altered by the human transcribers, and no systematic measurements are available about the time it takes to verify one minute of speech.

2.5.4. Prosodic annotation

An interesting topic of research is that of establishing the role of prosody in spoken communication. Unraveling the prosodic mechanisms is also of great importance for the further development of human-machine dialog systems. The success of prosodic research will depend to a considerable extent on the availability of large prosodically labeled corpora. As there are no such corpora for Dutch as yet, we decided to perform a prosodic annotation of one quarter of the one million words that were selected for further enrichment.

After having consulted potential users of the prosodic annotation, it was decided to strive for a perceptually based annotation (as, e.g., in Portele and Heuff (1995), Grover et al. (1998), Wightman and Rose (1999)) that can serve as a starting point for further detailed prosodic labelings (e.g. a ToBI labeling like in Wightman and Rose (1999)).

The aims of the proposed annotation are: (i) to mark syllables carrying a clear prominence, (ii) to locate important between-word and within-word interruptions of the normal speech stream (henceforth called 'breaks'), and (iii) to mark unusual lengthening of individual vowels and consonants not carrying prominence. To simplify things even further, a syllable is either marked as prominent or not (no different degrees of prominence), and a break can either be weak or strong. Clearly, the proposed annotation scheme constitutes a compromise between what is desirable information for a large number of users, and what can actually be labeled with a sufficiently high degree of consistency at a limited cost.

During manual annotation, the transcribers are looking at a computer screen with a display of the signal together with an orthographic transcript. So as to preserve as much as possible the perceptual nature of the annotation, and to reduce any bias towards putting breaks at syntactic boundaries, all punctuation is removed from the orthography. On the other hand, as the manually checked word segmentation also delimits clear pauses between words, it was possible to split up the speech in phrase-like units in an automatic way on the basis of this information. The displayed orthography was therefore synchronized with the signal at the level of the phrases. The automatic phrasing is designed in such a way that it produces units that are no longer than 10 seconds, and that are separated by long pauses (typically longer than 300 ms) which always correspond to strong breaks.

Since the prosodic annotation is to be performed by non-expert transcribers (students) working at four different sites, under the direction of four different supervisors, it is very important to install mechanisms for enforcing a maximum degree of consistency between students and sites. Two important actions were taken in this respect.

1. Since prominence and break strengths are basically ordinal variables which are to be labeled on a 2 and 3-point scale respectively, it is important to develop a common understanding of these labels. Therefore, we developed a written protocol providing examples and describing the general rules and procedures to follow during the annotation.

2. Since the textual examples in the protocol are mainly suggestive, they are supplemented with real examples of speech fragments and their prosodic annotation. These real examples are supplied in the form of a learning corpus for which the supervisors created a consensus annotation.

Two learning corpora (one for Dutch and one for Flemish), each containing 15 minutes of speech were designed in the course of a pilot study that was set up with the following four goals in mind: (i) Test and refine the protocol, (ii) estimate the attainable degree of consistency between students, (iii) estimate the time needed to perform the annotations, and (iv) make recommendations for the actual production of the annotations. The pilot study is described in detail in another paper in the present proceedings (Buhmann et al., 2002). It was performed simultaneously at two Dutch and two Flemish sites, and it involved 2 students per site. During a learning phase, students learned their job by gradually annotating a learning corpus under the supervision of the site responsible, and during a subsequent test phase they independently transcribed a 45 minutes long test corpus (about 8000 words). The most important conclusions of the study can be summarized as follows:

1. Only one of the eight students delivered test annotations that deviated significantly from those of the other students. This indicates that most of the students do come to a similar interpretation of the protocol.

2. Agreement between students is not very high, but acceptable. The kappa coefficients (Cohen, 1960) for prominence are in the range 0.58 to 0.89, those for breaks in the range from 0.70 to 0.88. 
3. Leaving out the two extrema, the percentage of prominent words per student ranged from 16 to 23%, the percentage of words separated by a break from 17% to 20%.

4. When individual student annotations are compared to a reference annotation deduced from the mean of the remaining students, one finds correlations between 65 to 85% for prominence and between 90 and 95% for break strength. Part of the high correlation for boundary strength is obviously due to the automatic phrasing that was carried out on the basis of the word alignment.

5. The students need on average 40 minutes time to annotate one minute of speech.

Based on the experiences gathered during the pilot study, a plan for the production of the annotations has been worked out. It is scheduled to start in the summer of this year. As the measured inter-student agreement on prominence is not very high, we plan to provide two independent annotations made at different sites of each file.

3. Quality control and consistency

To maintain consistency between the annotation levels and to obtain optimal quality control, we have been using the procedures such as:

- Transcriptions and annotations of one transcriber/annotator are checked by another transcriber/annotator.

- In so far as one type of annotation builds on an other type (as POS tagging on orthographic transcription, but also for part of the material — syntactic annotation on POS tagging), this automatically involves a verification of the output of a previous annotation; upon the detection of what is perceived to be an error, a bug report is filed with the team responsible for the annotation.

- All words (tokens) and lemmas in the orthographic transcriptions are validated against the lexicon, as are all combinations of token-tag pairs.

- Quality checks are also made on the basis of the information in the frequency lists that are produced regularly: Low frequency items typically help to pinpoint potential errors, while alternative entries for one and the same item help to identify inconsistencies.

Tools that we have found useful for quality control and consistency are:

- A script to automatically convert a printed text version to a version that conforms to a large extent to the protocol and can be used in the transcription process,

- A customized version of a spelling checker (which helps to conform to some of the conventions adopted in the protocol for orthographic transcription),

- A script to automatically expand numbers represented as digits to their full written forms,

- an XML parser for validating the format of the datafiles,

- a POS tagger for automatically tagging the corpus,

- a tag selection program that is used for the manual verification of the tagger output,

- the Annotate software for syntactic annotation,

- and a grapheme-to-phoneme converter for automatically generating a phonetic transcription.

4. External evaluation of the CGN project

During the summer of 2001, a mid-term external evaluation of the CGN project was performed. The evaluation consisted of a technical evaluation of the intermediate product (releases 1–3) and a scientific evaluation of the project as a whole.

4.1. Technical evaluation

The technical evaluation was performed by BAS (Bavarian Archive for Speech signals) under the direction of Christoph Draxler. In a formal validation part, BAS checked the correctness of the file names and formats, the completeness of the data, the consistency between data and metadata, and the quality of the documentation. In a content evaluation part, it checked the validity of the signals and their transcriptions (orthography, POS tags and lemmas).

For the content validation, the aim was to perform a large scale evaluation (on 3 hours of speech) that would reflect the way potential users of the CGN would assess the transcriptions. Therefore, BAS was not asked to create independent transcriptions, but rather to check the CGN transcriptions against the signal and the transcription protocols. The validation was performed by native speakers of Dutch and Flemish, and was carried out on 84 samples that were randomly selected from the 14 main components of the CGN.

The formal validation showed that the bulk of the data was formally correct. Some minor errors were discovered, however, which have already been corrected in the fourth release. The content validation clearly demonstrated that the manual annotations met international standards. To quote from the BAS report: "Compared to SpeechDat and comparable speech data collection efforts, the CGN shows good to very good results".

In its evaluation report, BAS formulates a number of recommendations. Some were suggestions for further increasing the usability of the corpus (e.g., provide more information on recording conditions, include format conversion tools), others for maximally enabling the addition of new enrichments to the data (e.g., make format checkers available, provide tools for subcorpus extractions, etc.), and still others for optimization of the corpus distribution (e.g., use DVD’s for the speech files, make annotations available on the Web).
4.2. Scientific evaluation

The sponsors of the CGN project also wanted a scientific evaluation of the CGN project by a panel of international experts. The chairman, Reinier Salverda (University College London), and his team consisting of Steven Bird (LDC), Jan Hajic (University Prague) and Harald Hoge (Siemens, Munich) read the BAS evaluation report, and had access to all the CGN documentation that was available in English. In addition, they had a full-day discussion with the CGN Board and the CGN Steering Committee, as well as with members of the CGN User Group.

Based on all this input, the panel was requested to draw up an evaluation report. This report (Salverda et al., 2001) is publicly available on the CGN web-site (http://www.elis.rug.ac.be/cgn/index.nl.html). It provides answers to questions regarding the design of the corpus, the choices that were made in defining the annotation protocols, the technical evaluation, etc. It also contains recommendations for future developments (e.g., develop ideas and plans for research projects that will use the CGN, continue the validation of new annotations as soon as they become available).

In summary, the mid-term evaluation of the CGN project was a very interesting experience. It first of all confirmed that our product (the CGN corpus) in its present state (releases 1 to 3) meets international standards. This was exactly what the sponsors and the people working in the project were hoping to hear. But furthermore, the evaluation also produced a list of valuable recommendations which will definitely raise the quality of the final product.

5. References


C. M. Sperber-McQueen and L. Burnard. 1994. Text encoding initiative (TEI) guidelines for electronic text encoding and interchange. ACH-ACL-ALLC.


