A corpus of European Portuguese child and child-directed speech

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Abstract

We present a corpus of child and child-directed speech of European Portuguese. This corpus results from the expansion of an already existing database (Santos, 2006). It includes around 52 hours of child-adult interaction and now contains 27,595 child utterances and 70,736 adult utterances. The corpus was transcribed according to the CHILDES system (Child Language Data Exchange System) and using the CLAN software (MacWhinney, 2000). The corpus itself represents a valuable resource for the study of lexical, syntax and discourse acquisition. In this paper, we also show how we used an existing part-of-speech tagger trained on written material (Généreux, Hendrickx & Mendes, 2012) to automatically lemmatize and tag child and child-directed speech and generate a line with part-of-speech information compatible with the CLAN interface. We show that a POS-tagger trained on the analysis of written language can be exploited for the treatment of spoken material with minimal effort, with only a small number of written rules assisting the statistical model.

Keywords: acquisition, child corpus, part-of-speech-tagging

1. Introduction

The main purpose of this paper is to present a new database of child and child-directed speech, known as the SANTOS database, which was transcribed according to the CHILDES1 (Child Language Data Exchange System) system and using the CLAN software (MacWhinney, 2000), and which is an enlarged version of the database of Santos (2006). This database has already been used by the author and collaborators as the basis of research on syntactic and discourse development; here, we present an enlarged and enriched version of the same database, which now includes part-of-speech tagging.

As tools to annotate automatically child spoken material are still in their infancy, so to speak, especially for Portuguese (Branco et al., 2012), a second purpose of this work is to show how we can use existing tools developed for more widely available data. Porting existing tools to annotate data substantially different from the training set is not a trivial matter, given that training and target sets of data differ in two aspects: written versus spoken and adult versus child. Our approach is based on the post-processing of the output provided by a statistical model using a set of rules designed after a careful examination of the corpus. Portability of NLP (Natural Language Processing) tools between closely related languages is also an important area of research.

First, we present the corpus in detail, including options of data collection and transcription. In the second part, we describe how this corpus was lemmatized and tagged using a general-purpose tagger trained on written text and adapted to work on speech data.

2. Constitution of the corpus

The first version of this corpus resulted from a Ph.D. project (Santos, 2006). It included 52 files, each corresponding to 45-50 minutes of child-adult interaction (more than 40 hours of speech), and containing the spontaneous production of three different monolingual children acquiring European Portuguese (INI – age ranging from 1;6.6 to 3;11.12; TOM – age ranging from 1;6.18 to 2;9.7; INM – age ranging from 1;5.9 to 2;7.24). The data were collected using videotape and correspond to child-adult interaction in a naturalistic setting: children were taped at their homes interacting with their family (most often their mother) and the researcher. The data from one of the children (INI) were collected by Maria João Freitas (Freitas, 1997). The data from the other two children were collected between 1999 and 2002 by the author of the original database. These children were videotaped every other week, even though only one videotape per month was selected for transcription.

The original CLAN files in the corpus developed for Santos (2006) contained only orthographic transcriptions, carried out by the author. Since the data was meant to serve research on syntax and the syntax-discourse interface, all adults and children utterances were transcribed. The initial transcription of INI and TOM was based on audio copies of the video files. The transcription of data from INM was based on DVD copies of the video files. Given the better quality of the DVD copies, all the transcripts from INI and TOM were compared with the video DVD files at the end of 2004. The data from INM were also subjected to a revision using additional information provided by video. Finally, the transcription always progressed from the earlier to the later stages, since this strategy facilitated the process and ultimately

1 http://childes.psy.cmu.edu/.
improved accuracy.
The original database of Santos (2006) contained 18,492
child utterances. The mean length of utterances in words
(MLUw) in this database is presented in Table 1,
according to the counts made available by the author.

| Child | Age          | MLUw     | Number of files | Number of child’s utterances |
|-------|--------------|----------|-----------------|------------------------------|
| INI   | 1:6.6 - 3:11.12 | 1.527 - 3.815 | 21              | 6,591                        |
| TOM   | 1:6.18 - 2:9.7  | 1.286 - 2.954 | 16              | 6,800                        |
| INM   | 1:5.9 - 2:7.24  | 1.315 - 2.370 | 15              | 5,101                        |

Table 1 – Spontaneous production in the original
database.

Within the same Ph.D. project, data corresponding to
more advanced stages of acquisition were collected for
the same children, along with data from other children,
but these data could not be transcribed at the time.
The corpus that we now present is an extension of this
initial corpus. This enlarged version of the corpus
includes not only more data but also new facilities,
namely sound-transcription alignment and tagging.
Occasionally, revisions were also made to the original
corpus, resulting in small changes, e.g. in values of
MLUw.

First, this enlarged version includes 15 new files with
orthographic transcriptions, which were added to the
initial data (corresponding to an increase of 12 hours of
child-adult interaction). Transcription was based on the
video files and was performed by one researcher and
independently assessed by another researcher. All the
cases in which both researchers did not agree were
signalled and subjected to discussion, after which a final
decision was taken or the case was marked as doubtful. In
order to align the transcription with sound, the 15 new
files and the files of TOM and INM from the original
corpus (a total of 46 files) were converted from the
original videos (Hi8 format) to digital video and audio.
The digital videos are QuickTime files (mpeg 4 format)
with a H.264 codec and an AAC audio codec, with
dimensions of 480x360 pixels at 25 frames per second.
The digital audios are in wave format, with 16 bit mono at
44 KHz sampling rate. Sound-transcription alignment was
carried out with sound-text linking facilities within the
CLAN software. For the time being, only the files for
TOM and INM are linked to sound, but we intend to
extend this facility to the entire database.

In Table 2, we present general information on the present
corpus, namely age and MLUw (calculated with the dates
and the mlu commands in CLAN). This corpus now
includes 27,595 child utterances and also a total of 70,736
adult utterances.

| Child | Age          | MLUw     | Number of files | Number of child’s utterances |
|-------|--------------|----------|-----------------|------------------------------|
| INI   | 1:6.6 - 3:11.12 | 1.530 - 3.827 | 21              | 6,591                        |
| TOM   | 1:6.18 - 3:10.16 | 1.286 - 3.089 | 30              | 15,548                       |
| INM   | 1:5.9 - 2:9.3  | 1.345 - 2.834 | 16              | 5,456                        |

Table 2 – Child speech in SANTOS corpus.

3. POS-tagging and lemmatizing the
corpus

In this section, we describe our work on automatically
lemmatizing and tagging the corpus with part-of-speech
(POS). The CLAN software includes the MOR program, a
morphological analyser, with the possibility of building
MOR grammars for each particular language. As there is
no MOR grammar currently developed for European
Portuguese, we propose a partial solution to this
state-of-affairs by tagging (annotating) the corpus with
lemmas and part-of-speech. Failing to have a MOR
grammar for Portuguese, users of this corpus are now able
to read and search the annotations we provide with the
usual CLAN interface. Note that the tagger we used was
trained statistically on large domain written material, so
we have adapted the tagger by specializing it, at least
partly, for child spoken material.

During the transcription process, various annotations and
metadata were introduced. These annotations were either
removed or by-passed. For example, the utterance:

(1) CHILD: xxx que(r) bo(n)eca
       want   doll
       ‘(He?) wants the doll.’

is tagged as follows:

(2) %mor: V|querer   CN|boneco
       V|want.INF     CN|doll

Since “xxx” denotes unintelligible speech and letters
between parenthesis mean that the child did not
pronounce the corresponding sound, these annotations
were disregarded. Unintelligible speech is reintroduced in
the transcription, albeit untagged. The fully-tagged
utterance indicates that the word “quer” was assigned the
POS-tag “Verb” and the lemma “querer”, while the word
“boneca” was assigned the POS-tag “Common Noun”
and the lemma “boneco”. Each utterance was tagged and
lemmatized individually, which means that the tagger did
not use context outside the utterance being currently
analysed. Note that as in any automated tagging process,
there are inevitably errors, which we will report later in
The tagger we used was developed in our research group and is described in length in Généreux, Hendrickx & Mendes (2012). Here we will only highlight its main features. The POS-tagger was statistically trained on 644K tokens from a written corpus using a set of 80 POS-tag labels. The tagger has been evaluated and obtained an F-score of 0.954. The lemmatizer combines a machine learning algorithm with a lookup into a dictionary of 120,768 wordform-lemma combinations produced in-house. The lemmatizer has been evaluated and achieved an accuracy of 96.7%. As child-spoken data represents a serious challenge for any system statistically trained on written material, we decided to include a number of rules to assist the statistical model. Hand-crafted rules were applied directly on the results produced by the statistical model, mostly to provide specificities pertaining to child speech or in some cases to correct outright systematic errors. The rules are as follows, in no particular order:

1. a list of 80 words typically used as interjections were always tagged as such;  
2. if the first word of an utterance is tagged as relative, change the tag for interrogative;  
3. if the first word of an utterance is either ‘quando’ ‘when’, ‘porque’ ‘why / because’, “como” ‘how / like’ or ‘quanto’ ‘how much / as’ and is tagged as a conjunction, change the tag for interrogative;  
4. the lemmas ‘pronto’ ‘ready’, “vá” ‘go’ or “olha” ‘look’ opening a sentence are always tagged as a discourse marker;  
5. if a word is tagged as past participle not in compound tense and the lemma is “segurar,seguro” ‘hold/secure’, change the POS-tag for verb and the lemma for “segurar” ‘hold’;  
6. the word “segura” ‘hold / secure.FEM’ should always be POS-tagged with verb and lemmatized to “segurar” ‘hold’;  
7. if a word is POS-tagged as para-linguistic material and lemmatized as “queque” ‘cake’, change the POS-tag for common noun;  
8. if a word is POS-tagged as a prepositional phrase and lemmatized as “porquê” ‘why’, change the POS-tag for interrogative;  
9. if a word is lemmatized as “mamã” ‘mommy’, change its POS-tag for common noun;  
10. if the word “se” ‘if / CLITIC’ is POS-tagged as a conjunction and follows a word POS-tagged as a verb, change the POS-tag for clitic.

In this section we provide an evaluation of the lemmatizer-tagger that we adapted for child spoken material. We tagged three files2 picked randomly from our corpus, one file from each of the three different children. The files had a total of 21,972 tokens, 1,572 types and 4,736 utterances. These three files were revised manually by a human expert for tagging errors. We found a total of 1,128 POS-tagging errors, for a precision of 94.9%. We also found 442 lemmatizing errors, for a precision of 98%. These two results are in the same precision bracket as the evaluation we mentioned earlier made on written material, which is a very encouraging result. Table 3 below summarizes the ten most frequent POS-tagging errors and Table 4 the ten most frequent lemmatizing errors.

| #Occurrences | Word | Assigned tag | Corrected tag |
|--------------|------|--------------|---------------|
| 148          | que  | Relative     | Interrogative |
| 52           | olha | Verb         | Discourse Marker |
| 51           | se   | ‘CL’ / ‘if’  | Conjunction   |
| 45           | a    | ‘PREP’ / ‘the’ | Definite Article |
| 36           | a    | ‘PREP’ / ‘the’ | Definite Article |
| 36           | pois | ‘because’ / ‘indeed’ | Conjunction |
| 26           | onde | ‘where’      | Interrogative |
| 25           | olha | ‘look’       | Discourse Marker |
| 25           | outra | ‘other’      | Indefinite |
| 24           | quem | ‘who’        | Interrogative |

Table 3 – Ten most frequent POS-tagging errors.

Some of the POS-tagging errors are clearly related to the distinction between spoken and written data. For instance, “olha” ‘look’ and “pois” ‘indeed’ are frequently used in dialogues: in child-adult spoken interaction, ‘olha’ is frequently used to catch the child’s attention and “pois” as an answer to a yes-no question or generally as an expression of agreement.

2 Each file represents a full child speech production during one session.
| #Occurrences | Word       | Lemma assigned | Lemma corrected |
|------------|------------|----------------|----------------|
| 52         | olha       | olhar.INF      | olha           |
|            | ‘look’     |                |                |
| 25         | olha       | olha           | olhar.INF      |
|            | ‘look’     |                |                |
| 25         | outra      | outro          | outra          |
|            | ‘other.FEM’|                | ‘other.FEM’    |
| 21         | conta      | conta          | contar         |
|            | ‘tell/’    |                | ‘tell.INF’     |
|            | ‘account’  |                |                |
| 12         | foi        | ser            | ir             |
|            | ‘was/’     | ‘be’           | ‘go’           |
|            | ‘went’     |                |                |
| 9          | bolas      | bolas          | bala           |
|            | ‘balls’    | ‘to hell’      | ‘ball’         |
|            | ‘to hell’  |                |                |
| 9          | espera     | espera         | esperar        |
|            | ‘wait/’    | ‘delay’        | ‘wait.INF’     |
|            | ‘delay’    |                |                |
| 9          | girar      | girar          | giro           |
|            | ‘turn.INF’ | ‘cute.MASC’    | ‘cute,MASC’    |
|            | ‘turn’     |                |                |
| 7          | carrinho   | carrinho       | carro          |
|            | ‘little car’| ‘little car’   | ‘car’          |
| 6          | abracinho  | abracinho      | abraço         |
|            | ‘little hug’| ‘little hug’   | ‘hug’          |

Table 4 – Ten most frequent lemmatizing errors.

Lemmatization errors are often caused by ambiguity of word forms and inherent to the POS-tagging model. This is exemplified with a case like “olha” ‘look’, which can be a verb or a discourse marker or the case of “foi”, which can either be a form of the verb “ser” ‘be’ or “ir” ‘go’. In some rare cases (“outra” ‘other.FEM’) the conflicting lemmas were normalized to be consistent with the general behaviour of the lemmatizer, which assumes different lemmas for the masculine and the feminine in the case of closed class categories. The error rate for lemmatization therefore includes errors not specific to child spoken material.

5. Conclusion

The database we have presented is a relevant resource for language acquisition research. Given the fact that it presents child and child-directed speech, reproducing the complete child-adult interaction in the original recordings, it may be a source of information on both the acquisition of syntax and the development of the syntax-discourse interface.

As far as tagging and lemmatizing go, our experiments showed that, given a set of well-crafted rules, a statistical model trained and developed for written material can be ported to POS-tag and lemmatize spoken data from children with almost the same performance. Only ten simple rules have been developed to assist the statistical model, which cannot be considered prohibitively high in man-hour cost. We would think that similar minor adjustments could be made to successfully bring other statistically trained systems for other languages to a par with their performance on the same type of material on which they were trained.

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