Intelligent Computer-Assisted Language Learning

Part IV: On Annotating Learner Corpora

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based on joint research with
Luiz Amaral, Holger Wunsch, Ana Díaz-Negrillo, Salvador Valera; cf. also:

Díaz-Negrillo/Meurers/Valera/Wunsch (2009): *Towards interlanguage POS annotation for effective learner corpora in SLA and FLT*.
http://purl.org/dm/papers/diaz-negrillo-et-al-09.html

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Roadmap

- Which role can learner corpora play in Foreign Language Teaching & Second Language Acquisition (SLA) research?
- Why is linguistic annotation relevant?
- How can high quality annotation be obtained?
- Corpus Representation: A Concrete Case
  - The NOCE (NOn-native Corpus of English) learner corpus
  - XML and TEI representation of the annotated corpus
  - Towards linguistic annotation of NOCE
- Analyzing learner language:
  - sources of evidence for POS annotation
  - mismatches in combining evidence

Learner Corpora

- Learner corpora can serve
  - as a teaching resource for Foreign Language Teaching materials design,
  - provide insights into typical student needs, and
  - contribute an empirical basis for theories of Second Language Acquisition.
- Depending on the corpus composition, it can support *qualitative* and *quantitative* analysis of examples found

On compiling learner corpora

- Many current learner language corpora consist of essays.
- Yet learners produce language in a wide range of contexts, naturalistic or instructed, e.g.,
  - email and chat messages
  - answering reading or listening comprehension questions
  - asking questions in information gap activities

⇒ To obtain corpora representative of learner language, it is important to include language produced in a variety of contexts, ideally also including longitudinal data.

  - Including explicit task contexts in the meta-information of a corpus can also provide constraining information useful for interpreting learner language.
    - e.g., it's easier to infer what a learner wanted to say if one knows the text they are answering questions about.

Annotation of Learner Corpora

- Effective querying of corpora for specific phenomena often requires reference to corpus annotation.
- To find relevant classes of examples, the terminology used to single out learner language aspects of interest needs to be mapped to instances in the corpus (Meurers 2005; Meurers & Müller 2009).
- Annotations function as an index to classes of data which cannot easily be identified in the surface form.

Annotation of Learner Corpora (cont.)

- Example: Finding all sentences containing modal verbs using only the surface forms is possible, but involves specifying a long list of all forms of all modal verbs.
  - Even so, sentences where *can* is not actually a modal would be wrongly identified:

(1) *Pass me a* ***can*** *of beer.*

(2) ***I can*** *tuna for a living.*

- Many search patterns cannot be specified in finite form, e.g, finding all sentences with past participle verbs.
- What type of learner language annotations are needed to support the searches for the data which are important for FLT and SLA research?

Data in SLA research

Clahsen & Muysken (1986)

- They studied word order acquisition in German by native speakers of Romance languages
- Stages of acquisition:
  1. S (Aux) V O
  2. (AdvP/PP) S (Aux) V O
  3. S V[+fin] O V[-fin]
  4. XP V[+fin] S O
  5. S V[+fin] (Adv) O
  6. *dass* S O V[+fin]

  Stage 2 example: *Früher* *ich kannte* *den Mann*
  earlier$_{AdvP}$ I$_S$ knew$_V$ [the man]$_O$

  Stage 4 example: *Früher* *kannte* *ich den Mann*
  earlier$_{AdvP}$ knew$_{V[+fin]}$ I$_S$ [the man]$_O$

- How is the data characterized?
  - lexical and syntactic categories and functions

Data in SLA research

Kanno (1997), Pérez-Leroux & Glass (1997)

- They studied the use of overt and null pronouns by non-native speakers of Japanese and Spanish.
- Examples:

(3) *Nadie dice que* ***él*** *ganará el premio.*
nobody says that he will win the prize
'Nobody$_i$ says that he$_{*i/j}$ will win the prize.'

(4) *Nadie dice que __ ganará el premio.*
nobody says that *pro* will win the prize
'Nobody$_i$ says that he$_{i/j}$ will win the prize.'

- How is the data characterized?
  - syntactic functions and semantic relations
  - not overtly expressed but interpreted elements

Annotation: Error annotation and beyond

- The annotation of learner corpora has focused on *errors* made by the learners (Granger 2003; Díaz-Negrillo & Fernández-Domínguez 2006).
- Yet, SLA research essentially observes correlations of linguistic properties, whether erroneous or not.
- Even research focusing on learner errors needs to identify correlations with linguistic properties, e.g., to identify
  - overuse/underuse of certain patterns
  - measures of language development (Developmental Sentence Scoring, Index of Productive Syntax, . . .)

Error annotation

Ambiguity and representation

- An error annotation scheme needs to support
  - unambiguous and consistent identification of error
    - generally involves identification of target intended by learner
  - a unique representation of the identified error
- Annotation scheme design thus requires answering questions such as:
  - Where can which ambiguities be reliably resolved, given what ling. context or other information (learner, task)?
  - In a hierarchical tagset (i.e., different levels of specificity) how is consistency of level of annotation achieved?

⇒ Only distinctions reliably identified given information present in a corpus or its meta-information should be included in an annotation scheme.

Error annotation

Ambiguity and representation (cont.)

- Identifying the nature of the error
  - Example: *The man eat cheese.*
    - agreement error: *The man*$_{3s}$ *eat*$_{not(3s)}$ *cheese.*
    - tense error, intended was: *The man ate cheese.*
- Localizing and representing the error
  - Which single, unique way is chosen to *annotate* an identified error, e.g., for binary relations?
  - Example for marking a subject-verb agreement error:
    - on the subject: *The man eat cheese.*
    - on the verb: *The man eat cheese.*
    - on an annotated relation: *The man* $\rightarrow_{agr}$ *eat cheese.*
  - Problem is non-trivial given that
    - suffixes in fusioning languages combine multiple features (e.g., person, number, gender, case)
    - often multiple relations are established (e.g., D–A–A–N)

Annotation of linguistic properties

- Annotation schemes have been developed for a wide range of linguistic properties, including
  - part-of-speech and morphology
  - syntactic constituency or lexical dependency structures
  - semantics (word senses, coreference), discourse structure
- Each type of annotation typically requires an extensive manual annotation effort → gold standard corpora
- Automatic annotation tools learning from such gold standard annotation are becoming available, but
  - Quality of automatic annotation drops significantly for text differing from the gold standard training material
- Interdisciplinary collaboration between FLT, SLA and Computational Linguistics crucial to adapt annotation schemes and methods to learner language corpora
  - Very little research on this so far (but cf. de Haan 2000; de Mönnink 2000; van Rooy & Schäfer 2002, 2003)

The importance of high-quality annotation

Precision of search

- By **precision** of search we are referring to:
  - Of the results to the query, how many represent the learner language patterns searched for?
  - False positives can result in two ways:
    - Term used for query also characterizes patterns other than the ones we are interested in.
    - Some of the annotations the query refers to are incorrect.
- Requirements on precision of search
  - for qualitative analysis: Needs to be high enough to find relevant examples among the false positives.
  - for quantitative analysis: For reliable results, very high precision is required, in particular where specific rare language phenomena are concerned (and as known from Zipf's curse, most things occur rarely).

The importance of high-quality annotation

Recall of search

- By **recall** of search we are referring to:
  - How many of the intended examples that in principle are in the corpus are in fact found by the query?
- Requirements on recall of search
  - for qualitative analysis: Any results found are useful, but danger of partial blindness if example subclasses are not captured by query approximating target phenomenon.
  - for quantitative analysis: Maximizing recall is crucial for reliable quantitative results.

⇒ Where the query characterizing the target phenomenon is expressed in terms of the annotation, quality and consistency of the annotation is important.

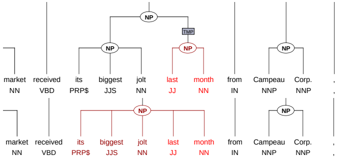
Annotation quality

Methods for obtaining quality

- How can a high quality gold standard be obtained?
  - Annotate corpus several times and independently, then test interannotator agreement (Brants & Skut 1998)
  - Keep only reliably and consistently identifiable distinctions, described in detailed manual, including appendix on hard cases (Voutilainen & Järvinen 1995; Sampson & Babarczy 2003)
  - Detection of annotation errors through automatic analysis of comparable data recurring in the corpus → DECCA (Dickinson & Meurers 2003a,b, 2005; Boyd et al. 2008)

DECCA: Variation n-gram error detection

- **Variation**: multiple occurrences, with different annotations
  a) **ambiguity**: different annotations correctly label the same material used in different contexts
  b) **annotation error**: annotation is inconsistent across comparable occurrences
- Variation between constituent and non-constituent:



DECCA: Variation n-gram error detection (cont.)

- Variation between two syntactic category labels:

  (5) *maturity* *next Tuesday*

  labeled as **NP** twice
  PP once

- Efficient methods for detecting such annotation errors have been developed for a range of annotation types (Dickinson & Meurers 2003a,b, 2005; Boyd et al. 2008):
  - positional: words, part-of-speech
  - binary relations: lexical dependencies
  - structural domains: chunks, constituents
- Python code is freely available from our project website:

  http://decca.osu.edu

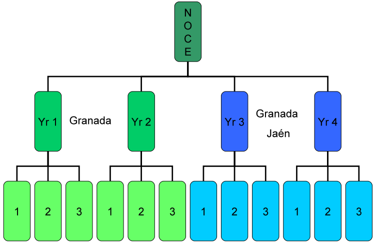
A Concrete Case

- The NOCE learner corpus (Díaz-Negrillo 2009)
- Towards linguistic annotation
- Corpus representation
  - XML
  - TEI
- Exploring automatic POS annotation of learner language
- What does it mean to POS-annotate learner language?

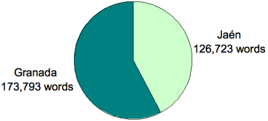
The NOCE Learner Corpus

- Participants
  - Writing by 1st/2nd year students of English at the universities of Granada and Jaén
  - Learner information included: age, level, L2 exposure, motivation, etc.
- Task
  - Written texts (argumentative, descriptive, narrative)
  - Around 250 words per text
  - Topics chosen from 3 suggestions or free writing
- Internal structure
  - 3 text collections per academic year
  - 4 years (2003-2005; 2007-2009)

NOCE: Corpus Structure



NOCE: Corpus Size



Overall figures		
300,516 words	994 texts	438 participants

NOCE: Annotation

- EYES (ExplicitlY Encoded Surface modifications) 100% of corpus annotated
  - Struckout units
  - Late insertions
  - Reordering of units
  - Missing/unreadable text
- EARS (Error Annotation and Retrieval System) ≈25% of corpus annotated
  - Spelling
  - Punctuation
  - Word, phrase and clause grammar
  - Lexis
- How about adding linguistic information?

First Step: Tokenization

- Maps input string into a series of tokens (words)
- Tokenization is
  - language dependent: e.g., English uses spaces to delimit words (vs. Chinese) (but: *in spite of*, *insofar as*)
  - character-set dependent: e.g., accented characters
  - application dependent: e.g., are there 1 or 2 tokens in
    - pronunciation vs. named entity: *US*
    - abbreviation vs. sentence-ending: *Mass.*
    - hyphenized words: *text-based*
    - contractions: *I'm*, *gonna*, *cannot*
- Learner spelling mistakes such as additional or missing spaces can create problems for tokenziation, e.g.:

(6) *I , saw , John , inthe , park , the , other , day .*

Second Step: POS-Tagging

- Automatic assignment part-of-speech tags to each token
- Three freely available taggers
  - Stanford Tagger (Stanford University NLP Group)
  - TnT (Universität des Saarlandes, Saarbrücken)
  - TreeTagger (University of Stuttgart)
- All three taggers use Penn Treebank tagset
  - Fairly general tag inventory, limited number of categories
- All three taggers come with models trained on the same newspaper texts (Wall Street Journal)
  - Comparable results
- Performance is known to degrade on other text genres
  - Learner essays ≠ newspaper text

Representing rich information: XML

- Many different types of information:
  - Learner information
  - Learner text
  - Error tags and editorial tags
  - Tokenization of the text
  - POS tags
- How can we keep the information in the same file, but still clearly separated?

⇒ Use XML

XML: Representation of annotation

- Primary data: everything between a <w> tag
- Edited out data: enclosed in <C> tags
- POS-tags: attributes on each token

```
<?xml version="1.0" encoding="ISO-8859-15"?>
<corpus>
  <w id='w520' pos-stt='IN' pos-tnt='IN' pos-tt='IN'>inside</w>
  <C>
   <w id='w521' pos-stt='NN' pos-tnt='(' pos-tt='('>(</w>
   <w id='w522' pos-stt='DT' pos-tnt='DT' pos-tt='DT'>the</w>
   <w id='w523' pos-stt='NN' pos-tnt='NN' pos-tt='NN'>cassette</w>
   <w id='w524' pos-stt='NN' pos-tnt=')' pos-tt=')'>)</w>
  </C>
  <w id='w525' pos-stt='DT' pos-tnt='DT' pos-tt='DT'>a</w>
  <w id='w526' pos-stt='JJ' pos-tnt='JJ' pos-tt='JJ'>small</w>
  <w id='w527' pos-stt='NN' pos-tnt='NN' pos-tt='NN'>cassette</w>
  <w id='w528' pos-stt='.' pos-tnt='.' pos-tt='SENT'
    sb='true'>.</w>

</corpus>
```

XML: TEI header

- TEI: Text Encoding Initiative (http://www.tei-c.org)
- TEI headers in NOCE contain information about:
  - Who compiled the corpus and where
  - The tasks the learners carried out
  - The learners (proficiency level, their reasons for learning English, native language(s), location, . . .)
  - The tools used to produce the corpus
  - . . .
- Particularly important for interdisciplinary research as it provides comprehensive and standardized information

XML: More on the benefits

- Standard XML tools help quickly find cases where
  - annotators forgot to type in closing error tags
  - accidentally interleaving error tags were annotated
  - error tags were mistyped

```
<?xml version="1.0" encoding="ISO-8859-15"?>
<corpus>
 To <LX.VR.IT.CC.MS>practice basketball, football
 <PN.CM.OM></PN.CM.OM> tennis <PN.EP.OV>...
 </PN.EP.OV> </LX.VR.IT.CC.MS> is a form
 <PG.CS.CP.NN.RE.NF.MS> to
   <LX.VR.IT.CC.MS> delete
   </PG.CS.CP.NN.RE.NF.MS> fats and sugars
 </LX.VR.IT.CC.MS>.
</corpus>
```

XML Schema: definition of annotation schemes

- Provide exact definition of annotation scheme
- Typos and confusions can be automatically detected while you type
  - e.g., <VBB> instead of <VBP> (verb, present, sg, ¬3rd)

POS tagging of NOCE: An experiment

Setup

- Used 3 POS taggers trained on newspaper text
  - TreeTagger, TnT tagger, Stanford tagger
- Tagged the error-annotated section in NOCE
  - 179 texts ≈ 44 000 words

Results

- Manually evaluated POS tags assigned by taggers to 10 texts by 10 different participants (1850 words)
- Accuracy of automatically assigned tags
  - TreeTagger: 94.95%
  - TnT Tagger: 94.03%
  - Stanford Tagger: 88.11%

POS tagging of NOCE: Some issues

Spelling

(7) *I think that university teachs to people* [. . .]

Word boundaries

(8) *They can't pay their studies and more over they have to pay a flat* [. . .]

- Found lower performance for expressions which do not exist in English (in line with de Haan 2000; van Rooy & Schäfer 2002)
- But is tagging learner language really just a robustness issue, like adapting taggers to another domain?
- What does it mean for a POS tag to be correct for learner language?!

Sources of Evidence for POS analysis

- POS analysis based on evidence in the text:
  - information in lexical entries

    (9) *I was surprised by the word* ***of*** *the day.*
  - information encoded in morphological information

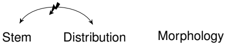
    (10) *There is a lot of* ***construction*** *going on here.*
  - information conveyed by distribution

    (11) *The old* ***man*** *the boat.*

Systematic POS categories for learner language

- POS tagging learner language usually handled as a domain transfer (robustness) problem
  - train/develop on native language
  - apply post-correction
- Are POS tags designed for native language suitable for *systematically* describing learner language?
- Can they make interesting properties of learner language explicit?
- We argue for developing a new POS category system that can better represent learner language

Case 1: Stem-Distribution mismatch



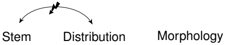
(12) [...] *you can find a big* ***vary*** *of beautiful beaches* [...]

Stem	Distribution	Morphology
verb	noun	?

(13) [...] *they are very kind and* ***friendship****.*

Stem	Distribution	Morphology
noun	adjective	?

Case 1: Stem-Distribution mismatch



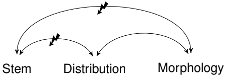
(14) [...] *that's the reason* ***because*** *I went to Tunisia twice.*

Stem	Distribution	Morphology
conjunction	wh-pronoun	?

(15) *RED helped him* ***during*** *he was in the prison.*

Stem	Distribution	Morphology
preposition	conjunction	?

Case 2: Stem-Distrib./Stem-Morph. mismatch



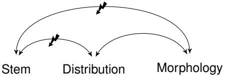
(16) [...] *one of the favourite places to visit for many* ***foreigns****.*

Stem	Distribution	Morphology
adjective	noun	noun / verb 3rd sg)

(17) [...] *to be* ***choiced*** *for a job* [...]

Stem	Distribution	Morphology
noun / adjective	verb	verb

Case 2: Stem-Distrib./Stem-Morph. mismatch



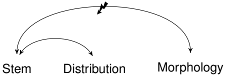
Stem Distribution Morphology

(18) […] *and dark **politicals** will be defeated.*

(19) […] *internet have some "pages" that **contents** something so horrible* […]

Derivational morphology and inflectional morphology point to different POS: Further splitting within slots?

Case 3: Stem-Morphology mismatch



Stem Distribution Morphology

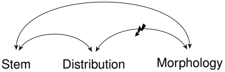
(20) […] *this film is one of the **bests** ever customes* […]

Stem	Distribution	Morphology
adjective (noun / verb)	adjective	noun / verb 3^{rd} sg

(21) […] *television, radio are very **subjectives*** […]

Stem	Distribution	Morphology
adjective / noun	adjective	noun / verb 3^{rd} sg

Case 4: Distribution-Morphology mismatch



Stem Distribution Morphology

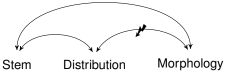
(22) […] *for almost every **jobs** nowadays* […]

Stem	Distribution	Morphology
noun	noun sg	noun pl / verb 3^{rd} sg

(23) […] *it has **grew** up a lot specially after 1996* […]

Stem	Distribution	Morphology
verb	verb past participle	verb past tense

Case 4: Distribution-Morphology mismatch



Stem Distribution Morphology

(24) […] *if he **want** to know this* […]

(25) *This first year **have** been wonderful* […]

Stem	Distribution	Morphology
verb	verb 3^{rd} person sg	verb non-3^{rd} sg

Mismatch-free leaner language

Realization using wrong allomorph

(26) *The mayority of people that die in Irak are **childs*** [...]

(27) *He **runned** to buy one* [...]

Mismatch-free leaner language

Realization using wrong stem

(28) [...] *the 11th March **cames** to our minds.*

Mismatch-free leaner language

Duplicate inflection

(29) ***Childrens** spend so much time* [...]

(30) [...] *it **stresseses** me a lot.*

Mismatch-free leaner language

Inappropriate word-formation rules

(31) [...] *internet can **modificate*** [...]

(32) [...] *different **socialities** and ways of life.*

Mismatch-free leaner language

Creative lexis

(33) [. . .] *people shouldn't be **menospreciated** because of the music they listen to* [. . .]
(menospreciados (span.): undervalued)

(34) [. . .] *for many **raisons**.*

Conclusion

- Data collected in learner corpora in principle can provide empirical insights for development & validation of theories
- We discussed
  - linguistic annotation of learner corpora to support effective querying for example patterns discussed in SLA research
  - design criteria for an error annotation scheme
  - practical aspects of XML/TEI encoding learner corpora
- We argued for an approach to the POS analysis of learner language, which distinguishes
  - lexical information
  - morphological information
  - distribution

  to obtain a systematic classification of POS properties capturing native-like text as well as learner innovations.

⇒ The (automatic) analysis of learner language collected in corpora provides many interesting challenges and opportunities.

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