On Annotating Learner Corpora: Why? Which annotations? How?

Detmar Meurers
Universität Tübingen

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Overview

- Motivations behind analyzing learner language and points of contact with computational linguistics
- Linguistic modeling of learner language
  - Which categories? A case study on parts-of-speech
    - sources of evidence
  - Which level of analysis?
    - between robustness and representing variation
  - Target hypotheses and error annotation
    - Inter-annotator agreement and available gold-standards
    - Comparative fallacy
  - Relevance of the task and learner modeling

Why Analyze Learner Language?

Second Language Acquisition (SLA)

- SLA research is aimed at understanding how second languages are acquired (and how language works)
  - empirical basis: analysis of learner data, . . .
- SLA research also studies **instructional interventions**
  - targeting different aspects of language,
  - in different types of tasks,
  - supporting different kinds of feedback, and
  - different sequencing of material
    - informed, e.g., by “teachability” (Pienemann 1998), “Zones of Proximal Development” (Vygotsky 1986)

Why Analyze Learner Language?

Foreign Language Teaching (FLT)

- adapt, advance, and test effectiveness of intervention methods and tests in teaching practice
- analysis of learner language helps advance our understanding of student abilities and needs

Contact Points with Computational Linguistics

- **Learner corpora**: representing, annotating, searching
  - can provide empirical evidence for SLA research
  - can provide insights into typical student needs in FLT

  annotation = off-line analysis
- **Writer's aid tools**: on-line analysis of learner language to provide immediate feedback *aimed at producing text*
- **Language testing**: off-line or on-line analysis to support or automate *assessment of learner abilities*
- **Intelligent Tutoring Systems**: on-line analysis *aimed at supporting language acquisition*
  - provide immediate, individualized feedback, e.g.:
    - meta-linguistic feedback in a form-focused activity
    - incidental focus-on-form in a meaning-based activity
    - feedback on meaning (very rare in ITS)
  - determine progression through pedagogical material

Data in SLA research

An example: 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
  - some acquisition stages are well-formed, others ill-formed

Annotation: Error Annotation and Beyond

- SLA research essentially observes correlations of linguistic properties, whether erroneous or not.
- Yet, the annotation of learner corpora has focused on *errors* made by the learners (cf., e.g., Granger 2003; Díaz Negrillo & Fernández Domínguez 2006).
- Even where errors are the research focus, their correlation with other linguistic properties is relevant.
- General linguistic annotation is useful for capturing
  - overuse/underuse of particular patterns
    - (Hirschmann, Lüdeling, Rehbein, Reznicek & Zeldes 2010, Wiersma, Nerbonne & Lauttamus 2011)
  - measures of language development
    - Complexity, Accuracy & Fluency (CAF, Wolfe-Quintero et al. 1998; Ortega 2003; Housen & Kuiken 2009; Lu 2010)
    - Criterial Features (Hawkins & Buttery 2009, 2010)

Annotation of Linguistic Properties

- Annotation schemes for native corpora have been developed for a wide range of linguistic properties:
  - 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 SLA & CL crucial to adapt annotation schemes & methods to learner language
  - Surprisingly little research on this (Meunier 1998; de Haan 2000; de Mönnink 2000; van Rooy & Schäfer 2002, 2003)

Annotation quality

- An annotation scheme is only as good as the distinctions it reliably supports making based on available evidence.
  - E.g., particle vs. preposition dropped in PTB tagset
  - Note: More classes can be more reliable if they are more coherent (cf. CLAWS7 annotation, followed by mapping to CLAWS5 in BNC Tag Enhancement Project).
- **How can high quality annotation be obtained?**
  - Keep only reliably and consistently identifiable distinctions
    - described in detailed manual
    - including appendix on hard cases

    (Voutilainen & Järvinen 1995; Sampson & Babarczy 2003)
  - Annotate corpus several times and independently, then test interannotator agreement (Brants & Skut 1998)
  - Detect annotation errors through automatic analysis of comparable data recurring in the corpus → DECCA (Dickinson & Meurers 2003a,b, 2005; Boyd et al. 2008)

Case study on part-of-speech annotating NOCE

(Díaz Negrillo, Meurers, Valera & Wunsch 2010)

- The NOCE learner corpus (Díaz Negrillo 2009)
  - Short essays written by Spanish students of English
- Part-of-Speech (POS) analysis of learner language
  - Exploring automatic POS annotation
  - What does it mean to POS-annotate learner language?

The NOCE Learner Corpus (Díaz Negrillo 2009)

- Participants
  - Writing by 1st and 2nd year students of English at the universities of Granada and Jaén
  - Corpus includes meta-information on learner: age, level, L2 exposure, motivation, etc.
- Task
  - Written text, around 250 words
  - Topics chosen from 3 suggestions or free writing
- Corpus structure and size
  - 3 text collections per academic year, for 4 years
  - 998 texts, 337.332 tokens (149.256 types)
- Annotation:
  - Editorial (struck-out units, insertions, reordering)
  - Error (179 texts, 39.165 tokens, 5.285 errors, 357 types)

⇒ How about adding linguistic information?

Automatic POS-Tagging of NOCE

Setup

- Used 3 POS taggers trained on WSJ newspaper text, using Penn Treebank tagset
  - TreeTagger, TnT tagger, Stanford tagger
- Tagged the error-annotated section of NOCE

Results

- Manually evaluated POS tags assigned by taggers to 10 texts by 10 different participants (1.850 words)
- Accuracy of automatically assigned tags
  - TreeTagger: 94.95%
  - TnT Tagger: 94.03%
  - Stanford Tagger: 88.11%

Aspects of a qualitative analysis

We found lower performance for expressions which do not exist in English (cf. also de Haan 2000; van Rooy & Schäfer 2002).

Spelling

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

Word boundaries

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

- But is tagging learner language really just a robustness issue, like adapting taggers to another domain?
- What does it mean to use POS tags developed for native language for the interlanguage of learners?
- What research questions can such "native POS" tags answer?

Three Sources of Evidence for POS analysis

Lemma/Lexical entry:

(3) *I was surprised by the word **of** the day.*

- *of* ⇒ preposition

Morphology:

(4) *There is a lot of **construction** going on here.*

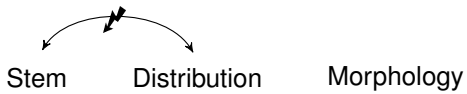
- *-ion* ⇒ noun

Distribution:

(5) *The old **man** left.*

- adj __ verb ⇒ noun

Case 1: Stem-Distribution mismatch



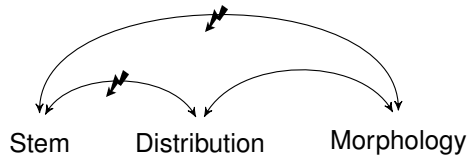
(6) [. . .] *you can find a big **vary** of beautiful beaches* [. . .]

Stem	Distribution	Morphology
verb	noun	?

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

Stem	Distribution	Morphology
preposition	conjunction	?

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



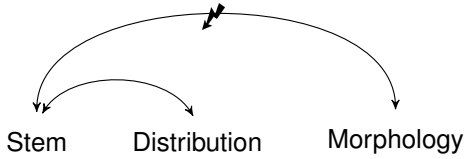
(8) [. . .] *one of the favourite places to visit for many **foreigns**.*

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

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

Stem	Distribution	Morphology
noun / adjective	verb	verb

Case 3: Stem-Morphology mismatch



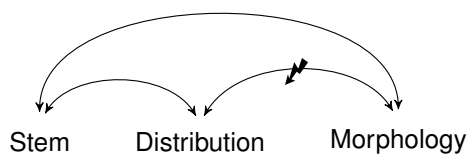
(10) [...] *this film is one of the* ***bests*** *ever* [...]

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

(11) [...] *television, radio are very* ***subjectives*** [...]

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

Case 4: Distribution-Morphology mismatch



(12) [...] *for almost every* ***jobs*** *nowadays* [...]

Stem	Distribution	Morphology
noun	noun sg	noun pl / verb 3rd sg

(13) [...] *it has* ***grew*** *up a lot specially after 1996* [...]

Stem	Distribution	Morphology
verb	verb past participle	verb past tense

Systematic POS for Learner Language

- A single, standard POS tag **fails to systematically identify properties of learner language**.
- Alternative: tripartite POS encoding of
  - distribution, stem, morphology
- Some errors in learner language are **epiphenomena of mismatches** in linguistic encoding.
  → Identify such errors through linguistic annotation.
- The value of identifying such mismatches systematically is confirmed by recent SLA research (Zyzik & Azevedo 2009)
  - L2 learners have difficulty distinguishing between word classes among semantically related forms
  - Hypothesis: limited ability to interpret syntactic and morphological cues

On the nature of categories for learner language

- Where do the categories abstracted to come from?
- Categories result from generalizations, which require a significant amount of comparable data to be made.
- How fine grained are they?
  - In NLP, *robustness* is the ability to *ignore* variation in the realization of a category to be identified.
  - The category system used must be sufficiently fine grained for the variation we want to identify and analyze.
- Syntax: breaking down constituency in terms of
  - overall topology of a sentence (Hirschmann et al. 2007)
  - chunks and chunk-internal word order (Abney 1997)
  - dependency
    - canonical, as interface to meaning (MacWhinney 2008; Rosén & Smedt 2010; Ott & Ziai 2010; Hirschmann et al. 2010)
    - surface-evidence based (Dickinson & Ragheb 2009)

Comparative fallacy

- Comparative fallacy is “the mistake of studying the systematic character of one language by comparing it to another.” (Bley-Vroman 1983, p. 6)
  - extended to include bias towards towards native language (Lakshmanan & Selinker 2001)
- Essentially trying to analyze a “non-canonical variety” using a “robust” version of the canonical grammar.
  - divergences from norm annotated as errors
  - note: the research question is the issue here, not corpus error annotation as such (Tenfjord et al. 2006)
- Issue more general than language acquisition research:
  - Eurocentrism in field work (Gil 2001)
  - Variationist sociolinguistics:
    - Importance of defining variation to be studied and when an instance is counted as one of the variants.

Error annotation

- Error annotation involves (implicitly or explicitly):
  a) Determining what the learner wanted to say (**target**).
  b) Identifying
     i. the **location** of the error, and
     ii. the **nature** of the error corresponding to the difference between the learner sentence and the target hypothesis.
  c) **Annotating** the error in the corpus
- Each of these steps can present ambiguity:
  a) multiple possible target hypotheses
  b) i. different locations in which the error can be rooted
     ii. different types of errors divergence can be attributed to
  c) different ways to mark an error location & type in corpus

Error annotation schemes: Desiderata

Inter-annotator agreement

- An annotation is only relevant and useful if it provides a uniform, reliable index to relevant classes of data.
- Traditionally every researcher develops their own error annotation scheme. (Díaz Negrillo & Fernández Domínguez 2006)
- Lack of studies showing what level of inter-annotator agreement can be reached for which type of distinctions.

Error annotation schemes: Desiderata

Gold standard annotation

- Freely available gold standard annotations for error annotation schemes supporting high inter-annotator agreement levels are crucially needed.
- Without an available gold standard annotation,
  - no reliable quantitative evaluation possible for research
  - no training, evaluation and comparison of NLP tools for error analysis is possible.
- Promising progress for some subclasses (det, prep).
  (e.g., Lee & Seneff 2006; Tetreault & Chodorow 2008; De Felice 2008)
  - but it is important to establish a tool-independent, transparent definition of the markables to be annotated.

Target hypotheses

- Target hypothesis should be explicit part of annotation (Lüdeling et al. 2005; Hirschmann et al. 2007; Lüdeling 2008).
- Fitzpatrick & Seegmiller (2004) report unsatisfactory levels of agreement in determining the learner targets.
  - But keeping the target hypothesis implicit results in error annotations which diverge even more unsatisfactorily.
- Corpora with explicit target hypotheses may support reliable error tagging.
  - Which type of target hypotheses support reliable annotation of which error distinctions?
  - Which evidence is needed to reliably determine such target hypotheses?

Difficulty of determining target hypotheses

- What are the target forms for the sentences taken from the Hiroshima English Learners' Corpus (Miura 1998):

  (14) *I didn't know*
  (15) *I don't know his lives.*
  (16) *I know where he lives.*
  (17) *I know he lived*

  They are taken from a translation task, for the Japanese of

  (18) *I don't know where he lives.*

- How can one obtain a better handle on target hypotheses?
  - focus on more advanced learners
  - support targets other than fully explicit surface forms
  - take explicit task context into account
  - take learners and learner strategies into account
    - Learners sometimes use known L2 chunks instead of trying to express appropriate meaning!

Constraining the search space of interpretation

Importance of activity and learner modeling

- Annotation of learner language = interpreting data given available evidence
- All approaches to modeling errors (annotation, *mal*-rules, constraint relaxation, statistical modeling) must model space of **well-formed and ill-formed variation** given
  - a particular activity, and
  - a given learner.
- For example, without task and speaker context, how would you interpret the following?

  (19) *I will not buy this record it is scratched*
  (20) *My hovercraft is full of eels.*

Exemplifying interpretation in context

Monty Python: Hungarian Phrase Book sketch
http://www.youtube.com/watch?v=akbflkF_1zY

Towards task-specific learner corpora

- Explicit task and learner models included as meta-information in a corpus can provide crucial constraining information 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.
  - = taking task, strategic competence, and L1 into account in learner models of Tutoring Systems (Amaral & Meurers 2008).
- Most 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 which are interpretable & representative of learner language, we need more language produced in a wide range of explicit task contexts.

Conclusion

- We discussed the different motivations for analyzing learner language in SLA, FLT, and their connection to CL
- We motivated linguistic annotation to support effective querying for SLA patterns and discussed an approach to the POS analysis of learner language separating
  - lexical, morphological, and distributional information
- Goal: Corpus annotation systematically characterizing language – native-like as well as learner innovations.
- Well-defined linguistic analysis subtasks on freely available corpora are crucial for sustainable progress.
- We argued for inter-annotator agreement as crucial for establishing which distinctions are replicable based on the available information.
- We explored the nature of target hypotheses and argued for explicit task and learner modeling to constrain the search space of interpretation.

Our Background

Analyzing language for learners

- Input enhancement of texts for learners (Meurers et al. 2010b)
- Search engine for language learners (Ott & Meurers 2010)
- Prediction of functional elements (Elghafari, Meurers & Wunsch 2010)

Analyzing learner language

- Intelligent Tutoring System TAGARELA for Portuguese (Amaral & Meurers 2008, 2009, 2011; Amaral et al. 2011)
- Linguistic analysis of NOCE corpus of English written by Spanish learners (Díaz Negrillo, Meurers, Valera & Wunsch 2010)
- Automatic analysis of learner language (Meurers 2009)
- Word order errors (Metcalf & Meurers 2006b; Boyd & Meurers 2008)
- Content assessment of answers to reading comprehension questions (Bailey & Meurers 2008) → SFB 833 A4 (CoMIC)
  - Longitudinal corpus collection using WELCOME (Meurers, Ott & Ziai 2010a) → KU/OSU collaboration
  - Dependency parsing of learner language (Ott & Ziai 2010)

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