Word Formation Variation as Features for Native Language Identification

Julia Krivanek Detmar Meurers
Universität Tübingen

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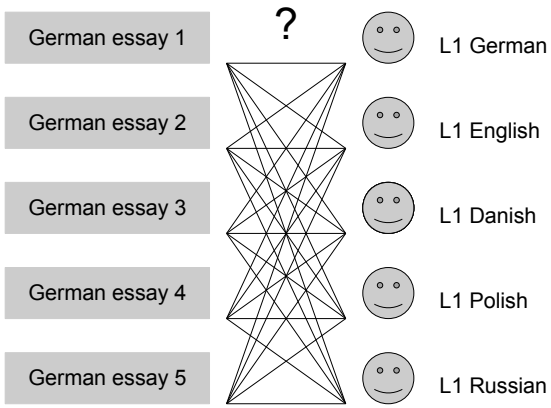
Introduction

- A key question in current corpus-based research concerns the role of linguistic abstraction:
  - When are linguistic categories relevant and when are surface-based characterizations just as successful?
- We need an experimental sandbox to try out different types of linguistic modeling and study their impact.
- How about Automatic Native Language Identification?
  - Transfer is known to involve many linguistic dimensions (lexicon, syntax, pragmatics, . . .).
  - Let's run classification experiments to quantify the effect of linguistic abstractions.

Native Language Identification (NLI)

- Automatically determine the native language of a writer based on a text they wrote in a second language.



Current NLI approaches

- Shallow approaches using surface n-grams
  (e.g., Brooke & Hirst 2012; Bykh & Meurers 2012; Jarvis et al. 2012)
  - high classification accuracy
  - large feature sets impossible to interpret qualitatively
  - some dependence on domain (genre, topic, . . .)
- Error pattern approaches (Wong & Dras 2009; Bestgen et al. 2012)
  - focus on one aspect of learner language
  - often requires manual error annotation
- NLI Shared Task 2013 (Tetreault et al. 2013):
  - English essays by writers with 11 native languages
  - approaches often use a combination of features, directly or using meta-classifiers

Linguistic Variation as Features for NLI

- Word-based features encode form and meaning together.
  - requires very high number of features to be applicable to unseen data, across domains
- Can we abstract away from the meaning to be expressed to choices in the linguistic system?
  - Idea: Study where the linguistic system provides multiple ways to express the same meaning or function.
    - method related to variationist sociolinguistics
- How about using valence alternations for NLI? (Krivanek 2012; Meurers et al. 2013)

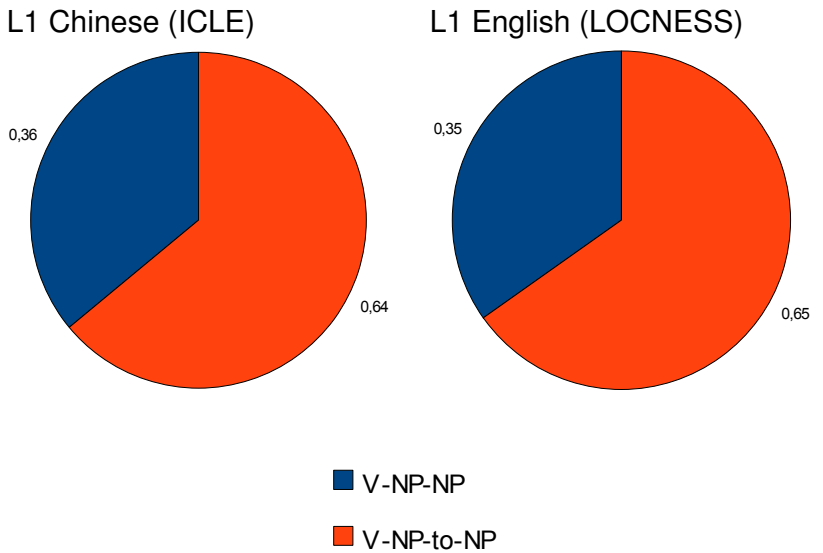
(1) a. *He gave the book to John.*
b. *He gave John the book.*

Dative Alternation

Popular topic in linguistics (Levin 1993), but so far little corpus-based SLA work (but cf. Callies & Zaytseva 2011).

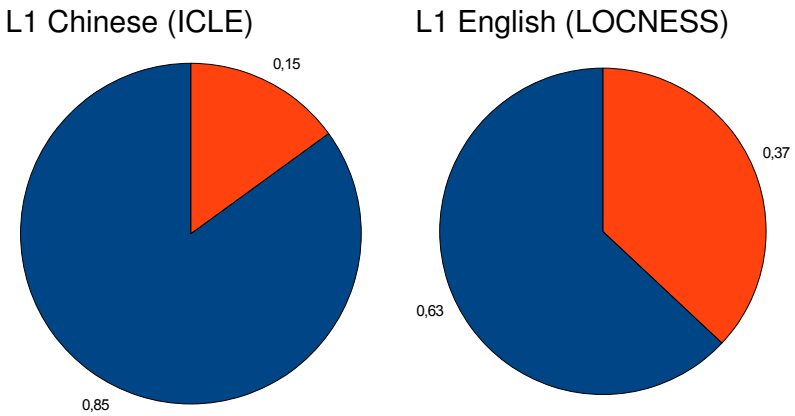
Syntactic alternations as features

A non-distinctive alternation: Dative Alternation Drop



Syntactic alternations as features

A distinctive alternation: Locative Preposition Drop



V-PPloc (Martha climbed up the mountain.)
V-NP (Martha climbed the mountain.)

Syntactic alternations as features

(Krivanek 2012; Meurers, Krivanek & Bykh 2013)

- Theory-driven approach:
  - 21 alternations from Levin (1993) as features

  ⇒ effective, but features not common enough in short texts
- Adding a data-driven twist:
  - define classes consisting of all verbs with the same set of syntactic realization alternatives occurring in a corpus
  - features encode variants chosen in text for a given class

  ⇒ improves accuracy, features qualitatively interpretable
- How about taking such a variationist perspective further?

Taking the next step

- We target German as L2.
  - language is morphologically richer than English
- Focus on morphological variation:
  - word formation
- Lexical features are attractive since there are many opportunities to observe words even in a short text.

Inflection

	singular		plural	
1. pers.	ich	schwimm**e**	wir	schwimm**en**
2. pers.	du	schwimm**st**	ihr	schwimm**t**
3. pers.	er/sie/es	schwimm**t**	sie	schwimm**en**

- Inflection directly reflects morpho-syntactic requirements

⇒ not likely to be informative for our purposes

Word Formation

- Language offers several options for forming new words:
  - with/without derivational morphemes
  - with different part-of-speech or gender as source and as target
- Example:

schreien$_{to\ shout}$ → das$_{the-neut}$ Schreien$_{shouting}$
der$_{the-masc}$ Schrei$_{shout}$
die$_{the-fem}$ Schrei**erei**$_{yelling}$
das$_{the-neut}$ **Ge**schrei$_{yelling}$

⇒ Define *word formation variables* and use *variants* as features

Variables and their variants as features for NLI

Morpheme alternation

Variants	Examples		
no affix	*Frau*$_{woman}$	+ *Welt*$_{world}$	→ *Frauenwelt*$_{woman's\ world}$
suffix	*Feminist*$_{feminist}$	+ ***in***$_{female}$	→ *Feministin*$_{feminist}$
prefix	***un***$_{in}$	+ *gerecht*$_{just}$	→ *ungerecht*$_{injust}$
verb particle	***auf***$_{up}$	+ *geben*$_{give}$	→ *aufgeben*$_{give\ up}$

Variables and their variants as features for NLI

Derived category alternation

Variants	Examples		
noun	*anerkennen*$_{recognize}$	+ ung	→ ***Anerkennung***$_{recognition}$
verb	*auf*$_{up}$	+ geben$_{give}$	→ ***aufgeben***$_{give\ up}$
adjective	*entsprechen*$_{correspond}$		→ ***entsprechend***$_{corresponding}$
adverb	*möglich*$_{possible}$	+ weise	→ ***möglicherweise***$_{possibly}$

Variables and their variants as features for NLI

Source category alternation

Variants	Examples		
noun	***Feminist***$_{feminist}$	+ in$_{female}$	→ *Feministin*$_{feminist}$
verb	***anerkennen***$_{recognize}$	+ ung	→ *Anerkennung*$_{recognition}$
adjective	***möglich***$_{possible}$	+ *weise*	→ *möglicherweise*$_{possibly}$
adverb	***so***$_{as}$	+ *bald*$_{soon}$	→ *sobald*$_{as\ soon\ as}$

- Combining the variants of the three variables, one obtains 29 distinct features.
- For each feature, count number of occurrences per text, normalized by derived category.

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Setup and Results
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Summary
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Setup and Results

- Corpus used:
  - 185 German essays from Falko corpus (Reznicek et al. 2012)
  - 5 native languages (English, Polish, Russian, Danish, German)
  - advanced learners of German and native control group
  - average text length: 470 words
  - POS and morphology: RFTagger (Schmid & Laws 2008)
- Classification setup:
  - WEKA SMO Classifier (Witten & Frank 2005)
  - Leave-one-out evaluation
- Accuracy: **55.1%** (20% random baseline)
  - morphological information can clearly contribute to NLI
  - can be integrated into ensemble classifier for high accuracy NLI (Bykh, Vajjala, Krivanek & Meurers 2013)

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Qualitative Results: Confusion Matrix

	ger	eng	pol	rus	dan
ger	**34**	0	1	1	1
eng	3	**20**	2	3	9
pol	1	1	**26**	6	3
rus	2	6	8	**16**	5
dan	4	11	2	2	**18**

- German control group is recognized the best.
- Most confusions arise
  - within Slavic language group
  - within Germanic language group

⇒ potential usefulness of cascading classification (cf. Vajjala & Loo 2013)

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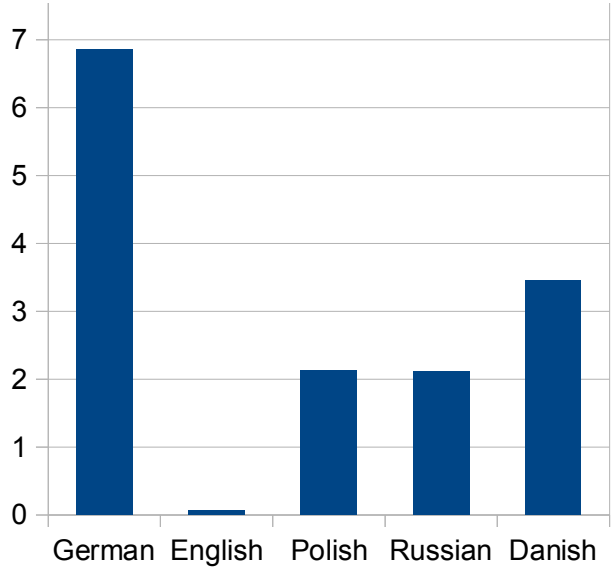
Qualitative Results: Overuse/Underuse

Verb particle feature (e.g., auf$_{up}$ + geben$_{give}$)



Summary

- Native Language Identification makes it possible to probe into the linguistic properties involved in Transfer.
- We argued for the use of variation within the linguistic system as meaningfully interpretable features for NLI.
  - syntactic variation as example (Meurers et al. 2013),
- We discussed new research on morphological variation:
  - targeting **German** learner texts
  - with features encoding **word formation** variants
- Results confirm that morphological variation can provide valuable information for NLI.
  - qualitatively interpretable features
  - can be integrated into ensemble classifiers for high quantitative results

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