How hard is it to automatically translate phrasal verbs from English to French?

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Outline

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1. Why are phrasal verbs hard to translate?
   - Definitions
   - Characteristics
   - Scope and goals
2. How to measure translation quality?
   - Evaluation protocol
   - Annotation
3. How hard is it to automatically translate phrasal verbs?
   - Experimental setup
   - Results
4. Wrapping up

Phrasal verbs (PVs)

Main verb + prepositional or adverbial particle

take + *on* or *away* =
take on $\Longrightarrow$ *take on a challenge*
take away $\Longrightarrow$ *I take away your books*

Examples

take off, *give up*, *pull out*, *pick up*, *make up*, *sort out*

Why phrasal verbs?

- Frequent type of MWE in (spoken) English [Sinclair, 1989]
- Complex syntactic and semantic behaviour
- Language asymmetries (*take off* $\Longrightarrow$ *décoller*)

Syntactic characterisation

Intransitive

she will show up later, the aircraft takes off

Transitive

Joint: *we made up this story, he took off his shoes*
Split: *we made this story up, he took them off*

- ***Verb-particle constructions***: *put off, give up, move on*
- ***Prepositional verbs***: *talk about, rely on, wait for*

Semantic characterisation [Bolinger, 1971]

Compositionality range

- ***Literal or compositional***: *take away*
- ***Aspectual or semi-idiomatic***: *fix up*
- ***Idiomatic***: *pull off*

Senses

- *figure out*, *look up*: 1 WN sense
- *pick up*: 16 WN senses
- *break up*: 19 WN senses

Our focus

Split transitive phrasal verbs

Verb + NP + Particle

Examples

take *your clothes* **off**, **give** *it* **up**, **pull** *things* **out**

- Word-based SMT [Brown et al., 1993] → phrase-based SMT [Koehn et al., 2003] → hierarchical SMT [Chiang, 2007]
- SMT can deal with some types of (contiguous) MWEs
- Intuitively, split PVs are hard to model

Our goals

Investigate the following questions:

- What proportion of split phrasal verbs is translated correctly/acceptably by current SMT paradigms?
- Which SMT paradigm, phrase-based or hierarchical, can better handle these constructions?
- What are the main factors that influence translation quality?

Our hypotheses

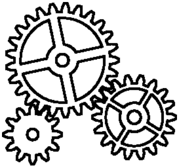
H1 Current SMT systems cannot translate PVs correctly

H2 Hierarchical models provide better translations than phrase-based models

H3 The quality of PV translation is determined mainly by their frequency in training data

Our experiments

1. Train two standard English-French SMT systems
   - phrase-based system (PBS)
   - hierarchical system (HS)
2. Translate a set of English sentences containing split PVs
3. Manually annotate PV translation quality



Outline

Translation quality

How to measure translation quality of a specific linguistic phenomenon inside the sentence?

- BLEU, NIST, Meteor - no insight into errors
- Manual annotation
    1. Specific test set
    2. Carefully designed annotation guidelines
    3. Interface to highlight the target context

1) Test set selection

1. ***Automatic extraction***: Parsing with RASP + mwetoolkit
   - VERB: POS starts with VV
   - OBJECT: sequence of 1 to 5 words, excluding verbs
   - PARTICLE: POS is II, RR or RP and depends on the verb with NCMOD_PART relation
2. ***Filtering heuristics***
   - Particles *about*, *well*, *at*
   - Verbs *go*, *walk*, *do*, *see* + locative words
   - Locative words + *here*, *there*, *way*
   - Verbs with double particles
   - Expressions *upside down*, *inside out*, *all over*
   - Long sentences (> 50 words)
3. ***Manual validation***

2) Annotation guidelines I

- Source and target (no reference) containing 1 PV
- Annotation data:
  - 250 similar PV translations - once
  - 500 different PV translations - consecutively in random order
- Highlight PV and its translation
- `http://cameleon.imag.fr/xwiki/bin/view/Main/Phrasal_verbs_annotation`

2) Annotation guidelines II

Adequacy

Extent to which the meaning of the English PV is preserved in the French translation

- 3 - FULL
- 2 - PARTIAL
- 1 - NONE
- 0 - UNABLE TO JUDGE

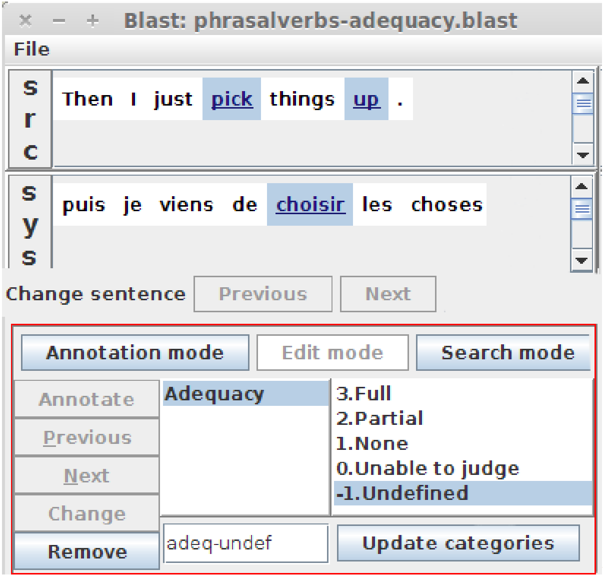
2) Annotation guidelines III

Fluency

Grammatical correctness in French of the translated PV (regardless of meaning)

- 4 - FLUENT
- 3 - NON-NATIVE
- 2 - DISFLUENT
- 1 - INCOMPREHENSIBLE

3) Annotation interface - BLAST [Stymne, 2011]



Annotation process

- 750 sentences, 4 annotators
- Proficient in English and French
- Access to Wordnet and online dictionaries
- Fluency and adequacy annotated in two passes

Inter-annotator agreement

- Pilot dataset of 156 sentences, 5 annotators
- ***Fluency***: $\kappa = 0.50$
- ***Fluency pairwise***: $\kappa = .33$ to $\kappa = .72$
- ***Adequacy***: $\kappa = .35$
- ***Adequacy pairwise***: $\kappa = .23$ to $\kappa = .52$

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Training and test data

English-French *TED Talks* parallel corpus [Cettolo et al., 2012][1]

	# sentences	
	Sys. 1	**Sys. 2**
Shared training set	137,319	137,319
PVs training set	1,034	1,037
Shared dev. set	2,000	2,000
PVs test set	1,037	1,034
Total	141,390	141,390

[1] https://wit3.fbk.eu/

Machine translation systems

Phrase-based system (PBS) and ***Hierarchical system (HS)***

- Moses toolkit [Koehn et al., 2007], standard training parameters[2]
- Word-alignment: GIZA++
- Phrase table extraction: *grow-diag-final* heuristic
- Language model: 5-grams, IRSTLM, monolingual part of training corpus
- Tuning: MERT
- Print out alignment information

[2] `http://www.statmt.org/moses/?n=Moses.Baseline`

Sanity check

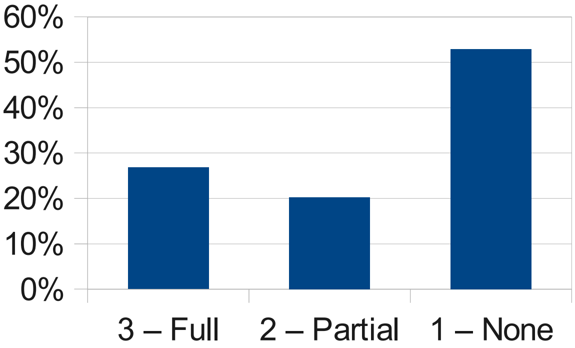
Compare with Google Translate - automatic metrics

BLEU			TER		
PBS	HS	Google	PBS	HS	Google
29.5	25.1	32.3	52.6	55.7	50.3

Translation examples

	could **boil** *this poem* **down** *to saying*
PBS	*pourriez* **furoncle** *ce poème* **jusqu'** *à dire*
HS	*pourriez* **bouillir** *ce poème* **descendu** *à dire*
	he would **think** *it* **through** *and say*
Both	*il* **pense que** *ça* **à travers** *et dire*
	you couldn 't **figure** *it* **out**
HS	*vous ne pouvais pas le* **comprendre**
PBS	*vous ne pouviez pas le* **découvrir**
	Then we 'll **test** *some other ideas* **out**
Both	*puis nous allons* **tester** *certains autres idées*

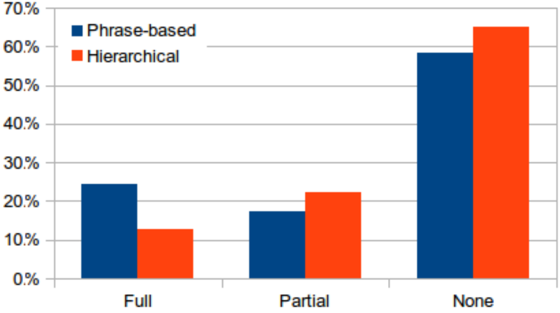
Finding 1: both systems are quite bad



Distribution of annotations - adequacy

Finding 2: PBS is better than HS

	Overall	PBS	HS	PBS-Diff.	HS-Diff.
Fluency (1-4)	2.57	2.67	2.46	2.63	2.25
Adequacy (1-3)	1.73	1.75	1.72	1.65	1.48



Why does the HS perform poorly?

- Some hypotheses
  - Insufficient training material
  - Standard parameters are inadequate
  - In the PBS, generally 2 bi-phrases are enough (*make up*, *make it up*)

Finding 3: similar translations are better

	Similar	Different
Fluency (1-4)	2.82	2.44
Adequacy (1-3)	2.07	1.56

Finding 4: frequency is not the only explanation

Kendall τ rank correlation between PV's average translation quality and:

	Adequacy		Fluency	
	PBS	**HS**	**PBS**	**HS**
Frequency split	0.173	***0.203***	0.168	***0.260***
Frequency joint	0.125	0.096	***0.197***	0.166
Verb-particle distance	0.073	0.061	0.083	0.151

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Wrapping up

Contributions

- A reusable pipeline to build test set (RASP + mwetk + filter)
- An evaluation protocol including detailed guidelines
- A systematic evaluation of EN-FR split PV translation

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Main contribution

Even though SMT is a mature framework, flexible constructions like PVs cannot be modelled appropriately

Moving on

- Improve base SMT systems (larger corpora)
- Develop better automatic PV identification
- Conceive clearer guidelines, annotator training, ranking task
- Investigate why the HS performs poorly
- Investigate why PV translation is poor
- Extend to other types of PVs (joint instances, double particles)
- Extend to other types of MWEs (idioms, support-verb constructions)

Thank you! Questions?

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Datasets available at
`http://cameleon.imag.fr/xwiki/bin/view/Main/Phrasal_verbs_annotation`

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