PARSEME corpora: Annotating verbal multiword expressions in a multilingual framework

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Multiword expressions (MWEs)

What is so special about the highlighted expressions?

*The **prime time** speech by **first lady** **Michelle Obama** **set** the house **on fire**. She made **crystal clear** which issues she **took to heart** but she was **preaching to the choir**.*

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Definition [1]

Combination of at least **two words** which exhibits lexical, morphological, syntactic, semantic and /or statistical **idiosyncrasies**.

Sample idiosyncrasies in MWEs

- **Non-compositional semantics**: the meaning of a MWE is surprising, given the meanings of its component words
  - EN *to **pull** one's **leg*** 'to tease someone playfully'
  - IT ***lasciar perdere*** 'to let lose'⇒'to give up'
- Morphosyntactic **irregularity** (token[a]-specific):
  - FR ***grand-mères*** 'grand$_{sing.masc}$-mothers$_{pl.fem}$' (defective agreement)
  - EN ***by and large*** 'mostly' (Prep Conj Adj is an irregular syntactic structure)
  - EN *to **go nuts*** 'to get crazy' (*go* alone is intransitive)
- Morphosyntactic **inflexibility** (type[b]-specific):
  - EN ***the die is cast*** 'a point of no-retreat has been passed' vs. *#someone cast the die*

[a] Token = individual occurrence

[b] Type = sets of surface realizations of the same expression

Major idiosyncrasy: Semantic non-compositionality

Semantic compositionality [3]

An expression E is semantically compositional if a **compositional semantic calculus** applies to it: given the meanings of E's components and E's **syntactic structure**, a grammar rule allows us to deduce the meaning of E.

Semantic non-compositionality – 3 cases

- A component has no individual meaning, it functions only within MWEs (*cranberry/fossil word*)
  - *to* ***go astray*** 'to become lost'
  - *to* ***let bygones be bygones*** 'to ignore a past offense'
- The syntactic structure is irregular
  - ***by and large*** 'mostly'
  - ***long live*** *the queen!* 'may she live for a long time'
  - *to* ***pretty-print*** 'use beautifying conventions for texts printing'
- The meaning is not deduced regularly
  - *a* ***hot dog*** 'a hot sausage served in a long bread roll' or 'a person showing off dangerous acts'
  - *to* ***pay*** *a* ***visit*** 'to visit'
  - *the* ***Black Sea*** 'a lake in Asia'

Defining idiosyncrasy

One usually tries to distinguish MWEs from "regular" or "free" constructions of the **same syntactic structure**.

Synt. structure	Regular construction	MWE
Adj N	*a hot soup*	*a **hot dog*** 'a hot sausage served in a long bread roll'
V Det N	*to pay a bill*, *to discuss a visit*	*to **pay** a **visit*** 'to visit'
V NP Prep Det N	*to throw fish to the dolphins*	*to **throw** Harry **to the lions*** 'to sacrifice or ruin Harry'
V Part NP	*to put up a flag*	*to **put up** a great performance* 'to show a great level of skill'
V Refl PP	*to wash oneself in the bath*	*to **find oneself** in times of trouble* 'to discover that one is in trouble'

Inflexibility of MWEs = a proxy for semantic non-compositionality

A MWE is (much) **less flexible** (variable) than a regular construction of the same syntactic structure.

Regular construction	**MWE**	**MWE property**
warm soup ≈[1] *hot soup* ≈ *warm stew*	***hot dog*** vs. *#warm dog* vs. *#hot terrier*	Lexical inflexibility
to throw meat to the lions ≈ *to throw meat to the lion*	*to* ***throw*** *someone* ***to the lions*** vs. *#to throw someone to the lion*	Morphological inflexibility
she held her elbow ≈ *she held his elbow*	*she* ***held*** *her* ***tongue*** 'she refrained from expressing her view' vs. *#she held his tongue*	Morpho-syntactic inflexibility

[1] '≈' means that the meaning shift is predictable from the formal change

Inflexibility of MWEs

Regular construction	MWE	MWE property
to throw meat to the lions ≈ *to throw meat to the hungry lions*	*to* ***throw*** *someone* ***to the lions*** vs. *#to throw someone to the hungry lions*	Syntactic inflexibility
he made it for her ≈ *It was made for her by him*	*he* ***made it*** *to the station well in advance* 'he managed to get to the station . . . ' vs. *#it was made by him to the station . . .*	
the die is stolen ≈ *someone stole the die*	***the die is cast*** 'a point of no-retreat has been passed' vs. *#someone cast the die*	
a text in red and blue ≈ *a text in blue and red*	*a photo in* ***black and white*** 'a photo in shades of gray' vs. *#a photo in white and black*	

Partial (in)flexibility of MWEs

Property	MWE respecting the property	MWE violating the property
free subject	*John **held** his **tongue*** ≈ *Adam **held** his **tongue***	***fear lends wings*** 'fear gives you unusual capacities' vs. *#Panic lends wings*
free object	***a little bird told** Suzy* 'Suzy received the information from a secret source' ≈ ***a little bird told** Mary*	*Suzy **crossed** her **fingers** for Tim* 'Suzy wishes good luck to Tim' vs. *#Suzy crossed her thumbs*
verb inflection	*Suzy **crossed** her **fingers*** ≈ *Suzy will **cross** her **fingers***	***a little bird told** Suzy* ≈ *#a little bird will tell Suzy*
object inflection	*Luke **held** his **tongue*** ≈ *Luke and Sue **held** their **tongues***	*Suzy **crossed** her **fingers*** vs. *Suzy crossed her finger*
object modification	*John **broke** my **fall*** 'John made my fall less forceful' ≈ *John **broke** my sudden **fall***	*Suzy **crossed** her **fingers*** vs. *Suzy **crossed** her long **fingers***
free poss. det.	*John **broke** my **fall*** ≈ *John **broke** his/her/our **fall***	*Suzy **crossed** her **fingers*** vs. *#Suzy crossed our fingers*
passive	*John **broke** my **fall*** ≈ *My **fall** was **broken** by John*	***fear lends wings*** vs. *#wings are lent by fear*

(In)flexibility as a matter of scale

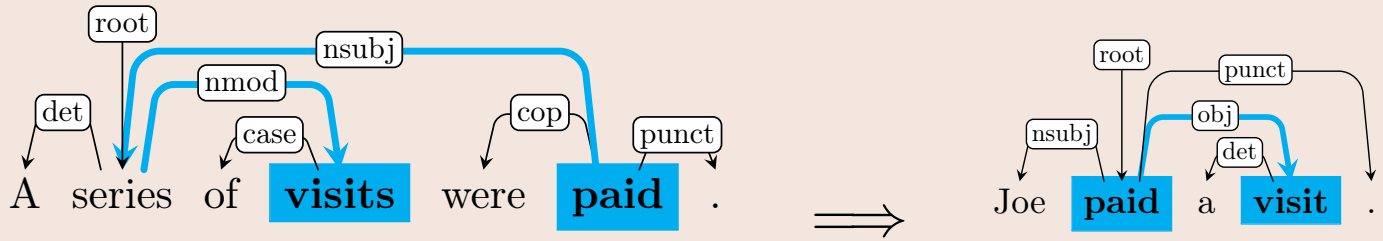
A MWE is **less flexible** than a regular construction of the same syntactic structure but it is often **not totally inflexible**.

Expression	Property						
	Free subject	Free object	Verb inflection	Object inflection	Object modif.	Free poss. det.	Passive
fear lends wings							
*Suzy **held** her **tongue***	✓		✓	✓			
*Suzy **crossed** her **fingers***	✓		✓				✓
***a little bird told** Suzy*		✓		✓	✓	✓	
*Suzy **broke** my **fall***	✓		✓	✓	✓	✓	✓
Suzy lends her books	✓	✓	✓	✓	✓	✓	✓
Suzy held her book	✓	✓	✓	✓	✓	✓	✓
Suzy crossed the road	✓	✓	✓	✓	✓	✓	✓
a little girl told Suzy	✓	✓	✓	✓	✓	✓	✓
Suzy broke my car	✓	✓	✓	✓	✓	✓	✓

Neutralizing flexibility

Canonical form

Least syntactically marked syntactic variant which preserves the idiomatic reading (active voice is less marked then passive, etc.)



Canonical forms are useful for **formalizing** the morpho-syntactic properties of MWEs. This is useful e.g. for **annotation guidelines**.

Lexicalization

MWE components

- **Lexicalized components** – mandatory components, always realized by the same lexemes; without them the MWE cannot occur. They are marked **in bold**.
- **Open slots** – mandatory components which can be realized (relatively) freely
- Example: *she set the house on fire* 'she made the people very excited'
  - *Michelle put the house on fire*, *His wife put the house on fire* → *she* is not lexicalized
  - *#she put the house on fire*[a], *#she set the house in fire*, *#she set the house in blaze* → *set*, *on* and *fire* are lexicalized
  - *she set the assembly/many lobbies on fire* → *the house* is not lexicalized
  - **she put on fire* → the direct object of *put* is an open slot
  - ⟹ *NP* ***set*** *NP* ***on fire***

[a] '#' and '*' signal the loss of idiomatic meaning and ungrammaticality, respectively.

Challenges for NLP

Pervasiveness

Up to 40% of words in a text belong to MWEs. [2, 7]

> *The **prime time** speech by **first lady Michelle Obama set** the house **on fire**. She made **crystal clear** which issues she **took to heart** but she was **preaching to the choir**.*

Here: 18 MWE components for 31 words of the text → 58%

Non-compositionality

Computational methods are mostly **compositional**. Complex phenomena are decomposed into simpler subproblems. Subproblems receive independent solutions, which are then composed to provide global solutions.
MWEs are **semantically non-compositional**. They are challenging for **semantically-oriented NLP applications**.

Machine translation

Word-to-word translations do not capture the idiomatic meaning.

Information retrieval

- The task: for a given query (one or more words), automatically find the relevant documents
- Bag-of-words approach:
  - Eliminate stop words, lemmatize the text, create an **index** (list of words contained in the text with their frequencies)
  - Example: *He **took the bull by the horns*** → {bull – 1, horn – 1, take – 1}
  - Each query word is looked up in the index. The documents containing the query words are weighted and returned.
- Challenges from MWEs:
  - A document contains *He **took the bull by the horns*** 'He dealt decisively with a difficult situation'
  - The query contains *horns of a bull*
  - The document is irrelevant but it will likely be returned

Opinion mining (= sentiment analysis)

- The task: automatically predict the valency (positive, neutral ou negative) of an opinion expressed by a text
- Examples:
  - *Huge respect to the French people for believing in better lives.*
  - *Nothing justifies violence or intimidation against an elected representative of the Republic.*
- Simple bag-of-word technique:
  - Single words are annotated with elementary valency: *respect* → 1, *violence* → -2, *justify* → 1, ...
  - Local rules modify elementary valency:
    - *huge*, *extreme* multiply the valency; *huge respect* → 2*1 = 2; *extreme violence* → 2*(-2) = -4
    - negation inverses valency: *nothing justifies* → -1*1=-1

Opinion mining – challenges from MWEs

Text	Comp. valency	True valency
kick$_0$ *the bucket*$_O$ 'die'	0	-2
go nuts$_O$ 'get crazy'		
make a mountain$_0$ *out of a molehill*$_0$ 'exaggerate'		
it's in the bag$_0$ 'success will obviously be achieved'		
kill$_{-2}$ *two birds*$_O$ *with one stone*$_O$ 'solve two problems with one single action'		
the sky's the limit$_{-1}$ 'there is no limit'		
beyond one's wildest$_{*(-1)}$ *dreams*$_1$ 'much better than expected'		
dark$_{-1}$ *horse* 'a person with a surprising ability'		

Opinion mining – challenges from MWEs

Text	Comp. valency	True valency
kick$_0$ *the bucket*$_O$ 'die'	0	-2
go nuts$_O$ 'get crazy'	0	-2
make a mountain$_0$ *out of a molehill*$_0$ 'exaggerate'	0	-1
it's in the bag$_0$ 'success will obviously be achieved'	0	2
kill$_{-2}$ *two birds*$_O$ *with one stone*$_O$ 'solve two problems with one single action'	-2	1
the sky's the limit$_{-1}$ 'there is no limit'	-1	2
beyond one's wildest$_{*(-1)}$ *dreams*$_1$ 'much better than expected'	-1	2
dark$_{-1}$ *horse* 'a person with a surprising ability'	-1	2

Solutions

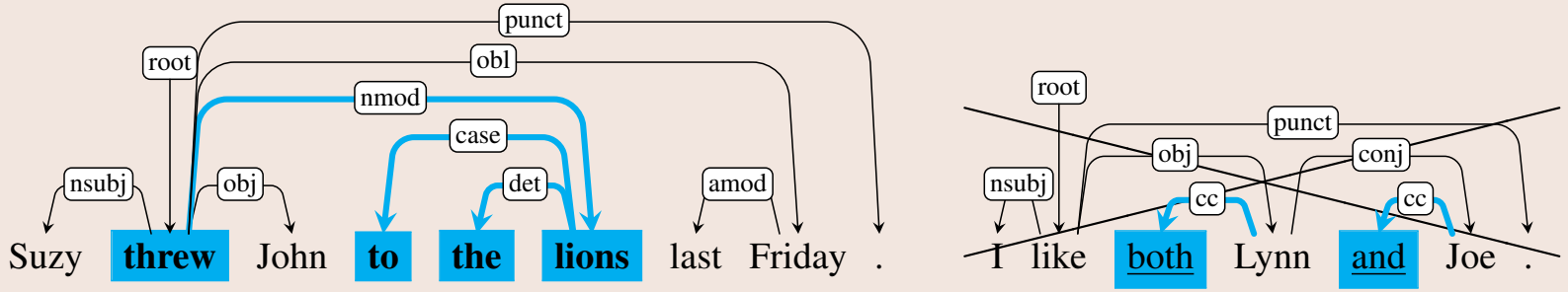
- Automatically identify the MWEs in the text, apply dedicated treatment
- Machine translation
  - rephrase the MWE prior to translation
  - *he **spilled** the **beans*** → *he revealed the secret* → *ha rivelato il segreto*
- Information retrieval
  - don't add the MWE components to the index
  - add the expression as a whole
  - *the re-election was **in the bag*** → {re-election – 1, in the bag – 1}
- Opinion mining
  - assing a valency to the whole expression
  - ***[kill two birds with one stone]***$_2$

Focus on **verbal** MWEs

Verbal MWEs (VMWEs)

Verbal MWEs – MWEs whose **canonical form** is such that:

- its syntactic head is a verb V
- its other lexicalized components form phrases directly dependent on V, i.e. the **dependency subgraph** of the lexicalized components is weakly **connected**



Challenges from **verbal** MWEs

- Discontinuity:
  - EN *Trying hard to **bear** all these more or less important indications **in mind***
  - DE *Klaus Kinkel (FDP) **ging** in seiner Würdigung des Mauerfalls zumindest auf den 9. November 1938 **ein**.*
- Variability: morphological, syntactic, lexical
  - EN *he **broke** my **fall*** vs. *both of my **falls** were hard to **break***
- Ambiguity: idiomatic vs. literal readings
  - EN *she **takes the cake*** 'she is the most outstanding' vs. *she takes the cake*
- Overlaps:
  - EN ***take** a **walk** and then a long **shower*** (coordination)
  - EN ***take** the fact that I **gave up** into account* (interleaving)
  - EN ***let** the cat **out** of the bag* (nesting)
- Multiword tokens
  - ES ***abstener/se*** 'abstain oneself'⇒'abstain' vs. *me abstengo*
  - DE ***auf/machen*** 'out|make'⇒'open' vs. *macht auf*
- Different languages ⇒ different behavior, linguistic traditions...

VMWEs: state of the art in NLP

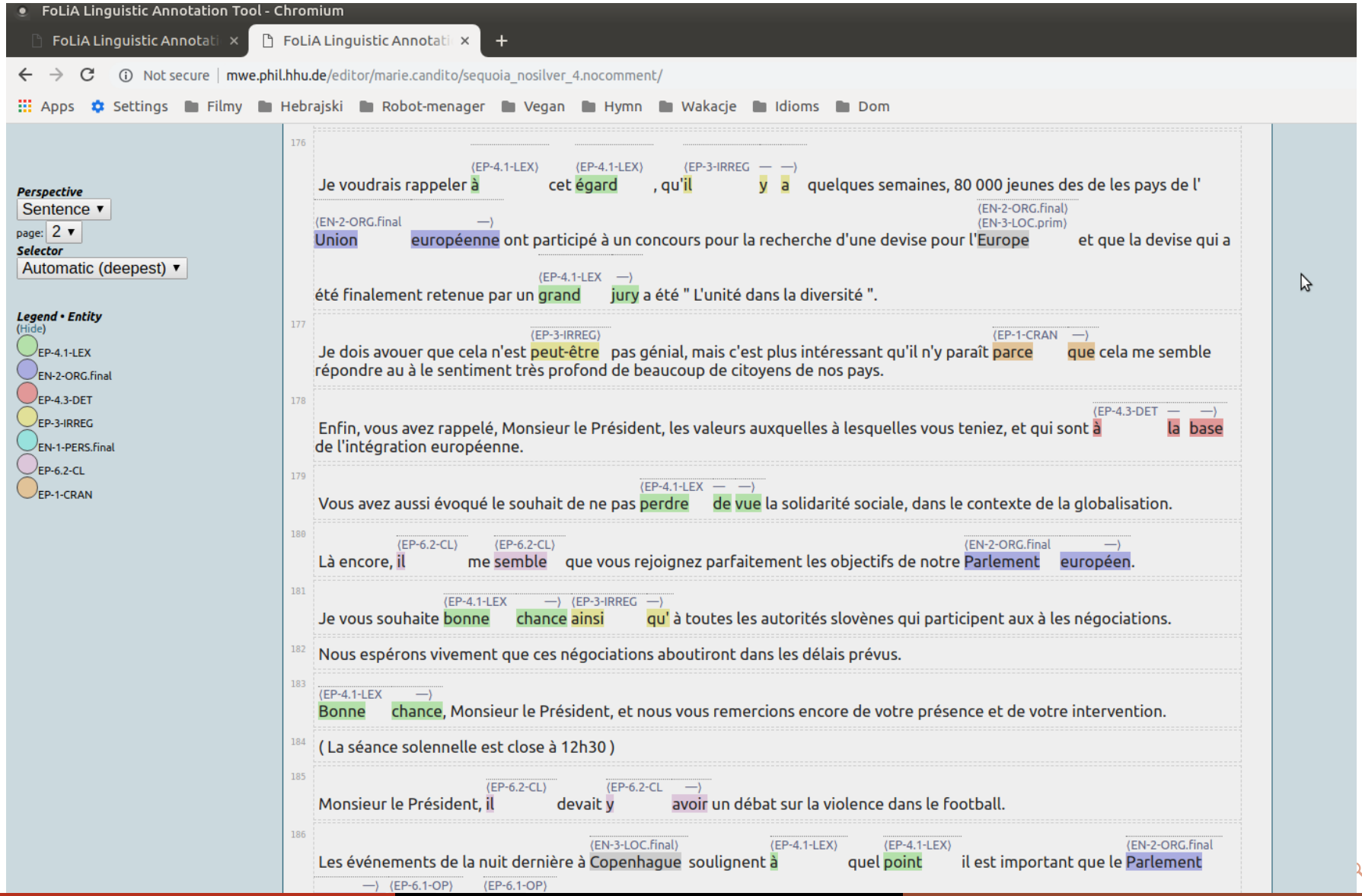
VMWE modeling via corpus annotation

- PARSEME corpus of verbal MWEs [8]

VMWE processing – identification in running text

- PARSEME shared task on automatic identification of verbal MWEs [6]

Annotating MWEs in corpus



PARSEME multilingual corpus of verbal MWEs

International cooperation [8, 6]

- collaborative effort of 14 language teams (20 in edition 1.1)
- unified terminology, typology and annotation guidelines
- corpus of 14 languages, 5,500,000 words, 68,500 annotated VMWEs

Language groups

- **Balto-Slavic**: Polish (PL), Edition 1.1: also BG, HR, LT, SL, CZ
- **Germanic**: German (DE), Swedish (SV) Edition 1.1: also EN
- **Romance**: French (FR), Italian (IT), Romanian (RO), Brazilian Portuguese (PT) Edition 1.1: also ES
- **Others**: Greek (EL), Basque (EU), Gaelic (GA), Hebrew (HE), Hindi (HI), Turkish (TR), Chinese (ZH) Edition 1.1: also AR, FA, HU, MT

VMWE typology

Universal categories (all languages)

- verbal idioms (**VID**)
  - EN *to **call it a day***
- light-verb constructions (**LVCs**)
  - EN *to **give** a **lecture*** (LVC.full)
  - EN *to **grant rights*** (LVC.cause)

Quasi-universal categories (many languages)

- inherently reflexive verbs (**IRVs**)
  - EN *to **help oneself*** 'to take something freely'
- verb-particle constructions (**VPCs**)
  - EN *to **do in*** 'to kill' (VPC.full)
  - EN *to **eat up*** (VPC.semi)
- multi-verb constructions (**MVCs**)
  - HI ***kar le-na*** 'do take.INF'⇒'to do something (for one's own benefit)'

VMWE typology

Language-specific categories

- inherently clitic verbs (**LS.ICV**) [4]

  IT ***prenderle*** 'to take it'⇒'to be beaten'

Unified multilingual annotation guidelines [version 1.2]

the fate of the republic rests on your shoulders

Annotation exercise

- Step 1: identify the candidate and its canonical form: *rests on your shoulders*
- Step 2: determine the lexicalized components
  - ***rests on*** *your/our* ***shoulders***, ***rests on*** *the* ***shoulders*** *of the deputies*, etc.
- Follow the decision tree
  - S.1 [1HEAD] (YES): *rests* is the only verbal head of the whole phrase
  - S.2 [1DEP] (YES): *on shoulders* is the only lexicalized dependent of *rests*
  - S.3 [LEX-SUBJ] (NO): *on* shoulders is not the subject of *rests*
  - S.4 [CATEG] (extended NP): *on shoulders* is a prepositional phrase
  - LVC.0 [N-ABS] (NO): *shoulders* is not abstract
  - VID.1 [CRAN] (NO): all components function also as stand-alone words
  - VID.2 [LEX] (YES): #*remains on your shoulders*, #*rests on your back/arms/head*
- Outcome: **VID**

Inter-annotator agreement

What is IAA?

A measure meant to assess:

- hardness of the annotation task
- quality of the annotation methodology
- quality of the resulting annotations

Popular IAA measure: Cohen's κ

- Setting: two raters classify **N items** into C **mutually exclusive categories**
- Measure:

$$\kappa = \frac{P_O - P_E}{1 - P_E}$$

  - P_O - observed agreement
  - P_E - expected (chance) agreement

Challenges for IAA

Challenges features of VMWE annotation

- *Unitising*, i.e. identifying the boundaries of a VMWE in the text
- *Categorisation*, i.e. assigning each identified VMWE to one of the pre-defined categories
- *Sporadicity*, i.e. the fact that not all text tokens are subject to annotation (unlike in part-of-speech annotation, for instance);
- *Free overlap*, e.g. in (CS) ***ukládal*** *různé* ***sankce*** *a* ***penále*** 'put various sanctions and penalties', where two LVCs share a light verb;

Challenges for IAA

- What are the atomic units (Cohen's items) of annotation?
  - text **tokens** ⇒ categories are not mutually exclusive due to ovelaps
  - text **spans** ⇒ two annotators may end up with different sets of units ⇒ unitising is part of the IAA measure
- In unitising IAA: What is the chance agreement?

Three IAA measures in the PARSEME corpus

F_{span}

- F-measure of annotator A1 prediction wrt. A2 (MWE-based or token-based)

κ_{span}

- Task simplification: For each verb v, decide if v belongs to a VMWE or not.
- Cohen's κ in which the chance agreement is based on the number of verbs

κ_{cat}

- Cohen's κ for VMWEs on which both annotators agree on the span

IAA: data newly annotated in the PARSEME corpus v 1.2

	S	A_1	A_2	F_{span}	κ_{span}	κ_{cat}
Greek	874	293	394	$0.652_{(0.694)}$	$0.608_{(0.665)}$	$\mathbf{0.715}_{(0.673)}$
Irish	800	312	270	0.715	0.663	0.835
Polish	900	252	296	$\mathbf{0.774}_{(0.619)}$	$\mathbf{0.732}_{(0.568)}$	$\mathbf{0.907}_{(0.882)}$
Br. Portug.	1251	253	232	$0.672_{(0.713)}$	$0.640_{(0.684)}$	$\mathbf{0.928}_{(0.837)}$
Swedish	700	364	257	0.734	0.671	0.847
Chinese	3953	883	840	0.584	0.544	0.833

- S = nb. of sentence
- A_1, A_2 = VMWEs per annotator
- subscripts = IAA in edition 1.1 (on different samples)

Format and split

CUPT: extension of the CoNLL-U format

1	-	-	PUNCT	_	_	4	punct	_	_	*
2	si	si	SCONJ	_	_	4	mark	_	_	*
3	vous	il	PRON	_	_	4	nsubj	_	_	*
4	présentez	présenter	VERB	_	_	0	root	_	_	1:LVC.full
5	ou	ou	CCONJ	_	_	8	cc	_	_	*
6	avez	avoir	AUX	_	_	8	aux	_	_	*
7	récemment	récemment	ADV	_	_	8	advmod	_	_	*
8	présenté	présenter	VERB	_	_	4	conj	_	_	2:LVC.full
9	un	un	DET	_	_	10	det	_	_	*
10	saignement	saignement	NOUN	_	_	4	obj	_	_	1;2

Corpus split

- Motivation: **unseen VMWEs** are critically and to identify automatically
- Strategy: split into `train/dev/test` so that `test` has at least 300 unseen VMWEs and the unseen ration is "realistic")

PARSEME corpus applications

PARSEME shared task on automatic identification of VMWEs

- 3 editions, dozens of teams, 22 languages in total
- Training and evaluation based on the PARSEME corpus

Corpus studies

- Characterizing the morpho-syntactic variability of the most frequent VMWEs in French [5]
- Quantifying and characterizing **literal readings** of VMWEs [9]
- Evaluating coverage of a formal grammar with encoded MWEs [10]

Future work

- Extending the annotation guideines to new MWE categories: named entities, nominal, adjectival, adverbial, prepositional MWEs, ...
  - nominal MWEs: non-compositional NPs (*hot dog*), named entities (*Red Sea*), complex terms (*recurrent neural network*)
  - adjectival MWEs: *crystal clear*, *as busy as a bee*
  - adverbial: *all of a sudden*
  - functional: *in front of*, *even if*
- Unifying PARSEME and UD annotation guidelines
- Including new languages and language families
- Continuous corpus enhancements (regular releases)
- Unified multilingual reference datasets with **MWE-annotated corpora** and NLP-oriented **MWE lexicons**.

Keep an ear to the ground 'keep informed'

MWE community

- PARSEME - European network on parsing and MWEs
- MWE section of SIGLEX (special interest group at the ACL) - join both

Keep an ear to the ground 'keep informed'

MWE events

- Yearly MWE workshop co-located with major NLP conferences
  - Joint event with the Linguistic Annotation Workshop community (LAW-MWE-CxG at COLING 2018)
  - Joint event with the WordNet community (MWE-WN at ACL 2019)
  - Joint event with the European Lexicographic Infrastructure (MWE-LEX at COLING 2020)
- PARSEME shared task on automatic identification of VMWEs
  - Editions 1.0, 1.1 and 1.2
  - New edition planned for 2022 (new languages and MWE categories)
- Yearly EUROPHRAS conferences
- MUMTTT workshops (on MWEs in MT)

Keep your nose to the wind 'keep informed'

Book series

Phraseology and Multiword Expressions, at Language Science Press, Berlin

- 2 volumes out, 3 others in the pipeline

MWE resources

- DIMSUM shared task dataset
- SIGLEX-MWE resource list
- PARSEME corpus of verbal MWEs - open-ended project:
  - Serbian is more than welcome! First contat with Cvetana...
  - New MWE categories (adverbials, nominals, ...) will be addressed
- PARSEME annotation guidelines
- PARSEME surveys
  - On MWE annotation in treebanks
  - On lexical resources of MWEs
  - On multilingual MWE resources

*Why do we **eat, sleep and breathe** MWEs?*

'Why are we so enthusiastic and passionate about MWEs?'

- MWEs are fascinating!
  - They convey messages succinctly and efficiently
  - They hide traces of history, stereotypes, and surprising connotations
  - They can be very funny
- MWEs are challenging
  - They are hard to understand for non-native speakers
  - They are signs of a speaker's fluency
  - They behave differently than regular combinations of words
  - They are hard to tokenize, identify, parse, translate automatically
- They are prevalent

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