

Multi-word Expressions in HPSG

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Overview for the week

- Day One

- Brief introduction to Head-driven Phrase Structure Grammar
 - Implementation in the English Resource Grammar (ERG)
 - Meaning representation in Minimal Recursion Semantics

- Day Two

- Classification of Multi-word Expressions (MWEs)
 - Implementation of MWEs in the ERG
 - Strengths and weaknesses of the approach

- Day Three

- Case study of one class of MWEs: idioms with possessives
 - Interactions with other linguistic phenomena and processing
 - Disambiguation challenges

- Day Four

- Lab session using the ERG to identify and analyse MWEs



Possessive Idioms

Joint work with Francis Bond, Jia Qian, and Christiane Fellbaum

- One constituent contains a possessive pronoun co-indexed with a different constituent (typically the subject)
- *wrack one's brains*: “think hard”
- *He wracked his brains. She wracked her brains.*
- **She wracked his brains.* “She made him think hard”



Motivation

- Machine translation, to parse or generate near-equivalent idioms
Japanese-English, where often no possessive in Japanese idiom
- Error correction in language learning
Immediate use in existing commercial online ELA course
10,000 primary school students composing paragraphs
Automatic error analysis with the ERG
- Corpus research to find instances and measure frequency of use



Collection of possessive idioms

- Consulted WordNet and online dictionaries, and corpus observation
- 324 expressions classified so far
- 290 involve locally controlled possession
 - 20 types cover all but 23 of these
- 34 have externally controlled possession
 - 6 types cover all but 9 of these



Internally controlled possessive idiom patterns

XNP V1 X's N1	118
XNP V1+P1 X's N1	12
XNP V1 [PP P1 X's N1]	29
XNP V1 X's N1 P1 X	2
XNP V1 X's N1 [PP P1 YNP]	30
XNP V1 X's N1 [PP P1 D1 N2]	13
XNP V1 X's N1 [PP P1 X's N2]	6
XNP V1 X's N1 A1	23
XNP V1 X's N1 Adj1	3
XNP V1 X's N1 and V2 N2	2
XNP V1 X's own N1	3
XNP V1 N1 [PP P1 X's N2]	3
XNP V1 D1 N1 [PP P1 X's N2]	2
XNP V1 YNP [PP P1 X's N1]	4
XNP V1 YNP D1 N1 [PP P1 X's N2]	2
XNP aux+neg V1 X's N1	3
XNP aux+neg V1 X's N1 [PP P1 YNP]	3
XNP be [PP P1 X's N1]	4
XNP be Adj1 [PP P1 X's N1]	3
XNP be A1 P1 X's N1 P2 YNP	2

Externally controlled possessive idiom patterns

XNP V1 YNP's N1	9
XNP V1 [PP P1 YNP's N1]	6
XNP V1 YNP's N1 P1	3
XNP V1 ZNP [PP P1 YNP's N2]	2
XNP V1 YNP D1 N1 [PP P1 Y's N2]	2
XNP V1 D1 N1 [PP P1 YNP's N2]	3



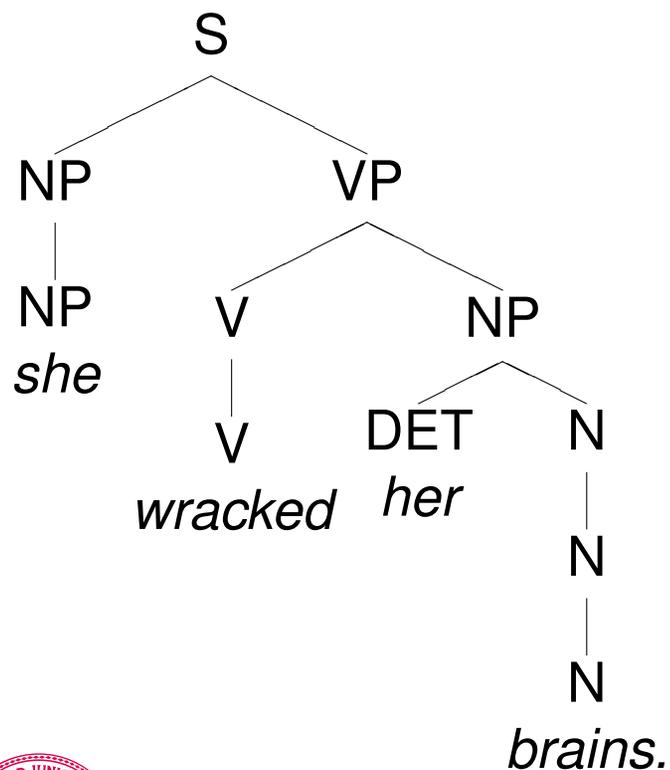
Some examples of possessed idioms

- *She bit her tongue and avoided insulting her guest.*
XNP V1 X's N1
- *He has already made up his mind about that topic.*
XNP V1+P1 X's N1
- *They finally came to their senses.*
XNP V1 [PP P1 X's N1]
- *She is going to pull her hair out in frustration.*
XNP V1 X's N1 A1
- *You always seem to have your head in the clouds.*
XNP V1 X's N1 [PP P1 D1 N2]
- *They just can not manage to get their head around that idea.*
XNP aux+neg V1 X's N1 [PP P1 YNP]



An example: Dependencies from MRS

She wracked her brains.



```
{e3:
  x5:pron<0:2>[]
  e3:_wrack_v_i<3:10>[ARG1 x5, ARG2 x6]
  i8:id<3:10>[ARG1 x5, ARG2 x7]
  _1:def_explicit_q<11:14>[BV x6]
  e13:poss<11:14>[ARG1 x6, ARG2 x7]
  x7:pron<11:14>[]
  x6:_brain_n_1<15:22>[]
}
```



An example: Dependency MRS (DMRS)

She wracked her brains.



Implementation: The idiom lexicon in the ERG

She wracked her brains.

```
wrack+brains := v_reflnp_idiom_mtr &  
  [ INPUT.RELS.LIST < [ PRED "_wrack_v_i_rel" ],  
    [ PRED "_brain_n_1_rel" ], ... > ].
```



Possessive idiom type definition

```
v_reflnp_idiom_mtr := monotonic_mtr &
  [ INPUT.RELS < [ ARG1 #verb-arg1,
                  ARG2 #verb-arg2 ],
    [ ARG0 #verb-arg2 ],
    [ PRED id_rel,
      ARG1 #verb-arg1,
      ARG2 #poss-arg2 ],
    [ PRED poss_rel,
      ARG1 #verb-arg2,
      ARG2 #poss-arg2 ] > ].
```



Possessive idiom rule, instantiated

```
v_reflnp_idiom_mtr := monotonic_mtr &
  [ INPUT.RELS < [ PRED "_wreck_v_i_rel" ],
    ARG1 #verb-arg1,
    ARG2 #verb-arg2 ],
  [ PRED "_brain_n_1_rel",
    ARG0 #verb-arg2 ],
  [ PRED id_rel,
    ARG1 #verb-arg1,
    ARG2 #poss-arg2 ],
  [ PRED poss_rel,
    ARG1 #verb-arg2,
    ARG2 #poss-arg2 ] > ].
```



Lexical type for idiomatic verb

```
wrack_v1_i := v_np_refl-idm_le &  
  [ ORTH < "wrack" >,  
    SEMPRED "_wrack_v_i_rel" ].
```

```
v_np_refl-idm_le := np_nontrans_verb &  
  [ CAT.VAL.COMPS < [ LOCAL.CONT.HOOK.XARG #arg2 ] >,  
    CONT [ HOOK.XARG #arg1,  
          RELS < [ PRED #pred ],  
                [ PRED id_rel,  
                  ARG1 #arg1,  
                  ARG2 #arg2 ] > ],  
    SEMPRED #pred,  
    IDIOM + ].
```



Lexical type for possessive pronouns

```
her_poss := d_-_poss_le &
  [ ORTH < "her" >,
    AGR [ PERNUM 3sing, GENDER fem ] ].

d_-_poss_le := det_word &
  [ CONT [ HOOK [ INDEX #arg1,
                 XARG #arg2 ],
          RELS < [ PRED def_explicit_q_rel,
                  ARG0 #arg1 ],
                 [ PRED poss_rel,
                  ARG1 #arg1,
                  ARG2 #arg2 ],
                 [ PRED pron_rel
                  ARG0 #arg2 ] > ] ]
```



Some variants of the same idiom

She wracked her brains.

She wracked her brain.

She wracked that brain of hers.

She wracked those brains of hers.



Some variants of the same idiom

She wracked her brains.

*She wracked her **brain**.*

*She wracked that brain **of hers**.*

She wracked those brains of hers.



Some variants of the same idiom

She wracked her brains.

She wracked her brain.

She wracked that brain of hers.

She wracked those brains of hers.

*She **racked** her brains.*

She racked her brain.

She racked that brain of hers.

She racked those brains of hers.



Some variants of the same idiom

She wracked her brains.

She wracked her brain.

She wracked that brain of hers.

She wracked those brains of hers.

She racked her brains.

She racked her brain.

She racked that brain of hers.

She racked those brains of hers.

*She wracked her **big** brain.*

She wracked that big brain of hers.



Another example of the same type

We'll wait our turn. (“We will wait until it is our turn.”)

```
{e3:  
  x5:pron<0:2>[]  
  e3:_wait_v_i<8:12>[ARG1 x5, ARG2 x6]  
  i8:id<8:12>[ARG1 x5, ARG2 x7]  
  _1:def_explicit_q<13:16>[BV x6]  
  e13:poss<13:16>[ARG1 x6, ARG2 x7]  
  x7:pron<13:16>[]  
  x6:_turn_n_of<17:22>[]  
}
```

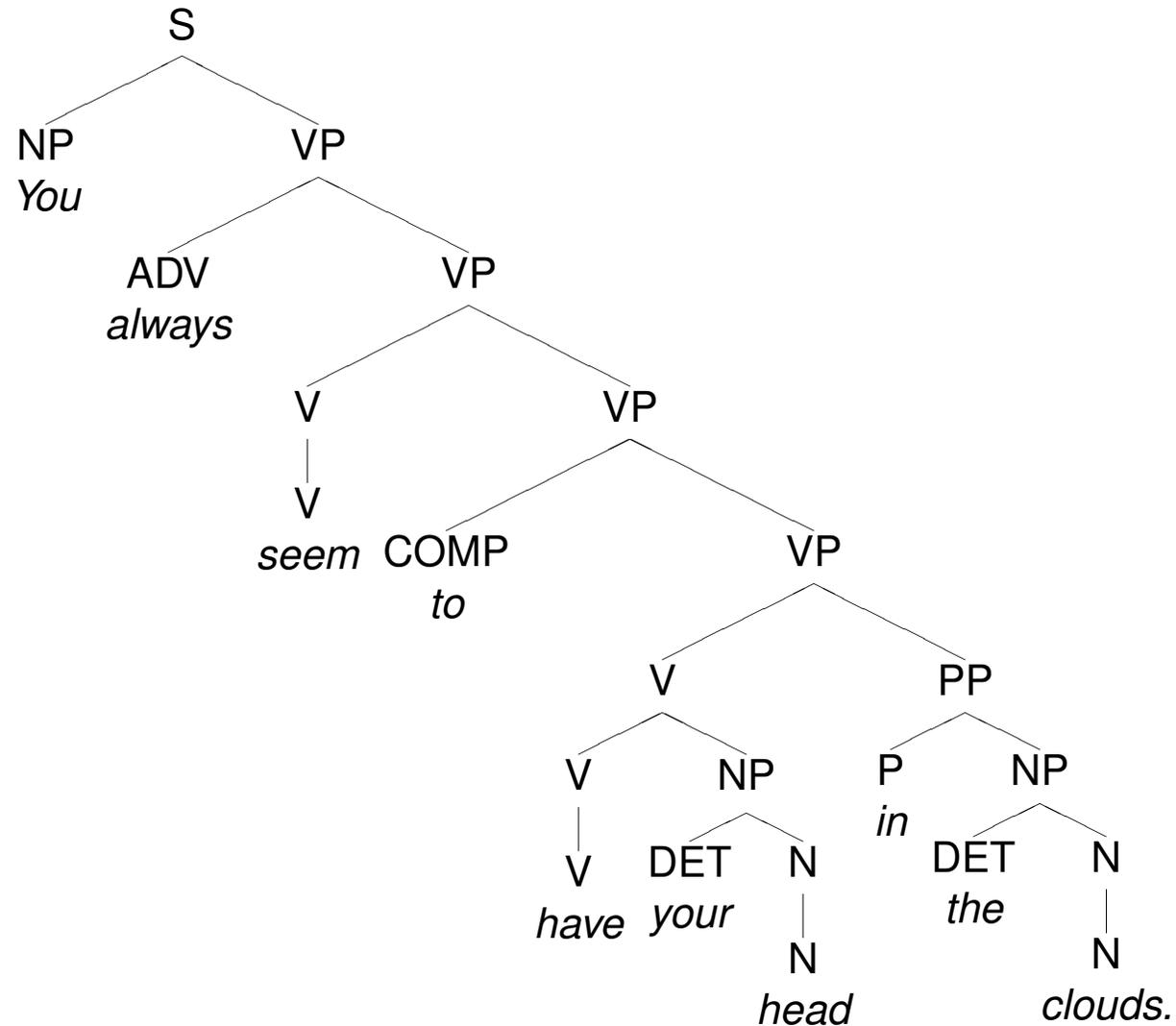
```
wait+turn := v_reflnp_idiom_mtr &  
  [ INPUT.RELS.LIST < [ PRED "_wait_v_i_rel" ],  
    [ PRED "_turn_n_of_rel" ], ... > ].
```



A syntactically more complex example

You always seem to have your head in the clouds.

“You are not paying attention to the immediate situation.”



A second type of idiom rule

You always seem to have your head in the clouds.

```
have+head+in+clouds := v_reflnp-pp_idiom_mtr &
  [ INPUT.RELS < [ PRED "_have_v_prd_rel" ],
    [ PRED "_head_n_of_rel" ],
    [ PRED "_in_p_rel" ],
    [ PRED "_clouds_n_i_rel" ], ... > ].
```



The second idiom rule type, instantiated

You always seem to have your head in the clouds.

```
v_reflpp-pp_idiom_mtr := monotonic_mtr &
  [ INPUT.RELS < [ PRED "_have_v_prd_rel" ],
    ARG1 #verb-arg1,
    ARG2 #verb-arg2, ARG3 #verb-arg3 ],
  [ PRED "_head_n_of_rel",
    ARG0 #verb-arg2 ],
  [ PRED _in_p_rel,
    LBL #verb-arg3,
    ARG1 #verb-arg2, ARG2 #prep-arg2 ],
  [ PRED "_clouds_n_i_rel",
    ARG0 #prep-arg2 ],
  [ PRED id_rel,
    ARG1 #verb-arg1,
    ARG2 #poss-arg2 ],
  [ PRED poss_rel,
    ARG1 #verb-arg2,
    ARG2 #poss-arg2 ] > ].
```



Interactions with other phenomena

- Unbounded dependencies

Those large brains of yours, you definitely ought to wrack immediately.



Interactions with other phenomena

- Unbounded dependencies

Those large brains of yours, you definitely ought to wrack immediately.

- Coordination

The students and the teachers should all rack their brains.



Interactions with other phenomena

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The students and the teachers should all rack their brains.

- Imperatives

Wrack your brains!



Interactions with other phenomena

- Unbounded dependencies

Those large brains of yours, you definitely ought to wrack immediately.

- Coordination

The students and the teachers should all rack their brains.

- Imperatives

Wrack your brains!

- Modification

You should wrack as quickly as possible those excellent brains of yours.



Interactions with other phenomena

- Unbounded dependencies

Those large brains of yours, you definitely ought to wrack immediately.

- Coordination

The students and the teachers should all rack their brains.

- Imperatives

Wrack your brains!

- Modification

You should wrack as quickly as possible those excellent brains of yours.

- Subordinate clauses

I think you should at least try to wrack your brains.

Those very large brains of yours, I definitely think you ought to try to wrack as quickly as possible.

