Wh-questions

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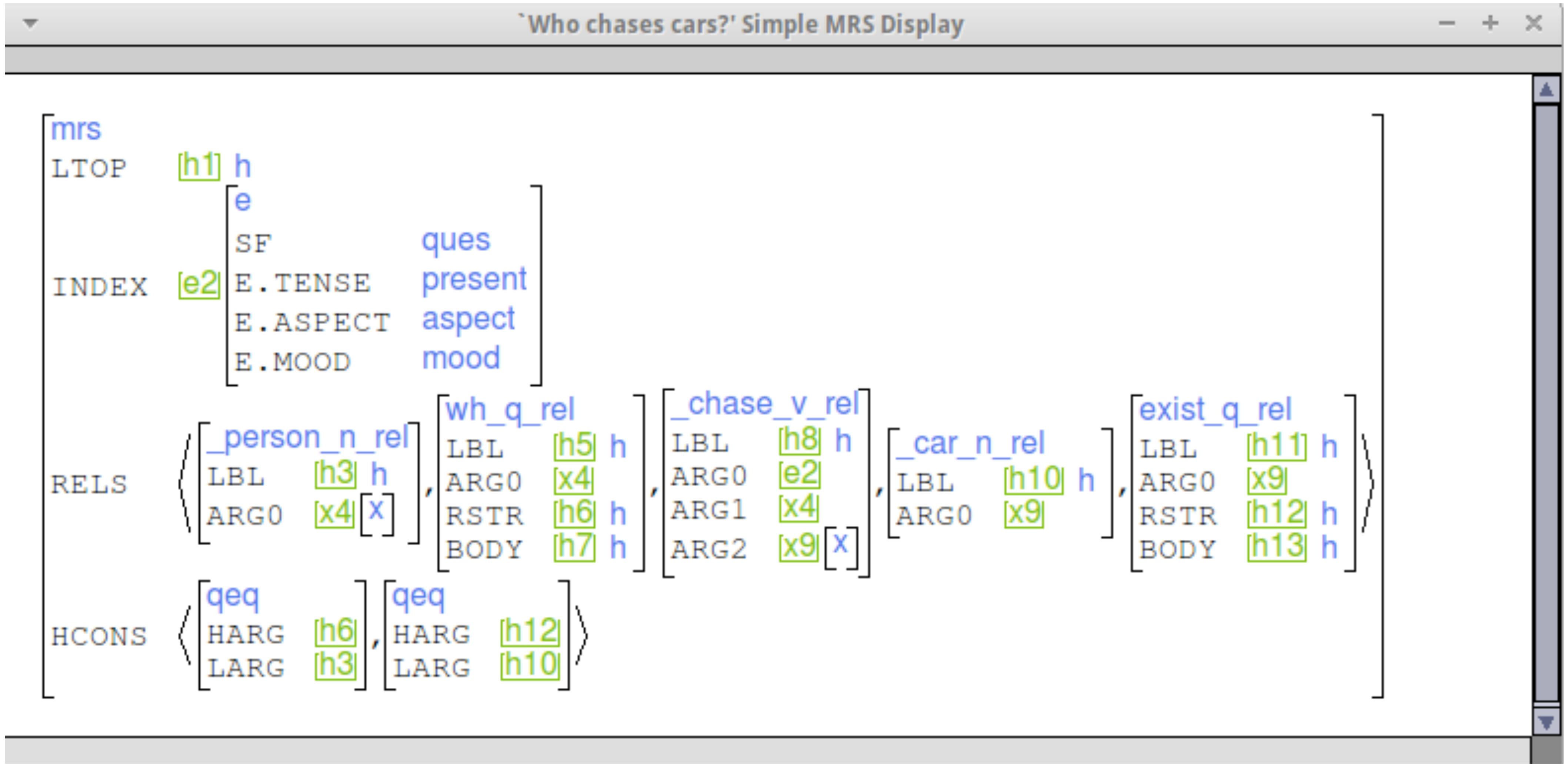
Overview

- Target representation
- The problem
- Solution for English
- Solution for pseudo-English
- Lab 7 overview
- Negative auxiliaries interactive debugging

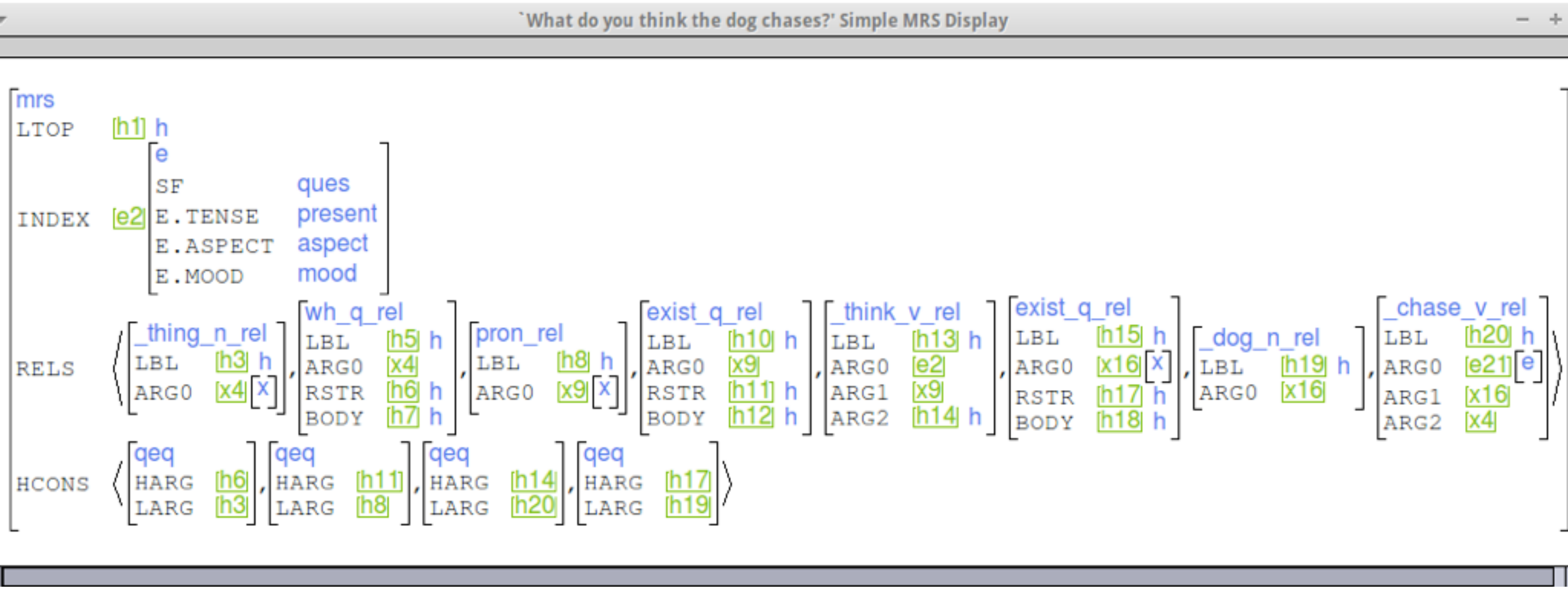
Wh-questions: Target representations



`Who chases cars?' Simple MRS Display

```
mrs
LTOP    h1 h
INDEX   e2 [ e
             SF         ques
             E.TENSE    present
             E.ASPECT   aspect
             E.MOOD     mood ]
RELS  ⟨ [ _person_n_rel       [ wh_q_rel        [ _chase_v_rel      [ _car_n_rel         [ exist_q_rel
          LBL   h3 h      ,     LBL   h5 h    ,   LBL   h8 h    ,     LBL   h10 h    ,     LBL   h11 h
          ARG0  x4 [x] ]        ARG0  x4          ARG0  e2            ARG0  x9 ]           ARG0  x9
                                RSTR  h6 h        ARG1  x4                                 RSTR  h12 h
                                BODY  h7 h ]      ARG2  x9 [x] ]                           BODY  h13 h ] ⟩
HCONS ⟨ [ qeq             [ qeq
          HARG  h6    ,     HARG  h12
          LARG  h3 ]        LARG  h10 ] ⟩
```

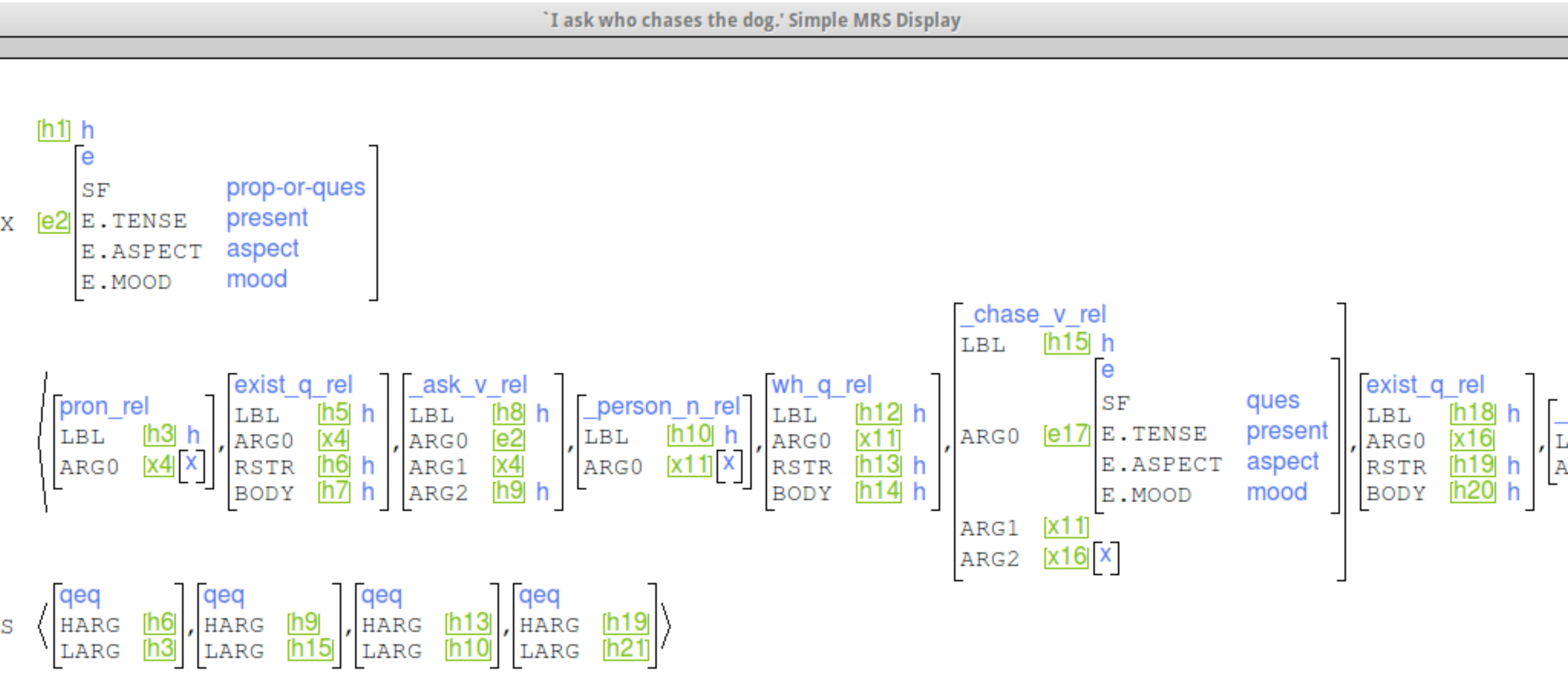
Wh-questions: Target representations



`What do you think the dog chases?' Simple MRS Display

```
mrs
LTOP    h1 h
INDEX   e2 [ e
             SF         ques
             E.TENSE    present
             E.ASPECT   aspect
             E.MOOD     mood ]
RELS  < [ _thing_n_rel      [ wh_q_rel         [ pron_rel         [ exist_q_rel      [ _think_v_rel     [ exist_q_rel          [ _dog_n_rel       [ _chase_v_rel
          LBL   h3 h          LBL   h5 h         LBL   h8 h         LBL   h10 h        LBL   h13 h        LBL   h15 h            LBL   h19 h        LBL   h20 h
          ARG0  x4 [x] ] ,    ARG0  x4           ARG0  x9 [x] ] ,   ARG0  x9           ARG0  e2           ARG0  x16 [x] ,        ARG0  x16 ] ,      ARG0  e21 [e]
                              RSTR  h6 h                            RSTR  h11 h        ARG1  x9           RSTR  h17 h                               ARG1  x16
                              BODY  h7 h ] ,                        BODY  h12 h ] ,    ARG2  h14 h ] ,    BODY  h18 h ] ,                           ARG2  x4 ] >
HCONS < [ qeq            [ qeq            [ qeq            [ qeq
          HARG  h6         HARG  h11        HARG  h14        HARG  h17
          LARG  h3 ] ,     LARG  h8 ] ,     LARG  h20 ] ,    LARG  h19 ] >
```

Wh-questions: Target representations



`I ask who chases the dog.' Simple MRS Display

```
   h1 h
      [e
       SF          prop-or-ques
x  e2  E.TENSE     present
       E.ASPECT    aspect
       E.MOOD      mood        ]

                                                                                                  [_chase_v_rel
                                                                                                   LBL   h15 h
                                                                                                              [e
 ⟨[pron_rel    ],[exist_q_rel ],[_ask_v_rel ],[_person_n_rel],[wh_q_rel    ],                                 SF         ques     ],[exist_q_rel ],[
  [LBL  h3 h   ] [LBL  h5 h   ] [LBL  h8 h  ] [LBL  h10 h   ] [LBL  h12 h  ]   ARG0  e17  E.TENSE    present   [LBL  h18 h  ] [L
  [ARG0 x4 [x] ] [ARG0 x4     ] [ARG0 e2    ] [ARG0 x11 [x] ] [ARG0 x11    ]              E.ASPECT   aspect    [ARG0 x16    ] [A
                 [RSTR h6 h   ] [ARG1 x4    ]                 [RSTR h13 h  ]              E.MOOD     mood    ] [RSTR h19 h  ]
                 [BODY h7 h   ] [ARG2 h9 h  ]                 [BODY h14 h  ]                                   [BODY h20 h  ]
                                                                                                   ARG1  x11
                                                                                                   ARG2  x16 [x]               ]

s ⟨[qeq       ],[qeq       ],[qeq        ],[qeq        ]⟩
   [HARG  h6  ] [HARG  h9  ] [HARG  h13  ] [HARG  h19  ]
   [LARG  h3  ] [LARG  h15 ] [LARG  h10  ] [LARG  h21  ]
```

The problem

- Wh questions involve long distance dependencies
    - Connecting sentence-initial wh-words to gaps
    - Detecting the presence of in-situ wh-words, and correlating [SF ques]

Solution for English

- SLASH (<= GAP) to encode the absence of an element
  - LDD Top: Head-filler rule
  - LDD Bottom: Comp & subj extraction rules (unary phrase structure rules)
  - LDD Middle: Lexical threading/amalgamation of SLASH; constraints on rules other than head-argument
- QUE to encode the wh property
  - Controls eligibility to be filler in wh question rule
- Initial symbol should require SLASH <! !>

Top: Head-Filler Rule

```
wh-ques-phrase := basic-head-filler-phrase & interrogative-clause &
            head-final &
   [ SYNSEM.LOCAL.CAT [ MC bool,
               VAL #val,
               HEAD verb & [ FORM finite ] ],
     HEAD-DTR.SYNSEM.LOCAL.CAT [ MC na,
                     VAL #val & [ SUBJ < >,
                                  COMPS < > ] ],
     NON-HEAD-DTR.SYNSEM.NON-LOCAL.QUE <! ref-ind !> ].
```

Bottom: Subject & complement extraction

```
extracted-comp-phrase := basic-extracted-comp-phrase &
  [ SYNSEM.LOCAL.CAT.HEAD verb,
    HEAD-DTR.SYNSEM.LOCAL.CAT.VAL.SUBJ cons ].

extracted-subj-phrase := basic-extracted-subj-phrase &
  [ SYNSEM.LOCAL.CAT.HEAD verb,
    HEAD-DTR.SYNSEM.LOCAL.CAT.VAL.COMPS < > ].
```

Bottom: Subject & complement extraction

```
basic-extracted-comp-phrase := basic-extracted-arg-phrase & head-compositional &
 [ SYNSEM canonical-synsem &
       [ LOCAL.CAT [ VAL [ SUBJ #subj,
                           SPR #spr,
                           COMPS #comps ],
                     MC #mc ] ],
   HEAD-DTR [ SYNSEM
           [ LOCAL.CAT [ VAL [ SUBJ #subj,
                               SPR #spr,
                               COMPS < gap &
                                       [ NON-LOCAL.SLASH #slash ]
                                       . #comps > ],
                         MC #mc ],
             NON-LOCAL.SLASH #slash ] ],
   C-CONT [ RELS <! !>,
            HCONS <! !>,
            ICONS <! !> ] ].
```

Bottom: Subject & complement extraction

```
gap := expressed-non-canonical &
  [ LOCAL #local,
    NON-LOCAL [ REL 0-dlist,
        QUE 0-dlist,
        SLASH 1-dlist &
            [ LIST < #local > ] ] ].
```

Middle: Lexical threading of SLASH values (cf: GAP Principle, Ling 566)

- Inspired by Bouma, Malouf & Sag 2001
- SLASH on mother comes from head daughter (except in head-adj rules)
- Elements with non-empty ARG-ST build their own SLASH value by appending SLASH of their arguments (basic-one-arg et al)
- Unexpressed arguments are stamped with the type unexpressed:

```
unexpressed := synsem-min &
  [ NON-LOCAL [ SLASH 0-dlist,
                REL 0-dlist,
                QUE 0-dlist ] ].
```

Middle: head-mod phrases

```
basic-head-mod-phrase-simple := head-mod-phrase & binary-headed-phrase &
  [ SYNSEM [ LOCAL.CAT.MKG #mkg,
             NON-LOCAL [ SLASH [ LIST #first,
                                 LAST #last ],
                         REL 0-dlist ] ],
    HEAD-DTR.SYNSEM
           [ ... ,
             NON-LOCAL #nonloc &
                  [ SLASH [ LIST #middle,
                            LAST #last ] ],
    NON-HEAD-DTR.SYNSEM
           [ ... ,
             NON-LOCAL [ SLASH [ LIST #first,
                                 LAST #middle ],
                         QUE 0-dlist & [ LIST null ] ] ],
    C-CONT [ RELS <! !>, ICONS <! !> ] ].
```

The wh words

- english.tdl

```
wh-pronoun-noun-lex := norm-hook-lex-item & basic-icons-lex-item &
  [ SYNSEM [ LOCAL [ CAT [ HEAD noun,
                           VAL [ SPR < >,
                                 SUBJ < >,
                                 COMPS < >,
                                 SPEC < > ] ],
                     CONT [ RELS <! [ LBL #larg,
                                      ARG0 #ind & ref-ind ],
                                    [ PRED "wh_q_rel",
                                      ARG0 #ind,
                                      RSTR #harg ] !>,
                            HCONS <! [ HARG #harg,
                                       LARG #larg ] !> ] ],
             NON-LOCAL.QUE <! #ind !> ] ].
```

- lexicon.tdl

```
what := wh-pronoun-noun-lex &
  [ STEM < "what" >,
    SYNSEM.LKEYS.KEYREL.PRED "_thing_n_rel" ].

who := wh-pronoun-noun-lex &
  [ STEM < "who" >,
    SYNSEM.LKEYS.KEYREL.PRED "_person_n_rel" ].
```

Solution for English

- SLASH (<= GAP) to encode the absence of an element
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Solution for pseudo-English

- Psuedo-English mimics a wh-in-situ language; the wh words stay put
- Still need to be able to tell that they're there
- Don't need SLASH, will use QUE to detect presence of the wh words
    - => Still need the lexical threading stuff working
    - => Same entries for wh pronouns
- Special rule at the top of the tree to license wh interrogatives
- Initial symbol requires QUE <! !>, to force the wh interrogative rule to apply

wh-int-cl

```
wh-int-cl := clause & head-compositional &  head-only &
  [ SYNSEM [ LOCAL.CAT [ VAL #val,
                   MC bool ],
          NON-LOCAL non-local-none ],
    C-CONT [ RELS <! !>,
          HCONS <! !>,
          HOOK.INDEX.SF ques ],
    HEAD-DTR.SYNSEM [ LOCAL.CAT [ HEAD verb & [ FORM finite ],
                         VAL #val &
                           [ SUBJ < >,
                             COMPS < > ] ],
                 NON-LOCAL [ SLASH <! !>,
                         REL <! !>,
                         QUE <! ref-ind !> ] ] ].
```

Ancillary changes

- Constrained the value of NON-LOCAL on the root symbol in roots.tdl to non-local-none.
- Added norm-zero-arg as supertype for adverb-lex.
- Modified bare-np-phrase to inherit from head-valence-phrase as an additional supertype (this copies up the NON-LOCAL value).
- Modified bare-np-phrase to constrain the element of the daughter's non-empty SPR list to be unexpressed

Ancillary changes

- Modified subj-raise-aux to constrain the element of the non-empty SUBJ list of its complement to be unexpressed
- Made the following modifications to the analysis of coordination (as type addenda):

```
topormid-coord-phrase :+ [ SYNSEM.NON-LOCAL #nl,
  LCOORD-DTR.SYNSEM.NON-LOCAL #nl,
  RCOORD-DTR.SYNSEM.NON-LOCAL #nl ].

bottom-coord-phrase :+ [ SYNSEM.NON-LOCAL #nl,
  NONCONJ-DTR.SYNSEM.NON-LOCAL #nl ].
```

Wh-questions further thoughts

- English does different things for matrix v. embedded, subject v. non-subject questions:
    - Who sleeps?
    - Who did they think sleeps?
    - What does the dog chase?
    - I ask who sleeps.
    - I ask who the dog chases.

Wh-questions further thoughts

- I think our semantic representations aren’t quite capturing all the info yet:
  - Who did you ask if Sandy saw?
  - => Two clauses with [SF ques], but which one does ‘who’ belong to as a question?

Lab 7 overview

- Wh-questions:
  - How do they work in your language? How do we need to modify the solutions posted to work with your grammar/the facts of your language?
- Negation: Working properly? If not, post to Canvas & we'll fix things
  - What is the pattern you are trying to model?
  - What tdl do you have so far?
  - What is going wrong?

Lab 7 overview: Corpus sentence

- Create a profile from your test corpus skeleton, and run a baseline.
- Use Browse | Results to see if anything is parsing.
- Look for some plausible candidate sentences. These should be relatively short and ideally have minimal additional grammatical phenomena beyond what we have already covered.
- Examine the lexical items required for your target sentence(s). Add any that should belong to lexical types you have already created.
- Try parsing the test corpus again (or just your target sentence from it).

Lab 7 overview: Corpus sentence

- If your target sentence parses, check the MRS to see if it is reasonable.
- If your target sentence doesn't parse, check to see whether you still have lexical coverage errors. Fixing these may require adapting existing lexical rules, adding lexical rules, and/or adding lexical types. Post to Canvas for assistance.

Lab 7 overview: Corpus sentence

- If your target sentence doesn't parse but your grammar does find analyses for each lexical item, then examine the parse chart to identify the smallest expected constituent that the grammar is not finding, and debug from there. Do you have the phrase structure rule that should be creating the constituent? If so, try interactive unification to see why the expected daughters aren't forming a phrase with that rule. Do you need to add a phrase structure rule? Again, post to Canvas for assistance.

- Iterate until either the sentence parses or you at least have a clear understanding of what you would need to add to get it parsing.

- Run your full test suite after any changes you make to your grammar to make sure you aren't breaking previous coverage/introducing spurious ambiguity.

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