The Grammar Matrix (Motivations, Technical Details)
Morphotactics in the Grammar Matrix

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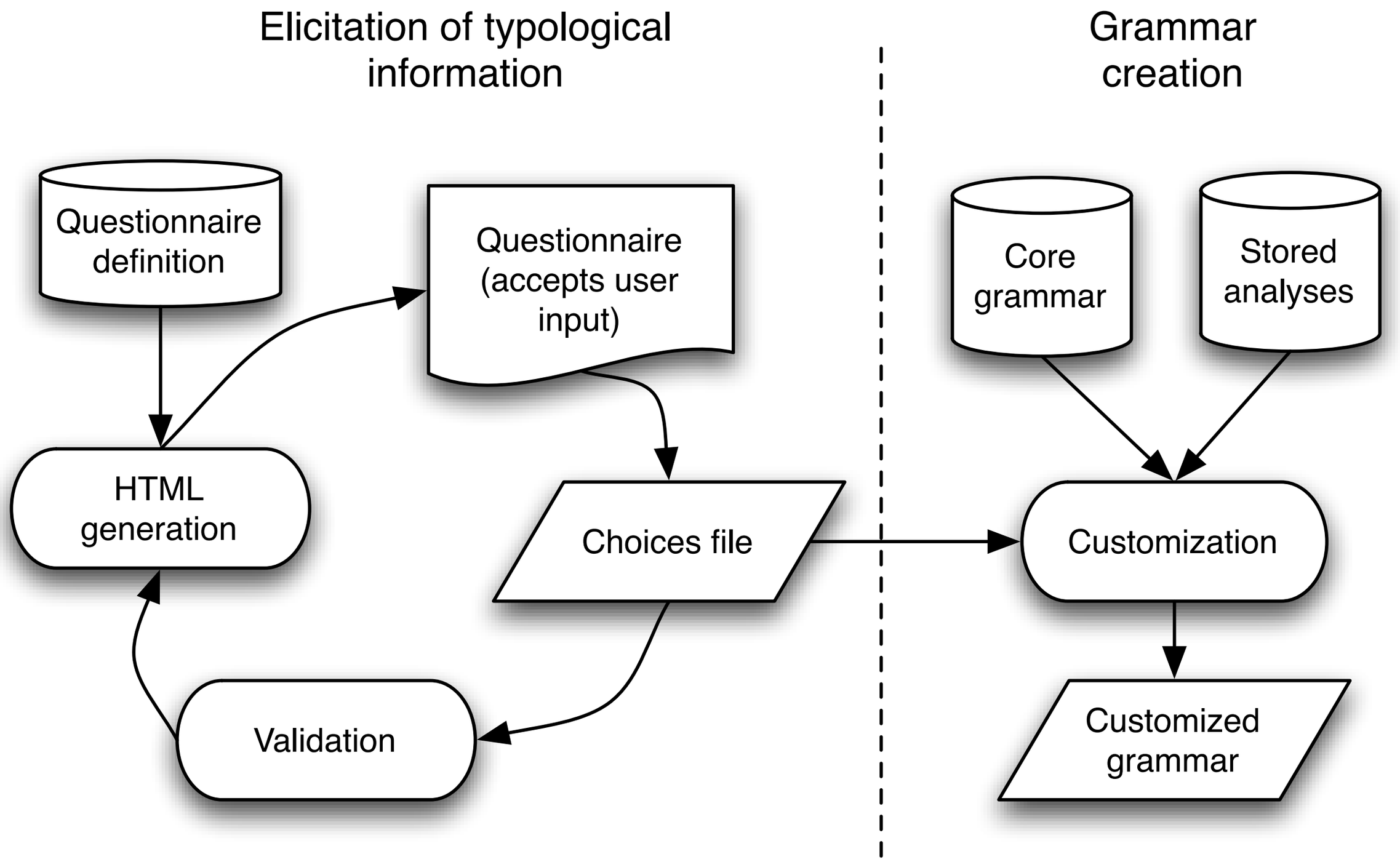
Overview

- Grammar customization
- Morphology: Who’s job is it anyway?
- Morphotactics in the customization system
- Morphotactics in customized grammars
- Agreement
- Argument optionality



(Bender et al 2010)

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Morphology: Basics

- Morpheme: The smallest meaningful unit of language/smallest pairing of “form” and “meaning”
- But:
  - “form” can be lots of things, including empty but also messy changes to word form
  - “meaning” can be just syntactic features
- Morphotactics: Which morphemes can combine, in what order
- Morphophonology: Relationship between underlying word forms and surface forms
- Morphosyntax: Relationship between morphemes and syntactic and semantic features

Morphology: Example

slolmáyaye
slol-ma-ya-yÁ
know-1SG.PAT-2SG.AGT-know

‘you know/knew me’ [lkt]

- Infixation, vowel harmony: Morphophonology
- Relative order of PAT and AGT marker, optionality of same: Morphotactics
- Mapping to constraints that the patient argument be 1sg and the agent 1pl: Morphosyntax
- Actually parsing the string: priceless!

What morphophonolgy can the LKB & the customization system handle?

	LKB	Customization System
polite concatenative morphology	✓	✓
zero morphemes	✓	✓
morphologically conditioned allomorphy	✓	✓
phon. chnages at morpheme boundary	✓	
ablaut		
infixation		
vowel harmony		
suppletion		

Assume a morphophonological analyzer...

- Morphophonological analyzers map surface forms to underlying strings of morphemes
- FSTs are up to the task (except for open-class reduplication)
  - XFST (Beesley & Karttunen 2003) is a very linguist-friendly set up; FOMA (Holden & Algeria 2010) is a open-source package with similar functionality
- But you don’t need to build one for this class!
- Use the morpheme segmented line of your IGT to represent what it would map to, and then (if you have any interesting morphophonology) have that line be the target for your grammar.

Morphophonology/morphosyntax boundary: Where to draw the line?

- Underlying morphemes can be represented as a sequence of phonemes or as as symbols representing morphological features.
- A canonical XFST-derived analyzer will also include POS tags as a morphological feature in the underlying form.
- From the point of view of the LKB:
  - The POS tag adds nothing
  - Spelling the morphemes as morphological features adds nothing: we still need a lexical rule that maps those strings to constraints on avms

Morphophonology/morphosyntax boundary: Where to draw the line?

- On the other hand: for XFST/FOMA, the POS tags (and maybe features) can be useful intermediate stages in processing

- The features can make it easier to create gloss lines automatically.

- On the third hand: using sequences of morphemes might make LKB input/output comprehensible to speakers

- So what should the upper tape have?

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Basic concepts

- Position class: A supertype to lexical rules which fit in the same slot
- Lexical rule type: *lex-rule* and its subtypes, all have DTR feature
- Lexical rule instance: A grammar entity (manipulatable by the LKB) which inherits from a lexical rule type and specifies a spelling change (including no change).
- Forbids constraint: A specification in the customization system stating that a stem lexical rule type (including a position class) cannot co-occur with another lexical rule type, instance, pc or stem.
- Requires constraint: A specification in the customization system stating that a stem lexical rule type (including a position class) must co-occur with another lexical rule type, instance, pc or stem.

Position classes, inputs and lexical rule hierarchies

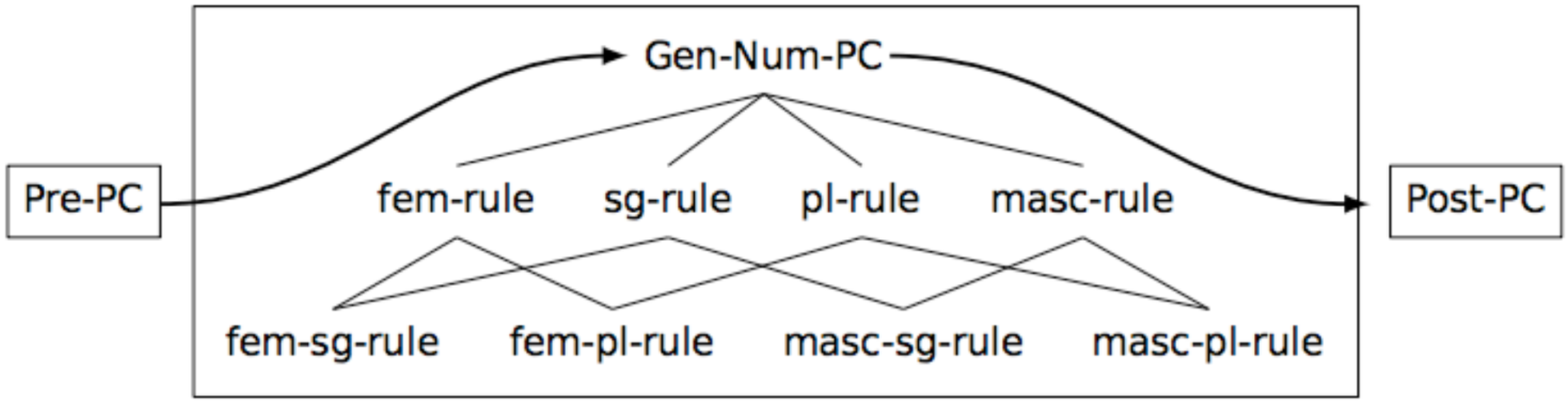

Figure 9: Example lexical rule type hierarchy in a position class

(Goodman 2013)

To define a position class

- Required:
  - Whether or not it is obligatory
  - Possible inputs and prefix/suffix
    - = position in the string
- Optional:
  - Requires/forbids constraints

To define a lex rule type

- Required
  - Nothing (though defaults fill in)
- Optional
  - Name
  - Supertype (if it doesn’t inherit directly from its position class)
  - Feature/value pairs (optional, but this is usually the point!)
  - Requires/forbids constraints

To define a lex rule instance

- Required
  - Affix v. no affix
  - Spelling for affix
- Optional
  - Nothing

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tdl files

- matrix.tdl: Supertypes for lex-rules, which handle the copying up of everything you're not changing
- my_language.tdl: Position classes and lex rule types defined through the customization system; features for inside INFLECTED
- lrules.tdl: Instances for non-spelling-changing lex rules (zero morphemes)
- irules.tdl: Instances for spelling-changing lex rules

Handling of morphotactics

- Rule order handled through super types and typing the DTR feature
- Requires/forbids through the INFLECTED feature

```
case-lex-rule-super := Representative-rule-dtr &
                       add-only-no-ccont-rule &
                       noun-telic-rule-dtr &
[ INFLECTED [ CASE-FLAG +,
              INNER-NEGATION-FLAG #inner-negation,
              NUMBERED-FLAG #numbered ],
  DTR case-rule-dtr &
      [ INFLECTED [ INNER-NEGATION-FLAG
                                  #inner-negation,
                    NUMBERED-FLAG #numbered ] ] ].
```

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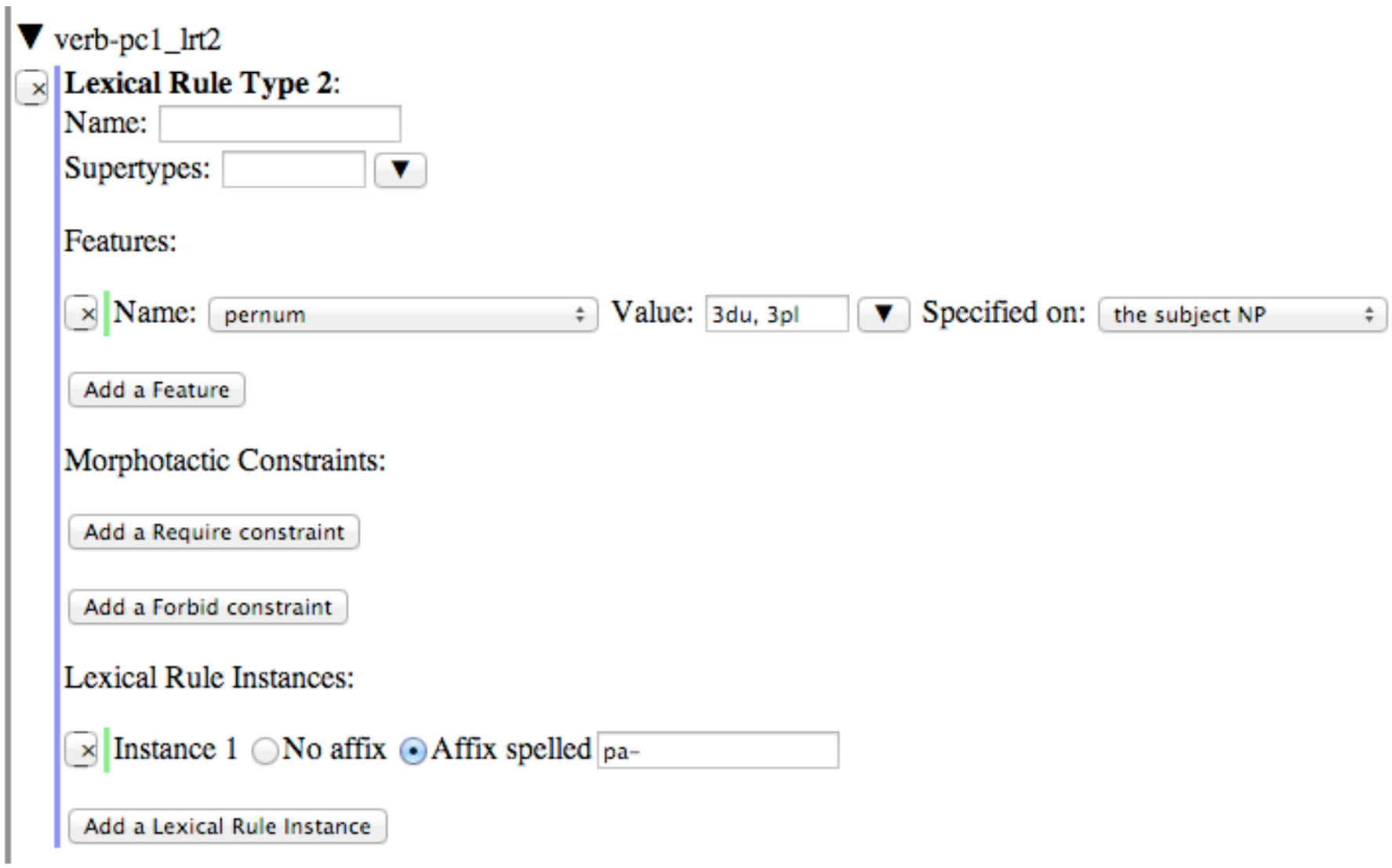
Agreement: Verbs and arguments

- The SHAC doesn't scale:
  - Verbs can agree with more than one argument
  - Many agreement features we actually want represented in the semantics
- Solution:
  - Agreeing verbs constrain the PNG features of their arguments
  - Typically implemented via lexical rules

Agreement: Example



Agreement: Nouns and determiners

- Determiners often agree with nouns in gender, number, and case.
- Sometimes the only overt mark of these features is on the determiners.
- Gender is usually inherent in nouns (= define on the lexical classes).
- Case comes from lexical rules applying to nouns (if it's overtly marked there) and/or constraints on the SUBJ and COMPS lists of the selecting verb.
- In the customization system, constraints on features of determiners are actually applied to the SPEC value so they enforce agreement with the nouns.

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Argument Optionality

- Most (all?) languages allow selected arguments to be unexpressed in certain circumstances
- The variation comes in what those circumstances are:
  - Subjects only/all arguments
  - Only if there is agreement marking on the verb/regardless of agreement marking on the verb
    - Some languages disallow the markers on the verb if the arguments aren’t dropped
  - Certain tense/aspect or person/number combinations

Argument optionality: HPSG analysis

- The analysis provided by the customization system involves non-branching phrase structure rules which shorten a valence list without realizing an overt dependent

- The application of the rules is controlled by the feature OPT:

  - [OPT -] arguments may not be dropped

  - (SPR values that must be realized by a bare-np rule are [OPT +]...)

- Lexical rules for agreement (or lack thereof) can constrain the OPT value and/or shorten the SUBJ/COMPS lists: this is handled with the pseudo-feature OVERT-ARG

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