Resumption and Extraction in an Implemented HPSG of Hausa

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Introduction

- Hausa is a major Afroasiatic language (Chadic sub-branch) spoken by over 35 million speakers in Northern Nigeria and bordering Niger
- Unbounded dependency constructions (UDCs) in Hausa feature both
    - standard extraction (filler–gap dependencies)
    - resumptive pronoun strategy
- Resumptive elements include
    - free pronouns
    - bound pronominal affixes
    - zero anaphora (see below)
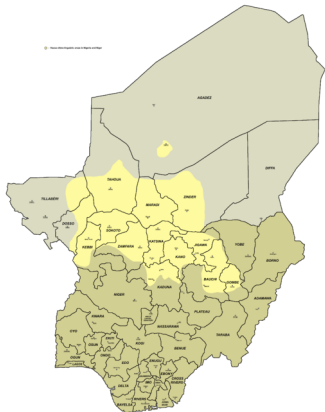
Resumption vs. gap strategy

▶ Choice of extraction strategy partially determined by the governing head

▶ Possessor complements of nouns only permit resumption

(1) wằ$_i$ ka   àuri 'ya-r   -sằ$_i$ / 'yā   *∅$_i$?
     who 2.M.CMPL marry daughter.F-of.F -3S.M   daughter
     'Whose daughter did you marry?'   (Jaggar, 2001)

▶ Complements of true prepositions equally do not permit gap strategy

(2) sàndā$_i$ sukà dǒkē shì   dà ita$_i$ / *∅$_i$
     stick   3P.CPL beat 3S.DO with 3S.F
     'It was a stick they beat him with.'   (Jaggar, 2001)

Human direct objects

- Direct objects of verbs, dynamic nouns, and verbal nouns can extract by way of a filler-gap dependency
- Overt resumptives are considered marginal

"Deletion is [...] the strongly preferred strategy for relativisation on direct objects." (Jaggar, 2001, p. 534)

(3) a. yāròn$_i$ dà sukà dòkā $\emptyset_i$ yanà̀ asìbitì
boy REL 3P.CPL beat up 3.S.M.CONT hospital
'The boy they beat up is in hospital'   (Jaggar, 2001, p. 534)

b. gà̀ yārinyàr$_i$ dà nakè̀ sô $\emptyset_i$
there is girl REL 1.S.CONT want.VN
'There's the girl I love.'   (Jaggar, 2001, p. 534)

c. ìnā littāfìn$_i$ dà kakè̀ màganà̀ $\emptyset_i$
where book REL 2.S.M.CONT talking
'Where is the book you're talking about?' (Jaggar, 2001, 534)

Human direct objects

- Marginality of resumption in highest clause familiar from subjects in Hebrew (Borer, 1984) and Irish (McCloskey, 1990)
- Resumption fine for more deeply embedded human objects (non-islands)

(4)   mùtumìn$_i$ dà dàlìbai sukà san [cêwā mālàma-r-sù
     man   REL students 3P.CPL know COMP teacher-L.F-3P.GEN
     tanà̀   sô-n-sà$_i$ / sô $\emptyset_i$]
     3.S.F.CONT like.VN-L-3.S.M.GEN / like.VN
     'the man that the students know that their teacher likes'   (Newman, 2000, 539)

Human direct objects

- Resumptives also found in across-the-board extraction from coordination
- ATB extraction in Hausa allows mixing of gap and resumptive strategy

(5) [àbōkī-n-ā]$_i$ dà [[na zìyartà̀ $\emptyset_i$] àmmā [bàn sàmē shì$_i$
friend-L-1.S.GEN REL 1.S.CPL visit but 1.S.NEG.CPL find 3.S.M.DO
à gidā ba]]
at home NEG
'my friend that I visited but did not find at home' (Newman, 2000, p. 539)

Human direct objects

- Resumption required with long relativisation
    - from complements of non-bridge verbs
    - from relative (or wh) clauses

(6) gầ   yârân$_i$ dà Àli ya   raɗằ   minì [wai ya   gan-sù$_i$
    there are children REL Ali 3.S.CPL whisper 1.S.IO COMP 3.S.CPL see-3P.DO
    / *ganī Ø gida-n   giyằ]
    / see Ø   house-L beer
    'Here are the children that Ali whispered to me that he saw in the bar.'
    (Tuller, 1986, 169)

(7) gầ   mùtumìn$_j$ dà ka   ga yārinyàr$_i$ [dà Ø$_i$ ta
    here.is man   REL 2.S.M.CPL see girl   REL   3.S.F.CPL
    san shì$_j$ / *sanī Ø$_j$]
    know 3.S.M.DO / know Ø
    'Here's the man that you saw the girl that knows him.' (Tuller, 1986, 85)

Indirect objects

- ▶ Both resumption and gaps possible with indirect objects

(8) mutằnên$_i$ dà sukà ƙi sayar musù / wà Ø dà àbinci sukà fìta
men REL 3P.CPL refuse sell 3P.IO / IOM with food 3P.CPL left
'the men they refused to sell food to left.' (Jaggar, 2001, 534)

- ▶ Resumption obligatory with long relativisation

(9) gầ tābōbîn$_j$ dà Àli ya san mùtumìn$_i$ [dà Ø$_i$ zâi yī
here.is cigarettes REL Ali 3S.M.CPL know man REL 3S.M.FUT do
musù$_j$ / *wà Ø$_j$ kwālī]
3P.IO / IOM Ø box
'Here are the cigarettes that Ali knows the man that will make a box for.'
(Tuller, 1986, 84)

Null pronouns

- Hausa has null subjects and null **non-human** direct objects

  (10) a. Kā ga littāfì-n Mūsa?
       2S.M.CPL see book-of Musa
       'Did you see Musa's book?'

  b. Ī, nā gan shì. / Ī, nā ganī ∅
     Yes 1.S.CPL see 3S.M Yes 1.S.CPL see
     'Yes, I saw it.' (Tuller, 1986, 61)

  (11) a. Kā ga ƙanè-n Mūsa?
       2S.M.CPL see brother-of Musa
       'Did you see Musa's brother?'

  b. Ī, nā gan shì. / *Ī, nā ganī ∅
     Yes 1.S.CPL see 3S.M Yes 1.S.CPL see
     'Yes, I saw him.' (Tuller, 1986, 62)

- Interpretation of zero arguments is specific (Jaggar, 2001; Tuller, 1986)

Null resumptives

- Long relativisation out of relatives possible with pro-dropped arguments (subject and non-human direct object); cf. (Tuller, 1986)

    (12) mùtumìn$_i$ dà ka   san littāfìn$_j$ [dà $\emptyset_i$ ya   rubùtā $\emptyset_j$]
          man   REL 2S.M.CPL know book   REL   3S.M.CPL write
          'the man that you know the book (he) wrote'   (Tuller, 1986, 81)

    (13) littāfìn$_i$ dà ka   san mùtumìn$_j$ [dà $\emptyset_j$ ya   rubùtā $\emptyset_i$]
          book   REL 2S.M.CPL know man   REL   3S.M.CPL write
          'the book that you know the man who wrote (it)' (Tuller, 1986, 81)

- Likewise, argument-drop permits relativisation out of wh-islands

    (14) mùtumìn$_i$ dà ka   san [mè$_j$ $\emptyset_i$ ya   rubùtā $\emptyset_j$]
          man   REL 2S.M.CPL know what 3S.M.CPL write
          'the man that you know what (he) wrote'   (Tuller, 1986, 80)

    (15) littāfìn$_i$ dà ka   san [wà$_j$ $\emptyset_j$ ya   rubùtā $\emptyset_i$]
          book   REL 2S.M.CPL know who 3S.M.CPL write
          'the book that you know who wrote (it)'   (Tuller, 1986, 80)

Islands for wh-fronting

- By contrast, wh-extraction cannot escape islands, e.g. relatives

(16) * wànè mùtûm$_i$ ka   bā   nì littāfìn$_j$ dà $\emptyset_i$ ya   rubùtā
        which man   2S.M.CPL give me book   REL 3S.M.CPL write
        $\emptyset_j$

        'Which man did you give me the book that wrote' (Tuller, 1986, 81)

(17) * wànè littāfì$_j$ ka   san   wà$_i$ $\emptyset_i$ ya rubùtā $\emptyset_j$
        which   book 2S.M.CPL know who   3S.M.CPL write
        'which book do you know who wrote'   (Tuller, 1986, 80)

- Overt resumptives do not improve island sensitivity of wh-phrases

(18)   wà$_j$ ka   yi màganà dà shī$_j$
        who 2S.M.CPL do talking with 3S.M
        'Who did you talk with?'   (Tuller, 1986, 158)

(19) * wà$_j$ ka   san mātâr$_i$ [dà $\emptyset_i$ ta   yi màganà dà shī$_j$]
        who 2S.M.CPL know woman REL   3S.F.CPL do talking with 3S.M

Triple relativisation

- Tuller (1986) cites a marginally acceptable example with triply nested relativisation

(20) ? gà̀   mằtâr*i* dà ka   bā nì littāfìn*j* dà mằlàmai
       here.is woman REL 2S.M.CPL give me book   REL teachers
       sukà san   mùtumìn*k* dà Ø*i* ta   rubùtā wà Ø*k* Ø*j*
       3P.CPL know man   REL   3S.F.CPL write for
       'Here's the woman that you gave me the book the teachers
       know the man she wrote it for.'   (Tuller, 1986, 84)

SLASH dependencies in DELPH-IN grammars I

- Unbounded dependencies in HPSG are mediated via a non-local set-valued feature SLASH, relating properties of the filler to properties at the gap site
- Most HPSG practitioners (Alotaibi & Borsley, 2013; Taghvaipour, 2005; Crysmann, 2012) agree, based on ATB facts, that resumption should be regarded as a SLASH dependency
- Following Sag (1997); Ginzburg & Sag (2000), SLASH passing is
  - lexical:
    gaps are introduced on the argument structure of the head
  - head-driven:
    heads determine their SLASH value from those of their arguments

  (21) SLASH amalgamation (Ginzburg & Sag, 2000)

  $$\begin{bmatrix} \text{SYNSEM} \begin{bmatrix} \text{NLOC} \begin{bmatrix} \text{SL} \ \boxed{1} \cup ... \cup \boxed{n} \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} \left\langle \begin{bmatrix} \text{NLOC} \begin{bmatrix} \text{SL} \ \boxed{1} \end{bmatrix} \end{bmatrix}, ... \begin{bmatrix} \text{NLOC} \begin{bmatrix} \text{SL} \ \boxed{n} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

SLASH dependencies in DELPH-IN grammars II

- ERG (Copestake & Flickinger, 2000) and the Grammar Matrix Bender et al., 2002) closely follow the standard HPSG treatment
  - sets are approximated by difference lists
  - amalgamation is effected by four lexical types (e.g. *basic-two-arg*)

$$
(22) \quad
\begin{bmatrix} o\text{-}diff\text{-}list \\ \text{LIST} \quad \boxed{1} \\ \text{LAST} \quad \boxed{1} \end{bmatrix}
\begin{bmatrix} 1\text{-}diff\text{-}list \\ \text{LIST} \quad \begin{bmatrix} \text{FIRST} \quad [\ ] \\ \text{REST} \quad \boxed{1} \end{bmatrix} \\ \text{LAST} \quad \boxed{1} \end{bmatrix}
\begin{bmatrix} basic\text{-}two\text{-}arg \\ \text{SYNSEM} \quad \left[\text{NLOC} \left[\text{SL} \begin{bmatrix} \text{LIST} \quad \boxed{1} \\ \text{LAST} \quad \boxed{3} \end{bmatrix} \right] \right] \\ \text{ARG-ST} \quad \left\langle \begin{bmatrix} \text{LIST} \quad \boxed{1} \\ \text{LAST} \quad \boxed{2} \end{bmatrix}, \begin{bmatrix} \text{LIST} \quad \boxed{2} \\ \text{LAST} \quad \boxed{3} \end{bmatrix} \right\rangle \end{bmatrix}
$$

- Restriction to at most one simultaneous SLASH dependency impedes treatment of long relativisation in Hausa
- Limitation even affects English:

(23) [A violin this well crafted]$_1$ even [the most difficult sonata]$_2$ will be easy [to play $_2$ on $_1$] ? (Pollard & Sag, 1994, 169)

Multiple SLASH dependencies: Island sensitivity

▸ ATB facts suggest that resumptives and true gaps are compatible in principle ($\Rightarrow$ both are SL elements)

▸ Island effects show that
  ▸ only relatives footed by a resumptive can escape islands
  ▸ both gap dependencies and phrasal fillers are island-sensitive

▸ Distinguish gaps/resumptives and wh/relatives by the amount being minimally shared
  INDEX (resumptive, relative) vs. LOC (gap, wh-filler)

(24)
$$\begin{bmatrix} \textit{gap-or-res} \\ \text{LOC} & \begin{bmatrix} \text{CONT.HOOK.INDEX} & \boxed{1} \end{bmatrix} \\ \text{NLOC} & \begin{bmatrix} \text{SL} \left\langle ! \begin{bmatrix} \text{CONT.HOOK.INDEX} & \boxed{1} \end{bmatrix} ! \right\rangle \end{bmatrix} \end{bmatrix}$$

(25)
$$\begin{bmatrix} \textit{local} \\ \text{CONT} & \textit{mrs} \end{bmatrix}$$

$$\begin{bmatrix} \textit{gap} \\ \text{LOC} & \boxed{1} \textit{full-local} \\ \text{NLOC} & \begin{bmatrix} \text{SL} & \left\langle ! \boxed{1} ! \right\rangle \end{bmatrix} \end{bmatrix} \begin{bmatrix} \textit{strict-res} \\ \text{NLOC} & \begin{bmatrix} \text{SL} & \left\langle ! \textit{light-local} ! \right\rangle \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \textit{full-local} \\ \text{CAT} & \textit{cat} \end{bmatrix} \qquad \textit{light-local}$$

Multiple SLASH dependencies: Launching

- Standard gap-type dependencies are introduced by CELR
- Full reentrancy of SL element with a dependent's LOC value
  - (26) Complement extraction

  $$\left[\text{SS} \left[\text{LOC} \left[\text{CAT} \left[\text{VAL} \left[\text{COMPS} \quad \boxed{1} \right] \right] \right] \right] \right.$$
  $$\left. \text{DTR} \left[\text{SS} \left[\text{LOC} \left[\text{CAT} \left[\text{VAL} \left[\text{COMPS} \quad \left\langle gap \mid \boxed{1} \right\rangle \right] \right] \right] \right] \right] \right]$$

- Lexical rules for resumption are crucially underspecified: compatible with both full (wh) fillers and light index dependencies
  - (27) Resumption

  $$\left[\text{SS} \left[\text{LOC} \left[\text{CAT} \left[\text{VAL} \left[\text{COMPS} \quad \boxed{1} \right] \right] \right] \right] \right.$$
  $$\left. \text{DTR} \left[\text{SS} \left[\text{LOC} \left[\text{CAT} \left[\text{VAL} \left[\text{COMPS} \quad \left\langle gap\text{-}or\text{-}res \mid \boxed{1} \right\rangle \right] \right] \right] \right] \right] \right]$$

Multiple SLASH dependencies: Retrieval I

- Multiple simultaneous unbounded dependencies require recursive perusal of SLASH list
- HaG recognises exactly two constructions for retrieval:
  - classic filler-head structures (for wh- and focus fronting) identifies TO-BIND.FILL with filler's entire LOC value
  - relative complementiser (cf. Alotaibi & Borsley, 2013) identifies index in TO-BIND.FILL with index of antecendent noun (in REL)
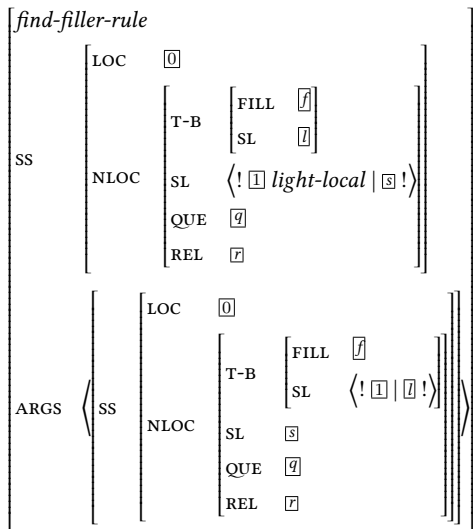
(28)

$$
\begin{bmatrix}
\textit{filler-head-rule} \\[4pt]
\text{SS.NLOC}
\begin{bmatrix}
\text{T-B}
\begin{bmatrix}
\text{FILL} & \langle \boxed{l} \rangle \\
\text{SL} & \boxed{s}
\end{bmatrix} \\[10pt]
\text{SL} & \langle ! \, ! \rangle
\end{bmatrix} \\[14pt]
\text{FILLER-DTR} \quad \begin{bmatrix} \text{SS} \begin{bmatrix} \text{LOC} & \boxed{l} \end{bmatrix} \end{bmatrix} \\[8pt]
\text{HD-DTR} \quad \begin{bmatrix} \text{SS} \begin{bmatrix} \text{NLOC} \begin{bmatrix} \text{SL} & \boxed{s} \end{bmatrix} \end{bmatrix} \end{bmatrix}
\end{bmatrix}
\begin{bmatrix}
\textit{rel-complementiser-lex} \\[4pt]
\text{SS}
\begin{bmatrix}
\text{NLOC}
\begin{bmatrix}
\text{T-B}
\begin{bmatrix}
\text{FILL} & \left\langle \begin{bmatrix} \text{CONT} \begin{bmatrix} \text{HOOK} \begin{bmatrix} \text{INDEX} \ \boxed{i} \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\rangle \\
\text{SL} & \boxed{s} \\
\text{REL} & \langle ! \ \boxed{i} \ \textit{ref-index} \ ! \rangle
\end{bmatrix} \\[14pt]
\text{SL} & \langle ! \, ! \rangle
\end{bmatrix}
\end{bmatrix} \\[14pt]
\text{ARG-ST} \quad \left\langle \text{S} \begin{bmatrix} \text{NLOC} \begin{bmatrix} \text{SL} & \boxed{s} \end{bmatrix} \end{bmatrix} \right\rangle
\end{bmatrix}
$$

Multiple SLASH dependencies: Retrieval II

- *find-filler-rule* recursively skips over *light-local* T-B.SL elements

- Skipped T-B.SL elements are restored to main SL

- Rule effectively rules in long relativisation with resumption (*light-local*)

- Rule enforces extraction island for gap dependencies (*full-local*)
  - wh/focus fronting
  - relativisation without resumptives

(29)

$$
\begin{bmatrix}
\textit{find-filler-rule} \\
\text{SS} \begin{bmatrix}
\text{LOC} & \boxed{0} \\
\text{NLOC} \begin{bmatrix}
\text{T-B} \begin{bmatrix} \text{FILL} & \boxed{f} \\ \text{SL} & \boxed{l} \end{bmatrix} \\
\text{SL} & \langle\,!\;\boxed{1}\;\textit{light-local}\;|\;\boxed{s}\,!\rangle \\
\text{QUE} & \boxed{q} \\
\text{REL} & \boxed{r}
\end{bmatrix}
\end{bmatrix} \\
\text{ARGS} \left\langle \begin{bmatrix}
\text{SS} \begin{bmatrix}
\text{LOC} & \boxed{0} \\
\text{NLOC} \begin{bmatrix}
\text{T-B} \begin{bmatrix} \text{FILL} & \boxed{f} \\ \text{SL} & \langle\,!\;\boxed{1}\;|\;\boxed{l}\,!\rangle \end{bmatrix} \\
\text{SL} & \boxed{s} \\
\text{QUE} & \boxed{q} \\
\text{REL} & \boxed{r}
\end{bmatrix}
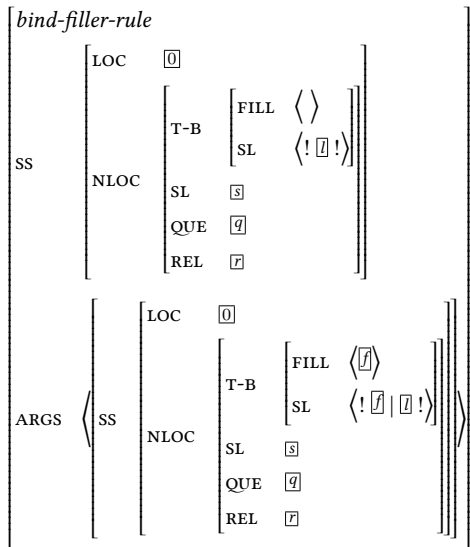\end{bmatrix}
\end{bmatrix} \right\rangle
\end{bmatrix}
$$

Multiple SLASH dependencies: Retrieval III

- *bind-filler-rule* performs actual identification of filler's properties with some first element on T-B.SL

- rule itself is agnostic as to the nature of the filler (i.e. *full-local* vs. *light-local*)

- bound SL element is not passed on

(30)

$$
\begin{bmatrix}
\textit{bind-filler-rule} \\
\text{SS} \begin{bmatrix}
\text{LOC} & \boxed{0} \\
\text{NLOC} \begin{bmatrix}
\text{T-B} & \begin{bmatrix} \text{FILL} & \langle\ \rangle \\ \text{SL} & \langle !\ \boxed{l}\ ! \rangle \end{bmatrix} \\
\text{SL} & \boxed{s} \\
\text{QUE} & \boxed{q} \\
\text{REL} & \boxed{r}
\end{bmatrix}
\end{bmatrix} \\
\text{ARGS} \left\langle \begin{bmatrix}
\text{SS} \begin{bmatrix}
\text{LOC} & \boxed{0} \\
\text{NLOC} \begin{bmatrix}
\text{T-B} & \begin{bmatrix} \text{FILL} & \langle \boxed{l} \rangle \\ \text{SL} & \langle !\ \boxed{l}\ |\ \boxed{l}\ ! \rangle \end{bmatrix} \\
\text{SL} & \boxed{s} \\
\text{QUE} & \boxed{q} \\
\text{REL} & \boxed{r}
\end{bmatrix}
\end{bmatrix}
\end{bmatrix} \right\rangle
\end{bmatrix}
$$

Adjunct extraction and termination

- As for argument extraction, number of simultaneous SLASH dependencies bounded by argument structure
- Number of adjunct gaps inherently unbounded: termination?
- Hausa permits at most one simultaneous gap dependency: long relativisation restricted to resumptive dependency
- Generally restrict remainder of SL list to *light-local* elements upon introduction of a *full-local* element

$$
(31) \quad
\begin{bmatrix}
\text{SS} & \begin{bmatrix} \text{NLOC.SL} & \begin{bmatrix} \text{LIST} & \left\langle \boxed{1}\ \textit{full-local} \mid \boxed{s} \right\rangle \\ \text{LAST} & \boxed{l} \end{bmatrix} \end{bmatrix} \\[4ex]
\text{DTRS} & \left\langle \begin{bmatrix} \text{SS.NLOC.SL} & \begin{bmatrix} \text{LIST} & \boxed{s}\ \textit{list(index-local)} \\ \text{LAST} & \boxed{l} \end{bmatrix} \end{bmatrix} \right\rangle
\end{bmatrix}
$$

- Weaker constraint for English, cf. (23):
  restrict SL to at most one adjunct gap (*list*([CAT.HD.MOD < >]))

Shortcomings of the ambiguity approach

- ▸ Duplication of
    - ▸ pronominal lexical items
    - ▸ pronominal affixation rules (accusative, dative, genitive)
    - ▸ zero pronoun rules
- ▸ Baseline implementation kept cost at bay by adopting an allomorphy approach to the 3 sets of pronominal affixes
- ▸ Lean formalisms force hidden costs out into the open
- ▸ Misses McCloskey's generalisation:
  in languages with resumption, resumptives are always the ordinary pronouns of the language
- ▸ Alternatives: Borsley (2010); Alotaibi & Borsley (2013)
    - ▸ Locates choice between resumptive and pronoun function outside pronominal element :-)
    - ▸ Cannot account for difference in semantics :-(
    - ▸ Does not play nice with SLASH amalgamation

Resumption by underspecification

- Solution:
  - decision on function is property of governing head (cf. Borsley)
  - combine with underspecification of *pronominal-synsem* (generalises across bound and free pronouns)
  - Expanded hierarchy of *synsem*
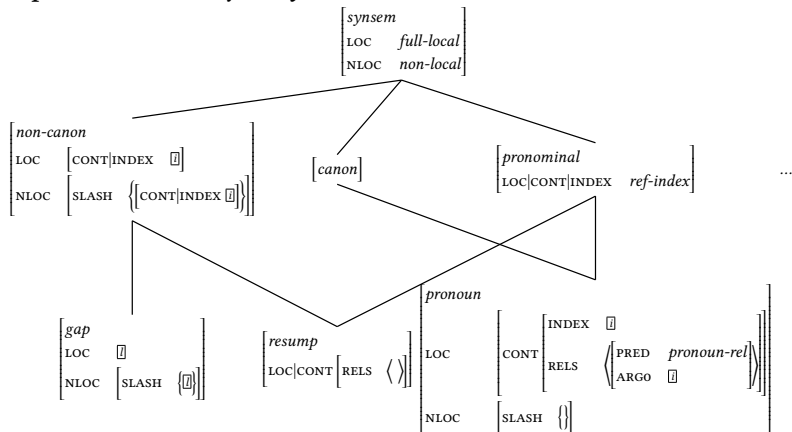
Implementation

- Pronominals lexically underspecified (via synsem)
- Obligatory lexical rule layer performs choice between slashed and unslashed complements on governing head
    - disambiguation restricted to subject and direct object valencies
    - obliques turn out to be selected by markers or prepositions
- Generation
    - Problem: *pronoun_rel* not detectable by static predicate coverage check
    - Solution:
      deterministically remove relation from internal MRS in
      pre-generation fixup
      post-generation check performed on external MRS

Conclusion

- Linguistically complete treatment of resumption in Hausa necessitates low-level revisions to current treatment of extraction in HPSG grammar engineering:
  - island-insensitive long relativisation gives rise to multiple simultaneous SLASH dependencies
  - Hard-wired restriction to maximally singleton SLASH replaced by a restriction on number of simultaneously open gap dependencies
  - Constraint motivated by island effects provides a solution for termination and efficiency issues
- Underspecification significantly improves over ambiguity approach to resumptives (Crysmann, 2015)
  - Disjunctions between ordinary pronouns and resumptives fully eliminated
  - Provides an account of McCloskey's generalisation
  - Semantics identical for gap and resumptive strategies (in contrast to Asudeh, 2004)

Shi ke nan. Kurunƙus.

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