‘Grammar matrix’ as grammar ontology.

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Much is possible with Typed Feature Structures.

One can see a grammar as a statement of the possible constructions in a language, through a type hierarchy encompassing the construction types. Grammars share a number of construction types, so that such hierarchies are connected by multiple inheritance.

We illustrate the idea, taking some basic construction types as examples of the formal construal of ‘construction’ (following Hellan 2019a), and having it as a background in viewing and formalizing certain construction types in Kwa and Bantu.

(1)

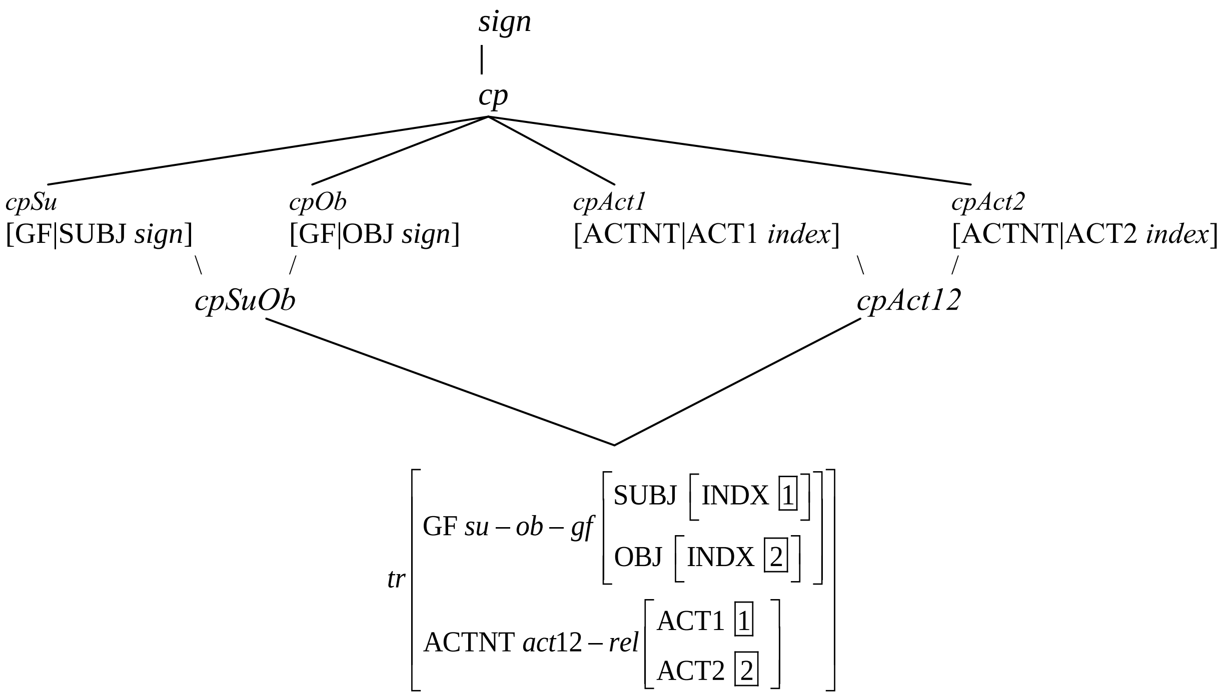
sign := *top* & [PHON *phon*, ORTH *string*, MEANING *meaning*]

cp := *sign* & [GF *gramfct*, ACTNT *actnt*, SIT *sit*].

(*cp* for ‘construction profile’)

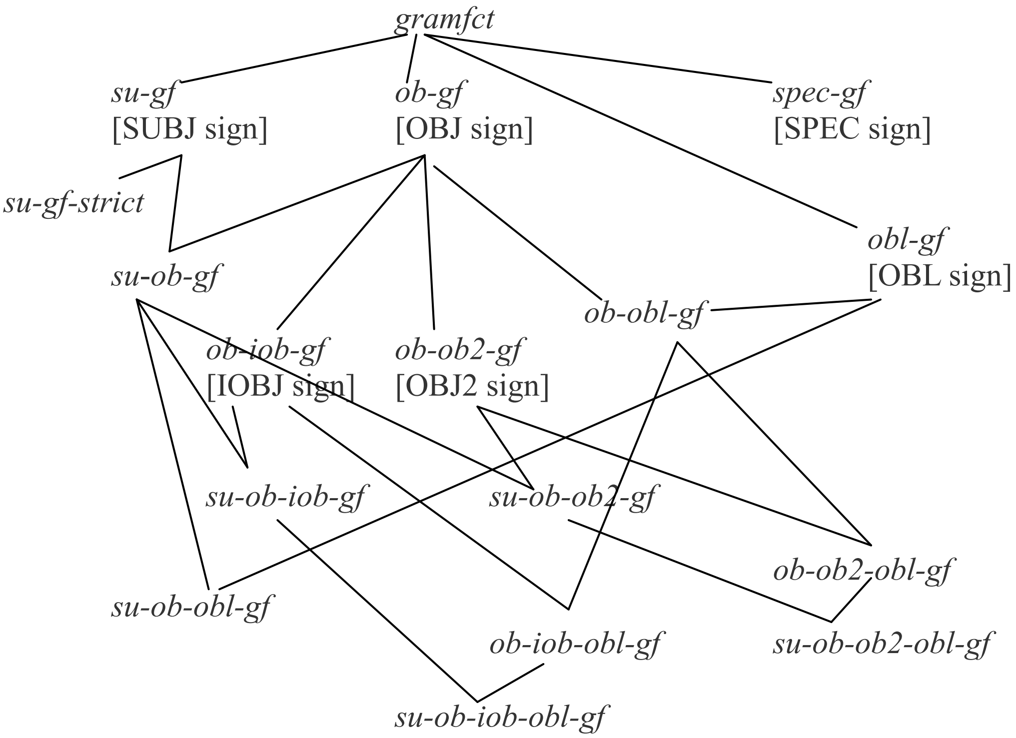
Example, showing the *cp* subtype ‘standardly linked transitive’ - *tr*:

(2)



Partial inventory of GFs and ACTNTs:

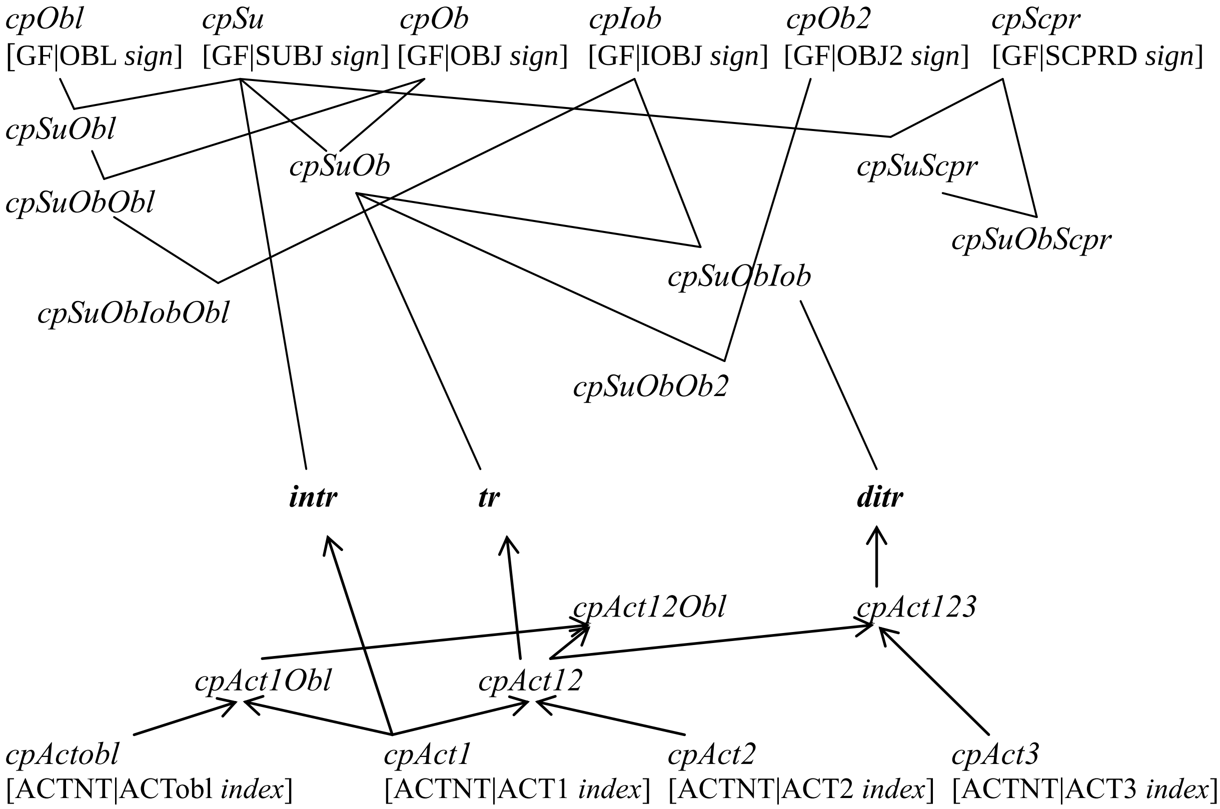
(3)



(4)

```
                          actnt
                     [PRED 'pred', ACT0 index]
                     /          |                   \
loc-rel              act1-rel                 dir-rel
[LOC index]          [ACT1 index]             [DIR index]
|               /    |                 \      /         |
act1loc-rel          act12-rel          act1dir-rel     |
|                    [ACT2 index]                       /
|              /     |                 \                        /
act12loc-rel         act123-rel           act12dir-rel
|                    [ACT3 index]
|                    /
act123loc-rel
```

(5) Definitions of some further *cp* types



Types introducing combinations of valence lists and GFspecifications
AVM-structures as seen above represent construction *types*, with no display of the full grammatical and semantic content of an actual sentence. To bridge between such 'forms' and actual sentences, one will need an algorithm for assigning the right content to the right slots in the form. A well established algorithm for such a purpose is one which associates the 'form' of the construction with the 'head' of the sentence, and represents each item in the form as an item in what is called *the valence frame* of the head; the bridge between the form of a sentence and its actual content can then be construed along the lines of 'valence satisfaction', for instance in the way this is done in *parsing* in HPSG. Commonly *verbs* are seen as such 'frame bearers', and we will assume such a role for verbs here.
The type of signs including valence lists can be construed as subtypes of the types considered so far. Regarding these types as lexical types, we can name them with a suffix '-lx', exemplified with the constellation in (7) using *tr* (cf. (6)) as one dominant type, and a type introducing the valence list attributes as a second, defined as the carrier of the attributes SPR and COMPS; the role of (7) is to introduce members of these lists and align them with GFs as defined for *tr*:

(6)

$$tr\begin{bmatrix} \text{GF } su-ob-gf\begin{bmatrix} \text{SUBJ}\begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix} \\ \text{OBJ}\begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \end{bmatrix} \\ \text{ACTNT } act12-rel\begin{bmatrix} \text{ACT1 } \boxed{1} \\ \text{ACT2 } \boxed{2} \end{bmatrix} \end{bmatrix}$$

(7)

$$\begin{array}{ccc} tr & & lex\ [\text{SPR } list\text{, COMPS } list] \\ \backslash & & / \end{array}$$

$$tr-lx \begin{bmatrix} \text{GF } su-ob-gf \begin{bmatrix} \text{SUBJ } \boxed{3} \\ \text{OBJ } \boxed{4} \end{bmatrix} \\ \\ \text{SPR } \left\langle \boxed{3} \right\rangle \\ \text{COMPS } \left\langle \boxed{4} \right\rangle \end{bmatrix}$$

With the index identities already defined for *tr*, the inheritance indicated in (7) yields the more fully specified sign (8) as the formal specification of a transitive verb:

(8)

$$tr-lx \begin{bmatrix} \text{GF } su-ob-gf \begin{bmatrix} \text{SUBJ } \boxed{3} \begin{bmatrix} \text{INDX } \boxed{1} \end{bmatrix} \\ \text{OBJ } \boxed{4} \begin{bmatrix} \text{INDX } \boxed{2} \end{bmatrix} \end{bmatrix} \\ \text{ACTNT } act12-rel \begin{bmatrix} \text{ACT1 } \boxed{1} \\ \text{ACT2 } \boxed{2} \end{bmatrix} \\ \text{SPR } \left\langle \boxed{3} \right\rangle \\ \text{COMPS } \left\langle \boxed{4} \right\rangle \end{bmatrix}$$

1 Bantu

1.1 Grammatical Functions and Actants

For sentences, one of the main formats of discursive representation is that of interlinear glossed text (IGT), illustrated in (1). The encoding of information exemplified here will serve as point of departure for an outline of how such information can be perspicuously represented also in a formal format. The sentence is from the Bantu language Citumbuka[1], with gloss tags for grammatical features on one line, part of speech (POS) tags on another, and grammatical functions (GF) tags on a third:[2]

(1)	Mary	wa-ka-mu-phik-**isk**-a	Tumbikani	nchunga
	Mary	1SM-Pst-1OM-cook-Caus-FV	Tumbikani	beans
	N	V	N	N
	SUBJ		OBJ	OBJ2
	'Mary made Tumbikani cook beans'			

In the format of a formal feature structure representation, a corresponding display (omitting display of the order of constituents, and for the moment, of semantics) may look like (2), reflecting just the information stated in (1):

(2)

$$
\textit{sign}\begin{bmatrix}
\text{ORTH "wakamuphikiska"} \\
\text{HEAD } \textit{verb} \\
\text{GF}\begin{bmatrix}
\text{SUBJ } \textit{sign}\begin{bmatrix}\text{ORTH "Mary"} \\ \text{HEAD } \textit{noun} \\ \text{NOUNCLASS 1}\end{bmatrix} \\
\text{OBJ } \textit{sign}\begin{bmatrix}\text{ORTH "Timbikani"} \\ \text{HEAD } \textit{noun} \\ \text{NOUNCLASS 1}\end{bmatrix} \\
\text{OBJ2 } \textit{sign}\begin{bmatrix}\text{ORTH "nchunga"} \\ \text{HEAD } \textit{noun}\end{bmatrix} \\
\end{bmatrix} \\
\text{TENSE } \textit{past}
\end{bmatrix}
$$

The format of Attribute-Value Matrices (AVMs) used in (2) is a powerful mechanism allowing for the specification of an in principle unlimited number of distinctions at in principle any number of levels of specification and sub-; the general governing regulations can be recalled as (3):[3]

(3)
[A] A given type introduces the same attribute(s) no matter in which environment it is used.
[B] A given attribute is declared by one type only (but occurs with all of its subtypes).

Next consider the aspect of the meaning in (1) signalled by the morph *–isk*, glossed as 'caus', in standard analysis seen as corresponding to the 'CAUSE' item in an intuitive logical form of the kind '[CAUSE (Mary, [cook (Tumbikani, beans)])]'. Noteworthy here is that although the NPs *Mary, Tumbikani* and *beans* are all syntactic arguments relative to the same verb form, as indicated in (2), the logical role of 'Mary' relates to 'CAUSE', whereas the logical roles of 'Tumbikani' and 'beans'

[1] Jean Chavula, p.c.
[2] '1SM' for 'subject marker for noun class 1', '1OM' for 'object marker for noun class 1', 'PST' for 'past tense', Caus for 'causative', and 'FV' for 'final vowel', these being the meanings and grammatical features associated with the hyphenated morphs; 'N' and 'V' stand for 'noun' and 'verb'.
[3] See Copestake 2002.

relate to ‘cook’. Thus there is a discrepancy, or lack of isomorphism, between the grammatical argument pattern and the logical argument pattern. This means that a specific structure must be supplied for the semantic argument patterns, i.e., the level of representation we call ACTNT. Here the participants are each represented by the attribute ACT(ant)n, and the boxed numbers indicate which actant corresponds to which syntactic constituent. The attribute ‘INDX’ of each syntactic constituent introduces its ‘referential index’. For a verbal sign the corresponding index – ACT0 - will be the ‘event index’. These specifications are illustrated in (4):

(4)

$$\mathit{sign}\begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix} \\ \text{OBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \\ \text{OBJ2 } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{3}\end{bmatrix} \end{bmatrix} \\ \text{INDX } \boxed{0} & \\ \text{ACTNT} & \begin{bmatrix} \text{PRED } \mathit{'cause'} & \\ \text{ACT0 } \boxed{0} & \\ \text{ACT1 } \boxed{1} & \\ \text{ACT2} & \begin{bmatrix} \text{PRED } \mathit{'cook'} \\ \text{ACT1 } \boxed{2} \\ \text{ACT2 } \boxed{3} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The attributes *ACT1, ACT2* etc. as used here can be seen partly as coarse *role labels*, and partly as *enumeration markers*: as enumeration markers, they list the participants present in the situation expressed (including implicit ones), starting with ACT1, using ACT2 only if there is an ACT1, and using ACT3 only if there is an ACT2. (This is analogous to the conventional listing of arguments of an operator in logical notation, where in expressions like ‘P(x,y)’ one introduces a comma only if there is more than one argument. The level of richness of the ACT notation is indeed similar to that of standard predicate logic notation.[4]) As role markers, when there is more than one argument, they express something close to ‘macro’ or ‘proto’ roles, so that when there is an ACT1 and an ACT2, ACT1 is the role associated with emanation of force, and ACT2 is the ‘impacted’ part relative to the force; an ACT3 would then express a slightly less directly involved participant than the ACT2, such as the recipient or benefactive in a ditransitive sentence; in these contrasts, the ACTs have the same intuitive basis as Dowty’s (1991) proto-roles.[5] When there is only one actant, however, it will be marked as ACT1, regardless of its role; here one is thus back to the enumeration modus.

Although the ACT attributes by no means purport to represent a rich amount of semantic roles, they are not replica of the GFs of the sentence represented, as observed in the ‘non-isomorphism’ patterning above, and also in that also implicit participants receive an ACT, and in that the ordering among the ACTs does not necessarily reflect the GFs carried by the constituents expressing the participants in question; thus, although the default linking is for *subject* to represent *ACT1*, in a passive sentence a subject can correspond to an ACT2 or ACT3 participant.

It may be noted that in (4), the partial specification

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[4] In formal and computational grammars using this notation one can derive predicate logic-like formulas; cf. Copestake et al. (200)5.

[5] The Paninian k-system is the earliest in this tradition (cf. Staal and Frits. (1972)). PropBank’s (http://verbs.colorado.edu/~mpalmer/projects/verbnet.html) use of ARG0, ARG1, … is similar to the k-roles in that both represent fixed roles. A less formal convention is ‘role’ indications in the style of ‘kicker’ and ‘kickee’ for a verb like *kick*, where the –er suffix corresponds to the one who kicks and the –ee suffix to the item kicked. When this convention is applied to any kind of verb (as envisaged, e.g., in Sag et al. 2003), it reduces to a counterpart of the enumeration aspect of ACT1, ACT2, and in a formally non-manageable way. Relative to HPSG, our proposal for situational specification – see below - has perhaps most in common with Davis 2000.

$$\text{ACT2}\begin{bmatrix}\text{ACT1 } \boxed{2}\ \textit{index} \\ \text{ACT2 } \boxed{3}\ \textit{index}\end{bmatrix}$$

presupposes that the outer ACT2 can declare a binary relation as its value. The ACT attributes will take *index* as their general value, and we let the type *index* have two subtypes, *indiv* and *actnt*, where *actnt* is the type generally declaring **ACT1, ACT2**, etc, being the value of the attribute ACTNT.

1.2 Derived signs

To formalize a sign-to-sign derivation, we need a way of representing the 'input' and the 'output' sign so as to indicate what information is taken over from the input to the output sign, and what is 'new'. Referring to the input sign as *D(erivational)-BASE*, the derivation hypothesized as underlying the structure of (1) can be displayed as in (5) in terms of GF and ACTNT - the ACTNT value of D-BASE is set identical to the 'caused' situation (the ACT2 of *'cause'*), and the referents of the input SUBJ and OBJ are those of the output OBJ and OBJ2, respectively.

(5) AVM for construction headed by verb derived by morphological Causative:

$$\textit{dbobCs}\begin{bmatrix}\text{HEAD } \textit{verb} \\ \text{GF}\begin{bmatrix}\text{SUBJ}\begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix} \\ \text{OBJ}\begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \\ \text{OBJ2}\begin{bmatrix}\text{INDX } \boxed{3}\end{bmatrix}\end{bmatrix} \\ \text{INDX } \boxed{4} \\ \text{ACTNT}\begin{bmatrix}\text{PRED } \textit{'cause'} \\ \text{ACT0 } \boxed{4} \\ \text{ACT1 } \boxed{1} \\ \text{ACT2}\begin{bmatrix}\text{K } \boxed{6}\, \textit{actn}\begin{bmatrix}\text{ACT1 } \boxed{2} \\ \text{ACT2 } \boxed{3}\end{bmatrix}\end{bmatrix}\end{bmatrix} \\ \text{D-BASE } \textit{sign}\begin{bmatrix}\text{GF}\begin{bmatrix}\text{SUBJ}\begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \\ \text{OBJ}\begin{bmatrix}\text{INDX } \boxed{3}\end{bmatrix}\end{bmatrix} \\ \text{ACTNT } \boxed{6}\end{bmatrix}\end{bmatrix}$$

The phenomenon Applicative is exemplified in (6), from the Bantu language Luganda,[6] through the morphological addition of *–ir*, and the restructuring of the valence frame with regard to one argument; there is in this case no tangible semantic effect:

(6) *Oluvannyuma etunuulira omusajja*

Oluvannyuma	e	tunuul	ir	a	o	mu	sajja.
	SBJ9AGR	look	APPL	FV	IV	1AGR	man
ADV	V				N		

"Afterwards it looks at the man."

[6] From the data collection https://typecraft.org/tc2wiki/Luganda_applicatives.

A representation of (6) with a display of its derivational history analogous to (5) is given in (7), where a hypothetical ‘base’ frame has the object as an oblique; the semantic effects are more subtle, and not amounting to any addition of ACTNT arguments, as opposed to the case of Causatives.

(7) AVM for construction headed by verb derived by morphological Applicative:

$$
\mathit{trAp}\begin{bmatrix}
\text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \end{bmatrix} \\
\text{INDX} & \boxed{4} \\
\text{ACTNT} & \begin{bmatrix} \text{ACT0} & \boxed{4} \\ \text{ACT1} & \boxed{1} \\ \text{ACT2} & \boxed{2} \end{bmatrix} \\
\text{SIT} & \boxed{6} \\
\text{D-BASE } \mathit{sign} & \begin{bmatrix}
\text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix} \\ \text{OBL} & \begin{bmatrix}\text{GOV} \begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix}\end{bmatrix} \end{bmatrix} \\
\text{ACTNT} & \begin{bmatrix} \text{ACT1} & \boxed{1} \\ \text{ACTobl} & \boxed{2} \end{bmatrix} \\
\text{SIT} & \boxed{6}
\end{bmatrix}
\end{bmatrix}
$$

The processes of (morphological) Causative, Applicative, and Passive can combine. A combination of Morphological Causative and Passive is exemplified in (8) and represented in (9). Formally this will be represented as a recursion of the D-BASE attribute. A substantive difference between the values of the two instances of the attribute D-BASE in (9) – ‘D-BASE’ and ‘D-BASE | D-BASE’ - is that the ACTNT content of the former – the passive construction - is set as the same as that of its ‘active’ input, i.e., ‘ACTNT ‘ = ‘D-BASE|ACTNT’, whereas ‘D-BASE|ACTNT’ is different from ‘D-BASE| D-BASE |ACTNT’:

(8) (from Kiswahili, based on Vitale, 1981:165, quoted in Kroeger, 2004, p.196, ex. (11a))

mke	wake	a-li-pi-**ish-w**-a	uji	na	Sudi
wife	his	S.agr-PAST-cook-CAUS-Pass-Ind	gruel	by	Sudi
N	PN	V	N	P	N

‘His wife was made to cook gruel by Sudi’

(9) Verb sign derived by Morphological Causative and subsequently Passive

$$
\textit{trOblPsCs}\left[\begin{array}{ll}
\text{HEAD } \textit{verb} & \\
\text{GF} & \left[\begin{array}{l}
\text{SUBJ } \left[\text{INDX } \boxed{2}\right] \\
\text{OBJ } \left[\text{INDX } \boxed{3}\right] \\
\text{OBL } \left[\text{INDX } \boxed{1}\right]
\end{array}\right] \\
\text{ACTNT } \boxed{7} & \\
\text{D-BASE} & \left[\begin{array}{ll}
\text{GF} & \left[\begin{array}{l}
\text{SUBJ } \left[\text{INDX } \boxed{1}\right] \\
\text{OBJ } \left[\text{INDX } \boxed{2}\right] \\
\text{OBJ2 } \left[\text{INDX } \boxed{3}\right]
\end{array}\right] \\
\text{ACTNT } \boxed{7} & \left[\begin{array}{l}
\text{PRED } '\textit{cause}' \\
\text{ACT1 } \boxed{1} \\
\text{ACT2 } \left[\text{K } \boxed{6} \left[\begin{array}{l}
\text{ACT1 } \boxed{2} \\
\text{ACT2 } \boxed{3}
\end{array}\right]\right]
\end{array}\right] \\
\text{D-BASE} & \left[\begin{array}{ll}
\text{GF} & \left[\begin{array}{l}
\text{SUBJ } \left[\text{INDX } \boxed{2}\right] \\
\text{OBJ } \left[\text{INDX } \boxed{3}\right]
\end{array}\right] \\
\text{ACTNTS } \boxed{6} &
\end{array}\right]
\end{array}\right]
\end{array}\right]
$$

Consider then an interaction between Causativization and Applicative, again using an example from Citumbuka, illustrating a case where a sequence of applications of first the Applicative rule and then an application of Causativization, produce a verb construction of type *ditrOblApCs-oblCsu_obCob2Aobl_ob2Cob* (= 'ditransitive-plus-oblique construction produced by Causativization preceded by Applicative' - the label reflecting the order of 'peeling off' one process after the other, starting from the result – and mentioning only the GF-changing mappings). The constituent label *oblCsu* here says that the oblique is derived by Causativization from underlying subject, *obCob2Aobl* says that the first object is 'promoted' by Causativization from obj2, before that promoted by Applicative from underlying oblique (so., mentioned in opposite order of the processes), and *ob2Cob* says that the second object is derived by Causativization from underlying object:

(10) (Ex.Citumbuka, by Jean Chavula, pc)
Tumbikani wakamuphik**iskir**a Temwa nchunga kwa Mary

Tumbikani	wa-ka-mu-phik-**isk-ir**-a	Temwa	nchunga	kwa	Mary
Tumbikani	1SM-pst-1OM-cook-Caus-Appl-fV	Temwa	beans	'to'	Mary

'Tumbikani made Mary cook beans for Temwa'

The resulting pattern expresses a causation with a person-causer, a three-actant caused event, and the **ACT1** of the caused event (the causee) expressed as oblique and the **ACT2** of the caused event as second object, whereas **ACTobl** of the caused event (labelled according to its 'pre-applicative' status), takes the position of first object. This is represented in 11):

(11) Verb sign derived by Morphological Applicative and subsequently Causative

$$
\textit{ditrOblApCs}\begin{bmatrix}
\text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX } \boxed{3}\end{bmatrix} \\ \text{OBJ2} & \begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \\ \text{OBL.GF} & \begin{bmatrix}\text{GOV} \begin{bmatrix}\text{INDX } \boxed{4}\end{bmatrix}\end{bmatrix} \end{bmatrix} \\
\text{ACTNTS} & \begin{bmatrix} \text{PRED cause} & \\ \text{ACT1 } \boxed{1} & \\ \text{ACT2.K } \boxed{5} & \begin{bmatrix} \text{ACT1 } \boxed{4} \\ \text{ACT2 } \boxed{2} \\ \text{ACTobl } \boxed{3} \end{bmatrix} \end{bmatrix} \\
\text{D-BASE} & \begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX } \boxed{4}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \\ \text{OBJ2} & \begin{bmatrix}\text{INDX } \boxed{3}\end{bmatrix} \end{bmatrix} \\ \text{ACTNTS } \boxed{5} & \\ \text{D-BASE} & \begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX } \boxed{4}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX } \boxed{2}\end{bmatrix} \\ \text{OBL.GF.GOV} & \begin{bmatrix}\text{INDX } \boxed{3}\end{bmatrix} \end{bmatrix} \\ \text{ACTNTS } \boxed{5} & \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

It may be noted that in these derivations, the semantics is monotonic: from step to step, the semantics either stays the same (as in passive), or something is added to it (as in causativization), but nothing is deleted from the 'input' semantic structure.

1.3 Construction profile labeling

1.3.1 Argument structure derivation

Below are listed labels reflecting derivational/ operational histories involving processes like Passive, Applicative, Causative, etc. In the explanations, '<' means "applying before". See Table 3 below for a corresponding annotation relative to the grammatical functions involved.

Table 1 Sample type labels representing word internally marked processes of operations on argument structure

intrPs = intransitive resulting from Passive; root transitive
intrApPs = intransitive resulting from Passive following after Applicative (A<P; root intransitive)
intrCsPs = intransitive resulting from Passive following after Causativization (C<P; root intransitive)
intrRf = intransitive resulting from Reflexivization; root transitive
intrRp = intransitive resulting from Reciprocization; root transitive
intrSt = intransitive resulting from Stativization; root transitive
intrOblCsPs= intransitive oblique resulting from Passive following after Causativization (C<P; root intransitive)
trAp = transitive resulting from Applicative; root intransitive
trCs = transitive resulting from Causativization; root intransitive
trApCs = transitive resulting from Applicative following after Causativization (C<A; root intransitive)
trApPs = transitive resulting from Passive following after Applicative (A<P; root transitive)
trCsPs = transitive resulting from Passive following after Causativization (C<P; root transitive)

trCsApPs = transitive resulting from Passive following after Applicative following after Causation (C<A<P; root intransitive)

trRf = transitive resulting from Reflexivization; root ditransitive

trApRf = transitive resulting from Reflexivization following after Applicative (A<Rf; root transitive)

trCsApRf = transitive resulting from Reflexivization following after Applicative following after Causation (C<A<Rf; root intransitive)

trRp = transitive resulting from Reciprocization; root ditransitive

trApRp = transitive resulting from Reciprocization following after Applicative (A<Rp; root transitive)

trCsApRp = transitive resulting from Reciprocization following after Applicative following after Causation (C<A<Rp; root intransitive)

trOblCs = transitive oblique resulting from Causativization; root transitive

ditrAp = ditransitive resulting from Applicative; root transitive

ditrCs = ditransitive resulting from Causativization; root transitive

ditrCsPs = ditransitive resulting from Passive following after Causativization (C<P; root ditransitive)

ditrCsApPs = ditransitive resulting from Passive following after Applicative following after Causation (C<A<P; root transitive)

ditrOblCs = ditransitive oblique resulting from Causativization; root ditransitive

ditrOblCsAp = ditransitive resulting from Applicative following after Causativization (C<A; root transitive)

tritrAp = tritransitive resulting from Applicative; root ditransitive

tritrCs = tritransitive resulting from Causativization; root ditransitive

tritrCsAp = tritransitive resulting from Applicative following after Causativizaton (C<A; root transitive)

tritrCsPs = tritransitive resulting from Passive following after Causativization (C<P; root ditransitive)

tritrCsApPs = tritransitive resulting from Passive following after Applicative following after Causativization (C<A<P; root ditransitive)

qtrCsAp = quatrotransitive resulting from Applicative following after Causativization (C<A; root ditransitive)

dbobAp = **ditrAp** = double-object resulting from Applicative; root transitive

dbobCs = **ditrCs** = double-object resulting from Causativization; root transitive

dbobCsPs = **ditrCsPs** = double-object resulting from Passive following after Causativization (C<P; root ditransitive)

dbobCsApPs = **ditrPsApCs** = double-object resulting from Passive following after Applicative following Causation (C<A<P; root transitive)

dbobOblCs = **ditrOblCs** = double-object oblique resulting from Causativization; root ditransitive

dbobOblCsCsAp = **ditrOblCsCsAp** = double-object resulting from Applicative following after Causativization (C<A; root transitive)

triobAp = **tritrAp** = triple-object resulting from Applicative; root ditransitive

triobCs = **tritrCs** = triple-object resulting from Causativization; root ditransitive

triobCsAp = **tritrCsAp** = triple-object resulting from Applicative following after Causativizaton (C<A; root transitive)

triobCsPs = **tritrCsPs** = triple-object resulting from Passive following after Causativization (C<P; root ditransitive)

triobCsApPs = **tritrCsApPs** = triple-object resulting from Passive following after Applicative following Causativization (C<A<P; root ditransitive)

qtrobCsAp = **qtrCsAp** = quadruple-object resulting from Applicative following after Causativization (C<A; root ditransitive)

This list reflects theoretical possibilities, which are presumably not all instantiated in the same language. Even so it makes some simplifications in (i) omitting possible instances of repetition of the same process, and (ii) not representing possible distinct varieties of a given process.

The labels given represent effects on argument structure or semantics. For cases where a morpheme is used without its ‘expected’ argument structure effects, the relevant label is not entered in the core label. However, the morpheme may well be entered as an extension of the head category in slot 1, as now illustrated.

1.3.2 Morphological derivation

The following table gives a list of such extensions in cases where the head category is **v** (of course applicable also for morphemes appearing when an argument-changing process does have the 'expected' effect).

Table 2 Sample labels reflecting verb as head category and morphological formatives on the head word

v = construction is headed by Verb.

$\left[\text{HEAD verb}\right]$

vPas = construction is headed by Verb and the verb has a Passive formative

$\left[\text{HEAD verb}\left[\text{FORMATIVES } \langle\text{passive}\rangle\right]\right]$

vPrf = construction is headed by Verb and the verb has a Perfect formative

vAor = construction is headed by Verb and the verb has an Aorist formative

vProg = construction is headed by Verb and the verb has a Progressive formative

vHab = construction is headed by Verb and the verb has a Habitual formative

vSm = construction is headed by Verb and the verb has a Subject Marker formative. This and several following are used for languages where arguments must be marked on the verb according to the syntactic function of the argument.

$\left[\text{HEAD verb}\left[\text{FORMATIVES } \langle\text{SM}\rangle\right]\right]$

vOm = construction is headed by Verb and the verb has an Object Marker formative

$\left[\text{HEAD verb}\left[\text{FORMATIVES } \langle\text{OM}\rangle\right]\right]$

vAgr = construction is headed by Verb and the verb has an Agreement formative (used only for languages/constructions where there is no contrast between Subject Marker and Object Marker)

$\left[\text{HEAD verb}\left[\text{FORMATIVES } \langle\text{AGR}\rangle\right]\right]$

vSmOm = construction is headed by Verb and the verb has a Subject Marker and an Object Marker formative

$\left[\text{HEAD verb}\left[\text{FORMATIVES } \langle\text{SM, OM}\rangle\right]\right]$

vAppl = construction is headed by Verb and the verb has an Applicative formative

vApplPas = construction is headed by Verb and the verb has an Applicative and a Passive formative

vCaus = construction is headed by Verb and the verb has a Causative formative

vCausPas = construction is headed by Verb and the verb has a Causative and a Passive formative

vCausAppl = construction is headed by Verb and the verb has a Causative and an Applicative formative

vCausApplPas = construction is headed by Verb and the verb has a Causative, an Applicative and a Passive formative

vCausSmOm = construction is headed by Verb and the verb has a Causative formative, a Subject Marker and an Object Marker

$\left[\text{HEAD verb}\left[\text{FORMATIVES } \langle\text{causative, SM, OM}\rangle\right]\right]$

In these extensions we make no principled distinction between morphemes counted as 'derivational' and morphemes counted as 'inflectional'. When there are more than one formative, they are entered according to their linear order.

A substring like 'vCaus-trCs-…' may occur frequently in an inventory, meaning that the verb carries a causative affix and the construction has undergone the derivational process of causativization. This might seem redundant, but isn't, since cases occur when a verb may carry the affix without such a derivation having taken place, or the derivation may have taken place without the verb carrying the affix. This can be observed for most of the derivations and their associated affixes.

1.3.3 Specification of arguments

A template for the example (1) and (5), repeated,

(1)	Mary	wa-ka-mu-phik-**isk**-a	Tumbikani	nchunga
	Mary	1SM-Pst-1OM-cook-Caus-FV	Tumbikani	beans
	N	V	N	N
	SUBJ		OBJ	OBJ2
	'Mary made Tumbikani cook beans'			

(5) AVM for construction headed by verb derived by morphological Causative:

$$
\mathit{dbobCs}\begin{bmatrix}
\text{HEAD } \mathit{verb} \\
\text{GF}\begin{bmatrix}
\text{SUBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{1}\mathit{index}\end{bmatrix} \\
\text{OBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{2}\mathit{index}\end{bmatrix} \\
\text{OBJ2 } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{3}\mathit{index}\end{bmatrix}
\end{bmatrix} \\
\text{INDX } \boxed{4} \\
\text{ACTNT}\begin{bmatrix}
\text{PRED } '\mathit{cause}' \\
\text{ACT0 } \boxed{4} \\
\text{ACT1 } \boxed{1}\mathit{index} \\
\text{ACT2 } \mathit{index}\begin{bmatrix}\text{K } \boxed{6}\mathit{actn}\begin{bmatrix}\text{ACT1 } \boxed{2}\mathit{index} \\ \text{ACT2 } \boxed{3}\mathit{index}\end{bmatrix}\end{bmatrix}
\end{bmatrix} \\
\text{D-BASE } \mathit{sign}\begin{bmatrix}
\text{GF}\begin{bmatrix}
\text{SUBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{2}\mathit{index}\end{bmatrix} \\
\text{OBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{3}\mathit{index}\end{bmatrix}
\end{bmatrix} \\
\text{ACTNT } \boxed{6}
\end{bmatrix}
\end{bmatrix}
$$

will, according to the labels now introduced, have the following type:
vCaus-dbobCs

We now indicate how the subject and the objects per se can be specified. Relative to the derivation they will be represented as follows:
suC_obCsu_ob2Cob
This means that the subject has been created through Causativization, the object has been 'changed' from subject through Causativization, and ob2 has been 'changed' from object through Causativization. As for their AVMs, each label has an AVM which concerns just the constituent in question through its derivational stages. These specifications must unify with the Core specification. This means that the three labels will have AVMs as follows, each matching a substructure of (5):

(12) AVMs for the labels *suC_obCsu_ob2Cob* relative to (5)

a.

$$
\mathit{suC}\begin{bmatrix}
\text{GF}\begin{bmatrix}\text{SUBJ } \mathit{sign}\begin{bmatrix}\text{INDX } \boxed{1}\end{bmatrix}\end{bmatrix} \\
\text{ACTNT}\begin{bmatrix}\text{PRED } '\mathit{cause}' \\ \text{ACT1 } \boxed{1}\end{bmatrix}
\end{bmatrix}
$$

b.

$$
obCsu\left[\begin{array}{ll}
\mathrm{GF} & \left[\mathrm{OBJ}\left[\mathrm{INDX}\ \boxed{2}\right]\right] \\
\mathrm{ACTNT} & \left[\begin{array}{l}\mathrm{PRED}\ \text{'}\textit{cause}\text{'} \\ \mathrm{ACT2}\left[\mathrm{K}\ \boxed{6}\ \textit{actn}\left[\mathrm{ACT1}\ \boxed{2}\right]\right]\end{array}\right] \\
\mathrm{D\text{-}BASE}\ \textit{sign} & \left[\begin{array}{l}\mathrm{GF}\left[\mathrm{SUBJ}\left[\mathrm{INDX}\ \boxed{2}\right]\right] \\ \mathrm{ACTNT}\ \boxed{6}\end{array}\right]
\end{array}\right]
$$

c.

$$
ob2Cob\left[\begin{array}{ll}
\mathrm{GF} & \left[\mathrm{OBJ2}\left[\mathrm{INDX}\ \boxed{3}\right]\right] \\
\mathrm{ACTNT} & \left[\begin{array}{l}\mathrm{PRED}\ \text{'}\textit{cause}\text{'} \\ \mathrm{ACT2}\left[\mathrm{K}\ \boxed{6}\ \textit{actn}\left[\mathrm{ACT2}\ \boxed{3}\right]\right]\end{array}\right] \\
\mathrm{D\text{-}BASE}\ \textit{sign} & \left[\begin{array}{l}\mathrm{GF}\left[\mathrm{OBJ}\left[\mathrm{INDX}\ \boxed{3}\right]\right] \\ \mathrm{ACTNT}\ \boxed{6}\end{array}\right]
\end{array}\right]
$$

For a verb sign derived by Applicative and subsequently Morphological Causative, whose root label is *ditrOblApCs* (cf. (11) above), the type of the object will report two derivational stages, for the object tentatively *obCob2Aobl*. A verb sign derived by Morphological Causative and subsequently Passive, whose root label is *trOblCsPs* (cf. (9) above), will similarly report *suPobCsu* for its subject, with an AVM as in (13):

(13)

$$
suPobCsu\left[\begin{array}{ll}
\mathrm{GF} & \left[\mathrm{SUBJ}\left[\mathrm{INDX}\ \boxed{2}\right]\right] \\
\mathrm{ACTNT} & \boxed{7} \\
\mathrm{D\text{-}BASE} & \left[\begin{array}{ll}
\mathrm{GF} & \left[\mathrm{OBJ}\left[\mathrm{INDX}\ \boxed{2}\right]\right] \\
\mathrm{ACTNT} & \boxed{7}\left[\begin{array}{l}\mathrm{PRED}\ \text{'}\textit{cause}\text{'} \\ \mathrm{ACT2}\left[\mathrm{K}\ \boxed{6}\left[\mathrm{ACT1}\ \boxed{2}\right]\right]\end{array}\right] \\
\mathrm{D\text{-}BASE} & \left[\begin{array}{l}\mathrm{GF}\left[\mathrm{SUBJ}\left[\mathrm{INDX}\ \boxed{2}\right]\right] \\ \mathrm{ACTNTS}\ \boxed{6}\end{array}\right]
\end{array}\right]
\end{array}\right]
$$

A range of encodings of derivational shifts and sequences of shifts are given in Table 3 below.

Table 3 Specifications tracing the derivational history of a syntactic argument, characterized by its GF (in a way similar to ‘chains’ in GB and Relational Grammar)

A. Single shifts

For effects of *Morphological causativization*:

`obCsu` = **ob** which would have been *su* relative to *input* of *Causative* formation
`obCob` = **ob** which would have been *ob* relative to *input* of *Causative* formation
`obCob2` = **ob** which would have been *ob2* relative to *input* of *Causative* formation
`obCiob` = **ob** which would have been *iob* relative to *input* of *Causative* formation
`obCobl` = **ob** which would have been *obl* relative to *input* of *Causative* formation

ob2Csu = **ob2** which would have been *su* relative to *input* of *Causative* formation
ob2Cob = **ob2** which would have been *ob* relative to *input* of *Causative* formation
ob2Cob2 = **ob2** which would have been *ob2* relative to *input* of *Causative* formation
ob2Cobl = **ob2** which would have been *obl* relative to *input* of *Causative* formation

iobCsu = **iob** which would have been *su* relative to *input* of *Causative* formation
iobCob = **iob** which would have been *ob* relative to *input* of *Causative* formation
iobCiob = **iob** which would have been *iob* relative to *input* of *Causative* formation
iobCobl = **iob** which would have been *obl* relative to *input* of *Causative* formation

oblCsu = **obl** which would have been *su* relative to *input* of *Causative* formation
oblCob = **obl** which would have been *ob* relative to *input* of *Causative* formation
oblCob2 = **obl** which would have been *ob2* relative to *input* of *Causative* formation
oblCiob = **obl** which would have been *iob* relative to *input* of *Causative* formation
oblCobl = **obl** which would have been *obl* relative to *input* of *Causative* formation

For the 'promotional' part of *Passive formation*:
suPob = **su** which would have been *ob* relative to *input* of *Passive* formation
suPob2 = **su** which would have been *ob2* relative to *input* of *Passive* formation
suPiob = **su** which would have been *iob* relative to *input* of *Passive* formation
suPobl = **su**which would have been *obl* relative to *input* of *Passive* formation

For the 'promotional' part of *Stative* formation:
suSob = **su** which would have been *ob* relative to *input* of *Stative* formation

For the 'promotional' part of *Middle* formation:
suMob = **su** which would have been *ob* relative to *input* of *Middle* formation

For the 'promotional' part of *Applicative* formation:
obAobl = **ob** which would have been *obl* relative to *input* of *Applicative* formation
iobAobl = i**ob** which would have been *obl* relative to *input* of *Applicative* formation
ob2Aobl = **ob2** which would have been *obl* relative to *input* of *Applicative* formation

'Repercussion' effects:
obUob2 = *ob* 'up from' *ob2* (because old *ob* has disappeared (promoted, deleted,...))
ob2Uob3 = *ob2* 'up from' *ob3* (because old *ob2* has disappeared)
ob3Uob4 = *ob3* 'up from' *ob4* (because old *ob3* has disappeared)
ob2Dob = *ob2* 'down from' *ob* (because a new *ob* has appeared)
ob3Dob2 = *ob3* 'down from' *ob2* (because a new *ob2* has appeared)
ob4Dob3 = *ob4* 'down from' *ob3* (because a new *ob3* has appeared)

'Absorption' effects:
nilRob = ob is 'absorbed' through Reflexivization
nilRPob = ob is 'absorbed' through Reciprocization

B. Iteration of shifts (one operation applied to the output of another):
suPobCsu = **su** which would have been *ob* relative to *input* of *Passive* formation, where this ob would have been *su* relative to *input* of *Causative* formation
suPobCob = **su** which would have been *ob* relative to *input* of *Passive* formation, where this ob would have been *ob* relative to *input* of *Causative* formation
suPobCob2 = **su** which would have been *ob* relative to *input* of *Passive* formation, where this ob would have been *ob2* relative to *input* of *Causative* formation
suPobCiob = **su** which would have been *ob* relative to *input* of *Passive* formation, where this ob would have been *iob* relative to *input* of *Causative* formation

`suPobCobl` = **su** which would have been *ob* relative to *input* of *Passive* formation, where this ob would have been *obl* relative to *input* of *Causative* formation

`suPob2Csu` = **su** which would have been *ob2* relative to *input* of *Passive* formation, where this ob2 would have been *su* relative to *input* of *Causative* formation
`suPob2Cob` = **su** which would have been *ob2* relative to *input* of *Passive* formation, where this ob2 would have been *ob* relative to *input* of *Causative* formation
`suPob2Cob2` = **su** which would have been *ob2* relative to *input* of *Passive* formation, where this ob2 would have been *ob2* relative to *input* of *Causative* formation
`suPob2Ciob` = **su** which would have been *ob2* relative to *input* of *Passive* formation, where this ob2 would have been *iob* relative to *input* of *Causative* formation
`suPob2Cobl` = **su** which would have been *ob2* relative to *input* of *Passive* formation, where this ob2 would have been *obl* relative to *input* of *Causative* formation

`suPiobCsu` = **su** which would have been i*ob* relative to *input* of *Passive* formation, where this iob would have been *su* relative to *input* of *Causative* formation
`suPiobCob` = **su** which would have been i*ob* relative to *input* of *Passive* formation, where this iob would have been *ob* relative to *input* of *Causative* formation
`suPiobCob2` = **su** which would have been i*ob* relative to *input* of *Passive* formation, where this iob would have been *ob2* relative to *input* of *Causative* formation
`suPiobCiob` = **su** which would have been i*ob* relative to *input* of *Passive* formation, where this iob would have been *iob* relative to *input* of *Causative* formation
`suPiobCobl` = **su** which would have been i*ob* relative to *input* of *Passive* formation, where this iob would have been *obl* relative to *input* of *Causative* formation

`suPoblCsu` = **su** which would have been *obl* relative to *input* of *Passive* formation, where this obl would have been *su* relative to *input* of *Causative* formation
`suPoblCob` = **su** which would have been *obl* relative to *input* of *Passive* formation, where this obl would have been *ob* relative to *input* of *Causative* formation
`suPoblCob2` = **su** which would have been *obl* relative to *input* of *Passive* formation, where this obl would have been *ob2* relative to *input* of *Causative* formation
`suPoblCiob` = **su** which would have been *obl* relative to *input* of *Passive* formation, where this obl would have been *iob* relative to *input* of *Causative* formation
`suPoblCobl` = **su** which would have been *obl* relative to *input* of *Passive* formation, where this obl would have been *obl* relative to *input* of *Causative* formation
`suPobAobl` = **su** which would have been *ob* relative to *input* of *Passive* formation, where this ob would have been *obl* relative to *input* of *Applicative* formation
`suPob2Aobl` = **su** which would have been *ob2* relative to *input* of *Passive* formation, where this ob2 would have been *obl* relative to *input* of *Applicative* formation
`suPiobAobl` = **su** which would have been i*ob* relative to *input* of *Passive* formation, where this iob would have been *obl* relative to *input* of *Applicative* formation

`suRAISsuMob` = subject is raised from subject, and before that promoted thereto from object by Middle Formation
`obRAISsuMob` = object is raised from subject, and before that promoted thereto from object by Middle Formation

2 Kwa

Kwa languages are generally known to make little use of prepositions and adjectives, so that constructions involving nouns and verbs may be seen as playing a larger role than, e.g., in Indo-European languages (IELs). Thus *multiverb expressions* (MVEs) are known to play a large role in the language, subsuming *Serial Verb Constructions (SVCs)*, *Extended Verb Complexes (EVCs*) which are sequences of preverbs preceding a main verb, heading a clause by itself or partaking in an SVC), and *Verbid Constructions (ViD*), where verb phrases play a role of adverbials in similar functions as PPs and AdvPs do in IELs. Less attention may have been paid to the complexity of pre-nominal specifiers within noun phrases, but we here focus on multiverb expressions.

They are often counted as types of Complex Predicates, which are in general understood as multi-word expressions which semantically function like a single predicate, or in alternative terms, express a unique situation. If constructions are in general supposed to be composed of just one 'head', namely a verb, accompanied by 'arguments' and 'adjuncts', how will MVEs fit into such a picture? We discuss SVCs in 2.1-2.4, and EVCs in 2.5.

2.1 Formal analysis of SVCs

An SVC appears as a sequencing of any number of VPs, with pervasive uniformity between the verbs, both in their morphology and regarding their arguments. Interpretations range from temporal sequences of events reflecting the sequencing of VPs to pairwise more special combinations. (1) is an example of the latter, from Ga (from Dakubu 2010):

(1)	Á-gbele	gbɛ	á-ha	bo
	3.PRF-open	road	3.PRF-give	2S
	V	N	V	Pron
	'You have been granted permission.'			

This SVC has two verbs, both with an expressed object; their subjects are identical, and likewise their aspects. In AVM form, this can be provisionally exposed as follows, where the notions 'V1', 'V2' are standard labels for the VPs in the sequence:

(2)

$$\begin{bmatrix} \text{V1} & \begin{bmatrix} \text{HEAD } \textit{verb} \\ \text{GF} \begin{bmatrix} \text{SUBJ} \begin{bmatrix} \text{INDX } \boxed{1} \end{bmatrix} \\ \text{OBJ} \begin{bmatrix} \text{INDX } \boxed{2} \end{bmatrix} \end{bmatrix} \\ \text{ACTNT} \begin{bmatrix} \text{PRED } \textit{open-rel} \\ \text{ACT1 } \boxed{1} \\ \text{ACT2 } \boxed{2} \\ \text{ASPECT } \boxed{4}\ \textit{perf} \end{bmatrix} \end{bmatrix} \\ \text{V2} & \begin{bmatrix} \text{HEAD } \textit{verb} \\ \text{GF} \begin{bmatrix} \text{SUBJ} \begin{bmatrix} \text{INDX } \boxed{1} \end{bmatrix} \\ \text{OBJ} \begin{bmatrix} \text{INDX } \boxed{3} \end{bmatrix} \end{bmatrix} \\ \text{ACTNT} \begin{bmatrix} \text{PRED } \textit{give-rel} \\ \text{ACT1 } \boxed{1} \\ \text{ACT2 } \boxed{3} \\ \text{ASPECT } \boxed{4} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Not shown here is whether **V1** and **V2** are related in the fashion of head plus complement, head plus adjunct, or conjuncts, or something else. What *is* displayed in (2) is the sharing of arguments of the two verbs, viz. their subjects (or **ACT1**s),[7] and their sharing of Aspect.

(1)/(2) is a case of so-called *subject sharing*. A case of '*switch* sharing' – between object of one verb and the subject of the subsequent verb - is exemplified in the Akan example (3). Examples with pronominal clitics marking subject identity are given in (1) and (4), and (5) is an example with identical objects in addition to identical subjects, where however the objects are expressed by empty pronominals. Constructions where identity of subject or object is pronominally expressed we call *reference sharing*, as opposed to *function sharing*, or just *sharing*, when no pronominal appears.

(3) '*switch* sharing' between object of one verb and subject of the subsequent verb (Akan)

Kofi	to-o	ne	nan	wɔ-ɔ	Kwame	
Kofi	throw-PERF	3Poss	leg	pierce-PERF	Kwame	
N	V	Pron	N	V	N	'Kofi kicked Kwame'

(4) SVC with subject reference sharing (with clitic pronominal on second verb) (Ga)

Hii	lɛ	tsi	mi	amɛ-gbee	shi	
men	DEF	AOR.push	1S	3P-AOR.fell	down	
N	DET	V	Pron	V	N	'The men pushed me down.'

() SVC with subject sharing and referential object sharing (Akan)

Ama	tu-u	bayerɛ	twitwa	noa	di-i
Ama	uproot-PERF	yam	cut	cook	eat-PERF
N	V	N	V	V	V

'Ama uprooted (tuber of) yam, cut it in pieces, boiled them (and) ate'

SVCs are like European-type 'Equi'-constructions in the identities of arguments across the verbs – subject sharing ((1)/(2)) corresponds to 'subject control', and switched sharing (3) to 'object control', in the terminology developed for Equi-constructions. However, in the SVC constructions under discussion both verbs are finite, but identical in aspect, while in an Equi construction, the second verb is in infinitive form. A further difference between Equi and SVC is that in an Equi construction the first verb takes the second as a complement, while in an SVC this is not so - the second verb fills no valence requirement of the first verb – in general in SVCs, both verbs are free to occur by themselves, i.e., as heads in non-serial verbal constructions. Thus, the representation with V1, V2 etc is adequate.

2.2 Digression: Grammatical functions vs. valence lists

In the framework HPSG, a construct like GF is not generally supposed to be necessary (while in LFG it is essential). While a parsing strategy as indicated in 1.4 will need the mechanism of valence lists, could it be that, once in play, they can render GFs unnecessary? A problem with such an approach will be that valence lists, at the level of construction representation, are empty, thus providing no hooks on which to directly attach the information represented by the actual constituents (only their semantic information, as it is assembled from the combinations, will remain).[8]

It can also be shown that for the purpose of correct parsing per se, there are construction types where valence lists need access to information which are, at the point in the parsing process

[7] Given the gloss 'give', one might expect also a theme-argument of the second verb, 'shared' with the object of the first verb; in the analysis as proposed, this is not the case.

[8] Formally, the HPSG approach will keep a record of all the constituents of the phrase structure, in which all information about the constituents will be available, but this does not constitute information about the construction as such.

needed, not to be found in any valence list. One example is switch-sharing Serial Verb Constructions (SVCs), as in (3) above, repeated, from Akan:[9]

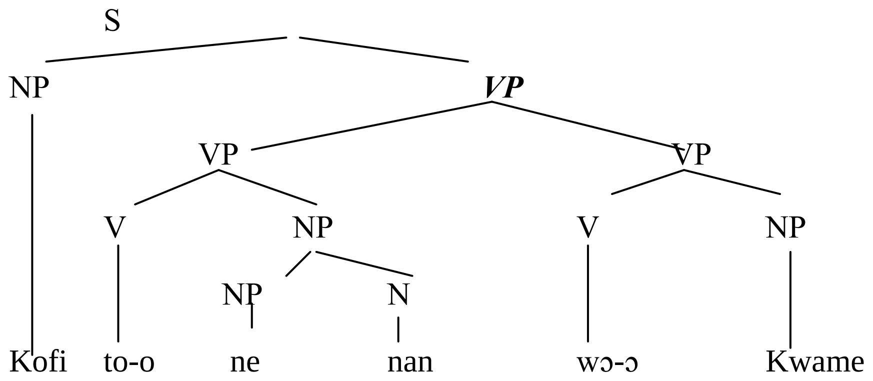
(3)

Kofi	to-o	ne	nan	wɔ-ɔ	Kwame
Kofi	throw-PERF	3Poss	leg	pierce-PERF	Kwame
N	V	Pron	N	V	N

‘Kofi kicked Kwame’

The ‘sharing’ here resides in the identity between *ne nan* in its function as object of the first verb and its understood role as subject of the second verb. The syntactic constellation where the semantic representation of switch sharing will be imposed is the italicized boldfaced VP in (6), combining the two immediately dominated VPs, to constitute the AVM in (7) for the construction:

(6)



(7)

$$\begin{bmatrix} \text{V1} & \begin{bmatrix} \text{HEAD } \textit{verb} \\ \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix} \text{INDX } \boxed{1} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{INDX } \boxed{2} \end{bmatrix} \end{bmatrix} \\ \text{ACTNT} & \begin{bmatrix} \text{PRED } \textit{throw-rel} \\ \text{ACT1 } \boxed{1} \\ \text{ACT2 } \boxed{2} \\ \text{AKTRT } \boxed{4}\ \textit{perf} \end{bmatrix} \end{bmatrix} \\ \text{V2} & \begin{bmatrix} \text{HEAD } \textit{verb} \\ \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix} \text{INDX } \boxed{2} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{INDX } \boxed{3} \end{bmatrix} \end{bmatrix} \\ \text{ACTNT} & \begin{bmatrix} \text{PRED } \textit{pierce-rel} \\ \text{ACT1 } \boxed{2} \\ \text{ACT2 } \boxed{3} \\ \text{AKTRT } \boxed{4} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

At the point in the combinatorial processing in (6) where the VPs combine, the COMPS lists in the signs of both of the VPs will be empty, since both of these VPs have been processed by the rule of verb–object combination already. In the formulation of a combinatorial rule for this constellation, the COMPS lists thus offer no information about which index to be assigned to the understood subject of VP2, i.e., as value in the position V2|GF|SUBJ (cf. (7)). The only item representing the

[9] Example provided by Clement Appah, p.c. For further discussion of the construction see chapter 6, section 3.

identity of the object of the first VP is the OBJ attribute inside V1, at the path 'V1|GF|OBJ|INDX [2]' in (7). This is thus the item to which the understood subject of the second VP must be set identical, and only the GF specification provides this information.

2.3 *Formal analysis of SVCs*

2.3.1 *Combining VPs*

That there is no head-complement relation between the verbs in an SVC leaves open the possibility that there might be a *head-adjunct* relation between the first VP and the second. In this respect, it should be noted that in Semitic and Indic languages, where the counterpart to SVCs are called *converb constructions*, only one verb in the sequence counts as finite, whereas the others are participial in some way or other, suggesting that in these constructions, there is a head-adjunct relation between each pair of verbs. This could be assumed also for the SVCs. Since adjunction can be iterated at any length, this analysis would accommodate examples like (4-7) where there are four VPs.

To technically allow for a head-adjunct analysis of SVCs, we need to give verbs in general the possibility of modifying other verbs; while unexpected from the viewpoint of European languages, there is no problem connected to this move. On such an analysis, the **V2** sign in (2) would appear in an **ADJ** list relative to the preceding verb, following the pattern of a Head-Modifier rule as stated in (8) below; (9) is schematically the type of structure for subject-sharing SVCs that it induces; how the elements in (9) get mapped to the attributes V1 and V2 we show later below.

(8) *Head-Modifier rule*:

$$\left[\begin{array}{l}
\text{HEAD } \boxed{5} \\
\text{GF } \boxed{1}\left[\text{ADJ } \langle ..., \boxed{7}\rangle\right] \\
\text{SPR } \langle \boxed{3} \rangle \\
\text{COMPS } \langle\ \rangle \\
\text{INDX } \boxed{2} \\
\text{ACTNT } \boxed{6} \\
\text{HEAD-DTR } \quad \boxed{4}\left[\begin{array}{l}
\text{HEAD } \boxed{5} \\
\text{GF } \boxed{1}\left[\text{SUBJ}\left[\text{INDX } \boxed{3}\right]\right] \\
\text{SPR } \langle \boxed{3} \rangle \\
\text{COMPS } \langle\ \rangle \\
\text{INDX } \boxed{2} \\
\text{ACTNT } \boxed{6}
\end{array}\right] \\
\text{NONHEAD-DTR } \boxed{7}\left[\begin{array}{l}
\text{MOD } \langle \boxed{4}\left[\text{INDX } \boxed{3}\right]\rangle \\
\text{COMPS } \langle\ \rangle \\
\text{ACTNT } \left[\text{ACT1 } \boxed{3}\right]
\end{array}\right]
\end{array}\right]$$

(9) Schematic structure for subject-sharing SVCs

$$\begin{bmatrix} \text{HEAD } \textit{verb} & \\ \text{GF} & \begin{bmatrix} \text{SUBJ} \begin{bmatrix} \text{INDX } \boxed{1} \end{bmatrix} \\ \text{ADJ} \left\langle \begin{bmatrix} \text{HEAD } \textit{verb} \\ \text{INDX } \boxed{4} \\ \text{ACTNT} \begin{bmatrix} \text{ACT0 } \boxed{4} \\ \text{ACT1 } \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix} \\ \text{INDX } \boxed{3} & \\ \text{ACTNT} & \begin{bmatrix} \text{ACT0 } \boxed{3} \\ \text{ACT1 } \boxed{1} \end{bmatrix} \end{bmatrix}$$

In the **ACTNT** representations, the **ACT1** of **V2** (the ACT1 within ADJ in (7)) is an individual, shared with an argument of **V1**, as opposed to the constellation in more standard versions of a Head-Modifier rule where the ACT1 of V2 is identical to the event expressed by V1.

2.3.2 Shared subjects and objects

As has been argued already, in cases of *object sharing* and *switch sharing*, the relevant **COMPS** lists of the daughter VPs will be empty at the stage of syntactic combination where identities must be be assessed, which means that the object-related requirements have to be imposed on the path **GF.OBJ**, since only the GF information is propagated unchanged up through the combination tree.

In cases of object sharing, moreover, the second VP will typically be one where a transitive verb occurs without its object. Thus, the analysis of these constructions not only requires a way of assigning identities, but also a way of accounting for 'missing' objects. The most obvious strategy for the latter will be a 'de-transitivizing' rule, which applies only inside of the second VP in an SVC. The operation stated in (10) below does that, as an operation turning a transitive lexeme into an intransitive one, and the way in which this operation gets related to the VP's participation in an SVC is through its **MOD** specification, which stipulates that this happens only when the VP in question follows another VP whose object is identical to the object of the VP in question. Formally the operation is like one of lexical derivation of de-transitivation, but the context of its application is more like those where items get 'dropped', and it applies even in cases where a verb is obligatorily transitive and thus not amenable to a 'detransitivation' process if the grammar contains one.

(10)

$$\begin{bmatrix} \textit{obj} - \textit{sharing} - \textit{drop} - \textit{rule} \\ \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \langle\ \rangle \\ \text{MOD } \left\langle \begin{bmatrix} \textit{sv} - \textit{obj} - \textit{sharing} \\ \text{HEAD verb} \\ \text{GF } \begin{bmatrix} \text{OBJ } \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{GF } \boxed{5} \begin{bmatrix} \text{OBJ } \boxed{1} \end{bmatrix} \\ \text{ACTNT } \boxed{4} \\ \text{BASE } \left\langle \begin{bmatrix} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \langle \boxed{1} \rangle \\ \text{GF } \boxed{5} \\ \text{ACTNT } \boxed{4} \end{bmatrix} \right\rangle \end{bmatrix}$$

Note that through the part of the specification (10) rendered in (11)

(11)

$$\text{MOD} \left\langle \begin{bmatrix} \textit{sv-obj-sharing} \\ \text{HEAD verb} \\ \text{GF} \begin{bmatrix} \text{OBJ } \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle$$

it is envisaged that the head VP will carry the type label *sv-obj-sharing*, and so will the VP dominating the combination of the head and the adjunct VP, and in turn the S-node, thereby labeling the construction as such. (The rule (10-11) just builds up one block of the construction, namely the adjunct VP.)

A similar process is needed for 'deleting' the *subject* under a stipulated identity with the appropriate item in the preceding VP, as in *subject-sharing* and *switched sharing*. The strategy of referencing a preceding VP through the **MOD** attribute is thus used also in (12a) and (12b) below, (12a) for referencing the subject of the VP ('*subject sharing'*), and (12b) for referencing the object of the VP ('*switch sharing'*). When an SVC displays both subject sharing and object sharing, both (a) and (b) apply.

(12)

a.

$$\begin{bmatrix} \textit{subj-sharing-drop-rule} \\ \text{HEAD verb} \\ \text{SPR } \langle\ \rangle \\ \text{COMPS } \boxed{2} \\ \text{MOD} \left\langle \begin{bmatrix} \textit{sv-subj-sharing} \\ \text{HEAD verb} \\ \text{SPR } \langle \boxed{1} \rangle \\ \text{GF} \begin{bmatrix} \text{SUBJ } \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{GF } \boxed{5} \begin{bmatrix} \text{SUBJ } \boxed{1} \end{bmatrix} \\ \text{ACTNT } \boxed{4} \\ \text{BASE} \left\langle \begin{bmatrix} \text{HEAD verb} \\ \text{SPR } \langle \boxed{1} \rangle \\ \text{COMPS } \boxed{2} \\ \text{GF } \boxed{5} \\ \text{ACTNT } \boxed{4} \end{bmatrix} \right\rangle \end{bmatrix}$$

b.

$$\begin{bmatrix} \textit{switch-sharing-drop-rule} \\ \text{HEAD verb} \\ \text{SPR } \langle\ \rangle \\ \text{COMPS } \boxed{2} \\ \text{MOD} \left\langle \begin{bmatrix} \textit{sv-switch-sharing} \\ \text{HEAD verb} \\ \text{GF} \begin{bmatrix} \text{OBJ } \boxed{1} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{GF } \boxed{5} \begin{bmatrix} \text{SUBJ } \boxed{1} \end{bmatrix} \\ \text{ACTNT } \boxed{4} \\ \text{BASE} \left\langle \begin{bmatrix} \text{HEAD verb} \\ \text{SPR } \langle \boxed{1} \rangle \\ \text{COMPS } \boxed{2} \\ \text{GF } \boxed{5} \\ \text{ACTNT } \boxed{4} \end{bmatrix} \right\rangle \end{bmatrix}$$

In (13) below, the same patterns are repeated for cases where the relevant items are not deleted, but appear as *pronouns* (cliticized or not) – in such cases we speak of *reference sharing*.

(13)

a. b. c.

$$\left[\begin{array}{l} \textit{subj-ref-sharing-rule} \\ \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{MOD } \left\langle \left[\begin{array}{l} \textit{sv-subj-ref-sharing} \\ \text{HEAD verb} \\ \text{GF.SUBJ.INDX } \boxed{1} \end{array}\right] \right\rangle \\ \text{GF } \boxed{5} \left[\text{SUBJ } \left[\begin{array}{l} \text{HEAD pron} \\ \text{INDX } \boxed{1} \end{array}\right] \right] \\ \text{ACTNT } \boxed{4} \\ \text{BASE } \left\langle \left[\begin{array}{l} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{GF } \boxed{5} \\ \text{ACTNT } \boxed{4} \end{array}\right] \right\rangle \end{array}\right]
\quad
\left[\begin{array}{l} \textit{obj-ref-sharing-rule} \\ \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{MOD } \left\langle \left[\begin{array}{l} \textit{sv-obj-ref-sharing} \\ \text{HEAD verb} \\ \text{GF.OBJ.INDX } \boxed{1} \end{array}\right] \right\rangle \\ \text{GF } \boxed{5} \left[\text{OBJ } \left[\begin{array}{l} \text{HEAD pron} \\ \text{INDX } \boxed{1} \end{array}\right] \right] \\ \text{ACTNT } \boxed{4} \\ \text{BASE } \left\langle \left[\begin{array}{l} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{GF } \boxed{5} \\ \text{ACTNT } \boxed{4} \end{array}\right] \right\rangle \end{array}\right]
\quad
\left[\begin{array}{l} \textit{switch-ref-sharing-rule} \\ \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{MOD } \left\langle \left[\begin{array}{l} \textit{sv-switch-ref-sharing} \\ \text{HEAD verb} \\ \text{GF.OBJ.INDX } \boxed{1} \end{array}\right] \right\rangle \\ \text{GF } \boxed{5} \left[\text{SUBJ } \left[\begin{array}{l} \text{HEAD pron} \\ \text{INDX } \boxed{1} \end{array}\right] \right] \\ \text{ACTNT } \boxed{4} \\ \text{BASE } \left\langle \left[\begin{array}{l} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{GF } \boxed{5} \\ \text{ACTNT } \boxed{4} \end{array}\right] \right\rangle \end{array}\right]$$

A similar set of rules can be designed to constitute what we may call the *TAM-sharing* cluster, where again more than one of the rules can apply- cf. (14) below. What we here call 'TAM' ('tense/aspect/mood') pertains to morphologically realized features, whose connection to SIT structure we leave open. For instance, while morphological features counting as 'aspect' in a given description may be systematically related to Aktionsart or similar dimensions within the SIT system, this may not always be the case.

(14)

a.

$$\left[\begin{array}{l} \textit{tense-sharing-rule} \\ \text{HEAD verb} \\ \text{TAM } \left[\text{TENSE } \boxed{5}\right] \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{MOD } \left\langle \left[\begin{array}{l} \textit{sv-tense-sharing} \\ \text{HEAD verb} \\ \text{TAM } \left[\text{TENSE } \boxed{5}\right] \end{array}\right] \right\rangle \\ \text{ACTNTS } \boxed{4} \\ \text{BASE } \left\langle \left[\begin{array}{l} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{ACTNT } \boxed{4} \end{array}\right] \right\rangle \end{array}\right]$$

b.

$$\left[\begin{array}{l} \textit{aspect-sharing-rule} \\ \text{HEAD verb} \\ \text{TAM } \left[\text{ASPECT } \boxed{5}\right] \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{MOD } \left\langle \left[\begin{array}{l} \textit{sv-aspect-sharing} \\ \text{HEAD verb} \\ \text{TAM } \left[\text{ASPECT } \boxed{5}\right] \end{array}\right] \right\rangle \\ \text{ACTNTS } \boxed{4} \\ \text{BASE } \left\langle \left[\begin{array}{l} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{ACTNT } \boxed{4} \end{array}\right] \right\rangle \end{array}\right]$$

c.

$$\left[\begin{array}{l} \textit{mood-sharing-rule} \\ \text{HEAD verb} \\ \text{TAM } \left[\text{MOOD } \boxed{5}\right] \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{MOD } \left\langle \left[\begin{array}{l} \textit{sv-mood-sharing} \\ \text{HEAD verb} \\ \text{TAM } \left[\text{MOOD } \boxed{5}\right] \end{array}\right] \right\rangle \\ \text{ACTNTS } \boxed{4} \\ \text{BASE } \left\langle \left[\begin{array}{l} \text{HEAD verb} \\ \text{SPR } \boxed{2} \\ \text{COMPS } \boxed{3} \\ \text{ACTNT } \boxed{4} \end{array}\right] \right\rangle \end{array}\right]$$

If for instance the last VP in a VP+VP combination has undergone both *subj-sharing-drop-rule* and *obj-sharing-drop-rule*, this is reflected in the MOD specification of the head VP, which will have the type *sv-subj-obj-sharing*, due to type joins defined as indicated below:

(15) Type joins in the MOD specification of types of dominating VPs in SVC VP combinations:

sv-subj-sharing *sv-obj-sharing* *sv-subj-sharing* *sv-obj-ref-sharing* *sv-subj-ref-sharing* *sv-obj-ref-sharing*

\ / \ / \ /

sv-subj-obj-sharing *sv-subj-obj-ref-sharing* *sv-subj-ref-obj-ref-sharing*

```
sv-aspect-sharing               sv-tense-sharing          sv-mood-sharing      sv-aspect-sharing
                 \              /                \              /     \                /
              sv-aspect-tense-sharing         sv-tense-mood-sharing   sv-aspect-mood-sharing
                                \                /
                              sv-aspect-tense-mood-sharing

sv-subj-sharing  sv-aspect-sharing
         \          /
   sv-subj-aspect-sharing
```

… etc.

These rules (11)-(14), combined with the *Head-Modifier-rule* (8) for the point where one VP syntactically combines with another, will be adequate for parsing most known patterns of SVCs, and of any length, since what is the head of one adjunct can be an adjunct of another VP. The types of SVCs which have been characterized are, in terms of the types of the top VPs of every combination of a head VP with an adjunct VP, as follows (i.e., the top VP node carries the type entered in the MOD specification of each of the rules (11)-(14):

(16) Types assigned to mother- and adjunct VP-nodes in SVC syntactic combination trees:

```
a.       VP                    b.       VP                c.       VP                   d.       VP
sv-subj-sharing                      sv-obj-sharing             sv-switch-sharing                 sv-subj-ref-sharing
/        \                           /        \                 /        \                        /        \
         VP                                   VP                         VP                                VP
  subj-sharing-drop-rule           obj-sharing-drop-rule     switch-sharingdrop-rule          subj-ref-sharing-rule

e.       VP              f.       VP              g.       VP            h.   VP            i.   VP
sv-obj-ref-sharing       sv-switch-ref-sharing    sv-aspect-sharing      sv-tense-sharing   sv-mood-sharing
         /\              /        \               /        \             /        \              /   \
         VP                       VP                       VP                     VP                 VP
  obj-ref-sharing-rule     switch-ref-sharing-rule  aspect-sharing-rule   tense-sharing-rule  mood-sharing-rule
```

If we assume that SVCs are composed of binary branching structures, thus, the rules given constitute a recursive mechanism for verb sequences of any length.[10]

2.3.3 Type classification of SVCs

While actual *parsing* of the various types of SVCs is essential to the grammar, *classification* is also essential. As before, the classification should be derivable from the grammar specifications. Since a common way of analytically navigating inside an SVC is by reference to 'V1', 'V2', 'V3', etc., it will be desirable to bring these labels out as equal-level attributes in the AVM of an SVC, and from this vantage point also summarize in one sequence the salient relations between the various VPs. This we do in the CL notation as now outlined.

No verb by itself could reasonably be lexically classified as 'first svc-verb', 'second svc-verb', etc., since any verb can occur at any place in a sequence, and by itself. Hence, if we want attributes like 'V1', 'V2', etc. to appear in the feature structure of an SVC, they have to be introduced in the course of the combinations. To this end, a rule like (16a) can be phrased as in (17a), where the labels 'V1' and 'V2' are brought into play for subject-sharing, and in (17b) correspondingly for switch-sharing. The rules in (17) both inherit from *head-modifier-phrase II* and

[10] Stipulations in the combination mechanism can regulate whether in such structures of iterated adjunctions, the over-all branching will be leftwards or rightwards. Empirical evidence for what is to be preferred may come from 'movement' or 'gapping' possibilities involving sequences of VPs while leaving other VPs unaffected (for instance as discussed in Beermann and Hellan (2002) for VP-chaining in Oria), but we will not go into facts from any single language here.

sv (see type definitions in (19b) below). The attribute 'ARGS' introduces the constituents to be combined reflecting their linear order, with the head VP first. A fuller instantiation of (17b) is shown in (18) (using the notions HEAD-DTR and NON-HEAD-DTR as alternatives to the ordered elements in the ARGS list).[11] [12]

(17) a.

$$\begin{bmatrix} \mathit{sv-subj-sharing-phrase} \\ \text{V1}\ \boxed{1} \\ \text{V2}\ \boxed{2} \\ \text{ARGS}\ \ \left\langle \boxed{1}\left[\mathit{sv-subj-sharing}\right], \boxed{2}\left[\mathit{subj-sharing-rule}\right] \right\rangle \end{bmatrix}$$

b.

$$\begin{bmatrix} \mathit{sv-switch-sharing-phrase} \\ \text{V1}\ \boxed{1} \\ \text{V2}\ \boxed{2} \\ \text{ARGS}\ \ \left\langle \boxed{1}\left[\mathit{sv-switch-sharing}\right], \boxed{2}\left[\mathit{switch-sharing-rule}\right] \right\rangle \end{bmatrix}$$

(18) *SVC switch sharing rule*:

[11]The effect described in addition needs to be propagated from the highest VP node to the S node, by the following addition to the *Head-Specifier Rule* already established:

(i)

$$\begin{bmatrix} \mathit{svc-subj-sharing-phrase} \\ \text{V1}\ \boxed{1} \\ \text{V2}\ \boxed{2} \\ \text{ARGS}\ \ \left\langle \left[\text{HEAD noun}\right], \begin{bmatrix} \mathit{subj-sharing-rule} \\ \text{V1}\ \boxed{1} \\ \text{V2}\ \boxed{2} \end{bmatrix} \right\rangle \end{bmatrix}$$

[12] Note that rules like (17) display only **V1** and **V2**, not **V3** or **V4** or higher. Technically, however, in the constellation (i), the path **V2.V2** can be interpreted as **V3**, and similarly for the higher numbers

(i)

$$\begin{bmatrix} \text{V1} \\ \text{V2}\begin{bmatrix} \text{V1} \\ \text{V2} \end{bmatrix} \end{bmatrix}$$

$$\left[\begin{array}{l} \textit{sv}-\textit{switch}-\textit{sharing}-\textit{phrase} \\ \text{V1 } \boxed{7} \left[\begin{array}{l} \text{HEAD } \textit{verb} \\ \text{GF } \boxed{5} \left[\begin{array}{l} \text{SUBJ } \boxed{4} \left[\text{INDX } \boxed{1}\right] \\ \text{OBJ } \left[\text{INDX } \boxed{2}\right] \end{array}\right] \\ \text{SPR } \left\langle \boxed{4} \right\rangle \\ \text{COMPS } \langle\ \rangle \\ \text{ACTNT } \left[\begin{array}{l} \text{PRED } \textit{throw-rel} \\ \text{ACT1 } \boxed{1} \\ \text{ACT2 } \boxed{2} \end{array}\right] \end{array}\right] \\ \text{V2 } \boxed{8} \left[\begin{array}{l} \text{HEAD } \textit{verb} \\ \text{GF } \left[\begin{array}{l} \text{SUBJ } \left[\text{INDX } \boxed{2}\right] \\ \text{OBJ } \left[\text{INDX } \boxed{3}\right] \end{array}\right] \\ \text{SPR } \left\langle \left[\text{INDX } \boxed{2}\right] \right\rangle \\ \text{COMPS } \langle\ \rangle \\ \text{ACTNT } \left[\begin{array}{l} \text{PRED } \textit{pierce-rel} \\ \text{ACT1 } \boxed{2} \\ \text{ACT2 } \boxed{3} \end{array}\right] \end{array}\right] \\ \text{GF } \boxed{5} \\ \text{SPR } \left\langle \boxed{4} \right\rangle \\ \text{COMPS } \langle\ \rangle \\ \text{HEAD-DTR } \boxed{7} \\ \text{NONHEAD-DTR } \boxed{8} \end{array}\right]$$

In (19) below is defined a set of types for characterizing SVCs. (19a) is a set of general verb types, some to be used further in (19b,c). The types in (b) are those that introduce the labels 'V1' and 'V2' explicitly, and make characterizations of identities across the VPs in an SVC. The types in (c) are for characterizing the valence of the component VPs of an SVC. These types are all purely classificatory, in that they reflect information expressed in an AVM, but do not 'drive' the parsing process or add to the coverage of the grammar.

(19)
a.

```
vp := phrase & [ HEAD verb,
                 COMPS < > ].
v-sign := syn-struc & [ HEAD verb ].
v-word := word & v-sign.
v-intr-sign := intr-sign & v-sign.
v-intrObl-sign := intrObl-sign & v-sign.
v-tr-sign := tr-sign & v-sign.
v-trObl-sign := trObl-sign & v-sign.
v-ditr-sign := ditr-sign & v-sign.
v-dbob-sign := dbob-sign & v-sign.
v-ditrObl-sign := ditrObl-sign & v-sign.
v-dbobObl-sign := dbobObl-sign & v-sign.
v-trCs-sign := trCs-sign & v-sign.
v-dbobCs-sign := dbobCs-sign & v-sign.
v-trOblCs-oblCsu-sign := trOblCs-oblCsu-sign & v-sign.
v-trOblCs-obCsu-sign := trOblCs-obCsu-sign & v-sign.
```

b.

```
sv := syn-struc &
 [ V1 v-sign,
   V2 v-sign ].
sv3 := sv &
 [ V3 v-sign ].
sv4 := sv3 &
 [ V4 v-sign ].
sv_suIDALL := sv &
 [ V1.GF.SUBJ #1,
   V2.GF.SUBJ #1 ].
sv3_suIDALL := sv3 & sv_suID &
 [ V2.GF.SUBJ #1,
   V3.GF.SUBJ #1 ].
sv4_suIDALL := sv4 & sv3_suID &
 [ V3.GF.SUBJ #1,
   V4.GF.SUBJ #1 ].
sv_obIDALL := sv &
 [ V1.GF.OBJ #1,
   V2.GF.OBJ #1 ].
sv3_obIDALL := sv3 & sv_obID &
 [ V2.GF.OBJ #1,
   V3.GF.OBJ #1 ].
sv4_obIDALL := sv4 & sv3_obID &
 [ V3.GF.OBJ #1,
   V4.GF.OBJ #1 ].
sv_aspIDALL := sv &
 [ V1.ASPECT #1,
   V2.ASPECT #1 ].
sv3_aspIDALL := sv3 & sv_aspID &
 [ V2.ASPECT #1,
   V3.ASPECT #1 ].
sv4_aspIDALL := sv4 & sv3_aspID &
 [ V3.ASPECT #1,
   V4.ASPECT #1 ].
sv_suObIDALL := sv_suID & sv_obID.
sv3_suObIDALL := sv3_suID & sv3_obID.
sv4_suObIDALL := sv4_suID & sv4_obID.
sv_suAspIDALL := sv_suID & sv_aspID.
sv3_suAspIDALL := sv3_suID & sv3_aspID.
sv4_suAspIDALL := sv4_suID & sv4_aspID.
sv_suObAspIDALL := sv_suObID & sv_aspID.
sv3_suObAspIDALL := sv3_suObID & sv3_aspID.
sv4_suObAspIDALL := sv4_suObID & sv4_aspID.
```

c.

```
v1intr := sv &
 [ V1 v-intr-sign ].
v2intr := sv &
 [ V2 v-intr-sign ].
v3intr := sv3 &
 [ V3 v-intr-sign ].
```

```
v4intr := sv4 &
 [ V4 v-intr-sign ].
v1tr := sv &
 [ V1 v-tr-sign ].
v2tr := sv &
 [ V2 v-tr-sign ].
v3tr := sv3 &
 [ V3 v-tr-sign ].
v4tr := sv4 &
 [ V4 v-tr-sign ].
v1ditr := sv &
 [ V1 v-ditr-sign ].
v2ditr := sv &
 [ V2 v-ditr-sign ].
v3ditr := sv3 &
 [ V3 v-ditr-sign ].
v4ditr := sv4 &
 [ V4 v-ditr-sign ].
```

This type apparatus will allow for type characterizations like (20), (a) for a two-VPs SVC with subject and aspect sharing and V1 and V2 being transitive, (b) for a two-VPs SVC with switch sharing ('v1obIDv2Su ' meaning that **V1**'s object is identical to **V2**'s subject) and aspect sharing, and (c) for a four-VPs SVC with subject-, object- and aspect sharing:

(20) a. svSuAspIDALL-v1tr-v2tr
b. svAspIDALL- v1tr-v2tr-v1obIDv2Su
c sv4SuObAspIDALL

Instances of these are the following examples (from above, repeated):

(21) for (20a), cf. (1):
svSuAspIDALL-v1tr-v2tr

Á-gbele	gbɛ	á-ha	bo
3.PRF-open	road	3.PRF-give	2S
V	N	V	Pron

'You have been granted permission.'

(22) for (20b), cf. (3):
sv2AspIDALL- v1tr-v2tr-v1obIDv2Su

Kofi	**to-o**	**ne**	**nan**	**wɔ-ɔ**	**Kwame**
Kofi	throw-PERF	3Poss	leg	pierce-PERF	Kwame
N	V	Pron	N	V	N

'Kofi kicked Kwame'

(23) for (20c):
sv4SuObAspIDALL

Ama	tu-u	bayerɛ	twitwa	noa	di-i
Ama	uproot-PERF	yam	cut	cook	eat-PERF
N	V	N	V	V	V

'Ama uprooted (tuber of) yam, cut it in pieces, boiled them (and) ate'

Types like those in (20) cannot be associated with any particular verb of a given sentence, and thereby will not play a role in a parser, except as a type which can be associated with the parse result for a given sentence for classificatory purposes.

2.4 Semantics of SVCs

2.4.1 Uni- vs. multi-situational

Christaller (1875, 1881) made a distinction between ‘essential’ and ‘accidental’ verb combinations in Akan, a distinction Osam (1994) suggested to be recast as ‘(VP/clause) Chaining’ vs ‘Integrated SVCs’. While the distinction is by no means clear cut, diagnostics of Chaining SVCs (CSVC) are that they can span any number of verbs, and that the verb sequence reflects the temporal order of the events expressed by the individual VPs; the opposite holds for ISVCs. Accompanying the differences is that the verbs in CSVCs all maintain a meaning close to what they have when being the sole verb in a clause, whereas the contribution made by each verb in an ISVC may be less recognizable from the meaning when it occurs alone. The proposal is even often made that although there are two (or three) verbs in an ISVC, the whole ISVC expresses just one unified event. We will comment on this idea.

According to Schiller (2001), event types expressible by SVCs comprise those indicated in Figure 1, what he calls an ‘expanded event model’.[13]

Event

TAM LOC	Method	**Core**	Orientation	Rational
Tense, Aspect Modality Location	Instrument Manner	**Actants**	Directionality Source Goal	Cause Reason Purpose Result

Figure 1 Expanded Event Model (Schiller 2001)

Classificatory studies of SVCs seem to suggest that all of these event attributes can be expressed as components of an Integrated SVC giving rise to different well-known types of SVCs as there are ‘Locative SVC’, ‘Instrumental SVC’,’ Manner SVC’, ‘Purpose SVC’, ‘Causal SVC’ and so forth. We here consider how the notion of ‘locative SVC’ could be made precise in the present framework. As an example, consider the SVC (24):

(24) *John too ɔboɔ no faa ntokura no mu.* (Akan)

John	to-o	ɔ-boɔ	no	fa-a	ntokura	no	mu.
John	throw-PST	SG-stone	DEF	pass-PST	window	DEF	inside
N	V	N	DET	V	N	DET	N

'John threw the stone through the window'

Here both *to* and *fa* are verbs, but combine to express the content ‘throw into’, which should probably be seen as uni-situational.[14] [15] The situational representation of the combination can be suggested as (25).

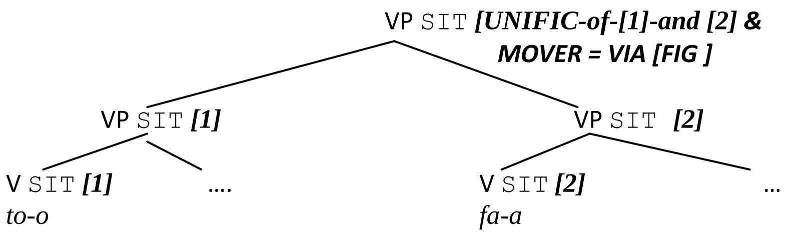
[13] The figure taken from Beermann and Hellan 2017.
[14] The example was provided by Kofi Ofori, class discussion at NTNU.

(25) ‘*throw… through …’*:

$$\begin{bmatrix} \text{ACTOR} \\ \text{LAUNCHER} \\ \text{LAUNCHED } \boxed{4} \\ \text{MOVER } \boxed{4} \\ \text{VIA} \begin{bmatrix} \text{FIG } \boxed{4} \\ \text{GRND} \\ \text{CONTAINED} + \\ \text{TRANSITIVE} + \end{bmatrix} \end{bmatrix}$$

The combination of the two verb phrases will involve a constructional rule with essentially the content shown in (26), where ‘SIT’ is the attribute introducing situational specification in the representation of the full sign, and the identity of FIG and MOVER is induced as part of the combination, over the individual lexical semantic specifications in (27):[16]

(26) Schematic view of information sharing between the VPs in (24):



(27)

a. *to* ‘throw’:

$$\begin{bmatrix} \text{ACTOR} \\ \text{LAUNCHER} \\ \text{LAUNCHED } \boxed{4} \\ \text{MOVER } \boxed{4} \end{bmatrix}$$

b. *fa…mu* ’pass…through’

:

$$\begin{bmatrix} \text{VIA} \begin{bmatrix} \text{FIG} \\ \text{GRND} \\ \text{CONTAINED} + \\ \text{TRANSITIVE} + \end{bmatrix} \end{bmatrix}$$

[15] It is well known that spatial features can in principle be carried not only by prepositions but also by nouns and by verbs, and in languages where there are no or few prepositions, and multiverb constructions are in the core register of the grammar, transitive verbs can function in similar ways as prepositions, such as *fa* in (1), whose status as a verb in Akan is demonstrated, for instance, by its tense marking. In the topological domain, nouns likewise carry some of the features carried by prepositions in English, like the relational noun *mu* ('inside') in (24).

[16] Such procedures for unifying AVMs are also familiar from the construction of f-structures in LFG.

Given an adjunction analysis of the syntactic combination as argued above, the verb *fa* will have the representation (28), specifying the necessary SIT-properties of the preceding VP inside the MOD attribute:

(28) *fa* ’pass’:

$$\begin{bmatrix} \text{HEAD}\,[\textit{verb}] \\ \text{MOD}\begin{bmatrix} \text{HEAD } \textit{verb} \\ \text{SIT } \boxed{2}\,[\text{MOVER } \boxed{4}] \end{bmatrix} \\ \text{COMPS } \langle [\text{INDEX } \boxed{5}] \rangle \\ \text{SIT } \boxed{2}\ \textit{locomotionViapoint}\begin{bmatrix} \text{MOVER } \boxed{4} \\ \text{VIA } \textit{spatial}\begin{bmatrix} \text{FIG } \boxed{4} \\ \text{GRND } \boxed{5} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

With the unifications of SIT values, the SVC (24) thereby gets the SIT specification (25), which may be regarded as construing the meaning of the construction as ‘uni-situational’.

Having thereby illustrated how the SIT specification can serve to give content to the view that ISVCs are ‘uni-situational’, we make a digression.

2.4.2 Digression: Situating SVC analysis relative to Translation and ‘Interlingua’

In the ACTs-based semantic display of a full sentence adopted in *Minimal Recursion Semantics* (MRS; Copestake et al. 2005), ACTNT representations are strung together in a list, as illustrated in the representation of (24) in Figure 2 below. Each bracketed block, called an *elementary predication (EP)*, represents the semantic ACTNT specification assigned to a single word. In keeping with conventions for MRS, we use ‘ARG’ rather than ’ACT’, and illustrate how semantic role information can be located inside of ARG specifications, following Beermann and Hellan 2008, 2012.

$$\text{RELS}\left\langle \begin{array}{l} \ldots\begin{bmatrix} \text{\_John\_n\_rel} \\ \text{ARG0 x4} \end{bmatrix}, \begin{bmatrix} \text{\_to\_v\_rel ('throw')} \\ \text{ARG0 e2} \\ \text{ARG1 x4} \\ \text{ARG2 x9[ROLE locomotor]} \end{bmatrix}, \begin{bmatrix} \text{\_boo\_n\_rel ('stone')} \\ \text{ARG0 x9} \end{bmatrix}, \begin{bmatrix} \text{\_fa\_v\_rel ('go')} \\ \text{ARG0 e2} \\ \text{ARG1 x9} \\ \text{ARG2 x10[ROLE via-pnt]} \end{bmatrix}, \\ \begin{bmatrix} \text{\_mu\_n\_rel ('inside')} \\ \text{ARG0 x10} \\ \text{IARG}\begin{bmatrix} \text{FIG x9} \\ \text{GRND x14} \\ \text{TOPFEAT}\begin{bmatrix} \text{TRANSITIVE +} \\ \text{SCALAR -} \\ \text{EMBEDDED +} \\ \text{CONTAINED +} \\ \text{INTEGRATED -} \end{bmatrix} \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \text{\_ntokura\_n\_rel ('window')} \\ \text{ARG0 x14} \end{bmatrix}, \begin{bmatrix} \text{\_poss\_rel} \\ \text{ARG1 x14} \\ \text{ARG2 x10} \end{bmatrix}, \ldots \end{array} \right\rangle$$

Figure 2. Partial MRS-structure for the sentence (24)

In approaches using MRS in *Machine Translation (MT)*,[17] one of the key mechanisms is to map any conceivable EP of language X to an EP of language Y (by so-called *transfer rules*), whereby the MRS produced through the parsing of a sentence in language X can be mapped to an MRS within language Y, and in turn a sentence in Y can be generated from this new MRS, by a generation facility generally associated with a parsing program using MRS.

An *interlingua*, in the context of translation design, is conceived as a kind of common semantic ground onto which all languages can in principle be mapped, such that whenever a sentence S_x in language X gets assigned a certain interlingua representation, that representation will at the same time be the interlingua representation of a sentence S_y in a language Y, and an interlingua-based translation will 'automatically' establish S_x and S_y as mutual translations. Interlingua representations would by design-definition be independent of the actual wordings of either language, thus the MRS based approach just illustrated is not one of interlingua (although in the EPs, cross-linguistically notions can of course be used).

In the present context, however, the *Situation Structure* format might be conceived as a format which could in principle qualify for the purpose of interlingua representation. For instance, both the Akan sentence (24) and its English translation would have the SIT representation (25) (augmented with likewise language-non-specific encodings of 'Kofi', 'stone' and 'room', and definiteness factors tied to these), and so would in principle any sentence of any language with that same meaning. Unlike the MRS format, the links to word contributions are not explicitly indicated within the SIT specification itself, but the construction of SIT specifications can be done in an algorithmic fashion, so that each word has its SIT contribution lexically defined, and SIT unifications are governed by sign combination rules. Thereby SIT representations will be available both as the result of parsing and for serving as input to generation, and thus *could* in principle be able to serve in the essential steps of an MT procedure.[18]

2.5 Extended Verb Complexes (EVCs)

This construction type has been found both in Kwa and Gur (see Dakubu (2008), Dakubu Hellan & Beermann (2007), Dakubu (2004)). The construction type holds a particular interest in that EVCs act as single verbs relative to the environment, but are dividable into word-like units, namely a limited number of *preverbs* or *postverbs (pv)* together with the *main verb*. A simple example is the Ga sentence (29), with the preverb sequence *kɛ-ba*:

(29)	Tɛte	kɛ-ba-biɛ
	Tettey	take-to-here-bring
	N	V
	"Tettey brought it here."	

The valence of the main verb determines the valence of the whole relative to the containing clause, its subject is necessarily the subject of all the preverbs, and its Aspect, Modality and Polarity marking is wholly determined from left to right. Most preverbs are intransitive, but some, like *kɛ*, can be transitive.

Conventions for enumerating the preverbs of an EVC can be similar to those for enumerating verbs of an SVC, although since the range of combinations in an EVC is very limited, a small number of labels covering the totality of combinations is more correct. Thus subject and aspect identities need not be specified. Since these labels will be language dependent, for convenience we here still use the numbered labels, with the proviso that, e.g. in Ga, 'ev2' can only stand for two fixed combinations: **kɛ**+deictic, (for example, **e-<u>kɛ</u>-<u>ba</u>-ha lɛ "**he came and gave it to

[17] An approach tried out in the *Verbmobil* project (https://en.wikipedia.org/wiki/Verbmobil) and some subsequent initiatives, although currently not a dominant branch in MT.
[18] Formally one could, for instance, use the basic algorithms of MRS, but modelling the EPs on SIT specifications rather than ACTNT specifications.

him”, and neg+deictic (eg. **e-ka-ba-na lɛ** “he is not to come see him.”). Given the similarity with SVCs, we use as initial label of an EVC the label ‘ev’ plus a number indicating the number of verbs, as stated in (30):

(30) ‘Global labels’ of EVCs

ev = ev with one preverb and the main verb

$$\begin{bmatrix} \text{HEAD verb} \\ \text{PV1} \begin{bmatrix} \text{HEAD verb} \end{bmatrix} \end{bmatrix}$$

ev2 = ev with two preverbs and the main verb

$$\begin{bmatrix} \text{HEAD verb} \\ \text{PV1} \begin{bmatrix} \text{HEAD verb} \end{bmatrix} \\ \text{PV2} \begin{bmatrix} \text{HEAD verb} \end{bmatrix} \end{bmatrix}$$

ev3 = ev with three preverbs and the main verb

Identities spanning the whole EVC are expressed as for SVCs, e.g. (31):

(31)

ev3 _suAg = EVC with three preverbs, where all verbs share subject reference and where the role of the subject relative to all the verbs is Agent; the topmost attributes ‘GF’ and ‘ASPECT’ qualify the main verb.

$$\begin{bmatrix} \text{HEAD verb} \\ \text{GF} \begin{bmatrix} \text{SUBJ } \boxed{1} \begin{bmatrix} \text{INDX} \begin{bmatrix} \text{ROLE agent} \end{bmatrix} \end{bmatrix} \\ \text{OBJ sign} \end{bmatrix} \\ \text{ASPECT } \boxed{2} \text{ perf} \\ \text{PV1} \begin{bmatrix} \text{HEAD verb} \\ \text{GF} \begin{bmatrix} \text{SUBJ } \boxed{1} \end{bmatrix} \\ \text{ASPECT } \boxed{2} \end{bmatrix} \\ \text{PV2} \begin{bmatrix} \text{HEAD verb} \\ \text{GF} \begin{bmatrix} \text{SUBJ } \boxed{1} \end{bmatrix} \\ \text{ASPECT } \boxed{2} \end{bmatrix} \\ \text{PV3} \begin{bmatrix} \text{HEAD verb} \\ \text{GF} \begin{bmatrix} \text{SUBJ } \boxed{1} \end{bmatrix} \\ \text{ASPECT } \boxed{2} \end{bmatrix} \end{bmatrix}$$

Pursuing the parallel notation with SVCs, we can specify each preverb in an EVC separately relative to valence and other properties, with labels such as the following for valence in (32a), and (32b) for other properties:

(32)

a.

pv1intr = preverb 1 is intransitive

$$\begin{bmatrix} \text{PV1} \begin{bmatrix} \text{GF} \begin{bmatrix} \text{SUBJ sign} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

pv2intr = preverb 2 is intransitive
pv3intr = preverb 3 is intransitive
pv1tr = preverb 1 is transitive
pv2tr = preverb 2 is transitive
pv3tr = preverb 2 is transitive

b.

pv1suAg = the subject of preverb 1 (PV1) is an Agent

$\left[\text{PV1}\left[\text{GF}\left[\text{SUBJ}\left[\text{INDX}\left[\text{ROLE agent}\right]\right]\right]\right]\right]$

pv1aspPerf = the aspect of PV1 is Perfective
pv2suSM = the subject of PV2 is targeted by subject agreement on the verb
pv2suClit = the subject of PV2 is realized as a cliticized pronoun

(33) exemplifies the notation:

(33)
`ev_suAg-pv1tr-pv1obPossp_pv1suIDpv1obSpec_pv1obBPpv1ObSpec-pv1obTh-vtr-obPostp-obLocus`

E-kɛ e-hiɛ fɔ-ɔ o-nɔ
3S$_1$-move 3S$_1$-face throw-HAB 2S.POSS-surface
‘She trusts you.’

Explanation:
Extended verb with one preverb (**kɛ**) and a shared Agent role for subjects of both verbs; PV1 (the only preverb) is transitive and its object is a possessive phrase **e-hiɛ** (represented by the part `pv1suIDpv1obSpec`); relative to PV1, its subject is identical to the specifier of the object; the object of PV1 is a Body Part of its specifier ('her face' being part of 'her') and has a Theme role; the main verb is transitive and its object—which is the object of the whole verbal complex, and therefore having no prefix on 'ob'—is a postpositional phrase **o-nɔ**, and semantically in a part-whole relation to its specifier ('your surface' being a part of 'you'); moreover the object has a Locus role relative to the main verb (the implicit item thrown—the face—ending on 'your surface'). Its AVM:

(34)

$$\left[\begin{array}{ll}
\text{HEAD verb} & \\
\text{GF} & \left[\begin{array}{ll}
\text{SUBJ} & \left[\text{INDX}\boxed{1}\left[\text{ROLE agent}\right]\right] \\
\text{OBJ} & \left[\begin{array}{ll}
\text{GF}\left[\text{SPEC}\left[\text{INDX}\boxed{2}\right]\right] & \\
\text{INDX}\boxed{3}\left[\text{ROLE locus}\right] & \\
\text{ACTNTS} & \left[\begin{array}{l}
\text{PRED spatial-coord-of} \\
\text{ACT1}\boxed{3} \\
\text{ACT2}\boxed{2}
\end{array}\right]
\end{array}\right]
\end{array}\right] \\
\text{PV1} & \left[\begin{array}{ll}
\text{HEAD verb} & \\
\text{GF} & \left[\begin{array}{ll}
\text{SUBJ} & \left[\text{INDX}\boxed{1}\right] \\
\text{OBJ} & \left[\begin{array}{ll}
\text{GF}\left[\text{SPEC}\left[\text{INDX}\boxed{1}\right]\right] & \\
\text{INDX}\boxed{4}\left[\text{ROLE theme}\right] & \\
\text{ACTNTS} & \left[\begin{array}{l}
\text{PRED spatial-coord-of} \\
\text{ACT1}\boxed{4} \\
\text{ACT2}\boxed{1}
\end{array}\right]
\end{array}\right]
\end{array}\right]
\end{array}\right]
\end{array}\right]$$

When an EVC occurs as a verbal constituent of an SVC, the two patterns of specification are combined, as illustrated in the following example with an extended verb complex as V2 in a serial verb construction:

(35)
`sv_suAspID_suAg-v1tr-v1obTh-v2ev2-v2pv1tr-v2pv1obThsit-v2pv2intr-v2tr-v2iobRec`

E-tao adeka kɛ-ba-ha mi
3S-search box move-INGR-give 1S
'He found a box for me.'

Explanation:
A serial verb construction with two verb constructions, sharing subject and aspect, with both subjects being Agents; V1 is transitive and has a Theme object; V2 is an extended verb with two preverbs; PV1 of V2 is transitive and the object of PV1 is a Situational Theme; PV2 of V2 is intransitive; the main verb is transitive and its object is a Beneficiary. Its AVM:

(36)

$$\begin{bmatrix} \text{V1} & \begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX}\boxed{1}\begin{bmatrix}\text{ROLE agent}\end{bmatrix}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX}\boxed{2}\begin{bmatrix}\text{ROLE theme}\end{bmatrix}\end{bmatrix} \end{bmatrix} \\ \text{ASPECT}\boxed{3} & \end{bmatrix} \\ \text{V2} & \begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX}\boxed{1}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX}\begin{bmatrix}\text{ROLE ben}\end{bmatrix}\end{bmatrix} \end{bmatrix} \\ \text{ASPECT}\boxed{3} & \\ \text{PV1} & \begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX}\boxed{1}\end{bmatrix} \\ \text{OBJ} & \begin{bmatrix}\text{INDX}\boxed{2}\begin{bmatrix}\text{ROLE theme-sit}\end{bmatrix}\end{bmatrix} \end{bmatrix} \\ \text{ASPECT}\boxed{3} & \end{bmatrix} \\ \text{PV2} & \begin{bmatrix} \text{GF} & \begin{bmatrix} \text{SUBJ} & \begin{bmatrix}\text{INDX}\boxed{1}\end{bmatrix} \end{bmatrix} \\ \text{ASPECT}\boxed{3} & \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

3 Discussion

The above outline has one foot in descriptive concerns, one in computational modeling. Comments on both aspects will follow.

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