Are Iterating Slot-Filler Structures Universal?

Roland Hausser
Universität Erlangen-Nürnberg (em.)

Abstract

An example of an iterating slot-filler[1] structure is repeating infinitives as in John decided to try to persuade Bob to run (Sect. 3). Each infinitive serves as a phrasal object with a slot, e.g. to try *slot*. The slot is filled by another infinitive with a slot, i.e. to persuade Bob *slot*, and so on, except for the last one, which terminates the iteration with an intransitive verb. Similar slot-filler repetitions are iterating object clauses (Sect. 4) and iterating adnominal clauses (Sect. 5).

Another kind of iterating slot-filler or filler-slot structure is known as gapping. For example, Bill bought an apple, peeled a pear, ..., and ate a peach. is called subject gapping. Here the open-ended sequence *slot* peeled a pear, *slot* ate a peach, an so on, takes Bill as the shared subject. The end of the iteration is announced by the function word and in penultimate position. Systematic variants are predicate gapping, and object gapping (Sect. 6).

Iterating slot-filler structures may interact with other grammatical constructions. A prime example is a *long distance dependency*, such as Whom did John say that Bill claims that Suzy believes that ... Mary loves?, i.e. the single filler-slot pair Whom and Mary loves? is separated by a slot-filler iteration of object clauses (Sect. 7).

Remarkably, all of these highly conspicuous constructions occur in natural languages which are completely unrelated to English and other European languages, namely in Korean, Tagalog, and Georgian. They are therefore candidates for being universal[2] thought structures.

keywords: hear mode, content, speak mode, iteration, marked vs. unmarked slots, infinitive, object clause, adnominal clause, gapping, long distance dependency, intra- vs. extrapropositional relations

1 Language and Thought

The agent-based data-driven ontology of DBS treats cognitive contents as sets of proplets (order-free), defined as nonrecursive feature structures with ordered attributes. Proplets are connected into contents by the classical semantic relations of structure coded by address. Language content and thought content are treated alike

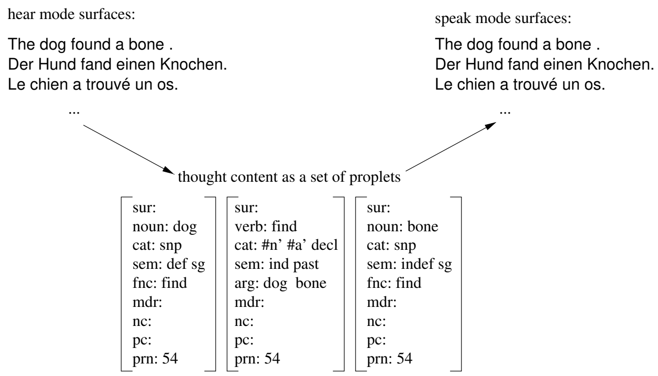
[1] McCord (1980) used the slot-filler principle for *Slot Grammar*.

[2] What exactly constitutes a universal is a difficult question (Harbsmeier 2001).

except that the proplets of a language content have language-dependent sur(face) values which are absent in the proplets of a thought content.

A content may use different surfaces from typologically similar languages. For example, The dog found a bone, Der Hund fand einen Knochen, and Le chien a trouvé un os are surfaces in different languages for the same content:

1.1 FROM CONTENT TO SPEAK MODE TO HEAR MODE TO CONTENT

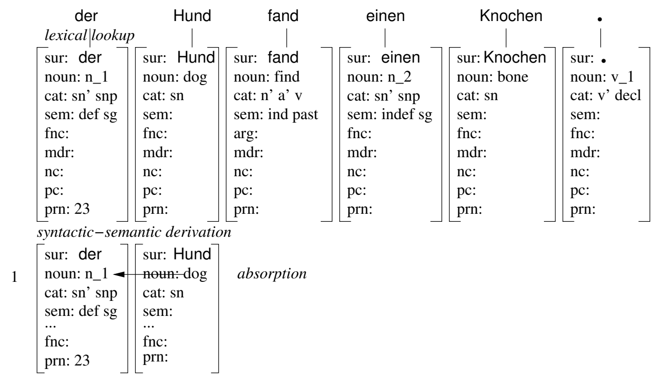


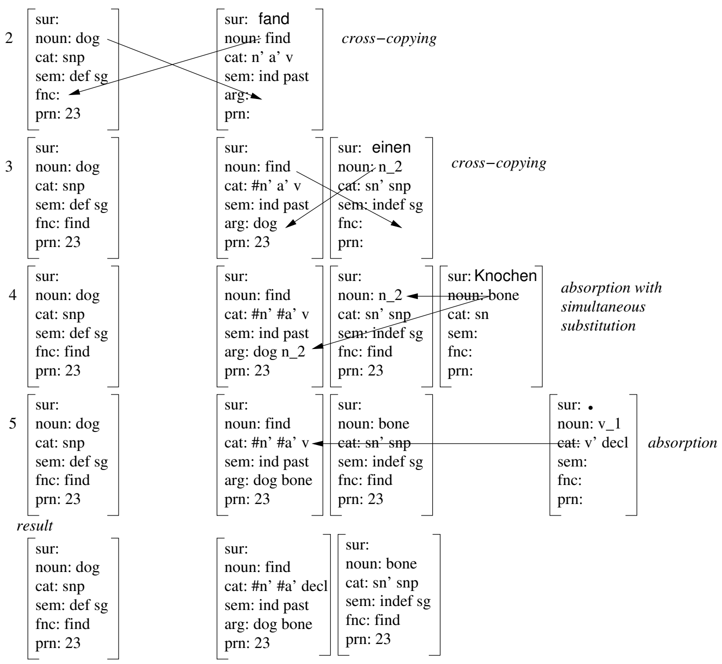
In language communication, automatic word form recognition provides lexical proplets in the hear mode. They are connected into content, which may be used as input to inferencing or the speak mode for surface production.

As the computational data structure of DBS, a proplet encodes all lexical and compositional properties of a content word as proplet-internal attribute-value pairs called features. For example, the noun proplets in 1.1 have the lexical features [sem: def sg] and [sem: indef sg] for definiteness and number, and the verb proplet has the lexical features [cat: #n′ #a′ decl] for valency and syntactic mood, and [sem: past ind] for tense and verbal mood. The syntactic-semantic distinction between subject and object is coded inside the verb proplet by the value order in the feature [arg: dog bone]. The subject proplet *dog* and the object proplet *bone* are connected to the *find* proplet by their respective [fnc: find] features.

Consider the explicit hear mode derivation of the German example in 1.1:

1.2 SURFACE COMPOSITIONAL TIME-LINEAR HEAR MODE DERIVATION

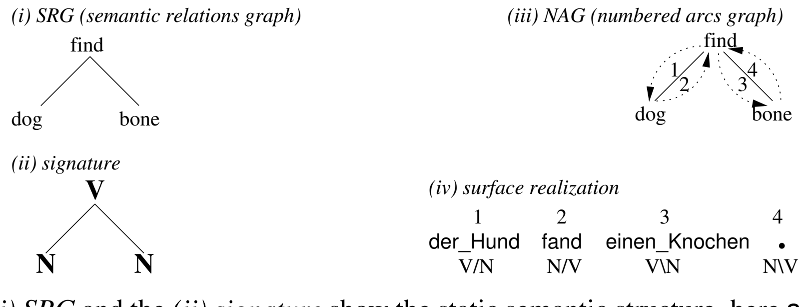




The reading derived is *surface compositional* because each input surface has exactly one lexical proplet representation and there are no lexical proplet representations without a concrete surface. The derivation is *time-linear* as shown by the stair-like addition of one new next word form in each line. The proplets of the function words the and a absorb their respective content words, as shown in lines (1,2) and (4,5), while the . proplet is absorbed into the top verb (5, result).

Contents resulting from hear mode derivations are possible inputs to the think mode operations of (a) selective activation by navigation and (b) inferencing. Either may be mirrored by language-dependent surfaces in the speak mode riding piggyback on sequences of think mode operations:

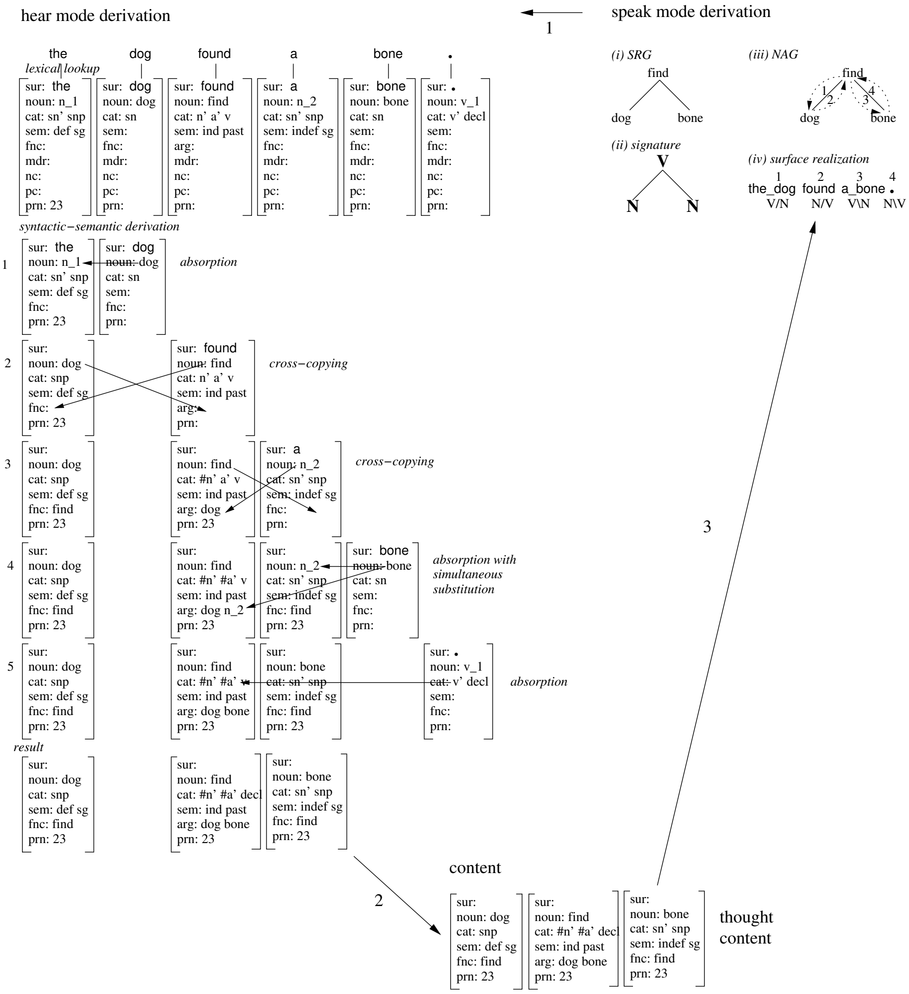
1.3 Semantic relations underlying speak mode derivation



The *(i) SRG* and the *(ii) signature* show the static semantic structure, here subject/predicate and object\predicate, whereby the nodes in the *SRG* represent the core values and in the *signature* the core attributes of the proplets in the content. The *(iii) NAG* and the *(iv) surface realization*, in contrast, show the dynamic aspect of the think mode which activates content by a navigation for inferencing and for speak mode realization of language-dependent surfaces.

The hear mode derivation 1.2, the content 1.1, and the speak mode derivation 1.3 combine into the following cycle of natural language communication in DBS (shown for English surfaces):

1.4 CYCLE OF NATURAL LANGUAGE COMMUNICATION



This constellation supports two important functions of turn taking (Schegloff 2007): (i) transfer of a content from the speaker to the hearer (two agents, arrow sequence 3, 1) and (ii) interpreting content in the hear mode and reproducing it in the speak mode (one agent, arrow sequence 2, 3).

2 Slot-Filler Iteration

There is comparatively little argument that, roughly speaking, all natural languages distinguish between the word kinds noun, verb, and adj, the syntactic moods declarative, interrogative, and imperative, the verbal moods indicative and subjunctive, the tenses present, past, and future, the semantic relations of functor-argument and coordination, the degrees of elementary, phrasal, and clausal grammatical complexity, and the intra- vs. extrapropositional semantic relations of structure, whereby the latter may be intra- or extrasentential. The basic grammatical structures built on these notions may be considered likely to be universal contents.

In contrast, structures perhaps more promising for being nonuniversal is the conspicuous iteration of slot-fillers or filler-slots[3] such as the following:

2.1 EXAMPLES OF DIFFERENT SLOT-FILLER ITERATIONS

1. *Iterating infinitives* (phrasal)
   John decided to try to persuade Bob to sing.

2. *Iterating object clauses* (clausal)
   Mary saw that Peter saw that Suzy saw Fido.

3. *Iterating adnominal clauses* (clausal)
   Mary saw the man who loves the woman who feeds the child.

4. *Subject gapping* (phrasal)
   Bob bought an apple, peeled a pear, and ate a peach.

5. *Predicate gapping* (phrasal)
   Bob bought an apple, Jim a pear, and Bill a peach.

6. *Object gapping* (phrasal)
   Bob bought, Jim peeled, and Bill ate the peach.

7. *Object clause iteration with long distance dependency* (clausal)
   Whom did John say that Bill believes that Mary claims that Suzy loves?

In this list, three construction kinds may be distinguished: (i) marked slot-filler repetition using different fillers (1-3), (ii) unmarked filler-slot or slot-filler repetition using the same filler (4-6), and (iii) a single filler-slot relation with an intervening object clause iteration, resulting in a long-distance dependency.

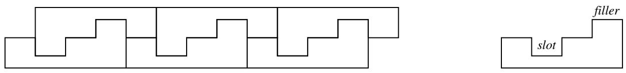
3 Marked Slot-Filler Repetition in Infinitives

In English, marked slot-filler repetition occurs at the phrasal level as (a) repeating infinitives,[4] and at the clausal level as (b) repeating object clauses and (c) repeating adnominal clauses. The cognitive structure common to all three may be shown abstractly as follows:

[3] Perhaps because they are of low frequency and not in every tree bank.

[4] In HPSG, infinitives are treated as a kind of clause (Sag 1997). It seems, however, that the adnominal use of infinitives, as in The decision to try..., is restricted to nominalized transitive verbs.

3.1 Slot-filler repetition as abstract cognitive structure



For example, the slot-fillers in an infinitive iteration consist of a sequence of transitive predicates taking another transitive predicate as their second argument, except for the last one. The lower predicate's subject is absent in the surface (slot) but equals implicitly the next higher subject (subject control, e.g. try, promise) or the next higher object (object control, e.g. persuade).

The function word marking the slots in English is to. The characteristic semantic connections in iterating infinitives may be illustrated as follows:

3.2 Marked slots in iterating infinitives

John decided *slot*
↑
to try *slot*
↑
to persuade Bob *slot*
↑
to run.

The initial predicate decide_*slot* is filled by to try_*slot* which is filled by to persuade Bob_*slot* which is filled by to run. The last filler terminates the iteration because it does not introduce another slot. Whether an infinitive has subject or object control (CLaTR Sects. 15.4–15.6) depends on the verb.

Consider the surface compositional time-linear derivation of John decided to try to persuade Bob to run.:

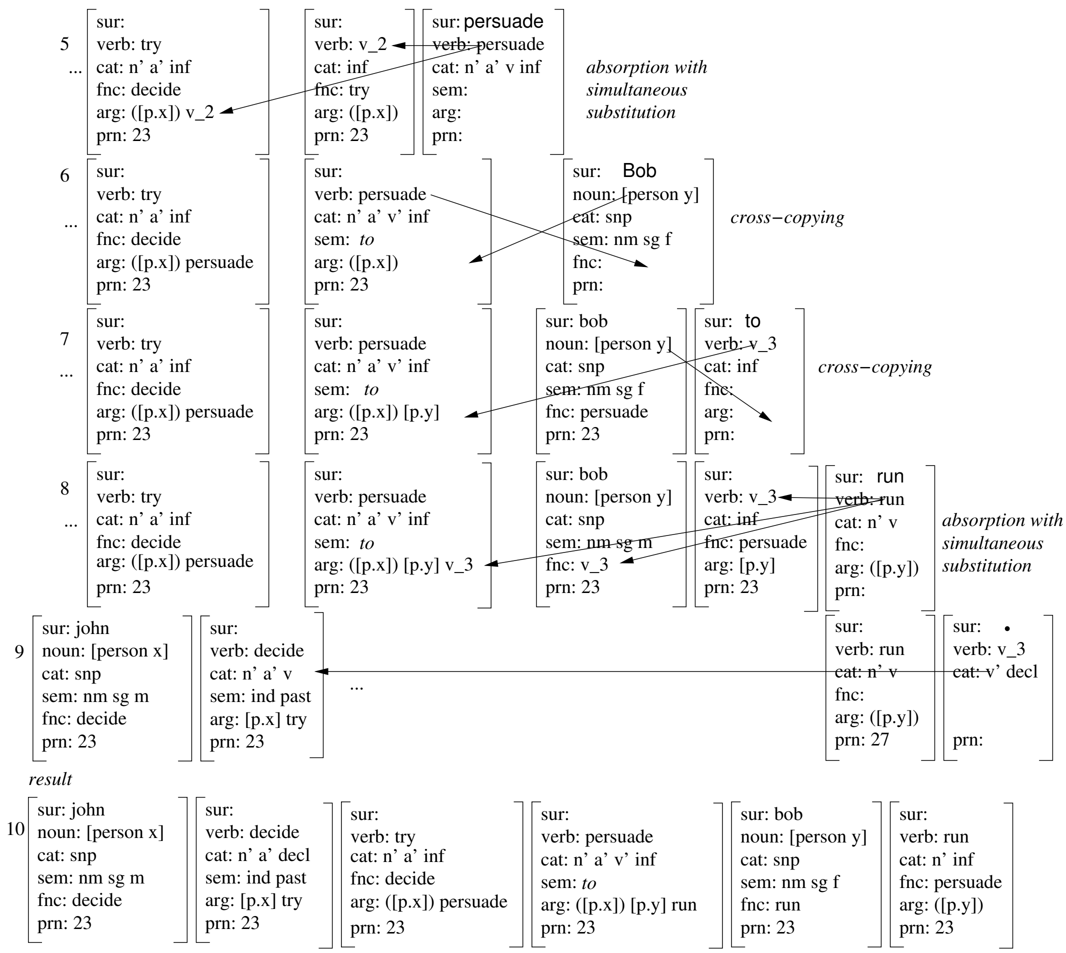
3.3 Hear mode derivation of repeating infinitives

	sur: John	sur: decided			
1	noun: [person x]	verb: decide			
	cat: nm sg m	cat: #n' a' v			*cross−copying*
	sem: ind past	sem: ind past			
	fnc:	arg:			
	prn: 23	prn: 23			

	sur: john	sur:	sur: to		
2	noun: [person x]	verb: decide	verb: v_1		
	cat: nm sg m	cat: #n' a' v	cat: inf		*cross−copying*
	sem: ind past	sem: ind past	fnc:		
	fnc: decide	arg: [p.x]	arg:		
	prn: 23	prn: 23	prn:		

	sur: john	sur:	sur:	sur: try	
3	noun: [person x]	verb: decide	verb: v_1	verb: try	
	cat: nm sg m	cat: #n' #a' v	cat: inf	cat: n' a' v	*absorption with*
	sem: ind past	sem: ind past	fnc: decide	sem:	*simultaneous*
	fnc: decide	arg: [p.x] v_1	arg; ([p.x])	arg:	*substitution*
	prn: 23	prn: 23	prn: 23	prn:	

	sur: john	sur:	sur:	sur: to	
4	noun: [person x]	verb: decide	verb: try	verb: v_2	
	cat: nm sg m	cat: #n' #a' v	cat: n' a' inf	cat: inf	*cross−copying*
	sem: ind past	sem: ind past	fnc: decide	fnc:	
	fnc: decide	arg: [p.x] try	arg: ([p.x])	arg:	
	prn: 23	prn: 23	prn: 23	prn:	



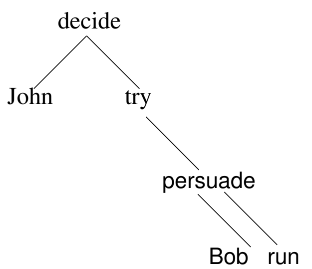
Intrapropositional V\V connects decide directly with to_try, try directly with to_persuade, and persuade directly with to_run (surface compositionality). The implicit subject and object control of the infinitives is shown explicitly as the values [person x] and [person y], i.e. the named referents of John and Bob.

For the corresponding speak mode, consider the following graph analysis:

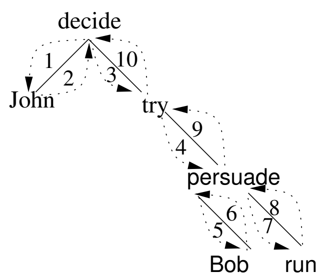
3.4 SYNTACTIC-SEMANTIC ANALYSIS OF INFINITIVE REPETITION

John decided to try to persuade Bob to run.

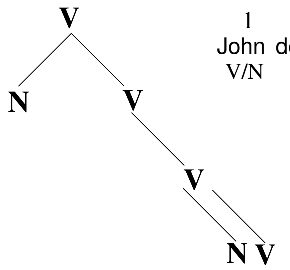
(i) SRG (semantic relations graph)



(iii) NAG (numbered arcs graph)



(ii) signature



(iv) surface realization

1	2	3	4	5	6	7	8	9	10
John	decided	to_try	to_persuade	Bob		to_run			.
V/N	N/V	V\V	V\V	V\N	N/V	V\V	V\V	V\V	V\V

content

sur: john noun: [person x] cat: nm sg f sem: fnc: decide ... prn: 32	sur: verb: decide cat: n′ a′ decl sem: ind past arg: [person x] try ... prn: 32	sur: verb: try cat: n′ a′ inf sem: *to* arg: ([person x]) persuade ... prn: 32	sur: verb: persuade cat: n′ a′ v′ inf sem: *to* arg: ([person x])[person y] run ... prn:32
sur: bob noun: [person y] cat: snp sem: nm sg m fnc: run ... prn: 32	sur: verb: run cat: n′ a′ inf sem: *to* arg: ([person y]) ... prn: 32		

The first two infinitives have subject control, while the third has object control. Of the verbs, run is 1-place, decide and try are 2-place, and persuade is 3-place. The valency positions are marked with ′. The #-marking is omitted.

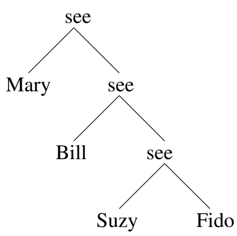
4 Marked Slot-Filler Repetition in Object Clauses

The clausal counterpart to phrasal infinitive iteration is the extrapropositional repetition of object sentences, as in the following example:

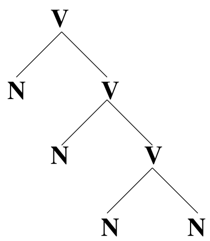
4.1 OBJECT CLAUSE REPETITION

Mary saw that Bill saw that Suzy saw Fido.

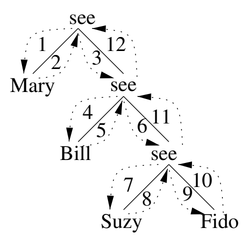
(i) SRG (semantic relations graph)



(ii) signature



(iii) NAG (numbered arcs graph)



(iv) surface realization

1	2	3	4	5	6	7	8	9	10	11	12
Mary	saw	that	Bill	saw	that	Suzy	saw	Fido			.
V/N	N/V	V\V	V/N	N/V	V\V	V/N	N/V	V\N	N/V	V\V	V\V

content

sur: mary noun: [person x] cat: snp sem: nm sg f fnc: see ... prn: 33	sur: verb: see cat: #n′ #a′ decl sem: ind past arg: [person x] (see 34) ... prn: 33	sur: bill noun: [person y] cat: snp sem: nm sg m fnc: see ... prn: 34	sur: verb: see cat: #ns3′ #a′ v sem: ind past arg: [person y] (see 35) ... prn: 34
sur: suzy noun: [person z] cat: snp sem: nm sg m fnc: see ... prn: 35	sur: verb: see cat: #ns3′ #a′ v sem: ind past arg: [person z] (see 35) ... prn: 35	sur: fido noun: [dog w] cat: snp sem: nm sg m fnc: see ... prn: 35	

The extrapropositional nature of the example is shown by the different prn values, from 33 to 35. The function word marking the slots is that:

4.2 MARKED SLOTS IN ITERATING OBJECT CLAUSES

Mary saw *slot*

↑

that Bill saw *slot*

↑

that Suzy saw Fido.

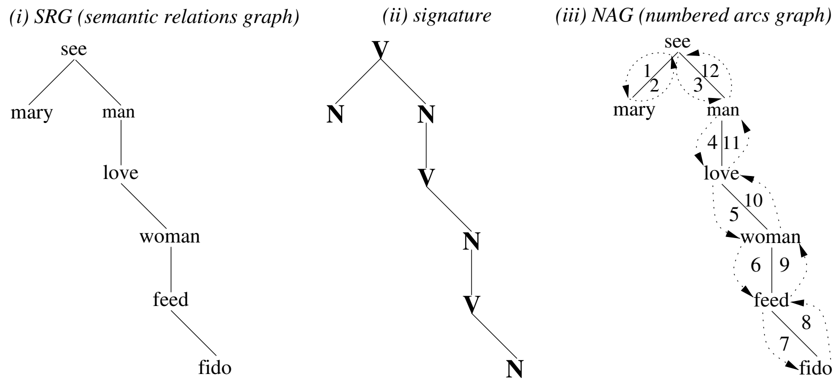
The last clause terminates the iteration because the filler does not introduce another slot. The analyses 3.3, 3.4, and 4.1 rely on the strictly time-linear derivation order of DBS.

5 Marked Slot-Filler Repetition in Adnominal Clauses

Like infinitives and object clauses, adnominal clauses may be iterated, as in Mary saw the man who loves the woman who ... feeds Fido.

5.1 GRAPH ANALYSIS UNDERLYING MULTIPLE ADNOMINAL CLAUSES

Mary saw the man who loves the woman who fed Fido.



(iv) surface realization (English, subject gap)

1	2	3	4	5	6	7	8	9	10	11	12
Mary	saw	the_man	who_loves	the_woman	who_fed	Fido					•
V/N	N/V	V\N	N|V	V\N	N|V	V\N	N\V	V|N	N\V	V|N	N\V

content

sur: mary	sur:	sur:	sur:	sur:
noun: [person x]	verb: see	noun: man	verb: love	noun: woman
cat: snp	cat: #n′ #a′ decl	cat: snp	cat: #ns3′ #a′ v	cat: snp
sem: nm f	sem: past	sem: def sg	sem: *who* pres	sem: def sg
fnc: see	arg: [person x] man	fnc: see	arg: ∅ woman	fnc: love
mdr:	mdr:	mdr: (love 30)	mdd: [man 29]	mdr: (feed 31)
prn: 29	prn: 29	prn: 29	prn: 30	prn: 30

sur:	sur: fido
verb: feed	noun: [dog x]
cat: #n′ #a v	cat: snp
sem: *who* past	sem: nm
arg: ∅ [dog x]	fnc: feed
mdd: [woman 30)	mdr:
prn: 31	prn: 31

In this construction, the function word marking the slot is a “relative pronoun” (subordinating conjunction with argument role) such as who, whom or which. As shown by the increasing prn values, the construction is extrapropositional.

5.2 Marked slot structure of iterating adnominal clauses

Mary saw the man *slot*

↑

who loves the woman *slot*

↑

who fed Fido

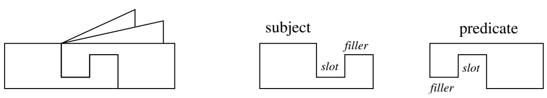
The function word marking the slots in this example is who.

6 Unmarked Slot-Filler Iteration in Gapping Constructions

In gapping constructions, a single unmarked slot is used several times, as in subject and predicate gapping (filler-slot), and object gapping (slot-filler). This is in contradistinction to slot-filler iterations which use several different marked slots (Sects. 3–5).

In subject gapping, a single subject slot takes multiple predicate fillers, which may be shown as follows:

6.1 Subject gapping as an abstract cognitive structure



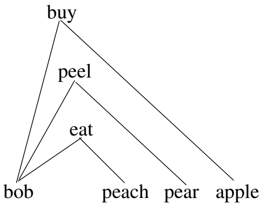
Without the multiple predicates, this three-dimensional graph would equal a simple subject-predicate combination, i.e. a subject with a single intransitive or transitive verb. Computationally, the slot-filler combination is implemented as a cross-copying between order-free proplets.

Instead of marking the slots with a function word, as in slot-filler iteration, gapping marks the slots with a pause in speech or a comma in writing. This kind of slot is called 'unmarked,' but indicated by ∅ for analysis:

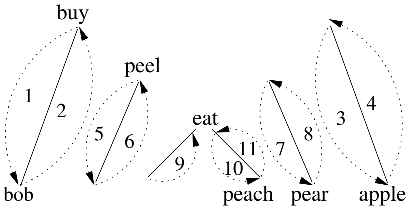
6.2 DBS ANALYSIS OF SUBJECT GAPPING (TExer Sect. 5.2)

Bob bought an apple ∅ peeled a pear, and ∅ ate a peach**.**

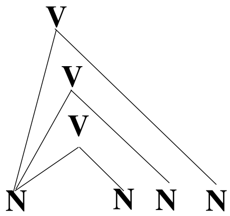
(i) SRG (semantic relations graph)



(iii) NAG (numbered arcs graph)



(ii) signature



(iv) surface realization

1	2	3	4	1	6	7	8	5	9	10	11
Bob	bought	an_apple			peeled	a_pear			and_ate	a_peach	.
V/N^{i}	N^{s}/V	$V\backslash N$	$N\backslash V$	V/N^{s}	N^{s}/V	$V\backslash N$	$N\backslash V$	V/N^{s}	$N^{s}\backslash V$	$V\backslash N$	$N\backslash V$

content

sur: bob noun: [person x] cat: snp sem: nm m fnc: buy peel . . . eat prn: 32	sur: verb: buy cat: #n′ #a′ decl sem: past arg: [person x] apple . . . prn: 32	sur: noun: apple cat: snp sem: indef sg fnc: buy . . . prn: 32	sur: verb: peel cat: #n′ #a′ v sem: past arg: [person x] pear . . . prn: 32	sur: noun: pear cat: snp sem: indef sg fnc: peel . . . prn: 32

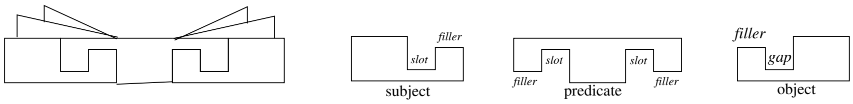
sur: verb: eat cat: #n′ #a′ v sem: *and* past arg: [person x] peach . . . prn: 32	sur: noun: peach cat: snp sem: indef sg fnc: eat . . . prn: 32

In contradistinction to the depth-first numbering of the NAGs in marked slot-filler constructions, the NAG numbering in gapping constructions is breadth-first (TExer Chap. 1). The final gapped item is announced by the function word *and*, coded in the sem slot of the *eat* proplet.

The proplet *bob* serves as the shared subject of the predicates buy, peel, and eat by specifying them in its fnc slot as the *gap list*. The inverse relation from the predicates to their shared subject is established by writing the core value [person x] of *bob* into the first (subject) arg slot of the verbs. The construction is treated as intrapropositional, as indicated by the common prn value 32.

The next gapping construction is predicate gapping, in which a single predicate takes multiple subjects and objects as fillers (three-dimensional):

6.3 PREDICATE GAPPING AS AN ABSTRACT THOUGHT STRUCTURE

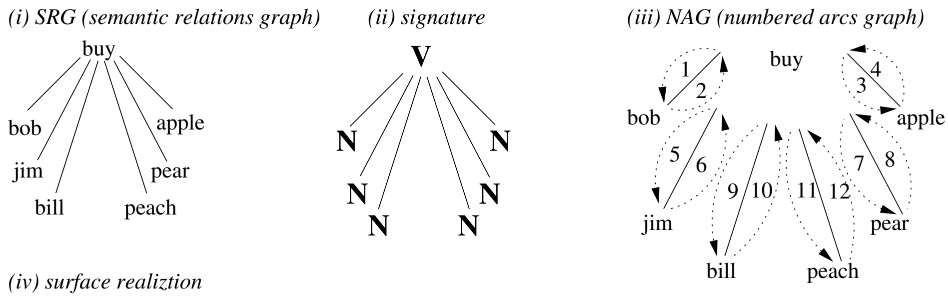


Without the multiple subjects and objects, the graph would equal a simple subject/predicate\object combination.

The canonical DBS graph analysis of predicate gapping may be shown as follows:

6.4 DBS ANALYSIS OF PREDICATE GAPPING (TExer Sect. 5.3)

Bob **bought** an apple, Jim ∅ a pear, and Bill ∅ a peach**.**



(iv) surface realiztion

1	2	3	4	5	6	7	8	9	10	11	12
Bob	bought	an_apple		Jim		a_pear			and_Bill	a_peach	.
V^p/N	N/V^i	V\N	N\V	V^p/N	N/V^p	V\N	N\V	V^p/N	N/V^p	V\N	N\V

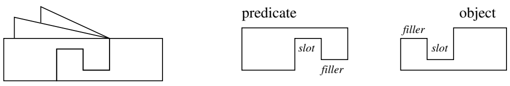
content

sur: Bob noun: [person x] cat: snp sem: nm m fnc: buy ... prn: 33	sur: verb: buy cat: #n′ #a′ decl sem: past arg: [person x] apple [person y] pear [person z] peach ... prn: 33	sur: noun: apple cat: snp sem: indef sg fnc: buy ... prn: 33	sur: Jim noun: [person y] cat: snp sem: nm m fnc: buy ... prn: 33	sur: noun: pear cat: snp sem: indef sg fnc: buy dots prn: 33
sur: Bill noun: [person z] cat: snp sem: *and* nm m fnc: buy dots prn: 33	sur: noun: peach cat: snp sem: indef sg fnc: buy ... prn: 33			

The shared item is the predicate *buy*. Its arg slot contains the gap list, here the subject-object pairs *bob apple, jim pear,* and *bill peach*. The conjunction *and* is coded into the initial sem slot of *bill*. The subject and object proplets take buy as their shared fnc value.

In object gapping a single object is taken by multiple predicates. Its graph is the mirror image of the three-dimensional graph for subject gapping (6.1):

6.5 Object gapping as an abstract thought structure

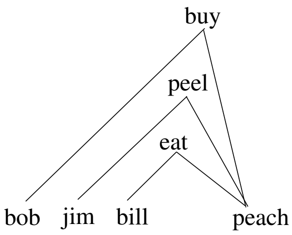


Without the multiple predicates, the graph would equal a simple object\predicate combination (including a predicate without a subject, as in imperatives).

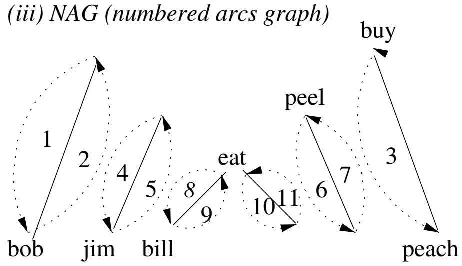
6.6 DBS analysis of object gapping (TExer Sect. 5.4)

Bob bought ∅, Jim peeled ∅, and Bill ate a peach

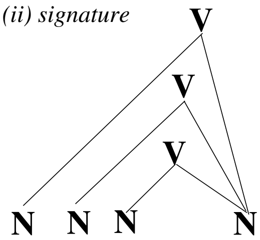
(i) SRG (semantic relations graph)



(iii) NAG (numbered arcs graph)



(ii) signature



(iv) surface realization

1	2	3	7	4	5	6	11	8	9	10	11
Bob	bought			Jim	peeled			and_Bill	ate	a_peach	•
V/N	N/V	V\N^o	N^o\V	V/N	N/V	V\N^o	N^o\V	V/N	N/V	V\N^f	N^f\V

content

[sur: Bob
noun: [person x]
cat: snp
sem: nm m
fnc: buy
...
prn: 34]

[sur:
verb: buy
cat: #n′ #a′ v
sem: past
arg: [person x] peach
...
prn: 34]

[sur: Jim
noun: [person y]
cat: snp
sem: nm m
fnc: peel
...
prn: 34]

[sur:
verb: peel
cat: #n′ #a′ v
sem: past
arg: [person y] peach
...
prn: 34]

[sur: Bill
noun: [person z]
cat: snp
sem: *and* nm m
fnc: eat
...
prn: 34]

[sur:
verb: eat
cat: #n′ #a′ decl
sem: past
arg: [person z] peach
...
prn: 34]

[sur:
noun: peach
cat: snp
sem: indef sg
fnc: buy
peel
eat
...
prn: 34]

Gapping constructions are intrapropositional, like iterated infinitives.

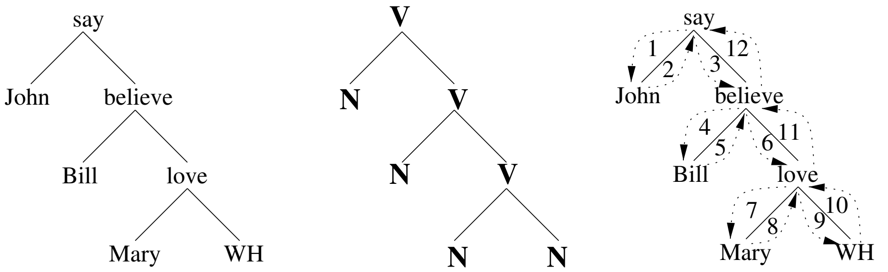
7 Long-Distance Dependency

The slot-filler iteration of object clauses (Sect. 4) may be combined with a single filler-slot relation, taking the filler in first and the slot in last position. This results in the following long-distance dependency (TExer Sect. 5.5):

7.1 OBJECT-CLAUSE ITERATION WITH LONG-DISTANCE DEPENDENCY

Whom did John say that Bill believes that Mary loves?

(i) SRG (semantic relations graph) *(ii) signature* *(iii) NAG (numbered arcs graph)*



(iv) surface realization

3	6	9	10	11	12	1	2	3	4	5	6	7	8	11	12
		Whom				does John	say	that	Bill	believes	that	Mary	loves		?
V\V	V\V	V\N	N\V	V\V	V\V	V/N	N/V	V\V	V/N	N/V	V\V	V/N	N/V	V\V	V\V

[sur:
noun: wh_1
cat: obq
sem: *whom*
fnc: love
. . .
prn: 26&]

[sur:
verb: say
cat: #ns3′ #a′ interrog
sem: *do* pres
arg: [person x] (believe 28)
. . .
prn: 27]

[sur: john
noun: [person x]
cat: snp
sem: nm m
fnc: say
. . .
prn: 27]

[sur:
verb: believe
cat: #ns3′ #a′ v
sem: *that* pres
arg: [person y] (love 26&)
fnc: (say 27)
. . .
prn: 28]

[sur: bill
noun: [person y]
cat: snp
sem: nm m
fnc: believe
. . .
prn: 28]

[sur:
verb: love
cat: #ns3′ #a′ v
sem: *that* pres
arg: [person z] wh_1
fnc: (believe 28)
. . .
prn: 26&]

[sur: mary
noun: [person z]
cat: snp
sem: nm f
fnc: love
. . .
prn: 26&]

As in the object clause iteration 4.1, the slots are marked with the function word that.

In DBS, an unbounded dependency has the form of an unbounded suspension, here between initial whom and the final transitive verb form loves. Because the length of the suspension is only determined at the end of the input sentence, the time-linear surface compositional hear mode derivation has the following syntactic ambiguity structure (NLC 7.6.5):

7.2 AMBIGUITY STRUCTURE OF AN UNBOUNDED SUSPENSION

A	Whom	does	John	love?											
	1	1	1	1											
B		does	John	say	that	Bill	loves?								
		2	2	2	1	1	1								
C					that	Bill	believes	that	Mary	loves?					
					3	3	3	1	1	1					
D								that	Mary	claims	that	Suzy	loves?		
								4	4	4	1	1	1		

This systematic ambiguity does not affect the linear time complexity of DBS because the time-linear derivation replaces each previous reading with the new input. Accordingly, 7.2 has only a single reading, namely D.

Conclusion

This paper investigates grammatical structures which are conspicuous in that they are based on repeated sharing. The question is whether these constructions are (i) limited to a certain language type or (ii) universal in that they may be found in numerous typologically unrelated natural languages. The latter hypothesis is supported by the fact that the iterations discussed have direct structural counterparts in several languages completely unrelated to the European languages, namely Korean[5], Tagalog[6], and Georgian[7]. This is remarkable, and analyzed data from additional languages supporting or opposing the conjecture would be interesting.

[5]Thanks to Professor Kiyong Lee, native speaker of Korean.

[6]Thanks to Mrs. Guerly Söllch, M.A., native speaker of Tagalog.

[7]Thanks to Mrs. Sofia Tekmalaze-Fornwald, M.A., native speaker of Georgian.

Bibliography

CC = Hausser, R. (2019) *Computational Cognition; Integrated DBS Software Design for Data-Driven Cognitive Processing*, `lagrammar.net`

Delshad, F. (2009) *Georgica et Irano-Semitica, Philologische Studien zu den iranischen und semitischen Elementen im georgischen Nationalepos 'Der Recke im Pantherfell'*, Schriften zur Literaturwissenschaft, Wiesbaden `https://www.db-thueringen.de/servlets/MCRFileNodeServlet/dbt_derivate_00003610/Diss.pdf`

Harbsmeier, C. (2001) "May Fourth Linguistic Orthodoxy and Rhetoric" *New Terms for New Ideas*, pp. 373–410, ed. Lackner, Kurtz, Amelung, Leiden: Brill

McCord, M.C. (1980) "Slot Grammars," *American Journal of Computational Linguistics*, Vol. 6.1:31–43

NLC = Hausser R. (2006) *A Computational Model of Natural Language Communication – Interpretation, Inferencing, and Production in Database Semantics*, Springer, pp. 360; 2nd ed. 2017, pp. 363, `lagrammar.net`

Sag, I. (1997) "English relative clause constructions," *Journal of Linguistics*, Vol. 33.2:431-48

Schegloff, E.A. (2007) *Sequence Organization in Interaction,* New York: Cambridge U. Press

TExer3 = Hausser, R. (2020) *Twentyfour Exercises in Linguistic Analysis, DBS software design for the Hear and the Speak mode of a Talking Robot*, pp. 324. DOI: 10.13140/RG.2.2.13035.39200, `lagrammar.net`