Bare resultatives[*]

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Abstract

This paper provides a complex-predicate analysis of resultatives in terms of bare phrase structure. Our main claim is that the predicate types and thematic mapping rules required for simplex verbs can be used to explain core properties of resultative constructions if a strict versions of Chomsky's inclusiveness condition is adopted. The analysis supports a view of subjects as external arguments in the sense of Williams 1980, rather than as structurally defined, as in Stowell 1981,1983, Bowers 1993, etc.

1 Subjects in bare phrase structure
1.1 On the structural definition of subject

The theory of bare phrase structure proposed in Chomsky 1995a is an attempt to reduce the machinery involved in the generation of syntactic trees to a minimum. Its basic assumption, inclusiveness, states that properties of syntactic structure must ultimately derive from information stored in the lexicon. On its most restrictive interpretation, which we will adopt here, it reads as follows:

(1) *Inclusiveness*: The syntactic properties of a non-terminal node are fully recoverable from its daughters; the syntactic properties of a terminal node are fully recoverable from its lexical entry.

By implication, bar levels, coindexation and the like must be dispensed with and analyses relying on such notions must therefore be reconsidered. In this paper we will deal with one such analysis, namely that of subjects as specifiers.

The most common view of subjects in government and binding theory accords them the status of specifier of a lexical head. Thus, the DP in (2) is the subject of X, if X is

[*]We would like to thank Annabel Cormack, Dick Hudson and the students in *Current Issues in Syntax* 2000-2001 for useful comments.

a noun, preposition, adjective or verb (Stowell 1981, 1983; Kuroda 1986; Koopman & Sportiche 1991).

(2) $[_{XP}$ DP $[_{X'}$ ... X ...]]

Specifiers, in this theory, are defined as the unique constituent which is the daughter of a maximal and the sister of an intermediate projection. Without bar levels, this definition of specifier and the associated view of subjects cannot be maintained. The seriousness of the problem becomes clear when we compare the underlying representations assigned to unergative and unaccusative verbs in bare phrase structure ((3a) and (3b) respectively). If subjects are generated in the projection of V, these representations are identical (abstracting away from linear order):

(3) a. $[_V$ DP V]
b. $[_V$ V DP]

There is a way in a theory of bare phrase structure to maintain the view that subjects are specifiers of lexical heads. Chomsky (1995b) defines a head's complement as the first phrase merged with it and its specifier as the phrase merged subsequently. On the assumption that unergative verbs are hidden transitives with an incorporated object, as argued by Hale & Keyser (1993), the structure in (3a) must be revised as in (4). Since the subject is now merged after merger of a nominal category, it counts as a specifier.

(4) $[_V$ DP $[_V$ N-V $t_N]]$

As will be obvious, this analysis stands or falls with the claim that unergatives are hidden transitives. On the face of it, there is some evidence for deriving unergatives through noun-incorporation: many unergative verbs have a nominal counterpart, witness pairs like *a laugh* and *to laugh*. Such pairs would be related by incorporation of the noun into an empty verbal head:

(5) $[_V$ they $[_V$ laugh$_N$-0$_V$ $t_N]]$

Despite its initial appeal, this proposal must be rejected on the basis of empirical evidence, discussed by Don (1993), which suggests that in some cases the noun is derived from the verb, rather than vice versa. This means that at least some unergatives cannot have the underlying structure in (5).

Don analyzes analogous noun-verb pairs in Dutch. The Dutch data are more informative than the English ones, since Dutch nouns either take *het* or *de* as their definite determiner. As in English, Dutch verbs have either regular or irregular verbal inflection. When we look at existing noun-verb pairs in Dutch, all combinations are attested, except one: there are no nouns which take *het* as a definite determiner, while the related verb is inflected irregularly.

(6) *Dutch noun-verb pairs*

	N_{de}	N_{het}
$V_{regular}$	de fiets *the bicycle* fietsen - fietste - gefietst *cycle - cycled - cycled*	het werk *the work* werken - werkte - gewerkt *work - worked -worked*
$V_{irregular}$	de slaap *the sleep* slapen - sliep - geslapen *sleep - slept - slept*	

Don argues that this pattern can be accounted for by assuming two morphological processes, whose existence is in fact supported by a wealth of further evidence. The process in (7a) derives nouns that take *de* from verbs, while the process in (7b) derives regular verbs from nouns. The analysis thus attributes the gap in the paradigm in (6) to the fact that there is no process that can connect a *het*-taking noun with an irregular verb.

(7) a. $V \rightarrow N_{de}$
b. $N \rightarrow V_{regular}$

One consequence of Don's proposal is that irregular unergative verbs cannot be derived from the corresponding noun. On the contrary, the noun *slaap* in (6) must be derived from the homophonic verb. But this means that Dutch irregular unergatives cannot be analyzed as hidden transitives. Therefore, the problem in (3) seems unavoidable for this class of verb: their subject, if generated internally to the verbal projection, is structurally indistinguishable from a complement (and hence from the subject of an unaccusative).

The problem in (3) only arises if we combine inclusiveness (which underlies bare phrase structure) with the assumption that subjects are generated internally to the

projection of the predicative head. Whereas inclusiveness seems unavoidable in a minimalist theory, the same cannot be said about the second assumption. In fact, Williams 1980 and subsequent work argues that subjects are external arguments; that is, generated outside the maximal projection of the predicative head. On this view, it becomes trivial to distinguish the underlying subject of an unaccusative from the subject of an unergative. The former is generated internally to the verbal projection, while the latter occupies a position in the projection of a higher head, represented as α in (8).

(8) a. $[_{\alpha}$ DP $[_{\alpha}$ α V]]
b. $[_{\alpha}$ α $[_{V}$ V DP]]

It seems therefore that bare phrase structure necessitates a view of subjects as VP-external.

1.2 The status of the mediating head

The debate about the position of subjects is directly relevant to the question of how syntactic structures are mapped onto semantic representations. Stowell's uniform definition of subjects as specifiers presupposes that the semantic relation of predication corresponds to exactly one syntactic configuration. By contrast, Williams' theory allows subjects to be realized in a variety of positions, which means that the same semantics can be encoded by more than one structure.

Although bare phrase structure favours an analysis of subjects as external arguments, it does not answer the question whether semantic relations are mapped onto unique syntactic configurations. Indeed, it is fair to say that both Stowell's and Williams' conception of the mapping between syntax and semantics can be incorporated into a minimalist syntax. A one-to-one mapping is guaranteed if the relation between a predicate and its subject is mediated by a unique functional head. This is the line taken in Hornstein & Lightfoot 1987, Bowers 1993, Den Dikken 1995 and other work. Henceforth we will refer to this head as H* and to the analysis assuming it as the single head hypothesis:

(9) *Single Head Hypothesis*
$[_{\alpha}$ $DP_{subject}$ $[_{\alpha}$ α X]], where α = H*

On Williams' approach, the head whose projection hosts subject and predicate does not have a mediating function. Consequently, predication is possible in the projection of any head:

(10) *Arbitrary Head Hypothesis*
$[_{\alpha}\ DP_{subject}\ [_{\alpha}\ \alpha\ X]]$, where α is any head

Consider the effects of the two analyses for secondary predication. If we assume that a predicate and its subject can be hosted by any projection, the minimal structure for sentences containing an object and a subject depictive are as in (11a) and (11b), respectively. In (11a) the head allowing external realization of the subject is V, while *v* has this function in (11b).[1]

(11) a. $[_{v}$ John $[_{v}$ met-*v* $[_{V}$ Mary $[_{V}\ t_{V}$ $drunk_{A}$]]]]
b. $[_{v}$ John $[_{v}\ [_{v}$ met-*v* $[_{V}\ t_{V}$ Mary]] $drunk_{A}$]]

By contrast, if predication involves a unique mediating head, the secondary predicate cannot enter into a direct relation with its semantic subject. Rather, it must be the complement of a H* head, whose specifier is PRO, as shown in (12). The correct interpretation then results from control by one of the arguments of the verb. (Note that *v* must be identified with H* if (9) is correct).

(12) a. $[_{H^*}$ John $[_{H^*}$ met-H* $[_{V}$ Mary $[_{V}\ t_{V}\ [_{H^*}$ PRO $[_{H^*}$ H* $drunk_{A}$]]]]]]
b. $[_{H^*}$ John $[_{H^*}\ [_{H^*}$ met-H* $[_{V}\ t_{V}$ Mary]] $[_{H^*}$ PRO $[_{H^*}$ H* $drunk_{A}$]]]]

There is a trade-off between the complexity of syntactic structures and the complexity of the syntax-semantics mapping. The structures in (11) are maximally simple, but require that predication can be established in more than one syntactic configuration. The structures in (12), on the other hand, allow a maximally simple mapping, but necessitate complications of the syntax. Not only is the structure larger, but in addition a relation of control must be assumed. It will be clear, then, that considerations of simplicity are not sufficient to choose between (9) and (10). The choice is an empirical one.

On the basis of depictives, no convincing empirical argument can be constructed, since PRO is inaudible and the properties of obligatory control and predication are largely identical (although problems concerning the distribution of PRO and the non-availability of optional control remain to be addressed). However, as we will argue in this paper, resultative predicates provide evidence in favour of the view that there is no unique

[1] On this theory, a DP may be related to multiple predicates. See for discussion Chomsky 1986 and Williams 1983, 1994.

externalizing head, as expected if semantic relations can be encoded in more than one syntactic configuration.

1.3 Resultatives

A well-known contrast between depictives and resultatives is that the latter can license an argument that is not licensed by the verb in isolation. The intransitive verb *miaow*, for example, appears in a transitive structure when accompanied by a resultative:

(13) The cat miaowed Frank awake.

On the single head hypothesis, the contrast between depictives and resultatives can be understood if depictive small clauses are adjuncts, while resultative small clauses are complements. In the latter case, the subject of the small clause is governed by a case assigning head (in terms of GB theory) or can move to a case checking position (in minimalist terms). Analyses along these lines have been proposed by Hoekstra 1988 and Bowers 1993:

(14) $[_{H^*}$ The cat $[_{H^*}$ miaowed-H* $[_V\ t_V\ [_{H^*}$ Frank $[_{H^*}$ H* $\text{awake}_A\ ]]$

On the arbitrary head hypothesis, an alternative view of resultatives is available, dating back to Chomsky 1955, which assumes that the verb and the resultative form a complex predicate that functions as the head of the VP. The complex predicate has a θ-grid composed on the basis of the thematic properties of its constituent parts. Thus, resultative sentences are structured as in (15).[2]

(15) a. The cat $[_v$ miaows-*v* $[_V$ Frank $[_V\ t_V\ \text{awake}_A\ ]]]]$
b. De kat zal $[_V$ Frank $[_V$ wakker miauwen]]
the cat will Frank awake miaow

This analysis is incompatible with the single head hypothesis because the externalizing head is a lexical category: V. Indeed, it must be a lexical category, given that it contributes thematic information to the complex predicate. The distinction between depictives and

[2] There is no evidence for overt movement of the verb to *v* in the Germanic OV languages. The movement could be covert or, alternatively, VP-shell formation may be restricted to VO languages (Haider 1997; Neeleman & Weerman 1999).

resultatives, then, is that depictives are adjuncts while resultatives are part of a complex predicate. Since only the head of VP can license argument positions within this constituent, resultatives but not depictives can have transitivizing effect.

The aim of this paper is to show that a cluster of properties associated with resultatives follows straightforwardly from complex predicate formation and in particular the system of θ-grid composition underlying it. The analysis extends the empirical coverage of existing theories of resultatives and at the same time reduces the required theoretical machinery.

In section 2 we develop a system of thematic mapping that derives the θ-grid of simplex verbs from an impoverished lexical semantics. In section 3 we show that the properties of resultative complex predicates can be fully reduced to this system. In other words, principles of thematic mapping do not only determine what is a possible simplex verb but also what is a possible complex predicate. Section 4 contains a summary and evaluation.

2 The thematic interface

A speaker uses two major linguistic resources to construct an LF: a lexicon and a syntax. The lexicon contains semantic information, but has no combinatory capacity. The syntax, on the other hand, is a computational system and can therefore be used to combine lexical items. On standard assumptions, it cannot read semantic information. This implies that there must be a system of encoding, which associates the semantics of a lexical item with features that the syntax can manipulate.

In this section we explore the syntactic encoding of semantic roles. The minimal theory specifies a transparent set of mapping conditions, based on a limited number of semantic and syntactic primitives. As far as the syntax is concerned, we adopt the standard view that syntactic predicates contain an ordered set of (anonymous) θ-roles, of which one may be external. Since this system approaches conceptual necessity, progress in understanding the thematic interface must primarily be based on the further development of a 'grammar' of lexical semantic representations, in so far as it is relevant to mapping.

The literature contains various proposals concerning this 'grammar'. We should particularly mention Borer (1994), Grimshaw (1990), Jackendoff (1990), Pesetsky (1995), Pustejovski (1991), Reinhart (2000) and Wunderlich (1997). For reasons of space, we cannot compare these proposals with our own, but we will indicate where we adopt previous insights.

2.1 Basic assumptions

We distinguish three types of primitive semantic predicates, namely states (abbreviated as ST), activities (ACT) and locations (LOC). Representatives of states are the adjectives and verbs in (16), the verbs in (17) exemplify activities, while the verbs and prepositions in (18) are locations. We indicate predicate types as labeled bracketings and the arity of predicates by lambda-bound variables.

(16) a. $\lambda x\ [_{ST}\ x\ ]$ exist; green, intelligent
b. $\lambda y\ \lambda x\ [_{ST}\ x\ y]$ know, see, understand

(17) a. $\lambda x\ [_{ACT}\ x\ ]$ laugh, shake, work
b. $\lambda y\ \lambda x\ [_{ACT}\ x\ y]$ kiss, hit, stroke

(18) $\lambda y\ \lambda x\ [_{LOC}\ x\ y]$ contain, have, in, into, out of

Two remarks are in order. First, this overview of predicate types does not include events (achievements and accomplishments in Vendler's (1967) terminology). The reason for this is that we do not view events as primitive predicates, but rather as more complex semantic structures, created by embedding of one predicate in another (compare Wunderlich 1997). Second, it has been argued by Bach (1982) and others that there is no semantically relevant distinction between activities and states. We will see, however, that the principles governing the well-formedness of lexical semantic structures distinguish between the three categories we identify.[3]

[3] There is additional evidence for this tripartite classification. The existence of locations is inevitable in view of questions that ask for them (such as *Where is the money?*). The distinction between activities and states is demonstrated by the contrast between (ia) and (ib). The data cannot be explained in terms of the agentivity of the subject, given the well-formedness if (ic).

(i)a. John laughed, but he did not do anything else.
b. #John knew the answer, but he did not do anything else.
c. The machine shook, but it did not do anything else.

By their very nature, predicates must introduce a lambda-bound variable.[4] We assume that they never introduce more than two. Hence, the following semantic well-formedness conditions hold:

(19) a. A semantic predicate must introduce an argument variable.
b. No semantic predicate introduces more than two argument variables.

A third arity condition is required for locations. A state may express a non-relational property and thus be monadic. Similarly, there are monadic non-relational activities. Both types of predicate can also be relational and therefore dyadic. There is no such thing, however, as a non-relational location. This can be clarified as follows. A property ascribed to an entity by a state or activity cannot exist without the entity existing, but a location ascribed to an entity can exist independently of that entity and the entity can exist independently of the location. The property green cannot be in the world without something being green, but a location (say a box) can exist without it containing anything. The suggestion is that a property ascribed to an entity by a state or activity is part of the predicate, while a location must be an argument. If so, the condition in (20) holds:

(20) A locational predicate must introduce two argument variables.

We assume that the arity conditions in (19) and (20) hold at the point at which a lexical semantic representation is introduced into a derivation. θ-role assignment may have the effect that nodes higher in the syntactic representation encode semantic predicates with fewer argument variables.

In predicates with more than one argument, there must be a way of semantically distinguishing the arguments from each other. Following the spirit of Reinhart 2000, we do so by assigning a feature to one of them. The rules for assignment are given in (21), where I stands for initiator, M for mental state and L for locational.

(21) In $[_{\text{PRED}}$ x ...], where PRED is a two-place predicate,
a. x = M if PRED = ST
b. x = I if PRED = ACT
c. x = L if PRED = LOC

[4] It appears that there are no zero-argument verbs. Occasionally, weather verbs are analyzed in this way, but Chomsky (1981:325) argues that the apparently expletive subject in *It rains* must in fact be an argument, given that it can act as a controller in *It often rains without PRO snowing*.

These rules determine the interpretation of two-place predicates depending on their type. The first argument of *know*, *see*, etc., is interpreted as an experiencer, since it is assigned the feature M; the first argument of *kiss*, *hit*, etc., is interpreted as the 'initiator' of the activity, since it is assigned the feature I; the first argument of *contain*, *have*, etc., is interpreted as a location, since it is assigned the feature L. To be sure, we do not pretend that these features are sufficient to distinguish all types of arguments, nor that our set of predicate labels are exhaustive. However, the notions introduced here are sufficient for the purposes of this paper.

(22)	a.	$\lambda y\ \lambda x\ [_{ST}\ x\ y]\ \&\ x = M$	know, see, hear, understand
	b.	$\lambda y\ \lambda x\ [_{ACT}\ x\ y]\ \&\ x = I$	kiss, hit, touch, stroke
	c.	$\lambda y\ \lambda x\ [_{LOC}\ x\ y]\ \&\ x = L$	contain, have, in, into, out of

L is used here as a blanket feature to cover a variety of interpretations, including that of source, goal, trajectory, location and possession. We will not distinguish between these interpretations in what follows, as the system of mapping rules we develop does not need to refer to them.

The features assigned by the rules in (21) may be supplemented in individual lexical entries as appropriate. For instance, the first argument of *watch* is best characterized as both I and M, whereas the first of argument of *hit* does not seem to have M, as is apparent from examples like *the hammer hit the nail*. Thus, the presence of M on its first argument is a lexical, and therefore idiosyncratic, property of *watch*.

Let us now consider how the lexical semantics of the predicates discussed so far is mapped onto θ-grids. For the sake of concreteness, we assume that the syntax expresses ordering as subordination, so that unergative, transitive and ditransitive predicates have the θ-grids in (23a-c). Unaccusative predicates differ from unergatives in that their single θ-role is subordinated, even though no superordinate θ-role is present (cf. (23d)).

(23)	a.	$< \theta >$	unergative
	b.	$< \theta < \theta >>$	transitive
	c.	$< \theta < \theta\ < \theta >>>$	ditransitive
	d.	$<<\theta>>$	unaccusative

The arity of a θ-grid is determined by the mapping principle in (24), which states that there is a one-to-one correspondence between lambda-bound semantic variables and θ-roles.

(24) Given a lexical entry $<R_{Sem}, R_{Syn}>$, where R_{Sem} is a lexical semantic representation and R_{Syn} an associated syntactic node, each lambda operator in R_{Sem}, its restriction and the variable(s) it binds corresponds to a θ-role in R_{Syn} and vice versa.

In the case of the one-place predicates discussed above, the mapping from semantic representation to syntactic θ-grid is trivial. The single argument is realized as an external θ-role. This is as expected, since (23a) is the simplest possible θ-grid:

(25) a. $\lambda x [_{ST} x]$ exist; green, intelligent
a'. $< \underline{\theta}_x >$
b. $\lambda x [_{ACT} x]$ laugh, sleep, snore, work
b'. $< \underline{\theta}_x >$

One might wonder why a single argument predicate would ever be associated with the more complex grid in (23d). We will address this question in section 2.3.

Two-place predicates give rise to the θ-grid in (23b). Since the system of thematic mapping must fully determine the relation between semantic arguments and thematic functions, it must in this case specify which semantic argument will be associated with which θ-role. Linking is based on the features introduced by the rules in (21). In particular, in the case of verbs, arguments marked by a feature are associated with the superordinate θ-role:

(26) a. $\lambda y \lambda x [_{ST} x y] \& x = M$ know, see, hear, understand
a'. $< \theta_x < \theta_y >>$
b. $\lambda y \lambda x [_{ACT} x y] \& x = I$ kiss, hit, touch, stroke
b'. $< \theta_x < \theta_y >>$
c. $\lambda y \lambda x [_{LOC} x y] \& x = L$ contain, have
c'. $< \theta_x < \theta_y >>$

This observation extends to two-place adjectives. Uncontroversial examples of such adjectives are hard to find in English. The reason is that complements of adjectives are introduced by an idiomatic preposition in this language, which raises the question what the thematic structure is of prepositional complements (see Neeleman 1997 for some discussion). The situation is largely comparable in Dutch, but *trouw* 'faithful', *kwijt* 'lost' and several other adjectives take a DP object as well as a DP subject:

(27) a. Jan is [[zijn principes] trouw].
John is his principles faithful
'John is faithful to his principles'
b. Jan is [[zijn paraplu] kwijt].
John is his umbrella lost
'John does not know where his umbrella is'

These adjectives are two-place states and, as will be apparent from the examples, it is the argument marked M that is mapped onto the external θ-role:

(28) a. $\lambda y\ \lambda x\ [_{ST}\ x\ y]\ \&\ x = M$ trouw 'faithful', kwijt 'lost'
b. $< \theta_x < \theta_y >>$

The following linking rule must therefore be assumed for verbs and adjectives:

(29) Given a lexical entry $<R_{Sem}, R_{V/A}>$, where R_{Sem} is a lexical semantic representation and $R_{V/A}$ an associated verbal or adjectival node, a θ-role associated with a semantic variable marked I, M or L in R_{Sem} subordinates a θ-role associated with an unmarked semantic variable in $R_{V/A}$.

This not to say that the linking rules are constant across categories. The semantic argument marked L in a verb like *contain* is mapped onto the external θ-role, while the internal θ-role is associated with the unmarked argument. The mapping is systematically reversed in prepositions, however, as exemplified by the contrast in (30).

(30) a. The box contains chocolates.
b. The chocolates are in the box.

In other words, the mapping in prepositional locational predicates is as below:

(31) a. $\lambda y\ \lambda x\ [_{LOC}\ x\ y]\ \&\ x = L$ in, into, out of
b. $< \theta_y < \theta_x >>$

The relevant mapping principle is given in (32).

(32) Given a lexical entry $<R_{Sem}, R_P>$, where R_{Sem} is a lexical semantic representation and R_P an associated prepositional node, a θ-role associated with an unmarked

semantic variable in R_{Sem} subordinates a θ-role associated with a semantic variable marked L in R_p.

The fact that there is no uniformity in the semantics associated with internal and external arguments across categories provides a strong argument for the existence of thematic mapping.

There is an alternative to this view. Den Dikken (1995) argues that verbs of possession (HAVE) should be decomposed into BE and an incorporated possessive preposition (compare Kayne 1993 for a decompositional approach to auxiliary *have*). Thus, the French example in (33b) is derived from (33a) by (i) movement of *à* to *être,* (ii) a spell-out rule realizing this combination as *avoir* and (iii) movement of the object of the preposition to the subject position.

(33) a. Le livre est à Jean.
the book is to John
b. Jean a le livre.
John has the book

The difference in mapping between prepositions and verbs can be avoided if such a decompositional analysis is applied across the board. Thus, *contain* in (30) must be BE plus IN, *surround* must be BE plus AROUND and a verb like *cover* must be BE plus ON. It is not obvious that this theory relies on fewer assumptions than the one proposed here, since the reversal of internal and external argument (step (iii) in the derivation of (33b)) must be triggered by incorporation of a preposition. Why incorporation would have this effect is not immediately obvious. More importantly, the proposal faces the, in our view insurmountable, problem that there do not seem to be any languages which spell out any possessive or locational verb as *be* with an incorporated preposition. Thus, there is no variant of French in which (33b) takes the form of **Jean à-est le livre*.

Having established the basic components of the thematic interface, we now turn to semantic predicates that have a composite structure.

2.2 Embedding

The types of predicate discussed above are insufficient for the full classification of verbs. It is not necessary, however, to extend the set of primitive semantic predicates. Rather, the meaning of many verbs can be characterized by embedding of predicates (see Jackendoff 1983, Pustejovski 1991, Wunderlich 1997, amongst others). For instance, the

transitive verb *break* expresses an activity that results in a state. This is captured by the representation in (34), which is typical of events (achievements and accomplishments).

(34) $\lambda y\ \lambda x\ [_{ACT}\ x\ [_{ST}\ y\ ]]\ \&\ x = I$ break

The theory developed so far implies three restrictions on embedding. First, since the features I, M and L hold of individuals (variables) rather than predicates, the embedded predicate cannot occupy a position to which such a feature is assigned. Therefore, the following abstract representation is ruled out:

(35) * $\lambda y\ \lambda x\ [_{PRED\text{-}1}\ [_{PRED\text{-}2}\ ...\ x\ ...\ ]\ y\ ]\ \&$ PRED-2 = I/M/L

Second, we have argued that every predicate must introduce at least one variable (cf. (19)). This implies that embedding in the single argument position of a monadic predicate is impossible, because the monadic predicate would not introduce an argument variable:

(36) * $\lambda x\ [_{PRED\text{-}1}\ [_{PRED\text{-}2}\ ...\ x\ ...\ ]]$

Similarly, since a locational predicate must introduce two argument variables (cf. (20)), it cannot embed another predicate:

(37) * $\lambda y\ \lambda x\ [_{LOC}\ x\ [_{PRED}\ ...\ y\ ...\ ]]$

Indeed, there are no variants of locational verbs such that the subject expresses a location which has the effect that the object is in a particular state or engaged in a particular activity.

Third, it is impossible to embed a two-place predicate in a predicate of the same type. This is so, because it results in a complex predicate containing two identically marked arguments. Since semantic arguments are mapped onto θ-roles on the basis of their feature content, the mapping rules cannot syntactically realize both arguments: the associated θ-roles cannot be ordered. Therefore, the following predicates are ruled out in the mapping from lexical semantics to syntax.[5]

[5] This replicates part of Hale & Keyser's (1993) theory of lexical semantics, namely that a causal head cannot select a causal complement. Hale & Keyser state this directly; in the present theory it comes about as a consequence of conditions on thematic mapping.

(38) a. * λz λy λx [$_{ST}$ x [$_{ST}$ y z]] & x = M, y = M
b. * λz λy λx [$_{ACT}$ x [$_{ACT}$ y z]] & x = I, y = I
c. * λz λy λx [$_{LOC}$ x [$_{LOC}$ y z]] & x = L, y = L

The restrictions just mentioned still leave room for various types of embedding. Example (34), repeated here as (39a), is a case of a one-place state embedded as the second argument of a two-place activity. By the rules of feature assignment in (21) the first argument of the activity is marked I, which implies that this argument will be mapped onto an external θ-role, as indicated by the associated θ-grid in (39b).

(39) a. λy λx [$_{ACT}$ x [$_{ST}$ y]] & x = I — break, plough, crumple, paint
b. < θ_x < θ_y >>

As we have seen, embedding of a dyadic predicate in an identical dyadic predicate is ruled out. There is no reason, however, why a monadic predicate could not be embedded as the second argument of its dyadic variant. This option is not available for locations, which are necessarily two-place predicates. However, (40a) and (40b) show that one-place activities can be embedded in activities and one-place states in states.

(40) a. λy λx [$_{ACT}$ x [$_{ACT}$ y]] & x = I — boil, shake, rattle
a'. < θ_x < θ_y >>
b. λy λx [$_{ST}$ x [$_{ST}$ y]] & x = M — like, hate, fancy
b'. < θ_x < θ_y >>

The semantic formula ascribed to transitive verbs like *boil* expresses that they involve an initiated activity which gives rise to a further activity. This should be compared with a simple two-place activity such as *kiss*. When John boils the water, the water ends up bubbling, but there is no similar consequence which results from John's kissing Mary. In the same vein, the formula ascribed to *fancy* expresses that an argument experiences another argument as being in a particular state. For example, if John fancies Mary, he experiences Mary as attractive. Again, there is a contrast with simple two-place states such as *hear*. If John hears Mary, there is no implication that he perceives Mary as being in a particular state.

Note that the system of thematic mapping imposes a restriction on the argument of the embedded predicate: it must not be marked I in (40a) or M in (40b). Just as in (38), this would give rise to a predicate that contains two identically specified arguments whose associated θ-roles can consequently not be ordered. Indeed, there appear to be no

variants of the verbs in (40a) in which the object is interpreted as causal. The objects of the verbs in (40b) are similarly never required to have a mental state.

The lexical semantics in (41a) is a variant of (39a) in which the single argument of the embedded state has been marked M. This expresses the intuition that verbs like *anger* express an event in which an initiated activity gives rise to someone's mental state. Thus, if the newspaper angers John, it causes John to be in a state of anger.

(41) a. $\lambda y\ \lambda x\ [_{ACT}\ x\ [_{ST}\ y\ ]]\ \&\ x = I,\ y = M$ anger, hurt, impress
b. $< \theta_x < \theta_y >>$

Note that the feature M in (41) is not assigned by rule, but must be stored as a lexical property of the verbs in question. The co-occurrence of an argument marked I and an argument marked M allows us to state a further mapping principle: as indicated by the θ-grid in (41b), the argument marked I outranks the argument marked M. Therefore, we supplement (29) with the principle below:

(42) Given a lexical entry $<R_{Sem}, R_V>$, where R_{Sem} is a lexical semantic representation and R_V an associated verbal node, a θ-role associated with a semantic variable marked I in R_{Sem} subordinates a θ-role associated with a semantic variable marked M or L in R_V.

(29) and (42) form a hierarchy I > M/L > 0. In what follows we reserve the term 'most prominent argument variable' for that variable of a semantic predicate which carries the most prominent feature in this hierarchy.

With this in mind, let us turn to permissible instances of embedded dyadic predicates. Two such cases involve embedding of states and locations in activities (cf. (43)). Verbs like *show* express an event in which an initiated activity gives rise to someone experiencing something. Verbs like *give* express an event in which an activity causes something to be in a particular location (recall from note ? that L subsumes possession). As the thematic hierarchy predicts, the argument marked I will be mapped onto the external θ-role, while the θ-role associated with the argument marked M or L outranks the one associated with the argument that remains unmarked.

(43) a. $\lambda z\ \lambda y\ \lambda x\ [_{ACT}\ x\ [_{ST}\ y\ z]]\ \&\ x = I,\ y = M$ show, teach, tell
a'. $< \theta_x < \theta_y < \theta_z >>>$
b. $\lambda z\ \lambda y\ \lambda x\ [_{ACT}\ x\ [_{LOC}\ y\ z]]\ \&\ x = I,\ y = L$ hand, give, throw
b'. $< \theta_x < \theta_y < \theta_z >>>$

There is one issue that has been skirted so far, namely how embedded predicates are interpreted. In fact, it is surprising that embedded predicates exist in lexical semantics at all. Verbs must express a single eventuality, as demonstrated by the fact that there is no coordination of predicates in lexical semantics. If coordination were possible, we would expect to find mappings of the type in (44).

(44) a. $\lambda y\ \lambda x\ [_{ACT}\ x\ ]\ \&\ [_{ST}\ y\ ]\ \&\ x = I$
b. $< \theta_x < \theta_y >>$

In other words, we would expect verbs which express that the subject is engaged in an activity, while the object is in a non-resultant state. A hypothetical example would be a verb HAPPY-WORK, which would mean "subject works and object is happy". Such lexical items are correctly ruled out if verbs express a single eventuality (cf. Cormack & Smith 1999):

(45) Lexical semantic representations express a single eventuality.

Given (45) the existence of embedding in lexical semantics will require interpretive rules which have the effect that the embedded and matrix predicate do indeed express a single eventuality. The content of the rule of embedding in activities can be inferred from the interpretation associated with complex activities like *break*, compared to simplex activities like *kiss*. It is not the case that the second argument of *break*, the embedded state, is interpreted on a par with the second argument of *kiss*, a variable. If John breaks the vase, he causes a particular state. However, if he kisses Mary, he does not cause her. Indeed, individuals cannot be caused.

However, the notion of causation is not sufficiently rigid, since it does not express that the embedded and matrix predicate form a single eventuality. As has been shown by Fodor (1970) and Bittner (1999), amongst others, lexical causatives express direct rather than indirect causation. If Johns paints the door, he causes the door to be painted without the intervention of a third party. In other words, there is a single event in which John affects the door such that the door ends up being painted. This intuition is confirmed by the fact that, if John hired someone to paint the door, one cannot truthfully say that John painted the door. The latter situation can only be expressed syntactically, as in *John got someone to paint the door*.

In sum, the interpretive rule for embedding in an activity expresses that the argument variable in the matrix predicate affects the arguments of the embedded predicate such that the embedded predicate holds true. Crucially, this rule establishes a direct relation

between x and y, with the consequence that the complex structure mentioned in (46) count as a single eventuality.

(46) In $[_{ACT}$ x $[_{PRED}$ ... y ...]], x affects y with the result that y obtains the property expressed by PRED.

A comparable rule for embedding in states can be based on the assumptions that humans classify information about the world as either factual or a matter of opinion (see Hermann & Rubenfeld 1985).[6] Consider the semantics of a complex state like *fancy*. If Mary fancies a beer, she perceives the beer as attractive. This property is not inherent in the beer, but only exists in Mary's perception. In other words, the interpretation of complex states is governed by the rule in (47):

(47) In $[_{ST}$ x $[_{PRED}$ ... y ...]], x experiences y as having the property expressed by PRED.

As in (46), the relation between x and y is direct, in that it cannot be mediated by a third party (indeed it is hard to imagine what such mediation would consist of). Thus, even though the structure mentioned in (47) is complex, it expresses a single eventuality.[7]

Although humans classify states as either factual or perceived, locations and activities seem to be uniformly classified as factual. If so, locations and activities cannot be embedded in states, a desirable result:

(48) a. $*\lambda z\ \lambda y\ \lambda x\ [_{ST}\ x\ [_{LOC}\ y\ z]]\ \&\ x = M$
b. $*\lambda y\ \lambda x\ [_{ST}\ x\ [_{ACT}$ ... y ...]] & x = M

The condition that lexical items express a single eventuality does not only underlie the interpretive rules in (46) and (47); it also disallows recursive embedding of semantic predicates. Given that states may be embedded in both activities and states, one might expect to find states embedded in states which are themselves embedded in an activity. However, verbs expressing this type of semantics (x causes y to experience z as having a particular property) are not attested:

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[6] This is a cognitive classification; we are not implying anything with respect to science or philosophy, where the distinction between fact and opinion is not as clear-cut.

[7] (47) predicts that verbs meaning "subject knows object to have <property>" do not exist. The reason is that the property in question must at the same time be interpreted as perceived (by (47)) and as factual (given the semantics of *know*). The same holds for other states implying factuality (such as *see* and *hear*).

(49) *λz λy λx [$_{ACT}$ x [$_{ST\text{-}1}$ y [$_{ST\text{-}2}$ z]]] & x = I, y = M

The problem with (49) is that it cannot express a single eventuality. Although x is directly related to y by (46), and y is directly related to z by (47), neither of these rules directly relates x and z.[8] Consequently, x and z cannot be interpreted as belonging to the same eventuality.

To summarize, the set of simple predicates in (50a-e) can be extended with predicates derived by embedding. Various restrictions conspire to limit the available types of embedding to those in (50f-j). Notice that this captures Wunderlich's (1997) observation that all three-place verbs have a causative meaning. All such verbs rely on the interpretational principle in (46).

(50) a. λx [$_{ST}$ x]
b. λx [$_{ACT}$ x]
c. λy λx [$_{ST}$ x y] & x = M
d. λy λx [$_{ACT}$ x y] & x = I
e. λy λx [$_{LOC}$ x y] & x = L
f. λy λx [$_{ACT}$ x [$_{ST}$ y]] & x = I
g. λy λx [$_{ACT}$ x [$_{ACT}$ y]] & x = I
h. λy λx [$_{ST}$ x [$_{ST}$ y]] & x = M
i. λz λy λx [$_{ACT}$ x [$_{ST}$ y z]] & x = I, y = M
j. λz λy λx [$_{ACT}$ x [$_{LOC}$ y z]] & x = I, y = L

2.3 Suppression

Although the predicate types in (50) do not exhaust what can be expressed by verbs, it is not necessary to assume additional combinatory operations. All we need to say is that the semantic arguments of a predicate need not all be realized in syntax. In other words, we need a method by which the arity of a predicate can be reduced.

The simplest case of a predicate whose θ-grid contains fewer roles than would be expected on the basis of its semantic structure is represented by verbs like *catch* and *receive*. If John catches a ball, he is involved in an activity that causes the ball to end up in a particular location (say his baseball glove). We would therefore expect *catch* to be a three place predicate, which – much like *give* – projects an AGENT, a THEME and a

[8] By (46), x also has a direct relation with ST-2. It does not, however, have a relation with argument variables contained in ST-2.

GOAL. What makes *catch* different is that the agent and the goal are mapped onto the same θ-role. If John catches the ball, the ball ends up with him. This can be captured by having a single lambda operator bind two argument positions, as in (51a). If mapping is sensitive to the number of lambda operators, the associated θ-grid will be the one in (51b).

(51) a. $\lambda y\ \lambda x\ [_{ACT}\ x\ [_{LOC}\ x\ y]]\ \&\ x = I,\ x = L$ catch, receive, emit
b. $< \theta_x < \theta_y >>$

There are other mismatches between semantic and syntactic arity that do not lend themselves to this treatment. Perhaps the best-known of these is the unergative use of semantically two-place predicates such as *smoke*. If John smokes, then he smokes something. Clearly, we cannot capture this reading by letting a single lambda operator bind two argument positions, since this would give the reading "John smokes himself". Rather, what is required is the rule in (52), adopted from Chierchia 1989, which replaces a lambda operator by an existential quantifier. (The effects of the rule can of course be formalized in various ways, something which is not relevant here).

(52) *Suppression*
$\lambda x \rightarrow \exists x$

An application of (52) to the two-place predicate in (53a), yields (53b), which is mapped onto the θ-grid in (53c).

(53) a. $\lambda y\ \lambda x\ [_{ACT}\ x\ y]\ \&\ x = I$ smoke
b. $\exists y\ \lambda x\ [_{ACT}\ x\ y]\ \&\ x = I$ smoke (unergative)
c. $< \theta_x >$

As is well-known, transitive verbs used unergatively may impose a restriction on the interpretation of the missing object. Thus, if John smokes, the implication is that he smokes tobacco. This could be expressed by enriching the representation in (53b) along the lines of (54).

(54) $\lambda x\ \exists y\ (\text{tobacco } y)\ [_{ACT}\ x\ y]\ \&\ x = I$ smoke (unergative)

Note, however, that such semantic enrichment does not apply in all cases of suppression. For instance, if John is watching or writing, there is no implication as to what he is

watching or writing. Indeed, in many cases where a restriction is present, its nature is highly idiomatic and therefore a matter of lexical storage, witness examples like *Mary is expecting*.

In the case just discussed, suppression targets verbs that exist independently in the language. However, there are also verbs which do not have a variant without suppression. Examples are *shoulder*, *bag* and *drop*. These verbs are all actions that embed a location. Thus, if John drops something, he is involved in an activity that causes the thing he drops to travel along a path. But as opposed to verbs like *send*, *drop* does not project a locational argument. This can again be understood in terms of suppression, resulting in a reduction of the verb's syntactic arity.

(55)a. $\lambda z\ \exists y\ \lambda x\ [_{ACT}\ x\ [_{LOC}\ y\ z]]$ & x = I, y = L position, shoulder, pocket, bag, drop
b. $< \theta_x < \theta_z >>$

As with the unergative use of transitives, suppression in these verbs can be combined with insertion of a restriction, often expressed in the predicate name. Thus, *to shoulder* can be represented as:

(56) $\lambda z\ \exists y$ (shoulder y) $\lambda x\ [_{ACT}\ x\ [_{LOC}\ y\ z]]$ & x = I, y = L shoulder

One might try to dispense with the rule of suppression by postulating a phonologically null syntactic argument in the object position of verbs like *smoke* and *pocket*. This argument could then be the recipient of the apparently suppressed internal θ-role. The impossibility of referring back to suppressed arguments and the ungrammaticality of secondary predication targeting them strongly militates against this view, however:

(57) a. John drinks whisky, but it is of bad quality.
a'. *John drinks, but it is of bad quality.
b. John drinks his vodka cold.
b'. *John drinks cold.
c. John put the rubbish in a bag, but it had a hole in it.
c'. *John bagged the rubbish, but it had a hole in it.

The two ways of reducing a predicate's arity can be combined in a single verb. This is, in fact, typical of verbs of motion, such as *walk* and *run*:

(58) $\exists y\ \lambda x\ [_{ACT}\ x\ [_{LOC}\ x\ y\ ]]$ & x = I, y = L walk, run, jump

Verbs of this type involve an activity in which an individual causes motion of itself along a path. Thus, where in verbs like *catch* the AGENT is identified with the GOAL, in verbs of motion the AGENT is identified with the THEME. In addition, the GOAL is suppressed. We return to verbs of motion in section 3.6, where we will consider the argument structures to which this lexical semantic representation can give rise.

In the cases discussed so far, suppression targets a semantically subordinated argument; that is, an argument that would be mapped onto an internal θ-role. Naturally, suppression is not restricted to such arguments. For example, the alternation in (59) can be understood in terms of suppression of the most prominent semantic argument.

(59) a. John broke the vase.
b. The vase broke *t*.

We repeat the representation of transitive *break* in (60a). (60b) is the lexical semantics of unaccusative *break*, derived from (60a) by suppression of the argument variable *x*.

(60) a. $\lambda y\ \lambda x\ [_{ACT}\ x\ [_{ST}\ y\ ]]\ \&\ x = I$ break (transitive)
a'. $< \theta_x < \theta_y >>$
b. $\lambda y\ \exists x\ [_{ACT}\ x\ [_{ST}\ y\ ]]\ \&\ x = I$ break (unaccusative)
b'. $<< \theta_y >>$

Following Chierchia (1989) and Reinhart (2000), we assume that unaccusatives in general can be characterized as transitive predicates whose most prominent argument variable fails to be mapped.[9] If we assume the condition in (61), the remaining lambda-bound variable in (60b) cannot give rise to an external θ-role, with the consequence that unaccusative *break* has the θ-grid indicated.

(61) Only the most prominent argument variable is linked to an external θ-role.

[9] We do not assume that the source for a verb derived by suppression has to exist independently. Lexical semantics is a mini generative system whose outputs may or may not be stored (this point will be reinforced by our analysis of complex predicates). Hence, a distinction should be made between possible and actual lexical semantic representations. The same distinction exists in morphology. As argued by Allen (1978) and Di Sciullo & Williams (1987), words which are part of the lexicon may contain parts which are not stored independently. An example is *church goer*. Neither *church go* nor *goer* is part of the lexicon of English speakers.

The proposed analysis makes certain predictions about the types of predicates that underlie unaccusative syntax. Certain combinations of syntactically expressed arguments and associated lexical semantics can only be the result of suppression of the most prominent argument variable. Such combinations will therefore uniformly give rise to grids lacking an external θ-role. For example, we have argued that there are no one-place locations. Consequently, monadic locational
verbs must be derived through suppression of the argument marked L. Therefore, verbs like *stay* and *remain* are predicted to display unaccusative characteristics:[10]

(62) a. $\lambda y\ \exists x\ [_{LOC}\ x\ y]\ \&\ x = L$ stay, remain
b. $<< \theta_y >>$

This prediction is borne out by the fact that these verbs form perfectives with BE rather than HAVE in languages like Dutch. Other tests for unaccusativity converge, but will not be discussed here.[11]

(63) Jan is/*heeft gebleven
John is/has remained

A second group of unaccusative verbs express an activity with a resulting location, but project only the THEME. In such verbs, the argument variables marked I and L are suppressed, with the effect that the resulting unmarked argument must be mapped onto an internal θ-role:

(64) a. $\lambda z\ \exists x\ \exists y\ [_{ACT}\ x\ [_{LOC}\ y\ z]]\ \&\ x = I, y = L$ stumble, fall, tumble, appear
b. $<< \theta_z >>$

Indeed, these verbs take BE in the perfect in Dutch:

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[10] Suppression of the argument marked L is also attested in prepositional adverbs:

(i) $\lambda y\ \exists x\ [_{Loc}\ x\ y]\ \&\ x = L$ home, upward, north-bound

[11] This class of verb is problematic for theories which propose an aspectual characterization of unaccusatives (Van Valin 1990, Borer 1994, Van Hout 1994), since its members display durative aspect, rather than the terminative aspect claimed to be typical of such verbs. See Everaert 1994 and Reinhart 2000 for further arguments against the aspect-based approach.

(65) Jan is/*heeft gestruikeld.
John is/has stumbled

A very similar semantics, but now involving a resultant state, must be assigned to verbs like *wither* and *die*. Unaccusative *break*, as discussed above, belongs to the same class.

(66) a. $\lambda y\ \exists x\ [_{ACT}\ x\ [_{ST}\ y\ ]]\ \&\ x = I$ melt (unacc.), end (unacc.), wither, die
b. $<< \theta_y >>$

Unaccusativity is again confirmed by the perfect in Dutch:

(67) De plant is/*heeft verwelkt.
the plant is/has withered

This concludes our discussion of the system of thematic mapping. In the following section we turn to complex predicate formation and show that the properties of resultative complex predicates can be fully reduced to this system.

3 Complex predicate formation

The central question in understanding complex predicate formation is which relations obtain between the complex predicate and its parts. We argue that the non-verbal predicate is related to the complex predicated by an operation of copying, whereas the head is related to it through thematic mapping.

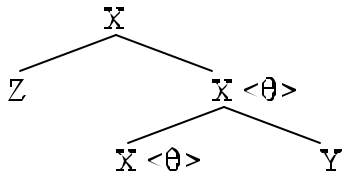
3.1 Inclusiveness and relations between nodes

The inclusiveness condition that underlies bare phrase structure has effects for the way in which θ-roles are assigned. In many cases arguments are generated as sisters to the predicate that selects them, which implies that θ-role assignment in accordance with inclusiveness is possible. Crucially, it can be determined in the mother node, by inspection of its daughters, that the selectional requirements of the predicate are satisfied. Hence, the arity of the mother node will be reduced by one (see Neeleman & Van de Koot 2000 for discussion).

(68) *Inclusiveness*: The syntactic properties of a non-terminal node are fully recoverable from its daughters; the syntactic properties of a terminal node are fully recoverable from its lexical entry.

However, if the predicative category is not a sister of the argument, inclusiveness triggers copying of its θ-roles to dominating nodes until assignment under sisterhood can take place. In order to see this, consider the tree in (69).

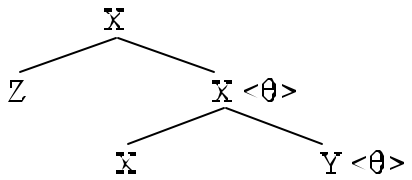
(69)



Suppose that the θ-role originating in the head X is to be associated with Z. Doing so directly would violate inclusiveness. The node that immediately dominates Z does not dominate the node that introduces the θ-role, so that direct satisfaction of the θ-role by Z is only possible if both Z and the head X (a daughter of a daughter) are accessed from the root node, contra inclusiveness. It follows that the θ-role introduced by the head must be copied to its mother, after which it can be assigned under sisterhood. Copying of θ-roles will always be necessary if an argument of a predicative category is not its sister (as in the case of multiple argument verbs).

Copying of θ-roles is also necessary to accommodate secondary predication under the arbitrary head hypothesis of section 1. Suppose that in (70) Y is a predicative category whose external θ-role is to be assigned to Z. By the same logic that applied to (69), the external θ-role of Y will have to be copied to the sister of Z in order to allow assignment. (For the time being, we ignore possible thematic properties of X and the way they are integrated with those of Y).

(70)



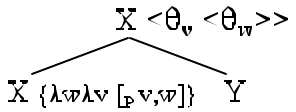
Structures of this type are exemplified by depictives. In the example below, Y would be *warm*:

(71) John drank the milk warm.

3.2 Delayed mapping

In section 2, we have introduced principles which govern the mapping of lexical semantics to θ-grids. So far we have assumed that the operation take place within a terminal node. However, inclusiveness makes available a second environment for mapping: it allows the lexical semantics of a head to be mapped onto a θ-grid in its first projection. In (72), the θ-grid in the X's first projection is recoverable from X's lexical semantics. We will henceforth refer to this option as delayed mapping:

(72)

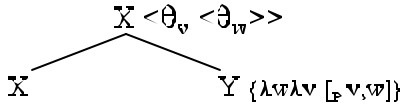


Given that θ-roles can be copied from a head as well as a non-head, the question arises whether the same is true of delayed mapping. In (72), mapping is from a head to its first projection. Would it also be possible to map from Y to the immediately dominating X? We assume that the answer to this question is negative: by (24), repeated here as (73), mapping must be to an associated syntactic node. Since a projection is a syntactic copy of its head in bare phrase structure, it indeed counts as such, so that mapping as in (72) is possible.

(73) Given a lexical entry $<R_{Sem}, R_{Syn}>$, where R_{Sem} is a lexical semantic representation and R_{Syn} an associated syntactic node, each lambda operator in R_{Sem}, its restriction and the variables it binds corresponds to a θ-role in R_{Syn} and vice versa.

In (74) below, however, the node that dominates Y is not a copy of Y. Hence, mapping from Y to X violates (73).

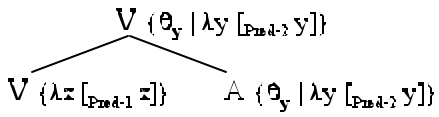
(74)



Delayed mapping and the copying of θ-roles, both implied by inclusiveness, conspire to create a loophole which is sufficient for complex predicate formation to take place. Suppose that a monadic verb with unmapped lexical semantics is merged with an

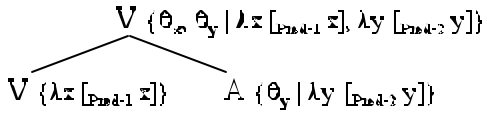
adjectival predicate. Due to (73), mapping will already have taken place internally to the adjective's projection, so that the only permissible relation between A and V is copying, as in (75). (Here and below we present thematic information in nodes in the following format: {θ-roles | associated semantics}).

(75)



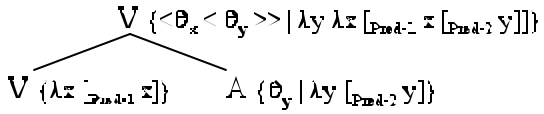
Since the lexical semantics of the verb has not been mapped yet, delayed mapping is possible. As a second step in the process of complex formation, the lambda operator, its restriction and the variable it binds will give rise to a second θ-role in the node that dominates A:

(76)



The third step involves the ordering of the θ-roles in the complex predicate. This ordering is accompanied by the integration of the lexical semantics of A and V in accordance with the principles established in section 2. We discuss semantic integration in detail in section 3.3. Here, we only consider the question what allows the θ-role of the non-verbal predicate to be ordered with respect to the θ-role associated with the verb's semantics. Crucially the relation between the two verbal segments involves mapping, a process comprising of both the linking of lexical semantics to one or more θ-roles and the subsequent ordering of these roles in a grid. The ordering of the θ-role copied from the adjective is parasitic on the latter component of mapping.

(77)



We do not wish to suggest that the representation in (75) and (76) exist as independent steps in a linguistic derivation, but for expository reasons we continue to discuss complex predicate formation as involving the three stages described above.

In conclusion, delayed mapping in combination with copying makes it possible to derive a new θ-grid for the complex predicate, different from both that of the adjectival predicate and that of the verb in isolation.

3.3 Semantic integration

So far we have only considered an abstract characterization of complex predicate formation. Let us now turn to some concrete examples to see what the process exactly entails, in particular as regards the semantic integration of verb and resultative. The examples to be discussed are given in (78). They vary in the nature of the verb (unergative, transitive and unaccusative, respectively); variation in the non-verbal predicate will be addressed below. For now, we mostly restrict ourselves to stative resultatives.

(78) a. dat Jan zijn handen stuk werkt.
that John his hands to-pieces works
b. dat Jan de kwast stuk breekt.
that John the brush to-pieces breaks
c. dat de vaas stuk breekt.
that the vase to-pieces breaks

The first question to ask is what semantics is contributed by the non-verbal predicate. It is implicit in the mapping principles formulated in section 2 that a θ-role encodes a lambda operator, a thematic variable and any restriction that limits the interpretation of the variable. This implies that the θ-role copied to the complex predicate can be represented as follows:

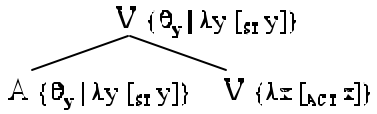
(79) $\{\theta_x \mid \lambda x\ [_{ST}\ x]\}$ stuk

In accordance with the system of lexical semantics developed above, the verbs in (78) can be characterized as below. Note that we do not include θ-roles in the sets of verbal properties, since these will result from the mapping to the complex predicate:

(80) a. $\{\lambda y\ [_{ACT}\ y]\}$ werken
b. $\{\lambda z\ \lambda y\ [_{ACT}\ y\ [_{ST}\ z]] \ \&\ y = I\}$ breken (transitive)
c. $\{\lambda z\ \exists y\ [_{ACT}\ y\ [_{ST}\ z]] \ \&\ y = I\}$ breken (unaccusative)

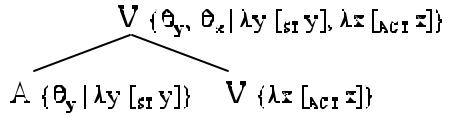
The first step in deriving (78a) involves copying of the AP's θ-role and its associated semantics to the complex predicate:

(81)



Subsequently, the lexical semantics of the verb is mapped onto a θ-role in the dominating node:

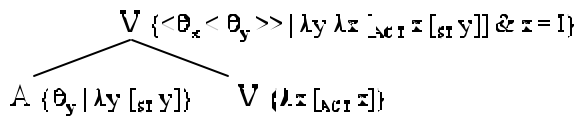
(82)



The final step involves ordering of the θ-roles and the integration of the lexical semantics of verb and adjective. The ordering and semantic integration must satisfy principles which hold of θ-grids, lexical semantic representations and their mapping. The joint effect of these principles is to allow integration by identification or embedding of predicates. Identification, by its very nature, is restricted to predicates that have the same arity and label. It has the effect that the θ-roles associated with the identified predicates cannot be ordered with respect to each other, so that they collapse into a single role (see Neeleman & Van de Koot 2000 for discussion). Integration through embedding is subject to the principles of section 2.2. It never gives rise to the collapse of θ-roles, but instead requires subordination of one with respect to the other in accordance with the thematic hierarchy.

Since the two predicates to be integrated in (82) have different labels, identification is impossible. Moreover, states can be embedded in activities, but not vice versa. The only option then, is to derive the semantic formula in (83), where the 'x = I' clause is an enrichment resulting from the application of (21b).

(83)



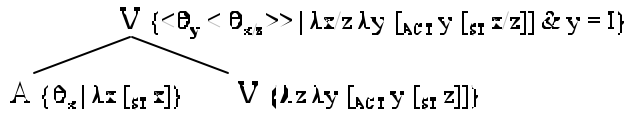
Given this semantic formula, the principles of the thematic hierarchy dictate that the complex predicate be assigned the θ-grid indicated. It follows, in other words, that resultatives have a transitivizing effect when they are combined with an unergative verb. Indeed, this appears to be a systematic property of resultatives.

Let us now turn to the example in (78b), which is headed by a transitive verb. As before, the θ-role of the non-verbal predicate is copied onto the complex predicate, including the associated semantics. Moreover, the semantics of the verb (given in (80b)) gives rise to two further θ-roles which jointly encode the verb's thematic properties. Thus, prior to semantic integration, the complex predicate contains the information below:

(84) $\{\theta_x, \theta_y, \theta_z \mid \lambda x\,[_{ST}\ x], \lambda z\ \lambda y\,[_{ACT}\ y\,[_{ST}\ z]] \ \&\ y = I\}$

Of the available options for integration, only identification of the adjective's state with the state supplied by the verb yields a grammatical representation. In particular, the state supplied by the verb cannot embed the adjective's state without violating the condition that lexical semantic representations express a single eventuality (see section 2.2 for discussion of the impossibility of recursive embedding). Identification of the states results in the semantic representation associated with the complex predicate in (85), which is related by the thematic hierarchy to the θ-grid indicated. Since the θ-roles associated with the two states remain unordered, they count as one and the same role. The resulting complex predicate has a simple transitive grid, as required.

(85)

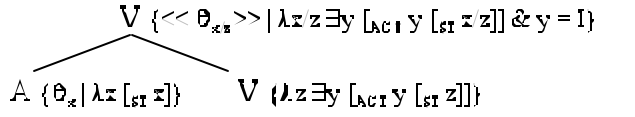


Finally, consider the example in (78c), which involves a complex predicate based on the unaccusative verb *breken* 'break'. After mapping of the verb's lexical semantics and copying of the adjective's θ-role, the complex predicate will contain the following information:

(86) $\{\theta_x, \theta_z \mid \lambda x\,[_{ST}\ x], \lambda z\ \exists y\,[_{ACT}\ y\,[_{ST}\ z]] \ \&\ y = I\}$

By the same logic that applied to (78b), the only grammatical semantic integration involves identification of the verb's and the adjective's states. This will give rise to a θ-grid in which the θ-roles associated with these states cannot be distinguished and hence collapse. Moreover, since the highest argument variable is existentially bound, the complex predicate will have an unaccusative grid:

(87)



3.4 Effects of integration

As we have seen, the system of semantic integration accounts for the fact that resultative predicates added to an unergative verb have a transitivizing effect. We now show that an analysis based on integration has a number of further consequences.

First, it explains why resultatives have a resultative reading. This is a consequence of the independently motivated interpretational rule in (46), which also underlies the resultative reading of simplex verbs like *break* ('cause to be broken'). The theory does not require a construction-specific mechanism for determining the semantics of complex predicates, in contrast to the small-clause analyses of resultatives. Hoekstra 1988, for example, assumes that a special RESULT role is assigned to small clauses in the complement position of activity verbs. It remains unclear why this role is never assigned to full-fledged clausal arguments. In fact, paraphrases of the resultative construction involve an adjunct rather than a complement clause:

(88) a. Jan verft [de deur groen].
b. *Jan verft [dat de deur groen wordt]
c. Jan verft de deur [met het resultaat [dat de deur groen wordt]]

Matters are made worse for the small clause analysis by the observation that the semantics of resultatives involves direct causation. In (88a), the activity of painting and its effect on the door form a single eventuality. This is confirmed by the fact that no place or time adverbial can modify the resulting state. Thus, although the matrix and embedded predicate can be modified independently in a syntactic causative, this is impossible for the alleged small clause structure in (89b) (despite the fact that it is not implausible that Frank wakes up in the bedroom as a result of the cat miaowing in the garden).

(89) a. Bill made [[Frank win] in Moscow] by training him in the Swiss mountains.
b. *In the garden, the cat miaowed [[Frank awake] in the bedroom].

These problems do not arise under the complex predicate analysis, since it relies on the lexical semantic rule in (46), which implies direct causation and thus excludes modification of the resulting state.[12]

[12] An alternative view classifies resultatives in aspectual terms. They mark terminative aspect by expressing the endpoint of an action. This view is invalidated by examples like (i), which are durative.

Second, the interpretational rule just mentioned also predicts that resultative complex predicates are exclusively headed by a verb expressing an activity. After all, the rule's structural description mentions predicates embedded in activities. Indeed, there is a contrast between the complex predicates discussed so far, which are headed by an activity verb, and the ones in (90b), which are headed by a verb that denotes a state.

(90) a. *John hears himself deaf.
b. *John understands himself smart.

Third, given that a resultative reading is tied to embedding of a predicate in the second argument position of the activity, and given the mapping principles that relate lexical semantics to θ-grids, it follows that resultative predicates must be object-oriented. Let us briefly indicate the logic underlying this conclusion. Activities, like every other type of predicate, must introduce an argument variable. If the activity also contains an embedded predicate, its argument variable must be marked I, which makes it the most prominent argument variable in the complex predicate. It therefore blocks mapping of argument variables contained in the embedded predicate to an external θ-role, by condition (61). This is true regardless of whether the first argument of the activity has undergone suppression.

Simpson (1983) observes that, as expected, resultatives are uniformly predicated of the object. Consider the contrast between (91a) and (91b). In (91a), *moe* 'tired' cannot be predicated of *Jan* on a resultative reading. (91b) is grammatical, since *moe* is predicated of the reflexive, which is in turn bound by *Jan*.

(91) a. *Jan rijdt de auto moe. (resultative subject-oriented reading)
John drives the car tired
b. Jan rijdt zich moe.
John drives himself tired

Essentially the same pattern is found with unergative verbs:

(92) a. *Jan werkt moe. (resultative subject-oriented reading)
John works tired
b. Jan werkt zich moe.

(i) Jan schuurde het hout urenlang/*in een uur steeds gladder.
John sanded the wood for-hours/in an hour ever smoother

John works himself tired

The only case in which a resultative can be associated with a surface subject is if the latter has moved from an underlying object position:

(93) a. *De vaas heeft stuk gebroken.
the vase has to-pieces broken
b. De vaas is *t* stuk gebroken.
the vase is to-pieces broken

Fourth, the proposed analysis accounts for various semantic restrictions on the object in a resultative sentence. The argument-taking properties of the verb correlate with the interpretation of the object in the following ways:

(94) a. If the verb that heads a resultative construction is obligatorily transitive, then the object is obligatorily interpreted as both the external argument of the resultative predicate and the internal argument of the verb.
b. If the verb that heads a resultative construction is optionally transitive, then the object is obligatorily interpreted as the external argument of the resultative predicate and optionally as the internal argument of the verb.
c. If the verb that heads a resultative construction is unaccusative, then the raised subject is obligatorily interpreted as both the external argument of the resultative predicate and the internal argument of the verb.

These restrictions fall out from the fact that an optionally transitive verb like *paint* can participate in the configurations in (83) and (85), whereas an obligatorily transitive verb like *break* can only appear in the latter. Similarly, the single θ-role of an unaccusative verb is obligatorily assigned, with the effect that the configuration in (87) is the only one available. (94) is illustrated by (95), (96) and (97):

(95) a. Jan breekt *(de vaas).
John breaks the vase
b. Jan heeft de vaas stuk gebroken.
John has the vase to-pieces broken
c. *Jan heeft zijn handen moe gebroken.
John has his hands tired broken

(96) a. Jan verft (de deur).
John paints the door
b. Jan heeft de deur groen geverfd.
John has the door green painted
c. Jan heeft de kwast stuk geverfd.
John has the brush to-pieces painted

(97) a. Het papier/*er scheurt *t*.
the paper/there tears
b. Het papier scheurt *t* stuk.
the paper tears to-pieces
c. *De prullenbak scheurt *t* vol.
the bin tears full

As is apparent from (95a), *breken* 'break' is obligatorily transitive. Indeed, the resultative example in (95c), in which the object of the complex predicate cannot be interpreted as bearing the verb's internal θ-role, is ungrammatical. The situation is different with the verb *verven* 'paint', which is optionally transitive. Here, the object of the complex predicate can or cannot be interpreted as the verb's object. (96b) and (96c) are thus both allowed. Finally, (97a) shows that the single θ-role of an unaccusative is assigned obligatorily. As expected, the single argument in (97b,c) must be interpreted as the recipient of this θ-role.

Carrier & Randall (1992) and Neeleman & Weerman (1993) point out that the small clause analysis can only accommodate these data by assuming that a verb like *break* exceptionally θ-marks the small clause subject. This is an unwanted assumption since there is no independent evidence for the option of downward θ-marking. Furthermore, variation must be allowed in the position to which the internal θ-role of a verb is assigned, contra the UTAH. This is unfortunate, because the single head hypothesis, which underlies the small clause analysis, is based on UTAH.

The final prediction made by the system of semantic integration described above is that double object constructions do not allow resultative predication. Crucially, the semantic representation of a double object verb consists of an activity which embeds a two-place predicate. The non-verbal predicate is a maximal projection and therefore monadic (see Neeleman & Van de Koot 2000 on the ungrammaticality of dyadic maximal projections). Therefore, prior to semantic integration, a resultative complex predicate headed by a double object verb contains the following information:

(98) $\{\theta_w, \theta_x, \theta_y, \theta_z \mid \lambda w\ [_{ST}\ w], \lambda z\ \lambda y\ \lambda x\ [_{ACT}\ x\ [_{ST}\ y\ z]] \ \&\ x = I, y = M\}$

As explained earlier there are two methods of semantic integration: embedding and identification. Embedding of the resultative state is ruled out, because it would yield a structure involving recursive embedding, contra the condition that lexical semantic representations express a single eventuality. Identification is also ruled out, since the arity of the embedded verbal state does not match that of the resultative state. In other words, since neither identification nor embedding is an option in this case, resultative complex predicates based on double object verbs are ruled out.

This prediction is borne out. The example in (99) cannot mean that John gives Mary the book in such a way that it ends up being torn.

(99) *Jan geeft Marie het boek stuk. (resultative direct object-oriented reading)
John gives Mary the book to-pieces

The ungrammaticality of this example cannot be due to some general restriction against complex predicates in the head position of a double object construction. As shown by (100), verb-particle combinations can select two objects. This is expected under our proposal, since particles differ from resultatives in that they do not have to be interpreted as predicates. This is apparent from the fact that there are unergative particle constructions, such as *John gave up*.

(100) Jan geeft Marie het zout door.
John gives Mary the salt through
'John passes Mary the salt'

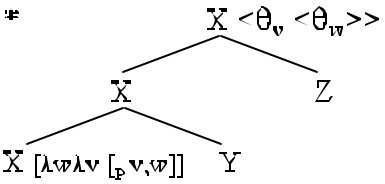
We now turn to a number of further predictions, which derive from the structural configuration in which delayed mapping and semantic integration take place.

3.5 Effects of inclusiveness

Complex predicate formation involves delayed mapping of the head's thematic information as well as copying of the non-head's thematic role. We now argue that this has the consequence that the head of a complex predicate cannot itself be complex, whereas the non-head can.

Delayed mapping, like copying, is constrained by inclusiveness. The node containing the θ-grid that is the output of delayed mapping must immediately dominate the node containing the input semantics. Mapping across an intervening node violates inclusiveness, as the thematic properties of the top node in (101) cannot be recovered from its daughters:

(101) *



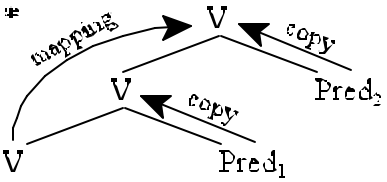
This explains why a resultative predicate cannot be separated from the verb by adverbial material (modulo cases in which the verb or the resultative move). The relevant restriction is easily demonstrated in Dutch:

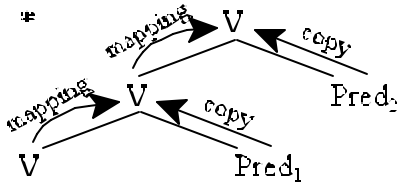
(102) a. *Jan heeft de vaas [$_V$ stuk$_A$ [$_V$ gisteren$_{Adv}$ gebroken]].
John has the vase to-pieces yesterday broken
b. *De kat heeft Frank [$_V$ wakker$_A$ [$_V$ luid$_{Adv}$ gemiauwd]].
the cat has Frank awake loudly miaowed

In English, too, there is handful of resultative expressions in which the verb is not separated from the non-verbal predicate by movement to *v*. Exactly in those cases, the adjacency effect can be observed:

(103) a. John quickly cut open the box.
a'. *John cut quickly open the box.
b. John probably made clear his intentions.
b'. *John made probably clear his intentions.

The theory developed here also disallows complex predicate formation on the basis of a complex predicate (that is, complex predicate formation is predicted to be non-recursive). Potentially, this could involve the two derivations depicted in (104).

(104) a. 

b. 

In (104a), the head with unmapped lexical semantics merges with two predicates in succession, after which delayed mapping applies to create a θ-grid in the topmost node. This scenario faces the same problems as the one involving merger of an adverbial prior to complex predicate formation: it violates inclusiveness, because delayed mapping takes place across an intervening node.

In (104b), the head with unmapped lexical semantics enters into two consecutive processes of complex predicate formation, each involving an operation of delayed mapping. This derivation is excluded as well, because the first of these processes exhausts the available unmapped semantics in the verb. The second instance of complex predicate formation therefore requires an unlicensed operation of mapping.

The non-recursivity of complex predicate formation is illustrated by the data in (105) (see Neeleman 1994 for discussion); similar data can be given for English (see Roeper & Keyser 1992).

(105) a. dat Jan de aardappelen [gaar kookt].
that John the potatoes done boils
b. dat Jan de aardappelen [stuk kookt].
that John the potatoes to-pieces boils
c. *dat Jan de aardappelen [stuk [gaar kookt]].
that John the potatoes to-pieces done boils

The generalization extends to complex predicates derived by merger of a verb and a particle, followed by merger of a resultative predicate:[13]

[13] The claim that a particle and a resultative cannot be combined seems to be contradicted by (i).

(i) dat Jan de deur groen bij verft

(106) a. dat Jan zijn moeder belt.
that John his mother phones
b. dat Jan zijn moeder op belt.
that John his mother up phones
c. dat Jan zijn moeder af belt.
that John his mother off phones (cancels an appointment by phone)
d. dat Jan zijn moeder gek belt.
that John his mother crazy phones
e. *dat Jan zijn moeder af op belt.
that John his mother off up phones
f. *dat Jan zijn moeder gek op belt. (on a resultative reading)
that John his mother crazy up phones

Whereas the thematic contribution of the head of the complex predicate depends on mapping, the non-head makes its contribution through copying of a θ-role. Since copying is an operation that can apply recursively, it is not restricted to contexts in which unmapped lexical semantics is accessible. This implies that the non-head of a complex predicate may have internal structure, a prediction borne out by the data in (107).

(107) a. Jan heeft de deur [[erg groen] geverfd].
John has the door very green painted
b. Jan heeft de kwast [[aan stukken] geverfd].
John has the brush to pieces painted

---

that John the door green up touches

However, there is little evidence that *groen* in (i) is a resultative. The semantics of (i) is not that of a resultative construction: the act of touching up does not lead to a green door. Rather, *groen* is interpreted as 'with green paint'.

Furthermore, modifiers of this type do not have the transitivizing effect, typical of resultatives. If the particle verb is unergative, as in (iia), addition of a modifier does not give rise to a transitive structure (see (iib)). In other words, all grammatical structures of the type in (i) involve a transitive particle verb, which is unexpected if we are dealing with resultatives.

(ii) a. dat de krant af geeft
that the newspaper off gives
b. dat de krant (*mijn handen) zwart af geeft
that the newspaper (my hands) black off gives

The hypothesis that the head and the non-head contribute in different ways to the complex predicate also predicts that all information in the head can be involved in thematic mapping, while inheritance from the non-head is restricted to its external θ-role. It will be clear that internal θ-roles must be assigned within the projection in which they originate; only external roles can be copied from one projection to the next. It trivially follows that internal θ-roles of the non-verbal predicate cannot be involved in complex predicate formation. This prediction is borne out, as demonstrated by the following directional resultatives in Dutch:

(108) a. Jan rijdt een leuke auto.
John drives a nice car
b. Jan heeft de auto [[naar Den Haag] gereden].
John has the car to the Hague driven
c. *Jan heeft Den Haag de auto [naar gereden].
John has the Hague the car to driven

As (108a) shows, the verb *rijden* 'drive' may assign an internal as well as an external θ-role. Both these roles have been assigned in (108b), which suggests that both are inherited by the complex predicate. By contrast, the internal θ-role of the non-verbal predicate cannot be assigned to an argument in VP. In (108b), the PP *naar Den Haag* 'to The Hague' and the verb *rijden* form a complex predicate. The THEME of the preposition has given rise to a verbal internal θ-role, which is assigned to *de auto* 'the car'. Although verbs can in principle host a GOAL argument, (108c) shows that the semantics corresponding to the internal argument of the preposition *naar* cannot motivate a second internal θ-role in the grid of the complex predicate.

Finally, since inclusiveness implies that complex predicate formation is restricted to a head and its sister, one would expect complex predicates to behave as constituents. This cannot easily be shown in a language like English, in which the verb raises to *v*. However, such movement does not take place in an OV language, such as Dutch, at least not in overt syntax. Indeed, Dutch resultatives seem to form a unit with the verb under all known constituency tests (see also Hoeksema 1991). As is shown in (109a), they can jointly head a so called nominal infinitive, the Dutch version of the English gerund. This is not something non-constituents, such as the indirect object and the verb in (109b) can do.

(109) a. het *wakker miauwen* van Frank
the awake miaowing of Frank

b. *het *Frank voorstellen* van Marie
the Frank introducing of Mary
'the introduction of Mary to Frank'

A further argument can be based on the observation that stranded prepositions must be adjacent to the verb (cf. (110a)). The fact that such a preposition can precede a resultative indicates that it has a particularly close relation with the verb (cf. (110b)).

(110) a. *Dit is het geluid waar de kat Frank mee gisteren irriteerde.
this is the sound that the cat Frank with yesterday irritated
b. Dit is het geluid waar de kat Frank mee *wakker miauwde*.
this is the sound that the cat with awake miaowed

Finally, consider (111), in which verb and resultative are jointly topicalized. Similar examples are usually discarded as evidence for constituency on the grounds that Dutch has remnant topicalization. In the case at hand, such an analysis is excluded since it cannot accommodate the pro-form *dat* which is coreferent with *groen verven* 'green paint' rather than *de deur groen verven* 'the door green paint'.

(111) [Wakker miauwen], dat doet-ie Frank niet t_{dat}.
awake miaow that does-it Frank not

As will be obvious, none of these data can be easily accommodated under the small clause analysis. In fact, that analysis predicts that object and resultative should behave as a constituent, contrary to fact. Whereas the ECM complement in (112a) allows substitution by a pronoun, the alleged small clause in (112b) does not.

(112) a. Bill expected *Frank to win* and Peter expected *it*, too.
b. *Bill laughed *himself silly* and Peter laughed *it*, too.

Similarly, an ECM complement can be the target for question formation, as opposed to the alleged small clause in (113b).

(113) a. *What* do you expect?
a'. I expect *Frank to win.*
b. **What* did you laugh?
b'. I laughed *myself silly*.

Finally, as we have already seen in (89), the complement of an ECM verb can be modified by a place adverbial, but the alleged resultative small clause cannot, contrary to what would be expected if it is a constituent.

3.6 Verbs of controlled motion

The complex predicates discussed so far are all based on the semantic embedding of a state in a activity. However, the theory of lexical semantics developed in section 2 makes available two further types of embedding: activities allow locational predicates as their second arguments and states can be the second argument of two-place states. We postpone discussion of complex predicates involving the latter type of embedding to section 3.7. Here we will deal with complex predicates with embedded locations.

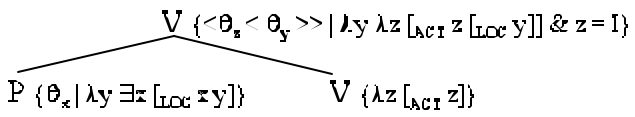
Suppose that a verb expressing a one-place activity is combined with a locational predicate whose first argument is either suppressed or assigned internally to the predicate's maximal projection. As before, copying of the non-head's external θ-role and mapping of the verb's lexical semantics will give rise to information on the dominating node which requires semantic integration:

(114) $\{\theta_y, \theta_z \mid \lambda y\ [_{LOC}\ y], \lambda z\ [_{ACT}\ z]\}$

Recall that a θ-role encodes a lambda operator, the variable it binds and any labelled brackets that restrict its interpretation. This implies that the semantics inherited by the complex predicate from the locational predicate is that of a one-place locational expression. Recall that locations are required to be two-place predicates by (20). As discussed in section 2.1, however, arity conditions hold at the point at which a lexical semantic representation is introduced into the syntactic representation; higher nodes may encode semantic predicates with fewer argument variables.

Identification of the predicates in (114) is impossible, since they have different labels. However, embedding of locations in activities is sanctioned by (46), and therefore a locational resultative predicate can be derived:

(115)



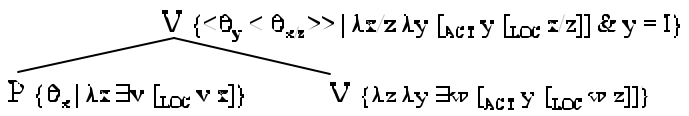
Some examples instantiating this configuration are given below. The verb in (116a) is unergative, while the verbs in (116c-d) are optionally transitive, used here in their unergative form (with a suppressed internal argument).

(116) a. Frank voetbalde zijn team de krant in.
Frank soccer-played his team the newspaper into
b. Karel dronk zich het ziekenhuis in.
Charles drank himself the hospital into
c. Jan keek Marie de kamer uit.
John looked Mary the room out-of
d. Maria zong zich het podium op.
Maria sang herself the stage onto

A theory of complex predicate formation based on semantic integration predicts that locational resultatives can freely appear with unergative verbs, but not necessarily with verbs that obligatorily assign an internal θ-role. This is so because semantic integration of a locational predicate is impossible if the verb's semantics contains an embedded state, as in (117b). Similarly, semantic integration of a stative predicate is impossible if the verb's semantics involves an embedded location, as in (117c). The only successful integrations are that of a stative predicate with an activity verb that itself embeds a state, as in as in (117a), and that of a locational predicate with an activity verb that embeds a location, as in (117d). Semantic integration in the latter case gives rise to the representation in (118).

(117) a. $\{\theta_x, \theta_y, \theta_z \mid \lambda x\,[_{\text{STATE}}\ x],\ \lambda z\ \lambda y\,[_{\text{ACT}}\ y\,[_{\text{STATE}}\ z]]\}$ semantic integration - (85)
b. $\{\theta_x, \theta_y, \theta_z \mid \lambda x\,[_{\text{LOC}}\ x],\ \lambda z\ \lambda y\,[_{\text{ACT}}\ y\,[_{\text{STATE}}\ z]]\}$ no semantic integration
c. $\{\theta_x, \theta_y, \theta_z \mid \lambda x\,[_{\text{STATE}}\ x],\ \lambda z\ \lambda y\,[_{\text{ACT}}\ y\,[_{\text{LOC}}\ z]]\}$ no semantic integration
d. $\{\theta_x, \theta_y, \theta_z \mid \lambda x\,[_{\text{LOC}}\ x],\ \lambda z\ \lambda y\,[_{\text{ACT}}\ y\,[_{\text{LOC}}\ z]]\}$ semantic integration - (118)

(118)



These predictions are borne out. Although there are few transitive verbs which do not have an intransitive counterpart, there are some for which an intransitive use is very marked. As the data in (119) and (120) show, the type of result encoded by the verb determines whether the resultative is locational or stative. The verbs in (119) express a

resulting state and therefore can only be combined with a stative resultative predicate; the verbs in (120) express a resulting location and therefore can only be combined with a locational resultative predicate.

(119) a. Jan scheurt het papier in stukken/*de vuilnisbak in.
John tears the paper into pieces/the bin into
b. Jan breekt de vaas in stukken/*naar de vloer.
John breaks the vase into pieces/*to the floor
c. Jan slijt zijn schoenen scheef/*naar Amsterdam.
John wears-away his shoes crooked/*to Amsterdam
d. Jan bleekt het wasgoed witter/*de kast in.
John bleaches the wash whiter/the wardrobe into

(120) a. Jan stuurt het pakje naar Amerika/*zoek.
John sends the packet to America/lost
b. Nasa lanceerde de astronaut naar Mars/*duizelig.
Nasa launched the astronaut to Mars/dizzy
c. Jan hees de auto op de truck/*uit elkaar.
John hoisted the car onto the truck/in pieces
d. Jan werpt het papier de prullenmand in/*in kreukels.
John throws the paper the wastepaper-basket into/in creases

Note that the marked intransitive use of the verbs in (119) and (120) may give rise to marginally acceptable resultatives of the 'wrong kind'. This option is blocked with unaccusative verbs, whose semantics involves an embedded predicate: the single syntactic argument of an unaccusative cannot be suppressed. Thus, the verbs in (121), which express a resulting state, are incompatible with a locational resultative predicate. Similarly, the verbs in (122), which express a resulting location, are incompatible with a stative resultative predicate.[14]

(121) a. Het papier scheurt kapot/*de vuilnisbak in.
the paper tears into pieces/the bin into
b. De vaas breekt in stukken/*naar de vloer.
the vase breaks into pieces/*to the floor

[14] There is one, apparently lexical, exception to this generalization. The verb *vallen* 'fall' seems to be locational in semantics but can be combined with both locational and stative resultative predicates.

c. De schoenen slijten scheef/*naar Amsterdam.
the shoes wear-away crooked/*to Amsterdam
d. Zo bleekt het wasgoed witter/*de kast in.
thus bleaches the wash whiter/the wardrobe into

(122) a. Het vliegtuig stijgt naar 20000 voet/*instabiel.
the plane ascends to 20000 feet/unstable
b. Jan arriveert in Rome/*moe.
John arrives in Rome/tired
c. De auto glijdt van de weg/*kapot.
the car skids off the road/broken
d. Jan struikelde de kamer in/*kreupel
John tripped the room into/lame

The fact that locational and stative resultatives combine with different classes of verb underlies a well-known alternation with some verbs of motion, referred to here as verbs of controlled motion. When used in isolation, these verbs are said to be unergative, as in (123a), but locational resultative structures headed by them display either unaccusative syntax, as in (123b) or transitive syntax, as in (123c).

(123) a. Jan heeft/*is gefietst.
John has/is cycled
b. Jan is/*heeft naar Den Haag gefietst.
John is/has to The Hague cycled
c. Jan heeft Marie naar Den Haag gefietst.
John has Mary to The Hague cycled

Interestingly, this alternation is not found with stative resultatives (as pointed out to us by Peter Ackema). If the result is to be understood as applying to the subject, the only option is to have a strong resultative construction in which a reflexive object is bound by the subject:

(124) a. *Jan is moe gefietst.
John is tired cycled
b. Jan heeft zich moe gefietst.
John has himself tired cycled

In the theory developed here, these facts can be understood as follows. As we have already explained in section 2.3, verbs of controlled motion have a peculiar semantics. If John walks, he is both the AGENT of an activity and a THEME which moves along an unspecified path. In other words, a verb like *walk* is associated with the lexical semantics in (125).

(125) $\lambda x \exists y [_{ACT} x [_{LOC} y x]] \& x = I, y = L$ cycle, walk, jump, run

In this lexical semantic representation, a single lambda operator binds two argument variables. This implies that verbs like *walk* can in principle be associated with two θ-grids. If the first argument of the activity is taken as input to the system of thematic mapping, an unergative verb is derived, whose single θ-role encodes an activity:

(126) $\{ < \theta_x > | \lambda x [_{ACT} x] \& x = I\}$

Alternatively, the second argument of the location can be taken as input to thematic mapping, giving rise to an unaccusative verb, whose single θ-role encodes a resulting location:

(127) $\{ << \theta_x >> | \lambda x [_{ACT} [_{LOC} x]] \}$

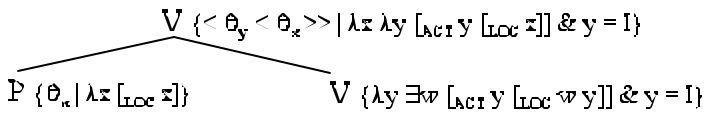
Representational economy determines that, all else being equal, the unergative grid is to be preferred. This explains why verbs of controlled motion are said to have an unergative syntax when used in isolation. Note, however, that in a discourse which requires that the verb's resulting location is encoded by its θ-role, an unaccusative syntax is obligatory, even if no directional adverb is present:

(128) Speaker A: Je weet dat Jan al jaren niet zo vrolijk is. Gisteren zag ik hem op de brug.
you know that John for years not very cheerful is. yesterday saw I him on the bridge.
Speaker B: O ja? En wat is er toen gebeurd?
o yes? and what is there then happened?
Speaker A: Hij is/*heeft gesprongen.
he is/has jumped

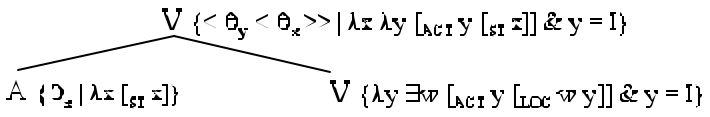
Let us now return to the data in (123) and (124). Verbs of controlled motion can combine with resultatives in various ways, depending on the nature of the resultative and the semantics encoded by the verb's θ-role.

If the θ-role mapped from the verb encodes the higher variable, the semantics inherited by the complex predicate will be that of a one-place activity (compare (126)). Since either a state or a location can be embedded in an activity, this mapping is compatible with both a locational resultative, as in (129), and a stative resultative, as in (130). These structures are exemplified by the data in (123c) and (124b).[15]

(129)

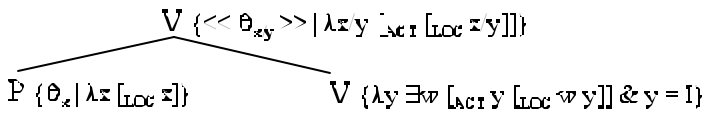


(130)



By contrast, if the θ-role mapped from the verb encodes the lower variable, a complex predicate can only be formed with a locational resultative. This is because the verbal semantics inherited by the complex predicate will be that of a resulting location (compare (127)). Semantic integration must therefore rely on identification, which is only possible with predicates that have identical labels. In other words, (131) is predicted to be grammatical, as is borne out by the example in (123b). The semantics in (132), which results from copying of a stative θ-role from a resultative predicate plus mapping of the verb's lower argument variable, does not allow integration. This is confirmed by ungrammaticality of (124a).

(131)



(132) $\{ \theta_x, \theta_y \mid \lambda x\, [_{ST}\ x], \lambda y\, [_{ACT}\ [_{LOC}\ y]] \}$

[15] Note that the location in (129) is represented as a one-place predicate on the assumption that its first argument is realized internally to the PP; in (123c) the θ-role that encodes it is assigned to *Den Haag* 'The Hague'.

Hoekstra (1984) was the first to analyze the alternation in (123) within generative grammar. He interpreted it as evidence for a small clause analysis of secondary predication, arguing that if the surface subject is to be related to a locational resultative, it must originate in the specifier of a small clause complement. The surface order is derived by NP raising, which implies an unaccusative syntax. The present analysis incorporates Hoekstra's basic insight that the unaccusative syntax of (123b) is associated with the fact that resultatives are object-oriented. However, it also uncovers at least two potential pitfalls of the small clause account. First, it does not explain why in (123b) the subject is interpreted both as an argument of the verb and as the external argument of the locational adverb. This is a problem we have observed earlier in connection with the generalizations in (94). Second, the small clause account does not explain why the alternation is restricted to locational resultatives. In other words, it is unclear why (124a) should be ungrammatical.

3.7 Stative complex predicates

As mentioned earlier, the theory developed here predicts a third type of complex predicate, based on the semantic embedding of a state in a state. Such complex predicates will not be resultative in interpretation, since they are parasitic on the interpretive rule in (47), repeated below for convenience, rather than the rule in (46), which deals with embedding in activities.

(133) In $[_{ST}$ x $[_{PRED}$ ... y ...]], x experiences y as having the property expressed by PRED.

In other words, the third of type of complex predicate should have a semantics analogous to verbs like *fancy* and *detest*: the subject should experience the object as having the property denoted by the non-verbal predicate. We believe that such complex predicates indeed exist. Some examples are give below:

(134) a. dat Jan Marie aardig vindt.
that John Mary nice considers
b. dat Jan Marie schuldig acht.
that John Mary guilty considers

Sentences headed by verbs like *vinden* and *achten* have several properties in common with resultative structures. For instance, the verb and the non-verbal predicate have to

be adjacent (cf. (135)), complex predicate formation is not recursive (cf. (136)), and the non-verbal predicate is invariably object-oriented. In the examples in (134), it is Mary who is taken to be nice and guilty, respectively.

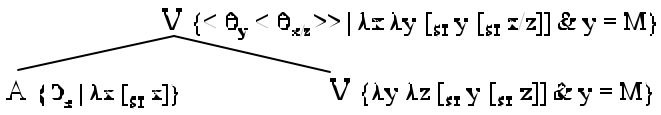
(135) a. *dat Jan Marie aardig gisteren vond.
that John Mary nice yesterday considered
b. *dat Jan Marie schuldig regelmatig acht.
that John Mary guilty regularly considers

(136) a. *dat Jan Marie aardig grappig vond.
that John Mary nice funny considered
b. *dat Jan Marie schuldig dom acht.
that John Mary guilty stupid considers

A number of constituency tests confirming that the verb forms a structural unit with the non-verbal predicate can be found in Neeleman 1994.

The complex predicates in (134) have the representation below, in which semantic integration involves identification of the state encoded by the non-verbal predicate's θ-role and the embedded state introduced by the verb (see below for some discussion). As predicted, the resulting interpretation is that of an experienced property. If John considers Mary intelligent, then he experiences Mary as having the property of intelligence.

(137)



Verbs like *vinden* and *achten* have the unexpected property that they must appear as heads of complex predicates. The examples in (138) are ungrammatical.

(138) a. *Jan vindt (Marie). (on the intended reading)
John considers Mary
b. *Jan acht (Marie).
John considers Mary

This kind of selection is unusual: heads typically select for arguments rather than other predicates. The theory of complex predicate formation, and in particular the notion of semantic integration, provides a natural way to accommodate these data. So far, we have

abstracted away from conceptual information, since the argument-taking properties of verbs can be accounted for in terms of their lexical semantic structure. However, the conceptual contents of the embedded states of verbs like *fancy* and *detest* is clearly different, despite the fact that their argument-taking properties are identical. This opens up the possibility that verbs like *vinden* and *achten* have an embedded state whose conceptual content is radically underspecified (note that this reflects speakers' intuitions about their semantics). When used in isolation, such verbs would yield a partially uninterpretable semantics. However, if the underspecified state can be identified with a state that is conceptually sufficiently specified, the result is a fully interpretable complex predicate. On this view, selection for a predicate is a side-effect of conceptual underspecification.

Conceptual underspecification of embedded predicates is not restricted to stative verbs. There are various activity verbs which seem to select a locational predicate. Two examples are *zetten* 'put' and *hangen* 'hang'. These verbs obligatorily appear in resultative complex predicates, as shown in (139) and (140).

(139) a. dat Jan de bloemen op tafel zette.
that John the flowers on table put
b. *dat Jan (de bloemen) zette.
that John the flowers put
c. *dat Jan de bloemen op tafel gisteren zette.
that John the flowers on table yesterday put

(140) a. dat Jan de jurk in de kast hing.
that John the dress in the wardrobe hung
b. *dat Jan (de jurk) hing.
that John (the dress) hung
c. *dat Jan de jurk in de kast snel hing.
that John the dress in the wardrobe quickly hung

This combination of data can be understood if verbs like *zetten* and *hangen* contain a conceptually underspecified location.

A similar pattern is found with the verb *maken*, which can be analyzed as containing an underspecified state:

(141) a. dat haar gezeur me gek maakt.
that her nagging me crazy drives

b. *dat haar gezeur (me) maakt.
that her nagging me drives
c. *dat haar gezeur me gek de hele tijd maakt.
that her nagging me crazy de entire time drives

4 Conclusion

In this paper we have presented an analysis of resultative complex predicates which derives their properties from the interplay of two theories that approach conceptual necessity. The first is the theory of bare phrase structure, as implied by Chomsky's (1995a) inclusiveness condition; the second, a minimal characterization of lexical semantic representations and their mapping to θ-grids. Together, they account for the following characteristics of the resultative construction:

(i) Resultative predicates form a constituent with the verb. (ii) The head of a resultative complex predicate cannot itself be complex, but the non-head can. (iii) All thematic information in the head can contribute to the θ-grid of a complex predicate, whereas the non-head can only contribute the thematic information associated with its external θ-role. (iv) The head of a resultative complex predicate expresses an activity, while the non-head expresses a resulting state or location. (v) Resultative predicates are object-oriented. (vi) Depending on the thematic properties of the head, the object (or derived subject) of a resultative complex predicate must, can or cannot be interpreted as the internal argument of the verb. (vii) A resultative complex predicate cannot head a double object construction.

The proposed analysis has two further benefits. First, it allows a treatment of verbs of motion that accounts for the well-known alternation found with directional resultatives. In addition, it explains why the same alternation is not found with stative resultatives. Second, a final type of complex predicate is predicted to exist, namely one in which the head denotes a state and the non-head is interpreted as a perceived property. We have suggested, following Chomsky 1955, that such complex predicates are instantiated by expressions like *consider intelligent*.

An alternative proposal might attribute properties (i) - (vii) to secondary predication in general, rather than to complex predicate formation.[16] However, the behaviour of

[16] Cormack & Smith (1999) argue that depictives are also part of a complex predicate; they analyze differences between depictives and resultatives in terms of independent factors.

resultatives contrast systematically with that of depictives. First of all, depictives do not necessarily form a constituent with the verb (property (i)):

(142) dat Jan de deur ongeschuurd aan Marie laat zien.
that John the door unsanded to Mary lets see

Second, structures containing a depictive do not obey the complexity constraint (property (ii)). Depictives can be added freely to sentences containing a resultative or a particle:

(143) a. dat Jan de deur ongeschuurd groen verft.
that John the door unsanded green paints
b. dat Jan Marie dronken opbelt.
that John Mary drunk up-telephones

Third, depictives can appear with stative verbs (property (iv)):

(144) a. dat Jan witte wijn alleen koud waardeert.
that John white wine only cold appreciates
b. dat Jan de wereld dronken begrijpt (maar nuchter niet).
that John the world drunk understands (but not sober)

Fourth, depictives can be subject-oriented, as well as object-oriented (property (v)):

(145) a. dat Jan het vlees rauw snijdt.
that John the meat raw cuts
b. dat Jan het vlees moe snijdt.
that John the meat tired cuts

Fifth, depictives added to an unergative verb do not have a transitivizing effect (property (vi)):

(146) a. dat Jan dronken werkt.
that John drunk works
b. *dat Jan zich dronken werkt. (on a non-resultative reading)
that John himself drunk works

Finally, depictives can appear in double object constructions (property (vii)):

(147) dat Jan Marie het boek ingepakt geeft.
that John Mary the book wrapped gives

The contrasts between depictive and resultative predication follow from the fact that only the latter is based on complex predicate formation. Hence, only the latter involves semantic integration in the lexical semantic component, with the associated restrictions. The freer distribution of depictives can be understood on the assumption that their integration is syntactic (see Neeleman & Van de Koot 2000 for an analysis of depictives along these lines).

To the best of our knowledge, small clause analyses of resultatives cannot account for all the properties listed above. In particular, data suggesting that verb and resultative form a constituent (property (i)) seem problematic, as do data suggesting that the object can be assigned the verb's internal θ-role (property (vi), see also Carrier & Randall 1992). A further potential problem is that, although analyses are available for the alternation found with verbs of motion (see Hoekstra 1984), there is as yet no analysis for the absence of this alternation with non-locational resultatives. In addition, the small clause analysis treats resultative constructions as essentially bi-clausal. This would lead one to expect that they are interpreted on a par with syntactic causatives (compare Bittner 1999). However, whereas syntactic causation is not necessarily direct, resultative causation is, as confirmed by the fact that adverbials can take scope over the complement of a causative verb, but not over the alleged small clause in a resultative construction.

Other generalizations can be captured, but only at the cost of additional assumptions. For example, the impossibility of adding a resultative predicate to resultative constructions, constructions containing a particle or double object constructions (properties (ii) and (vii)) can be made to follow if all of these are themselves analyzed as containing a small clause complement and if recursion of small clause structures is blocked in the relevant cases. A small clause analysis is implausible for unergative particle constructions (such as *John gave up*). But even such particle constructions do not allow the insertion of a resultative predicate (thus **John gave himself up depressed* cannot express that John gave up with the result that he became depressed).

The case of the double object constructions is very complex and a thorough discussion would take us too far afield. However, a small clause analysis of double object constructions must involve a head that predicates possession by the indirect object: if Mary gives John a book, this does not imply that John becomes or is a book, but rather that John receives or has a book. In order to avoid the introduction of a novel type of predication, the small clause analysis must be based on the decomposition of possessive predicates (such as *have*) into BE and a possessive preposition (see Den Dikken 1995 and

references cited there). However, as we have seen in section 2.1 such decomposition faces several problems of its own.

We began this paper with the question how one should characterize subject in bare phrase structure. A definition of subject as the specifier of a lexical category does not seem to be available. However, there are two alternatives, both of which are based on the idea that subjects are external arguments, but which differ in the nature of the externalizing head. Either there is a unique functional head H* that relates a subject to its predicate (the single head hypothesis in (9)), or externalization can be mediated by any head (the arbitrary head hypothesis in (10)). The single head hypothesis forces a small clause analysis of resultatives, while the arbitrary head hypothesis allows a complex predicate account. Given the empirical evidence in favour of the complex predicate analysis, we conclude that the single head hypothesis must be rejected.

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