84. Operations on argument structure

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In a framework with lexical decomposition, argument hierarchy is determined by the depth of embedding, and in turn determines the realization of structural arguments (1). Operations that reduce the number of arguments operate directly on the argument hierarchy (2), while operations that extend the number of arguments add semantic predicates, and thus themselves contribute to semantic composition (3). Causatives add a highest argument, while applicatives add a non-highest argument – what kind of machinery is necessary to represent this difference (4)? Certain affixes realize a whole bundle of possible operations, some of them even opposite ones (5). Multiple operations are possible; their order reflects steps of semantic composition (6). Lexical marking can override the argument hierarchy (7). Argument alternations such as the dative shift reflect lexical alternatives with different argument hierarchies that are not derived from each other (8). – Various kinds of evidence is given that morphological operations reflect semantic properties and relations rather than syntactic ones.

1. Introduction

Considering triplets such as those in (1), it is easy to see that *open* is an ambiguous lexical item, whose specifications belong to the same semantic classes as *dead*, *die*, and *kill.* That the main predicates of (1a), (1b), and (1c) belong to different semantic classes is attested by the different morphosyntactic contexts required by these predicates. The verbs in (1b) clearly differ in their argument structure from those in (1c), which is captured by the distinction between intransitives vs. transitives, while it is less obvious whether adjectives and intransitives differ in their argument structure. Probably most linguists would say yes, they do.

(1) a.	The bear is dead.	The door is open.	Die Tür ist offen.
b.	The bear died.	The door opened.	Die Tür öffnete sich.
c.	Mary killed the bear.	Mary opened the door.	Maria öffnete die Tür.

That *open* is threefold ambiguous raises the question of how these three meanings are related to each other. The answer provided in this article is that they are related by certain operations on argument structure. The adjective *open* denotes a relation between an object and a state holding at a certain time, while the intransitive *open* denotes a relation between an object and an event that ends in such a state; finally, the transitive *open* denotes a relation between an agent, an object, and an event in which the object ends in such a state. This semantic description suggests that the predicates in (1a) to (1c) are increasingly more complex, which implies the derivational chain (a) → (b) → (c).

In contrast, the German equivalents of *open* seem to indicate the derivational chain (a) → (c) → (b). The verb, showing umlaut, is derived from the adjective, not showing umlaut. However, (b) is a special case of (c); more precisely, (b) *sich öffnen* is the reflexive form of (c) *öffnen*, often called

medium (an intransitivization operation that has several semantic interpretations, see section 5). Note that the same operation is active in many languages, see, e.g., Latin (c) *aper-ire* → (b) *se aper-ire*. Latin also shows the variant in which three different suffixes are attached to one and the same stem: (a) *aper-tus*, (b) *aper-iri*, (c) *aper-ire* – here, morphology does not show what derives from what, just as in English *dead, die, kill*.

There is some tension between morphological and semantic complexity. Insofar as one is concerned with particular languages, systematic morphological derivation leads one to assume underlying operations on argument structure – passive, causative, or medium being typical examples. There is no need of universality; certain operations may be active only in a small subset of languages. On the other hand, constellations such as English *dead/die/kill* vs. $open_1/open_2/open_3$, force us to assume semantic relations between the individual elements, even if they are not supported by morphological familiarity (as in *dead/die/kill*) or by morphological distinctness (as in $open_1/open_2/open_3$).

In the following, the notions 'argument structure' and 'operations on argument structure' will be made more precise.

Lexical items belonging to one of the major lexical categories (verb, noun, adjective, adposition) are generally considered to be predicates which have one, two, three, or even more arguments, represented by open slots or variables. An n-place predicate (of type $<e_n,<\dots,<e_1,t>\dots>>$ in the simplest case) together with n argument variables forms an open proposition (of type t), while λ-abstraction forms a more articulated predicate (of the same complex type) from it, for instance with n=3:

(2) $\lambda z\, \lambda y\, \lambda x$ PRED(x,y,z) of type $<e,<e,<e,t>>>$

If such an expression is applied to a series of argument expressions, it gets converted into a saturated proposition, for instance

(3) $\lambda z\, \lambda y\, \lambda x$ PRED(x,y,z) (a)(b)(c) becomes PRED(a,b,c).

Both λ-abstraction and λ-conversion are stepwise operations: stepwise λ-abstraction produces a λ-sequence, and stepwise λ-conversion works off this sequence backwards.

One can identify PRED with what an individual verbal, nominal, adjectival, or adpositional item contributes semantically, and the series of argument expressions with what the morphological or syntactic complements of that item contribute semantically.

There are some specific differences between the lexical categories. The maximal projections of nouns can be used predicatively (*this is John's house*) or referentially (*let us meet at John's house*), a fact that in some languages (e.g. the Semitic ones) is marked by a nominal vs. verbal clause type – all other categories only allow predicative use. The highest argument of a noun is said to be its referential argument R; in the referential use the noun functions as the complement of another predicate expression (e.g., *meet_at*), and R is identified with an argument of that predicate, while in the predicative use R is overtly expressed by a DP (e.g., *this*) the noun is predicating of. Although verbs can only be used predicatively, they still refer to some sort of temporal event and therefore can be said to have a referential argument E (cf. article 34 (Maienborn) *Event semantics*); E is specified (or bound) by functional elements such as aspect, tense, mood, but never by a complement. If the verb undergoes event nominalization (*our meeting at John's house*), E becomes R of the resulting noun (cf. Bierwisch 1989b, and article 51 (Grimshaw) *Deverbal nominalizations*).

In view of these differences, the featural encoding of argument hierarchy (Wunderlich 1997a) disregards the event argument of a verb but pays regard to the referential argument of a noun. That is, for the working of grammar the highest argument of a transitive verb is usually taken to be the agent (rather than the event in which the agent is involved), while the highest argument of a

relational noun must be R. Adjectives and adpositions are typically considered to lack a referential argument, so that no specific functional elements are found with them. To anchor the information of adjectives and adpositions, they must be construed together with some noun or verb as an attribute, adverbial, or secondary predicate.

The representations in (4) to (6) illustrate the predicate-argument structure of a few examples. The possessed noun is considered to be derived from the simple noun by possessivization, which operates on λx N(x), yielding λy λx [N(x) & POSS(y,x)] (Barker 1995). Similarly, the transitive variant of *cook* can be derived from the intransitive variant by causativization, which adds an agent argument ('one who causes that something cooks'). This result can undergo further operations: event nominalization, which only shifts the lexical category ('a process of cooking something by someone'), or agent nominalization, which binds the event argument existentially ('someone who cooks something'). Adjectives as well as adpositions can have one or two arguments.

(4) Nouns and possessed nouns

a.	*house*:	λx HOUSE(x)	x=R
b.	*someone's house*:	λy λx [HOUSE(x) & POSS(y,x)]	x=R

(5) Verbs and nominalizations

a.	*cook*, intransitive:	λy λs COOK(y)(e)	e=E
b.	*cook*, transitive:	λy λx λe [AGENT(x) & COOK(y)](e)	e=E
c.	*cooking*, noun :	λy λx λe [AGENT(x) & COOK(y)](e)	e=R
d.	*cook*, noun :	λy λx ∃e [AGENT(x) & COOK(y)](e)	x=R

(6) Adjectives and adpositions/adverbs

a.	*proud*:	λy λx PROUD(x,y),	*quick*:	λx QUICK(x)
b.	*behind*:	λy λx BEHIND(x,y),	*quickly*:	λx QUICK(x)

Arguments other than R and E are sometimes called participants, they must be realized by some pronominal affix or syntactic complement – otherwise existential closure would have to take place in order to yield a saturated proposition. The sequence of λ-abstractors indicates that part of a lexical item which is morphosyntactically active.

Turning now to the concept of argument structure, three distinct but related notions come to mind.

(i) Argument structure is identified with the list of semantic roles attributed to the participants x, y, z of the predication, for instance, x=agent(e), y=recipient(e), z=theme(e) for a ditransitive verb of the *give* type. This position is characteristic for Neo-Davidsonian approaches; although they mostly assume a flat structure (an unordered list of arguments), it is possible for them to induce additional structure by assuming a thematic role hierarchy (cf. article 18 (Davis) *Thematic roles*).

(ii) Argument structure is identified with the morphosyntactic structure of complement expressions (a)(b)(c) that realize the argument requirements of a predicate. Of course, (a)(b)(c) can vary in various ways, including word order and morphological case. This position is characteristic for syntactic approaches, taking syntax as the generative source of language (cf. article 83 (Pesetsky) *Argument structure*).

(iii) Argument structure is identified with the sequence of λ-abstractors, which models the need of complements. These λ-abstractors can be regarded as generalized θ-roles.

In any case, the notion of argument structure plays a role for all lexical categories. Verbs are in the center when one considers (operations on) argument structure only because they are particularly complex. Stiebels (2006) argues, however, that nouns can in principle show the same types of operations as verbs.

In this article, I will argue for position (iii) above, thereby restricting the discussion to verbs. Let us call λe VERB(x,y,z)(e) the semantic CORE of a verb (in this case, of a ditransitive verb), and λz λy λx CORE the respective θ-structure, representing an argument hierarchy with x as the highest and z as the lowest argument. For computational reasons, any list of arguments must be strictly ordered. Let us assume that the relative position of the λ-abstractors reflects the path in which the θ-structure is abstracted from CORE. Bierwisch (1989a) proposed an algorithm to perform this abstraction from a lexical decomposition structure, which shows how the meaning of a word is built up from a set of more atomic components (cf. article 17 (Engelberg) *Frameworks of decomposition*). Intuitively, this algorithm reflects the depth of embedding: the deeper an argument is embedded, the lower it is placed in the θ-structure, i.e. the respective λ-abstractor is positioned closer to the beginning of the sequence of λ-abstractors. (A similar account is found in Baker's (1997) relativized UTAH principle (Uniformity of Theta Assignment Hypothesis): the ordering of roles must correspond to their relative depth in D-structure.)

I take it for granted that for each individual predicate the arguments form a hierarchy. (If it appears that the arguments can be exchanged in their order, strictly spoken there exist two different, although similar predicates, see section 8.) It is often assumed that the argument hierarchy of an individual predicate is induced by a more general thematic hierarchy such as Agent > Instrument > Recipient > Theme > Goal (or similar ones). This requires that the typology of thematic roles be fine enough to capture all possible semantic roles of individual predicates, and that all these thematic roles can be ordered uniquely – which are probably just two unsolvable tasks (cf. article 18 (Davis) *Thematic roles*). Instead, the following tests can be used to determine the argument hierarchy of an individual predicate, without any reference to thematic roles.

(i) Binding properties: Among others, the higher argument can asymmetrically bind the lower argument (Barss & Lasnik 1986, Larson 1988).

(ii) Salience properties: According to harmonic alignment, the higher argument is more likely to be more salient (in terms of person, animacy, definiteness, topic, and so on) than the lower argument (Wunderlich 2006).

The θ-structure thus preserves structural properties of a lexical decomposition structure in terms of argument hierarchy, which in turn is mapped onto a morphosyntactic structure; in other words, it interfaces between semantic core and morphosyntactic structure. The θ-structure is the negative print of the hierarchy inherent to CORE and can produce various morphosyntactic positive copies of that hierarchy. For instance, the ordering λz λy λx (with x as the highest argument) is mapped onto the default ordering X Y Z in the syntax.

Linguists in the tradition of Grimshaw (1990), Jackendoff (1990), Dowty (1991) and others assume a direct mapping from semantic core properties onto morphosyntactic structure. The assumption of a separate θ-structure, however, is advantageous for a few reasons (Wunderlich 1997a).

Most importantly, the θ-structure allows us to formulate a very elegant mechanism of argument linking, first proposed by Kiparsky (1992) (cf. also Kiparsky 2001, and the section on case in article 78 (Kiparsky & Tonhauser) *Semantics of inflection*). If both the argument hierarchy and the structural cases are encoded by the same set of relational features, argument linking can easily check which structural case pattern fits best with a given θ-structure. Lexical Decompositional Grammar (Wunderlich 1997a, 2000, 2006) uses the features +hr = 'there is a higher argument role' (= 'not the highest role'), and +lr = 'there is a lower argument role' (= 'not the lowest role'); for reasons of markedness, these features differ slightly from those proposed by Kiparsky. The structural cases are specified as follows: dative = [+hr,+lr] is compatible with the medial argument, accusative = [+hr] with a non-highest, ergative = [+lr] with a non-lowest, and nominative = [ ] (the unspecified case) with any argument. (Cf. section 7 in article 17 (Engelberg) *Frameworks of decomposition*)

(7) Featural encoding of the argument hierarchy:
a. Er kaufte ihr einen Ring. ('He bought her a ring'; NOM – ACC –DAT)
b.
λz	λy	λx	PRED(x,y,z)
+hr	+hr	–hr	
–lr	+lr	+lr	

The actual case pattern (in this case NOM – ACC – DAT) follows as the optimal solution if a certain constraint ranking is observed. It should be clear that ergative appears under different circumstances than accusative, and that dative is present only in a subset of both the ergative- and the accusative-languages. Stiebels (2000, 2002) gives a full typology of structural case systems in terms of those constraint rankings. Wunderlich (2003) also includes lexical case marking, which interacts with structural case; he shows that all possible case patterns in German (11 different ones) as well as all possible case patterns in Icelandic (18 different ones), including those that appear in the passive, are determined by the same constraint ranking; the main difference is that Icelandic has more lexical case marking than German. Wunderlich (2006) points out that argument linking by case or pronominal affixation is not the only possible system; he presents a typology of argument linking that goes beyond case.

There are further advantages of introducing a separate θ-structure. First, expletive arguments can be represented by additional λ-elements that do not have a variable as semantic counterpart in CORE (so-called empty abstraction).

(8) Expletive arguments
a. Es schneit. ('It snows.')
b. λx GO(SNOW)

Second, lexical case can be represented by associating a feature that overrides what the actual hierarchy of arguments would predict. For instance, verbs with dative for the highest argument must be lexically marked, in particular if verbs with the same meaning exist that have nominative instead, consider German *gefallen* vs. *mögen*, expressing the same psychological state.

(9) Lexically marked vs. unmarked case.

a.	Er gefiel ihr.	Sie mochte ihn.	(both: 'She liked him.')
b.	λy λx LIKE(x,y)	λy λx LIKE(x,y)	
	+hr		

When lexical marking is lost historically, the DAT-NOM verb shifts into a NOM-ACC verb, compare Icelandic *lika*, a DAT-NOM verb, with English *like*.

Moreover, individual elements of a θ-structure can be associated with sortal restrictions such as animacy, or subcategorization information such as prepositional case or infinitive/participle for dependent verbs.

(10) Association with SUBCAT information
a. Er wartete auf Diana. ('He waited for Diana.')
b.
λy	λx WAIT(x,y)
AUF	

Third, the working of certain valency-decreasing operations can easily be represented by existential binding; in that case, the respective argument is invisible for argument linking.

(11) Valency-decreasing operations.
a. Er wurde geliebt. ('He was loved.' = 'Someone loved him.')
b. λy ∃x LOVE(x,y)

Valency-decreasing operations such as passive and antipassive can be defined directly on the θ-structure (section 2). In contrast, valency-increasing operations such as causative and applicative do not only add an argument but also a licensing predicate, and thus enrich the semantic core (section 3). The question of how exactly these valency-increasing operations function is dealt with in section 4. Cross-linguistically there is often a certain parsimony in the set of exponents; thus the problem arises that one and the same affix may, e.g., signal causative in one context but anticausative in another context - which is the subject of section 5. The ordering of operations is considered in section 6. Two further types of argument alternations are only briefly touched upon: those that come about through lexical marking (section 7), and those that make a choice in a set of complementary core predicates (section 8).

Most operations on argument structure can be marked morphosyntactically (by derivational affixes or syntactic constructions), or be left unmarked and only visible by their effects in the morphosyntactic complement structure. Languages widely differ in the amount of marking, and, of course, in the specific means of realizing these operations. English, e.g., often leaves the causative unmarked but marks the passive (12), whereas Basque marks the causative and leaves the passive unmarked (13).

(12) a. The horse galloped.
b. Someone galloped the horse.
c. The horse was galloped.

(13) a. Mikel joan da. (‘Mikel is gone.’)
M. GO.PERF 3.be
b. Mikel joan-araz-i du. (‘Someone made Mikel go.’)
M. go-CAUS-PERF 3E/3N.have
c. M. joan-araz-i da. (‘Mikel was made to go.’)
M. go-CAUS-PERF 3.be

With GALLOP, a typical intransitive predicate, the two-argument clause (12b) is only intelligible if a further predicate introducing the extra argument is assumed. Conversely, a causativized verb with only one argument, as in (13c), suggests some invisible argument reduction. Operations that have to be inferred by the listener can only apply in canonical instances, whereas a morphologically marked operation can also apply in more peripheral instances and may also lead to idiomatic lexicalization.

A still open question is why languages have all these operations. The most plausible answer is that every participant of an event should get the chance to be expressed as the most prominent argument (discourse anchor or topic, syntactic pivot or subject). For that reason, many operations can even apply in series. In languages that allow for at most two structural arguments, argument extension often has the effect that another participant is promoted to structural object, which in a way means that it is made more ‘visible’ and could become the topic or subject.

A last general remark concerns the relationship between semantic operations and their morpho-syntactic counterparts. The Latin deponential verbs (such as *auxiliari* ‘help’, *minari* ‘threaten’, *partiri* ‘divide’) are semantically active, but nevertheless require passive morphology when they are inflected (*auxili-or tibi* ‘help-1sg.PRES.PASS you’, ‘I help you’). One can assume that these verbs have the *lexical* feature +pass, which triggers passive morphology, and at the same time blocks the semantic operation of passive (which would have to use the same morphology). This shows that the morphological exponent of an operation and the operation itself must be distinguished. In this article, mismatches between lexical features and morphosemantic operations will not be considered any further.

2. Argument reduction: Passive, Antipassive, Reflexive, and others

Valency-decreasing operations reduce the number of syntactically active arguments; they apply directly on the θ-structure. (14) shows the passive, which binds the highest argument existentially, so that it remains unexpressed. (The event argument is irrelevant here and therefore ignored.)

(14) **PASS** [... λx VERB(x, ...)] = ... ∃x VERB(x, ...)
–hr

Some languages only allow passivization of transitive verbs, while other languages also include some subclasses of intransitive verbs. The class of verbs that can be passivized is often restricted to agentive verbs, but certain nonagentive verbs can be included as well (e.g., *The garden is surrounded by a fence*). Existential binding causes the passivized n-place verb to be realized with at most n-1 morphosyntactic complements; thus, a transitive verb is detransitivized, and an intransitive verb becomes impersonal. As a consequence, another argument is realized by nominative (the default case) and thus becomes morphosyntactic subject. (15) and (16) show that in the passive of ditransitive verbs there are different options regarding the choice of object that becomes nominative. In the two languages illustrated here (Yaqui and Georgian), both objects are marked by accusative in the active. If the recipient shifts to nominative in the passive (as in Yaqui) it is said to be the primary object, while if the theme shifts to nominative (as in Georgian) it is said to be the direct object (Dryer 1986).

(15) Double accusative and passive in Yaqui (Van Valin 2006)

a. Joan Peo-ta ʔuka vaci-ta miika-k.
Juan Pedro-ACC DET.ACC corn-ACC give-PERF
'Juan gave Pedro the corn.'

b. Peo ʔuka vaci-ta miik-wa-k.
Pedro DET.ACC corn-ACC give-PASS-PERF
'Pedro was given the corn.'

c. *Uʔu vaci Peo-ta miik-wa-k.
DET.NOM corn Pedro-ACC give-PASS-PERF
'The corn was given to Pedro.'

(16) Double accusative and passive in the present series of Georgian (Joppen-Hellwig 2001:50)

a. Ketino Eka-s xalitṣa-s s-čukni-s.
Ketino Eka-ACC carpet-ACC 3D-present-PRES.3N
'Ketino presents Eka with a carpet.'

b. xalitṣa e-čuk-eb-a Eka-s.
carpet PASS-present-TH-PRES.3N Eka-ACC
'The carpet is presented to Eka.'

c. * Eka e-čuk-eb-a xalitṣa-s.
Eka PASS-present-TH-PRES.3N carpet-ACC
'Eka is presented with a carpet.'

This shows that passivization is not only a test for subjecthood (answering the question of which argument is demoted in the passive) but also for objecthood, in that it makes a distinction between two types of double objects: primary vs. secondary object on the one hand, and direct vs. indirect object on the other (Dryer 1986, Wunderlich 2006: 136). Languages with symmetric objects (Bresnan & Moshi 1990) allow both alternatives: either the recipient or the theme becomes the syntactic subject in the passive. These differences clearly indicate that the promotion to nominative is not part of the passive operation, but a subsequent effect dependent on typological factors.

Passive is an operation found in nearly every language because it reflects a ubiquitous salience shift. If an argument other than the highest one is the actual topic, definite/specific, or a speech act participant, it might be more salient than the current highest argument; in that case, passive can shift it to a higher argument position, thus making its high salience also visible. (Aissen 1999 discusses subject choice in the framework of Optimality Theory.)

In most languages, the passive operation is marked by a verbal affix, a particle, or an auxiliary, but it can also be made visible by a shift in the complement pattern even if a separate marker of the passive is lacking. Some languages allow the so-called personal passive, in which the highest argument of a passivized verb is expressed by an oblique instrument, source, or agent phrase; such a phrase is best seen as an adjunct whose free argument is coindexed with the existentially bound argument. Assume that the sentence *John was kissed by Ann* is represented as λy ∃e {∃x KISS(x,y)(e) & AGENT(Ann,e)}(John), then x=Ann is a contextual default for the value of x.

Various theories of the passive have been proposed, among them the voice hypothesis (Kratzer 1994), claiming that verbs have a basic form without agent, and only if they are integrated into a voice phrase, is an agent either added (in the active voice) or not (in the passive voice). This hypothesis suggests that active voice is the more marked variant of a transitive verb, which, however, is only rarely observed cross-linguistically (e.g., in languages of the Austronesian family). Moreover, it does not describe the semantic effect of passive as existential binding but rather as the absence of an argument.

In view of examples such as those in (17), Keenan (1980) and Dowty (1982) argued that English passive must operate on transitive verb phrases rather than verbs, e.g., on the VP *think cancer to be unlikely to be caused by hot dogs* in (17a). However, already Bresnan (1982) showed that a lexical rule of passive is able to handle these more complex instances, too.

(17) Passive of raising and control predicates (Bresnan 1982: 65)
   a. Cancer is now thought to be unlikely to be caused by hot dogs.
   b. Intruders are now forced to be prepared to be attacked by dogs.

Let us assume that (18a) represents the passive of *think* and (18b) the embedded complex (itself being passivized), then (18c) results through functional composition as the approximate representation of (17a). This clearly shows that the most internal argument is shifted to the subject of the whole complex by means of two passive operations. (Note that in a polysynthetic language such as Greenlandic all the higher predicates are affixes, thus the operations are necessarily word-internal rather than affecting VPs.)

(18) Analysis of raising + passive
   a. λp ∃x THINK(x,p)
   b. λz ∃y UNLIKELY(CAUSE(y,z)) *Raising*
   c. λz ∃x THINK(x, ∃y UNLIKELY(CAUSE(y,z)))

Similarly, with the three pieces in (19a) one gets (19b) in the first step, and (19c) in the second step, representing (17b). Here, the most internal argument is stepwise identified with the subject of *be prepared* and the object of *force*; again, two passives are involved.

(19) Analysis of control + passive
   a λz ∃u ATTACK(u,z)
   λP λy PREPARED(y,P(y)) *Subject control*
   λQ λx ∃v FORCE(v, x, Q(x)) *Object control*
   b. λy PREPARED(y, ∃u ATTACK(u,y))
   c. λx ∃v FORCE(v, x, PREPARED(x, ∃u ATTACK(u,x)))

Antipassive is the counterpart to passive; it binds the lowest (rather than the highest) argument existentially, as shown in (20).

(20) **ANTIPASS** [λz ... VERB(... , z)] = ∃z ... VERB(... , z)
–lr

While the passive is induced by a particularly high salience status of the lower argument, the antipassive is induced by a particularly low status of that argument. It is therefore expected to be a less universal operation than passive. Whereas a canonical NOM-ACC verb turns into ∅-NOM by passivization, a canonical ERG-NOM verb turns into NOM-∅ by antipassivization; in both instances, a realization with a marked case is avoided. Although antipassive is particularly often found in ergative languages, it is not restricted to this type of language, the same way as passive is not restricted to accusative languages. A language can show both passive and antipassive by means of marked morphemes; an example is given in (21). One often finds a combination of causative with antipassive, as in (21c). Similarly, *he is cleaning* is derived from the causative verb *to clean* in English; 'object deletion' in languages such as English or German is just a form of antipassive without using a morpheme.

(21) Passive, antipassive, and causative+antipassive in Zoque (Johnson 2000)

a. huʔc-ʔəm-wə bi wakaš.
stab-PASS-COMPL DEF cow
'(They) killed the cow.'

b. behča cəm-ʔoy-pa.
horse carry-ANTIP-INCOMPL
'The horses will carry (it).'

c. miš-yak-keš-ʔoy-wə-ʔam dey.
2>1-CAUS-eat-ANTIP-COMPL-NOW now
'Now you have already fed me.'

What is known as antipassive (AP) in the Eskimo languages seems to be a more general construction. Several AP-markers are used with various imperfective, inceptive, frequentative or distributive readings; all of them lead to an intransitive verb morphologically, but preserve the original valency syntactically. The ERG-NOM pattern of a transitive verb gets shifted to a NOM-instrumental pattern. According to Beach (2003), there is an important difference between dative-marked agent phrases in the passive and instrumental-marked patient phrases in the antipassive. The latter can be associated with a floating quantifier (22c), and allows interclausal binding (23b), while the former resists those operations (22a,b, 23a). Beach concludes that the instrumental NP of the antipassive construction is a core argument, while the dative NP of the passive construction is a peripheral adjunct. (/-ja/ marks a simple passive, /-naq/ marks the combination of passive and causative, /-tit/ marks the simple causative, and /-si/ marks the antipassive.)

(22) Floating quantifiers in Inuktitut (Beach 2003)

a. arnaq anguti-nut taku-ja -u -laur -tuq (*atuniit)
woman.ABS man -DAT.pl see –PASS.PRT-be-PAST-IND.3sg (*each)
'The woman was seen by (*each of) the men.'

b. anguti-nut aannia -na -laur-tuq (*atuniit)
man-DAT.pl be.sick-PASS.CAUSE- PAST-IND.3sg (*each)
'It made (*each of) these men sick.'

c. anguti-nik aannia -tit -si -laur -tuq atuniit
man-INS.pl be.sick-CAUSE-AP-PAST-IND.3sg each
'It made each of the men sick.'

(23) Interclausal binding in Inuktitut (Beach 2003)

a. (*immi-nit) [Jaani-mut ulla-guma-na -raluar -ti -lu -gu] sukannisaqalaurtuq
self -ABL [John-DAT run-want-PASS.CAUSE-indeed-OBV-APPL-3s] there.was.someone.faster
'Although it made John want to run, there was someone faster (*than self).'

b. immi-nit [Jaani-mik ulla-guma-tit -si -galuar –ti -lu -gu] sukannisaqalaurtuq
self -ABL John-INS run-want-CAUSE-AP-although- OBV-APPL -3s] there.was.someone.faster
'Although he/she/it made John$_i$ want to run, there was someone faster than him$_i$.'

Moreover, the Eskimo antipassive construction is associated with semantic readings that are not usually attributed to antipassive. As Bittner (1987) showed, the instrumental NP in the antipassive needs neither to be indefinite nor unspecific, on the contrary it can be realized with proper nouns as well as with demonstratives. On the other hand, the nominative subject could also be indefinite or unspecific, so that in this respect a contrast between the two arguments is not necessary. According to Bittner, the various semantic effects of the antipassive construction show up in the context of an operator such as negation, quantifier, tense, modality, or distributive plural. Unlike the nominative object-NP of the plain transitive clause, the corresponding instrumental NP of the antipassive may have narrow scope, and that reading is preferred if the construction is contrasted with the plain transitive; only in that case is the instrumental NP indefinite or unspecific. (24) to (26) show some of Bittner's examples. The a-sentences are transitive and only allow the wide scope reading A, whereas the b-sentences are antipassivized and allow the narrow scope reading B as well. The notation is Bittner's, except that '∀y∈{they}' is used for her distribution operator.

(24) Narrow scope readings of Greenlandic antipassive (Bittner 1987)

a. *arnaq franskiq* *angirlaat-tar-pa-a.* = *A*, **B*
woman.NOM French.NOM [come.home.with]- HAB-TR.INDIC-3sgE/3sgN

b. [*arnaq-mik franskiq-mik* *angirlaat-*(*ss*)*i*]*-tar-pu-q.* = *A*, *B*
[woman- INS French- INS come.home.with-AP]-HAB-TR.INDIC-3sgN
'He often comes home with French woman.'
A. It's always the same woman.
B. Different women on different occasions.

A. ∃*x*[*x* is a French woman & *often* (he comes home with *x*)]

B. *often* (∃*x*[*x* is a French woman & he comes home with *x*])

(25) a. *ullut tamaasa irinarsurtuq* *tusar-pa-a.* = *A*, **B*
days all singer.NOM [hear]- TR.INDIC-3sgE/3sgN

b. *ullut tamaasa irinarsurtuq-mik tusar-si-pu-q.* = *A*, *B*
days all [singer-INS hear-AP]- INTR.INDIC-3sgN
'Every day he hears singer.'
A. Same singer every day.
B. Different singers on different days.

A. ∃*x*[*x* is a singer & *every day* (he hears *x*)]

B. *every day* (∃*x*[*x* is a singer & he hears *x*])

(26) a. *cigaretti* [*ikit*]*-pa-at* = *A*, **B*
cigarette.NOM [light]-TR.INDIC-3plE/3sgN

b. [*cigaretti-mik ikit-si*]*-ppu-t* = *A*, *B*
[cigarette- INS light-AP]-INTR.INDIC-3plN
'They lit cigarette.'
A. What they lit was just one cigarette for the whole group.
B. They lit a cigarette each.

A. $\exists x$(x is a cigarette & $\forall$y$\in${they}(lit(y, x)))

B. $\forall$y$\in${they}($\exists x$(x is a cigarette & lit(y, x)))

Inspired by these findings, Bittner detected similar effects of case alternations in Basque, Polish, Russian, and Finnish, where nominative has wide scope over negation, modals, etc., while genitive and partitive, triggered by these elements, can or must have narrow scope – this leads to the generalization in (27).

(27) *The Scope Generalization (Bittner 1987)*
If an argument can be expressed either by an NP in the case predicted by the parameter settings for the language [canonical argument structure] or by some other kind of phrase, then the parametric alternant [the NP] will obligatorily take wide scope with respect to sentential operators, such as negation, tense, aspect, modals, distributive operators, etc., while the nonparametric alternant [the other kind of phrase] will be permitted to take scope under these operators. It may in fact be restricted to take narrow scope.

This generalization suggests that argument structure alternations such as antipassive are motivated by the need to express different scope relations. Let us assume that a structural argument, in particular the nominative argument, is a good candidate for the topic, which usually has wide scope; then existential binding and/or a semantic case reduce the possibility of being the topic. Structurally, a semantic case typically indicates an adjunct rather than an argument; adjuncts belong to the VP predicating of the subject. The above-mentioned negation, modals, etc. are part of the VP, and therefore are able to take a semantic adjunct, but not the subject, into their scope.

Another argument reduction operation is the lexical reflexive. It establishes an anaphoric relationship by identifying a lower argument with the highest one. Such an operation is distinct from using a reflexive anaphora (such as *themselves*) in the syntax.

(28) **REFL** [λz ... λx VERB(x, ... , z)] = λx VERB(x, ... , x)
+lr –lr –lr

(29a) shows the canonical case, in which a transitive verb is detransitivized. In (29b) however, the verb remains transitive; in this case a possessor is added to the core arguments (which makes the verb ditransitive) and is then identified with the highest argument. In general, reciprocal functions similarly, but has a more complex semantics (Heim et al. 1991, Williams 1991): the antecedent X must be plural and must receive a distributed interpretation, and any x$\in$X is paired with some (or every) y$\in$X, where y$\neq$x. Interestingly, (29c) illustrates a case in which the reciprocal morpheme must be combined with the reflexive in order to unfold its full semantics.

(29) Reflexive and Reciprocal in Bolivian Quechua (van de Kerke 1996: 160, 146)

a. Pedru maylla-ku-n
P wash-REFL-3sg
'Pedro washes himself.'
REFL[λy λx WASH(x,y)] = λx WASH(x,x)

b. Pedru uya-n-ta maylla-ku-n
P face-3sg-ACC wash-REFL-3sg
'Pedro washes his (own) face.'
REFL[λz λy λx {WASH(x,z) & POSS(y,z)}] = λz λx {WASH(x,z) & POSS(x,z)}

c. maylla-na-ku-yku
wash-REC-REFL-1pl
'We wash each other.'

Incorporation is quite a different type of argument reduction; in this case, an argument is realized by a morphologically integrated nominal predicate. For instance, a noun can be prefixed to the verb stem, which indicates that this noun predicates of the lowest argument of the verb. Van Geenhoven (1998) analysed incorporated nouns as predicative indefinites. Formally, one can assume an operation that takes two elements in the input, a noun and a verb, and produces a coherent verb reading by argument identification, see (30).

(30) **INCORP** $<\lambda v\ \text{NOUN}(v),\ \lambda z\ ...\ \text{VERB}(\ ...\ ,\ z\ )> = \exists z\ ...\ \{\text{VERB}(\ ...\ ,\ z) \ \&\ \text{NOUN}(z)\ \}$
$-lr$

This analysis suggests that noun incorporation always leads to a general or unspecific reading; however, some languages also allow a specific reading of the incorporated noun, as in (31a), where a demonstrative is stranded. Its referent has to be identified with the entity the complex N-V predicate predicates of, see (31b).

(31) Noun incorporation with definite reading in Southern Tiwa (Baker 1988: 93)
   a. Yede a-seuan-mu-ban.
      that 2sg-man-see-PAST
      'You saw that man.'
   b. R('that') = ιz {SEE(you,z) & MAN(z)}.

Noun incorporation cannot be iterated, and only the lowest argument can be incorporated – probably because canonical λ-application takes place, affecting the lowest θ-role first. Noun incorporation creates a configuration where arguments other than the lowest one can function as structural object (or even as subject): a recipient (32a), an instrument (32b), a possessor (32c,d), or a goal (32e). A ditransitive verb is transitivized in (32a), and a transitive verb is detransitivized in (32b,c), but then either undergoes instrumental applicative (see next section) or inherits the possessor from the incorporated possessed noun, and thus again shows a transitive construction. Similarly, an intransitive verb again becomes intransitive when it undergoes applicative (32e) or inherits the possessor (32d). (The bracketing in the semantic representations shows the respective ordering of operations.)

(32) Noun incorporation (Baker 1988)
   a. Ka-'u'u-wia-ban. *Southern Tiwa*
      1sg/2sg-baby-give-PAST
      'I gave you the baby.'
      $\lambda y\ \lambda x\ \exists z\ \{(\text{ACT}(x)\ \&_{\text{CAUS}}\ \text{BEC POSS}(y,z))\ \&\ \text{BABY}(z)\}$
   b. Kua ta fakatino he tama e malala. *Niue* (*Polynesian*)
      PERF-draw-picture ERG-child NOM-charcoal
      'The child has been drawing pictures with a charcoal.'
      $\lambda z\ \lambda x\ \{\exists y\ (\text{DRAW}(x,y)\ \&\ \text{PICTURE}(y))\ \&\ \text{INST}(z)\}$
   c. Wa-hi-nuhs-ahni:nu: John. *Oneida*
      PAST-1sg/3m-house-buy John
      'I bought John's house.'
      $\lambda z\ \lambda x\ \exists y\ \{\text{BUY}(x,y)\ \&\ (\text{HOUSE}(y)\ \&\ \text{POSS}(z,y))\}$
   d. Hrao-nuhs-rakv ne sawatis. *Mohawk*
      3m-house-white John
      'John's house is white.'
      $\lambda y\ \exists x\ \{\text{WHITE}(x)\ \&\ (\text{HOUSE}(x)\ \&\ \text{POSS}(y,x))\}$
   e. Am-seuan-wan-ban liora-n. *Southern Tiwa*
      3pl-man-come-PAST lady-pl
      'The man came to the ladies.'
      $\lambda y\ \{\exists x\ (\text{COME}(x)\ \&\ \text{MAN}(x))\ \&\ \text{GOAL}(y)\}$

3. Argument extension: Causative, Applicative, Resultative, and others

The opposite of argument reduction is argument extension: valency-increasing operations extend the number of syntactically active arguments. Argument reduction always binds an existing argument, so the semantic core can remain unaffected. An additional argument, however, needs to be licensed by an additional predicate; therefore, argument extension always affects the semantic core itself. Either a higher predicate together with a higher argument is added, or a lower predicate together with a lower argument. A prototypical instance of the former type of operations is the causative, whereas different variants of the applicative are characteristic for the latter type of operations.

The causative adds a causer, who instigates the event expressed by the basic verb, either by direct coercion, or more indirectly by giving an order or admitting a certain course of affairs. Some version of causative is found in nearly every language, and many languages have more than one type of causative (differing morphosyntactically and often also in their finer semantic aspects). It is disputed in the literature whether the causative has to be represented explicitly by the predicate CAUSE (and whether this CAUSE is a relation between two events or between an entity and an event), or whether the causal relationship can be inferred from the lexical combination of an action predicate with another, simpler predicate (see, e.g., the different views advocated by Bierwisch 2002 vs. Wunderlich 2000, in press). For the purposes of this article, I use the notion $\&_{CAUSE}$, taken as a contextually-induced reading of the connector AND. (Notice that $\&_{CAUSE}$ is asymmetric, just as &, when used in a lexical decomposition from which argument hierarchy is derived.) Moreover, the causative usually gets a factive reading, which is expressed by existential binding of the verb's original event variable.

(33) **CAUS** [λe' VERB(...)(e')] = … λx λe {ACT(x) $\&_{CAUSE}$ ∃e' VERB(...)(e')}(e)

In a typical causative formed from a transitive verb the causee becomes the medial argument; it is marked dative in an accusative language such as Japanese (see below (39a)), as well as in an ergative language such as Basque (34).

(34) Causative in Basque

Ama-k	haurr-a-ri	zopa	jan-eraz-i	dio.
mother-ERG	child-DET-DAT	soup.NOM	eat-CAUS-PERF	have.3N.3sgD.3sgE

'Mother let the child eat the soup'

λz λy λx λe {ACT(x) $\&_{CAUSE}$ ∃e' EAT(y,z)(e')}(e)

In a double object construction the causee is realized as the primary object (which can become the subject under passive, can be co-indexed with an object affix, etc.). Besides this unmarked option, illustrated in (35a), there is also a marked option, in which the causee is obliquely realized and does not function as a structural object (35b). Such a marked option is found in various languages, even in those that otherwise have a dative; in Hungarian, for instance., it can be captured by the assumption that the causative morpheme lexically assigns instrumental case (36b) (Wunderlich 2002).

(35) Causative variation in Bantu: Chimwiini (a) vs. Chichewa-A (b) (Baker 1988: 183,163)

a. Mwa:limu ∅-wa-andik-ish-ize wa:na xati.
teacher SU-OB-write-CAUS-ASP children letter
'The teacher made the children write a letter.'

b. Anyani a-na-wa-meny-ets-a ana kwa buluzi.
baboons SU-PAST-OB-hit-CAUS-ASP children to lizard
'The baboons made the lizard hit the children.'

(36) Medial arguments in Hungarian
a. Anna Péter-nek adott egy könyv-et.
A. P.-DAT gave a book-ACC
'Anna gave a book to Peter.'
b. Anna könyv-et olvas-tat Péter-rel.
A. book-ACC read-CAUS P.-INST
'Anna has Peter read a book.'

Another possible variant of the causative is a construction formed with an object control verb, such as *force*, *make*, or *let* (*force him to go, make him go, let him go*). Such a verb adds two arguments, whereby it identifies the object with the subject of a dependent (infinitive) clause (37a). However, that a single morphological operation produces an object control configuration would be unexpected if a simpler alternative is available (37b).

(37) Object control vs. causative
a. λP λy λx FORCE(x,y,P(y))
b. λp λx {ACT(x) $\&_{CAUSE}$ p}

A few languages have operations that add a highest argument in a function distinct from causer. One such operation is the assistive in Quechua,. (38) shows that causative and assistive are structurally alike in Quechua: either a causer or a helper is added as the highest argument. Note that a helper does not necessarily contribute an additional event because she is involved in the same type of action as the helpee. (Quechua lacks a dative, therefore all objects are realized as accusative; object agreement on the verb refers to the highest object, which is the causee or helpee in these cases.)

(38) Causative and Assistive in Bolivian Quechua (van de Kerke 1996: 153, 157)
a. mama-y Maria-ta maylla-chi-wa-rqa
mother-1sg Mary-ACC wash-CAUS-1A-PAST
'My mother made me wash Maria.'
λz λy λx λe {ACT(x) $\&_{CAUSE}$ WASH(y,z)}(e)
b. mama-y Maria-ta maylla-ysi-wa-rqa
mother-1sg Mary-ACC wash-ASS-1A-PAST
'My mother helped me to wash Maria.'
λz λy λx λe {HELPER(x) & WASH(y,z)}(e)

Another operation that adds a highest argument is the affective in Japanese. That causative and affective are structurally alike is shown in (39a,b). Although the affective is formed with the same suffix (*-are*) as the passive and is therefore traditionally called 'indirect passive', its argument structure is clearly distinct from that of a passive (39c). (Note that *-ni* functions both as dative and as adverbial postposition.)

(39) Causative, affective and passive in Japanese (Washio 1995: 6)
a. John-ga Mary-ni tokei-o nusum-ase-ta.
John-NOM Mary-DAT watch-ACC steal-CAUS-PAST
'John let Mary steal a watch.'
λy λx λu λe {ACT(u) $\&_{CAUSE}$ STEAL(x,y)}(e)

b. John-ga Mary-ni tokei-o nusum-are-ta.
John-NOM Mary-DAT watch-ACC steal-AFF-PAST
'John had a watch stolen by Mary.'
= 'John was affected by Mary stealing (his) watch.'
λy λx λu λe {AFF(u) & STEAL(x,y)} (e)

c. Tokei-ga Mary-ni nusum-are-ta.
watch-NOM Mary-BY steal-PASS-PAST
'The watch was stolen by Mary.'
λy λe ∃x STEAL(x,y) (e)

For operations that add a non-highest argument, the term 'applicative' is used as a collective name; the added argument can be a recipient/beneficiary, a possessor, a location, or an instrument. In some languages, a single morpheme encodes all these extensions, while other languages have several distinct morphemes. The general scheme of applicatives when applied to a transitive verb is given in (40). (Whether BECOME is present or not depends on further circumstances, especially on the dynamics of the verb.)

(40) **APPL** [VERB(x,y)] = VERB(x,y) & POSS(z,y) 'z is (or becomes) a possessor of y'
& LOC(y AT z) 'y is (or becomes) located at z'
& INST(z,y) 'z operates as an instrument on y'

In principle, the operation is possible with ditransitive verbs, too. Locative and instrumental applicatives mostly apply on intransitive verbs as well; they then characterize a relation to the intransitive subject, or just a further participant of the event. Applied objects can also stand in a manner, comitative or sociative relation. In any case, the subject remains the same, while an object is added and therefore the realization of objects is shifted. In that sense one can say that *enter* ('x goes-and-becomes-located-at y') is a local applicative of *go* ('x goes'), although the relation *enter-go* is formally a suppletion.

The most prototypical instance of applicative is the benefactive alternation, shown in (41); here, the transitive verb 'buy' becomes ditransitive by means of the applicative suffix in (41b). Following Baker (1988), one might say that the preposition 'for' is incorporated into the verb, so that the prepositional object becomes a direct argument of the verb. However, since *untuk* 'for' and the applicative *kan* are quite distinct morphemes, 'incorporation' would have to be understood in a rather abstract sense. Conceptually it is more convenient to consider the applicative as a way of expressing further participants, independently of whether corresponding prepositional means exist. Thus, the relationship between (41a) and (41b) is purely semantical, not generative; the applicative applies on the verb, not on a syntactic construction. The predicate variable 'P' in (41a) serves as a placeholder for the prepositional phrase, which could also be 'with', 'in', etc. Even if one concedes that the applicative could have a comitative rather than a benefactive meaning, the verb in (41b) is more specific than that in (41a) because it has a third structural argument.

(41) Benefactive alternation in Bahasa Indonesia (Chung 1976)

a. Ali memi telefisi untuk ibu-nja.
Ali TR.buy televison for mother-his
'Ali bought a televison for his mother.'
λP λz λx λe{BUY(x,z) & P(z)}(e)

b. Ali mem-beli-kan ibu-nja telefisi.
Ali TR-buy-APPL mother-his televison
'Ali bought his mother a televison.'
λz λy λx λe{BUY(x,z) & BECOME POSS(y,z)}(e)

A similar argumentation holds for the locative alternation as described for English, German, or Hungarian. The semantically related sentences in (42a,b) or (43a,b) can be assumed to be base-generated rather than derived from each other. (This does not exclude the possibility of preposition incorporation in instances like (44).) It has often been observed that there are finer semantic differences between the respective a- and b-sentences (Brinkmann 1995), which follow from the different status of the arguments involved. The a-sentences are preferred if one wants to communicate that all parts of the stuff (hay, paint) were located somewhere, whereas the b-sentences are preferred if all parts of a location were occupied by the stuff. The question why 'hay' in (42b) and 'paint' in (43b) cannot be expressed as structural arguments cannot be discussed here, but see Wunderlich (1997a,b).

(42) Locative alternation in Hungarian (Ackermann 1992)
   a. a paraszt (rá-)rakta a szénát a szekérre.
      the peasant (onto-)loaded.3sg.DEF the hay.ACC the wagon.SUBL
      'The peasant loaded the hay onto the wagon.'
      λP λy λx λe {LOAD(x,y) & P(y)}(e)
   b. a paraszt meg-rakta a szekeret (szénával).
      the peasant PERF-loaded.3sg. DEF the wagon.ACC (hay.INSTR)
      'The peasant loaded the wagon (with hay).'
      λz λx λe {LOAD(x,y) & BECOME LOC(y, AT(z))}(e)

(43) Locative alternation in German (Brinkmann 1995)
   a. Die Vandalen spritzten Farbe auf das Auto.
      the vandals sprayed paint onto the car
   b. Die Vandalen be-spritzten das Auto (mit Farbe).
      the vandals BE-sprayed the car (with paint)

(44) Preposition incorporation in German
   a. Sie flogen über die Ostsee.
      they flew over the Baltic Sea.
      λP λx λe {FLY(x) & P(x)}(e)
   a. Sie über-flogen die Ostsee.
      they over-flew the Baltic Sea.
      λy λx λe {FLY(x) & LOC(x,AT(y))}(e)

The examples (45a-c) illustrate some applicative variants in the Bantu language Kinyarwanda; benefactive, possessor-raising, and instrumental applicative are marked by different suffixes. As one can see, *-iish* is ambiguous; it either marks instrumental applicative or causative (45c, d). The reading depends on the sortal properties of the complements: usually a child but not a piece of soap is washed, while soap but not a child can be an instrument of washing.

(45) Applicatives in Kinyarwanda (Polinsky & Kozinsky 1992)
   a. umugóre y-a-som-e-ye umwáana igitabo.
      woman 3sg-PAST-read-APPL-PERF child book
      'The woman read the book to the child.' (*benefactive applicative*)
   b. umugabo a-ra-kikir-ir-a umugóre umwáana.
      man 3sg-PRES-hold-APPL-IMPF woman child
      'The man is holding the woman's child.' (*possessor-raising applicative*)
   c. umugóre y-Ø-uhag-iish-ije umwáana isábune.
      woman 3sg-PAST-wash-APPL-PERF child soap
      'The woman washed the child with soap.' (*instrumental applicative*)

d. umugóre y-Ø-uhag-iish-ije umukoóbwa umwáana.
woman 3sg-PAST-wash-CAUS-PERF girl child
'The woman made the girl wash the child.' (*causative*)

A further type of argument extension on the lower end of the argument hierarchy is the strong resultative, by which both an object and a predicate are added to the verb (Washio 1997, Wunderlich 1997b, Kaufmann & Wunderlich 1998, Wunderlich 2000). As the examples (46a,b) show, the object is only licensed by the result predicate, not by the verb itself. (46c) shows the general templatic operation.

(46) Strong resultatives
a. Paul ran the lawn flat. (*Paul ran the lawn)
λy λx λe{RUN (x) &$_{CAUSE}$ BECOME FLAT(y)}(e)
b. Paul drank the fridge empty. (*Paul drank the fridge)
λy λx λe ∃z {DRINK(x,z) &$_{CAUSE}$ BECOME EMPTY(y)}(e)
c. **RES** [VERB(...)] = {VERB(...) &$_{CAUSE}$ BECOME RESULT(z)}, where RESULT is a predicate variable.

Interestingly, unlike causatives, which are usually encoded by a generalized morpheme leaving the causing action unspecific, resultatives are rarely encoded by a generalized morpheme, but mostly by the presence of a predicate that specifies the result. This might be predicted by a general cognitive principle "A causal action can remain unspecific, but a result must be specified". In any case, , although they add a lower argument as well, resultatives crucially differ from applicatives in that they always specify the result property. The only generalized resultative marker I am aware of is Chinese *de*, derived from the verb 'obtain', which is used in a verbal compound as in (47).

(47) Chinese *de*-construction
a. Ta ku-**de** shoujuan quan shi le.
he cry-DE handkerchief all wet FIN
lit. 'He cried such that the handkerchief got all wet.'
'He cried the handkerchief all wet.'
b. Lisi zhui-**de** Zhangsan hen lei.
L chase-DE Z very tired
lit. 'Lisi chased somebody and [as a result] Zhangsan got very tired.'
'Lisi chased Zhangsan very tired.'

More specific markers of resultativity are found as prefixes or particles in languages such as Hungarian, Russian, or German. In (48), the prefix *er-* contributes the result predicate POSS.

(48) German prefix verbs (Stiebels 1996)
a. Sie er-schrieb sich den Pulitzer-Preis.
She **er**-wrote herself the Pulitzer price.
'She won the Pulitzer price by her writing'
b. λv λu λx λe ∃y {WRITE(x,y) &$_{CAUSE}$ BECOME POSS(u,v)}(e)
y becomes non-structural here and cannot be realized as a complement (Wunderlich 1997b).

4. Functor vs. incorporation

Derivational morphemes such as causative and applicative are usually considered to be morphological heads; they apply on a verb in order to form a more complex verb. Even if the Kinyarwanda suffix *-iish* is ambiguous between causative and applicative, there is certainly no difference in the

headedness status between causatives and applicatives. However, as outlined above, the causative adds a new highest argument, while the applicative adds a non-highest argument; therefore, they must have a different status in functional composition. I take it for granted that the functor in a derivation contributes the highest argument. Thus, the causative morpheme is a functor that takes the verb, but, in virtue of the same logic, the applicative morpheme cannot be the functor. Hence, in that case the verb itself must be the functor, but has to undergo a templatic predicate extension in order to incorporate a further predicate.

(49a,b) repeats the pair of sentences (45d,c) from above, and adds a benefactive formed from the same verb. Let (50a) represent the causative reading of *-iish*, and (50b) the verb 'wash'. Then, (50c) derives via functional composition; a highest argument is added, and all original arguments of the verb are inherited.

(49) Causative, instrumental, and benefactive applicative in Kinyarwanda

a. umugóre y-Ø-uhag-iish-ije umukoóbwa umwáana.
woman 3sg-PAST-wash-CAUS-PERF girl child
'The woman made the girl wash the child.'

b. umugóre y-Ø-uhag-iish-ije umwáana isábune.
woman 3sg-PAST-wash-APPL-PERF child soap
'The woman washed the child with soap.'

c. umugóre y-Ø-uhag-e-ye umukoóbwa umwáana.
woman 3sg-PAST-wash-APPL-PERF girl child
'The woman washed the child for the girl.'

(50) The causative as a functor on the verb

a. causative *-iish*: $\lambda V\ \lambda u\ \lambda e\ \{\text{ACT}(u)\ \&_{\text{CAUSE}}\ \exists e'\ V(e')\}(e)$

b. *uhag*: $\underline{\lambda y\ \lambda x}\ \lambda e\ \text{WASH}(x,y)(s)$

c. *uhag-iish*: $\underline{\lambda y\ \lambda x}\ \lambda u\ \lambda e\ \{\text{ACT}(u)\ \&_{\text{CAUSE}}\ \exists e'\ \underline{\text{WASH}(x,y)}(e')\}(e)$

However, with applicatives preserving the original subject, the verb must function as functor. In order for that, the verb undergoes the templatic extension shown in (51), incorporating the predicate P, whatever it is.

(51) Predicate incorporation into a verb:

P-INCORP $\langle P, \ldots \lambda e\ \text{VERB}(\ldots)(e)\rangle = \lambda P \ldots \lambda e\{\text{VERB}(\ldots)(e)\ \&\ P(e)\}$,
which can be simplified as $\{\text{VERB}(\ldots)\ \&\ P\}(e)$

Let us assume that the verb 'wash' is augmented in this way (52a), and that P is instantiated by an instrumental predicate (52b), then (52c) is derived via functional composition. Here, the original arguments of the verb remain the highest ones, whereas those of the incorporated predicate become lower ones. For the complex event denoted by the derived verb to be coherent, incorporans and incorporandum should share an argument. In principle, v can be identified with either e or y (with slightly different readings: 'instrument of performing an action', 'instrument operating on an individual entity'), but certainly not with x. This yields one of the representations given in (52d); the difference is that the instrumental object is either the lowest or the medial argument of the complex verb. When combined with a transitive verb, the applied instrumental object (u) in the Bantu languages does in fact sometimes have properties of the lowest, and sometimes of a medial argument (Marantz 1993).

(52) The (extended) verb as functor on the applicative

a. P-INCORP(*uhag*): $\lambda P\ \lambda y\ \lambda x\ \lambda e\ \{\text{WASH}(x,y)\ \&\ P\}(e)$

b. applicative *-iish*: $\underline{\lambda v\ \lambda u}\ \text{INSTR}(u,v)$

c. *uhag-iish*: λv λu λy λx λe {WASH(x,y) & INSTR(u,v)}(e)
d. λu λy λx λe {WASH(x,y) & INSTR(u)}(e)
λy λu λx λe {WASH(x,y) & INSTR(u,y)}(e)

In contrast, the applied beneficiary mostly shows properties of the medial argument, and the applied locative object shows properties of the lowest argument (Alsina & Mchombo 1990). This is expected, given that the predicate that integrates beneficiaries is assumed to be POSS(**u**,v), with u being the applied object, whereas the predicate in the case of locative application is LOC(v, AT **u**), again with u being the applied object. (McGinnis (2005) proposes a phase-theoretic analysis for the different behavior of these types of applicatives.)

Of course, one could think of representing the causative and applicative morphemes in a more uniform way, e.g. as {CAUSER(u) & VERB} vs. {VERB & INSTR(u)}, but in that case the actual hierarchy of arguments would not be determined by functional composition, and additional reasons would have to be found.

In the German prefix verbs, the verb is both the head and the functor. (53a) repeats (48a) from above. (53b) shows the verb extended by P-INCORP, and (53c) the semantic contribution of the prefix *er*-. Functional composition then yields the result in (53d). As a matter of fact, the document written (y) cannot be expressed because it neither is in the position of a structural argument (Wunderlich 1997b) nor can be identified with the thing to become possessed (v); therefore it must be bound existentially.

(53) German prefix verbs (Stiebels 1996)
a. Sie *er*-schrieb sich den Pulitzer-Preis.
She *er*-wrote herself the Pulitzer price.
'She won the Pulitzer price by her writing'
b. **P-INCORP**(*schreib*): λP λy λx λe {WRITE(x,y) & P}(s)
c. resultative *er*-: λv λu BECOME POSS(u,v)
d. *er-schreib*: λv λu λy λx λe {WRITE(x,y) & BECOME POSS(u,v)} (e)
⇒. λv λu λx λe ∃y {WRITE(x,y) & BECOME POSS(u,v)}(e)

The representation (53d) is still unsatisfactory because it doesn't make explicit the difference between a factual and an intended result. If I write a novel for Paul I intend Paul to become the possessor of the novel (WRITE(x,y) $\&_{\text{INTEND}}$ BECOME POSS(u,y)), however, if Paul then wins the Pulitzer price with this novel (pretending to have written it himself) the sentence 'Ich erschrieb Paul den Pulitzer-Preis' becomes true. The minimal repair in (53d) would be '$\&_{\text{CAUSE}}$' instead of '&', but this would require a slightly different incorporation template to start with.

5. Parsimony in the set of exponents: polyfunctional affixes

In the Pama-Nyungan languages of Australia a single affix often functions as a general transitivization marker. For instance, the Kalkatunga suffix *-nti* adds a causer if it is combined with an inchoative or stative verb (54a), but it adds a beneficiary, instrument, or location if it is combined with an agentive verb (54b). In a subgroup of these languages the same affix can be applied to transitive verbs as well, but usually only when they have first been detransitivized by antipassive, as in (54c), where the demoted object is realized by oblique dative marking.

(54) Transitivization in Kalkatunga (Austin 1997)
a. iti 'return' iti-nti 'send/bring back'
nguyi 'fall' nguyi-nti 'push over'
b. nuu 'lie' nu-nti 'lie on (something)'
wani 'play' wani-nti 'play with (something)'

c. Nga-thu kati-nti-mi tharntu kupangurru-u.
1-ERG bury-TR-FUT hole.NOM old.man-DAT
'I will bury the old man in a hole.'

A canonical transitive verb can possibly be decomposed into an active (controller) and an affected predicate. Given that an intransitive verb is either active or affected, the function of the transitivizing affix then is to derive a canonical verb, i.e. to add the respective complementary predicate.

(55) **TR** [VERB] results in a canonical transitive verb
TR [λy AFF(y)] = λy λx ACT(x) & AFF(y)
TR [λx ACT(x)] = λy λx ACT(x) & AFF(y)

A different type of affix such as *-e* in Japanese either transitivizes or detransivizes. Comrie (2006) lists 57 inchoative/causative pairs in which *-e* derives the causative verb (56a), and 36 pairs in which it functions as the opposite, namely derives the inchoative verb from the transitive one (56b). Even larger is the number of pairs where the two verbs are derived by different means (56c).

(56) Causatives vs. anticausatives in Japanese (Comrie 2006)

a.	ak-u 'open'	ak-e-ru 'open (tr.)'
	itam-u 'hurt'	tam-e-ru 'injure'
	tat-u 'stand'	tat-e-ru 'raise'
b.	nuk-u 'remove'	nuk-e-ru 'come off'
	or-u 'break (tr.)	or-e-ru 'break'
	tuka-u 'use'	tuka-e-ru (be usable)
c.	kowa-s-u 'destroy'	kowa-re-ru 'be destroyed'.

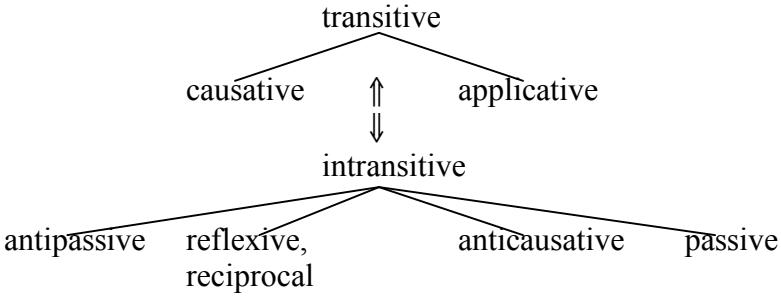
A similar phenomenon has been observed in other languages as well (Haspelmath 1993). The majority of languages tend to use the causative operation more frequently than its opposite, called anticausative. Only the semitic languages exhibit more anticausatives, however, they use a number of different prefixes. Formally, one can describe the function of Japanese -e as in (57). It is important to note that, unlike passive, the anticausative does not imply the presence of an agent.

(57) VERB and –**e**[VERB] differ in their transitivity status
-e [λy AFF(y)] = λy λx {ACT(x) &$_{CAUSE}$ AFF(y)}
-e [λy λx {ACT(x) &$_{CAUSE}$ AFF(y)}] = λy AFF(y))

Obviously, the anticausative operation conflicts with the principle of monotonicity, which states that no semantic information is deleted in the course of derivation. Therefore it is hard to imagine that an affix could have emerged with a pure anticausative function; it would have been blocked by the monotonicity principle. What one indeed finds are morphemes with a broader function including the anticausative reading as a special case. One possibility is, within the inchoative/causative pairs, that a marker can choose either the more complex or the more basic item. Given a grammatical dimension in which pairs of lexical items derived from a common stem can be ordered, one member of the pair should have the semantic property X, while the other lacks it. Usually one expects pairs <σ,σ'> such that σ=<PF,SF> and σ'=<PF+pf, SF+sf>, where <pf,sf> is the contribution of an affix or some other morphophonological operation. However, if a form expressing SF+sf is more likely to be used than the alternative form expressing SF simpliciter it is conceivable that the more complex meaning is combined with the simpler PF, i.e., pairs <σ,σ'> such that σ=<PF,SF+sf> and σ'=<PF+pf, SF> might become possible as well. (Bidirectional optimality theory would be able to model such a situation, see Blutner & Zeevat 2004).

The other possibility is detransitivization as a multi-functional operation, which derives several kinds of intransitive readings, depending on the specific meaning of the verb. The middle voice is typically known for its multiple readings. Unlike passive and antipassive as special operations for deactivating the higher or the lower argument (the agent or patient) respectively, the middle seems to be a general operation that basically contrasts intransitives (of any kind) with transitives. According to the diagram (58) general transitivizers and general detransitivizers can be distinguished from more specific operations. Above I illustrated the specific pair causative/anticausative; it would be interesting to know whether other specific pairs such as antipassive/applicative exist as well, and if not, why not.

(58) Transitivity alternations



A fusion of detransitivizing operations in a single affix is much more common than the fusion of causative and applicative in a single affix (see (54)) . An extreme example of polyfunctionality is attested in Chukchi, where the suffix *-tku/-tko* not only functions as a general detransitivizer comprising anticausative, antipassive, reflexive, and reciprocal (59), but also derives both paucer ('island' → 'a group of islands') and iterative ('bite' → 'bite several times') readings; moreover, this affix also derives verbs from instrumental nouns ('rifle' → 'to shoot'), and functions as 1pl object marker in the presence of a 2nd person subject (*pela-tko-tək* leave-1pl-2pl 'you left us'); of course, some of the latter functions should be considered accidental homonymy.

(59) Detransitivization in Chukchi (Nedjalkov 2006: 222)

a.	ejpə-nin 'he closed it'	ejpə-*tku*-ɣʔi 'it closed' (*anticausative*)
b.	ʔəttʔ-e juu-nin 'the dog bit him'	ʔəttʔ-ən nə-jɣu-*tku*-qin 'the dog bites' (*antipassive*)
c.	tewla-nen 'he shook it off'	tewla-*tko*-ɣʔe 'he shook himself' (*reflexive*)
d.	ommačajpə-nen 'he hugged him'	ommačajpə-*tko*-ɣʔat 'they hugged each other' (*reciprocal*)

Thus, besides all its other functions, *-tku/-tko* provides a whole set of detransitivizing operations.

(60) **-tku/-tko** [λy λx (ACT(x) & AFF(y))] =
{λy AFF(y), λx ∃y (ACT(x) & AFF(y)), λx (ACT(x) & AFF(x)), …}

In Kharia, a South Munda language, every predicate must be voice-marked for either middle or active (where voice is always fused with tense-mood). Several verbs are middle-only or active-only, whereas the majority of verbs allow both options. The verb gets an inchoative reading in the middle, but a causative reading in the active (61a). Furthermore, verbs that are independently marked for passive/reflexive require the middle (61b), and those that are marked for causative require the active (61c).

(61) Middle/active pairs in Kharia (Peterson 2005)

a.	ayo	'become a mother'	'accept s.o. as a mother'

khatam	‘come to an end’	‘finish’ (TR)
sebol	‘become sweet’	‘make sweet’
tuta	‘go down’	‘put down’

b. yo dom-ki-kiyar.
see PASS/REFL-MIDDLE.PAST-DUAL
‘They two were seen (by someone else). / They two saw themselves.’

c. yohan beta o-dam-e.
John boy CAUS-arrive-ACT.IRR
‘John will bring the boy.’

Besides some sorts of intransitivity, the middle characterizes habitual, persistent, self-directed, attempted (but not successful), spontaneous or unexpected actions, as well as those in which the subject participates only indirectly. As Peterson (2006) argues, the middle appears to mark those events which differ somewhat from prototypical actions, in contrast to the active, which marks events that are closer to prototypical actions.

Similarly, the middle voice in Greek, and the reflexive in Spanish, Russian, and other Indo-European languages of Europe are notoriously known for their multifunctionality, including the anticausative reading.

(62) Spanish reflexives (Kaufmann 2004: 191)

a.	Juan se lava.	‘Juan washes himself.’	(*reflexive*)
b.	La cuerda se rompe.	‘The rope splits.’	(*anticausative*)
c.	El libro se publicó en 1952.	‘The book was published in 1952.’	(*passive*)
d.	Se vive bien aqui.	‘People live well here.’	(*impersonal*)
d.	Estas frutas se comen.	‘These fruits are edible.’	(*modal*)

Kaufmann (2004) tried to find a general meaning of the middle affixes in Classical Greek and those in Fula from which the specific subreadings could follow as special contextual instances. Regardless of whether such a reconstruction succeeds for a number of readings, one might remain skeptical whether such an enterprise is on the right track in general. Could it be that the ‘reflexive’ *se* just marks intransitivity, contrasting with the transitive verb – whatever the preferred reading might be for the intransitive variant?

Watters (2005) reports about Kusunda, a language isolate of Nepal, that a particular harmonic mutation on verbs marks the semantically more articulated category in a pair of categories, regardless of the particular dimension; it marks causative in the transitivity dimension, irrealis in the modality dimension, negation in the polarity dimension, and dependent in the dependency dimension. Thus, a single phonological feature (mutation) is paired with semantic markedness, whereas the concrete semantic operation has to be chosen from a set of alternatives.

In a language in which each verb has exactly one canonical semantic variant, in one of many possible dimensions, there would be no problem with maximal parsimony, marking all of the respective marked variants in the same way. Then, knowing the meaning of a marked item only requires knowing what the canonical semantic variant is. This does not exclude the possibility that non-canonical variants (differing in one of the other dimensions) are formed by more articulate means.

6. Multiple operations and the order of derivation

Operations on argument structure can be combined cyclically, so that the output of a first operation serves as the input for a further operation. In particular, argument reduction and argument extension often alternate. Yucatec Maya illustrates a type of language in which no more than two structural arguments are possible; in a certain state of affairs a verb can either be transitivized or detransitivized. More precisely, causative (suffixation with -s) or applicative (suffixation with -t)

applies to verbs in an intransitive state, whereas passive, antipassive or noun incorporation applies to verbs in a transitive state. These operations can easily be combined. (63a) shows the ordering V-CAUS-PASS, (63b) V-APPL-PASS, (63c) V-PASS-CAUS-PASS, and finally (63d) V-INCORP-APPL. The last line in each example indicates the semantic representation of the complex verb.

(63) Alternation of transitivization and intransitivization in Yucatec Maya (Krämer & Wunderlich 1999)

a. kíin-s-áab-en tumèen leti
die-CAUS-PASS.PERF-1 PREP PRON.3.SG
'I was killed by him.'
λy λe ∃x {ACT(x) &$_{CAUS}$ DIE(y)}(e)

b. k=a kóoy-t-áal
INCOMPL=2 dig -APPL-PASS.IMPF
'It gets dug (up).'
λy λe ∃x {DIG(x) & AFFECTED(y)}(e)

c. k=u káan-s-áal
INCOMPL=3 learn.PASS-CAUS-PASS.IMPF
'It is being taught'
λz λe ∃x {ACT(x) &$_{CAUS}$ ∃y LEARN(y,z)}(e)

d. taan=u kon-lol -t -ik -et
INCOMPL=3 sell-flower-APPL-IMPF-2
'He's selling you flowers.' (lit. 'he's flower-selling you')
λy λx λe {∃z (SELL(x,z) & FLOWER(z)) & AFFECTED(y)}(e)

Several other languages supply evidence that argument changing operations can be combined freely, though they may be subject to some sequential constraints. (64a) gives an example from Chichewa with the ordering V-APPL-REC-CAUS. (64b) shows the stepwise semantic derivation; the symbol ⊕ indicates a reciprocal relationship between the two occurrences of a variable.

(64) Interaction of argument changing operations in Chichewa (Bantu)

a. M-lenje a-na-mang-ir -an -its -a a-tsikana nkhuni.
1-hunter 1-PAST-tie-APPL-REC-CAUS-FV 2-girl firewood
'The hunter caused the girls to tie firewood for each other'

b. *mang*: λy λx λe TIE(x,y)(e)
mang-ir: λy λ**z** λx λe {TIE(x,y) & BEC POSS(**z**,y)}(e) (*benefactive appl.*)
mang-ir-an: λy λx$^{⊕}$ λe {TIE(x,y) & BEC POSS(x,y)}(e) (*reciprocal*)
mang-ir-an-its: λy λx$^{⊕}$ λu λe {ACT(u) &$_{CAUSE}$ ∃e'{TIE(x,y) & BEC POSS(x,y)}(e')}(e) (*causative*)

It is easy to imagine that any other order of affixes would yield a different interpretation:

- REC-CAUS-APPL: 'The hunter caused the girls to tie each other at the firewood';
- CAUS-REC-APPL: 'The hunters caused each other to tie firewood for the girls'.

However, some surface orders of suffixes are forbidden. According to Hyman and Mchombo (1992), the causative suffix *-its* may not appear after the applicative suffix *-ir* or the passive suffix *-idw*. In other words, the affix ordering is fixed, independently of semantic scope.

(65) Surface alignment constraints in Chichewa

a. *-ir-its (-APPL-CAUS)
b. *-idw-its (-PASS-CAUS)

That the first constraint leads to ambiguity, which, however, can be resolved in a normal context, is shown in (66). In (66a), the applied instrument 'sticks' clearly relates to 'making cry' and not 'cry', whereas in (66b) the applied instrument 'spoon' relates to the lower verb 'stir'. (Interestingly, the passive of (66a) requires 'sticks' as the subject, and the passive of (66b) requires 'woman' as the subject, thereby reflecting the different semantic scope.)

(66) Chichewa CAUS-APPL representing both scopes (Hyman 2003)
a. alenjé a-ku-líl-**íts-il**-a waná ndodo.
hunters 3pl-PROG-cry-CAUS-APPL-FV child sticks
'The hunters are making the child cry with sticks.' (INST (CAUSE (CRY)))
b. alenjé a-ku-tákás-**íts-il**-a mkází mthíko.
hunters 3pl-PROG-stir-CAUS-APPL-FV woman spoon
'The hunters are making the woman stir with a spoon.' (CAUSE (INST (STIR)))

A similar ambiguity is caused by the second constraint: TIE-PASS-CAUS 'u causes y to be tied' and TIE-CAUS-PASS 'x is caused to tie y' clearly mean different things, that is, two different semantic compositions are mapped onto the same surface string *mang-its-idw-a.* Unless there is a strong contextual bias to the contrary, the compositional reading in which the order of suffixes reflects the order of semantic operations should be assumed to be the default option for the hearer.

Another type of mismatch found in Chichewa is semantically empty suffix repetition. In (67), the second occurrence of the reciprocal suffix *-an* has to be ignored because the semantic reciprocal operation cannot be repeated in the same domain.

(67) Redundancy in Chichewa:
A-tsikana a-na-mang-an **-its -idw** -ir *-an* -a m-nkhalango.
2-girl 2-PAST-tie-REC-CAUS-PASS-APPL-(REC)-FV LOC-forest
'The girls were caused to tie each other in the forest'

Similarly, double or triple causative found in languages of India often only means emphasized causative, e.g., Kashmiri *khy-aav-inaav* 'eat-CAUS-CAUS' and *khy-aav-inaav-inaav* 'eat-CAUS-CAUS-CAUS' both mean 'have someone feed someone'.

Several other studies (e.g., Muysken 1986 and van de Kerke 1996 on Quechua) have established the insight that the order of affixes reflects the order of semantic composition in most instances, though unfortunately not in all. Surface alignment constraints partially destroy the ideal picture. Hyman (2003) argues that Proto-Bantu started with a fixed template (verb-CAUS-APPL-REC-PASS) of which many residuals are still present; he also cites Abasheikh (1978), who found that Chimwiini (a Swahili dialect of Somalia) has a fixed affix ordering.

In order to see how constraints such as those in (65) work, parallel processing can be assumed: For each suffix (contributing a phonological form and a semantic operation), the phonological output PF and the semantic output SF are computed separately. Differences between the input and output in PF do not affect the output in SF. The derivation fails only if one of the parallel lines of processing yields a zero output.

(68)

Input:	PF	SF	
a	mang	λy λx λs TIE(x,y)(s)	
b	mang-idw	λy ∃x λs TIE(x,x)(s)	(p*assive*)
c	mang-idw-its	λy ∃x λu λs {ACT(u) & ∃s'TIE(x,x)(s')}(s)	(c*ausative*)
↓			
Output:	*mang-its-idw*		

According to (65b), the PF arrived at in line c is forbidden, so the second-to-best position of *-its* is chosen, that is, *-its* is in fact infixed.

Stiebels (2003) distinguishes between transparent, restricted and opaque affix orders. If both affix orders (-A-B and -B-A) occur and transparently reflect the underlying scope relations they are called transparent. If due to a language-specific constraint only one affix order occurs and receives a surface-true, i.e. compositional, interpretation it is called restricted. If a given affix order has both the compositional and the non-compositional interpretation – the latter violating the revised mirror principle – it is called opaque.

(69) Mirror Principle
   a. Morphological derivations must directly reflect syntactic derivations (and vice versa). (Baker 1985:375)
   b. Revised: The affix order must mirror semantic composition. (Stiebels 2003: 292)

The revised mirror principle claims a correspondence between morphology and semantics rather than between morphology and syntax. Crucial for this claim are scope relations.

As the reader will have observed, the argument shifting operations presented in this article are realized by suffixes on the verb, except for the resultative prefixes, which are special. Thus, the linear ordering from left to right indicates the actual path of computing argument structure. Everything that precedes a certain suffix (operation) is in its scope: the underlying predicate together with all of the arguments as well as the result of preceding operations. Different suffix orders such as -CAUS-REC VS. -REC-CAUS generate different readings because they manipulate argument *variables*, which are scope-internal and therefore independent of the position of DPs that realize the arguments, hence, independent of any DP movement. If, in contrast, argument changing operations were phrasal, they would operate on VPs (rather than Vs), so that some arguments would already be saturated, and DP movement could easily extract the DP from the relevant scope.

(70) Morphologically determined scope relations are immune to DP movement, syntactically determined scope relations are not.

The following data from Wechsler (1989) show that only core arguments and not PPs are included in the scope of a bound morpheme. The participants of the repeated situation expressed in the Chichewa example (71a) include the writer and the essay, but not the instrument; in (71b), however, the instrument is included as well, because the (instrumental) applicative has applied.

(71) Chichewa repetitives (Wechsler 1989: 429)
   a. Mu-lembe=<u>nso</u> chimangirizo [ndi nthenga]$_{\mathbf{PP}}$
      you-write=again essay with feather
      'you write the essay again, with a quill (this time)'
      AGAIN [λy λx λe WRITE(x,y)(e)] & INSTR(feather,e)
   b. Mu-lembe-*re*=<u>nso</u> nthenga chimangirizo.
      you-write-APPL=again feather essay
      'you write the essay with a quill again'
      AGAIN [{λy λz λx λe WRITE(x,y) & INSTR(z,y)}(e)]

Conversely, the English examples in (72) show that the repetitive adverb can include the locative PP in its scope (72a), but the repetitive prefix cannot (72b). Only if the location is incorporated into the verb is it in the scope of the prefix *re-* (72c); recall that *enter* is in fact a locative applicative in English.

(72) English repetitives
  a. John ran to the forest again.
     AGAIN (to the forest (run (John)))
  b. * John reran to the forest.
     § to the forest (AGAIN (run (John))
  c. John reentered the forest. - This forest, John reentered several times.
     AGAIN (entered (John, the forest))

Note that *rerun* with the only possible reading λx λe AGAIN (RUN(x)(e)) is semantically deviant because running is an unbounded event, but *re-* only applies to bounded events. However, *reenter* is possible because entering something is a bounded event.

These examples clearly show that morphology is in a way immune to syntax. A bound morpheme such as 'again' – be it an affix or a clitic – takes in its scope all core arguments of the simple or derived verb to which it is attached, but nothing from outside, e.g., an adjunct. In the syntax it is possible to move argument-realizing DPs, thereby shifting scopal properties, which, however, has no influence on the scope of *re-* (which only sees the argument variables). Conversely, a PP or an adverb (syntactic adjuncts) can take the verb and some or all of the syntactically realized arguments into its scope. Von Stechow's (1996) idea was that 'again' can have scope over different parts of the lexical decomposition of a verb; in which sense that could be true is still a matter of dispute (Wunderlich 2001: 492ff).

In any way, there is strong evidence that morphology and syntax behave differently. Although both reflect semantic conditions, they are not derived from each other. Therefore, morphological theories that are couched in a syntactic framework, such as Distributed Morphology, seem to be on the wrong track. Similarly, when phase theory, a syntactic theory, is used to clarify the conditions that govern multiple applicatives in the Bantu languages (McGinnis 2005), primarily a morphological phenomenon, one has to assume either that phase theory is particularly semantically inspired or that it is the wrong tool for this subject matter.

7. Argument alternation through lexical marking

From the semantic point of view, lexical marking is a trivial operation on argument structure. In the history of the Germanic languages (English, German, Scandinavian, Icelandic), many verbs encoding dative-nominative (73a) shifted to nominative-accusative (73b) without any relevant semantic change.

(73) Lexical marking shift from Early New High German to Modern German
  a. Mir ahnte das.
     I.DAT anticipated that (NOM)
  b. Ich ahnte das.
     I.NOM anticipated that (ACC)

The case-pattern shown in (73b) represents canonical transitive verbs, while the pattern in (73a) is characteristic for a certain subclass, the experiencer verbs. In general, lexical marking serves to classify verbs according to their inherent meaning, nevertheless it is a pure surface operation, which only affects subcategorization and not the semantic core. These lexical features, whatever they are (Wunderlich 2003), are added or removed during historical development. Small meaning differences can only emerge if for a particular verb different states of lexical marking coexist. It is important to note that lexical marking on the highest argument usually excludes passivization – verbs of the type (73a) cannot be passivized. However, (73b) allows passivization, at least in principle; *das wurde von niemandem geahnt*, the passive of 'nobody anticipated that', is fine.

8. Argument alternation: Dative shift, and others

Another type of argument alternation results from a choice between semantically similar core representations, and not from a particular operation. In the so-called dative shift of English a verb with a prepositional object (PO) is shifted to a verb with double object (DO).

(74) PO-DO alternation in English
  a. Anna gave a photo to Max. (PO)
  b. Anna gave Max a photo. (DO)

However, a more precise investigation,provides evidence that the two alternative constructions are connected with slightly different semantic representations, spelled out as 'change of location' vs. 'change of possession', so that there cannot be an operation between them (Pinker 1989, Krifka 2004).

(75) Semantic representation of the PO-DO alternation
  a. PO: $\lambda y\ \lambda z\ \lambda x\ \{\text{ACT}(x)\ \&_{\text{CAUSE}}\ \text{BECOME LOC}(z, \text{AT } y)\}$
  b. DO: $\lambda z\ \lambda y\ \lambda x\ \{\text{ACT}(x)\ \&_{\text{CAUSE}}\ \text{BECOME POSS}(y, z)\}$

These two representations crucially differ with respect to argument hierarchy: the recipient (=goal) is the medial argument in (75b), but the lowest one in (75a). This fact allows us to make some important predictions.

In the DO construction, the recipient (y) should consistently behave as the higher object: it should be able to bind a reflexive theme, license a negative polarity item (such as *any*), be moved in multiple questions, etc., which is indeed the case according to the several tests applied by Larson (1988). In contrast, in the PO construction the recipient (y, construed as a goal) should behave consistently as the lower argument: it should not allow binding by a theme, movement in multiple questions, etc. One of the possible tests is that a quantifier in the higher argument can bind the possessor of a lower argument, but not vice versa, as exemplified in (76),

(76) Argument hierarchy in the PO vs. DO construction
  a. He gave every baby_i to its_i mother.
    *He gave her_i baby to every woman_i.
  b. He gave every woman_i her_i baby.
    *He gave its_i mother every baby_i.

Another prediction concerns harmonic alignment. In general, the construction in which the higher argument outranks the lower one in terms of saliency should be favored. It is thus expected that PO is preferred if the theme is more salient than the recipient, e.g., first or second person, animate, a pronoun, definite, specific, or the topic. Conversely, DO should be preferred if the recipient (rather than the theme) has one of these properties. This is indeed the case, as shown by Bresnan & Nikitina (2003). (77) illustrates the distribution of pronominal vs. NP arguments.

(77) Salience in the PO vs. DO construction
  a. They gave him to an old woman.
    ?They gave a crying baby to him.
  b. They gave him a crying baby.
    *They gave an old woman him.

Similar observations have been made regarding the alternation between the serial verb (SV) construction and the DO construction in West African languages. In Fongbe, a Kwa language of Benin, the SV construction in (78) shows the ranking theme > recipient, while the DO construction

in (79) shows the reverse ranking recipient > theme, indicated by the possibility of a quantifier binding a possessive pronoun.

(78) Serial verb construction in Fongbe (Lefebrve & Brousseau 2001: 463)
a. Ùn sɔ́ fɔ̀tóò dòkpódòkpó xlɛ fɔ̀tóó'tɔ́ tɔ̀n.
1sg take picture every show picture.owner GEN
'I showed every picture to its owner.'
b. *Ùn xlɛ́ fɔ̀tóò tɔ̀n xlɛ mɛ̀ dòkpódòkpó
1sg take picture GEN give person every
* 'I showed his picture to every person.'

(79) Double object construction in Fongbe (Lefebrve & Brousseau 2001: 455)
a. Ùn xlɛ́ mɛ dòkpódòkpó fɔ̀tóò tɔ̀n. (*or*: ... fɔ̀tóò tɔ̀n mɛ̀ dòkpódòkpó)
1sg show person every picture GEN
'I showed every person his picture.'
b. *Ùn xlɛ́ fɔ̀tóò dòkpódòkpó fɔ̀tóó'tɔ tɔ̀n
1sg show picture every picture.owner GEN
*'I showed its owner every picture.'

In Akan, a related Kwa-language of Ghana, pronominal or definite themes, which are high in salience, require the SV-construction.

(80) SV and DO construction in Akan (Campbell 1996: 101)
a. Me-tOnn nwoma no maa Kofi.
1sg-sold book that gave Kofi
'I sold the book to Kofi.'
b. Me-maa Kofi nwoma (*no).
1sg-gave Kofi book (that)
'I gave Kofi a/*the book.'

It has been argued that POSS(y, z) and LOC(z, AT y) are weakly equivalent because usually if one of them is true, the other is true as well. If z is located at y, then y is able to exert some ownership on z. Conversely, if y has possession of z, then z must be located in the vicinity of y for y to be able to exert his possessorship (Wunderlich 2006: 151). For that reason possession is often expressed by means of a locative construction (e.g., Russian *u menja kniga* 'at me.GEN book' means 'I have a book'). Note that POSS(y, z) and LOC(z, AT y) are not exactly converse to each other because AT y refers to some neighboring region of y rather than to y itself. However, this fact doesn't seem to have any influence on the capability of (80a,b) to represent alternative readings of one and the same verb; what counts here is the difference in argument hierarchy.

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