10

The ontology of roots and verbs

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10.1 Introduction

Verbs can be classified in ways that seem to reflect both semantic and morphosyntactic similarity at the same time, as shown in great detail in Levin (1993).[1] However, we are still far from understanding how exactly to connect the semantic properties with the morphosyntactic properties. In this chapter, I argue that some such correlations can be derived from the semantic types of the roots which form the lexical core of verbs. This idea in itself is not new, as for example Rappaport Hovav and Levin (1998) argue that the meaning of what they call 'constants' determines some aspects of a verb's syntactic realization. However, what is novel to the present approach (a development of the view put forward in Levinson 2007b) is putting this idea together with Distributed Morphology approaches that give roots a life in the syntax, rather than simply in the lexicon. This makes additional predictions regarding the compositional semantic interpretation of roots, which I argue in this chapter are borne out. These findings also provide evidence that such roots are not semantically vacuous in isolation as has been proposed by Borer (2005a), Acquaviva (2009), and Harley (2009).

The key aims of this chapter are to provide an explicit compositional account for verbal lexical decomposition and to show that this formalization can provide important insight into this domain. It is also hoped that this chapter contributes to our understanding of the ontology of lexical roots, and also shows that what may appear to be verb polysemy sometimes also involves structural ambiguity, potentially combined with **root** polysemy. Due to this last fact, great care must be taken in controlling for such 'lexical' ambiguities when classifying and analyzing verbs.

[1] I would like to thank Chris Barker, Jon Brennan, Marcel den Dikken, Richard Kayne, Tom Leu, Alec Marantz, Øystein Nilsen, Liina Pylkkänen, Oana Savescu-Ciucivara, Anna Szabolcsi, Eytan Zweig, and two anonymous reviewers for very helpful comments on the topic of this chapter.

The model of grammar that I am assuming is closest to that presented in Marantz (1997) and Arad (2005) in connection with the Distributed Morphology framework (Halle and Marantz 1993). One key assumption from Marantz (1997) is the 'single engine hypothesis', that there is one computational system which generates both words and larger constituents. In this framework, words are not built in the lexicon, but rather in the same fashion as phrasal constituents, in the syntax. Words are not atomic, but are built from *roots*, which constitute the atomic syntactic terminals providing the "lexical" content. These roots do not bear categories like "verb" or "noun" (see also Pesetsky 1995, Barner and Bale 2002, Barner and Bale 2005, Borer 2005a, Borer 2005b). Rather, they seem to "join" these syntactic categories when they combine with what are considered to be category-specific heads in the syntax. Throughout the chapter, I use the term "verb" either in the informal, traditional sense of the word, or as a descriptive term for complex constituents which contain a *v* head.

I add to this framework the assumption that the mapping between such syntactic constituents and interpretation is strongly compositional. The strong interpretation of compositionality I will take is one that admits no semantic rules that do not correspond to steps in the syntactic derivation, nor semantic elements that do not correspond to elements in the syntax. In formalizing the semantic proposals, I will assume an extensional typed λ-calculus in which variables of type *e* range over individuals, type *s* over eventualities, and type *t* over truth values. The type *s* is subdivided into the sorts s_e for events and s_s for states. I further assume that the only available modes of semantic composition are functional application (as defined in Heim and Kratzer 1998), predicate modification (functional intersection) (as defined in Heim and Kratzer 1998), and event identification (Kratzer 1996).

Given these assumptions, roots must be specified for semantic type (in the sense of formal type theory) in order to compose with other syntactic constituents. The type of the root has apparently syntactic ramifications, as it determines the arguments the root combines with and the combinatorial possibilities in semantic composition. Further, what appears to be the same root conceptually may vary across languages with respect to verb class membership, which would not follow if roots represented only universal conceptual information. Thus contrasts in cross-linguistic realization of verbs and argument structure motivate the storage of some 'arbitrary' linguistic specifications in association with roots, including semantic type. This proposal puts the onus of certain linguistic contrasts on the semantic properties relevant to the root itself, which is in opposition to the positions put forth by Borer (2005a), Borer (2008), Acquaviva (2009), and Harley (2009), that roots do not have grammatical properties of this kind. Such opposition to the semantic specification of roots is picked up by Acedo-Matellán and Mateu (this volume), while other contributions in this volume (Roßdeutscher this volume, Alexiadou this volume, Anagnostopoulou and Samioti this volume, Doron this volume, Rappaport Hovav

this volume) share the current view that such root properties are empirically necessary.

In addition to accounting for the regularities of root environments by association with semantic types, if the present proposal is correct, another locus for the semantic idiosyncracies of roots must be identified as well. I will argue that some such 'idiosyncracy' is due to cases of root polysemy, given that roots may vary in a given language with respect to their semantic type. Some more radical cases of idiosyncracy that fall beyond the scope of this chapter may call for a resuscitation of the proposal put forward in Marantz (1996), later abandoned in Marantz (2007), that words are a potential domain for idiomatic interpretation on a par with larger phrasal constituents.

The verb classes and the relevant contrasts that I will argue can be explained by this approach are summarized in Table 10.1:

Table 10.1. Verb Class Patterns

Verb Class	Pseudo-Resultative	Double Objects	Obligatory Theme
Root Creation Verbs	✓	*	✓
Explicit Creation Verbs	*	✓	*
Change of State Verbs	*	✓	✓

How can these contrasts be explained? In brief, the proposal is as follows. Root creation verbs have the properties they do because they are built from roots which denote predicates of individuals, or entities (like "common nouns"). This fact constrains the possible contexts that can build this root into a verb, or predicate of eventualities. Explicit creation verbs are structurally distinct from root creation verbs, driven by the fact that they are derived from a root which denotes a predicate of eventualities, not individuals. Therefore, verbs that occur in both "frames" are actually ambiguous between two **structures**, leading to different morphosyntactic realizations. The different structure of explicit creation verbs does not license pseudo-resultatives, but does allow for applicatives and optional objects. Change of state verbs involve yet another structure, where the root is a predicate of individuals mapping to a predicate of states.

Thus, the contrasts are argued to be due to the contrasts shown in Table 10.2 between the root types involved in the derivation of these verb classes:

Table 10.2. Root Types and Verb Classes

Verb Class	Root Type
Root Creation Verbs	<e,t>
Explicit Creation Verbs	<s_e,t>
Change of State Verbs	<e, <s_s,t>>

This is not meant to be an exhaustive list of root types or verb classes. However, these classes will be used to illustrate the general approach.

10.2 Root creation verbs

Root creation verbs (Levinson 2010), exemplified in (1), coincide largely with those called 'goal' verbs by Clark and Clark (1979:774).

(1) Root Creation Verbs:
   a. The stylist **braided** her hair. → At least one braid was created.
   b. The decorator **piled** the cushions. → At least one pile was created.
   c. The baker **sliced** the bread. → At least one slice was created.
   d. The barista **ground** the coffee beans. → Fine coffee grounds were created.

These verbs entail the creation of an individual, without the expression of that individual as a DP argument. The meaning of (1a) is parallel to that in (2):

(2) The stylist **made/reconfigured** her hair **into** a **braid**.

In examples like (2), the object of the preposition *into* names the created individual. However, in root creation verbs, this individual is named by the root of the verb itself. That is, in (1a), what is created is a braid, in (1b) what is created is a pile, and so on. This is why the class is called "root creation", because the root names the creation. Another crucial ingredient of this "verb frame" is the presence of the material which is reconfigured, such as *her hair* in (1a).

In this section, I will first summarize the proposal for the analysis of these verbs from Levinson (2010), and then show how this proposal predicts the properties of root creation verbs summarized in Table 10.1—namely that these verbs occur with pseudo-resultative predicates, don't occur in the double object construction, and require theme objects.

10.2.1 Proposal

It is argued in Levinson (2010) that the created individual contributed by root creation verbs is present in the syntax and is denoted by the root of the verb. The basic idea is that, in order to build a verb from such a root, which has a denotation like a common noun, root creation verbs essentially amount to a conflation of elements similar to those bolded in (2) into one word, where the created individual is contributed by a root rather than a DP. For example, the root √braid is argued to contribute a property denotation of λx_e.braid(x), which is type <e,t>. The root is related to the "reconfigured" argument, *her hair*, by two functional heads, called IN and TO. IN takes the root as an argument and the result denotes the state of being a braid:

(3) $[\![\text{IN}]\!] = \lambda f_{<e,t>}.\lambda y_e.\lambda s_s.\exists x_e.f(x)$ & being-in(s,x) & theme(s,y)

TO is a purely syntactic head licensed by the causative *v* which has the potential to assign case:

(4) ⟦TO⟧ = semantically/type-theoretically vacuous

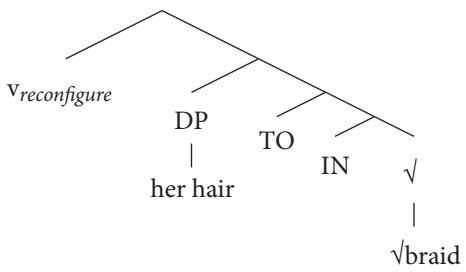
Since the root itself does not contribute any eventuality variable, with such verbs the sole event variable is introduced by a causative *v* head with "reconfiguration" semantics that entail a kind of creation that involves reconfiguration:

(5) $[\![v_{reconfigure}]\!] = \lambda f_{<s_s,t>}.\lambda e_{s_e}.\exists s_{s_s}.f(s)$ & reconfiguration(e) & CAUSE(s,e)

I assume that there is not simply one *v* head, but rather that there is an inventory of heads which can serve as verb categorizers. This is akin to the fact that there are different T and C heads which vary with respect to their syntactic features, semantics, and selectional restrictions. Folli and Harley (2005) describe this diversity of verbal categorizers as the availability of different 'flavors' of *v*. Here I use the descriptive predicate 'reconfiguration' to distinguish this head from the *v* used with explicit creation verbs, but the meaning of this *v* can actually be quite light, as can be seen by its interchangeability in the phrasal context with light verbs such as *make* (as in (2)).

The verb produced by the heads detailed above is a complex that can be built syntactically by incorporation, head movement, or conflation (which I assume has no semantic import).

(6)



The denotation for this whole phrase given in (6) will amount to a predicate of events as follows:

(7) Formally: $\lambda e_{s_e}.\exists s_{s_s}.\exists x_e$.braid(x) & being-in(s)(x) & theme(s,her hair) & reconfiguration(e) & CAUSE(s)(e)

(8) Informally: A set of reconfiguration events which cause a state in which 'her hair' is in a braid.

The most crucial aspect of this analysis for the purpose of the current chapter is that the root denotes a predicate of individuals. This makes predictions for

modification possibilities and argument structure which will be detailed in the following sections.

10.2.2 Root modification

One prediction made by the analysis of root creation verbs given in the previous section is that the root, syntactically 'active' and of type <e,t>, might be available for modification by categories which modify elements of type <e,t> in other contexts, such as adjectives. Levinson (2007a, 2010) presents evidence showing that this prediction is in fact borne out, as evidenced by pseudo-resultative modification. Pseudo-resultatives are adjectival predicates that are superficially similar to resultative secondary predicates:

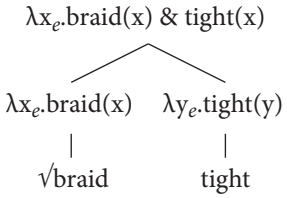
(9) Pseudo-resultatives:
   a. The stylist braided her hair **tight**. → At least one tight braid was created.
   b. The decorator piled the cushions **high**. → At least one high pile was created.
   c. The baker sliced the bread **thin**. → At least one thin slice was created.
   d. The barista ground the coffee beans **fine**. → Fine coffee grounds were created.

However, pseudo-resultatives do not modify the DP object as resultatives do. The resultative-like semantics found with pseudo-resultatives is contributed not by the addition of or modification of a resultant state, but by modification of an individual which is created as a result of the event. In languages like Finnish, there is a morphological distinction between the two types of predicate, which will be useful later on. As can be seen in (10) and (11), resultatives have translative case marking, while pseudo-resultatives have illative case marking.

(10) Mari hakkasi metalli-n litteä**ksi**. (resultative)
Mari.NOM hammered metal-ACC flat-**TRANS**
'Mari hammered the metal flat.'

(11) Mari leti-tt-i hiuksensa tiukka-**an**. (pseudo-resultative)
Mari braid-CAUS-PAST hair-ACC.POSS tight-**ILL**
'Mari braided her hair tight.'

The proposal regarding these predicates is that the pseudo-resultative adjective, a property of type <e,t>, can combine with the root via predicate (intersective) modification, a standard treatment of adjectival modification:

(12)


This gives the entailments shown in (9). It is because the root is of type <e,t> that the pseudo-resultative predicate is able to modify it. Therefore, adjectival predicates will only modify the root of a verb in this way when the root is of type <e,t>. Such an adjective will only receive a pseudo-resultative interpretation when the role of the root in the meaning of the verb is that of a created individual. It will be seen in later sections that verbs that are derived from other types of roots do not support pseudo-resultative modification.

10.2.3 Double objects

As discussed in Pylkkänen (2008), English only has double object constructions which encode an intended transfer of possession associated with the event introduced by the verb. This is in contrast with other languages which allow for purely benefactive readings like the Luganda example in (13):

(13) Katonga ya-kwaant-i-dde Mukasa ensawo.
Katonga 3SG.PAST-hold-APPL-PAST Mukasa bag
'Katonga held the bag for Mukasa.' (Pylkkänen 2008: ex.23b)

However, English does permit benefactive-like readings which also encode an intended result of possession. Such readings are typically found with creation verbs, as noted in Levin (1993) and shown in (14):

(14) a. The chef cooked the customer a delicious soup.
b. The university built the department a new lab.

In these examples, the object of the verb is an effected argument and comes to be in the possession of the benefactive argument as a consequence of the creation event.

Root creation verbs do not license either type of the double object construction, even if a transfer of possession of the created object as a result of the event is plausible:

(15) a. #The worker braided her boss the rope. (where 'the rope' is the material, not the created object)
b. * The baker sliced the customer the loaf of bread.

Although these 'verbs' are elsewhere compatible with benefactive applicative arguments in the double object construction, it is only on the explicit creation reading, which will be discussed in section 10.3. In these cases, the theme is not the material from which the created object is created, but is the created object itself, and thus these are not truly root creation verbs:

(16) a. The jeweler braided her customer a necklace.
b. The pastry chef sliced everyone a piece of cake.

Verbs which are unambiguously root creation verbs more clearly illustrate the incompatibility of root creation verbs with double objects and for this reason will be used for the rest of this discussion:

(17) * The librarian piled the student the books.

The incompatibility between the root creation reading and the double object construction fact can also be observed in Finnish:

(18) * Hn leti-tti minu-lle minu-n tukka-ni.
s/he braid-CAUS.PST 1SG-ALL 1SG-GEN hair-POSS1SG
'She braided me my hair.'

As in English, this contrasts with an explicit creation reading of the same verb:

(19) Hn leti-tti minu-lle pullapitko-n.
s/he braid-CAUS.PST 1SG-ALL braided.bread-ACC
'She braided me a "braided bread".' (explicit creation reading)

The analysis proposed above provides a straightforward semantic explanation for the lack of double objects with root creation verbs. If we assume an analysis of double objects as involving applicative heads as in Pylkkänen (2008), these structures involve an applicative head which introduces a relation between two arguments, such that the first comes to be in the possession of the second. For example, in (20), the head APPL would take *a book* and *Mary* as arguments and relate them such that the book is the intended possession of Mary.

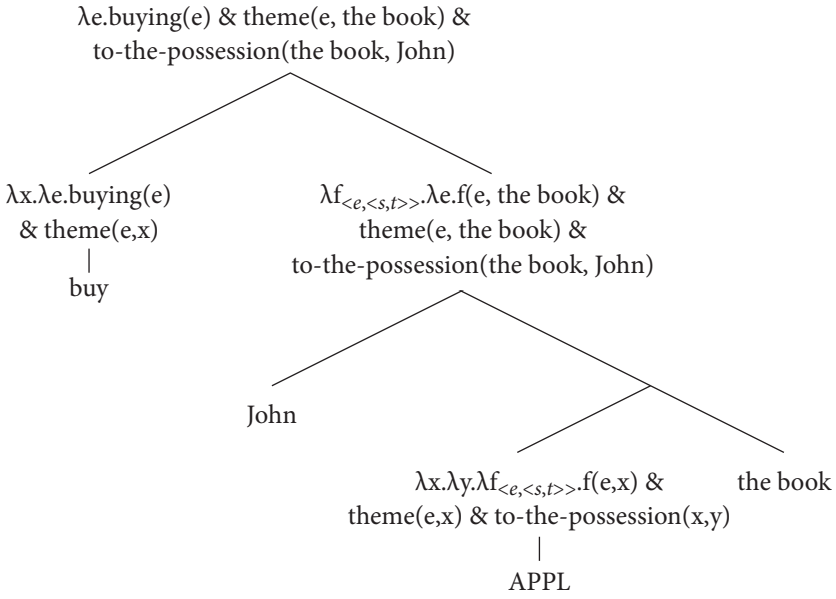
(20) Bill sent Mary a book.

After relating these arguments, the applicative head then takes an eventive verbal head as an argument, relating the arguments to that event. Formally, the APPL head takes two individual arguments before combining with a constituent of type <e,<s,t>>:

(21) Low-Appl$_{To}$ (recipient applicative):
$\lambda x.\lambda y.\lambda f_{<e,<s,t>>}.\lambda e.f(e,x)$ & theme(e,x) & to-the-possession(x,y) (Pylkkänen 2008:ex. 137b)

Pylkkänen (2008:ex. 37) provides the following analysis of the sentence *Mary bought John the book* (setting aside for current purposes merge of the voice head and external argument):

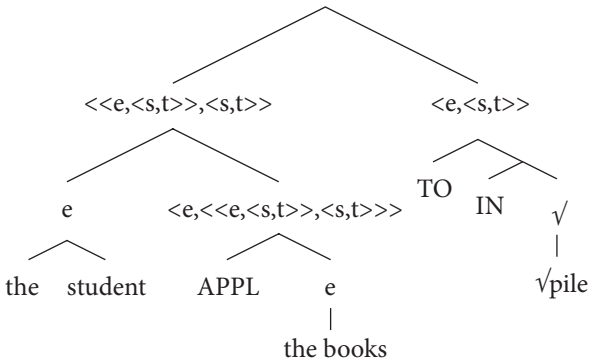
(22)



Recall that root creation verbs must be built up from a root which denotes a predicate of individuals, which is then embedded in the necessary structure which builds it into a verb. The only position in such a structure which could accommodate the semantic composition of the applicative phrase is as in (23b):

(23) a. *The librarian piled the student the books.

b. $\lambda s_s.\exists x_e$.pile(x) & being-in(s,x) & theme(s, the books) & theme(s, the books) & to-the-possession(the books, the student)



The denotations of the ApplP and PP nodes would be as follows:

(24) $[\![\text{ApplP}]\!] = \lambda f_{<e,<s,t>>}.\lambda e_s.f(e, \text{the books}) \ \&\ \text{theme}(e, \text{the books}) \ \&\ \text{to-the-possession}(\text{the books}, \text{the student})$

(25) $[\![\text{PP}]\!] = \lambda y_e.\lambda s_{s}.\exists x_e.\text{pile}(x) \ \&\ \text{being-in}(s,x) \ \&\ \text{theme}(s,y)$

There are two types of problems that would arise upon composition of ApplP and PP. On the one hand, there is no straightforward analysis for the syntactic merge of these two constituents, given that they are two maximal projections and neither is an adjunct. If the complex PP syntactically selects for a DP in the specifier which usually creates a position for the reconfigured material argument, this selection would also fail to be satisfied. These syntactic problems have their source in the semantic type of the root, since it is the status of the root as a predicate of individuals which requires it to be embedded in this more complex structure to produce a verb.

Even if there might be a solution to this syntactic problem such as the availability of an additional null linking element, the resulting interpretation is not consistent with either the pure possession or benefactive possession readings that are found with English double object constructions. The denotations for the *v* head and the composed *v*P would be:

(26) $[\![\text{v}_{\textit{reconfigure}}]\!] = \lambda f_{<s,t>}.\lambda e_{s_e}.\exists s_{s_s}.f(s) \ \&\ \text{reconfiguration}(e) \ \&\ \text{CAUSE}(s,e)$

(27) $[\![v\text{P}]\!] = \lambda e_{s_e}.\exists s_{s_e}.\exists x_e.\text{pile}(x) \ \&\ \text{being-in}(s,x) \ \&\ \text{theme}(s, \text{the books}) \ \&\ \text{theme}(s, \text{the books}) \ \&\ \text{to-the-possession}(\text{the books}, \text{the student}) \ \&\ \text{reconfiguration}(e) \ \&\ \text{CAUSE}(s,e)$

Given the fact that the created object is denoted by the root, not the direct object, there is no way for the created entity to be related to the intended recipient or benefactive argument. That is, the relation established by the applicative head is between the student and the books, not the student and the pile. Since the verb is not inherently a verb of transfer, a benefactive interpretation would be required, but there is no way to establish the appropriate relationship between the created object and the benefactee. Thus semantically the relation established doesn't fit the general condition for English benefactives that the direct object be created with the intention of resulting possession for the benefit of the indirect object argument.

Put in other words, if composition is syntactically licensed at all, a benefactive reading of (23a) would require that the books, not the pile, were created for the benefit and directed to the possession of the student as a result of the piling event. (15a) would mean that that rope was created to benefit the boss, and (15b) that the loaf was created to benefit the customer. Yet these readings are not compatible with the entailments of the verbs which require that the root denotes the created object.

Since it is impossible to establish such an applicative relation with root creation verbs, the prediction is that low applicative heads and pseudo-resultatives should be

in complementary distribution; the latter require a root of type <e,t>, while the former are not compatible with syntactic and semantic environments necessary to derive a root creation verb from that root type.

10.2.4 Obligatory theme

Root creation verbs require direct object themes. This is difficult to illustrate directly because of the same caveat that popped up in the previous section—that in English, many roots that produce root creation verbs also can be realized in explicit creation verbs due to root polysemy. However, again the facts are clear when using an unambiguous root:

(28) * Mary piled.

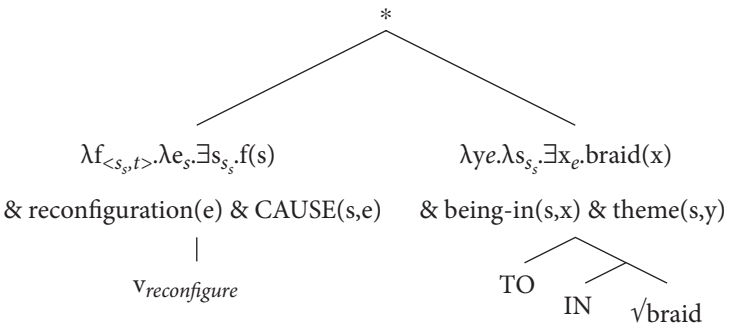
With roots that are ambiguous, we must control for the interpretation. It is difficult to control for interpretation without the presence of an object. However, since it has been established that pseudo-resultatives occur with root creation verbs, but not explicit creation verbs, we can use them to help in this task. One way to control for the right class of verb without the presence of the object is by using the pseudo-resultative predicate, which can only occur with the root creation verb:

(29) The stylist braided *(hair) **tight** all day. (root creation)

This example shows that true root creation verbs require an object. This is not an effect of the pseudo-resultative itself, since, unlike resultatives, the pseudo-resultative would not modify or depend on the object in any case.

This behavior also follows from the analysis given. The head IN is obligatory in the decomposition of such verbs, and this head introduces an empty argument slot. The "PP" constituent is of type <e,<s,t>>, looking for an individual argument. This argument slot must be saturated first before this lower material can combine with the *v* head, and this is the role of the direct object. If the direct object is missing, the PP cannot compose with the *v* head, which is of type <<s,t>,<s,t>>, as indicated by the asterisk on the root node in (30):

(30)



10.2.5 Root creation verb summary

In this section it has been shown how the internal structure of root creation verbs accommodates pseudo-resultative modification, but not applicatives or optional objects, due to the semantic type of the root and the elements it must combine with to "become a verb".

10.3 Explicit creation verbs

While *braid* as a root creation verb relates the object DP to a created individual denoted by the root, *braid* can also appear as an explicit creation verb, where it expresses no such relation and is parallel instead to verbs like *bake* and *build*:

(31) a. The jeweler braided a necklace (out of strands of silver).
b. The pastry chef baked a cake.
c. The contractor built a house.

In Levin (1993), these are called "build verbs". In these examples, the object DP expresses the created object and the root contributes a **manner** specification for the creation of that object. This interpretation of *braid* can be paraphrased as in (32):

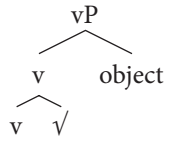
(32) The jeweler **made/created** a necklace (out of strands of silver) **by braiding**.

As summarized in Table 10.1, explicit creation verbs do not occur with pseudo-resultatives, do occur in the double object construction, and do not require a theme (more specifically, they systematically alternate with activity verbs which lack a theme). In this section, I will first present an analysis for explicit creation verbs, and will then show how this analysis explains these properties.

10.3.1 Proposal

Marantz (2005) argues that creation verbs like *bake* have the structure in (33), where the root combines with a *v* head and then the resulting constituent takes the DP object as an argument:

(33)



Here the theme DP explicitly refers to the created object. This is in contrast with root creation verbs, where no DP argument refers to the created object. A minimal pair can be constructed as in (34):

(34) a. The stylist braided her hair. (root creation)
b. The jeweler braided a necklace. (explicit creation)

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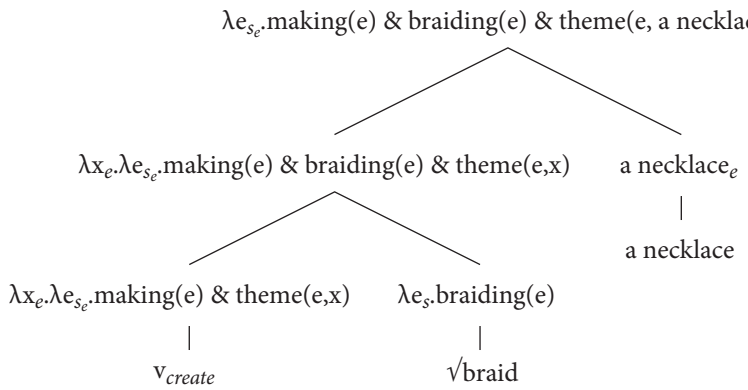
One might assume that, structurally, these verbs are equivalent. After all, they seem to be derived from the same root. However, this does not seem to be correct, as there are syntactic contrasts which correlate with these different readings, as already seen in the previous section. (34a) patterns with verbs that are unambiguously root creation verbs, and (34b) with those that are clear cases of explicit creation verbs.

Semantically, in this environment, √braid cannot be of type <e,t>—there is no set of braids denoted, just as there is no set of "bakes" denoted by the verb *bake*. I propose that the composition of such verbs based on the structure above is as follows:

(35)



Here the root is not of type <e,t>, but rather of type <s_e,t>, a predicate of events, and combines with the *v* via Event Identification (Kratzer 1996). Given the fact that *braid* can be either a root creation verb or an explicit creation verb, the **root** √braid must be polysemous in English between an <e,t> and an <s_e,t> interpretation. In this case, this root polysemy corresponds with a structural difference as well. The v_{create} proposed should have a meaning similar to that of *make* as used in (32) above. Here it is the *v* that introduces the argument position for the object.

The realization of the root in this type of structure is related to its possible denotations. The proposal is that such roots denote predicates of events (of type <s_e,t>), and this is able to combine with the relevant *v* heads directly, rather than in a relational structure. V_{create} must be of type <e,<s_e,t>>, since it takes a DP complement, and thus requires an individual argument. This v_{create} and the event-predicate root √braid can combine via event identification (Kratzer 1996). Although this mode of composition is different from that by which predicates of events combine with manner adverbs, the result is equivalent, in that both the root and v_{create} come to take the same event as an argument. The difference is that here the resulting expression has an open individual argument slot. That this argument slot is introduced by the *v* head, not the root itself, is another desirable property of this analysis. This complex head can then semantically compose with the DP of type *e*.

The correlation of the root type $<s_e,t>$ with the structure in (35) is what ultimately leads to the generalizations cited above.

10.3.2 Root modification

The analysis above predicts that pseudo-resultatives should be unavailable with explicit creation verbs, since the root is not of type <e,t>. In English, this is somewhat difficult to test precisely, since given a sentence like (36), one cannot reliably determine whether the sentence-final predicate is modifying the root or the object:

(36) Mary braided the necklace tight.

Is it the necklace itself that is "tight", or the braid that constitutes the necklace? Since the necklace created by braiding is itself a braid, these two things cannot be teased apart easily. However, languages which distinguish between pseudo-resultatives and resultatives morphologically show that this predicate is likely to be a resultative in English, not a pseudo-resultative. In Finnish, translative (resultative) case occurs on the secondary predicate with the verb for braiding when the created object is realized as the DP object argument of the verb:

(37) Mari leti-tt-i **leti-n** tiuka-ksi.
Mari braid-CAUS-PAST braid-ACC tight-TRANS
'Mari braided the braid tight.'

Norwegian similarly shows resultative morphology, in the shape of adjectival agreement, on such resultative predicates with explicit creation verbs, whereas agreement is not possible with root creation verbs which combine with pseudo-resultatives. Thus agreement morphology on the predicate disambiguates between the root and explicit creation verb readings:

(38) a. Marit skjærte kaka tynn-∅.
Marit cut cake-DEF.F thin-M/F.SG
'Marit cut the cake thin.' (Resultative—one whole, thin cake is created)

b. Marit skjærte kaka tyn-t.
Marit cut cake-DEF.F thin-NEUT.SG
'Marit cut the cake into thin slices.' (Pseudo-resultative)

Default neuter agreement forces a pseudo-resultative interpretation, and thus also a root creation verb reading in (38b). Feminine agreement, on the other hand, gives a resultative interpretation, and thus an explicit creation verb, as in (38a).

10.3.3 Double objects

As seen in section 10.2, explicit creation verbs do allow for benefactive applicatives:

(39) She braided Mary a necklace. (explicit creation—the necklace is the creation)

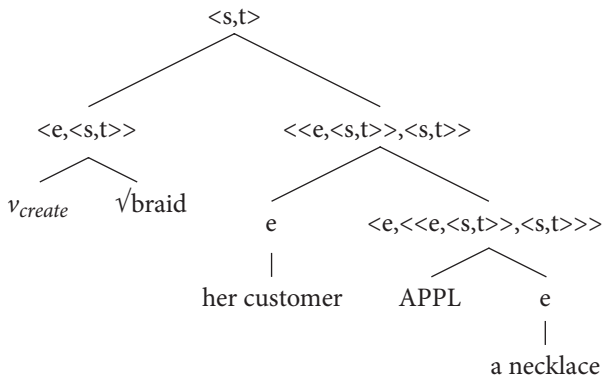
As shown in the section on root creation verbs, the same is found in Finnish:

(40) Hn leti-tti minu-lle pullapitko-n.
s/he braid-CAUS.PST 1SG-ALL braided.bread-ACC
'She braided me a "braided bread".'(explicit creation reading)

The fact that these verbs can occur with applicative arguments is also predicted, given that there is a direct object slot of type *e* which combines with a complex *v* head of type <e,<s,t>>. This provides a site for inserting an APPL head. The combination of the applicative head with this structure would be as in (42):

(41) The artisan braided her customer a necklace.

(42)



The denotations of the ApplP, root-modified *v* and *v*P nodes would be as follows:

(43) $[\![\text{ApplP}]\!] = \lambda f_{<e,<s,t>>}.\lambda e_s.f(e, \text{a necklace}) \& \text{theme}(e, \text{a necklace}) \& \text{to-the-possession}(\text{a necklace, her customer})$

(44) $[\![v_{create} + \sqrt{\text{braid}}]\!] = \lambda x_e.\lambda e_s.\text{making}(e) \& \text{braiding}(e) \& \text{theme}(e,x)$

(45) $[\![v\text{P}]\!] = \lambda e_{s_e}.\text{making}(e) \& \text{braiding}(e) \& \text{theme}(e, \text{a necklace}) \& \text{theme}(e, \text{a necklace}) \& \text{to-the-possession}(\text{a necklace, her customer})$

This sentence would then entail that a necklace was directed to Mary's possession by an event of creating it, which is a natural low applicative interpretation. The analysis is the same as Pylkkänen's (2008) analysis of *buy* above in (22) except for the fact that the root meaning is separated from the functional *v* head.

10.3.4 Optional theme

Given that roots of explicit creation verbs do not themselves introduce individual argument slots, it is correctly predicted that such roots should be possible in intransitive contexts. This prediction appears to be borne out, as noted in Levin

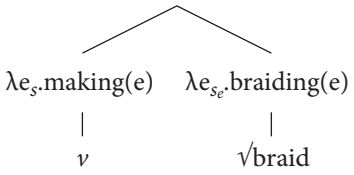
(1993). This can be seen from the examples in (46) which contain verbs based on the same roots as explicit creation verbs:

(46) a. The chef baked all day.
b. The workers were building for days.

This is in contrast with root creation verbs, which are obligatorily transitive, as discussed in section 10.2. This contrast is another which can be explained by contrasts in root type.

Above, v_{create} is analyzed as introducing the object argument position for explicit creation verbs. However, the root could just as easily combine with a different *v* which does not have such an open argument slot, and still retain the same activity interpretation:

(47) λe_{s_e}.making(e) & braiding(e)



Thus, it is correctly predicted that roots of type $<s_e,t>$ should easily occur in intransitive contexts. Technically, in such a context, these are not explicit creation verbs anymore, if the verb type is taken to be determined by the structure in which the root is embedded. However, these are activity verbs built from the same roots as explicit creation verbs, and the proposal here predicts a systematic alternation between these two verb classes.

10.3.5 Explicit creation verb summary

In this section, it was shown that deriving explicit creation verbs from a root of type $<s_e,t>$ can explain certain facts about their morphosyntactic behavior. It was also seen that some verbs, such as *braid*, are nevertheless ambiguous between a root creation and an explicit creation verb reading. This means that roots like √braid can be either of type <e,t> or $<s_e,t>$. The proposal is not that there is homophony between two roots, but that one root is able to have more than one associated denotation, leading to 'allosemy' of the root. This would be parallel to the ability of one root to have multiple allomorphs. As with allomorphy, it is language-specific what denotations are associated with which roots. Thus in English, √braid can denote either a predicate of type <e,t>, or of $<s_e,t>$, while in another language, only one of these denotations might be available. The available denotations would determine the possible environments for insertion of the root.

10.4 Change of state verbs

Change of state verbs are those that denote a change of state of the theme argument. Dowty (1979) describes them as being derived from stative adjectives, though classes of verbs like Levin's (1993) '*break* verbs' seem to pattern similarly despite not appearing to be derived from adjectives. The change of state uses of the verb *open* are illustrated in (48):

(48) a. The door opened. (inchoative/anti-causative)
b. The bellhop opened the door. (causative)

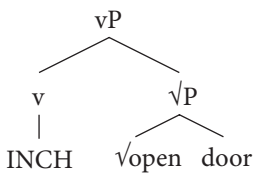
(48a) is an example of an inchoative, and (48b), where an additional causative relation is introduced, a causative.

In the introduction, it was indicated that change of state verbs do not occur with pseudo-resultatives, but require themes and participate in the double object construction. The following section lays out the proposal for these verbs and is followed by an explanation of how this proposal explains these generalizations.

10.4.1 Proposal

Dowty (1979), Parsons (1990) and Hale and Keyser (1993) all propose that change of state verbs are deadjectival, while Harley (1995) proposes the structure in (49), where an inchoative head selects a √P:

(49)

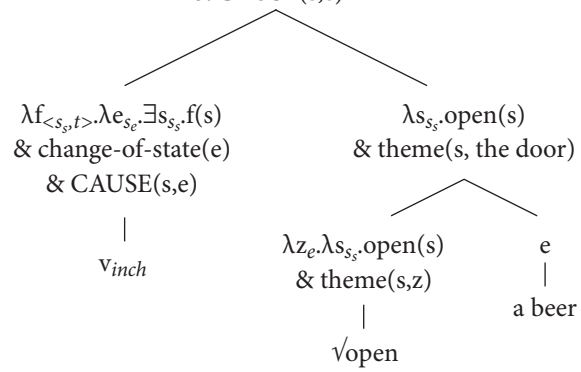


Pylkkänen (2008) and Alexiadou et al. (2006) also treat the "adjectival" root as category-neutral. In these analyses of change of state verbs, a stative root combines first with a theme argument before combining with a *v* head.

A stative root can occur in a structure like (49) because it has an argument structure such that it combines first with a type *e* argument, and then with a state argument. That is, it is of type $<e,<s_s,t>>$. This is in contrast with the roots of root or explicit creation verbs, which can only take arguments indirectly via a relational structure or an argument-taking *v* head. Therefore, the type of *v* that roots of type $<e,<s_s,t>>$ combine with will be different than that which combines with these other roots. The fact that the unaccusative variants are possible can be explained by the fact that change of state *v* heads require state arguments in their complements. The composition of the *v*P of an intransitive change-of-state verb would be as in (50b):

(50) a. The door opened.

b. $\lambda e_{s_e}.\exists s_{s_s}.$open(s) & theme(s, the door) & change-of-state(e) & CAUSE(s,e)



10.4.2 Root modification

Like explicit creation verbs, change of state verbs do not appear to license pseudo-resultative modification. The modifiers that occur with them are resultatives, where the secondary predicate modifies the direct object:

(51) The river froze solid.

(52) The wind froze the river solid.

Semantically, the sentence-final predicate is generally considered to modify the theme, in these examples 'the river'. One could argue perhaps that it is the 'freeze' that is solid, which would be a pseudo-resultative interpretation. However, in Finnish these are clearly marked as resultative (with translative case), not pseudo-resultative (illative case):

(53) Joki jäätyi kiinte-ksi.
river froze solid-TRANS
'The river froze solid.'

The unavailability of pseudo-resultatives with change of state verbs follows from the fact that again there is no subconstituent of the verb which is a predicate of individuals for the pseudo-resultative to modify. Resultatives are possible as modifiers of the theme instead.

However, despite the unavailability of pseudo-resultatives, change of state verbs seem to license another kind of root modifier. Pylkkänen (2008) argues that certain cases of apparent 'verb' modification found with lexical causatives in English are actually root modification, such as with the bolded modifiers in (54) (examples originally from Tenny 2000):

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(54) a. John closed the door **partway**.
b. John **partly** closed the door.
c. Roger **half** filled the glass.
d. Roger filled the glass **halfway**.
e. Nicolas **mostly** filled the glass.

These modifiers have lower scope than verbal modifiers, such that *partway* in (54a) modifies the "closed" state, not the causing event. This can be seen by the fact that *partway* receives the same interpretation in the intransitive variant in (55):

(55) The door closed partway.

This is in contrast with verbal modifiers which seem to lack the lower scope reading in causatives, as illustrated in (56) from Pylkkänen (2008:ex. 45):

(56) a. Bill awoke grumpily.
b. John awoke Bill grumpily. (false if John wasn't grumpy)

Pylkkänen argues that the low scope illustrated in (54) is root modification, and therefore change of state verbs must be root-derived. I propose that this modification is possible because it is compatible with the root type of $<e, <s_s,t>>$.

10.4.3 Double objects

As mentioned above, the roots found in change of state verbs often participate in the causative–inchoative alternation, whereby they also appear in transitive frames. Thus, one can ask whether such roots are compatible with double objects in such a transitive context. As with root creation verbs, these verbs do not inherently encode any kind of transfer or motion of the object, and thus they are not expected to be automatically compatible with pure possession double objects. The transitive variants also do not allow for double objects with a pure benefactive type reading, as shown in (57):

(57) a. * The mother cooled her daughter the room.
b. * The tenant opened the landlord the door.
c. * The assistant cleared the executive her schedule.

This is to be expected, as English does not generally allow for pure benefactives. However, intended possession benefactives could be available. When stative roots embedded in transitive change-of-state contexts are compatible with a similar creation interpretation, they also license benefactive double objects:

(58) The host opened the guest a beer.

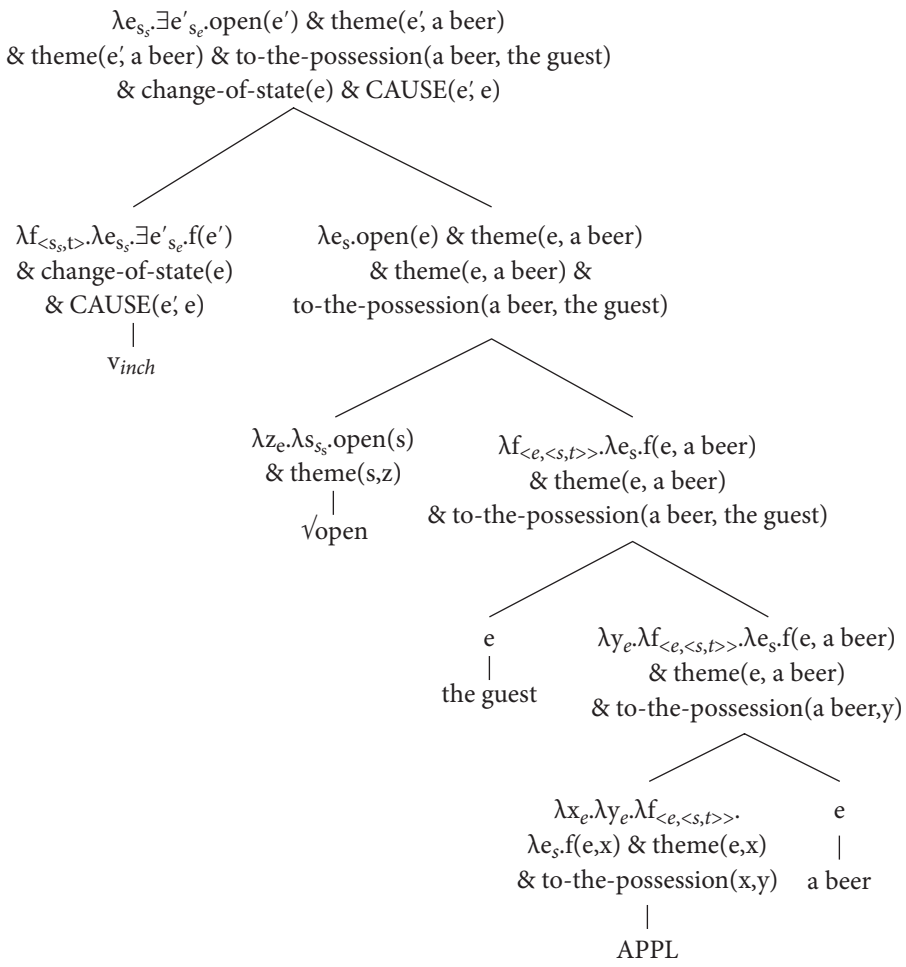
(59) The father cracked his children some walnuts.

(60) The bartender cleared the patron a spot at the bar.

(61) Her neighbor grew her a Christmas tree.

These benefactives can be derived with the low applicative head as in (62), representing the *v*P for (58):

(62)



The applicative head can take the direct and indirect object directly as arguments and then compose with the root. Unlike root creation verbs, transitive change of state verbs can have direct objects that are construed as created objects. In this case, what is construed as being created for the benefit of the indirect object is an open beer. This is not encoded directly in the semantics, given that change of state verbs do not always have such entailments, but in the context of an applicative head, the object is compatible with being construed in this way. For root creation verbs, the direct object cannot be interpreted as a created object because the root itself denotes the entity or entities created by the event, and the object is interpreted as the source from which the object is created.

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On this analysis, the applicative head takes as its third argument a predicate of eventualities which is a predicate of states rather than a predicate of events. This should be possible if the applicative head selects for a head of type <e<s,t>>, with the eventuality being unspecified for eventive or stative sort. At first this might seem to conflict with the position in Pylkkänen (2008:18) that, in English, "since low applicatives imply a transfer a possession, they are nonsensical with verbs that are completely static." However, in Pylkkänen's analysis, this requirement is not encoded directly into the applicative head, and there does not seem to be a reason that the requirement for eventivity should be stated as a requirement holding specifically for the argument of APPL. If the constraint can rather be formulated as a requirement on the *v*P, this can be satisfied with the introduction of the change of state *v* head which introduces dynamic inchoative semantics. This formulation of the constraint would still allow us to rule out sentences such as (63) which have stative *v*Ps:

(63) * I held him the bag. (Pylkkänen 2008:ex. 20)

10.4.4 Obligatory theme

Change of state verbs can be intransitive, but since they are unaccusative, their sole argument in such cases will be the theme, and themes are thus obligatory. This can be explained by the fact that the root itself selects for an individual argument, as it is of type <e,<s_s,t>>. However, unlike root creation verbs, which have <e,t> roots, it is possible for the root to combine directly with this individual argument because it returns a predicate of type <s_s,t>, not type t, and thus can combine with the appropriate kind of *v*.

10.4.5 Change of state verb summary

In this section, it was shown that change of state verbs do not license pseudo-resultative modification, but do require themes and allow applicative arguments. It was argued that these facts can be attributed to the fact that the root of such verbs is of the type <e,<s_s,t>>.

10.5 Conclusions and future directions

In the introduction to this chapter, it was suggested that, in order to capture contrasts between verbs which are all derived from category-neutral roots, it is necessary to make recourse to their semantic type. This has been shown to be a desirable move, since both apparently syntactic and semantic generalizations have been shown to depend on the root type. The semantic generalizations are directly derived from the argument structure and composition of the root with other elements, while syntactic generalizations arise because of the semantic restrictions on the composition which lead to different structural contexts for different types of

roots. More specifically, I have argued that certain morphosyntactic verb classes differ due to the type of their lexical roots, as summarized in Table 10.3:

Table 10.3. Summary of Root Types and Verb Behavior

Verb Type	Pseudo-resultatives	Double Objects	Obligatory Theme	Root Type
Root Creation	✓	*	Yes	<e,t>
Explicit Creation	*	✓	No	<s_e,t>
Change of State	*	✓	Yes	<e,<s_s,t>>

The analysis shows that attempting a formal compositional analysis of such decomposition can provide important insight not only into syntax, but also the ontology of lexical roots and the functional elements they combine with. This work raises the question of what other kinds of syntactic and argument structure generalizations can be explained or discovered by this kind of approach, and hopefully future work can help to answer this question. To the extent that this approach proves to be an empirically desirable approach to explaining such data, it casts doubt on approaches which argue that roots are only loosely associated with non-linguistic conceptual meaning or semantically vacuous in the absence of additional structure.

It was also shown that it is crucial in determining the properties of verbs and verb classes to carefully control for structural ambiguities "below" the word level—for example, it was seen that there are two structurally distinct verbs *braid*, and there is polysemy with respect to the root √braid. This predicts that what we have previously considered polysemy is tied up with structure in a way that should also affect linguistic processing. From this perspective, polysemy breaks down into three different categories: 'normal' polysemy, structural ambiguity, and polysemy plus structural ambiguity.