Chapter 2

Primary vs. secondary meaning facets of polysemous nouns

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Inherently polysemous nouns, or dot-type nouns, have two or more meaning facets that are systematically related to each other and can be addressed simultaneously in copredication constructions. In this paper, we investigate the internal semantic structure of inherently polysemous nouns and argue for a distinction between primary and secondary meaning facets. Evidence is provided by showing that copredication constructions behave asymmetrically for certain polysemous nouns in English and Chinese. We develop two proposals for modelling restrictions on copredication: First, an approach that distinguishes between (i) predicates that pick a specific facet, thereby blocking other facets for subsequent predications, and (ii) predicates that address a specific facet without blocking other facets. Second, as an alternative, we propose to model the distinction between primary and secondary facets within the representations of dot-type nouns via default constraints, where secondary facets are defeasible and can be blocked in certain predication constructions while primary facets cannot be blocked.

1 Introduction

Inherently polysemous nouns, or dot-type nouns, have different meaning facets that can be targeted by different predications over the same occurrence of the noun in a sentence or phrase. This phenomenon is known as *copredication*. While there is already a large body of work on the types of meaning facets and their semantic relationships, the internal semantic structure of polysemous nouns and how they license copredication is still a topic of ongoing research. For example, Pustejovsky (1995) and Asher (2011) model the meaning facets of complex type

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nouns as facets of equal status; Chen et al. (2022) assume that all the facets are on the same level and related to each other by attributes in the frames of the nouns; Babonnaud et al. (2016) suggest that one of the facets stands for the noun and the other facet is its attribute; Retoré (2014) proposes "flexible" and "rigid" as a feature of the facet to represent the compatibility of a semantic type with other types, which implies that different meaning facets might not be equally prominent; Ortega-Andrés & Vicente (2019) introduce the concept of "activation package" to indicate the close semantic relationship between the facets that can be jointly addressed by copredication; Murphy (2021) suggests a "complexity hierarchy" of the semantic types which leads to a copredication hierarchy.

Following Chen et al. (2022), we assume that predication over a noun involves either targeting one or several meaning facets of the noun or performing coercion. For example, *book* has an object facet and an information facet. In *read the thick book*, *read* targets both facets while *thick* targets the object facet. On the other hand, since *book* cannot be predicated by typical event-targeting verbs such as *perform* or *conduct*, it does not have an event facet. Consequently, *enjoy the book* is a case of coercion, because *enjoy* targets an event.

The meaning facets of an inherently polysemous noun may differ with respect to accessibility and persistence. This is reflected, among others, by asymmetries in copredication constructions. Such asymmetries have been noticed in previous research, especially in cases where a noun has multiple meaning facets. Asher (2011: 63) observed that the felicity of copredication related to the polysemous noun *city* in (1a) is higher than in (1b).

(1) a. The city has 500,000 inhabitants and outlawed smoking in bars last year.
    b. ? The city outlawed smoking in bars last year and has 500,000 inhabitants.

Similarly, Retoré (2014) noticed that for the polysemous noun *Liverpool*, the senses of *people* and *place* can be subject to copredication, but the sense of *football team* cannot be elicited together with any of the others. Jezek & Melloni (2011) conducted case studies on deverbal nouns and determined constraints on the copredication with action nominals. Chatzikyriakidis & Luo (2015) investigated the case of *newspaper* and discovered that the *organization* reading can occur with the *physical object* or *information* readings in copredications only under certain conditions. Ortega-Andrés & Vicente (2019) investigated the copredication of *school* and proposed two "activation packages" of *school*, one corresponding to the *institution* sense and the other corresponding to *object-information* sense,

and only meaning facets in the same activation package can occur together in copredications. Sutton (2022) observed that for the noun *statement*, the *physical entity* sense and the *eventuality* sense are incompatible for copredication, but that both can occur in copredications with the *informational content* sense. Murphy (2021) investigated the order of copredication more systematically and claimed that complexity and coherence are the decisive factors for the order of copredication. Michel & Löhr (2024) further suggest that context is a more fundamental factor than complexity, and explain the order of copredication with the notion of "expectation".

The above studies have shown that for nouns with multiple meaning facets, some facets are easier to occur in a copredication construction than the others, and it is more natural to predicate over some facets than the others in a copredication construction. However, many of them do not distinguish copredication from coercion, which are different in the mechanisms of composition. For example, it is debatable whether the reading of *managing entity* of *city* or *school* is an inherent meaning or a coerced meaning. We will therefore focus on more unquestionable cases where the nouns have two distinct meaning facets. According to our observation, these asymmetries of copredication also occur with nouns with only two meaning facets, and the choice of the predicate also affects the felicity of copredication. For example, in (2), it is easier to target the object facet of *lunch* first and target the event facet later (as in 2a) than the opposite order (as in 2c), and if the event facet is targeted by *quick* rather than *slow*, copredication can still happen.[1]

(2) a. Kerry Weins and Joanne Weins organized a delicious lunch at Bette Axani's home in Union Bay.

b. In one instance I am obsessing over how to improve my blog and in the next I am ordering a quick lunch using Foodpanda!

c. # In one instance I am obsessing over how to improve my blog and in the next I am ordering a slow lunch using Foodpanda!

In this paper we focus on polysemous nouns with only two meaning facets and examine whether the two meaning facets are equally prominent or not. As observed in the previous works (e.g. in Chatzikyriakidis & Luo 2015 and Jezek & Melloni 2011), the syntactic construction may also affect copredication acceptability, so we only consider the following two copredication patterns: V+Mod+N

[1] If not mentioned otherwise, the English examples in this paper are from the English Web 2021 corpus (enTenTen21; see Jakubíček et al. 2013) provided by SketchEngine (www.sketchengine.eu).

and Mod1+Mod2+N.[2] Based on data from English and Mandarin Chinese, we argue that polysemous nouns have primary facets and secondary facets. Primary facets are more prominent and stable in the noun's meaning, which is to say, they cannot be blocked by a predication over another facet. In particular, they can be targeted in any type of copredication pattern. Secondary facets, by contrast, might be unavailable in certain predication patterns, such as the object facet of *lunch* (see above). Concretely, a predication over a different facet might exclude a subsequent predication over a secondary facet.

We base our analyses on observed possibilities and restrictions for copredication constructions. Concretely, we examine three common dot-types, discuss restrictions on copredications for these types, in particular in relation to the different facets, and sketch possible ways to model dot-type nouns and predications over them. We will present one analysis that distinguishes between predicates that pick only one of the facets, thereby excluding further predications over the other facets, and predicates that address one of the facets while keeping the other facets for further predication. We call the first type of predication *facet-picking* and the second type of predication *facet-addressing*. As an alternative, we sketch a second approach that explicitly encodes primary and secondary facets in the representations of dot types and that models composition during predication in such a way that certain predications exclude further predications over different facets. This second approach assumes that primary facets can never be blocked for further predication. As a formalization for our semantic representations, we choose semantic frames. In the first proposal, facet-picking predications roughly move the access point of the noun's frame to the picked facet. In the second proposal, we use default logic and model secondary facets as default attributes that can be removed due to conflicting frame constraints.

2 Primary facets, secondary facets and restrictions on copredication

Three common facets of dot-type nouns in English and Chinese (as well as other languages) are *event*, *info(rmation)*and *obj(ect)*. In this section, we investigate the dot-types *event•food*, *obj•info* and *event•info* regarding the restrictions on copredication. We provide empirical evidence for facet-picking and facet-addressing

[2]Constructions of the form Mod1+and+Mod2+N (*delicious and romantic dinner*) or Mod1+, +Mod2+N (*delicious, romantic dinner*) are not exactly the same as the construction we consider, since the two modifiers in these constructions are coordinated and the acceptability of copredication is higher in this case.

predications over the dot-type nouns, which yields hypotheses for the respective patterns of primary and secondary facets.

2.1 *Event • food*

Nouns for meals in English and Chinese, such as 午饭 (wǔcān) 'lunch', 自助餐 (zìzhùcān) 'buffet', 晚饭 (wǎncān) 'dinner', and 大餐 (dàcān) 'feast' have an event and an object facet. In the copredication pattern V+Mod+N, the Mod(ifier) can target the object facet and the V(erb) the event facet as in (3a) and (3b), but the other direction of copredication is only possible for some modifiers: in (3c), 'lively' seems to exclude further predication over the object facet, while in (3d) 'early' is facet-addressing.

(3) a. On Saturday night, the INTA had organized a delicious dinner in the CityNorth Hotel.
b. how to organize a vegan dinner[3]
c. # order the lively dinner
d. benefits of eating an early dinner[4]

The Chinese examples in (4) reveal a similar asymmetry in copredication possibilities.[5]

(4) a. 组织 美味/丰盛 的 晚餐
zǔzhī měiwèi/fēngshèng de wǎncān
organize delicious/abundant MODM[6] dinner
'organize a delicious/abundant dinner'
b. # 带走 热闹/两个小时 的 晚餐
dàizǒu rènào/liǎnggèxiǎoshí de wǎncān
take.away lively/two.hours MODM dinner
'take away the lively/two-hour dinner'

The copredication pattern Mod1+Mod2+N in (5) also shows the asymmetry of the availability of copredicating the two facets. There is a rich literature on the preferred order of noun-modifying adjectives and the underlying semantic

[3]https://otttimes.ca/life/food/how-to-organize-a-vegan-dinner/, retrieved 31 May 2024.
[4]https:// pharmeasy.in/ blog/ eat-light-and-feel-light-benefits-of-eating-an-early-dinner/, retrieved 31 May 2024.
[5]The Chinese examples in this paper are all from the CCL corpus (corpus of the Center for Chinese Linguistics of PKU, see Zhan et al. 2019).
[6]'MODM' stands for modifier markers.

factors.[7] For example, type-modifying adjectives tend to be closer to nouns than token-modifying adjectives (McNally & Boleda 2004); individual-level adjectives tend to be closer to nouns than stage-level adjectives (Larson 1998); subsective adjectives tend to be closer to intersective adjectives (Morzycki 2016). However, the following data imply that these theories are not always able to explain the adjective orders in the case of copredication.

(5) a. Whether using the tool to whip up her own [...] veggie-heavy vegan chili recipe, or an impromptu healthy dinner for her family, McDonald knows that slow cookers are a no-fuss way to prepare meals even when there's no meat in your recipe.

b. ? Whether using the tool to whip up her own her veggie-heavy vegan chili recipe, or a healthy impromptu dinner for her family, McDonald knows that slow cookers are a no-fuss way to prepare meals even when there's no meat in your recipe.

c. I made this shrimp and pasta salad a couple of weeks ago as a *planned cold* lunch.

d. # I made this shrimp and pasta salad a couple of weeks ago as a *cold planned* lunch.

e. Labrosse, our landlord, had a late hot dinner waiting for us in the smaller room off the large dining-room.

f. # Labrosse, our landlord, had a hot late dinner waiting for us in the smaller room off the large dining-room.

In the examples in (5), *healthy*, *cold* and *hot* targets the object facet and *impromptu*, *planned* and *late* targets the event facet. The object facets are always targeted first in these examples.[8] The aforementioned theories might not be able to explain this preferred order. For example, *healthy* is an intersective adjective but it is closer to the noun; *hot* and *cold* are stage-level adjectives and are more likely to be modifying the token based on the context, but they are also closer to the noun. Therefore, we propose that the primary and secondary facet is also an important factor in deciding the adjective orders.

[7] See Scontras (2023) for a more comprehensive discussion of this topic.

[8] In this paper the order of targeting is based on syntactic structure rather than linear sequence. Therefore although linearly *impromptu* comes before *healthy*, structurally *impromptu* is modifying *healthy dinner*, so *dinner* is targeted by *healthy* first, and then by *impromptu*.

The asymmetry also exists in coercion. Usually, in Chinese the classifier 顿 (dùn) is used for events and 份 (fèn) is used for objects.[9] However, as shown in (6), 顿 (dùn) can sometimes also be used for food nouns like 饺子(jiǎozi) 'dumpling' while 份 (fèn) can never be used for event nouns like 晚宴 (wǎnyàn) 'banquet'. This also indicates that in the context with the event and the food, usually the event is more prominent.

(6) a. 一 顿 饺子/晚宴
yī dùn jiǎozi/wǎnyàn
one CLF$_e$ dumpling/banquet
'a meal of dumplings/a banquet'

b. 一 份 饺子/#晚宴
yī fèn jiǎozi/#wǎnyàn
one CLF$_o$ dumpling/#banquet
'a portion of dumplings/a banquet'

One reason for this asymmetry is related to the semantic relation between the meaning facets. In the 'dinner' concept, there is an event during which food is consumed. An interpretation in the other direction is less natural, i.e., 'dinner' is food which is consumed in an eating event. So conceptually it is more reasonable that the food is embedded under the event, which means the event is more prominent and is the primary facet.

Another possible explanation for the asymmetry is that when the food within a meal is being referred to specifically, it is more accurate and informative to mention the name of the food directly, like answering the question *What did you eat last evening*, *I ate a pizza* would be better than *I ate a dinner*. However, the event facet of a meal seldom has its own name. Therefore, when referring to the event, the dot-type noun, such as *I will attend the dinner* is used. Otherwise less efficient phrasings like *I will attend the eating activity in the evening* is required to convey the same idea.

As already observed (see 3d), despite being a secondary facet, the object facet is not always unavailable when the event facet is targeted first. Further examples are given in (7) where both *quick* and *slow* target the event facet of *lunch*. In (7a), (7c) and (7e) *quick lunch* has the object facet and can still be predicated by *cook*, *pack* or *serve*, but *slow lunch* does not have the object facet and cannot replace *quick lunch* in those sentences.

[9] In Chinese, different classifiers apply to different types of nouns, in general. For example, 顿 (dùn), 次 (cì), 场 (chǎng) can only modify event nouns but not physical object nouns, while 份(fèn), 只 (zhī) can only modify physical object nouns but not event nouns. Here, classifiers that modify events are glossed by CLF$_e$, and classifiers that modify objects by CLF$_o$.

(7) a. We prepared the poultice and cooked a quick lunch, waiting for the minnow trap to work for fishing bait.
b. # We prepared the poultice and cooked a slow lunch, waiting for the minnow trap to work for fishing bait.
c. So, we packed a quick lunch and headed out to find...
d. # So, we packed a slow lunch and headed out to find...
e. Since 2006, Ronnie's Cafe has been serving hot breakfast and quick lunches to ASU West students and Glendale residents alike.
f. # Since 2006, Ronnie's Cafe has been serving hot breakfast and slow lunches to ASU West students and Glendale residents alike.

Based on the difference in (7), we can categorize adjectival modifiers into facet-addressing modifiers and facet-picking modifiers. Facet-addressing modifiers such as *quick* or *early* tend to keep the secondary facets in the phrase after modifying the primary facet, while facet-picking modifiers such as *slow* and *lively* tend to pick out only the primary facet.

The reasons why some adjectives are facet-addressing or facet-picking are related to the conceptual relationships between the meanings of the adjective and the dot object. For example, in a *lively dinner*, the liveliness is usually not only about eating the food, but also about the eaters talking and other activities not involving food, thus the food is more neglected in a *lively dinner*, making the object facet unavailable; on the other hand, an *early dinner* means a dinner where the food is eaten earlier than usual, so the food is still an essential part of the meaning of the phrase, thus the object facet is preserved. However this may not be able to explain all the facet-addressing/picking adjectives, especially for the case of *quick dinner* and *slow dinner*, where the two adjectives are very close in meaning. The exact reasons why certain adjectives tend to be facet-addressing while others are facet-picking require further research.

2.2 *Object • info*

The two facets in *object • info* are usually of equal status and both are primary facets since the copredication of V+Mod+N is always available. (8) and (9) are copredication examples of English *book* and Chinese 书 (shū) 'book'.

(8) a. Others may regard reading thick books as a dull way to learn.
b. Individuals cannot carry their religious books [...] with them.

Table 1: Facet availability after modification for 书 (shū) 'book'

	targeted facet	modified 书 'book'
两千字 (liǎngqiān zì) '2000 characters'	info	object, info
两百页 (liǎngbǎi yè) '200 pages'	object	object, info
幽默 (yōumò) 'humorous'	info	object, info
厚 (hòu) 'thick'	object	object, info

(9) a. 我 读 了 一 本 很 厚 的 书 。
wǒ dú le yī běn hěn hòu de shū .
1SG read ASP one CLF_o very thick MODM book
'I read a very thick book.'

b. 翻开 那些 难懂 的 书
fānkāi nàxiē nándǒng de shū
open those difficult MODM book
'Open those difficult books.'

Table 1 presents some common modifiers of 书 (shū) 'book' and the facets the phrases have after application of these modifiers. The second column indicates the target facet of the modification, and the third column the facets accessible for further predication after modification. After the modification, the phrases can still be the argument of 带走 (dàizǒu) 'take away' (which targets the object facet) or 阅读 (yuèdú) 'read' (which targets the info facet).

2.3 *Event • info*

Speech and *lecture* are typical *event • info* nouns in English. Neither the event facet nor the info facet is particularly prominent. Copredications of the pattern V+Mod+N or Mod+Mod+N where the leftmost predicate addresses the event facet and the second the info facet are possible (see 10a–10c) but it seems that they are not always felicitous, as can be seen in (10d) and (10e). In general, we can conclude from (10) that facet-addressing predications over the info facet are possible. Whether the event facet is primary is less clear. Facet-addressing predications over the event facet seem less acceptable (see 10f) but in order to exclude them, we still need to look at more data. For the moment, we assume that both facets are secondary, which means that predicating over them can be excluded due to a predication over the respective other facet.

(10) a. I recently attended a most informative lecture delivered by two of Ireland's most prominent obstetricians.

b. Pendleton denounced them as unconstitutional, and concluded an elaborate speech against them in these words.

c. [...]after a short instructive lecture on [...][10]

d. ? Yesterday there was a speech, and the speaker elaborated the details on frame semantics. I attended the detailed speech.

e. ? Yesterday there was a lecture, and the speaker elaborated the details on frame semantics. I missed it because the organizers rescheduled the detailed lecture from Friday to Monday and I wasn't informed.

f. # Yesterday the famous scientist made a speech. There was a large audience and I liked the content very much. So today I am going to recite that crowded speech.

In Chinese, however, we can find *event • info* nouns with primary facets. There are two nouns for *speech* in Chinese, namely 讲话 (jiǎnghuà) and 演讲 (yǎnjiǎng).[11] The former is usually used for speeches given in more serious situations or by important people, while the latter is a more general word for *speech*. Both are of type *event • info*, but they behave differently in copredication.

(11) a. 背诵/进行 一 篇 演讲
bèisòng/jìnxíng yī piān yǎnjiǎng
recite/perform one CLF$_i$ speech
'recite/perform a speech'

b. 背诵/#进行 一 篇 讲话
bèisòng/#jìnxíng yī piān jiǎnghuà
recite/#perform one CLF$_i$ speech
'recite/perform a speech'

c. 背诵/进行 详细 的 演讲/讲话
bèisòng/jìnxíng xiángxì de yǎnjiǎng/jiǎnghuà
recite/perform detailed MODM speech
'recite/perform a detailed speech'

[10] *The Musical Magazine* Vol. 2, 1840, p. 210.

[11] The two morphemes in 讲话 (jiǎnghuà) mean 'speak' and 'words', and the two morphemes in 演讲 (yǎnjiǎng) mean 'act/perform' and 'speak'.

Table 2: Facet availability after modification for 讲话 (jiǎnghuà) ‘speech’ and 演讲 (yǎnjiǎng) ‘speech’

	targeted facet	讲话 (jiǎnghuà)	演讲 (yǎnjiǎng)
两千字 (liǎngqiānzì) ‘2000 characters’	info	info	info, event
两个小时 (liǎnggèxiǎoshí) ‘2 hours’	event	event	event
详细 (xiángxì) ‘detailed’	info	both	both
盛大 (shèngdà) ‘grand’	event	event	event
沉闷 (chénmèn) ‘dull’	event	event	event

d. #背诵/进行 两个小时 的 演讲/讲话
bèisòng/jìnxíng liǎnggèxiǎoshí de yǎnjiǎng/jiǎnghuà
recite/perform two.hours MODM speech
‘recite/perform a two-hour speech’

The Chinese classifier 篇 (piān) in (11a)–(11b) combines only with nouns that have an info facet. When it combines with 演讲 (yǎnjiǎng), the result 一篇演讲 (yì piān yǎnjiǎng) ‘a speech’ still has the event facet and can be predicated by 进行(jìnxíng) ‘perform’; but when it combines with 讲话 (jiǎnghuà), the event facet is blocked for subsequent predication. If 讲话 (jiǎnghuà) and 演讲 (yǎnjiǎng) are modified by facet-addressing modifiers such as 详细 (xiángxì) ‘detailed’ in (11c), the resulting phrase will still be a dot object. If they are modified by facet-picking modifiers like 两个小时 (liǎng ge xiǎoshí) ‘2 hours’ in (11d), the phrases only have the event facet and cannot be predicated by 背诵 (bèisòng) ‘recite’.

Table 2 lists the accessible facets of both nouns after modification by some adjectival or nominal modifiers. The event facet of 演讲 (yǎnjiǎng) is always preserved, but when 讲话 (jiǎnghuà) is modified by 两千字 (liǎngqiānzì) ‘2000 characters’, only the info facet remains accessible. Therefore, it can be concluded that in 讲话 (jiǎnghuà), both facets are secondary facets, whereas in 演讲 (yǎnjiǎng), the event facet is the primary facet.

The reason why 演讲 (yǎnjiǎng) has a primary facet while 讲话 (jiǎnghuà) does not is probably related to the Chinese lexical system. The info and event facets of 讲话 (jiǎnghuà) can also be referred to as 讲话稿 (jiǎnghuàgǎo) ‘speech draft’ and 讲话会 (jiǎnghuàhuì) ‘speech meeting’, respectively. Neither is a frequent word. On the other hand, although the info facet and the event facet of 演讲 (yǎnjiǎng) can also be referred to as 演讲稿 (yǎnjiǎnggǎo) ‘speech draft’ and 演

讲会 (yǎnjiǎnghuì) 'speech meeting', 演讲稿 (yǎnjiǎnggǎo) 'speech draft' is much more commonly-used when the info facet is targeted, while 演讲会 (yǎnjiǎnghuì) 'speech meeting' is not frequently used.

3 Modelling composition with polysemous nouns

3.1 Background: Syntax-driven composition of semantic frames

For modelling composition at the syntax-semantics interface, we build on the framework of Kallmeyer & Osswald (2013), which involves tree rewriting on the syntactic side and frame unification on the semantic side. The basic representational components of the approach are *elementary constructions*, which are pairs of constituent trees and semantic frames, together with a partial map from constituent nodes to nodes of the associated frame.

Frames are here understood as *generalized feature structures*.[12] While conventional feature structures require that each node of the frame is accessible from a distinguished root node via a finite attribute sequence, frames relax this condition in that each node is required to be accessible from at least one of a non-empty set of *labeled nodes*. A corresponding generalization applies to the unification of frames: Instead of identifying the designated root nodes of feature structures, *frame unification* relies on the identification of all nodes that carry the same labels. Similarly, *subsumption* naturally extends from ordinary feature structures to frames. As in the single-rooted case, the unification of two frames is their least upper bound with respect to subsumption, if existent.

In order to characterize the properties of frames and frame nodes, we make use of *attribute-value formulas* and *descriptions*, which gives us a logical language tailored for the description of frames and for drawing inferences about them. The vocabulary of this language consists of type symbols (e.g. *apple*, *sweet*, *eating*), attribute symbols (e.g. TASTE, ACTOR, EATER), relation symbols, node variables (e.g. *a*, *b*, *c*, ...), and node names. Examples of (primitive) attribute-value descriptions are *apple*, TASTE : *sweet*, and ACTOR $\doteq$ EATER. They can be seen as one-place predicates which might be satisfied at a node of a frame (under a given interpretation of the vocabulary). For instance, TASTE : *sweet* is satisfied at a node v if v has an attribute denoted by TASTE whose value node is an instance of type *sweet*. The description ACTOR $\doteq$ EATER is satisfied at v if v has attributes denoted by ACTOR and EATER whose value nodes are identical. In contrast to

[12] For a formal account of frames and the logic of attribute-value descriptions and formulas see Kallmeyer & Osswald (2013: Sect. 3) or the more recent version in Chen et al. (2022: Appendix).

descriptions, attribute-value *formulas* are not satisfied at nodes but by frames. Formulas include "grounded" attribute-value descriptions such as $x \cdot \textit{apple}$ and $x{\cdot}\textsc{taste} : \textit{sweet}$, which are satisfied by a frame F if F has a node labeled x at which the respective descriptions are satisfied. Formulas include also expressions such as $x \cdot \textsc{actor} \doteq y$, which is satisfied by F if F has nodes labeled x and y such that the latter node is the value of the attribute denoted by ACTOR of the former node. Attribute-value formulas and, likewise, descriptions, can be combined by Boolean connectives.

Crucially, frames can be seen as *minimal models* of conjunctive attribute-value formulas. Conjunctions of attribute-value descriptions or formulas will be often presented in the well-known format of *attribute-value matrices* (AVMs). In addition to descriptions and formulas, we also make use of (universal) *attribute-value constraints*, which are basically universally quantified descriptions. If ϕ is an attribute-value description then the constraint $\forall\phi$ is satisfied if ϕ is satisfied at every node. We write $\phi \Rrightarrow \psi$ instead of $\forall(\phi \rightarrow \psi)$. Typical use cases are subtyping (e.g. $\textit{apple} \Rrightarrow \textit{fruit}$), incompatibilities (e.g. $\textit{fruit} \wedge \textit{meat} \Rrightarrow \bot$), and attribute requirements (e.g. $\textit{eating} \Rrightarrow \textsc{eater} : \top$).[13] Given a finite set of constraints $\phi \Rrightarrow \psi$ with non-disjunctive ψ and a frame F, there exists a unique minimal frame F' subsumed by F that satisfies all constraints (if no inconsistencies occur and F' keeps being finite).

The tree rewriting formalism used in this paper is Tree Adjoining Grammars (TAG; Joshi & Schabes 1997, Abeillé & Rambow 2000).[14] A TAG is a finite set of elementary trees that can be combined into larger trees via the tree composition operations *substitution* (replacing a leaf with a new tree) and *adjunction* (replacing an internal node with a new tree). The trees that can be added by adjunction are special in that they have a leaf node that is marked as *foot node* and that has the same non-terminal label as the root. These trees are called *auxiliary trees*. The effect of an adjunction is that the root of the adjoined auxiliary tree replaces the target node of the adjunction and the tree below the target node ends up below the foot node.

As mentioned at the beginning of this section, elementary and derived constructions are understood as pairs of constituent trees and semantic frames together with a partial map that takes constituent nodes to frame nodes. This mapping is encoded by the feature I(NDEX) carried by the constituent nodes. Due to this linking and the resulting identification of the I values, syntactic operations,

[13] $\bot$ is satisfied by nothing, $\top$ is satisfied by everything.

[14] Formalisms with different tree operations are also possible; e.g., the Tree Wrapping Grammar formalism described in Kallmeyer & Osswald (2023).

here substitution and adjunction, can give rise to the unification of the associated frames. Consider Figure 2 below for an example. The substitution of the tree of 'the book' into the object NP node of 'took away' leads to a unification of the respective frames under the identification of the node labels p and u. The resulting frame is represented at the bottom of the figure.

The example also illustrates the specific grammatical theory, Role and Reference Grammar (RRG; Van Valin 2005, Bentley et al. 2023), that we use for our syntactic representations. RRG provides an elaborate theory of clause linkage, which is helpful for the analysis of copredication constructions. Moreover, RRG assumes a layered structure consisting of *nucleus* (NUC), *core* (CORE) and *clause* (CL). The nucleus contains the main predicate, the core contains the nucleus and the (non-extracted) syntactic arguments, and the clause includes the core and extracted arguments. Adjuncts can attach to each layer, and the assumption of a layered structure holds across categories. Notice that the specific choice of the syntactic inventory does not play an important role for the purposes of the present paper. A more common X-bar schema would also do for the compositional mechanisms proposed in the following.

3.2 The representation of meaning facets and dot type nouns

Following Chen et al. (2022), we assume that frame-semantic representations of polysemous nouns come with facet attributes whose values characterize the individual meaning facets of the nouns. Predicates and modifiers then access meaning facets of the semantic frames contributed by their arguments. Non-polysemous nouns can be integrated into this picture by assuming that they provide a single meaning facet that points to the denoted entity itself. For example, suppose that our semantic model provides a type *apple*, whose instances are denoted by the English word *apple*, and that *apple* is a subtype of *food*, and *food* is a subtype of *physical-object* (*phys-obj*). Moreover, let us assume that each instance of type *phys-obj* has an attribute OBJECT-FACET (OBJ-FCT) whose value is the instance itself. A formal presentation of these constraints is given in (12), where SELF stands for the identity function.

(12) a. $\mathit{apple} \Rrightarrow \mathit{food}, \quad \mathit{food} \Rrightarrow \mathit{phys\text{-}obj}$
b. $\mathit{phys\text{-}obj} \Rrightarrow^{15} \text{OBJ-FCT} \doteq \text{SELF}$

It follows that each instance x of type *apple* is of type *phys-obj* and has an attribute OBJ-FCT whose value is x, in symbols, $x \cdot \text{OBJ-FCT} \doteq x$.

[15] '$\Rrightarrow$' is always the last operator to be combined.

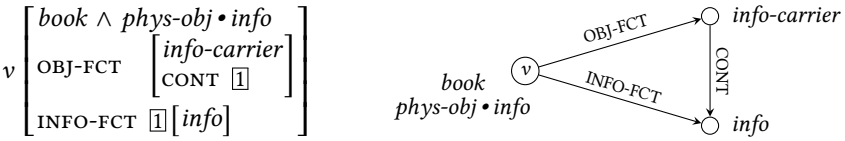


Figure 1: AVM and minimal frame model for the *book* frame

Polysemous nouns are assumed to denote instances of a dot type, whose associated facet attributes have values that differ from the dot-type instance, in general. This is illustrated by the attribute-value constraint in (13b): Instances of type *phys-obj • info* have two attributes OBJ-FCT and INFO-FCT, whose values are related by the attribute CONT(ENT) and are of type *info-carrier* and *info*, respectively.

(13) a. *book* ⟹ *phys-obj • info*
b. *phys-obj • info* ⟹ OBJ-FCT : *info-carrier* ∧ INFO-FCT ≐ OBJ-FCT · CONT
c. *info-carrier* ⟹ *phys-obj* ∧ CONT : *info*

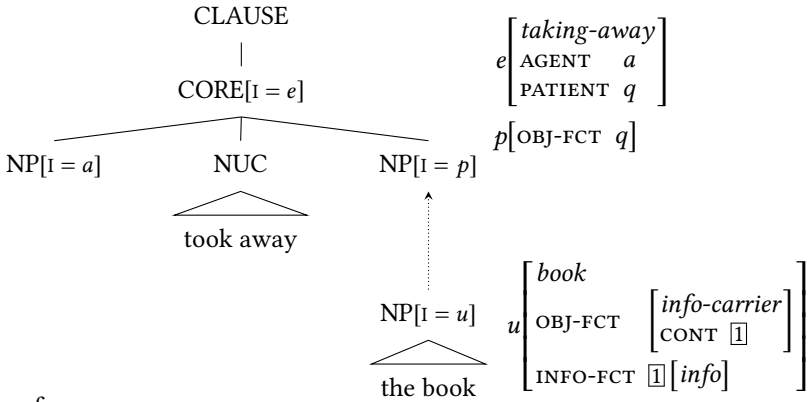
The type *info-carrier* is specified in (13c) as a subtype of *phys-obj* whose instances have a CONT attribute of type *info*. In (13a), *book* is specified as a subtype of *phys-obj • info*. Figure 1 shows the minimal frame model for an instance *v* of *book*, subject to the constraints in (13), together with the corresponding AVM. Figure 2 illustrates how syntactic argument substitution in the derivation of *took away the book* can give rise to a unification of the 'book' frame and the 'take away' frame.

The complex types *event • food* and *event • info*, together with their respective subtypes *dinner* and *speech*, can be specified in a similar vein. In (14b), instances of type *event • food* are characterized as having the facet attributes EV-FCT and OBJ-FCT, where the value of EV-FCT is of type *eating* and the value of OBJ-FCT is the THEME of the *eating* instance, which (14c) requires to be of type *food*.[16]

(14) a. *dinner* ⟹ *event • food*
b. *event • food* ⟹ EV-FCT : *eating* ∧ OBJ-FCT ≐ EV-FCT · THEME
c. *eating* ⟹ *event* ∧ THEME : *food*

According to (15b), an instance of type *event • info* has a facet attribute EV-FCT of type *info-event*, which in turn has an attribute CONT of type *info* (15c), whose value is identical to the value of the INFO-FCT attribute of the dot-type instance.

[16] We omit the fact that *dinner* restricts the event time to the evening since it does not play a role for possible predications over facets.



Resulting frame:

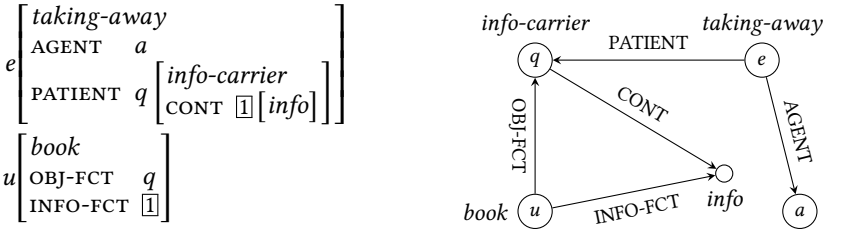


Figure 2: Derivation for *took away the book* with resulting frame

(15) a. $speech \Rrightarrow event \bullet info$

b. $event \bullet info \Rrightarrow \text{EV-FCT} : info\text{-}event \wedge \text{INFO-FCT} \doteq \text{EV-FCT} \cdot \text{CONT}$

c. $info\text{-}event \Rrightarrow event \wedge \text{CONT} : info$

The following more general constraints encode various type restrictions and incompatibilities for the basic types *event*, *info* and *phys-obj* and the facet attributes EV-FCT, INFO-FCT and OBJ-FCT:

(16) a. $event \wedge info \Rrightarrow \bot$, $event \wedge phys\text{-}obj \Rrightarrow \bot$, $phys\text{-}obj \wedge info \Rrightarrow \bot$

b. $\text{EV-FCT} : \top \Rrightarrow \text{EV-FCT} : event$, $\text{INFO-FCT} : \top \Rrightarrow \text{INFO-FCT} : info$, $\text{OBJ-FCT} : \top \Rrightarrow \text{OBJ-FCT} : phys\text{-}obj$

c. $event \wedge (\text{INFO-FCT} : \top \vee \text{OBJ-FCT} : \top) \Rrightarrow \bot$,
$info\text{-}obj \wedge (\text{EV-FCT} : \top \vee \text{OBJ-FCT} : \top) \Rrightarrow \bot$,
$phys\text{-}obj \wedge (\text{EV-FCT} : \top \vee \text{INFO-FCT} : \top) \Rrightarrow \bot$

In addition to (16c), there are constraints on *event* and *info* that resemble the constraint in (12b) on *phys-info*, with OBJ-FCT replaced by EV-FCT and INFO-FCT,

respectively. They ensure that the basic types license exactly one facet attribute, which encodes self-reference.

3.3 Using top and bottom features for facet-picking modifiers

Our first approach to modelling copredication restrictions uses feature-structure based TAG (FTAG, Vijay-Shanker & Joshi 1988). In an FTAG, each node has a top and a bottom feature structure, except for substutition nodes, which only have a top structure. Nodes in the same elementary tree can share feature values. When adjoining an auxiliary tree β to a node v, the top of the root of β unifies with the top of v while the bottom of the foot of β unifies with the bottom of v. In the final derived tree, top and bottom feature structures must unify for all nodes.

We use the capability of FTAG auxiliary trees to separate the top and bottom feature structures of the target adjunction site. This allows adjoining constructions, roughly, to embed the frame of a dot type noun while passing upwards only the frame of the facet that they pick. As an example, consider the composition of *lively* and *dinner* in Figure 3. The NUC_N node of *dinner* has a bottom feature structure with an I feature whose value is the label u of the dot type frame. The I value in the top feature structure of that node is shared with the bottom of the CORE_N node. If nothing adjoins, all I features in the *dinner* tree will be set to u due to the final top-bottom unification. In Figure 3, an adjunction takes place at that node. The adjoining tree of *lively* retrieves the *dinner* frame via the top I feature (value t) of its foot node and via final top-bottom unification (which unifies t with u), and passes the event facet (EV-FCT, label z) of this frame upwards via the bottom feature structure of its root node. Figure 4 shows the result of the adjunction after the final top-bottom unification. Due to the adjunction, the I feature has changed from u (= dot type) on the lower NUC_N node to z (= event) on the higher NUC_N node.

In contrast to a facet-picking modifier such as *lively*, a facet-addressing modifier such as *vegan* in *vegan dinner* just adds information to one facet (here the object facet, OBJ-FCT) but does not change the I feature. Figure 5 shows the corresponding elementary construction for *vegan*. After adjoining it to *dinner* and performing a final top bottom unification, we obtain a tree where all nodes on the path from *dinner* to the root have the same I feature value, namely the label of the dot type frame (the unification of u and v).

Now we consider combinations of two modifiers. Figure 6 shows the adjunction of the elementary tree of *lively* to the tree of *vegan dinner* (the latter before final top-bottom unification). Throughout the paper, we follow standard practices in TAG by assuming that nothing can be adjoined at foot nodes, therefore 'lively'

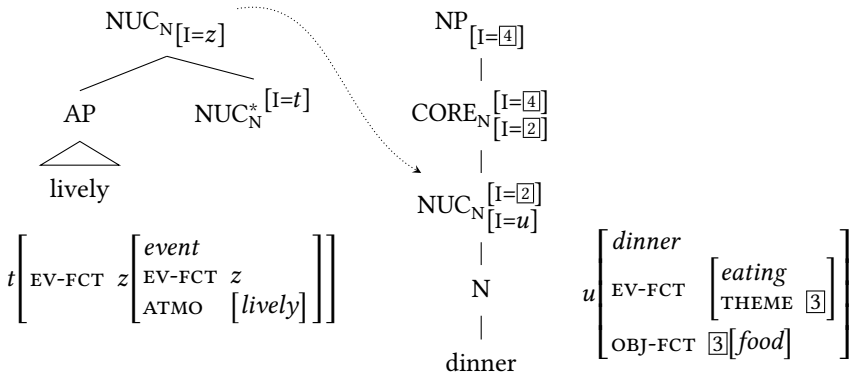


Figure 3: Using top and bottom features for facet picking: The syntactic and semantic composition of *lively dinner*

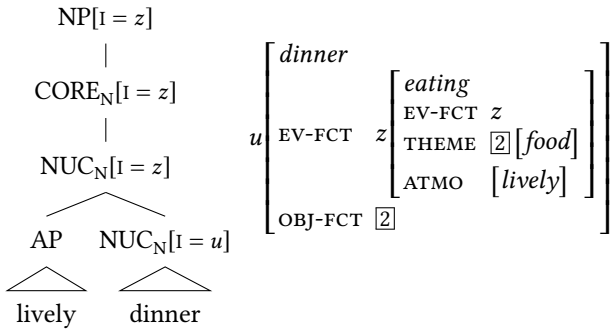


Figure 4: Derived construction for *lively dinner* after final top-bottom unification

can only be adjoined to the higher NUC_N node in the 'vegan dinner' tree.[17] Figure 7 shows the resulting derived construction, both before and after top-bottom unification.

When adjoining the two modifiers in the reverse order, i.e., adjoining *vegan* higher than *lively*, we obtain the derived tree in Figure 8 (before final top-bottom unification). On the NUC_N node in the middle in the derived tree (shaded in gray), the top feature structure has an I feature with value v and the bottom feature structure has an I feature with value z. In the final top-bottom unification, when v and z unify, the type *event* of z is incompatible with the attribute OBJ-FCT of

[17]Note that this *null adjunction* at foot nodes is only imposed to avoid spurious ambiguities. Different adjunction orders for the same surface order would lead to the same tree.

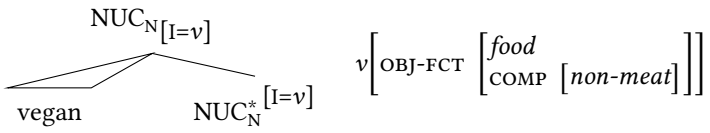


Figure 5: Elementary construction for *vegan*

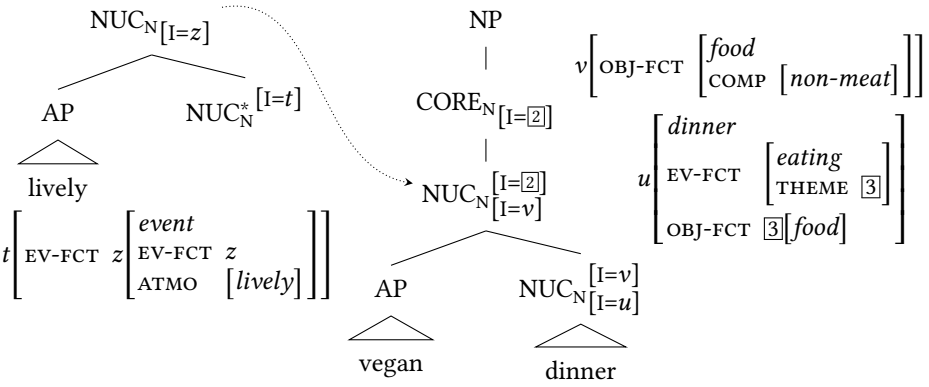


Figure 6: Adjunction of *lively* to *vegan dinner*

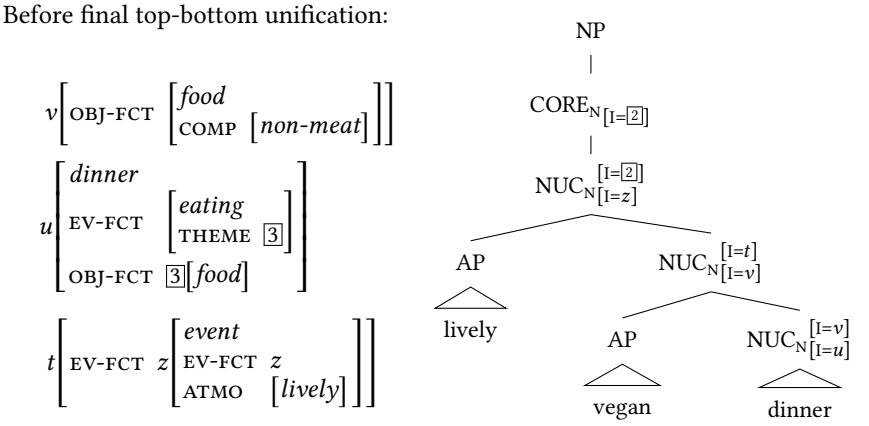
v, resulting in a unification failure. Thus, the infelicitous phrase #*vegan lively dinner* is excluded.

This model also excludes infelicitous verbal predications such as #*take away the lively dinner*. As shown in Figure 4, the value of the I feature of the NP of *lively dinner* is the frame node *z*, which is of type *event*. If this NP is substituted at the object NP node on the elementary tree of *take away*, the frame *z* will unify with a frame with OBJ-FCT (see Figure 2), which results in a unification failure.

3.4 Using default constraints for secondary facets

A shortcoming of the preceding approach is that the frame of the dot type noun does not distinguish between primary and secondary facets. In the following, we aim at modelling this distinction in such a way that the semantic representation of the noun restricts possible facet selection patterns. To this end, we propose to model secondary facets as *default attributes* that will only be present if there is no conflict with other constraints. For example, *dinner* is of type *event* • *food* and usually has an EV-FCT and an OBJ-FCT. However, as discussed above, when *dinner* is modified by an event modifier such as 'lively', its OBJ-FCT is no longer

a) Before final top-bottom unification:



b) After final top-bottom unification:

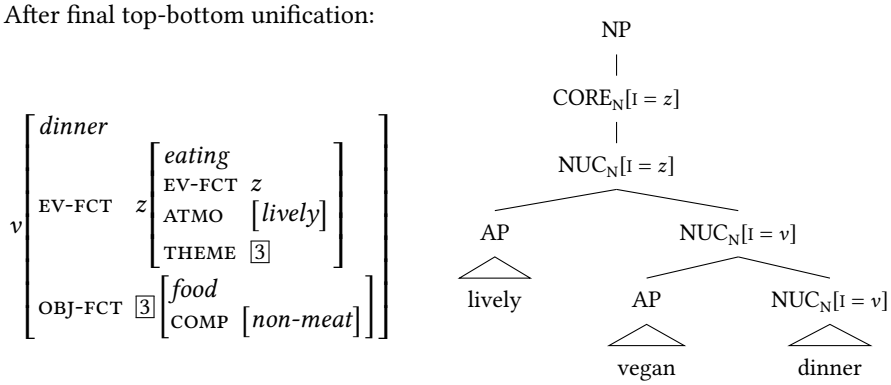


Figure 7: Derived construction for *lively vegan dinner* a) before and b) after final top-bottom unification

available in the resulting frame. In the following, we model this by analyzing the OBJ-FCT of *event* • *food* nodes as a defeasible attribute.

To this end, we introduce *default constraints* (indicated by $\Rightarrow_D$) into our logical system. Given a default constraint $\alpha \Rightarrow_D \beta$ and a frame F that satisfies α, we may assume that F also satisfies β if β is compatible with the properties of F.[18] The assertion that F satisfies β is defeasible and needs to be retracted if more information about F is known that is not compatible with β.

The facet constraints for *event* • *food* in (14b) are now replaced by the following set of constraints, where the OBJ-FCT attribute, representing a secondary facet, is introduced by the default constraint (17b).

[18] A default constraint $\alpha \Rightarrow_D \beta$ is basically the same as a normal default rule $\frac{\alpha : \beta}{\beta}$ in the sense of Reiter (1980); see also Osswald (2005).

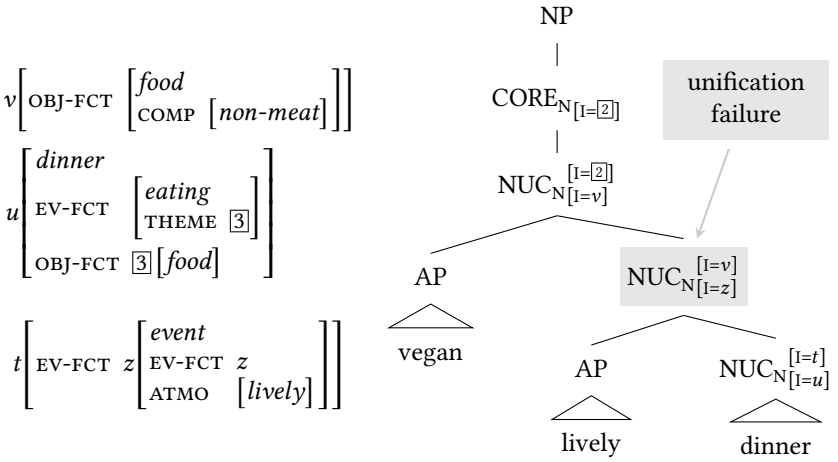


Figure 8: Derived construction for #"vegan lively dinner" before top-bottom unification

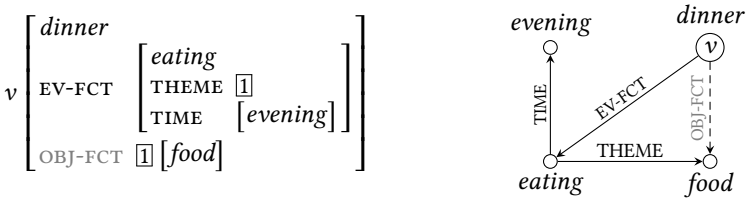


Figure 9: The AVM and graph representations of the frame of *dinner* (default constraints are depicted in gray in AVMs and as dashed edges in graph representations)

(17) a. $event \bullet food \Rrightarrow \text{EV-FCT} : eating$

b. $event \bullet food \Rrightarrow_D \text{OBJ-FCT} : \top$

c. $event \bullet food \wedge \text{OBJ-FCT} : \top \Rrightarrow \text{OBJ-FCT} \doteq \text{EV-FCT} \cdot \text{THEME}$

The minimal frame for an instance of type *dinner* under the constraints in (17) is given in Figure 9. The attribute depicted in gray in the AVM and as a dashed edge in the graph (OBJ-FCT) is a default attribute.

In addition, we make use of a type *event-active* for marking frames of facet-picking modifiers such as *lively*, which target event facets. In particular, *event-active* holds at nodes whose event facet has been targeted by a facet-picking modifier at some point of the composition. The constraint in (18) ensures the "picking" behavior of the modifier in that an instance of both *event-active* and *event • food* cannot have the attribute OBJ-FCT.

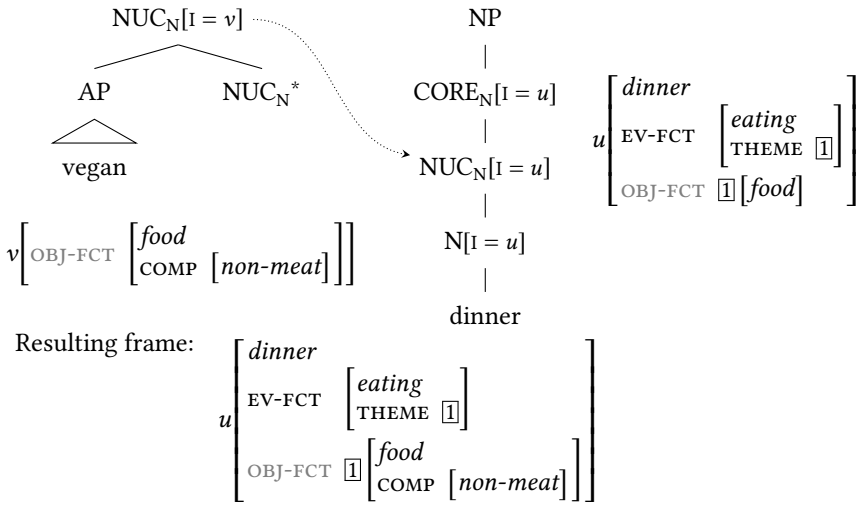


Figure 10: Derivation for *vegan dinner*

(18) *event-active* ∧ *event* • *food* ∧ OBJ-FCT : ⊤ ⇛ ⊥

Likewise, we assume that the presence of *event-active* in a lexical entry excludes the presence of INFO-FCT when combined with nouns of type *event* • *info* (19a). There are also types that encode the picking of other facets than *event-active*. For instance, the type *info-active* excludes the attribute EV-FCT when combined with nouns of type *event* • *info* (19b).

(19) a. *event-active* ∧ *event* • *info* ∧ INFO-FCT : ⊤ ⇛ ⊥
b. *info-active* ∧ *event* • *info* ∧ EV-FCT : ⊤ ⇛ ⊥

Facet-addressing modifiers do not require specific restrictions of this kind. For instance, modifiers such as *vegan* target the object facet of *event* • *food* nouns without affecting the event facet. Figure 10 and Figure 11 illustrate the representations of *vegan* and *lively*, respectively. Note that their facets are modelled as default attributes. In this way, they can target a primary facet, in which case the default attribute in the modifier construction turns into a non-default attribute, but also a secondary default facet, in which case the facet remains a default attribute. Furthermore, they can only combine with frames whose type is compatible with the default facet they address.

Figure 10 shows the derivation of *vegan dinner*. The frames are unified under the identification of u and v, and the OBJ-FCT remains a default attribute. The resulting frame has the same facets as the *dinner* frame before modification. The

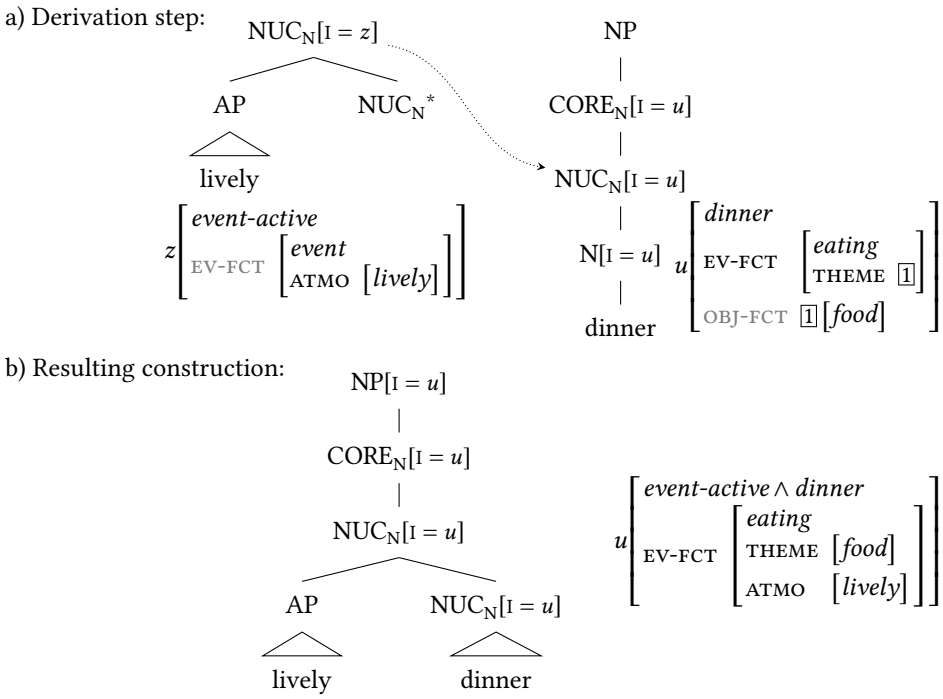


Figure 11: Derivation of the construction for *lively dinner*

frames of 'lively' and 'dinner' specified in the upper part of Figure 11 are not unifiable because of the constraint in (18). The presence of default constraints, however, allows us to retract defeasible information if necessary. In the case at hand, the default constraint in (17b) can be taken out of the game, thereby leading to a 'dinner' frame without the OBJ-FCT attribute, which then unifies with the 'lively' frame without problems, as shown in the lower part of Figure 11.

In general, the decision which defaults to retract is non-deterministic since unification clashes may be resolvable in different ways. In particular, we can consider both of the frames to be unified as candidates for a retraction of defeasible information, or we may take only one of them into account. For the present purposes, the latter option turns out to be more appropriate. The two frames to be unified in a derivation step can be distinguished according to the role their syntactic components play in the derivation. In our model, only the frame of the element which is "predicated over" can be subject to a retraction of defeasible information. In an adjunction, this is the frame of the target tree, in a substitution,

it is the frame of the substitution tree.[19]

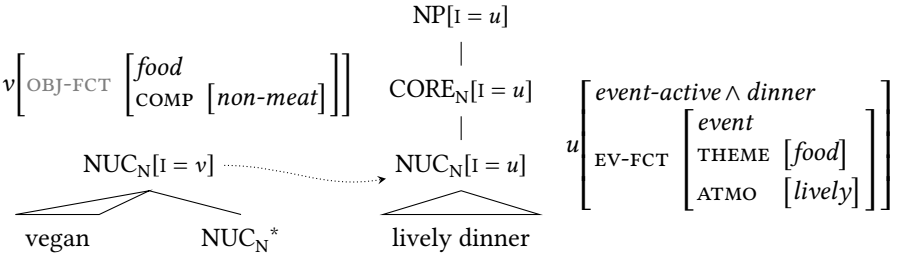
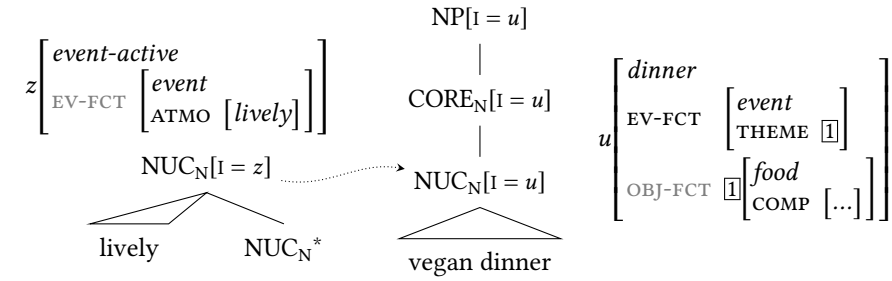


Figure 12: Derivation for #*vegan lively dinner*: the unification failure is due to the incompatibility of *event-active* ∧ *dinner* and OBJ-FCT : ⊤.

Figure 12 illustrates the unification failure that underlies the infelicitous phrase #*vegan lively dinner*. Although the OBJ-FCT attribute in the frame for *vegan* goes back to a default constraint, it cannot be retracted because the frame belongs to the adjoining tree and not to the target tree. Therefore, the incompatibility of the attribute OBJ-FCT and *event-active* ∧ *dinner* given by (18) leads to a unification failure.



Resulting frame:

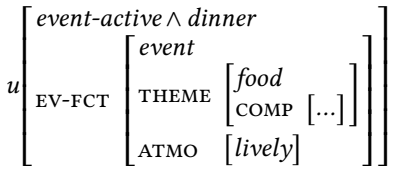


Figure 13: The derivation of *lively vegan dinner*

[19]This "asymmetric" approach to unification under default constraints is somewhat related to the "credulous default unification" proposed in Carpenter (1994). Carpenter assumes for the default unification of F and G that the information in F is strict and all of G is defeasible.

The successful derivation of the construction for *lively vegan dinner* is shown in Figure 13. Here, the frames of *vegan* and *dinner* unify first, and then the frame of *lively* unifies with the resulting frame. Note that the use of binarized trees and null adjunction constraints on foot nodes is crucial for controlling the unification of frames under default constraints: Lower modifiers must be adjoined before higher ones in order to have the frame of the higher modifier unified with the unification of the frames of the lower modifier and the noun. In cases where different modifiers adjoin at different sides of a noun (e.g., #'the lively dinner on the table'), additional features might be necessary in order to enforce the correct adjunction order.

The described approach can handle V+Mod+N copredication constructions as well. For example, the combination #*take away the lively dinner* is excluded since the object NP argument of *take away* is required to have an OBJ-FCT attribute in its frame (see Figure 2) while the type of the frame of *lively dinner* is *event-active* $\wedge$ *dinner*, which is incompatible with OBJ-FCT. It follows that substituting *the lively dinner* at the object NP argument position of *take away* would lead to a frame unification failure.

Let us finally turn to nouns of type *event* • *info*. According to the working hypothesis proposed in Section 2.3, both facets of *event* • *info* nouns are secondary, as long as there are no lexical specifications to the contrary. This can be formalized by replacing the strict constraint (15b) by the constraints in (20). The existence of both facets relies on the default constraints (20a) and (20b), and a further constraint (20c) ensures the presence of at least one of them.

(20) a. *event* • *info* $\Rrightarrow_D$ EV-FCT : $\top$

b. *event* • *info* $\Rrightarrow_D$ INFO-FCT : $\top$

c. *event* • *info* $\Rrightarrow$ EV-FCT : $\top$ $\vee$ INFO-FCT : $\top$

d. *event* • *info* $\wedge$ EV-FCT : $\top$ $\Rrightarrow$ EV-FCT : *info-event*

e. *event* • *info* $\wedge$ EV-FCT : $\top$ $\wedge$ INFO-FCT : $\top$ $\Rrightarrow$ INFO-FCT $\doteq$ EV-FCT $\cdot$ CONT

The values of the two facets, if existent, are related to each other by the CONT attribute (20e), as before.

Concerning the two Chinese nouns for 'speech' discussed in Section 2.3, it was observed that 演讲 (yǎnjiǎng) has a lexically specified primary event facet. One option to implement this is by introducing a specific subtype of *event* • *info* that (strictly) implies EV-FCT : $\top$. Alternatively, we could anchor the constraint $\top \Rrightarrow$ EV-FCT : $\top$ locally to the dot-type node of the lexical frame. Instantiation of the lexical item then leads the non-defeasible presence of EV-FCT. The noun 讲话 (jiǎnghuà), by contrast, follows the general pattern of *event* • *info* nouns described in (20), according to which both of its facets are defeasible.

4 Discussion and conclusion

We presented two approaches to modelling facet-picking and facet-addressing predications over polysemous nouns: One based on top and bottom feature structures on nodes and the possibility to separate these via adjunction, and a second approach based on a default logic that allows the removal of defeasible facets.

The first approach builds on an established framework of the syntax-semantics interface (Kallmeyer & Osswald 2013, Chen et al. 2022). Top and bottom feature structures have long been used in the context of TAG (see the analyses in the XTAG grammar, XTAG Research Group 2001) and have been shown to be useful for a wide range of phenomena. The way frame constraints are unified in this approach is order-independent and monotonic. This facilitates the understanding of the semantic contribution of elementary trees.

This approach can capture in an elegant way the fact that in some predications over dot-type nouns, one facet is picked while the other facets, even though still present in the semantic representation, are no longer accessible for further predications. A potential disadvantage of this approach is that the choice of facet-picking versus facet-addressing depends entirely on the predicate (in our examples on the modifier). The data considered above have however shown that the dot-type nouns clearly influence the result of such a composition in terms of available facets as well. A large part of the data suggests that there are dot-type nouns that distinguish between primary and secondary facets among their meaning components and that allow facet picking combined with the unavailability of other facets only when the other facets are secondary (see for instance the Chinese data concerning the two words for 'speech'.) For these cases, the analysis we have so far might require more than one predication tree for the same lexical item depending on the facet properties of the target noun (which can be encoded via the target type). This would mean a multiplication of predication trees. Note, however, that this might be less problematic than it sounds since these trees would be described in a factorized way within a metagrammar, i.e., a principled description of the possible elementary constructions (Crabbé et al. 2013, Kallmeyer & Osswald 2013, Lichte & Petitjean 2015).

The default approach presented here provides a way to model the distinction between primary and secondary facets in dot-type nouns. Secondary facets are modelled as default attributes that can be retracted in case of conflicting frame constraints. For this analysis we extended the frame logic of Kallmeyer & Osswald (2013; cf. also Chen et al. 2022) by default constraints and made use of a non-commutative and non-associative notion of default unification.

An advantage of the default approach is that it requires only a single feature structure per syntactic node, and not top and bottom feature structures. (Note, however, that we might need top and bottom feature structures in order to express other constraints.) On the other hand, a disadvantage of the default approach is that the non-commutativity and non-associativity of unification make meaning contributions less transparent and impose more constraints on the possible syntactic constructions, compared to the top-bottom approach.

In conclusion, this paper develops two promising options for modelling constraints on copredications over dot-type nouns. However, in order to decide which of the two approaches is preferable, further empirical and theoretical investigations are needed. In future work, we will examine more data, taking lexical properties beyond the picking/addressing of facets into account, in particular with respect to the internal structure of the dot-type frames, and we will also investigate and model further kinds of syntactic copredication constructions.

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