What makes a theta-role[*]

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This paper develops a characterization of a θ-role inspired by Carlson (1984) and connects that to one of the central ideas in Hagit Borer's *Structuring Sense* program. Its narrow empirical aim is to show how a θ-role can be designed to explain where implicit arguments are. In particular, the fact that implicit arguments are not possible with external arguments or the objects of prepositions is derived from the syntax of θ-role assignment in concert with the semantics of a θ-role. To explain the ability of external θ-roles to become implicit in the passive, I show how the syntax of θ-role assignment developed here expresses Chris Collins' proposal (Collins 2005) that the passive *by* is an expression of voice.

External θ-roles have a neediness that internal θ-roles lack. It is commonplace for an internal θ-role to be bereft of an argument. Many verbs allow their object argument to go unmentioned.

(1)   a. Ayaka ate (the cake).
        b. Ayaka climbed (the stairs).
        c. Ayaka scolded (the Dean).

d. Ayaka explained (the problem).

e. Ayaka drove (the car).

f. Ayaka painted (the house).

g. Ayaka scrubbed (the table).

h. Ayaka pulled (the cart).

It's not that when these verbs are used without a direct object, they don't have an internal θ-role. As the contradictory nature of (2) indicates, the meanings of these verbs entail that there is an object to the eventuality they describe, even when that object isn't overtly present.

(2) a. # Ayaka ate, but there wasn't anything that she ate.

b. # Ayaka climbed, but there wasn't anything that she climbed.

c. # Ayaka scolded, but there wasn't anyone that she scolded.

d. # Ayaka drove, but there wasn't anything that she drove.

e. # Ayaka painted, but there wasn't anything that she painted.

f. # Ayaka pulled, but there wasn't anything that she pulled.

It's the presence of the internal θ-role that ensures this entailment.

That isn't the situation we find with external θ-roles, however. If a verb is capable of lacking the argument that gets the external θ-role, then it is because the external θ-role is absent. The version of the verbs without an external argument in (3) do not entail that there is something with the θ-role that argument would bear, as (4) shows.

(3) a. The iron melted.

compare: She melted the iron.

b. The box slid down the ramp.

compare: She slid the box down the ramp.

c. The ball bounced across the court.

compare: She bounced the ball across the court.

d. The window closed.

compare: She closed the window.

e. The Stewartia grew by the front door.

compare: She grew the Stewartia by the front door.

(4) a. The iron melted, but there wasn't anything that melted it.

b. The box slid down the ramp, but there wasn't anything that slid it.

c. The ball bounced across the court, but there wasn't anything that bounced it.

d. The window closed, but there wasn't anything that closed it.

e. The Stewartia grew by the front door, but there wasn't anyone who grew it there.

In order for a verb to fail to have an overtly expressed external argument, it must fail to have the θ-role that would normally be assigned to that external argument.[1] I will say that a θ-role whose argument is unexpressed has an "implicit" argument.[2] This paper seeks a way of deriving (5).

(5) A θ-role is incapable of having an implicit argument if it is external.

It is possible to make an external θ-role have an implicit argument, but it does not happen spontaneously. It requires an operation.[3] In the passive, for

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1 Carlson (1984) points out that verbs are also capable of having optional internal θ-roles as well. That is, there are alternations, like that in (i), which involve objects and should be characterized in the same way that the alternations in (3) are.

   i. a. The mule kicked something.
       b. The mule kicked, but it didn't kick anything.

                         Carlson (1984, based on (4), p. 264)

2 I do not mean that an expressed argument is necessarily phonologically overt. I assume that it is possible for syntactically present arguments to be phonologically null. By "unexpressed argument" I mean to describe situations in which there is nothing in the syntax that corresponds to the argument of a predicate. One way of telling if a sentence contains a null argument is to determine whether the conditions that license sentences of that type can be shorn from idiosyncratic meanings of the predicates involved. The silent subjects of control infinitives in English, for instance, are licensed by syntactic properties of the infinitives they stand in, and not the meanings of the θ-roles they receive. A similar situation might arise in languages that have productive impersonal constructions. Because the absence of an internal argument illustrated by (1) depends on the verb chosen, I conclude that there isn't a null argument in these examples.

3 The construction that is most likely to counter-exemplify (5) in English is the middle:

   i. The book read easily last night.

It is likely that the external θ-role has gone implicit in (i), as the entailment diagnostic of a θ-role is present.

   ii. # The book read easily last night, but no one read it.

3

instance, the external θ-role remains, but its argument goes implicit; this is demonstrated in (6).[4]

(6)   a.   The iron was quickly melted.
         # The iron was quickly melted, but there wasn't anything that melted it.
      b.   The box was carefully slid down the ramp.
         # The box was carefully slid down the ramp, but there wasn't anything that slid it.
      c.   The ball was slowly bounced across the court.
         # The ball was slowly bounced across the court, but there wasn't anything that bounced it.
      d.   The cake was eaten.
         # The cake was eaten, but nothing ate it.
      e.   The stairs were climbed.
         # The stairs were climbed, but nothing climbed them.

An explanation for (5) should also provide a way of understanding how operations like the passive allow external θ-roles to host implicit arguments. The answer given in this paper is that what the passive does is change an external θ-role to an internal θ-role.

I don't believe the difference between internal and external θ-roles illustrated in these examples is due to something intrinsic to the particular θ-role. That is, I don't think the explanation for the asymmetry can be found by giving the set of θ-roles that can be external a different denotation than the set of θ-roles that can be internal. That is because there are examples where I think it is plausible that the same θ-role can be found as internal and external, but the asymmetry persists. The difference between the pairs of verbs in (7),

In English, the middle arises only in a narrow range of environments; certain semantic and syntactic conditions must be met. It doesn't have the freedom that implicit internal θ-roles have. I suggest that the reason for this is that the middle is formed by an operation that gives rise to those conditions. Thus, like the passive, these are cases where an external θ-role must be changed in order for it to be implicit. Unlike the passive, the middle doesn't get signaled morphologically. This is nothing more than wishful thinking at present. My hope is that the middle will at most require modification of the proposals made here, and not their downfall.

4 I add manner adverbs to these examples to help ensure that they are verbal passives, rather than deverbal adjectives.

for instance, is often, and plausibly, characterized as a difference in how their two identical θ-roles are arranged.[5]

(7) a. i. Natto scares me.
       ii. I fear natto.
     b. i. Natto disgusts me.
       ii. I loathe natto.

The experiencer θ-role of these verbs can be implicit when it is internal.

(8) a. Natto scares.
     b. Natto disgusts.

But when the experiencer θ-role is external, there is no grammatical way of making it implicit. Because grammatical sentences in English must have something in their surface subject position, a sentence with an implicit external θ-role would have to put something else in the surface subject position. As the passive indicates, the normal method of meeting this requirement in English is to move the direct object into surface subject position. Therefore, if the experiencer θ-role could be implicit when it is external, we should expect examples like (9) to be grammatical.

(9) a. * I scare.
     b. * I disgust.

I credit the ungrammaticality of (9) to the impossibility of making an external θ-role implicit. If that is correct, and the θ-roles assigned internally by *scare* and *disgust* are the same as are assigned externally by *fear* and *loathe*, then it is not in the nature of the θ-roles themselves that we will find the asymmetry.

Instead, what seems to matter is where syntactically a θ-role is assigned. The explanation I will pursue therefore seeks a way of understanding why a θ-role that is assigned externally cannot have the same range of outcomes that it has when that θ-role is assigned internally. My more general aim, however,

5 The complication with this argument is that it could be that the surface subjects in these examples are not always assigned an external θ-role. Belletti and Rizzi (1988) famously argued that the surface subjects of *scare* and *disgust* are assigned an internal θ-role, and move to the surface subject position. But if passive can affect only external θ-roles in English, then the grammaticality of *I was gradually scared by the political culture of the U.S.* indicates that the θ-roles borne by the surface subject of *scared* is external. Note that the adverb *gradually* disambiguates the participle *scared* into its verbal passive form. Adjectives do not comfortably combine with *gradually* (#*I was gradually angry at the the political culture of the U.S.*). See Pesetsky (1995) for this, and other, reasons to doubt that the surface subjects of verbs like *scare* and *disgust* bear internal θ-roles.

is to model what kind of thing a θ-role is. I will use the difference between combining internally and externally to inform the model. I will seek a definition of θ-role that captures some of properties they seem to have, but also gives an explanation for the external/internal asymmetry we've seen here.

1 Internal theta roles

As the introduction presupposes, I'll take a neo-Davidsonian view of verb meanings. That view partitions the meaning of a verb into a description of eventualities and relations between those eventualities and the entities, the "arguments," that are involved in them. In this section, I will narrow my attention to the relation that "direct objects" have to the eventualities described by the verb, and more particularly, I will consider just nominal direct objects. My aim is to bring a neo-Davidsonian view closer to the framework that Hagit Borer develops in her magisterial *Structuring Sense* series (Borer 2005a,b, 2013).

An important ingredient in Borer's framework is the view that event descriptions that come by way of verbs are constructed by the functional structure in the syntax of the phrases those verbs project. I will adopt the view that the two neo-Davidsonian parts – the event description and the predicates that relate arguments to that eventuality – are part of the material within a Borerian VP. Borer has argued that one piece of a VP is a term – the "root" – that gets its meaning by the functional material around it. It is the root that comes closest to being that neo-Davidsonian term which describes eventualities. On Borer's view, the root is an entirely phonological item. It is only in combination with surrounding material that a denotation is assigned to the root (and its accompanying structure). This plays a key role in a complex set of effects, but one of its goals is to explain why the same root, even when it is expressed with the same word, can have a multiplicity of meanings. For instance, Borer points to the contrasting verbal uses of the noun *siren* in (10).[6]

(10)   a. The police car sirened the Porsche to a stop.
       b. The police car sirened up to the accident site.
       c. The police car sirened the daylight out of me.

<div align="right">(Borer 2013, (8): 26)</div>

Note that the direct objects in (10a) and (10c) bear very different relations to the verb *siren*, and there is, and cannot be, a direct object in the (10b) use of the verb. If we were to think of the denotation of *siren* as determining

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6 Borer credits Clark and Clark (1979) for these examples.

a relation between the subject DP and the material that follows the verb, it would be difficult indeed to define that relation. There is a constant element of meaning that derives from *siren* in all of these sentences, but the details of the sirening is significantly determined by the non-verbal material in the VP.

What (10) illustrates is that a noun can be "used" as a verb without difficulty, and that the meaning it invokes is shaped by the syntactic context of the VP it heads. Roots were invented for this kind of thing.[7] They provide a way of finding a common core to the many kinds of words that seem to be related by virtue of their phonology and vague sense of meaning, but which aren't transparently related morphologically. *Structuring Sense* drives home that the contribution that roots make goes well beyond the neatly grammaticized cases that it had been confined to previously. They should be used to model neologisms as well. Borer's solution aims at this goal, but brings in many other particular ways in which, for instance, nominal and verbal uses of roots differ.

In this paper, I want to focus on the particular kind of issue that (10) illustrates. What I'll propose here doesn't carry through to the many other problems *Structuring Sense* engages, but my hope is that it's not inconsistent with the solutions offered there. The proposal is to take roots to be simple predicates – as in the neo-Davidsonian tradition – but leave them untyped. I will use the variable name "a" for things that don't belong to a semantic type, and the commonplace method of indicating a root with "$\sqrt{\ }$." The proposal, then, is that roots have denotations like those illustrated in (11).

(11)   a. $[\![\sqrt{\text{eat}}]\!] =_{\text{def}} \lambda a\ \text{EAT}(a){=}1$
        b. $[\![\sqrt{\text{walk}}]\!] =_{\text{def}} \lambda a\ \text{WALK}(a){=}1$
        c. $[\![\sqrt{\text{see}}]\!] =_{\text{def}} \lambda a\ \text{SEE}(a){=}1$
        d. $[\![\sqrt{\text{report}}]\!] =_{\text{def}} \lambda a\ \text{REPORT}(a){=}1$

Roots have semantic content on this view; they are descriptions. But those descriptions are nothing more than what one associates with what an eat, walk, see, or report is. The details of how those descriptions are used will be left to the meanings of the functional material that tie roots to their syntactic environment.

A key ingredient in enriching the bland descriptions of roots is typing them. Part of the process of enrichment is fixing the semantic type of the predicates. To illustrate, consider the meanings that *report* can have. In its verbal guise, it is a description of eventualities.

(12)   She reported the incident slowly.

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7 See Halle and Marantz (1993), Marantz (1997).

In its nominal guise it can be a description of eventualities too, as the meaning of the modifier *slow* indicates in (13).

(13)   The slow report (of the incident) took too long.

But it can also be a description of entities, as the meaning of *in hardcover* indicates in (14).

(14)   The report (of the incident) in hardcover was sent to the committee.

This isn't a possibility for *report* in its verbal guise.

(15)   * She [[reported the incident] in hardcover].

We need a theory of roots that allows their meaning to be independent of the kind of thing they describe. The kind of thing they describe should be determined by the morphosyntactic environment those roots are in. If roots are untyped descriptions of things, as in (11), then we can let the semantic contributions made by the material that surrounds a root fix the type of thing being described by the root. This is the way I'll think about the phenomena illustrated by (10).

There will be two semantic types of interest to us. One is the entity type, for which I will use the variable names x, y, z, and the other is the eventuality type, for which I will use the variable names $\epsilon, \epsilon', \epsilon''$. The need for two types traces back to understanding how to sort properties. Things of the entity type can have physical properties – color, weight, size, shape, for instance. Things of the eventuality type cannot. Things of the eventuality type can be individuated temporally, but things of the entity type cannot. Thus a walking eventuality is different from a stepping eventuality fundamentally by virtue of the time slice you take of a multi-step process. Entities cannot be individuated temporally in that way. I do not mean to take too seriously the distinction between eventualities and entities. There are plausible ways of thinking about individuating things that blur these lines. See, for instance, Schwarzschild (2008) for the idea that entities are merely kinds of eventualities, and Elliott (2017) and Kratzer (1990), for reasons to equivocate among entities, worlds and events. The vagueness inherent in individuating eventualities and entities is, I believe, a way of characterizing Borer's view of roots. The proposal I am going to pursue lets predicates like those associated with roots contribute to the criteria that individuate the lumps of stuff that entities and eventualities are. DP arguments and θ-roles will also make contributions, as we'll see. We can imagine that all there is to typing is finding those lumps of stuff that can be reasonably construed as having the properties that these predicates, jointly, require of it. But rather than talk in this vague way, I will talk as if lumps of stuff can be neatly individuated into entity and eventuality types.

Using variable names to indicate semantic types, then, *a* can be understood as either semantic type eventuality or semantic type entity. Thus, the denotation for the root of *eat* should be understood in the way (16) describes.

(16) λa EAT(a)=1 $\equiv$ λx EAT(x)=1 or $\lambda \epsilon$ EAT(ϵ)=1

Similarly for the denotation of every other root. To type a root amounts to choosing one of the two options for *a*. I suggest that the meaning of a θ-role pushes untyped descriptions, like those that roots have, towards the eventuality type. This is how I interpret the program laid out in Carlson (1984, 1998), who argues that θ-roles are responsible for individuating eventualities. Their method of individuating stuff, I suggest, invokes criteria that are more suitable for eventualities than entities. I'll assume that VPs in the sentential contexts that we will see them in must be predicates of eventualities because of the terms they semantically compose with. In a finite clause, for instance, a VP will syntactically compose with aspect, or perhaps tense, and these terms require – I submit – that their arguments be a predicate of eventualities. If we can find a way of ensuring that the semantic type of a VP derives from the semantic type of the root that heads it, this will cause the root to be a description of eventualities in its verbal context. The normal situation, then, is one where a root that heads the VP of a clause will coexist with θ-roles that help bring it to an eventuality-typed description.

I will adopt the commonplace view that eventualities and entities can have parts, and that those parts are organized in a mereology. I will assume that every part of something that is an entity type is also an entity type. But every part of something that is an eventuality type can be either an eventuality type or an entity type. This expresses the intuition that the entities involved in an event are part of that event.[8] This will play a role in how I express the relationship between entities and eventualities that θ-roles establish.

The other neo-Davidsonian part to a VP's meaning is a term that relates arguments – things of the semantic type entity – to the eventuality described by the root. These are θ-roles. As mentioned above, Carlson has the idea that θ-roles are responsible for individuating the eventualities described by verbs. In particular, he suggests that θ-roles do that by virtue of the description they provide of the role played by an argument.

> . . . thematic roles can be looked upon as functions which map individuals to sets of events – the events in which that individual participates in that particular way.
>
> (Carlson 1984, p. 268)

8 See Elbourne (2005) for a view like that I'm adopting.

9

I will interpret "participates in" to mean "is a part of," and I will fiddle a little with the way in which the function applies, but this is the role-model for my proposal. Concretely, then, the proposal is that θ-roles be that class of expressions which describe eventualities by virtue of the kinds of entities they contain. They will be functions from eventualities to entities, and will have the particular form in (17).

(17) $\lambda \epsilon \; \exists x \; [x < \epsilon \wedge \theta(x)]$

(17) holds of eventualities that contain an entity with the property denoted by θ. Like the more common view of Parsons (1990), and many others, this conceives of θ-roles as relations between eventualities and entities, but that relation will always be some form of containment (like the proper part relation, "$<$," in (17)) and the entity part will be individuated by virtue of the criteria associated with θ. This equips θ-roles with the ability to fix the semantic type of the root they combine with by virtue of the information they add to the description of that eventuality. Let's see how.

   If roots and θ-roles are of the same semantic type, they can compose by predicate modification.

(18)   Predicate Modification
       In γ, if $[\![\alpha]\!]$ is $\lambda a \; P(a) = 1$ and $[\![\beta]\!]$ is $\lambda b \; Q(b) = 1$, then when a and b are the same semantic type, $[\![\gamma]\!]$ can be $\lambda a \; [P(a) \wedge Q(a)] = 1$.
       $\alpha \quad \beta$

By way of illustration, consider how a patient θ-role and the root $\sqrt{eat}$ might compose.

(19) $\lambda \epsilon \; [\text{EAT}(\epsilon) \wedge \exists x \; [x < \epsilon \wedge \text{PATIENT}(x)]]$
       V

       $\lambda \epsilon \; \text{EAT}(\epsilon)$ $\lambda \epsilon \; \exists x \; [x < \epsilon \wedge \text{PATIENT}(x)]$
       V θ
       | |
       $\sqrt{eat}$ patient

Because predicate modification requires that the lumps of stuff that θ-roles and roots have in their domain be the same, then we can let the way that the θ-role individuates that stuff be responsible for typing the root. What a θ-role describes are lumps which have parts that that meet their criteria. For instance, theme requires that the entity have a lump which meets the criteria to be a theme. Suppose the criteria that THEME uses to individuate entities is "changes location as a fixed entity." The theme θ-role will therefore describe

lumps of stuff that have as a part a fixed entity changing location. Perhaps that is sufficient information about the lump of stuff that theme describes to type it as an eventuality. Entities, perhaps, cannot be individuated by virtue of having another location-changing entity within them. Eventualities, by contrast, can. To be a PATIENT might similarly require the lump of stuff that contains it to be eventive. In general, my suggestion is to operationalize Borer's program by seating it in the fuzzy ways that predicates individuate the lumps of stuff they apply to. More particularly, θ-roles combine a predicate that characterizes entities with a requirement that that entity be part of another lump of stuff. Together, these requirements type the domain of θ-roles as eventualities.

(19) illustrates how θ-roles might function to type the predicates that roots are. But it also illustrates how I propose to model an implicit internal argument. Implicit arguments arise when a root combines with a θ-role that existentially closes the argument part of that θ-role. This has the virtue of explaining why the existential quantifier that closes the θ-role cannot scope over anything else in the sentence, as Fodor and Fodor (1980) shows. Like many accounts of implicit arguments, see Bresnan (1982) for an early example, it does so by putting the existential quantification inside the denotation of the verb.

What remains is to understand how a θ-role can relate a phrase – an explicit argument – to the root. For this, I propose that any given θ-role has two versions. In addition to the "closed" version in (17), there is also an "open" version, whose form is (20).

(20) $\lambda\epsilon \ \lambda x \ [x < \epsilon \wedge \theta(x)]$

Just like (17), (20) is a description of eventualities that depends on the kinds of entities they contain. In this case, however, the identity of those entities will be supplied syntactically. We need to develop a syntax and semantics now that explains how open θ-roles combine with DPs.

The root $\sqrt{eat}$ is one of those verbs that can combine with an open version of patient. Unlike the closed version, an open version of patient cannot compose by predicate modification with $\sqrt{eat}$. (21) is ill-formed, as "$\wedge$" requires its two arguments to be able to have a truth value, and "$\lambda x[x < \epsilon \wedge \text{PATIENT}(x)]$" doesn't.

(21) $\lambda\epsilon\ [\text{EAT}(\epsilon) \wedge \lambda x\ [x < \epsilon \wedge \text{PATIENT}(x)]]$
                                    V

  $\lambda\epsilon\ \text{EAT}(\epsilon)$ $\lambda\epsilon\ \lambda x\ [x < \epsilon \wedge \text{PATIENT}(x)]$
         V θ
         | |
     $\sqrt{}$eat   patient

A closed θ-role, however, can compose with a definite description, pronoun, trace or other DP which informally has the characteristics of something of the entity type. I will suggest that these DPs do not, however, belong to the semantic type entity. Instead, they refer to entities that are in an eventuality. Formally, they are functions from eventualities to entities. This is what makes them capable of combining with an open θ-role.

To see why we might want to consider definite descriptions, and the like, to be functions from eventualities to entities, consider a sentence like (22).[9]

> Jack and Jill are neighbors. The town they live in sends a garbage truck around to collect trash once a week. Only garbage left at the curb, however, will be taken. Today is the day for trash pickup, and surprisingly...

(22)   Jack and Jill independently took the trashcan to the curb
       at precisely 6AM.

Definite descriptions like *the trashcan* have a uniqueness presupposition. They can refer only when there is a unique entity that meets their description. As a consequence, we expect this presupposition to require that a unique trashcan be the object of *take* in (22). But in fact, it is quite possible to understand the trashcan that Jack took to the curb to be different than the trashcan that Jill took to the curb. This is linked to the fact that it is quite possible to understand (22) to describe two taking eventualities: one with Jack as agent and another with Jill as agent. The uniqueness presupposition is satisfied for *the trashcan* if we consider only the entities in each of these independent events. Indeed, (22) does carry the presupposition that for each of the taking events, there is a unique trashcan; (22) is infelicitous if there is more than one trashcan at either Jack or Jill's home. We can capture this if we let *the trashcan* be a description of eventualities, each of which have a unique trashcan in them.[10]

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9 My thanks to Satoshi Tomioka for this example, and for leading me to the rule in (24).

10 Taking definite descriptions, and other entity-typed expressions, to be functions from eventualities to entities in this way is also suggested in Carlson (1984, pp. 265–66). He suggests that arguments of this type combine with the event-descriptions that verbs provide by pred-

(23)　⟦the trashcan⟧ $=_{\text{def.}}$ $\lambda\epsilon\ \iota x\ [\text{TRASHCAN}(x) \wedge x{<}\epsilon]$

the trashcan should be a term that refers to entities in some eventuality, thereby allowing its reference to change with those eventualities. Heim (1990) develops this idea about definite descriptions to capture certain facts about anaphora. See Elbourne (2005) for extensive discussion. Adopting the view that definite descriptions are relations between eventualities and entities is not *ad hoc.*

To compose the denotations of definite DPs and θ-roles, I will repurpose a rule of semantic composition used in intensional logic that allows for intensionalized functions to combine with intensionalized arguments by identifying the worlds that those functions and arguments belong to and then effecting function application. I'll call the rule "event-relativized function application."

(24)　Event-Relativized Function Application

　　Let s be the type for eventualities. For any types, a, b:

$$\underbrace{\llbracket\gamma\rrbracket}_{\substack{\alpha_{<s,<a,b>>} \qquad \beta_{<s,a>}}} = \lambda\epsilon\ \llbracket\alpha\rrbracket(\epsilon)(\llbracket\beta\rrbracket(\epsilon))$$

Event-Relativized Function Application expresses the idea that functions which are related to some eventuality can apply to arguments which are also related to that eventuality.[11]

(25) illustrates how this rule composes the patient θ-role with a definite description, here *the apple.*[12]

(25)　　　　$\lambda\epsilon\ [\iota x\ \text{APPLE}(x){<}\epsilon \wedge \text{PATIENT}(\iota x\ \text{APPLE}(x))]$
　　　　　　　　　　　　θP

$\lambda\epsilon\ \lambda x\ [x < \epsilon \wedge \text{PATIENT}(x)]$　　　$\lambda\epsilon\ \iota x\ [\text{APPLE}(x) \wedge x{<}\epsilon]$
　　　　　θ　　　　　　　　　　　　　　　　　DP
　　　　　|
　　　　patient　　　　　　　　　　　　　　the apple

icate modification. That won't fit my way of characterizing the difference between implicit and explicit arguments, and it doesn't provide a means of introducing the information that θ-roles contribute.

11 It seems likely to me that Event-Relativized Function Application should apply just in cases where the domain of the function, and the argument, are both part of the same eventuality. That is, we should constrain the rule so that not just any relation between the function/argument pair and an eventuality licenses it. Because definite descriptions and θ-roles do indeed put the entities they describe inside an eventuality, they would meet a restriction of this kind.

12 I've suppressed the term "$x < \epsilon$" in the ι expression as it does no work.

The patient θ-role has converted the DP it combines with to something that can now combine by predicate modification with the root.

(26) $\lambda\epsilon\ [\text{EAT}(\epsilon) \wedge \iota x\ \text{APPLE}(x){<}\epsilon \wedge \text{PATIENT}(\iota x\ \text{APPLE}(x))]$

VP

$\lambda\epsilon\ \text{EAT}(\epsilon)$ $\lambda\epsilon\ [\iota x\ \text{APPLE}(x){<}\epsilon \wedge \text{PATIENT}(\iota x\ \text{APPLE}(x))]$
V θP
|

$\sqrt{}$eat θ DP
|
patient   the apple
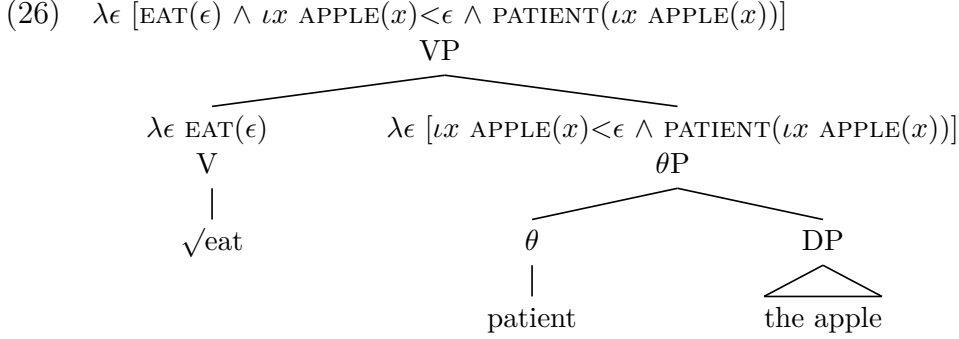
This is in general how I suggest θ-roles work when they have explicit arguments.

The recipe for θ-roles given here has several properties which I would like to frame as virtues. These properties can be appreciated by comparing the proposal here with the popular view that θ-roles express relations between eventualities and entities, as in (27).

(27) $\lambda\epsilon\ \lambda x\ \text{PATIENT}(\epsilon)(x)$

Nothing in (27) ensures that x will be a part of ϵ. The formulas for θ-roles in (17) and (20), by contrast, require the relation between an entity and an eventuality that a θ-role expresses to always be one of inclusion. This predicts that θ-roles like (28) won't arise.

(28) $\lambda\epsilon\ \lambda x\ \exists p\ \exists p'\ \exists c\ p = \{m\text{: location\_occupied\_by\_}\epsilon(m)\} \wedge p' = \{n\text{:}$
location_occupied_by_$x(n)\} \wedge \forall m \in p\ \exists n \in p'$
distance_between_$(m, n) = c$

What (28) tries to express is that each element in the set of locations that an eventuality occupies must be a constant distance, c, from a location in the set of locations that an entity occupies. Even less formally: the path that an eventuality traces out (i.e., p) must "follow" the path that an object traces out (i.e., p'). This might, for instance, be the kind of relation that *parallel to* expresses.[13]

(29)   Ayaka ran parallel to the Connecticut river.

---

13 There has to be more to the definition of the paths, p and p', than (28) provides if it is to capture the meaning of *parallel to*. The locations in the set that make a path must all be adjacent and organized in a linear way.

The run that (29) describes must trace a path that follows a path traced out by the Connecticut river – this is what the denotation in (28) approximates. Note that there is nothing in (28) that requires the path of the eventuality to be proximate to the path of the entity, and this seems correct for *parallel to*. The run described in (29) can happen in upstate New York, many miles from the course of the Connecticut river.

By contrast, if the path of the Connecticut river is related to the path of a running eventuality by a θ-role, as plausibly happens in (30), they must be proximate.

(30) Ayaka ran the Connecticut river.

The θ-role that (30) gives to *the Connecticut river* can't be the relation between eventualities and entities that (28) describes because it doesn't include the "part of" relation that θ-roles must on my proposal. It could be, however, if the entity that *the Connecticut river* refers to is part of the eventuality described by *run*, bringing it in line with the recipe for making a θ-role. This will force the paths of the running event and the Connecticut river to be within the same eventuality, however. I suggest that this is why (29) and (30) differ in this way. If Ayaka's run is in New York, then the θ-role that connects that run to the Connecticut river in (30) will require the running eventuality to include locations in New York as well as Massachusetts (where part of the Connecticut river resides). That's too large a location for a running eventuality, it seems. For this reason, (30) conveys the information that Ayaka's run is proximate to the location of the Connecticut river in a way that (29) doesn't. In general, then, the ingredient in my recipe for a θ-role will force an argument that bears a θ-role to be proximate to the eventuality described by the root. To the extent that this is a generalization about θ-roles, the proposal here captures it.

There are cases which threaten this proposal about how θ-roles should be constrained, and I'll look at two of them now. Suppose that the θ-role "stimulus" is responsible for connecting *the Y2K panic* in (31) to the eventuality described by *remember*.

(31) I remember the Y2K panic.

$[\![\text{stimulus}]\!] =_{\text{def}} \lambda\epsilon\ \lambda x\ [x < \epsilon \wedge \text{STIMULUS}(x)]$

The times at which the Y2K panic held and the times at which the remembering eventuality hold do not have to intersect. And yet, just like locations, if the entity referred to by *the Y2K panic* must be a part of the eventuality described by *remember*, then the temporal trace of *the Y2k panic* must be a part of the temporal trace of *remember*. My proposal requires that *the Y2K panic* is not an argument of the θ-role in (31).

I suggest that the resolution of the problem in (31) comes by way of movement. Movement allows a DP to be replaced by a variable that the DP binds. Thus, for instance, the syntax for (31) might involve Quantifier Raising which produces (32).

(32)

$$
\begin{array}{c}
\text{TP} \\
\swarrow \qquad \searrow \\
\text{DP} \qquad\qquad \text{TP} \\
\text{the Y2K panic} \qquad \lambda 2 \qquad \text{VP} \\
\lambda\epsilon\,[\textsc{remember}(\epsilon) \wedge t_2 < \epsilon \wedge \textsc{stimulus}(t_2)] \\
\lambda\epsilon\,\textsc{remember}(\epsilon) \qquad \lambda\epsilon\,[t_2 < \epsilon \wedge \textsc{stimulus}(t_2)] \\
\text{V} \qquad\qquad \theta\text{P} \\
\sqrt{}\text{remember} \qquad \theta \qquad t_2 \\
\text{stimulus}
\end{array}
$$
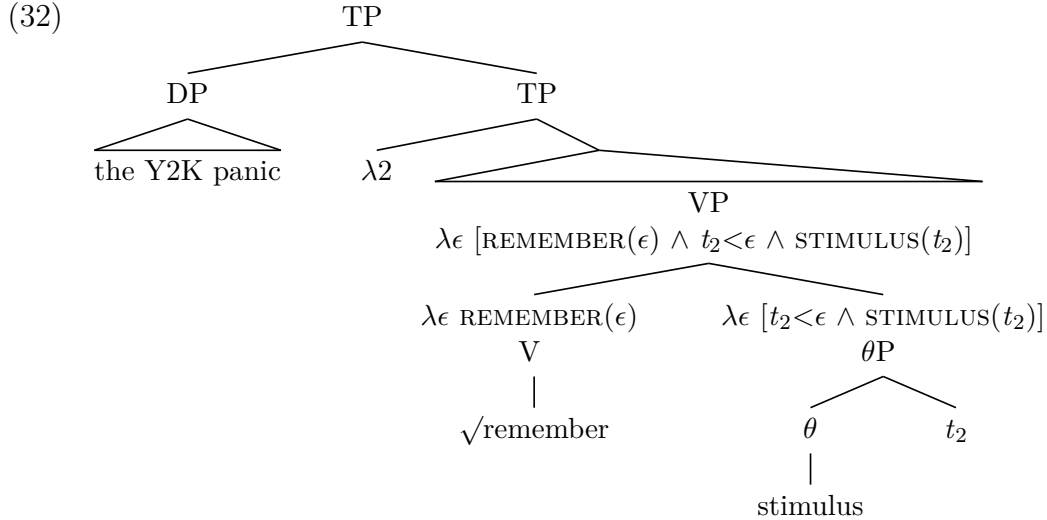
the Y2K panic can refer to something in (32) that happened wholly in past times relative to the times that the *remember* eventuality happens because *the Y2K panic* is strictly speaking not the argument of *remember*. Instead, the trace bound by *the Y2K panic* is. The stimulus θ-role requires that trace to be part of the *remember* eventuality, not the *Y2K panic*.[14] Some other putative counter-examples might find a solution with this method.[15]

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14 Obviously, then, unlike times, the locations of a trace and its binder cannot be independent, if the effect illustrated by (30) is to be captured.

15 For instance, clausal complementation, which can be made to bind a trace of the right type, as in Moulton (2009). This in general is also how open θ-roles relate quantificational DPs to the verbs they are arguments of. Quantificational DPs are not of a suitable type for Event-based Function Application. Note that traces must have the same semantic type as definite descriptions, on this view. Their meaning must be something like $\lambda\epsilon\,\iota x\,[x < \epsilon \wedge x = g(n)]$, where n is the index borne by the trace.

But one that doesn't, in my opinion, is (33).[16]

(33)   I want a better solution.

The object of *want* in (33) not only doesn't refer to an entity that is part of the want eventuality, it (sadly) doesn't even belong to the worlds that contain those wanting eventualities. These are counter-examples to my proposal if they involve θ-roles. I suggest they don't.[17]

If θ-roles are restricted to expressing relations that require the entity they characterize to be a part of the eventualities they describe, we thereby get an interesting, and perhaps correct, limit on the ways θ-roles can shape event descriptions, as (30) illustrates. I would like to allow, however, the part-of relation they impose to be able to vary as well. In my formula for closed and open θ-roles, that relation is simply the proper part of relation: "$<$." But as (22) illustrates, we want the entity referred to by an argument, in (22) it's *the trashcan*, to be able to be evaluated relative to the sub-events that make up the event description, in (22), that event description is *take*. Indeed some of the relationships that arguments have to the eventualities that roots describe can be modeled by giving them a part/whole relation different than "$<$." Krifka (1989, 1992, 1998) argues, for instance, that what Scha (1981) calls a cumulative reading for sentences like (34) can be captured by letting the parts of the plural arguments be related to the plural event described by the verb.[18]

(34)   The dogs accompanied the girls.

The cumulative reading of (34) is one in which the individual dogs and the individual girls all participated in the accompany-event, but the relation between any particular girl-dog pair is not necessary mediated by *accompany*. Krifka's proposal about how to capture this interpretation could be modeled in my recipe for θ-roles by making the part of relation that "$<$" presently stands in for more complex. In a similar way, Krifka suggests that the "measuring out"[19]

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16 I don't know what to think of relational verbs, like those in (i).

    i.   a. An introduction preceded the talk.
          b. When one "f" follows another "f," Minion Pro has a ligature.

Could the eventualities these verbs denote be states that include their two arguments? It's possible that relational verbs are also counter-examples my characterization of θ-roles. It's also possible that their meanings don't involve θ-roles.

17 See Larson, den Dikken, and Ludlow (2018) for evidence that cases like (33) don't involve θ-roles.

18 See also Schein (1993).

19 Tenny (1992).

property that the objects of certain verbs have on the event description can be modeled by framing the part/whole relationship between the object and the eventuality more narrowly. In (35), for instance, the eating eventuality's beginning and end is determined by the apples.

(35)   Ayaka ate the apples.

This could be captured by imposing a homomorphism on the sub-events of the eating and the parts of the plurality referred to by *the apples*. That homomorphism requires that each sub-event of eating contain a part of the apples, and each part of the apples be a part of a sub-event.[20] That's a stronger form of the simple $<$ relation in my recipe for a θ-role. Moreover, Krifka extends that idea to give an account of how properties of the arguments can determine the telicity of the event description. He does this by requiring that the part/whole relation of the material that makes up an argument fix the part/whole relation that makes up the eventualities described by verbs. We should let the "$<$" part of my recipe for a θ-role admit of a variety of different kinds of part-whole relations. This, I suggest, is another dimension along which θ-roles can vary. To the extent that Krifka's project is successful, it will also give a home for how θ-roles can influence the telicity of the events they describe.

One ingredient in my recipe for a θ-role is the $<$ relation, which causes the argument to be understood as a part of the eventuality being described. The other ingredient is a predicate that individuates that part; this ingredient is what the θ-role is named after. This ingredient provides a way of capturing what Carlson (1984) calls the uniqueness of θ-roles, and I'd like to construe that as evidence for the idea that θ-roles have this ingredient. The uniqueness of θ-roles can be demonstrated with the pair of sentences in (36). (The argument I report here is from Barry Schein.)

(36)   a. Ayaka and Toma carried the television.
       b. Toma carried the television.

Both of these sentences describe an event of carrying whose theme is *the television*. In (36a), the agent of that eventuality is a plural made up of Ayaka and Toma. This sentence is false if either one of Ayaka or Toma were not involved in the carrying eventuality as an agent. In (36b), the carrying-eventuality involves Toma as the agent. These sentences each, then, describe an eventuality of television carrying that involves Toma as agent. What needs to be understood is why (36a) and (36b) cannot be used to describe the same eventuality. (36b) suggests that Toma being the agent was sufficient for the television to be

20 See Krifka (1992, section 4).

18

carried, and that is inconsistent with the meaning conveyed by (36a). Carlson (1998) suggests deriving this effect by, first, taking the eventualities that roots describe to be singulars, and then by understanding the individuating properties that θ-roles provide to exhaustively individuate those singular eventualities. Thus, the agent θ-role completely determines the particular eventualities that the sentences in (36) describe, and because the agents are different, so also are the eventualities. Carlson (1984) suggests that this is also the root cause for the absence of verbs that assign the same θ-role twice.[21] He points out, for instance, that there are no verbs like *stouch* which describe eventualities in which the subject and object arguments are both touched.

(37)   John stouched Bill.   Carlson (1984, (10): 271)

Suppose we call the θ-role that is assigned to *John* and *Bill* by this verb "patient." If each θ-role completely individuates a singular eventuality, then the two patient θ-roles in (37), the reasoning goes, should have to individuate distinct eventualities, and this is at odds with the idea that roots, here $\sqrt{\text{stouch}}$, denote singular eventualities.

Krifka (1998, p. 10) points out that there are problems for this way of characterizing the uniqueness of θ-roles when verbs like *see* are considered. I'll use (38) to demonstrate the problem.[22]

(38)   Toma saw the entire train.

This can describe a situation in which Toma watches a two mile long train pass by. Imagine that there is no particular time during this event in which all of the train is visible to Toma. There is no time, then, at which "saw the entire train" is an event in which Toma participated. I suggest that (38) can be true because the sum of eventualities that make up the event described in (38) is an event that Toma participated in. Thus the eventuality in (38) is parallel to a plural nominal, like *Ayaka and Toma*, which can collectively be the subject of a verb like *gather* even though their parts cannot be. Carleton's way of capturing the uniqueness of θ-roles requires that plural eventualities

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21 Perfectly symmetric verbs are not allowed on this view. Thus, for example, verbs like *resemble*, which certainly seem to require that their object and subject arguments bear the same relation to the eventuality described, are possible counterexamples. Like the other relational verbs mentioned in footnote 16, these stative predicates are not as easy to characterize in terms of θ-roles.

22 Krifka suggests that the eventuality described by *see X* must be allowed to be composed of sub-eventualities of *see a part of X*. (38) is aimed at illustrating that property. Another way of getting at it is to consider (38) and *Toma saw each car of the train.* These can be used to describe the same eventuality, and yet, just like (36), the object θ-role relates a different object to each.

of this kind don't exist. There is, on his view, a one-to-one correspondence between θ-roles and eventualities. In (38), however, the θ-roles are necessarily related to a plurality of eventualities.

Framing θ-roles as terms that contain a predicate that holds of entities makes it possible to capture the uniqueness of θ-roles with the same techniques used to capture the uniqueness of definite descriptions. The uniqueness of definite descriptions is often-times captured by way of a maximality operator. Let's build into the denotation of θ-roles that maximality operator, as in (39).

(39) $[\![\text{stimulus}]\!] =_{\text{def}} \lambda\epsilon\lambda x \ [x < \epsilon \wedge \text{MAX-STIMULUS}(x)]$, *where*

$\text{MAX-STIMULUS}(a) = \text{STIMULUS}(a) \wedge \forall y < \epsilon \ [\text{STIMULUS}(y) \rightarrow y \leq a]$

The strengthened MAX-STIMULUS says that the entity it holds of contains all of the entities that are the stimulus of the eventuality. The argument of a stimulus θ-role must therefore refer to a thing that contains all of the things that are the stimulus parts of that eventuality. If it refers to a singular, then that singular, or its parts, must be the only entity that is the stimulus of the eventuality. If it refers to a plurality, then the singulars that make up that plurality must include everything that is the stimulus.

If *the entire train* bears the stimulus θ-role in (38), then the plural seeing event it describes tolerates the requirements of MAX-STIMULUS because the only thing seen is the train and its parts. For the same reason, the event described by (38) can also be described with *Toma saw each car of the train*, even though these two sentences have different stimulus θ-role bearers, because each car of the train is a part of the entire train, MAX-STIMULUS holds of both.

In this way Krifka's counter-examples to Carlson's method of deriving the uniqueness of θ-roles is avoided. But its correct effects are maintained: (37) is correctly blocked, and the sentences in (36) necessarily describe different events. (37) is blocked if the patient θ-role that subject and object bear are both maximized. This will require the things that the subject refers to to be a part of the thing that the object refers to, and also that the thing the object refers to to be a part of the thing the subject refers to. This is only possible if the subject and the object refer to the same individual, and that is blocked for independent reasons. This is what prevents the same θ-role from being assigned to more than one argument of a root. In (36b), maximizing the agent θ-role causes it to describe an eventuality in which Toma (or any of his parts) is the agent, but nothing else is. That is clearly different from the eventuality described by (36a), which describes an event whose agent is both Toma and Ayaka. If the predicate part of the meaning θ-roles have is always maximized in the way (39) describes, then the uniqueness of θ-roles is derived. I'll assume this to be the case from here out.

These are my reasons, then, for suggesting that the meanings of θ-roles have the ingredients in the recipes in (17) and (20). θ-roles are relations between eventualities and entities that, first, require the entity to be a part of the eventuality. This makes θ-roles impose a proximity requirement on the argument and the event description which (30) illustrates. It also plays a key role in capturing the effects that DPs related by θ-roles to an event description have on the structure of the event, as Krifka's work has explored. The second ingredient in my recipe for a θ-role is a predicate that individuates the entity within the eventuality. This predicate can be maximalized, and doing so captures Carlton's proposal that θ-roles are unique. Finally, these two ingredients can be used to type the event description, perhaps modeling the plasticity of roots that Borer's work has established. I propose that these recipes are the criteria by which we identify a θ-role.

I turn now to the syntactic conditions on θ-roles. θ-roles have a very constrained syntactic distribution, and so far as I can see, this has nothing to do with their denotations. Moreover, in English, I suggest, they are never morphologically expressed independently. A θ-role always seems to depend on the word chosen to express the root. Thus, for instance, the lexical item *eat* expones $\sqrt{eat}$, agent, and patient – all three parts. It is not possible to use the verb *eat* unless all three are present, and it is not possible for any of these parts to be present without using the verb *eat* (or another word that expones the θ-roles). The syntax I will use separates these three parts, and so the mapping between them and the lexical item that expones them is not trivial. I will say about the root and θ-roles that are tied to a lexical item in this way, that they "belong" to each other.

θ-roles must always combine with either the root that they belong to, or to one of the arguments that will be related to that root. Their sole role is to give the eventualities described by roots a characterization by way of the entities within those events. I don't know how to derive this, so I will stipulate it.

(40)   If a θ-role belongs to a root, then it must:
   a. be a syntactic part of the X° that expones that root, or
   b. be the head of a phrase whose complement expones an argument related to that root

This makes the morphosyntax of θ-roles rather like the relationship often thought to characterize Case and Agreement. The relations that Case/Agreement express are either marked with morphology on the head (parallel to (40a)) or on the Case-marked DP (parallel to (40b)). My hope is that the correct theory of Case/Agreement will explain (40).[23]

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23 This view of the syntax of θ-roles gives expression to Fillmore (1968)'s way of thinking of θ-roles as kin to Case.

(40) prevents monsters like *bleem* in (41).

(41)   the bleem took an hour, *where*
$[\![\text{bleem}]\!] =_{\text{def.}} \lambda\epsilon \; \exists x \; [x < \epsilon \wedge \text{MAX-THEME}(x)]$

   compare:

(42)   the discussion took an hour, *where*
$[\![\text{discussion}]\!] =_{\text{def.}} \lambda\epsilon \; \exists x \; [\text{DISCUSS}(\epsilon) \wedge x < \epsilon \wedge \text{MAX-THEME}(x)]$

The denotation of *discussion* results from composing $\sqrt{\text{discuss}}$ with the THEME θ-role it belongs to. The denotation of *bleem* is what that theme θ-role would mean without a root. The theme θ-role in (42) is part of the verb that expones its root, and therefore satisfies (40). That same θ-role is not part of a verb that expones its root in (41), however, nor is it merged with a DP that is related to its root. This is why it is ungrammatical: it violates (40).

Roots have a morphological independence that θ-roles don't. When a root is typed so that it holds of entities, it can exist without the θ-roles that belong to it. This is what we see with the noun *report* in (43).

(43)   Because I read the report, I know that it doesn't report anything.

Note that the fact that (43) isn't anomalous shows that there is no internal θ-role associated with the noun *report*. This isn't what θ-roles can do. Typing *bleem* so that it holds of entities would not improve (41). θ-roles exist only when the roots they belong to do, and (40) describes where syntactically those θ-roles can be relative to their roots. It is this independence of roots that allows them to show up as different kinds of words.

The morphosyntactic choices that (40) offers a θ-role correlate with its semantic type. If a θ-role appears merged with a DP, it must be open. A closed θ-role in this syntactic position will not have a coherent way of semantically combining with the DP it merges with.[24] Closed θ-roles are only allowed to show up as part of the verb that expones the root. This is the heart of the reason external θ-roles cannot have implicit arguments, as we'll see in the next section.

2 External Theta roles

Suppose the agent θ-role has the open and closed denotations in (44).

(44)   a. $\lambda\epsilon \; \lambda x \; [x < \epsilon \wedge \text{MAX-AGENT}(x)]$
       b. $\lambda\epsilon \; \exists x \; [x < \epsilon \wedge \text{MAX-AGENT}(x)]$

---

24 In particular, Event-relativized Function Application and Predicate Modification cannot apply.

This is a θ-role that belongs to $\sqrt{\text{run}}$, and it is deployed externally in (45).

(45) The dog ran to the park.

I believe it's this same θ-role that is deployed internally in (46).

(46) Ayaka ran the dog to the park.

This is another case of a particular θ-role being deployed externally or internally. Like the psych-predicates in (7), these examples teach us that being a particular θ-role does not determine whether it will be external or internal. In this case, we see that both possibilities can arise even with the same root.

The alternation between (45) and (46) can be derived with (47).

(47)   a. $\sqrt{\text{run}}$ must have exactly one external θ-role.
       b. the θ-role *Ayaka* bears cannot be internal.

When there is only one θ-role at play, then that θ-role must be deployed externally. When there are two θ-roles at play, then the one that doesn't belong to $\sqrt{\text{run}}$ – the θ-role borne by *Ayaka* – must be deployed externally. (47b) follows from the syntax and semantics of θ-roles developed in the previous section. I'll demonstrate how in a moment. What needs to be added to this system is (47a).

To be external means to be assigned to a position outside of the VP headed by $\sqrt{\text{run}}$. It is a wholly syntactic property. A syntactic way of saying (47a) is (48).

(48) The VP headed by $\sqrt{\text{run}}$ must combine with a term, X, that relates that VP to a θ-role.

(48) requires that the VP headed by $\sqrt{\text{run}}$ find itself in the XP described in (49).

(49)

```
                XP
          ┌─────┴─────┐
         θP          XP
                ┌─────┴─────┐
                X          VP
                            │
                            V
                            │
                          √run
```
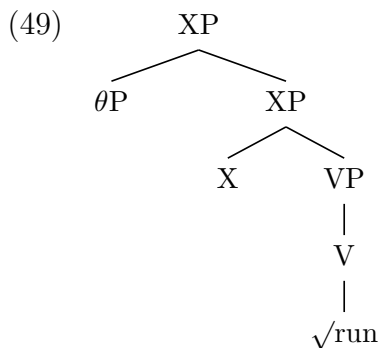
Let's see how the system of θ-roles described in the previous section plays out in (49).

Suppose the only three ingredients of XP are the root, the agent θ-role, and X. The semantic contribution that X makes is minimal. I suggest (50).

(50) $[\![X]\!] = \lambda P\ \lambda Q\ \lambda\epsilon\ [P(\epsilon) \wedge\ Q(\epsilon)]$

The two arguments of X will be predicates of eventualities; and $[\![X]\!]$ merely makes them predicates of the same eventuality. Consider first what would happen if we choose to put a closed version of the agent θ-role into the θP position. We'd get (51).

(51)

$$\lambda\epsilon\ [\text{RUN}(\epsilon) \wedge \exists x\ x < \epsilon \wedge \text{MAX-AGENT}(x)]$$
XP

$\lambda\epsilon\ \exists x\ [x < \epsilon \wedge \text{MAX-AGENT}(x)]$ $\lambda Q\ \lambda\epsilon\ [\text{RUN}(\epsilon) \wedge Q(\epsilon)]$
θP   XP

agent $\lambda P\ \lambda Q\ \lambda\epsilon\ [P(\epsilon) \wedge\ Q(\epsilon)]$ $\lambda\epsilon\ \text{RUN}(\epsilon)$
X   VP

V

$\sqrt{}$run

This is ungrammatical, but semantically well-formed. This is an example of an external θ-role having an implicit argument. XP's meaning describes eventualities that are runnings and have an implicit agent. What blocks (51) is the syntactic condition on θ-roles in (40). (51) is a case where a closed θ-role is acting as an argument on its own. It is the same kaiju we encountered in (41). (40) prevents it by insisting that a θ-role syntactically combine with either the root it belongs to or an argument that it relates to that root. The agent θ-role in (51) has done neither of these things. For this reason, if the agent θ-role is to occupy the θP position, it must be the open version of agent:

(52)

$$\lambda\epsilon \; [\textrm{RUN}(\epsilon) \land \iota x \; \textrm{DOG}(x){<}\epsilon \land \textrm{MAX-AGENT}(\iota x\textrm{DOG}(x))]$$

XP

$\lambda\epsilon \; [\iota x \; \textrm{DOG}(x){<}\epsilon \land \textrm{MAX-AGENT}(\iota x \; \textrm{DOG}(x))]$
θP

θ DP
|
agent   the dog

$\lambda Q \; \lambda\epsilon \; [\textrm{RUN}(\epsilon) \land Q(\epsilon)]$
XP

$\lambda P \; \lambda Q \; \lambda\epsilon \; [P(\epsilon) \land Q(\epsilon)]$
X

$\lambda\epsilon \; \textrm{RUN}(\epsilon)$
VP
|
V
|
$\sqrt{}$run
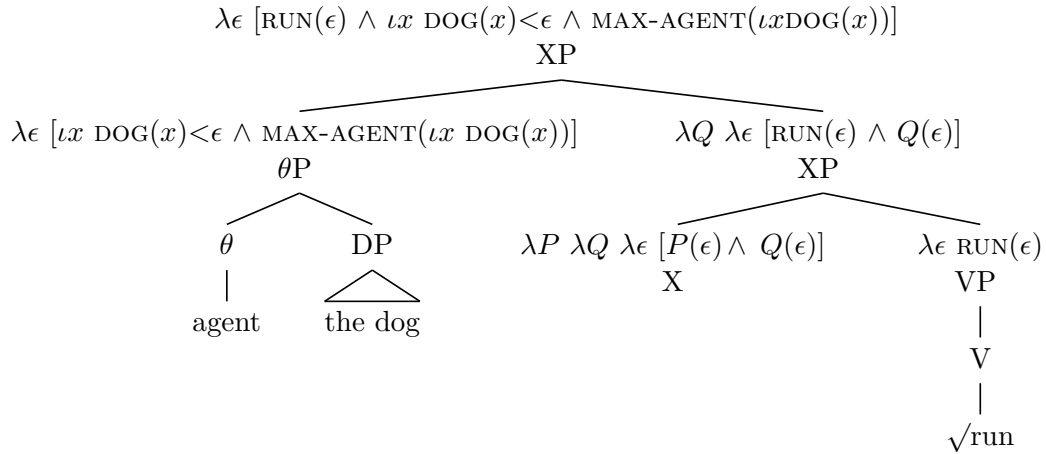
This is the solution I suggest for the problem laid out in the introduction. External θ-roles are defined as those θ-roles that X relates to the VP that contains their root. Because an external θ-role is an argument of X, it cannot syntactically combine with its root, and this prevents closed θ-roles in this position. The only option is an open θ-role, and these necessarily have explicit arguments. The syntactic conditions on θ-roles – they must be either within an argument DP or within the verb that expones their root – intersects with their possible denotations to permit only open θ-roles in external position.

Of the tasks set out in the introduction, the one that is left is to account for how passive allows an external θ-role to become implicit. Before doing that, it will be useful to consider how the system here accounts for the other expression of $\sqrt{}$*run*: its transitive guise in (46).

(46)   Ayaka ran the dog to the park.

I'll pursue the well-worn idea that (46) has a causative in it. In particular, the causative in (46) is what Pylkkänen (2000, 2008) calls "root selecting." This is one of the few cases in English where a root selecting causative can combine with a VP headed by an unergative predicate. A more common situation is one in which the causative combines with a root that has just an internal θ-role, as with *bounce* or *melt*. I'll assume, that the causative morpheme comes with an agent θ-role. This is what Pylkkänen calls a "bundling" of cause and agent. If the PP *to the park* is ignored, the syntax is (53).

25

(53)

$$\lambda\epsilon\ [\exists\epsilon'\ [\textsc{run}(\epsilon') \land \iota x\ \textsc{dog}(x)<\epsilon' \land \textsc{max-agent}(\iota x\ \textsc{dog}(x)) \land \epsilon\ \text{causes}\ \epsilon' \land [\![\text{Ayaka}]\!]<\epsilon \land \textsc{max-agent}([\![\text{Ayaka}]\!])]$$

XP

$\lambda\epsilon\ [[\![\text{Ayaka}]\!]<\epsilon \land \textsc{agent}([\![\text{Ayaka}]\!])]$
θP

$\qquad\theta\qquad$ DP

$\qquad$ agent $\qquad$ Ayaka

$\lambda Q\lambda\epsilon\ [\exists\epsilon'\ [\textsc{run}(\epsilon') \land \iota x\ \textsc{dog}(x)<\epsilon' \land$
$\textsc{max-agent}(\iota x\ \textsc{dog}(x)) \land \epsilon\ \text{causes}\ \epsilon' \land Q(\epsilon)]$
XP

X $\qquad$ $\lambda\epsilon\exists\epsilon'\ [\textsc{run}(\epsilon') \land \iota x\ \textsc{dog}(x)<\epsilon' \land$
$\textsc{max-agent}(\iota x\ \textsc{dog}(x)) \land \epsilon\ \text{causes}\ \epsilon']$
CauseP

$\lambda P\lambda\epsilon\exists\epsilon'\ [P(\epsilon') \land \epsilon\ \text{causes}\ \epsilon']$

cause

$\lambda\epsilon\ [\textsc{run}(\epsilon) \land \iota x\ \textsc{dog}(x)<\epsilon \land$
$\textsc{max-agent}(\iota x\ \textsc{dog}(x))]$
VP

V $\qquad$ θP

$\sqrt{}$run $\quad\theta\qquad$ DP
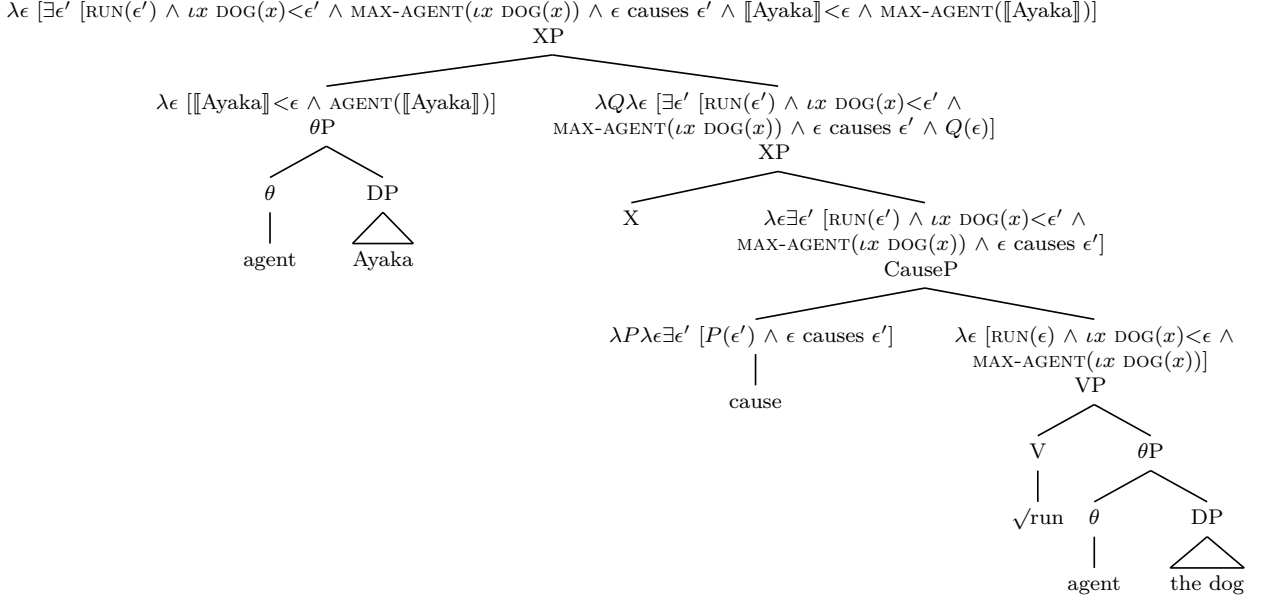
$\qquad$ agent $\qquad$ the dog

The denotation of XP is a description of eventualities that have Ayaka as their agent and which cause eventualities of running that have the dog as their agent. Note that because there are two eventualities here – the cause eventuality and the run eventuality – the uniqueness condition on θ-roles is met for each agent θ-role. Ayaka can be the sole agent of the causing eventuality, and the dog can be the sole agent of the run eventuality.[25] The reason these two agent θ-roles are correctly matched with the eventualities that they are agents for is entirely because of their syntactic position. The semantics we have developed will require that the agent attached to *the dog* be combined with $\sqrt{}$*run*. The denotation assigned to X will require that the agent θ-role on *Ayaka* combine with cause. X cannot be lower than it is in (53); for instance, it cannot have the position indicated in (54) again because of the semantics.

25 This is problematic, though. It requires that there be a way of individuating events for the purposes of evaluating the maximality operator that separates the causing eventuality from the resulting eventuality. Kratzer (2005) argues that direct causation, of the kind that (53) illustrates, should put these two eventualities together into a larger eventuality.

(54)

```
              CauseP
             /      \
         cause       XP
                    /    \
                  θP      XP
                 /\      /    \
              Ayaka   X        VP
                             /    \
                            V      θP
                            |      /\
                          √run   the dog
```
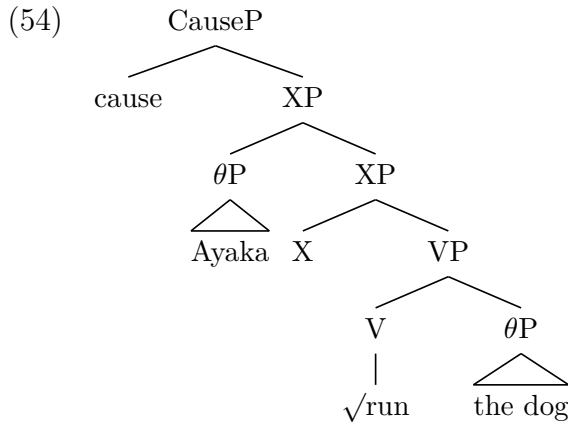
The problem with (54) is the uniqueness of θ-roles. The semantics will require the eventuality described by $\sqrt{run}$ in (54) to have both *Ayaka* and *the dog* as agents in (54), and this is blocked by the maximality operator on θ-roles.

(47a), repeated here, corresponds to the idea that X obligatorily coöccurs with √run.
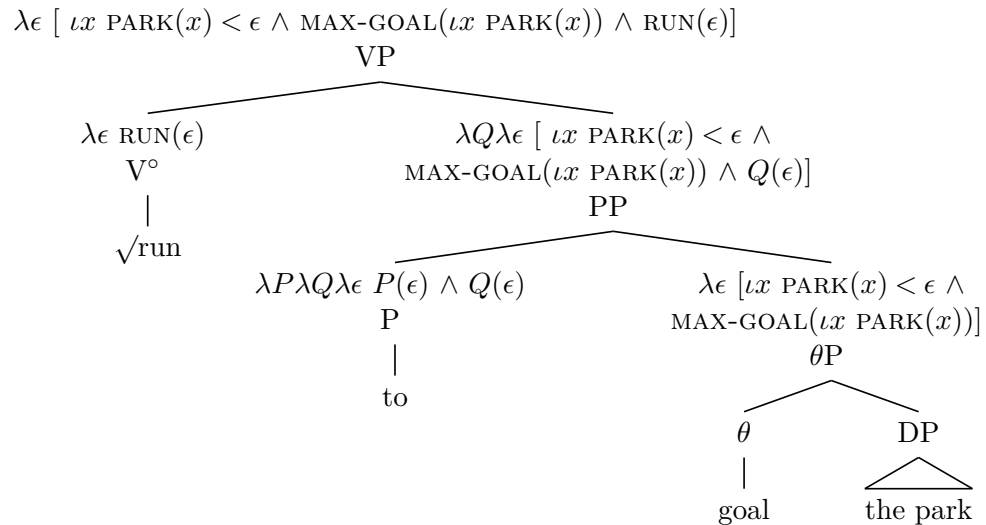
(47a)   √run must have exactly one external θ-role.

I suggest, then, that X is like a θ-role in that it can belong to a root. Whether the inventory of θ-roles a root belongs to includes one that is external depends, on this view, on whether X also belongs to that root. Transitives and unergatives come with X, and unaccusatives don't. Because $\sqrt{run}$ comes with X, it will have to be deployed in the position shown in (53) when there is cause. Otherwise it will combine with the VP headed by $\sqrt{run}$ directly (as in (58)). This gives a complete account, then, of the two ways of expressing *run* in (45) and (46).

One of the two popular ways of deriving Burzio's generalization is to link the presence of an external θ-role to the presence of structural (accusative) Case. Burzio's generalization expresses the fact that if a DP argument gets structural case by virtue of being in proximity to a verb, then that verb has an external θ-role. On the model here, it is X that is responsible for making a θ-role external. We should conclude that X assigns structural (accusative) Case.

Consider what X might be. It is a term that relates an argument DP to a projection of a verb, and it can assign structural Case. This is also a description of what a preposition can be. The preposition *to* in (55), for instance, could be seen as a term that relates the root to the θ-marked DP it assigns accusative Case to.

(55)

$\lambda\epsilon\,[\,\iota x\ \text{PARK}(x) < \epsilon \wedge \text{MAX-GOAL}(\iota x\ \text{PARK}(x)) \wedge \text{RUN}(\epsilon)]$
VP

$\lambda\epsilon\ \text{RUN}(\epsilon)$
V°
|
$\sqrt{\text{run}}$

$\lambda Q\lambda\epsilon\,[\,\iota x\ \text{PARK}(x) < \epsilon \wedge$
$\text{MAX-GOAL}(\iota x\ \text{PARK}(x)) \wedge Q(\epsilon)]$
PP

$\lambda P\lambda Q\lambda\epsilon\ P(\epsilon) \wedge Q(\epsilon)$
P
|
to

$\lambda\epsilon\,[\iota x\ \text{PARK}(x) < \epsilon \wedge$
$\text{MAX-GOAL}(\iota x\ \text{PARK}(x))]$
θP

θ
|
goal

DP

the park

If prepositions like *to* have the semantic type I've assigned to X, as is indicated in (55), the fact that prepositions cannot have implicit arguments is accounted for. Expressions like (56) are ungrammatical.

(56)   a.   * The dog ran to.
       b.   * Ayaka spoke about.
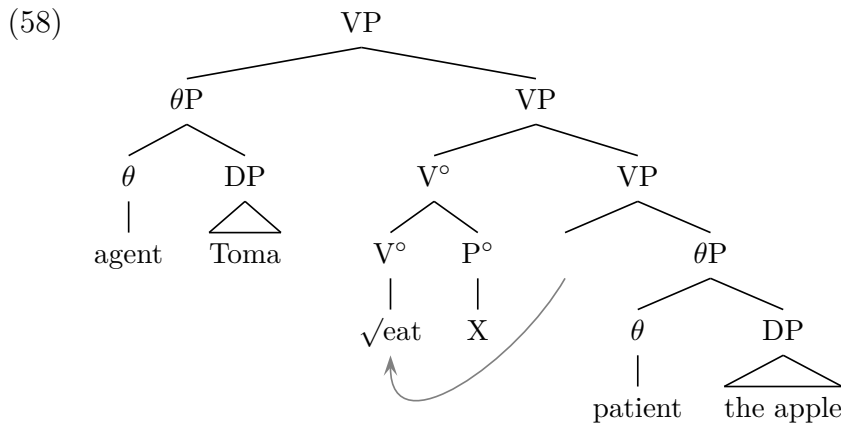   c.   * Toma stood on.
       d.   * Ayaka pined for.

Because closed θ-roles can appear only within the verb that expones that θ-role's root, the complements of prepositions are positions blocked for closed θ-roles. Prepositions, like X, can only combine with θPs that host the open θ-role that belongs to the root. X has a close resemblance to certain prepositions, then.

Two differences between X and prepositions are their syntactic position relative to the root and their overtness. X is not matched to an independent lexical item, and prepositions (typically) are. Prepositions, unlike X, relate θP arguments that are within the VP to the root. I believe these two properties can be tied together. Let me describe how.

Suppose that X and (some) prepositions are the same class of terms. Let me call those terms "θ-linkers." Arguably, both types of θ-linkers – prepositions and X – are tied to roots in the same way that θ-roles are. Like θ-roles, I'll say that θ-linkers belong to roots. Like θ-roles, I suggest that θ-linkers are subject to syntactic constraints that sharply limit their positions. Those constraints are (57).

(57)   If a θ-linker belongs to a root, then it must:
   a.   be a part of the X° that expones that root, or
   b.   be the head of a phrase whose complement has a θP related to that root.

This explains why X is silent. Its syntactic position is not the one described by (57b). But it can have the position that (57a) describes. Because X c-commands the V° containing the root, Head Movement can create a syntax in which X is part of a head that expones the root. (58) illustrates.

(58)

```
                            VP
                  _____
                 /                        \
               θP                          VP
          _____                    _____
         /      \                  /              \
        θ       DP               V°                VP
        |       /\         _____            _____
      agent   Toma        /      \          /           \
                         V°      P°                      θP
                         |       |                   _____
                       √eat      X                  /         \
                                                    θ          DP
                                                    |          /\
                                                 patient   the apple
```

The explanation for why X is not an independent word, then, is that this is inconsistent with it being part of the lexical item that expones the root. This leaves prepositions as the only instances of θ-linkers that can be independent words. Why they appear to necessarily be independent words is not derived from my syntax.

The parse in (58) expresses the idea that X is just another kind of preposition – one of those that are related to roots in the way that θ-linkers are. The claim, then, is that prepositions can take as complements something that is not the DP they Case-mark. In this respect, my proposal is the same as the proposals in Kayne (2004) and Kayne (2000, chapter 14), which argue that prepositions in Romance can syntactically combine with clause or VP like constituents, but nonetheless be related to DPs they Case-mark. It may be that the preposition which X is is the thing often called "voice."

And this brings us to the passive. The suggestion I've sketched above is that X is a preposition that combines first with a verbal projection and then with a θ-marked DP. This is a syntactic property of X. Its semantics is always just the same as the semantics of any other θ-linker: it's a relation between two predicates of eventualities which causes both predicates to describe the

same eventuality. But X orders how those arguments combine so that the VP combines with it first and the DP combines with it second. The two syntactic properties about X in (59) follow from this.

(59)   When X selects a VP as its first argument:

   a.   X must be silent (Head Movement puts X within the head that expones the root)

   b.   X cannot Case-mark the DP it combines with, but can Case-mark another DP that it c-commands.

The arrangement of terms in (58) reveals why. Because X combines with VP first, it c-commands both the head of that VP and the DP within it. As we've seen, because X c-commands the head of VP, Head Movement can combine them, allowing X to be expressed by the same word that expones the root. Because X c-commands the object DP, it can assign Case to that DP. Because X does not c-command the DP that it semantically combines with – the DP in its Specifier position – that DP will not get the Case that X assigns.

  I suggest that what the passive does is simply reverse the order in which X combines with its arguments, and this requires a syntax that prevents it from having the two properties in (59).

(60)   Passive makes X combine first with its θ-marked argument.

A syntax that honors (60) is (61).

(61)
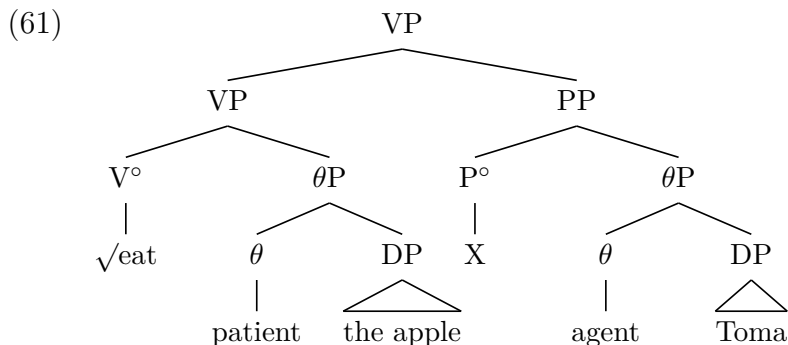
X now c-commands the agent DP, but not the patient DP. For this reason, the agent DP, but not the patient DP, will be Case marked. This derives the fact that in the Passive, a DP argument internal to the VP must find Case from some other source. In (61), X does not c-command the verb in the way that it did in the active syntax of (58). For that reason, X cannot be exponed by the same word that expresses the root. In English, it is instead exponed by the preposition *by.*

What I have just presented is in its essentials the analysis that Collins (2005) offers for the passive. Collins suggests that the word *by* is how voice is pronounced in the passive. If we equate the X with voice, then we have arrived at the heart of Collins' theory of the passive. I've merely developed a semantics for the pieces of Collins' account.

That semantics interacts with the morphosyntax in a way that now allows the external θ-role to be implicit. An implicit argument arises when a closed θ-role occurs. Closed θ-roles are required by their morphosyntax to be exponed by the word that expresses the root they belong to. X can also be exponed by the word that expresses the root X belongs to. When X is not forced to syntactically combine with a VP, both of these conditions can be met with the syntax in (62).

(62)

$\lambda\epsilon$ EAT$(\epsilon) \wedge \exists x\ [x < \epsilon \wedge$ MAX-AGENT$(x)] \wedge \iota x$ APPLE$(x) < \epsilon \wedge$ MAX-PATIENT$(\iota x$ APPLE$(x))$
VP

$\lambda\epsilon$ EAT$(\epsilon) \wedge \exists x\ [x < \epsilon \wedge$ MAX-AGENT$(x)]$ $\lambda\epsilon\ [\iota x$ APPLE$(x) < \epsilon \wedge$ MAX-PATIENT$(\iota x$ APPLE$(x))]$
V° θP

$\lambda\epsilon$ EAT(ϵ) $\lambda Q\lambda\epsilon\ [\exists x\ [x < \epsilon \wedge$ MAX-AGENT$(x) \wedge Q(\epsilon)]$ the apple
V   P
|
$\sqrt{}$eat   P $\lambda\epsilon\exists x\ [x < \epsilon \wedge$ MAX-AGENT$(x)]$
                       | θ
                       X |
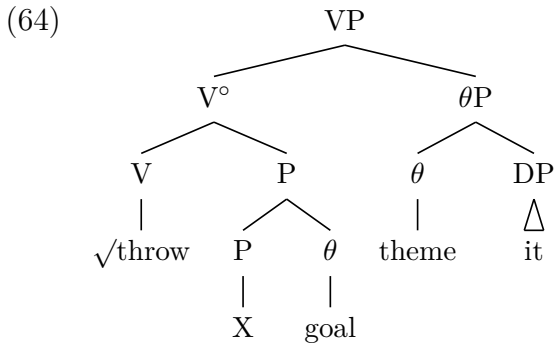   agent
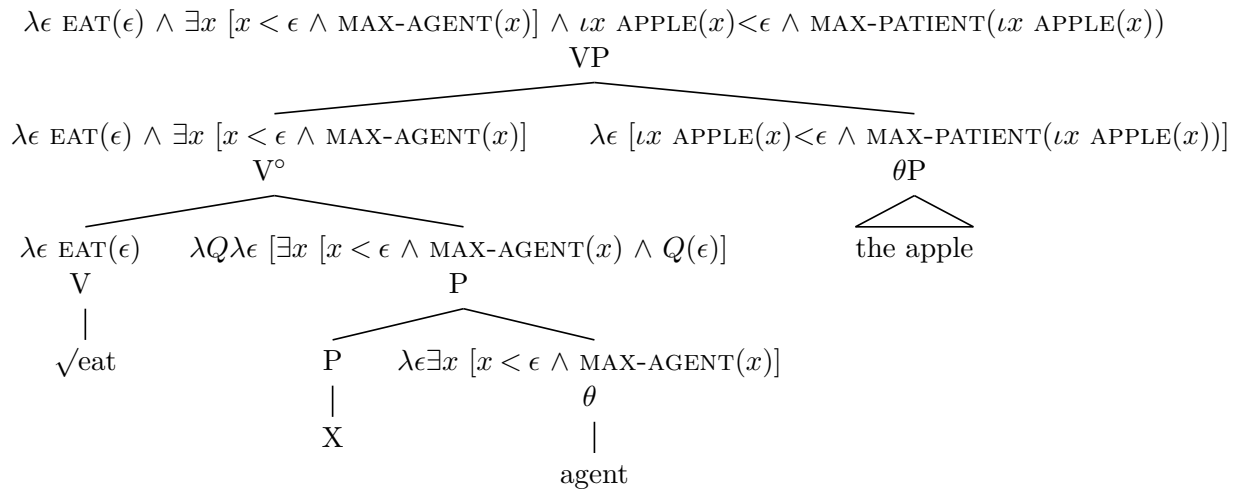
The meaning derived for this VP is the right one: it describes eating eventualities that have *the apple* as its patient and for which there is some agent. The V° can be expressed with the passive participle, *eaten*, and in this way both X and the agent θ-role meet their morphosyntactic requirements. They are both exponed by the same word that expresses the root they belong to.

The proposal, then, is that in the Passive, the term that relates an external θ-role to the root has become internal. There are two ways of expressing that term. It can head its own phrase, as in (61), in which case it is pronounced as *by*. Or it can be expressed with the same word that expresses the root, as in (62). These two expressions necessarily correlate with the open and closed versions of the external θ-role. Because both kinds of θ-roles are possible, so also are the explicit and implicit methods of expressing the arguments.

That prepositions can sometimes be expressed by the verb that expones the root has been used to account for certain argument structure alternations. Some examples of its utility in modeling the *spray/load* alternation, for instance, are in Wilson (2021), Damonte (2005), Brinkmann (1995), and Wunderlich (1991). The proposal here is that the same is true for the passive *by*: its optionality, and the concomitant implicitness of its argument, are tied to how it is morphologically expressed. This account can be extended to how indirect objects can be implicit more generally. They are implicit just when the preposition that would normally introduce them is no longer overt. On the proposal here, that arises because those prepositions can be exponed by being part of the verb. Thus, for instance, the implicit goal in (63) has a syntax like (64).

(63)   Ayaka threw the ball (#but she didn't throw it anywhere.)

(64)

```
                          VP
              ┌───────────┴───────────┐
             V°                       θP
        ┌─────┴─────┐            ┌─────┴─────┐
        V           P            θ           DP
        |        ┌──┴──┐         |           △
     √throw      P     θ       theme         it
                 |     |
                 X    goal
```

The proposal here, then, is that the implicit subject of a passive verb has the same syntax that allows indirect objects to be implicit.

3 Summary

I've combined several ingredients from the literature to give an account of where implicit arguments can be found in the verbal domain. My hope is that this account can be extended into the much more complex cases involving nominals, and the harder to diagnose situations involving adjectives. Those ingredients are, first, Greg Carlson's ideas about what θ-roles are. I've sketched how those ideas might be able to be embedded in Hagit Borer's *Structuring Sense* framework. I've proposed that θ-roles have the morphosyntax that governs Case/Agreement morphology. That limits their syntactic positions to just DP arguments or the roots that those DPs are arguments of. I've then tied that syntax to particular ways of expressing θ-roles so that it explains why implicit arguments (i.e., closed θ-roles) are not found as arguments of prepositions, but are found as internal arguments of verbs. I've then suggested that

it is a preposition which makes some θ-roles external, and this explains why those external θ-roles cannot be implicit. Finally, I've adopted Chris Collins' idea that the passive allows this preposition to be pronounced as *by*, and be positioned within the VP. In essence, then, the passive allows an external θ-role to be expressed internally, and this lets in the possibility that the external θ-role can be implicit.

Stepping back, the proposals I've made about θ-roles makes them very similar to definite DPs. I've adopted the view here that definite DPs are descriptions of entities that are parts of eventualities. Those descriptions are used to refer to the entities. My treatment of θ-roles is parallel. They too are descriptions of entities that are parts of eventualities. I've argued that, like definite descriptions, θ-roles use maximalized predicates to individuate the entities they refer to. The picture here then resembles in some respects that of Hale and Keyser (2002), who countenance a process by which objects and roots incorporate to form a verb. Moreover, the basic mode of composition between a verb and its object in this paper is not function application, as in many standard semantics, but predicate modification. This makes the way verbs standardly combine with objects closer to the special cases of pseudo-incorporation and weak indefinites,[26] holding the promise of a better understanding of why these cases arise.

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26 See Dayal (2011) and Chung and Ladusaw (2004), for examples.

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