The Linking of Event Structure and Grammatical Functions in Finnish

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1 Introduction

In recent years, syntactic research has to a growing extent recognized that the mapping between syntactic and semantic arguments is sensitive to event structure (e.g. Tenny 1987, 1994, Grimshaw 1990, Ritter and Rosen 1993, Filip 1996, Li 1995). At the same time, semanticists have observed that many semantic phenomena can be accounted for by event-based theories of logical forms, such as Parsons (1990). What is typical of the syntactic theories is that they do not generally rely on a carefully articulated semantics. Similarly, Parsons (1990), only gives a sketchy account of how his semantic representations might relate to syntax. In this paper I attempt to examine this relationship more seriously. I show how combining an event-based semantic theory, such as Parsons (1990), with a mono-stratal syntactic theory, such as Lexical Functional Grammar (LFG), gives us a straightforward account of the relationship between semantic roles and syntactic arguments. The data I examine are Finnish causative constructions. Their complicated linking patterns are fully accounted for by the new proposal, while they pose problems for theories which rely on a more superficial analysis of event-structure.

2 Parsons (1990) and Finnish Causatives

Parsons theory is "neo-davidsonian", which means that it follows Davidson (1967) in representing events as arguments in logical forms, but departs from it by separating event participants and the semantic roles they bear to the eventuality from the main predicate. For Parsons, thematic roles are relations between individuals and eventualities and are added to the main predicate by conjunction.

What is especially relevant for the purposes of this paper is Parsons' treatment of verbs with causative meanings. According to Parsons, causative predicates involve existential quantification over two causally related eventualities. This approach is now generally called the *bieventive* approach, and it is motivated by various ambiguities associated with causatives. For instance, the following Finnish sentence, like its English translation, is ambiguous between the readings in (a) and (b). In Parsons framework the ambiguity is captured as in (1') and (1'').

(1) Kerttu lennä-ttä- ä leija-a museo- n takana.
Kerttu.NOM fly- CAUS-3SG kite-PAR[1] museum-GEN behind
'Kerttu flies the kite behind the museum'
a. What Kerttu does happens behind the museum (but the kite doesn't necessarily fly there).
b. The kite flies behind the museum (but Kerttu is not necessarily there).

(1') (∃e)[**Agent**(e,Kerttu) & **Theme**(e, kite) & **Behind**(e,Museum) & (∃e')[**Flying**(e') & **Theme**(e',kite) & **CAUSE**(e,e')]]

(1'') (∃e)[**Agent**(e,Kerttu) & **Theme**(e, kite) & (∃e')[**Flying**(e') & **Theme**(e',kite) & **Behind**(e',Museum) & **CAUSE**(e,e')]]

In Finnish, if the input to causativization is intransitive, the causative morpheme *-tta* can be reiterated. This has the effect of introducing yet another argument slot. If Parsons's theory is correct, we would expect these double causatives to denote three eventualities. Scope phenomena provide evidence that this is, indeed, the case. The following example, for instance, has three interpretations.

(2) Ministeri juoksu-t-utti sihteeri- llä lähetti-ä koko päivä-n.
minister.NOM run-CAUS-CAUS.PAST secreterary-INSTR messenger-PAR whole day

[1] In Finnish, partitive is an object case, along with accusative. The accusative case is used to indicate that the event is telic, while the partitive can be considered the default.

'The minister had the secretary have the messenger run on errands all day long'

One interpretation is that the minister, all day long, kept asking the secretary to have the messenger run on errands as represented in (2'). The second interpretations is that the minister told the secretary what s/he needs only once, after which the secretary, all day long, kept asking the messenger to run on errands (2''). Finally, it is possible that both what the minister did and what the secretary did happened only once, with the result that the messenger had to run on errands all day long (2''').

(2') (∃e)[**Agent**(e, Minister) & **Theme**(e, Secretary) & **AllDay**(e) & (∃e')[**Agent**(e', Secretary) & **Theme**(e', Messenger) & (∃e'')[**Run**(e'') & **Agent**(e'', Messenger) & **CAUSE**(e,e') & **CAUSE**(e',e'')]]]

(2'') (∃e)[**Agent**(e, Minister) & **Theme**(e, Secretary) & (∃e')[**Agent**(e', Secretary) & **Theme**(e', Messenger) & **AllDay**(e') & (∃e'')[**Run**(e'') & **Agent**(e'', Messenger) & **CAUSE**(e,e') & **CAUSE**(e',e'')]]]

(2'') (∃e)[**Agent**(e, Minister) & **Theme**(e, Secretary) & (∃e')[**Agent**(e', Secretary) & **Theme**(e', Messenger) & (∃e'')[**Run**(e'') & **Agent**(e'', Messenger) & **AllDay**(e') & **CAUSE**(e,e') & **CAUSE**(e',e'')]]]

Another significant set of data in favor of the event argument has to do with entailments. For instance, our semantic theory has to account for the fact that in the following (3c) entails both (3a) and (3b), whereas (3b) entails (3a) but not (3c), while (3a) entails neither (3b) nor (3c):

(3) a. Koira kävele-e.
dog-NOM walk-3GS
'The dog walks'

b. Kalle kävel-yttä-ä koira-a.
Kalle-NOM walk-CAUS-3SG dog-PAR
'Kalle walks the dog'

c. Maija kävel-yt-yttä-ä koira-a Kalle-lla.
Maija-NOM walk-CAUS-3SG dog-PAR
'Maija causes Kalle to walk the dog'

A bieventive analysis accounts for these fairly complicated relations in an intuitive way:

(3a') (∃e)[**Walking**(e) & **Agent**(e,Dog)]
(3b') (∃e)[**Agent**(e,Kalle) & **Theme**(e,Dog) & (∃e')[**Walking**(e') & **Agent**(e',Dog) & **CAUSE**(e,e')]]
(3c') (∃e)[**Agent**(e,Maija) & **Theme**(e,Kalle) & (∃e')[**Agent**(e',Kalle) & **Theme**(e',Dog) & (∃e'')[**Walking**(e'') & **Agent**(e'',Dog) & **CAUSE**(e,e') & **CAUSE**(e',e'')]]]

Unlike in many other languages, in Finnish causativization is not restricted to intransitive verbs. Transitive and ditransitive verbs causativize, as well. Below I list the main causative types in Finnish with their grammatical functions (GFs) and neo-davidsonian logical forms.

Causativized Intransitives

(4) SUBJ OBJ
Matti kävel-yttä-ä koira-a.
Matti.NOM walk-CAUS-3SG dog-PAR
'Matti walks the dog'

(4') (∃e)[**Agent**(e,Matti) & **Theme**(e, Dog) & (∃e')[**Walk**(e') & **Agent**(e',Dog) & **CAUSE**(e,e')]]

Doubly Causativized Intransitives

(5) SUBJ OBJ OBL
Kaisa kävel-yt- yttä- ä koira-a Mati- lla.
Kaisa-NOM walk-CAUS1- CAUS2-3sg dog-PAR Matti-INSTR
'Kaisa causes Matti to walk the dog'

(5') (∃e)[**Agent**(e,Kaisa) & **Theme**(e, Matti) & (∃e')[**Agent**(e',Matti) & **Theme**(e',Dog) & (∃e'')[**Walk**(e'') & **Agent**(e'',Dog) & **CAUSE**(e,e') & **CAUSE**(e',e'')]]]

Causativized Monotransitives

(6) SUBJ OBJ OBL
Kalle rakenn-utta- a talo- n Peka-lla.
Kalle-NOM build- CAUS1-3SG house-ACC Pekka-INSTR
'Kalle has Pekka build a house'

(6') (∃e)[**Agent**(e,Kalle) & **Theme**(e, Pekka) & (∃e')[**Build**(e') & **Agent**(e',Pekka) & **Theme**(e',house) & **CAUSE**(e,e')]]

Causativized Ditransitives

SUBJ OBJ OBJ_{Goal} OBL
(7) Kaisa pistä-tti pulla- t uuni-in Peka-lla.
Kaisa-NOM put-CAUS1 buns-ACC oven-ILL Pekka-INSTR
'Kaisa had Pekka put the buns in the oven'

(7') (∃e)[**Agent**(e,Kaisa) & **Theme**(e, Pekka) & (∃e')[**Put**(e') & **Agent**(e',Pekka) & **Theme**(e',buns) & **Goal**(e', oven) & **CAUSE**(e,e')]]

Psychological Causatives

SUBJ OBJ
(8) Matti inho-tta-a Mikko-a.
Matti disgust-CAUS-3SG Mikko-PAR
'Matti disgusts Mikko'

(8') (∃s)[**Perceived**(s,Matti) & **Perceiver**(s, Mikko) & (∃s')[**FindDisgusting**(s') & **Experiencer**(s', Mikko) & **Stimulus**(s',Matti) & **CAUSE**(s,s')]][2]

The Finnish data show that Parsons' theory has considerable crosslinguistic appeal. However, representations such as the ones above raise non-trivial questions about the mapping between syntax and semantics. Traditionally, the relationship between syntactic and semantic arguments has been considered one-to-one. Well-formedness constraints such as the Function-argument biuniqueness (Bresnan and

[2] For elaboration on this logical form, see Pylkkänen (1997b) and section 5 of this paper.

Kanerva 1989) and the Theta Criterion reflect this. However, if we adopt a bieventive treament of causatives, this generalization can no longer hold. In (4), for instance, three event participants are expressed by two GFs and in (5) five event participants are realized with three GFs. Thus, in an event-based linking theory many event participants can be linked to the same GF, provided that the participants are coreferential, but not vice versa. The main question that complex predicates such as the ones in (4)-(8) pose is how do we define exactly when GFs must be shared and when they cannot be shared. In section (4) I attempt to answer this question. But first I want to show how some previous approaches fail to account for these Finnish data and why a new theory is needed.

3 Problems with Previous Approaches

The reason why most previous theories run into trouble with the Finnish data is that they do not rely on a sufficiently fine-grained semantics. For example, with the double causative below, all the participants are Agents of some event. For linking purposes, it is crucial to know exactly what relations each participant bears to which events. Theories which are not event-based are not able to draw these distinctions.

(9) Opettaja laula-t- utta- a oppila- sta kuoronjohtaja-lla.
teacher.NOM sing-CAUS-CAUS-3SG student-PAR choirleader- INSTR
'The teacher causes the choirleader to cause the student to sing'

(9') (∃e)[**Agent**(e,teacher) & **Theme**(e, choirleader) & (∃e')[**Agent**(e',choirleader) & **Theme**(e',student) & (∃e'')[**Sing**(e'') & **Agent**(e'',student) & **CAUSE**(e,e') & **CAUSE**(e',e'')]]]

Most recent linking theories either rely on Dowty's (1991) thematic proto-roles (e.g. Zaenen 1993, Filip 1996) or an additional semantic role Cause (Grimshaw 1990, Pesetsky 1995, Li 1995). Below I briefly review both the proto-role approach and Grimshaw 1990, which I take to be representative of the approaches that rely on the semantic role Cause.

3.1 Proto-Role Approaches

Dowty (1988, 1991) develops a theory of argument selection where the linking between syntactic and semantic arguments is determined not by a hierarchical organization of discrete thmatic roles, but by the number of so-called proto-role entailments that the event participants have. Dowty identifies the following contributing properties of the agent and patient proto roles:

Agent properties: (a) volition, (b) sentience (and/or) perception (counts only when no volition because volition implies sentience), (c) causes event, (d) movement, (e) referent exists independent of action of the verb

Patient properties: (a) change of state, (b) incremental theme, (c) causally affected by the event, (d) stationary (relative to movement of proto-agent), (e) referent may not exist independent of the action, or may not exist at all

Dowty proposes that "the argument of a predicate having the greatest number of proto-agent properties entailed by the meaning of the predicate will... be lexicalized as the subject of the predicate, the argument having the greatest number of the proto-patient properties will... be lexicalized as the direct object of the predicate". Let us now consider this proposal in light of Finnish. Consider the double causative again.

(10) SUBJ OBJ OBL

Kaisa kävel-yt- yttä- ä koira-a Mati- lla.
Kaisa-NOM walk-CAUS1- CAUS2-3sg dog-PAR Matti-INSTR
'Kaisa causes Matti to walk the dog'

Here 'Kaisa' has the proto-agent properties (a) 'volition', (c) 'causes event' and (e) 'referent exists independent of action of the verb'. She does not have the property (d) 'movement', since (10) is interpreted as implying that Kaisa causes Matti to walk the dog by instructing him to do so.[3] 'Matti' has all the same properties as 'Kaisa' with the addition of 'movement', since he moves alongside with the dog. Finally, *koira* 'dog' has the properties (b) 'sentience and/or perception', (d) 'movement' and (e) 'referent exists independent of action of the verb'. As regards patient-properties, 'Kaisa' has none, and 'Matti' and the dog both have (c) 'causally affected by the event' and perhaps (a) 'change of state', as is summarized below:

(11)	*Kaisa*	*koira* 'dog'	*Matti*
	agent: a, c, e	agent: d, e, b	agent: a, c, d, e
	patient: none	patient: c, a(?)	patient: c, a(?)

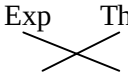
According to this approach, 'Matti' should surface as the subject, which clearly is wrong. The fact that 'Matti' has movement while 'Kaisa' doesn't is not enough to make 'Matti' eligible for subjecthood. Thus, whatever it is that makes 'Kaisa' the subject instead of 'Matti' is not captured in the proto-role approach. The problem has to do with the fact that the proto-role properties do not distinguish between participants that cause one event from participants that cause two or more events. Thus, a more detailed analysis of event structure is needed.

3.2 Grimshaw (1990)

Grimshaw (1990) is one attempt to incorporate aspectual information into a linking theory. Grimshaw proposes that linking is determined by two independent hierarchies, the thematic hierarchy and the so-called aspectual dimension.

(12)	Thematic Hierarchy:	(Agent(Experiencer(Goal/Source/Location/(Theme))))
	Aspectual Dimension:	(Cause(other(. . .)))

The idea is that if an argument gets assigned the role Cause, it is always realized as the external argument. Grimshaw suggests that since these two dimensions are independent, we should not be surprised if for some verbs they are misaligned, i.e. the most prominent role on the thematic hierarchy is not assigned to the same argument as the most prominent role of the aspectual dimension. According to her, this is the case with verbs such as *frighten* which realize their Theme, and not their Experiencer, as the subject, in violation of the thematic hierarchy.

(13) a. The building frightened the tourists.
b. *frighten*(x (y))
Exp Theme

Cause ... (Grimshaw 1990:25)

[3] This has to do with a so-called "curative" implicature associated with certain Finnish causative constructions. See Pylkkänen (1997a) for details.

In Grimshaw's theory, the argument flip of these psychological verbs results from the aspectual dimension overriding the thematic one. Thus, 'the building' surfaces as the subject even though it is not the most prominent argument on the thematic hierarchy. The fact that it is Cause is more important.

I believe that the underlying idea behind Grimshaw's theory is the same as in the proposal that I present in section 4. I, too, propose that linking is dependent on two independent hierarchies, one of which looks at thematic roles and the other at event structure. However, I believe that there are better ways to formalize this basic idea than along the lines that Grimshaw proposes.

First of all, ideally we would not have to introduce more semantic roles, since we already have such a hard time defining the old ones. For instance, as Grimshaw herself acknowledges, there is no principled way to assign the role Cause to 'the building' in (13a) but not, for example, in *The tourists feared the building*. Thus, there is a fundamental problem with the definition of Cause.

Second, Grimshaw's theory assumes that a verb can only have one argument for which the role Cause can be assigned. This, however, is not the case with double causatives. In (14a), where we have a singly causativized unergative verb, 'Matti' would surely be assigned the role Cause. Since the double causative in (14b) entails (14a), this assignment would also have to hold for (14b). But since in (14b) it is Kaisa that causes Matti to walk the dog, 'Kaisa' would also have be a Cause. But how do we then know which one becomes the subject?

(14) a. Matti kävel-yttä-ä koira-a.
Matti.NOM walk-CAUS-3SG dog-PAR
'Matti walks the dog'

b. Kaisa kävel-yt- yttä- ä koira-a Mati- lla.
Kaisa-NOM walk-CAUS1- CAUS2-3sg dog-PAR Matti-INSTR
'Kaisa causes Matti to walk the dog'

Obviously, we need to pay even closer attention to event structure. This is what I attempt in the section below.

4 Outlines of an Event-Based Linking Theory

In what follows, I outline a theory about the relationship between event participants and grammatical functions which minimizes reference to the properties (such as Agent, Goal or Cause) of event participants and instead refers to the events themselves. The main generalization to be captured is that if an eventuality E1 causes another eventuality E2, the participants of E1 always rank higher than the participants of E2. The theory is minimalistic in another way, as well. Namely, I show that after we infer prominence relations in the right way, intermediate levels between event structure and grammatical functions, such as argument structure, are no longer needed.

4.1 Inferring prominence

The core of my proposal is a new way to infer prominence from lexical semantic representations. The approach relies crucially on two central assumptions of Parsons (1990): (1) that thematic roles are relations between events and individuals and (2) that causation is a relation between events. The first assumption means that thematic relations only exist at the level of a single event. Consequently, the thematic hierarchy applies at the level of individual events and not at the level of the predicate. Thus, a predicate has as many thematic hierarchies as it has events.

To organize all the participants into a prominence hierarchy we need to rank the individual thematic hierarchies with respect to each other. I assume that this ranking is based on the second assumption, i.e. on

the causal relations between the events. More specifically, I propose that if E1 CAUSES E2, then the thematic hierachy of E1 ($E1_{\theta H}$) is ranked higher than the thematic hierachy of E2 ($E2_{\theta H}$). I refer to this as the *event hierarchy*. The event hierarchy allows us to reduce the thematic hierarchy to only three levels. This is because the thematic hierarchy is now restricted to individual events, and those can only have up to three participants (ditransitives). Thus, prominence is determined by the following two hierarchies:

(15) *Thematic Hierachy* Agent/Experiencer > Other > Theme
(16) *Event Hierarchy* CAUSE(E1,E2) → $E1_{\theta H}$ > $E2_{\theta H}$

The task of the linking constraints is then to determine the mapping between the prominence hierarchy and the grammatical function hierarchy.

(17) *GF Hierarchy* SUBJ > OBJ > OBJ_{θ} > OBL

In the linking constraints, I refer to grammatical functions with the variables GF_i, GF_j and so forth. Thus, a statement such as

(18) $GF_i > GF_j$

reads 'GF_i is more prominent than GF_j'.

In order to use unification in the linking constraints, I translate Parsons' logical forms into feature structures. The representation in (20') exemplifies an event structure with ranked participants (all information irrelvent to linking has been omitted):

(19) Matti kävel-yttä-ä koira-a
Matti.NOM walk-caus-3SG dog-PAR
'Matti walks the dog'

(20')

```
F-STR=      [ SUBJ=[ PRED= matti ]
              [      [ CASE= nom  ]
              [ OBJ= [ PRED= dog  ]
              [      [ CASE= par  ]

EVENTSTR=   [ E1=  [ θ_RELS=    [ AGENT=[ IND= matti ] ] ]
              [    [              [      [ RANK= 1    ] ]
              [    [              [ THEME=[ IND= dog  ] ]
              [    [              [      [ RANK= 2    ] ]
              [
              [ E2=  [ θ_RELS=    [ AGENT=[ IND= dog  ] ] ]
              [      [              [      [ RANK= 3    ] ]
              [      [ SEM_TYPE= Walk
              [
              [ REL= CAUSE(E1,E2)
```

Here IND stands for 'index', a pointer to an event participant, and RANK for the prominence of that participant. Thus, in this example, the participant with rank 1 is realized as the subject and the participants with the ranks 2 and 3 as the object. In what follows I try to explain why this is so.

4.2 Uniqueness

As already noted in section 2, in an event-based linking theory the relationship between event participants and GFs is not one-to-one. More than one event participant may be linked to the same GF. This possibility,

however, seems only to be available for two participants which participate in different eventualities. It is not available for monoeventive verbs, as the following illustrates.

(21)	a.	*Mari pesi. Mari-NOM wash 'Mary washed herself'		b.	Mari pesi itsen-sä. Mari-NOM wash herself-ACC 'Mary washed herself'

Thus, we could revise Bresnan and Kanerva's (1989) biuniqueness condition "in every lexical form, every expressed lexical role must have a unique syntactic function, and every syntactic function must have a unique lexical role" (Bresnan and Kanerva 1989:28) as in (22) (formalized in (23)).

(22) Uniqueness:
(i) For all eventualities E_n in a lexical representation L, every participant of E_n must have a unique syntactic function.
(ii) No two syntactic functions can be linked to any one event participant of L.

(23) UNIQUENESS:[4]
A lexical representation subsumed by either of the following feature structures is ill-formed:

$$\begin{bmatrix} \text{F-STR}= [GF_i= [PRED= \boxed{1}]] \\ \text{EVENTSTR}= \begin{bmatrix} E_n= [\theta\text{_RELS}= [\theta_1= [IND= \boxed{1}]] \\ E_n= [\theta\text{_RELS}= [\theta_2= [IND= \boxed{1}]] \end{bmatrix} \end{bmatrix}$$

if $\theta_1 \neq \theta_2$.

$$\begin{bmatrix} \text{F-STR}= \begin{bmatrix} GF_i= [PRED= \boxed{1}] \\ GF_j= [PRED= \boxed{1}] \end{bmatrix} \\ \text{EVENTSTR}= [E_n= [\theta\text{_RELS}= [\theta_1= [IND= \boxed{1}]]] \end{bmatrix}$$

if $i \neq j$.

Uniqueness tells us when linking two participants to the same GF is prohibited. Now I turn to a constraint which tells us when it is obligatory.

4.3 Identity
With verbs that denote multiple events, some event participants are always linked to the same GF. With the prominence system developed in section 4.1 it is easy to define which ones. The right generalization seems to be that if E1 causes E2, the lowest participant of E1 and the highest participant of E2 are always linked to the same GF. This is especially apparent with trieventive causatives, as (24) illustrates.

(24) 'The mother had the nurse feed the child'
mother-NOM eat-CAUS1-CAUS2Past **child**-ACC **nurse**-INSTR
Äiti syö-tä- tti **lapse**- n **hoitaja**-lla

(∃e)[Agent(e,**M**)&Theme(e,**N**)&(∃e')[Agent(e',**N**)&Theme(e',**C**)&(∃e'')[Agent(e'',**C**) & Eating(e'') & CAUSE(e,e') & CAUSE(e',e'')]]]

[4] Uniqueness, as stated in (23), is somewhat language particular. For instance, it does not account for the possibility of (i) and the impossibility of (ii) in English: (i) Mary bathed (=Mary bathed herself), (ii) *Mary saw. (≠Mary saw herself).

Identity can be formally stated as in (25).

(25) IDENTITY:

$$\begin{bmatrix} \text{F-STR}= & [\text{GF}_k= & [\text{PRED}=\boxed{1}\ ]]] \\ \text{EVENTSTR}= & \begin{bmatrix} E_i= & [\theta\text{_RELS}= & [\theta_1= & [\text{IND}=\boxed{1} \\ & & & \text{RANK}=n] \end{bmatrix} \\ & E_j= & [\theta\text{_RELS}= & [\theta_2= & [\text{IND}=\boxed{1} \\ & & & \text{RANK}=n+1] \end{bmatrix} \\ & \text{REL}= & \text{CAUSE}(E_i,E_j) \end{bmatrix} \end{bmatrix}$$

where $i \neq j$.

Identity can, of course, only be satisfied if the participants on both sides of the event boundary are identical. In Pylkkänen (1997) I argue that this is, in fact, a general semantic constraint on causativity in natural language; well-formed causative constructions must always have a unification at their event boundaries. I call this *event coherence*.[5]

(26) EVENT COHERENCE:

$$\begin{bmatrix} \text{EVENTSTR}= & \begin{bmatrix} E_i= & [\theta\text{_RELS}= & [\theta_1= & [\text{IND}=\boxed{1} \\ & & & \text{RANK}=n] \end{bmatrix} \\ & E_j= & [\theta\text{_RELS}= & [\theta_2= & [\text{IND}=\boxed{1} \\ & & & \text{RANK}=n+1] \end{bmatrix} \\ & \text{REL}= & \text{CAUSE}(E_i,E_j) \end{bmatrix} \end{bmatrix}$$

where $i \neq j$.

In the section below, I turn to examine our final linking constraint, Participant-GF Isomorphy.

4.4 Participant-GF Isomorphy

In demonstrating how Participant-GF Isomorphy works, I will use the shorthand in (27') for feature structures. (27') shows how linking is carried out for noncausative monotransitive verbs. The integer following the thematic role label stands for the rank of the participant indicated in the subscipt. The lines between the participants and GFs stand for unifications.

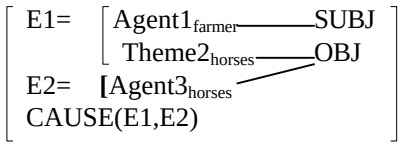
(27) John ate an apple.

(27') $\begin{bmatrix} \text{E1}= & \begin{bmatrix} \text{Agent1}_{\text{john}} & \text{——SUBJ} \\ \text{Theme2}_{\text{apple}} & \text{——OBJ} \end{bmatrix} \end{bmatrix}$

The intuitive idea behind the Participant-GF Isomorphy is simple. The most prominent participant unifies with the highest GF and the least prominent with the object function, which is the second most prominent GF. Participants which are neither most nor least prominent are then realized as either OBJ_θ or OBL. But several details must be taken into account in formalizing this. First of all, we must make sure that all linkings respect Uniqueness and Identity. For example, in (28'), $\text{Theme2}_{\text{horses}}$ is not realized as an oblique or as an indirect object even though it is at the middle of the prominence hierarchy. This is because such as linking would result in a violation of Identity.

(28) Isäntä syö-tti hevose-t.
farmer.NOM eat-CAUS horses-ACC
'The farmer fed the horses'

[5] Pustejovsky (1995) formalizes roughly the same idea in his Default Causative Paradigm.

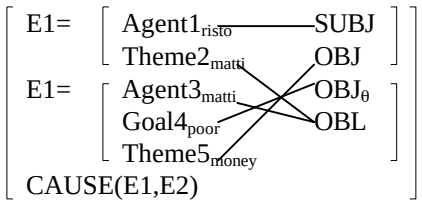
(28') 

Thus, the Participant-GF Isomorphy is only satisfied to the extent that it is possible without violating Uniqueness or Identity.[6]

Another issue to be considered is unaccusativity. While this is not an attempt to develop a theory about it, I do wish my proposal to be extendable into one. The existence of unaccusative verbs is essentially the reason why we cannot say that the highest event participant always unifies with the function SUBJ, because presumably the sole argument of unaccusative verbs is not linked to this function. This assumption differs from Bresnan and Kanerva (1989) who, based on evidence in Chichewa, do believe that unaccusative verbs are specified for the subject function. For the purposes of this paper, I will assume that in their lexical entry unaccusative verbs are only specified for the function OBJ. Thus, Participant-GF Isomorphy links the highest event participant to the highest available GF, which for unaccusative verbs is OBJ. This assumption, however, will not become relevant until the Appendix, where the linking of two types of Finnish unaccusatives is layed out.

Before formalizing Participant-GF Isomorphy, we need to say something specific about the linking of participants to the functions OBJ_θ and OBL. Consider the following causativized ditransitive, where both of these functions are present.

(29) Risto lahjoit- utti Mati- lla raha- t köyhi-lle.
Risto.NOM donate-CAUS Matti-INSTR money-ACC poor-ALL
Risto had Matti donate the money to the poor'

(29') 

Although the above linking seems complicated, the prominence system developed in this paper makes it fairly easy to predict. In order to formalize the generalization we, however, need to assume that after a GF or an event participant has been fully linked (i.e. linked so that Uniqueness and Identity are satisfied) it no longer "counts" with respect to the prominence or GF hierarchies. With this assumption we can state the Participant-GF Isomorphy as two ordered constraints.

(30) Participant-GF Isomorphy:
1. The most prominent participant unifies with the highest available GF.
2. The least prominent participant unifies with the highest available GF reiteratively.

Participant-GF Isomorphy together with Uniqueness and Identity gives us the right linking for ditransitive causatives. This can be shown step-by step. Since we are not dealing with an unaccusative verb, we first link the most prominent participant to SUBJ.

[6] Thus, the analysis has an apparent optimality character. Here I will, however, not attempt to formalize it in that framework.

Step1
E1= Agent1$_{risto}$ — SUBJ
Theme2$_{matti}$ OBJ
E1= Agent3$_{matti}$ OBJ$_\theta$
Goal4$_{poor}$ OBL
Theme5$_{money}$
CAUSE(E1,E2)

Then we reiteratively apply the second part of the isomorphy and link the least prominent participant to the highest available GF, until we come to an event boundary.

Step2
E1= Agent1$_{risto}$ — SUBJ
Theme2$_{matti}$ OBJ
E1= Agent3$_{matti}$ OBJ$_\theta$
Goal4$_{poor}$ OBL
Theme5$_{money}$
CAUSE(E1,E2)

Step3
E1= Agent1$_{risto}$ — SUBJ
Theme2$_{matti}$ OBJ
E1= Agent3$_{matti}$ OBJ$_\theta$
Goal4$_{poor}$ OBL
Theme5$_{money}$
CAUSE(E1,E2)

Step4
E1= Agent1$_{risto}$ — SUBJ
Theme2$_{matti}$ OBJ
E1= Agent3$_{matti}$ OBJ$_\theta$
Goal4$_{poor}$ OBL
Theme5$_{money}$
CAUSE(E1,E2)

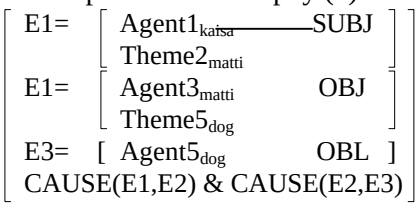
Now, to satisfy Identity, we must link Theme2$_{matti}$ to OBL .

Step5
E1= Agent1$_{risto}$ — SUBJ
Theme2$_{matti}$ OBJ
E1= Agent3$_{matti}$ OBJ$_\theta$
Goal4$_{poor}$ OBL
Theme5$_{money}$
CAUSE(E1,E2)

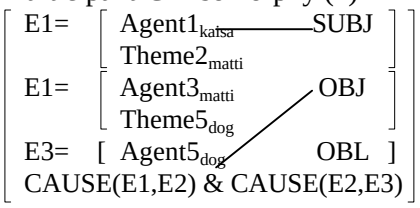
Step5 completes our linking and the result is exactly right. Below I show how the theory accounts for the problematic double causative, as well.

(31) Kaisa kävel-yt- yttä- ä koira-a Mati- lla.
Kaisa-NOM walk-CAUS1- CAUS2-3sg dog-PAR Matti-INSTR
'Kaisa causes Matti to walk the dog'

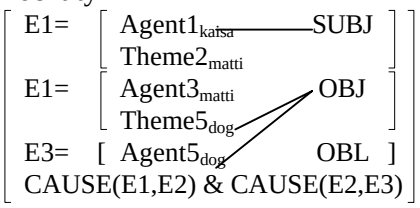
Step1: Participant-GF Isomorphy (1)



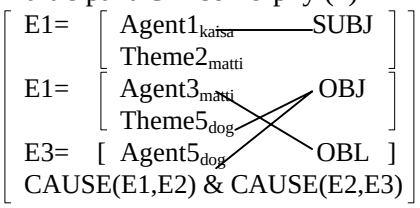
Step2: Participant-GF Isomorphy (2)



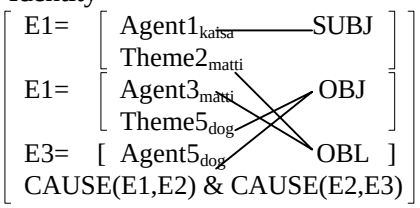
Step3: Identity



Step4: Participant-GF Isomorphy (2)

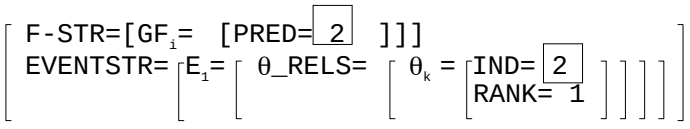


Step5: Identity



The linking of singly causativized intransitives and monotransitives is carried out in exactly the same fashion. Thus, Participant-GF Isomorphy can be formalized as below:

(32) PARTICIPANT-GF ISOMORPHY:

1. 

where there is no GF_j, *such that* $j<i$.

2. *(applies reiteratively)*

$$\begin{bmatrix} \text{F-STR}=[GF_i= [\text{PRED}= \boxed{2}\ ]]] \\ \text{EVENTSTR}=\begin{bmatrix} E_1= \begin{bmatrix} \theta\text{_RELS}= \begin{bmatrix} \theta_k= \begin{bmatrix} \text{IND}= \boxed{2} \\ \text{RANK}= n \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

where there is no GF_j, *such that* $j<i$ *and there is no* θ_m, *such that* $[\theta_m=[\text{RANK}= n+1]]$.

In addition to accounting for the complicated linkings of predicates such as Finnish double causatives and causativized ditransitives, the present proposal also explains the peculiar subject selection of psychological causatives. In the following I describe the solution it offers and some questions that remain.

5 The Linking of Psychological Causatives

As many languages, Finnish has two types of psych verbs. One of them is morphologically simple and realizes its Experiencer as the subject and the other is morphologically causative and realizes its Experiencer as the object.

(33) a. Mikko inhoa-a hyttysi-ä
Mikko.NOM disgust-3SG mosquitos-PAR
'Mikko finds mosquitos disgusting'

b. Hyttyset inho- **tta-** vat Mikko-a
mosquitos.NOM disgust-**CAUS**-3PL Mikko-PAR
'Mosquitos disgust Mikko'

At first glance, the (a) and (b) sentences seem almost synonomous. In Pylkkänen (1997b) I, however, argue that the morphological causative is also semantically causative. This conclusion is based on the fact that certain adverbials, such as 'almost', introduce ambiguities with the morphological causative but not with the noncausative. Thus, there is evidence that the causative is bieventive just like the other causatives discussed in this paper. In Pylkkänen (1997b) I propose that the causing eventuality of the psychological causatives is best treated as some kind of an abstract perception eventuality whose nature is further specified by context. Since it isn't clear which thematic relations hold between a perception eventuality and its participants, I simply call these roles 'Perceiver' and 'Perceived'. Thus, a psychological causative has two causally related states in its denotation, a perception and a mental state, as represented in (33b').

(33b') (∃s)[**Perception**(e) & **Perceived**(s,mosquitos) & **Perceiver**(s, Mikko) & (∃s')[**FindDisgusting**(s') & **Experiencer**(s',Mikko) & **Stimulus**(s',mosquitos) & **CAUSE**(s,s')]][7]

To determine the GF realization of (33b), we must first rank the participants. We know that since s causes s', the participants of s are more prominent than the participants of s'. In the caused eventuality the Stimulus falls into the 'Other' category of thematic relations, and is thus ranked lower than the Experiencer. At first glance the theory sketched in this paper does not, however, seem to make any predictions about the ranking of roles such as 'Perceiver' and 'Perceived'. They both fall into the 'Other' category. Thus, their ranking relative to each other seems to be left indeterminate.

[7] This logical form ignores several issues about the aspectual properties of Finnish psychological causatives which are not relevant for my present purposes. See Pylkkänen (1997b) for details.

A more careful look at the constraints, however, reveals that these two roles can only be ranked in one way for the prominence hierarchy to be well-formed. Namely, event coherence can only be satisfied if the participant bearing the role 'Perceiver' is at the event boundary between s and s'. This way it can unify with the highest participant of the caused event, the Experiencer. This means that the Perceived, which is identical to the Stimulus of the caused event, is forced to be the highest ranked participant. Consequently, it is realized as the subject.

Thus, the peculiar argument flip of psychological causatives can be explained by a general semantic well-formedness condition on causatives. However, some questions remain. These have to do with the linking of the lowest participant, i.e. the Stimulus of the caused event. After the first part of Participant-GF Isomorphy has linked the Perceived to SUBJ, its second part should link the Stimulus to OBJ. But for some reason it doesn't. I hypothesize that Stimulus remains unlinked, as represented below:

(34)
$$\left[\begin{array}{ll} \text{E1=} & \left[\begin{array}{l} \text{Perceived1}_x \text{——SUBJ} \\ \text{Perceiver2}_y \end{array}\right] \\ \text{E2=} & \left[\begin{array}{l} \text{Experiencer3}_y \text{——OBJ} \\ \text{Stimulus4}_x \end{array}\right] \\ \multicolumn{2}{l}{\text{CAUSE(E1,E2)}} \end{array}\right]$$

Thus, the Stimulus of the mental state is an implicit participant, i.e, present in the semantics but not realized syntactically. We know that it is present in the semantics, because a psychological causative entails the psychological state expressed by its corresponding noncausative counterpart. If we choose to represent the noncausative as involving the participants Experiencer and Stimulus, they must be present in the representation of the causative, as well.

However, I do not have similar empirical evidence for the implicitness of the Stimulus in the syntax. Some possible reasons come to mind. One is that is that linking the Stimulus to the syntax would in a way be redundant. After all, it is always coreferential with the Perceived, which is syntactically realized. Also, the implicitness of the Stimulus might have to do with the fact that for psych verbs, the syntactic and semantic processes involved in causativization somehow do not go "hand-in-hand". With all other types of verbs, causativization has the effect of introducing a new event and a new syntactic function. But for psych verbs, causativization introduces a new event without a new syntactic function. As a result, we have an imbalance between the syntax and the semantics. Causativized monotransitives, for example, express four event participants with three syntactic functions. While psychological causatives also have four event participants, they only have two syntactic functions. Thus, one might expect something to be left implicit.

6 Conclusion

In this paper I have proposed an approach to linking theory which is compatible with event-based semantic theories, such as Parsons (1990). I have shown that to account for the complicated GF realization of Finnish causatives, a linking theory must rely on a careful articulation event structure. To deal with the fact that detailed representations of event structure often involve more event participants than what seemingly are present in the syntax, I proposed two well-formedness constraints, Uniqueness and Identity. I also presented a new way to infer prominence, which, together with the well-formedness constraints, allowed me to define the relationship between event participants and syntactic functions as a straightforward order isomorphisim. This relationship was also defined without reference to intermediate levels of representation, such as argument structure. A level of argument structure was rendered unnecessary by the well-formedness constraints. Since Uniqueness tells us exactly when two participants must be linked to different syntactic functions, and Identity exactly when they must be linked to the same function, we do not need to go through an intermediate level which would merge certain participants into one.

Appendix

<A HREF="lfg97appen.ps">Click here for a demonstration of the theory with a larger set of Finnish data.</A>

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