

Verb Cluster Formation and the Semantics of Head Movement

Rajesh Bhatt and Stefan Keine

We argue that certain instances of restructuring infinitives involve verb cluster formation, the interpretation of which crucially relies on function composition. In these environments we find that material inside the embedded clause behaves as if it was outside of the scope of the embedding predicate: Quantificational elements take scope over the matrix predicate, the matrix predicate is unable to license NPIs in its syntactic scope and adjuncts within the embedded clause are construed with the matrix predicate. These effects follow from the properties of function composition. Our proposal provides an argument for function composition as a compositional primitive, albeit one whose distribution is very restricted. The proposal also argues that certain instances of head movement are semantically contentful. The data for our proposal come from restructuring in German, in particular the long passive construction.

1. Some background on long passives

In German, certain verbs embedding infinitival complements allow two kinds of passivization. Consider the sentence in (1). Passivizing the matrix verb *vergessen* ‘forget’ can lead to either of two structures: In the LOCAL PASSIVE in (2a) the embedded object *Traktor* ‘tractor’ retains its accusative case. This outcome is unsurprising as the accusative is assigned by the embedded verb *reparieren* ‘repair’, which does *not* undergo passivization. More surprising is the so-called LONG (DISTANCE) PASSIVE in (2b). Here the embedded object receives nominative case instead and controls verbal agreement in the matrix clause (Höhle, 1978). This passive qualifies as long-distance because passivization of the matrix predicate has an impact on the case and agreement of an embedded argument.

(1) *Active*

weil er **den Traktor** zu reparieren vergessen hat
because he the tractor.ACC to repair forgotten has
‘because he forgot to repair the tractor’

(2) a. *Local passive of (1)*

weil **den Traktor** zu reparieren vergessen wurde
because the tractor.ACC to repair forgotten was

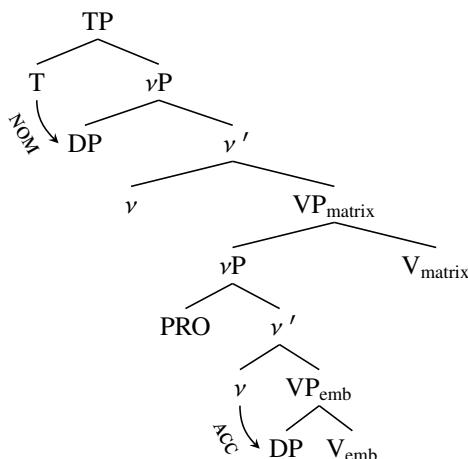
b. *Long passive of (1)*

weil **der Traktor** zu reparieren vergessen wurde
because the tractor.NOM to repair forgotten was
‘because it was forgotten to repair the tractor’

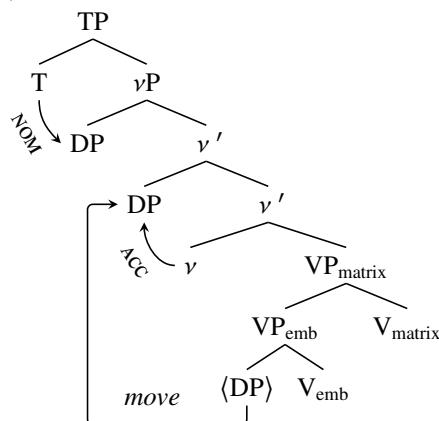
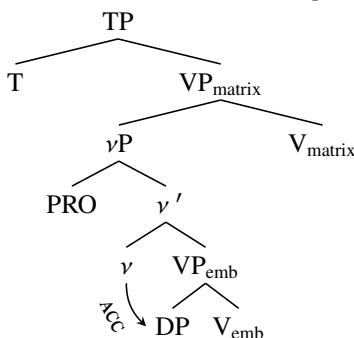
Following previous work by Wurmbrand (2001), Bobaljik & Wurmbrand (2005) propose that the embedded clause in (1) is structurally ambiguous and may or may not contain an accusative-assigning *v* head. If such a *v* head is present, the accusative assigned to *den Traktor* ‘the tractor’ stems from inside the embedded clause and is hence not affected by passivization of the matrix clause. It is hence retained

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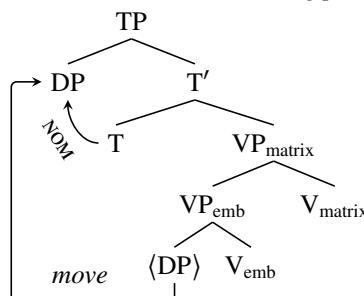
under passivization, resulting in (2a). By contrast, if the infinitival clause is a bare VP and hence lacks a v projection, the accusative in (1) stems from the matrix v head. Passivizing this clause hence removes the source of the accusative and the embedded object will receive nominative from matrix T instead. The result is the long passive in (2b). Under this account, then, the distinction between long and local passives reveals structural differences that are obscured in their active counterparts as these are surface-identical. As discussed by Bobaljik & Wurmbrand (2005), there is evidence that the nominative element undergoes raising into the matrix clause in at least the long passive. These structures are illustrated in (3–6), where ‘ V_{emb} ’ and ‘ V_{matrix} ’ refer to the embedded and the matrix verb, respectively. Both the structures in (3) and (4) correspond to the active string in (1). (5) underlies the local passive in (2a) and (6) is the structure of the long passive in (2b).

(3) Active clause with vP 

(4) Active clause with VP

(5) Passive clause with vP (local passive)

(6) Passive clause with VP (long passive)



2. Scope restrictions in long and local passives

Bobaljik & Wurmbrand (2005) observe that long passives exhibit scope restrictions not shared by either the local passive nor the active clause. While the embedded object may take scope below the matrix verb in the latter two (and in fact has to in the local passive), only matrix scope is available in the long passive. The two readings differ in their presuppositional content and neither entails the other. They can hence be reliably distinguished.¹

¹ Scenarios unambiguously diagnosing the scope relations in (7) are given in (i):

(i) a. *forget* >> *only*:

There are five tractors. John was told to repair only one of them. He forgot about that and inadvertently fixes all five.

b. *only* >> *forget*:

There are five tractors. John was told to repair all of them. He repaired four of them but forgot about the fifth one.

- (7) a. *Active*
 weil er **nur einen Traktor** zu reparieren vergessen hat
 because he only one tractor.ACC to repair forgotten has
 ‘because he forgot to repair only one tractor’ [forget >> only; only >> forget]
- b. *Local passive*
 weil **nur einen Traktor** zu reparieren vergessen wurde
 because only one tractor.ACC to repair forgotten was
 ‘because it was forgotten to repair only one tractor’ [forget >> only; *only >> forget]
- c. *Long passive*
 weil **nur ein Traktor** zu reparieren vergessen wurde
 because only one tractor.NOM to repair forgotten was
 ‘because there was only one tractor which they forgot to repair’
 [*forget >> only; only >> forget]

Bobaljik & Wurmbrand (2005) relate the obligatory wide scope in long passives to the obligatory raising of the embedded object into the matrix clause. Concretely, they assume that case checking takes place at LF. As a consequence, the embedded object has to be inside the matrix clause at LF and will hence necessarily take scope over the matrix predicate *forget*. An account along these lines is faced with a number of conceptual and empirical challenges, however. The requirement that case checking takes place at LF, for instance, is inconsistent with the large body of evidence that A-movement may reconstruct (see, among others, Barss, 1986; Romero, 1997; Fox, 2000; Sportiche, 2006; Lebeaux, 2009). More importantly, it has been observed by Takahashi (2010, 2011, 2012) and Wurmbrand (2013) for constructions containing the potential affix in Japanese that the wide scope requirement is not limited to direct objects. Other quantificational elements that receive their case within the lower clause, or no case at all, likewise have to outscope the matrix predicate. As demonstrated in the next section, this also holds for German. This makes it clear that the high scope restriction cannot be reduced to case assignment.

2.1. The ubiquity of wide scope

This section presents evidence against Bobaljik & Wurmbrand (2005)’s claim that the wide scope requirement in the long passive is the result of case-driven raising into the matrix clause. The crucial observation is that the scope restriction is not limited to the direct object. It extends to indirect objects and, surprisingly, adjuncts. Because none of these elements receive case from the matrix clause, a mechanism other than case assignment must be responsible for the scope behavior. To underscore the generality of this conclusion we will provide evidence involving quantificational DPs and negative polarity items.

2.1.1. Quantifier scope

Recall from (7) that the direct object has to take scope over the matrix verb in long passives. As (8) illustrates, this restriction also holds for the indirect object of an embedded ditransitive predicate.

- (8) a. *Local passive*
 weil *den Fritz* **nur einem Studenten** vorzustellen vergessen wurde
 because the Fritz.ACC only one student.DAT to.introduce forgotten was
 ‘because it was forgotten to introduce Fritz to only one student’
 [*only >> forget; forget >> only]
- b. *Long passive*
 weil *der Fritz* **nur einem Studenten** vorzustellen vergessen wurde
 because the Fritz.NOM only one student.DAT to.introduce forgotten was
 ‘because there was only one student which they forgot to introduce to Fritz’
 [only >> forget; *forget >> only]

The scope possibilities of indirect objects are thus restricted in a way that is entirely parallel to direct objects. In long passives, only matrix scope is available while in local passives, only an embedded reading is present. Note that it is the case of *Fritz* that determines the scope options of *student*. Because there is no evidence that case assignment to the latter differs between local and long passives, a purely case-driven approach to the scope restrictions does not obviously extend to the paradigm in (8).

2.1.2. Negative polarity items

Diagnostics of scope other than quantifiers produce identical results. Due to the implicit negation in its semantics, the verb *forget* may license a negative polarity item (NPI) in the embedded clause. The sentences in (9) demonstrate the behavior of the NPI *auch nur ein einziger Traktor* ‘even a single tractor’ in the two passives. As (9), where the NPI is the direct object of the embedded clause, shows *forget* may license an NPI in this position in the local passive but not the long passive.

- (9) a. *Local passive*
 weil **auch nur einen einzigen Traktor** zu reparieren vergessen wurde
 because also only a single tractor.ACC to repair forgotten was
 ‘because it was forgotten to repair even a single tractor’
- b. *Long passive*
 #weil **auch nur ein einziger Traktor** zu reparieren vergessen wurde
 because also only a single tractor.NOM to repair forgotten was

If it is the indirect object that is an NPI, a parallel generalization emerges, as (10) illustrated. As before, *forget* cannot license an embedded NPI in long passives regardless of the case assigned to this NPI.

- (10) a. *Local passive*
 weil *den Fritz* **auch nur einem einzigen Studenten** vorzustellen vergessen wurde
 because the Fritz.ACC also only a single student.DAT to.introduce forgotten was
 ‘because it was forgotten to introduce Fritz to even a single student’
- b. *Long passive*
 #weil *der Fritz* **auch nur einem einzigen Studenten** vorzustellen vergessen wurde
 because the Fritz.NOM also only a single student.DAT to.introduce forgotten was

The distribution of NPIs is captured under the same generalization as quantifier scope: No argument of the embedded clause may scope below the matrix predicate in long passives and above it in local passives.

2.2. Constraints on modification

Long passive constructions do not only impose restrictions on the scopal properties of embedded arguments but also on the construal of adverbs. Event-modifying adverbs like *fünfmal* ‘five times’ can be used for illustration. In the active clause in (11a) the adverb can be interpreted as either modifying the matrix or the embedded event, a straightforward attachment ambiguity. Under the former reading, five events of forgetting took place. Under the latter interpretation, the button should have been pressed five times and it is this requirement that was forgotten. The local passive counterpart in (11b) lacks the matrix construal of the adverb. The long passive in (11c), on the other hand, lacks the embedded reading. For the majority of speakers we have consulted (11c) can only mean that five events of forgetting took place.²

² We should point out that there are some speakers for whom an embedded construal of the adverb is marginally possible in (11c) under certain prosodic conditions. We discuss the link between prosody and interpretation in Keine & Bhatt (2014).

This restriction is remarkable because the linear position of the adverb does not preclude an embedded attachment of the adverb. In fact, the restriction persists regardless of the linear position of *fünfmal* ‘five times’.

- (11) a. *Active*
 weil er diesen Knopf **fünfmal** zu drücken vergessen hat
 because he this button.ACC five.times to press forgotten has
 ‘because he forgot to press the button five times’ [5.times(forget); 5.times(press)]
- b. *Local passive*
 weil diesen Knopf **fünfmal** zu drücken vergessen wurde
 because this button.ACC five.times to press forgotten was
 [*5.times(forget); 5.times(press)]
- c. *Long passive*
 weil dieser Knopf **fünfmal** zu drücken vergessen wurde
 because this button.NOM five.times to press forgotten was
 [5.times(forget); *5.times(press)]

The same point can be illustrated with adverbs that are pragmatically compatible only with an embedded construal. In (12) the adverb *mit einem Spezialwerkzeug* ‘with a special tool’ is pragmatically plausible only when modifying the event of repairing. In line with the conclusions we drew from (11), this adverb is felicitous in the active and the local passive but results in an odd interpretation in the long passive.

- (12) a. *Local passive*
 weil den Traktor **mit einem Spezialwerkzeug** zu reparieren vergessen wurde
 because the tractor.ACC with a special.tool to repair forgotten was
 ‘because it was forgotten to repair the tractor with a special tool’
- b. *Long passive*
 #weil der Traktor **mit einem Spezialwerkzeug** zu reparieren vergessen wurde
 because the tractor.NOM with a special.tool to repair forgotten was

Like (11), then, (12) suggests that the embedded event cannot be modified by an adverb in the long passive even when there is no indication that the adverb is unable to syntactically attach to the embedded clause.

2.3. Section summary

In this section we have presented evidence that the wide scope restriction in the long passive noted by Bobaljik & Wurmbrand (2005) is more pervasive than their account leads one to expect. First, the obligatory wide scope is not restricted to the element undergoing the case alternation but also affects other arguments. Second, adverb construal is similarly constrained. No adverb may modify the embedded event. This provides evidence against the case-based account they develop because the generalization encompasses elements whose case remains unaffected or which do not receive case to begin with.

The subsequent section will develop our own account. We propose that the infinitival verb incorporates into the matrix verb in certain configurations. We will show that the scope and construal restrictions then fall out from independent assumptions about the interpretation of movement and the fact that head movement does not extend the phrase marker. We should note that Takahashi (2010, 2011, 2012) and Wurmbrand (2013) notice very similar facts for Japanese and propose an account very different from the one developed here. Considerations of space preclude a full comparison between these accounts here, for which see Keine & Bhatt (2014).

3. The syntax and semantics of verb incorporation

3.1. The proposal

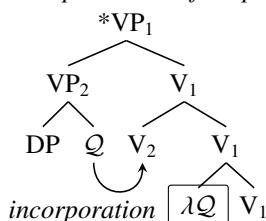
Against the general background of Wurmbrand (2001)'s and Bobaljik & Wurmbrand (2005)'s account laid out in section 1 and illustrated by the structures in (3–6) above, we propose that their account should be supplemented with semantically contentful verb cluster formation. That is, we propose that in the long passive structure in (6) (in which the embedded clause is a bare VP), the embedded verb incorporates into the higher verb, thereby forming a complex head.³ The two verbs are then semantically combined via function composition. Given independently motivated assumptions about the interpretation of movement chains, the wide scope and construal effects observed in the previous section then follow from the very nature of function composition.

We adopt a standard procedure for interpreting regular phrasal movement whereby a variable is left in the launching site and a λ -operator binding that variable is inserted in the position immediately below the landing site (see, e.g., Heim & Kratzer, 1998; Nissenbaum, 1998; Sauerland, 1998). As an illustrative example, consider (13):

$$(13) \quad [\text{John} \quad [\lambda x \quad [\text{I like } x \quad]]]$$

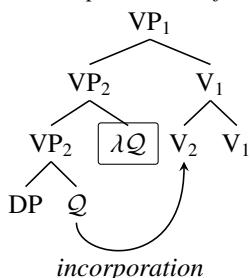
An immediate question arises when this procedure is applied to head movement. Head movement differs from phrasal movement in that the landing site does not c-command the launching position. If the λ -operator were inserted directly below the sister of the landing site, as in the case of regular phrasal movement, the structure would simply be uninterpretable as the operator does not bind the variable in the trace position of the moving head. This is illustrated in (14), where Q is used to refer to the variable and the λ -operator is inserted direct below the landing site of V_1 . Given the relative placement of the variable and the operator, the structure is semantically non-sensical.

(14) Illicit placement of λ -operator



To semantically interpret head movement, the λ -operator must be inserted into a position c-commanding the variable. The only available position is one *below the entire verbal complex created by movement* and shown in (15).

(15) Correct placement of λ -operator



³ We show in Keine & Bhatt (2014) that not all long passives involve verb cluster formation: Cluster formation only takes place if the verbs are structurally adjacent. It is blocked by movement of the infinitival VP or the presence of an intonational boundary (allowed by some but not all speakers). Thus our account is distinct from accounts such as von Stechow (1992) and Haider (1993), where verb clusters are crucially implicated in the formation of the long passive.

We would like to emphasize that the λ -placement in (15) follows directly from the way movement dependencies are interpreted and the non-extension property of head movement. As we will see shortly, the λ -placement in (15) has the result that the entire verbal complex comprising both V_1 and V_2 will be interpreted in the position of the variable Q .

A second question concerns the interpretation of the verbal complex created by incorporation. Standard methods of semantic combination like functional application or predicate modification are not applicable here because neither verb can take the other as its argument and the two verbs are not of the same type. Instead, we propose that the two denotations are combined via FUNCTION COMPOSITION (see, e.g., Ades & Steedman 1982; Steedman 1985; Di Sciullo & Williams 1987; Jacobson 1990, 1992; von Stechow 1992; Gärtner 2011; also see the concept of *c-locality* in Lidz & Williams 2002, 2005), as defined in (16).

- (16) a. SIMPLE FUNCTION COMPOSITION
 $(B \rightarrow C) \circ (A \rightarrow B) := (A \rightarrow C)$
 b. GENERALIZED FUNCTION COMPOSITION
 $(C \rightarrow D) \circ (A \rightarrow (B \rightarrow C)) := (A \rightarrow (B \rightarrow D))$

Function composition combines two functions to yield a single more complex function that takes all the arguments the two individual functions would have taken. Due to the placement and semantics of the λ -operator, this derived function will effectively be interpreted in the base position of the embedded verb. As a consequence, all quantificational elements must take scope over it and all adverbs must be interpreted as modifying the higher verb, even if they are syntactically attached inside the embedded clause.

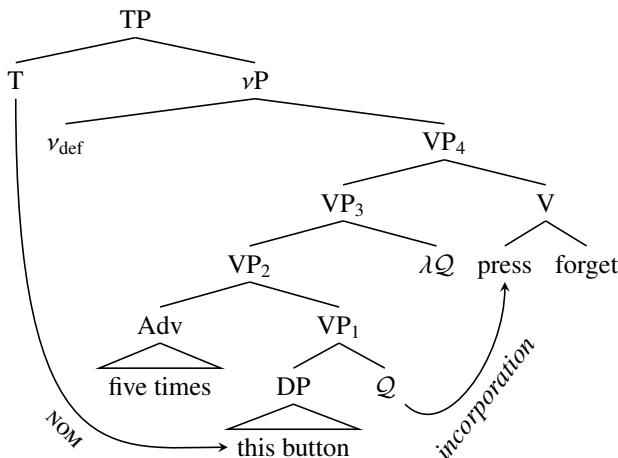
3.2. Application

To illustrate how this system derives the facts in section 2, consider first the example in (11c), repeated here as (17) for convenience. As we have seen above, the adverb *fünfmal* ‘five times’ can only be construed as modifying *forget*, not the embedded predicate *press*.

- (17) weil dieser Knopf fünfmal zu drücken vergessen wurde
 because this button.NOM five times to press forgotten was
 ‘because it was forgotten to press this button five times’ [5.times(forget); *5.times(press)]

The structure of (17) is given in (18). Because we are dealing with a long passive, the embedded clause lacks a v layer and the embedded object receives nominative case from the matrix T. The raising of *dieser Knopf* ‘this button’ into the matrix clause is irrelevant for the analysis and not shown in (18). Crucially, the lower verb *drücken* ‘press’ is incorporated into the matrix verb *vergessen* ‘forget’. A variable is inserted into the base position of the lower verb and λ -binder immediately below the verbal complex.

- (18) Structure of (17) after verb incorporation



The semantic interpretations assigned to crucial nodes in (18) are shown in (19). The verbal cluster is interpreted by functionally combining the two predicates, yielding (19c). Because of the way function composition is defined, only the event variable associated with *forget* is available at the level of the verb cluster. The event variable of *press* (viz., e' in (19c)) is buried inside the expression and thus inaccessible for further modification. Due to the placement of the λ -operator and the variable it binds this verbal cluster is effectively interpreted in the position of the variable Q . The VP_1 node will hence receive the denotation in (19e). Because *five times* requires access to the event variable of the event it is to modify, and because the event variable of *press* is inaccessible, the only possible construal of *five times* is one where it modifies the matrix predicate, as in (19g).

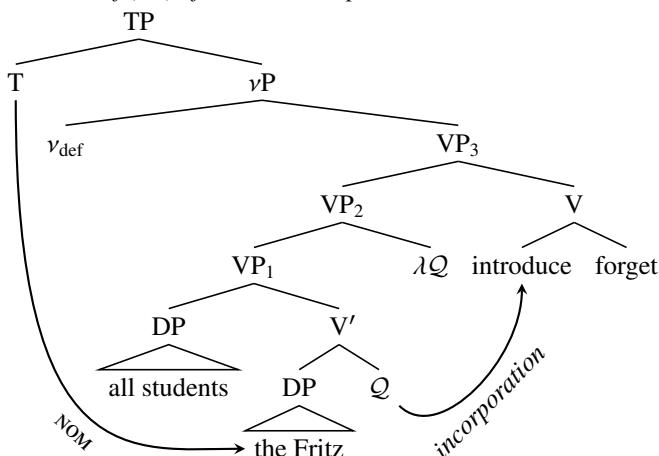
- (19) a. $\llbracket \text{press} \rrbracket = \lambda x_{\langle e \rangle} \lambda e_{\langle s \rangle} [\text{press}'(e) \wedge \text{theme}'(e) = x]$
 b. $\llbracket \text{forget} \rrbracket = \lambda P_{\langle st \rangle} \lambda e_{\langle s \rangle} [\text{forget}'(e) \wedge \text{theme}'(e) = P]$
 c. $\llbracket \text{forget} \rrbracket \circ \llbracket \text{press} \rrbracket = \lambda x \lambda e [\text{forget}'(e) \wedge \text{theme}'(e) = \lambda e' [\text{press}'(e') \wedge \text{theme}'(e') = x]]$
 d. $\llbracket \text{the button} \rrbracket = \iota x. \text{button}'(x)$
 e. $\llbracket VP_1 \rrbracket = \lambda e [\text{forget}'(e) \wedge \text{theme}'(e) = \lambda e' [\text{press}'(e') \wedge \text{theme}'(e') = \iota x. \text{button}'(x)]$
 f. $\llbracket \text{five times} \rrbracket = \lambda e [\text{five.times}'(e)]$
 g. $\llbracket VP_2 \rrbracket = \lambda e [\text{forget}'(e) \wedge \text{theme}'(e) = \lambda e' [\text{press}'(e') \wedge \text{theme}'(e') = \iota x. \text{button}'(x)] \wedge \text{five.times}'(e)]$

This analysis derives the curious property that *five times* may only modify the event of forgetting. Importantly, it achieves this result without imposing ad hoc syntactic restrictions on the placement of the adverb. In (18) *five times* is generated inside the embedded clause and stays there over the course of the derivation. Despite its placement below the matrix predicate, it semantically ends up modifying that predicate. This result is achieved because verb incorporation of *press* into *forget* semantically ‘pulls down’ *forget* into its base position and both verbs are interpreted in this position as a result. In this position *five times* has access to its event variable.

The system likewise accounts for the generalization that all quantificational expressions have to take scope over the matrix predicate in exactly the same way. Consider, for concreteness, the example in (20). The structure for (20) is given in (21).

- (20) weil der Fritz allen Studenten vorzustellen vergessen wurde
 because the Fritz.NOM all students.DAT to.introduce forgotten was
 ‘because all students are such that they forgot to introduce Fritz to them’
 $[*\text{forget} \gg \forall; \forall \gg \text{forget}]$

- (21) Structure of (20) after verb incorporation



The semantic calculations proceed as before. The crucial outcome is that the verbal complex, containing both *introduce* and *forget*, will be semantically construed as if it were inside the base position of *introduce*. As a result the quantificational noun phrase *all students* will take scope over *forget* despite the fact that it occupies a syntactic position lower than that of *forget*.

- (22) a. $[[\text{introduce}]] = \lambda x_{\langle e \rangle} \lambda y_{\langle e \rangle} \lambda e_{\langle s \rangle} [\text{introduce}'(e) \wedge \text{theme}'(e) = x \wedge \text{goal}'(e) = y]$
 b. $[[\text{forget}]] = \lambda P_{\langle st \rangle} \lambda e_{\langle s \rangle} [\text{forget}'(e) \wedge \text{theme}'(e) = P]$
 c. $[[\text{forget}]] \circ [[\text{introduce}]] = \lambda x \lambda y \lambda e [\text{forget}'(e) \wedge \text{theme}'(e) = \lambda e' [\text{introduce}'(e') \wedge \text{theme}'(e') = x \wedge \text{goal}'(e') = y]]$
 d. $[[\text{all students}]] = \lambda R_{\langle e \langle st \rangle \rangle} \forall x [\text{student}'(x) \rightarrow \exists e [R(x)(e)]]$
 e. $[[V']] = Q(\text{Fritz}')$
 f. $[[VP_1]] = \forall x [\text{student}'(x) \rightarrow \exists e [Q(\text{Fritz}')(x)(e)]]$
 g. $[[VP_2]] = \lambda Q_{\langle e \langle e \langle st \rangle \rangle \rangle} \forall x [\text{student}'(x) \rightarrow \exists e [Q(\text{Fritz}')(x)(e)]]$
 h. $[[VP_3]] = \forall x [\text{student}'(x) \rightarrow \exists e [\text{forget}'(e) \wedge \text{theme}'(e) = \lambda e' [\text{introduce}'(e') \wedge \text{theme}'(e') = \text{Fritz}' \wedge \text{goal}'(e') = x]]]$

As in the previous example, the system derives the scope facts without imposing a syntactic constraint on where the quantifier can take scope from. The scope restriction follows directly from the semantics of verb incorporation. As such, we now have a unified account of the wide scope of quantifiers as well as the matrix construal of adverbs.

Finally, to account for the fact discussed in section 2.1.2 that NPIs inside the embedded clause cannot be licensed by *forget*, we note that *forget* can in general only license NPIs inside complement clauses but not if the NPI is its complement:

- (23) a. John forgot to eat anything.
 b. *John forgot anything.

Krifka (1995) captures the contrast in (23) by requiring NPIs to undergo QR. In (23a) *anything* can undergo QR within the embedded clause and hence remain within the c-command domain of *forget*. In (23b), on the other hand, QR of *anything* automatically places it outside the c-command domain of *forget* and thus prevents its from being licensed. With this additional complication in place, the system now readily handles the NPI facts in (9) and (10). Because the verb cluster containing *forget* will be semantically construed in the base position of the infinitival verb, the NPI will either be its complement (if it is the direct object as in (9b)) or higher than the cluster (if it is the indirect object as in (10b)). In either case, QR of the NPI will place it outside of the licensing domain of *forget* and the NPI will hence be ill-formed.

4. Conclusion

This paper has presented evidence that in some restructuring configurations all material inside the embedded clause behaves as if it were outside the scope of the embedding predicate: Quantificational expressions have to take matrix scope, NPIs can no longer be licensed by the matrix predicate and embedded adjuncts have to be interpreted as modifying the matrix event. This generalization is a remarkable extension of Bobaljik & Wurmbrand (2005)'s generalization that the embedded direct object has to take matrix scope. We have proposed that these scope and construal restrictions are the result of verb incorporation, whereby the resulting cluster of the embedded and the matrix verb is interpreted via function composition. This account not only has greater empirical coverage than Bobaljik & Wurmbrand (2005)'s case-based account, it also allows us to dispense with the assumption that case checking must take place at LF. Because the analysis is wholly divorced from case, the scope facts follow independently of the mechanisms of case assignment.

While we have elaborated on the semantic properties and consequences of verb incorporation, we leave unaddressed here for reasons of space questions about its syntactic nature and distribution. In light

of its semantic effects, it is clear that verb incorporation cannot be a pure PF operation. Questions arise in particular regarding the more specific timing and syntactic motivation of the operation as well as restrictions on its application. In addition, for at least some speakers we have consulted the scope facts are somewhat more variable than depicted here. This variability seems to be tightly connected with the prosodic properties of the structure (see fn. 2 and 3). These open issues are taken up in detail in Keine & Bhatt (2014).

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