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Composing CPs: evidence from disjunction and conjunction*

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Abstract In this paper we compare CP disjunction to TP disjunction and CP conjunction to TP conjunction, and conclude that CPs and TPs do not have identical meanings (cf. similar observations reported in Szabolcsi 1997, 2016; Bjorkman 2013). We argue that this result is incompatible with the view that the CP layer of embedded clauses is semantically vacuous. We propose that the differences between CPs and TPs can be explained under a particular implementation of Kratzer's approach to the semantics of clausal embedding (Kratzer 2006, 2016; Bogal-Allbritten 2016, 2017; Moulton 2009, 2015; Elliott 2017), according to which CPs denote predicates of events whose content equals the embedded proposition.

Keywords: semantics of clausal embedding, conjunction, disjunction, content CPs

1 Introduction

Theories of clausal embedding seek to identify the contribution of the different syntactic pieces to the entailment patterns such sentences produce (1). In this paper we focus on the complementizer, or the abstract head COMP that it realizes, and ask: does it have a semantic contribution, and if so, what is it?

(1) Maria thinks /knows /is upset [$_{CP}$ that Dina is dancing].

The classical semantics for attitude reports due to Hintikka (1969) assigned no meaning to the complementizer. On Hintikka's theory (or a compositional rendering thereof, e.g. von Fintel & Heim 2011), the CP meaning inherits the meaning of the embedded TP—a proposition—with which the attitude verb composes: $[\![_{\text{CP}}$ that Dina dances$]\!] = [\![_{\text{TP}}$ Dina dances$]\!] = \{w : \text{Dina dances in w}\}$. A more recent approach, initiated by Kratzer 2006 and followed up in other work (Bogal-Allbritten 2016, 2017; Elliott 2017; Kratzer 2016; Moulton 2009, 2015), denies the claim that TP and CP are semantically equivalent. The proponents of this approach contend

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that while the TP denotes a proposition p, syntactic material in the CP layer maps p into a predicate of individuals with Content p.

This paper argues for a particular implementation of the latter approach. The empirical domain that serves as the basis for our claims is CP disjunction and CP conjunction embedded under attitude verbs: we show that they have different inference patterns compared to the corresponding disjunction and conjunction of TPs under a single COMP.[1] We investigate CP/TP disjunction and conjunction in four languages: English, Hebrew, Italian and Russian, and arrive at the following conclusions. First, complementizers have semantic contribution: $[\![\text{CP}]\!] \neq [\![\text{TP}]\!]$. Second, we follow Moulton 2015 and Elliott 2017 in arguing that they encode a relation of **identity** between the embedded proposition and the content of the matrix predicate, as is illustrated in (2).

(2) $[\![\text{COMP}]\!] = \lambda p_{st}.\lambda e_{e}.\ \text{CONT}(e) = p$

Sections 2 and 3 introduce the main empirical generalizations, section 4 presents our proposal, and section 6 provides some additional evidence in its favor. Section 7 introduces a potential problem for our account (unexpected low-scope readings of CP conjunction) and sketches a way to account for it, section 8 concludes the paper.

2 Embedded TP disjunction & CP disjunction

Consider the two minimal pairs in (3), which differ only in the size of disjunction:

(3) a. Bill knows that [Masha sang] or [Dina danced] (TP $\vee$)

b. Bill knows [that Masha sang] or [that Dina danced] (CP $\vee$)

The two sentences give rise to distinct sets of inferences, and the difference might for the moment be described in terms of scope. The most natural interpretation of the TP disjunction in (3a) is one where *know* takes scope above *or* (*know* > *or*)—a knowledge claim whose content is a disjunction—whereas CP disjunction in (3b) obligatorily gives rise to the reverse scope (*or* > *know*)—a disjunction of knowledge claims. There are at least two facts that point to this. The first has to do with

1 Some of our empirical claims are not without precedence in the literature. We are aware of Bjorkman's (2013) work on the so-called 'asymmetrical reading' of *and*, which contains some observations regarding CP conjunction that are similar to ours (though they are differently phrased). The generalizations we reach are even more reminiscent of those made by Szabolcsi (1997, 2016), who makes many of the same points we do (her main concern however is interrogative CPs, which we do not discuss). One can view the current paper as providing confirming evidence for Szabolcsi's (1997) claim that denotations of CPs and TPs are not identical. But the details of our account are different, and, we believe, constitute a more uniform analysis of the facts concerning declarative CPs, which is our focus. See the end of section 4 for a brief comparison between our proposal and Szabolcsi's.

ignorance inferences. If (3a) signals ignorance on part of the speaker at all, it is ignorance about which one of the embedded disjuncts {*Mary sang, Dina danced*} is true; this is expected on the surface scope since the factive presupposition of *know* is a disjunctive proposition. By contrast, (3b) robustly gives rise to an ignorance inference not about which of {*Mary sang, Dina danced*} is true, but about which of them is the content of Bill's knowledge; (3b) could be uttered even if the speaker knows that both {*Mary sang, Dina danced*} are true—in fact this is an inference from (3b) (see below). A continuation like *but not both* serves to bolster this point. As shown below, this continuation has a different contribution in the two cases: with TP disjunction it naturally conveys exhaustivity with respect to the embedded disjunctive proposition (4), whereas with CP disjunction it can only convey exhaustivity with respect to what constitutes Bill's knowledge (5).

(4) Bill knows that Masha sang or Dina danced but not both. (TP $\vee$)

a. $\rightsquigarrow$ It is not the case both Masha sang and Dina danced.

b. $\not\rightsquigarrow$ Bill doesn't know both facts.

(5) Bill knows that Masha sang or that Dina danced, but not both. (CP $\vee$)

a. $\not\rightsquigarrow$ It is not the case both Masha sang and Dina danced.

b. $\rightsquigarrow$ Bill doesn't know both facts.

Finally, when the matrix subject is first person, the sentence with CP disjunction is markedly odd (6). This is again because (3b) obligatorily gives rise to an ignorance inference about the content of the matrix subjects' knowledge; but it is odd to express that you are ignorant about what you know.

(6) # I know that Masha sang or that Dina danced (but not both).

The second way in which (3a) and (3b) differ has to do with the factivity inferences. With TP disjunction, we get a disjunctive presupposition (7); with CP disjunction on the other hand the presupposition is conjunctive (8): it is both presupposed that Masha sang and that Dina danced.

(7) Does Bill know that [Masha sang] or [Dina danced]? TP $\vee$
presupposes: *Masha sang or Dina danced*

(8) Does Bill know [that Masha sang] or [that Dina danced]? CP $\vee$
presupposes: *Masha sang and Dina danced*

This contrast is unexpected if the TP and the CP have the same denotation. Note that the presupposition that we get with CP disjunction is identical to the one we get with matrix disjunction (9).

(9) Does Bill know [that Masha sang] or know [that Dina danced]? matrix ∨
presupposes: *Masha sang and Dina danced*[2]

We have replicated the contrasts above in three more languages: Russian, Hebrew and Italian, and the judgments of all speakers converged. We provide example sentences for CP disjunction that our consultants were asked about below (10).

(10) *know* with CP disjunction: * *know* > *or*, ✓ *or* > *know*

a. *Russian*

Vasja znaet [$_{CP}$ čto Maša pela] ili [$_{CP}$ čto Dina tancevala].
Vasja knows COMP Masha sang or COMP Dina danced

b. *Hebrew*

Yosi yode'a [$_{CP}$ še Maša šara] o [$_{CP}$ še Dina rakda].
Yosi knows COMP Masha sang or COMP Dina danced

c. *Italian*

Vera sa [$_{CP}$ che Maria ha cantato] o [$_{CP}$ che Dina ha ballato].
V knows COMP M has sang or COMP D has danced

Furthermore, the pattern is more general than just *know*: as far as we checked, CP disjunction must take scope above any embedding attitude verb. For example with the emotive factive *got angry*:

(11) Bill got angry that [Masha sang] or [Dina danced]. (TP ∨, *angry* > *or*)

(12) Bill got angry [that Masha sang] or [that Dina danced]. (CP ∨, *or* > *angry*)

The meaning difference between TP- and CP-disjunction suggests, contra Hintikkan analysis of attitude verbs, that the CP meaning does not simply inherit the meaning of the embedded TP. If it did, it is not clear what would force the high scope for CP disjunction. The question then is: what is the contribution of the CP layer that would successfully capture the facts? Before we present our proposal, we would like to show that similar facts hold in the domain of conjunction.

2 A question that may arise at this point is whether sentences like (8) and (9) might have, at least in some cases, a weaker presupposition than the conjunctive one, due to filtering. The issue of presupposition projection from disjunction is complex both empirically and theoretically, and the literature is not decisive (for relevant discussion see Geurts 1999; Beaver 2001; Schlenker 2008, a.o.). But it seems to us that sentences of the form in (8) and (9) robustly project the factive presuppositions from both disjuncts, unfiltered, even if this leads to pragmatic oddity or implausibility. This might constitute an interesting problem for some theories of projection, but for the present purposes what is crucial is that empirically the presuppositions of TP disjunction and CP disjunction are not identical.

3 Embedded TP conjunction & CP conjunction

We investigated the readings that TP and CP conjunctions allow in the four languages, and the sentences we elicited had the structure *Subject Verb* COMP *p and q* (= TP conjunction) and *Subject Verb* COMP *p and* COMP *q* (= CP conjunction). We provide example sentences with emotive factives and the predicate *doubt* below (with two languages per the type of verbs due to space limitations).[3]

(13) *English*

a. Bill got angry [$_{CP}$ that [$_{TP}$ Masha sang] and [$_{TP}$ Dina danced]].

b. Bill got angry [$_{CP}$ that Masha sang] and [$_{CP}$ that Dina danced].

(14) *Hebrew*

a. hitacbanti [$_{CP}$ še [$_{TP}$ Maša šara] ve [$_{TP}$ Dina rakda]].
I.got.upset COMP Masha sang and Dina danced
'I got upset that Masha sang and Dina danced.'

b. hitacbanti [$_{CP}$ še Maša šara] ve [$_{CP}$ še Dina rakda].
I.got.upset COMP Masha sang and COMP Dina danced
'I got upset that Masha sang and that Dina danced.'

(15) *Russian*

a. Ja somnevajus', [$_{CP}$ čto [$_{TP}$ Maša pela] i [$_{TP}$ Dina tancevala]].
I doubt COMP Masha sang and Dina danced
'I doubt that Masha sang and Dina danced.'

b. Ja somnevajus', [$_{CP}$ čto Maša pela] i [$_{CP}$ čto Dina tancevala].
I doubt COMP Masha sang and COMP Dina danced
'I doubt that Masha sang and that Dina danced.'

(16) *Italian*

a. Dubito [$_{CP}$ che [$_{TP}$ Maria abbia cantato] e [$_{TP}$ Dina abbia ballato]].
doubt.1SG COMP Maria has.SUBJ sung and Dina has.SUBJ danced.
'I doubt that Maria sang and Dina danced.'

3 Some of the differences between TP conjunction and CP conjunction discussed in this section have been observed before by Bjorkman (2013) for English and by Szabolcsi (1997, 2016) for English and Hungarian.

b. Dubito [$_{CP}$ che Maria abbia cantato] e [$_{CP}$ che Dina abbia ballato].
doubt.1SG COMP Maria has.SUBJ sung and COMP Dina has.SUBJ danced.
'I doubt that Maria sang and that Dina danced.'

Our empirical findings with respect to the interpretations of TP and CP conjunction constitute a less clear picture than we've seen with disjunction: for some of the speakers across different languages *and* could take low scope in sentences with CP conjunction, resulting in the same meaning that TP conjunction has. We set those speakers aside for now and return to them in section 7. The rest of our speakers reported the same contrast that we've seen with disjunction: TP conjunction involves ATTITUDE > *and* reading, and CP conjunction involves *and* > ATTITUDE reading.

To illustrate this difference, conside the context in (17):

(17) *Context:* yesterday Masha sang and Dina danced at the same time, and they produced so much noise that Bill/I couldn't handle it. Individually, these events are always pleasant.

This context rules out an interpretation where Masha's singing and Dina's dancing individually affected the attitude holder in a negative way. It is only their combination that caused the negative emotion. TP conjunction in (13a) and (14a) is compatible with (17), but CP conjunction in (13b) and (14b) is not: it has an inference that the attitude holder was angry or upset about both events individually.

The same point can be illustrated with *doubt*. Consider the context in (18).

(18) *Context:* Masha's singing is quite likely, but Dina's dancing is very unlikely. Thus, the combination of these too events is also very unlikely.

If the context is as in (18), TP conjunction in (15a) and (16a) is felicitous: after all, the attitude holder is indeed justified to doubt that the combination of the two events occured due to the low probability of one of them. CP conjunction in (15b) and (16b), however, is infelicitous in this context: its use requires that both events are considered unlikely by the attitude holder.[4]

To sum up, data from disjunction and conjunction suggests that we need a semantics for clausal embedding according to which CPs and their embedded TPs are not semantically equivalent. Furthermore, the correct semantics ought to explain the scope generalization which is summarized in (19):

4 Here we only presented data with emotive factive verbs and with *doubt*, but there are other predicates that show the same pattern, e.g., Russian *nevozmožno* 'impossible' and Hebrew *lo yitaxen* 'not possible', Russian *ne dopuskat'* 'not allow for the possibility'. We have to leave for future research a proper investigation of these verbs and how to integrate them into our analysis.

(19) a. ⟦ATTITUDE [CP or CP]⟧ : * ATTITUDE > *or*, ✓ *or* > ATTITUDE
b. ⟦ATTITUDE [CP and CP]⟧ : * ATTITUDE > *and*, ✓ *and* > ATTITUDE

4 Proposal

We offer the following theory of clausal embedding, which draws heavily on the 'Content' approach to clausal embedding initiated by Kratzer (2006) and is rooted in a neo-Davidsonian framework where verbs have event arguments. The complementizer, we propose, is not semantically vacuous: it encodes a relation between a proposition and a contentful event/individual (Kratzer 2006, 2016; Moulton 2009, 2015). 'Content' should be thought of as a kind of a theta role: just like some events have Experiencers, Agents, etc., some (mental/abstract) events have Content. In particular we propose that the relation that COMP encodes is identity (Moulton 2015; Elliott 2017): the event's content **equals** the proposition described by the TP. Thus, the denotations for the complementizer (COMP), TP and CP are in (20).[5,6]

(20) a. $[\![\text{COMP}]\!]^w = \lambda p_{st}.\lambda e_e.\text{CONT}(e) = p$
b. $[\![_{\text{TP}}$ Mary sang$]\!]^w = \lambda w'_s.\text{sang}(\text{Mary})_{w'}$
c. $[\![_{\text{CP}}$ that Mary sang$]\!]^w = \lambda e_e.\text{CONT}(e) = \lambda w'.\text{sang}(\text{Mary})_{w'}$

The complementizer takes a proposition p and returns a predicate of events such that when the function CONT (for "Content") applies to them, it returns the proposition p. So the CP "that Mary sang", for example, denotes predicate of events such that their Content is the proposition 'Mary sang' (20c). Embedding verbs on this approach are simple predicates of events, like other verbs (21). They combine with the CP by Predicate Modification.

(21) $[\![\text{know}]\!] = \lambda e.\ \text{know}(e)$

One of the hallmarks of the Content approach to clausal embedding is that it allows a uniform analysis of content CPs that appear with attitude verbs and content CPs that appear with content nouns (*attitudinal objects* in (Moltmann 2020)) such as *fact, idea, rumor*. Assuming that events and individuals are of the same semantic type (see footnote 5), the compositional analysis of (22a) is straightforward: CP combines with the noun by Predicate Modification, just like with the verb.

(22) a. the idea/rumor/fact that Mary sang

5 We are assuming that both events/states and individuals are in the same domain D_e.

6 The above-cited works contain a number of specific implementations of the way CPs are related to an individual's/event's Content, but we disregard the differences in as much as our argumentation is not affected by the choice between them.

b. $\iota x \in D_e[$ idea(x)/rumor(x)/fact(x) $\wedge$ CONT(x) = λw'.sing(Mary)$_{w'}$]

Let's see how this helps us with the facts from sections 2 and 3. Our semantics predicts that CP disjunction is not equivalent to TP disjunction, see (24)-(25) (for the latter we assume that disjunction can have the type in (23), combining two $\langle e,t\rangle$-type denotations).

(23) $[\![\text{or}]\!] = \lambda P_{et}.\lambda Q_{et}.\lambda e_e.\ P(e) \vee Q(e)$

(24) **TP disjunction**
$[\![[_{\text{CP}}$ that $[_{\text{TP}}$ Mary sang] or $[_{\text{TP}}$ Dina danced]]$]\!]$ =
$\lambda e_e.$ CONT(e) = λw'.sang(Mary)$_{w'}$ $\vee$ danced(Dina)$_{w'}$

(25) **CP disjunction**
$[\![[_{\text{CP}}$ that Mary sang] or $[_{\text{CP}}$ that Dina danced]$]\!]$ =
$\lambda e_e.$ CONT(e) = λw'.sang(Mary)$_{w'}$ $\vee$ CONT(e) = λw'.danced(Dina)$_{w'}$

Disjunction of the two TPs in (24) denotes a predicate of events whose Content is the set of worlds where either Mary sang or Dina danced. Disjunction of the two CPs in (25) denotes a predicate true of some event if either its Content is the proposition "Mary sang" or its Content is the proposition "Dina danced". When TP disjunction and CP disjunction combine with the attitude verb, e.g. with *know* (21), and after the existential closure of the event variable applies, we get the truth conditions in (26) and (27) respectively.

(26) $[\![$Bill knows that $[_{TP}$ Mary sang] or $[_{TP}$ Dina danced]$]\!]$ = 1
iff $\exists$e [know(e) & Exp(e) = Bill & CONT(e) = λw'.sang(Mary)$_{w'}$ $\vee$ danced(Dina)$_{w'}$]

(27) $[\![$Bill knows $[_{CP}$ that Mary sang] or $[_{CP}$ that Dina danced]$]\!]$ = 1
iff $\exists$e [know(e) & Exp(e) = Bill & [CONT(e) = λw'.sang(Mary)$_{w'}$ $\vee$ CONT(e)
= λw'.danced(Dina)$_{w'}$]]

We can now explain the difference in ignorance inferences between TP and CP disjunction. The logical representation in (27) contains a disjunctive claim regarding what is the content of Bill's knowledge state. The ignorance implication generally associated with disjunction will derive that the speaker of (27) is not sure which proposition constitutes the content of the attitude, as desired. In (26), in contrast, the logical representation only entails that the content of the knowledge claim is a disjunction. Correctly, no ignorance about the content of Bill's knowledge is predicted.

The difference in factivity inferences can be accounted for if we make an additional assumption that factive presuppositions are encoded in the complementizer rather than in the embedding verb:

(28) $[\![\text{COMP}]\!]^w = \lambda p_{st}\text{: } \underline{p(w)=1.}\ \lambda e_e.\text{CONT}(e) = p$

The assumption that factivity is introduced by a complementizer can be motivated by the fact that some languages have morphologically distinct factive and non-factive complementizers. For example, Greek has a designated factive complementizer *pu* and a designated non-factive one *oti* (Roussou 1994; Joseph 2016). Designated factive complementizers are also found in dialects of Basque (Artiagoitia & Elordieta 2016): *ena* in Western Basque, *bait* in Lapurdian-Navarrese and Zuberoan dialects. In Adyghe factivity is also marked in the embedded clause: adding the prefix *zere* to the embedded predicate creates a factive complement (Serdobolskaya 2016). In other languages there are complementizers marked for non-factivity: Lithuanian *-ar* (Holvoet 2016), Maltese *jekk* (Borg & Fabri 2016) and Kalmyk *giǯə* (Knyazev 2016) are examples of such cases. Thus, we might hypothesize that factivity is always introduced by a complementizer, but languages differ in whether they mark this distinction overtly or not.[7]

Now we can capture the factivity difference between (25)/(27) and (24)/(26). (25) presupposes both that Mary sang and that Dina danced because there are two factive complementizers in the sentence introducing two factive presuppositions {*Mary sang, Dina danced*}, and so if disjunction acts as a hole with respect to presupposition projection,[8] we get the observed conjunctive presupposition. (24) has a weaker, disjunctive presupposition that Mary sang or Dina danced because there is only one complementizer, and disjunction is embedded under it.

As for conjunction, our proposal predicts that in contrast to TP conjunction, CP conjunction should lead to a pathological meaning, (29)-(30).

(29) **TP conjunction**
$[\![[_{\text{CP}}$ that $[_{\text{TP}}$ Mary sang] and $[_{\text{TP}}$ Dina danced]$]\!]$ =
λe_e. [CONT(e) = λw'.sang(Mary)$_{w'}$ $\wedge$ danced(Dina)$_{w'}$]

(30) **CP Conjunction**
$[\![[_{\text{CP}}$ that Mary sang] and $[_{\text{CP}}$ that Dina danced$]\!]$ =
* λe_e. [CONT(e) = λw'.sang(Mary)$_{w'}$] $\wedge$ [CONT(e) = λw'.danced(Dina)$_{w'}$]

No event can have two different propositions as its unique content. This means that the set of events that (30) is true of is an empty set. TP conjunction on the other hand produces a coherent meaning (29): we get a predicate of events whose unique

7 We would like to note that this view requires some kind of selectional process between the predicate and the CP to capture the lexical restrictions on the distribution of (non)-factive complements.

8 As we have noted in footnote 2, while it is far from clear that disjunction acts as a hole in the general case, it seems that disjunction acts as a hole with respect to factivity presuppositions projecting from CP disjunctions and matrix disjunctions.

content is a conjunctive proposition. Thus, we predict the correct meaning for TP conjunction and that CP conjunction should never be possible.

But as we saw in section 3, strings of the form *Subject Vs* COMP *p and* COMP *q* are possible. If these strings do not arise from true CP conjunction, then how are they derived? We suggest that these strings are derived by Conjunction Reduction or a similar kind of ellipsis, see (31) (or with an equivalent semantic mechanism that does not require ellipsis, such as Szabolcsi's (2016) type-lifting operation).

(31) **Subject Vs COMP p and COMP q**
[Bill is angry that Mary sang] and [~~Bill is angry~~ that Dina danced]
⇒ Bill is angry that Mary sang and that Dina danced.

Note that the complementizer encoding the **identity** relation in (20a) is crucial for getting the fact that CP conjunction is not equivalent to TP conjunction. Compare our result in (29)-(30) with the result that semantics based on the subset relation (Kratzer 2006) gives (32): this complementizer takes a propsition and returns a predicate of events such that in all worlds compatible with their Content this proposition is true.

(32) $[\![\text{COMP}]\!] = \lambda p_{st}.\lambda e_e.\ \forall w'[w' \in \text{CONT}_{e,w} \rightarrow p(w')=1]$. (Kratzer 2006)

The meaning in (32) does not predict that CP conjunction should be pathological. In fact, it predicts that CP conjunction and TP conjunction should result in the same interpretation. This is so because CP conjunction under the meaning of the complementizer in (32) is conjunction of two universals (34), and conjunction of two universals is equivalent to one universal scoping over the conjunction, which is the meaning that a single complementizer embedding a TP conjunction has (33).

(33) $[\![[_{CP}$ that $[_{TP}$ Ann came] and $[_{TP}$ that Lucy came]$]\!]$ =
$\lambda e_e.\forall w'[w' \in \text{CONT}_{e,w} \rightarrow \text{came}(\text{Ann})_{w'} \wedge \text{came}(\text{Lucy})_{w'}]$

(34) $[\![[_{CP}$ that Ann came] and $[_{CP}$ that Lucy came]$]\!]$ =
$\lambda e_e.\forall w'[w' \in \text{CONT}_{e,w} \rightarrow \text{came}(\text{Ann})_{w'}] \wedge \forall w'[w' \in \text{CONT}_{e,w} \rightarrow \text{came}(\text{Lucy})_{w'}]$

In both (33) and (34) we will get a predicate such that in all worlds compatible with its Content two things hold: (i) Ann came; (ii) Lucy came. Thus, on the subset semantics like in (32) something else would have to be blocking the low scope of *and* for CP conjunction.

We would now like to briefly compare the proposal advanced in this paper with the one argued for by Szabolcsi (1997, 2016), who also studies disjunction and conjunction of CPs and reaches conclusions that are very similar to ours. While Szabolcsi's main focus is interrogative CPs, she also briefly discusses declarative CPs and arrives at virtually the same empirical generalizations as the ones we

described in sections 2 and 3. In order to capture the facts she considers (both interrogative and declarative CPs), she proposes to treat COMP essentially as a type-lifter. The lifting reverses the argument-function relationship between the matrix verb and the embedded proposition, so that the proposition is a function that takes the embedding verb as an argument rather than the other way around as is standardly assumed. When CPs are dis/conjoined, this effectively derives high scope for dis/conjunction with respect to the matrix verb, since the matrix verb saturates an argument position in both CPs. Szabolcsi then explores two kinds of possible motivations for complementizers having the semantics of lifters, which rely on disjunctions of questions leading to ill-formed meanings (in (Szabolcsi 1997) the explanation is provided in terms of partition semantics, and in (Szabolcsi 2016) in terms of inquisitive semantics).[9]

While Szabolcsi's COMP-as-Lifter theory derives the clausal embedding facts with disjunction and conjunction, we believe that our account has the advantage that it is embedded in a general and independently motivated theory of clausal embedding, whereas the Lifting account is geared specifically to explain disjunction and conjunction. Here we list a number of arguments in recent literature that make crucial use of the Content approach to clausal embedding. For example, it has been argued that clauses have to be predicates of individuals or events based on the fact that they can modify content nouns (Kratzer 2006, 2016; see our (22)). Elliott (2017) provided further arguments for viewing CPs as modifiers by discussing substitution failures and nominalizations of clause-taking roots. It has also been observed that CPs can build attitudes even without a designated attitude verb: for example, as discussed in Kratzer (2016), intransitive verbs can combine with CPs (35).[10]

(35) Susi laughed / sighed that I forgot my keys again.

The abovenentioned phenomenona are difficult to analyze with a standard Hintikkan view of attitude reports without extra assumptions. Our claim then is that our specific implementation of the Content approach explains the dis/conjunction data and renders the COMP-as-Lifter hypothesis unneeded (at least for declaratives CPs).

9 Szabolcsi (2016, section 3.3) also briefly considers what appears to be a version of our Content analysis, as an alternative to the account where COMP is a type-lifter. One difference in that sketch is that she assumes that apparent cases of CP conjunction involve lifting both CPs, whereas we have argued that these cases involve syntactic ellipsis. While we don't have an argument against lifting in the general case, we would like to note that conjunction reduction would be necessary for some cases even if availability of lifting is assumed. For example, the difference between the examples (43) and (44) in the upcoming section 6 requires conjunction reduction strategy to be an option.

10 In this connection see (Bogal-Allbritten 2016, 2017) for discussion of the contribution of embedded clauses in building attitude reports based on data from Navajo, (Banerjee, Karmakar & Ghosh 2019) on how attitude reports are built from verbs that are not specialized attitude verbs in Bangla and (Özyıldız 2018) for discussion of unselected questions in Altaic languages.

5 Getting entailment with identity semantics

While the identity semantics gave us a way to explain the absence of the low scope of AND with CP conjunction, it comes with what might look like a significant shortcoming: we are loosing the account of entailment with upward-monotone predicates like *believe*:

(36) Susi believes that Mary sang. Susi believes that Dina danced.
⇒ Susi believes that Mary sang and Dina danced.

Nothing in our analysis so far derives the entailment in cases like (36). However, an account of such entailment in a theory with identity semantics for clausal embedding have been developed in Elliott 2017, who proposes to slightly enrich the assumptions about the ontology of belief states. Here we only have space to briefly outline the main idea of this approach.

Elliott (2017) proposes that an individual is an experiencer of a plurality of belief states at any given time. An individual's belief states form a Boolean algebra which has the closure property in (37).

(37) Let BS_x be the set of x's belief states. BS_x is closed under meet (sum): $e, e' \in BS_x$ iff $e \oplus e' \in BS_x$.

Propositions also form a Boolean algebra. Elliott proposes that the function CONT is a *homomorphism* from the Boolean algebra BS_x to the Boolean algebra of propositions.[11] This analysis has the important consequence in (38).

(38) Iff $\text{CONT}(e_1) = p$ and $\text{CONT}(e_2) = q$, then $\text{CONT}(e_1 \oplus e_2) = p \wedge q$.

Existence of events e_1 with content p and e_2 with content q in the Boolean algebra of belief states of the attitude holder guarantees that there should also be their sum — the state $e_1 \oplus e_2$ whose content is $p \wedge q$. This means that if the Boolean algebra of Susi's beliefs has a state e_1 such that $\text{CONT}(e_1) = \lambda w.\ \text{sang}(\text{Mary})_w$ and a state e_2 such that $\text{CONT}(e_2) = \lambda w.\ \text{danced}(\text{Dina})_w$, than there has to be a state $e_1 \oplus e_2$ among her belief states whose content is $\lambda w.\ \text{sang}(\text{Mary})_w \wedge \text{danced}(\text{Dina})_w$. The reverse is true as well: if Susi has a belief state $\lambda w.\ \text{sang}(\text{Mary})_w \wedge \text{danced}(\text{Dina})_w$, there have to be two smaller belief states that correspond to the two conjoined propositions. This, in a nutshell, is how the entailment is captured.[12]

11 A homomorphism is a function whose domain and range are Boolean algebras, and which is structure preserving, i.e., it commutes with the Boolean operations.

12 Note that it is a property of *believe* that states in its characteristic set form a Boolean algebra; arguably not all events of attitude predicates form Boolean algebras, which explains why the pattern in (36) does not hold for many other attitude predicates (e.g. emotive factives).

6 Additional evidence from Russian: *a* 'but' conjunction

In this section we provide additional support for the claim that strings of the form *Subject Vs* COMP *p and* COMP *q* are derived by Conjunction Reduction. The evidence comes from Russian conjunction *a* 'but' which requires two points of contrast between the propositions it conjoins.[13] Consider (39).

(39) a. Dina pela, a Masha tancevala.
Dina sang A Masha danced
'Dina sang, but Masha danced.'

b. *Dina pela, a Dina tancevala.
Dina sang A Dina danced

c. *Dina pela, a Masha pela.
Dina sang A Masha sang

d. Pozavčera Dina pela, a včera Dina tancevala.
day.before.yesterday Dina sang A yesterday Dina danced
'The day before yesterday Dina sang, but yesterday Dina danced.'

In (39a) we see a sentence where the subjects and the predicates in the two clauses contrast with each other. In (39b) and (39c) we see that when only subjects or only predicates contrast, the result is ungrammatical. Finally, (39d) shows that the subjects of the two clauses can be the same if some other elements (the temporal adverbs in (39d) contrast in the two clauses in addition to the predicates.

The logic of this argument is as follows. Under our proposal, strings of the form in (40a) are derived from (40b) by Conjunction Reduction. This makes a prediction that the grammaticality of (40a) should correlate with that of (40b): if (40b) is not possible, (40a) should be ungrammatical as well.

(40) a. Subject Verb CP and CP

b. Subject$_k$ Verb$_j$ CP and (Subject$_k$) Verb$_j$ CP

The requirement of *a* 'but' to conjoin propositions with two points of contrast allows us to see that this prediction is borne out. First, note that in constructions with attitude verbs any differences within the embedded CP count as a single point of contrast as far as *a* 'but' conjunction is concerned. This is illustrated in (41)-(42).

13 We are grateful to Masha Esipova for bringing *a* 'but' to our attention.

(41) * Lena dumala [$_{CP}$ čto Dina pela], a Lena dumala, [$_{CP}$ čto Maša
Lena thought COMP Dina sang A Lena thought COMP Masha
tancevala].
danced

Intended: 'Lena thought that Dina sang, but she thought that Masha danced.'

(42) Pozavčera Lena dumala [$_{CP}$ čto Dina pela], a včera Lena
day.before.yesterday Lena thought COMP Dina sang A yesterday Lena
dumala, [$_{CP}$ čto Maša tancevala].
thought COMP Masha danced

'The day before yesterday Lena thought that Dina sang, but yesterday she thought that Masha danced.'

In (41) the embedded clauses have both different subjects and different predicates, but this is not sufficient to conjoin the two matrix clauses with *a* 'but'. Additional point of contrast has to be present; in (42) this is achieved by adding two temporal adverbs that contrast with each other. Now consider (43)-(44).

(43) * Lena dumala [$_{CP}$ čto Dina pela], a [$_{CP}$ čto Maša tancevala].
Lena thought COMP Dina sang A COMP Masha danced

Intended: 'Lena thought that Dina sang, but that Masha danced.'

(44) Pozavčera Lena dumala [$_{CP}$ čto Dina pela], a včera
day.before.yesterday Lena thought COMP Dina sang A yesterday
[$_{CP}$ čto Maša tancevala].
COMP Masha danced

'The day before yesterday Lena thought that Dina sang, but yesterday (she thought) that Masha danced.'

We see that the same restriction that we have seen with matrix TP conjunction is present in (43)-(44), which have the structure in (40a): embedded CPs are viewed as a single point of contrast, and additional point of contrast needs to be added for *a* 'but' to be grammatical. Cf. the embedded TP conjunction (45), which is grammatical if the two points of contrast are within the two embedded propositions.

(45) Lena dumajet [$_{CP}$ čto [$_{TP}$ Dina pela], a [$_{TP}$ Maša tancevala]].
Lena thinks COMP Dina sang A Masha danced

'Lena thinks that Dina sang, but Masha danced.'

The data above shows that the string *Subject Verb CP and CP* (40a) is grammatical with *a* 'but' only when the corresponding string *Subject$_k$ Verb$_j$ CP and (Subject$_k$)*

Verb$_j$ CP (40b) is. We conclude from this that (40a) can be only derived by Conjunction Reduction, supporting our proposal that declarative embedded CPs cannot be conjoined due to the fact that the resulting meaning would be ill-formed.

7 The speakers with a low-scope AND

As we have mentioned in section 3, while judgments about CP disjunction were uniform across the speakers we consulted, we encountered variability in judgements about CP conjunction. Consider the following example from English:

(46) I doubt [$_{CP}$ that Mary came] and [$_{CP}$ that Dina came].

a. *and* > *doubt*:
I doubt that Mary came and I doubt that Dina came.

b. *doubt* > *and*:
I doubt that both Mary came and Dina came.
Scenario: Mary's coming is quite likely, but it's unlikely that both of them will come at the same time, because Dina avoids Mary.

In addition to the wide scope of conjunction that is available for all speakers (46a), there are speakers across different languages who also accept the narrow scope (46b). In (46b) the speaker does not doubt each proposition individually, but only the combination thereof. Speakers who accept (46b) find sentences like (47) felicitous.

(47) I don't doubt that Mary came, but I doubt that Mary came and that Dina came.

The speakers that accept the low scope of AND raise a number of questions for our proposal. First, given that we predict CP conjunction to be semantically deviant, how do some speakers get the low scope of AND with CP conjunction? Second, why are there no low scope OR readings with CP disjunction?[14] Finally, what drives the cross-speaker variation that we observe?

At this point, we do not have a handle on what drives the cross-speaker variation, so we cannot develop a full-fledged account of this phenomenon. However, we are fairly certain that the source of the variability cannot be that some speakers treat the CP layer as semantically vacuous: if for some speakers CPs just inherited the meaning of TPs, then CP disjunction and TP disjunction would have identical meanings for them too, contra to what we found. Therefore, an explanation that predicts the disjunction/conjunction asymmetry is called for.

14 We put aside cases which could be analyzed with decomposition and intermediate attachment of CP disjunction, e.g., *doubt* = *not think*. See Szabolcsi (2015, 2016) for discussion.

Here we will sketch a possible direction to the low-scope AND with CP conjunction which keeps the meanings of CPs and attitude verbs unchanged. The two main ingredients that our sketch will rely on are a special non-Boolean meaning for AND and Elliott's (2017) idea that an individual's belief states form a Boolean algebra (see section 5). We will assume that while there is a non-Boolean AND, there is no non-Boolean OR, thus deriving the observed asymmetry.

The non-Boolean AND that we need is presented in (48).

(48) $[\![\text{and}_{\text{NON-BOOL}}]\!] =$
$\lambda P_{et}.\lambda Q_{et}.\lambda e_e.\ \exists e_1,e_2,\ [e_1 \oplus e_2 = e \wedge P(e_1) = 1 \wedge Q(e_2) = 1]$

In (48) $\text{and}_{\text{NON-BOOL}}$ takes two predicates, P and Q, and returns a predicate which is true of sums of two individuals or events ($e_1 \oplus e_2 = e$) such that P is true of the first element of the sum ($P(e_1) = 1$) and Q is true of the second element ($Q(e_2) = 1$). While we need (48) for conjoining two CPs, such a lexical item might be independently needed in the nominal domain. There are cases of NP conjunction which result in predicates that hold of sums of two singulars (Heycock & Zamparelli 2005; Champollion 2016; Fox & Johnson 2016). Consider the following examples:

(49) Every **woman and man who came in together** are smiling and frowning respectively. (Fox & Johnson 2016: 6)

(50) that **mutually incompatible man and woman** ($\neq$ that mutually incompatible man and mutually incompatible woman)
(Heycock & Zamparelli 2005: 253)

The NPs in (49)-(50) denote predicates which hold of pluralities that are sums of two singulars: a man and a woman. The meaning for $\text{and}_{\text{NON-BOOL}}$ in (48) that we will use for non-Boolean CP conjunction could account for such cases.

With the meaning for AND in (48) and the meanings of CPs in (51), we get (52) as the meaning for the (non-Boolean) CP conjunction.

(51) a. $[\![\text{that Mary came}]\!] = \lambda e_1.\ \text{CONT}(e_1) = \lambda w.\ \text{came}(\text{Mary})_w$
b. $[\![\text{that Dina came}]\!] = \lambda e_2.\ \text{CONT}(e_2) = \lambda w.\ \text{came}(\text{Dina})_w$

(52) $[\![\text{that Mary came and}_{\text{NON-BOOL}}\text{ that Dina came}]\!] = \lambda e_e.\ \exists e_1,e_2,\ [e_1 \oplus e_2 = e \wedge \text{CONT}(e_1) = \lambda w.\ \text{came}(\text{Mary})_w \wedge \text{CONT}(e_2) = \lambda w.\ \text{came}(\text{Dina})_w]$

Now recall from the section 5 Elliott's (2017) proposal that belief states of an experiencer form a Boolean algebra. This proposal implies that if events in (52) are belief events, then (38), repeated below as (53), holds.

(53) Iff $\text{CONT}(e_1) = p$ and $\text{Content}(e_2) = q$, then $\text{CONT}(e_1 \oplus e_2) = p \wedge q$.

Therefore, CP conjunction with non-Boolean AND in (52) in fact denotes a predicate of events whose Content is p ∧ q:

(54) $[\![\text{that Mary came and}_{\text{NON-BOOL}} \text{ that Dina came}]\!] = \lambda e_e.\ \exists e_1,e_2,\ [e_1 \oplus e_2 = e \wedge \text{CONT}(e_1) = \lambda w.\ \text{came}(\text{Mary})_w \wedge \text{CONT}(e_2) = \lambda w.\ \text{came}(\text{Dina})_w]$
$= \lambda e_e.\ \text{CONT}(e) = \lambda w.\ \text{came}(\text{Mary})_w \wedge \text{came}(\text{Dina})_w.$

Thus, we can get the low scope AND with CP conjunction in this indirect way: by specifying the content of the two subevents of a belief event we are providing its content due to CONT being a homomorphism from the Boolean algebra of belief events to the Boolean algebra of propositions.

If *doubt* is analyzed as *not think*, we get the following meaning for (46).

(55) I doubt [that Mary came] and [that Dina came].
$\neg\exists e\ [\text{think}(e) \wedge \text{Exp}(e) = \text{Speaker} \wedge \exists e_1,e_2,\ [e_1 \oplus e_2 = e \wedge \text{Content}(e_1) = \lambda w.\ \text{came}(\text{Mary})_w \wedge \text{Content}(e_2) = \lambda w.\ \text{came}(\text{Dina})_w]]$
$= \neg\exists e\ [\text{think}(e) \wedge \text{Exp}(e) = \text{Speaker} \wedge \text{Content}(e) = \lambda w.\ \text{came}(\text{Mary})_w \wedge \text{came}(\text{Dina})_w]]$

This is equivalent to the TP conjunction *I doubt that Mary came and Dina came*.

8 Conclusion

In this paper we have argued that CP disjunction doesn't have a meaning it is expected to have if it were equivalent to a disjunction of propositions under a matrix attitude. This is also true for CP conjunction for some speakers. We've derived this difference between CP disjunction/conjunction and TP disjunction/conjunction using the idea that the CP layer contributes a relation of identity between the proposition and the content of an attitude state (Kratzer 2006, 2016; Moulton 2015; Elliott 2017).

We have observed that there are speakers for which CP conjunction can have a meaning equivalent to TP conjunction under a single complementizer. We've sketched a way to derive this low scope of AND with CP conjunction using non-Boolean denotation for AND and Elliott's (2017) idea that CONT is a homomorphism from the Boolean algebra of belief states to the Boolean algebra of propositions.

9 Appendix: emotive factives

In this appendix we provide an implementation of our proposal with respect to emotive factives. If an emotive factive verb falls into the category of predicates with which CPs express content (*subject matter* CPs in (Hartman 2012)), then we do not have to make any additional assumptions (see Elliott 2017).

But there is a potentially more difficult case: a case when a CP combining with an emotive factive denotes *a cause* of the mental state (*causer* CPs in (Hartman 2012)). We follow Elliott (2017) in treating such CPs as specifying the content of the causing event, which is introduced in syntax by a functional projection CAUSE:

(56) ⟦Bill is angry that Mary sang⟧ =
∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ CONT(e') = λw. sang(Mary)$_w$]

Unlike disjunction of TPs (57), disjunction of CPs (58) will then convey ignorance about the content of the cause of Bill's anger.

(57) ⟦Bill is angry that Mary sang or Dina danced⟧ =
∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ [CONT(e') = λw. sang(Mary)$_w$ ∨ danced(Dina)$_w$]

(58) ⟦Bill is angry that Mary sang or that Dina danced⟧ =
∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ [CONT(e') = λw. sang(Mary)$_w$ ∨ CONT(e') = λw. danced(Dina)$_w$]

Unlike TP conjunction (59), CP conjunction (60) will create an ill-formed meaning.

(59) ⟦Bill is angry that Mary sang and Dina danced⟧ =
∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ [CONT(e') = λw. sang(Mary)$_w$ ∧ danced(Dina)$_w$]

(60) ⟦Bill is angry that Mary sang and that Dina danced⟧ =
* ∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ [CONT(e') = λw. sang(Mary)$_w$ ∧ CONT(e') = λw. danced(Dina)$_w$]

Finally, the low scope of AND with CP conjunction can be achieved in the same way as with *doubt*, provided that we make an assumption that causing events of emotive factives form a Boolean algebra (61).

(61) ⟦Bill is angry that Mary sang and$_{\text{NON-BOOL}}$ that Dina danced⟧ = ∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ ∃e$_1$,e$_2$, [e$_1$ ⊕ e$_2$ = e' ∧ CONT(e$_1$) = λw. sang(Mary)$_w$ ∧ CONT(e$_2$) = λw. danced(Dina)$_w$]
= ∃e,e' [angry(e) ∧ Exp(e) = Bill ∧ Cause(e) = e' ∧ Exp(e') = Exp(e) ∧ CONT(e') = λw. sang(Mary)$_w$ ∧ danced(Dina)$_w$

The assumption that events causing emotive states form Boolean algebras might seem more plausible if the causers of emotive states are *facts*: if x is a fact with content p, and y is a fact with content q, then x ⊕ y is a fact with content p ∧ q.

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