Focus and Contrastive Topics in Question and Answer Acts

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Two kinds of alternative-introducing devices are investigated in questions and answers: Focus in answers to constituent questions and in polar questions, and contrastive topics in answers and in questions. A theoretical framework is presented in which conditions for these two sources of alternatives can be formulated that work for assertions as well as for questions. This framework extends the traditional notion of common ground with a component, called commitment space, that captures the possible future developments of shared information in the course of conversation.

1. Introduction

It is well-known that in many languages, the focus in the answer corresponds to the wh-element in a constituent question (cf. Paul 1880). That is, focus is used to express question-answer congruence. This is illustrated in the following example:

(1) a. S_1: *Who won the first prize?* S_2: *ED_F won the first prize.*
b. S_1: *Which price did Ed win?* S_2: *Ed won the $FIRST_F$ prize.*

It is generally assumed that the wh-constituent constitutes the focus of the question, and that a question and a congruent answer to the question have the same focus position. In languages with a dedicated focus position, the wh-constituent is realized in that position. And the wh-element is prosodically highlighted in in-situ constructions or when it is part of a wh-moved phrase (cf. Haida 2008):

(2) a. *Ed won WHICH prize?*
b. *The author of WHICH book won a prize?*

But a question might carry additional focus. One type is focus in polar questions, as in the following examples, where focus F is realized as a H* nuclear accent. This kind of focus can also be realized by a cleft sentence.

(3) S_1: *Did ED_F win the first price?* S_2: *Yes.*
Is it ED_F who won the first price? *#No. / No, ANN_F won the first prize.*

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It is characteristic for this type of focus in polar questions that a simple answer *no* is felt to be insufficient. With a *no* answer, the issue remains who won the first price, and this question begs for an answer.

There is a second type of focus in questions. This focus is realized by a L+H* contour, and can optionally be expressed by an *as for* construction. This is evidence that it is a contrastive topic (Büring 2003), or delimiter (Krifka 2008). With polar questions, the anwer patterns are different, as a simple *no* answer is felt to be complete, at least for the chosen contrastive topic.

(4) S_1: *I want to know which of your students won a prize.*
Did ED_{CT} *win a prize?* S_2: *Yes.*
As for ED_{CT}*, did* HE_{CT} *win a prize?* *No.*

Contrastive topics also occur in constituent questions:

(5) S_1: *I want to know which prizes our students won.*
Which prize did ED_{CT} *win?* S_2: ED_{CT} *won the* $SECond_F$ *prize.*
As for ED_{CT}*, which prize did he win?*

The change of predicate, from *won the first prize* to *won a prize,* is not by accident. For a declarative sentence with contrastive topic to be felicitous, it should not constitute a full answer. This is illustrated in the following example.

(6) S_1: *I want to know which of your students won the first prize.*
a. (#) *Did* ED_{CT} *win the first prize?*
b. # *As for* ED_{CT}*, did* HE_{CT} *win the first prize?*

Here, (a) actually is acceptable under the reading Ed_F, because the the L+H* accent and the H* accent are difficult to distinguish. For a recent work on the realization and the meaning of contrastive topics, cf. Constant (2012); for the realization of contrastive topics in other languages, cf. Sturgeon (2006) on Czech, Tomioka 2010 on Japanese, Kamali & Büring 2011 on Turkish, and Dukova-Zheleva 2010 on Bulgarian.

In this paper, I will develop a framework of discourse in which focus in answers to constituent questions, focus in polar questions, and contrastive topics in questions and their corresponding answers, can be modeled. Conversational moves are modeled as illocutionary acts in a novel framework based on commitment states of the interlocutors, and the ways how such commitment states can develop (cf. Cohen & Krifka 2013 for this model).

2. A Framework for Illocutionary Acts

What is an act? Something that changes the world in one way or other. Speech acts are no different: They produce some utterance or other (the locutionary act), and by this they produce a certain communicative effect (the illocutionary act, cf. Austin 1961). It is this illocutionary act that I will try to model here.

Changes of the world are functions from world-time indices to world-time indices, hence they have a semantic type (cf. Szabolcsi 1982, cf. also Levinson 1980, and Singh 1993). This allows for illocutionary acts to be embedded under semantic operators (cf.

Krifka 2014). Here, we will give a formal model of such changes, following Cohen & Krifka (2014). The two crucial assumptions are: Illocutionary acts change the commitments of the interlocutors, and they restrict the future development of these commitments.

The fundamental notion is the **commitment state**. A commitment state is the set of commitments that are publicly shared by the participants, and which will typically increase in the course of conversation. It is related to the well-known notion of common ground as the assumptions of which the interlocutors assume that they all hold them true with respect to the actual situation, at least for the purpose of communication (cf. Stalnaker 1979). In contrast to typical assumptions about the common ground, commitment states also contain information about which interlocutor is committed to which assumption. We will model commitment states as sets of propositions, specified in a formal language that allows for Boolean combinations of propositions. The global commitment represented in such a set is the conjunction of all the propositions in the set, but it is important that we represent a commitment state by a set of propositions, and not by the conjunction of all these propositions; so, $\{\varphi, \psi\}$ and $\{\varphi \wedge \psi\}$ are different commitment states. Of course, this is too little, as we will ultimately also want to capture quantification, discourse referents across propositions, etc. But sets of propositions are sufficient for the purpose at hand. We should understand φ, ψ as propositions, that is, sets of possible worlds, possibly dependent on context; hence $\varphi \wedge \psi$ is actually $\varphi \cap \psi$.

The basic function of a speech act is to change a commitment state, typically by adding new commitments. We will use letters $\mathfrak{A}$, $\mathfrak{B}$ for speech acts (specifically, for illocutionary acts). Using the ad-hoc notation $\mathfrak{A}_\varphi$ for an illocutionary act that adds the proposition φ to the commitment state c, we will use the following notation:

(7) Update of commitment state c with speech act $\mathfrak{A}_\varphi$:
$c + \mathfrak{A}_\varphi = c \cup \{\varphi\}$,
where φ: the commitment introduced by speech act $\mathfrak{A}_\varphi$.

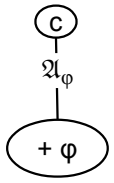


Figure 1: Update of commitment state

For the update of commitment states we will use illustrations as in Figure 1. The commitment state c, a set of propositions, is increased by the speech act $\mathfrak{A}_\varphi$, resulting in the set $c \cup \varphi$. This we render in this configuration simply as $+ \varphi$, as shorthand for $\cup \{\varphi\}$. Update is always represented in a top-down direction.

A plausible requirement for the update $c + \mathfrak{A}_\varphi$ is that $\varphi \notin c$, i.e. c does not contain c already. However, speakers may insist on their point by repeating their message, so this is a weak pragmatic requirement at best. The requirement that φ is **not entailed** by the information present in c would certainly be too strong, as speakers often explicitly draw consequences from what has been said so far. There is another requirement that commitment states should be **consistent**, that is, the set of formulas must not contradict each other, as this would lead to an empty global commitment. Again, this would be too strong, as speakers certainly can have inconsistent beliefs, and conversations can lead to inconsistent commitment states that are not even recognized as inconsistent. But we should at least require that there are no blatant inconsistencies, like e.g. a proposition and its negation being jointly part of the same commitment state. This is exemplified in Figure 2, which follows the possible updates of c with the propositions φ, ψ and their negations.

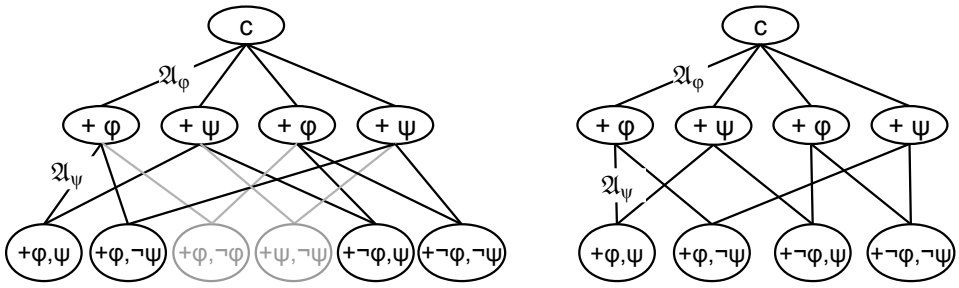


Figure 2: Possible updates of commitment state c with the propositions φ, ψ and their negations. Inconsistent commitment states are grayed out (left) or eliminated (right)

The commitment state rendered as +φ,ψ should be understood as $c \cup \{\varphi, \psi\}$. The figure illustrates update of c with φ, followed by update with ψ. Notice that update with ψ followed by update with φ would lead to the same result. In the following figures, only a few nodes in such cascades of commitment state updates are actually illustrated. They are sometimes left empty, just to indicate that there are such updates.

The notion of commitment states and their possible continuation naturally leads to the modeling of an information state in discourse that includes the orderly or "legal" continuations of a commitment state. We call this a **commitment space** (CS), and model it as a set of commitment states that also includes the non-empty intersection of these sets (cf. Cohen & Krifka 2014). This intersection is called the **root** of the commitment space; it is the commitment state that the interlocutors currently agree upon.

(8) C is a Commitment Space iff
   a. C is a set of commitment states, and
   b. there is a smallest commitment state in C: $\exists c \in C\ \forall c' \in C\ [c \neq \varnothing \wedge c \subseteq c']$
      This unique c (= ∩C) is the **root** of C, written √C.

For any two distinct commitment states c, c′ in a commitment space C, it holds that c can develop into c′ iff $c \subset c'$. In case it holds that $c \subset c'$ and there is no $c'' \in C$ such that $c \subset c'' \subset c'$, then we call this a **minimal transition** between c and c′.

The notion of update of a commitment state by an illocutionary act can be generalized to commitment spaces, as follows:

(9) Update of a commitment space with an illocutionary act $\mathfrak{A}$, where $\mathfrak{A}$ is defined for commitment states:
$C + \mathfrak{A} = \{c \in C \mid \sqrt{C} + \mathfrak{A} \subseteq c\}$

For illustration, consider the update in Figure 3, a commitment space which is the set of the commitment states of Figure 2. The commitment space C has √C as its root. The speech act $\mathfrak{A}_\varphi$, lifted to commitment spaces, is updating the commitment space C, leading to the commitment space $C + \mathfrak{A}_\varphi$, which is furthermore updated by $\mathfrak{A}_\psi$, leading to the commitment space $C + \mathfrak{A}_\varphi + \mathfrak{A}_\psi$.

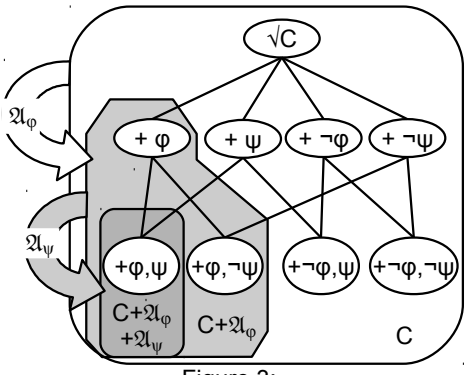


Figure 3:
Updates of commitment space

Why should we entertain, in addition to commitment states, the rather complex notion of commitment space that models all the legal continuations? We will see several useful applications of this with questions, answers and contrastive topics. In general, changes of commitment states can be seen as the "real" changes in the exchange of information, whereas changes of commitment spaces are proposals in which way the information change should develop. This corresponds to the notion of **common ground management** in Krifka (2008).

One important application of commitment spaces is with **denegations** of speech acts (cf. Cohen & Krifka 2014). It has been known since Searle (1969) that speech acts can undergo some sort of negation, as in the following example:

(10) *I don't promise to come* (≠ *I promise not to come*).

Notice that this is different from *I promise not to come*. Denegations have sometimes been expressed by simply putting a negation sign in front of a logical representation of a speech act (as in Searle 1969, or Searle & Vanderveken 1985, Vanderveken 1990), but as speech acts are not propositions, it is difficult to see what this should mean. Hare (1970) proposed that they are refusals to make a certain speech acts. We can model this with commitment spaces as follows:

(11) Update of a commitment space with the denegation of $\mathfrak{A}$:
$C + {\sim}\mathfrak{A} = C - [C + \mathfrak{A}]$

Figure 4 illustrates the denegation of the speech act introducing the proposition φ. Notice that this is distinct from the speech act that introduces the proposition ¬φ; the resulting commitment space C + ¬φ is rendered by a dotted line. In our small model, the final commitment states are the same, but the commitment spaces are different, as $C + {\sim}\mathfrak{A}_{\varphi}$ includes $C + \mathfrak{A}_{\neg\varphi}$. In more realistic models, the "final" commitments may be infinitely far away, and hence the two moves differ much clearly.

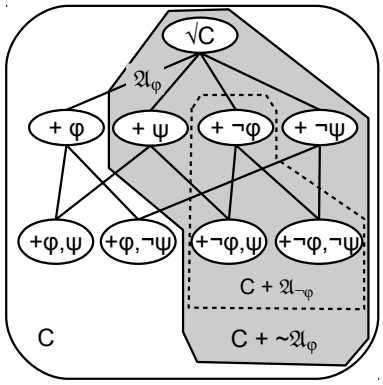


Figure 4:
Denegation of φ

Notice that denegation does not change the root of the commitment space, but prunes its legal developments. This is as it should be, because one could not say what the new commitments expressed by (10) should be. We call such changes of a commitment space that do not change the root a **meta speech act** (cf. Cohen & Krifka 2014).

In addition to denegation, Cohen & Krifka (2014) also define the operations of conjunction and disjunction on speech acts as operations on commitment spaces.

(12) Speech act conjunction: $C + [\mathfrak{A} \,\&\, \mathfrak{B}] = [C + \mathfrak{A}] \cap [C + \mathfrak{B}]$

(13) Speech act disjunction: $C + [\mathfrak{A} \vee \mathfrak{B}] = [C + \mathfrak{A}] \cup [C + \mathfrak{B}]$

Conjunction leads to sets of commitment states that are rooted, that is, regular commitment spaces, cf. Figure 5 With disjunctions, this is guaranteed only for meta speech acts; regular speech acts lead to non-rooted sets. This is illustrated in Figure 6.

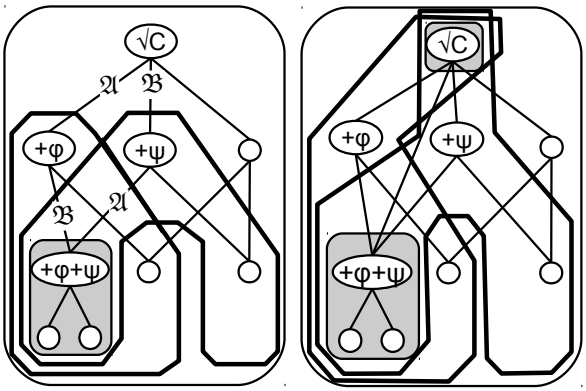


Figure 5:
Conjunction of regular (left) and meta speech acts (right)

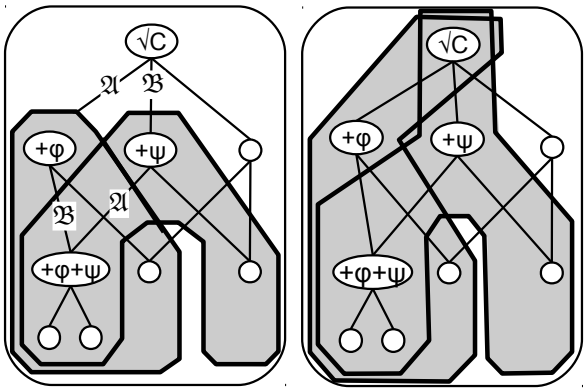


Figure 6:
Disjunction of regular (left) and meta speech acts (right)

In the current paper, I am mostly interested in the regular, monotonic changes of commitment spaces. Any realistic theory of common ground change has to assume that there are ways to change a common ground in a non-incremental way, by accepting information that was previously explicitly excluded. People sometimes change their minds, after all. We should assume that changes of the root of a commitment space (that is, the change of a commitment state) should count as a more destructive than changes in the possible continuations of the root. To give a promise and then revoke that promise is more severe than to say that one doesn't promise something, and then change one's mind and promise it later. (Incidentally, the possibility of revoking a promise has led Cohen & Krifka 2014 to a different analysis of denegation, which just rules out the initial moves immediately after the root.)

Here I assumed that denegation ~𝔄 excludes all performances of 𝔄, which might not be realistic – the speaker can be persuaded and finally agree to come. Such moves would involve a change of the commitment space C to a C′ that is not just a subset of C, but includes options that were previously excluded. I will not attempt to model such more radical changes in this paper.

We have introduced commitment states and commitment spaces, but we are not quite done yet. There are certain conversational moves that amount to a rejection of a move by the other participant. For this (and perhaps for some other ways of referring back to points in conversation) we need a record of the moves in conversation so far. We model this as a sequence of commitment spaces $\langle C_0, C_1, \ldots C_n\rangle$, and will call such sequences **Commitment Space Developments (CSD)**. Typically, we have $C_{i+1} \subset C_i$, that is, the immediate successor of a commitment space is included in its predecessor. But there are certain moves which do not obey this rule, and for this we need to record the succession of commitment spaces explicitly. For regular speech acts or meta speech acts, update of commitment space developments is as follows:

(14) Update of a commitment space development with a regular or meta speech act 𝔄:
$\langle ..., C\rangle + 𝔄 = \langle ..., C, C+𝔄\rangle$

CSDs are also a good place to indicate the actor, that is, the participant that performed the speech act in question. I will do this by indexing the update sign + and the result of the update by the participant:

(15) Update of a commitment space development with (meta) speech act $\mathfrak{A}$ by actor S:
$\langle ..., [C]_{...} \rangle +_S \mathfrak{A} = \langle ..., [C]_{...}, [C + \mathfrak{A}]_S \rangle$

The **rejection** of of the last speech act can be expressed by an operator $\mathfrak{R}$ with the following interpretation. That is, the commitment space development returns to the next-to-last commitment state while keeping a record of the rejection process.

(16) $\langle ..., [C]_{...}, [C']_{...} \rangle +_S \mathfrak{R} = \langle ..., [C]_{...}, [C']_{...}, [C]_S \rangle$

We have used the + notation to indicate the update of commitment states, commitment spaces, and commitment space developments. Note that + is just shorthand for functional application:

(17) a. $c + \mathfrak{A}_\varphi = \mathfrak{A}_\varphi(c)$, where $\mathfrak{A}_\varphi = \lambda c[c \cup \varphi]$
b. $C + \mathfrak{A} = \mathfrak{A}(C)$, where $\mathfrak{A} = \lambda C\{c \in C \mid \sqrt{C} + \mathfrak{A} \subseteq c\}$,
for speech acts $\mathfrak{A}$ that can also be applied to simple commitment states
c. $\langle ..., [C]_{...} \rangle +_S \mathfrak{A} = \mathfrak{A}(\langle ..., [C]_{...} \rangle)$, where $\mathfrak{A} = \lambda \langle ..., [C]_{...} \rangle \langle ..., [C]_{...}, [\mathfrak{A}(C)]_S \rangle$,
for speech acts $\mathfrak{A}$ that can also be applied to commitment spaces.
d. $\langle ..., C \rangle +_S \mathfrak{R} = \mathfrak{R}(\langle ..., [C]_{...} \rangle)$, where $\mathfrak{R} = \lambda \langle ..., [C']_{...}, [C]_{...} \rangle, \langle ..., [C]_{...}, [C']_{...}, [C]_S \rangle$

How does this model relate to the idea that speech acts are index changers (cf. Szabolcsi 1982)? Following Krifka (2014), I assume that for a communication situation s, the commitment state development CSD(s) up to the situation s is given. When a participant S performs a speech act $\mathfrak{A}$, then s changes minimally to that s′ such that CSD(s′) = CSD(s) $+_S$ $\mathfrak{A}$. The new situation s′ may affect the proposition φ of a speech act $\mathfrak{A}_\varphi$, which might depend on s′ as a parameter, specifying a time, a world, or a location. However, this will be disregarded in the following.

It is obvious that the way how speech acts are modeled is inspired by **modal logic,** with the process of update as a new kind of accessibility relation. The type of modality involved is a new one beyond the known types of epistemic, deontic, or dynamic modality, which are all defined on the level of propositions. It is a type that is related to what is allowed and ruled out in conversation, and hence could be called **conversational modality**.

3. Assertions

Having outlined the general framework for the representation of speech acts, we will now consider the speech act that is arguably most basic for human language, assertion. Without going into the varied literature on the nature of assertion (cf. the articles in Brown & Cappelen 2011 for a recent overview), I follow Brandom (1983), who highlights the social aspects of this conversational move and stresses that "illocutionary points are concerned with the assignment of epistemic and practical responsibilities, rights and obligations, to particular persons" (cf. also Alston 2001, and Linnell & Markova 2007). In asserting a proposition, the speaker undertakes responsibility for what is claimed, in two ways: (i) by committing oneself to justify the proposition, and (ii) by licensing the assertion, and inferences from it, by others.

As for (i), I will say that when a speaker S_1 asserts a proposition φ to an addressee S_2, then S_1 expresses a **commitment** towards S_2 for the truth of φ. That is, if φ turns out to

be false, then S_1 incurs social costs in his relationship to S_2, or to society at large. This is particularly so if S_1 believes that φ is false (in this case S_1 can be accused to be a liar), or in case S_1 did not have sufficient evidence for φ (in which case S_1 can be accused to be untrustworthy). The costs incurred depend on the circumstances; they may involve formal punishment if the assertion was done under oath, or they may reduce the credibility of the speaker for future conversational moves. I will call this the **truth commitment** of speaker S_1 to S_2.

As for (ii), S_1 wants to make φ to become a shared assumption of S_1 and S_2. I will call this move **proposition sharing**. The intention to make a proposition common ground is the most likely reason why S_1 declared responsibility for φ in the first place. This is nicely put in an essay by Peirce written around 1903 and published posthumously. Peirce talks about oaths and the potential punishments attached to them, and then writes:

> "(...) the assuming of responsibility, which is so prominent in solemn assertion, must be present in every genuine assertion. For clearly, every assertion involves an effort to make the intended interpreter believe what is asserted, to which end a reason for believing it must be furnished. But if a lie would not endanger the esteem in which the utterer was held, nor otherwise be apt to entail such real effects as he would avoid, the interpreter would have no reason to believe the assertion (CP 5.546, 1908).

There is evidence that having S_2 believe the asserted proposition φ is not the very essence of assertion but an intended consequence of the expression of commitment (hence, it is a **perlocutionary** act, in the sense of Austin 1962). Note that the speaker can explicitly refrain from this goal:

(18) *Believe it or not, Ed met Beth*.

If we analyze assertions as intentions of S_1 to make S_2 believe φ (cf. Bach & Harnish 1982), then (18) would be a blatant contradiction. So, what is the status of the proposition sharing? It is certainly an important feature of assertions, but (18) shows that it can be cancelled. Consequently, we should assume that it has the status of a conversational implicature.

Assertions have also be understood as expressing the belief that a proposition is true. However, this cannot be the essence of assertions either, for otherwise the following two assertions would have nearly the same meaning.

(19) a. *Ed met Beth.*
b. *I believe that Ed met Beth.*

In fact, (19)(b) is not a commitment to the proposition that Ed met Beth, but a commitment to the proposition of having a belief that Ed met Beth. It is easy to see why this can be used as a weak assertion: The belief of one person can be a good reason that others believe the same, but expressing just a belief, and not a binding commitment, to a proposition mitigates the social consequences for the speaker if the content of the belief should turn out to be false.

But what should we do about Moore's paradox, which seems to say that the expression of belief in a proposition is essential for the assertion of that proposition?

(20) # *Ed met Beth, but I don't believe it.*

The paradoxical nature of (20) can be derived from the fact that it is self-defeating to commit to the truth of a proposition (which carries social risks if it is not true), and at the same time commit to the proposition that one believes that it is not true. The resulting commitment state would be contradictory not for logical, but for moral reasons. The essence of assertion is to commit oneself publicly to the truth of a proposition, and there is a moral rule not to commit to the truth of a proposition that one considers false. If one publicly states that one believes a proposition not to be true, then one would blatantly violate this moral rule.

I will implement the content of the truth commitment of S_1 towards S_2 for the proposition φ using Frege's "Urtheilsstrich", and write $S_1[S_2]\vdash\varphi$. For the purpose of this paper it is not necessary to specify the addressee, and so I will generally just write $S_1\vdash\varphi$. This is to be understood as a proposition, a function from indices to possible worlds, which we can render as λi[at i, S_1 is committed to the truth of proposition φ towards S_2]. The nature and strength of that commitment can vary, e.g. from a guess to an oath, and it can be evidentially qualified, e.g. as hearsay or by reference to a source. We will not be concerned with this here. The truth commitment itself I will write as $+ S_1\vdash\varphi$, which is a function that changes a commitment state c such that it adds the proposition $S_1\vdash\varphi$. Similarly, I will implement the act of sharing the proposition φ as + φ, which is a function that changes the commitment state c to $c \cup \{\varphi\}$. As we have seen, these functions can be lifted to one that is defined for commitment spaces, and for commitment space developments, cf. (17).

The two acts that make up a standard assertion are executed one after the other. The first and most important one is the truth commitment; the second, arguably an implicated consequence of the first, the proposition sharing. The natural way to implement this is by performing the two acts in a sequence, as defined and illustrated below.

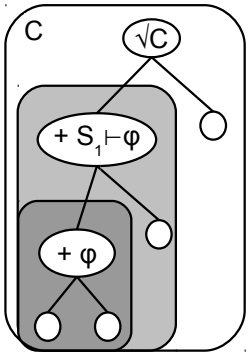


Figure 7: Assertion of φ

(21) $\langle ..., [C]_{...}\rangle +_{S_1} S_1\vdash \varphi +_{S_1} \varphi$
$= \langle ..., [C]_{...},$
$[C + S_1\vdash\varphi]_{S_1},$ truth commitment,
$[C + S_1\vdash\varphi + \varphi]_{S_1}\rangle$ proposition sharing

The second move, +φ, corresponds to the "projected set", and the first move, $+S_1\vdash\varphi$, to the commitments of S_1 in the framework of Farkas & Bruce (2011). But in contrast to that work, a permanent record is kept for which person is committed to which proposition.

How are assertions formally expressed? I assume that they come about by a syntactic operator that take an expression that denotes a proposition (of the category TP) and changes it to an illocutionary act, a function from CSDs to CSDs. Just like tense in the TP, this operator should be a head in its own syntactic projection; I will call it Speech Act Phrase (ActP), following Speas & Tenny (2003) (cf. also Cinque 1998 and Rizzi 1997 for speech act related syntactic categories). For assertions, the head of the ActP will be rendered by the punctuation sign that is most closely associated with assertion, the full stop. I assume the following syntactic structure, consonant with $\overline{X}$-theory.

(22) a. $[_{\text{ActP}}\ [_{\text{Act}'}\ [_{\text{Act}^{\circ}}\ .\ ]\ [_{\text{TP}}\ \textit{Ed met Beth}]]]$
b. $[_{\text{ActP}}\ \textit{Ed}\ [_{\text{Act}'}\ [_{\text{Act}^{\circ}}\ .\ \textit{met}]\ [_{\text{TP}}\ t_{\text{Ed}}\ t_{\text{met}}\ \textit{Beth}]]]$

I will mostly work with the structure (22)(a), but entertain the option (b), where I have assumed that the subject has moved from SpecTP to SpecActP, and the tensed verb to the head position of ActP. Associating the final movement of the verb with expressing a speech act is reminiscent of Truckenbrodt (2006), who assumes that this move creates verb second in German, and is associated with an illocutionary force.

Semantic interpretation is with respect to a function $[\![...]\!]^{S_1S_2}$ that specifies the speaker S_1, the addressee S_2 and additional parameters like the communicative situation and, with it, the world-time index of interpretation, which are suppressed here. The TP is interpreted as a proposition, and the assertion operator . is interpreted as a function that turns a proposition into a speech act that adds the truth commitment of the speaker to a commitment. In terms of Stenius (1968), the TP is the sentence radical of an assertion, and . is the illocutionary operator.

(23) $[\![[_{\text{Act}'}\ [_{\text{Act}^{\circ}}\ .\ ]\ [_{\text{TP}}\ \textit{Ed met Beth}]]]\!]^{S_1S_2}$
$= [\![[_{\text{Act}^{\circ}}\ .]]\!]^{S_1S_2}([\![[_{\text{TP}}\ \textit{Ed met Beth}]]\!]^{S_1S_2})$
$= \lambda p\ \lambda\langle ..., [C]_{...}\rangle\ [\langle ..., [C]_{...}, [C + S_1[S_2] \vdash p]_{S_1}\rangle]([\![[_{\text{TP}}\ \textit{Ed met Beth}]\!]^{S_1S_2})$
$= \lambda\langle ..., C\rangle\ [\langle ..., [C]_{...}, [C +_{S1} S_1[S_2] \vdash [\![[_{\text{TP}}\ \textit{Ed met Beth}]]\!]^{S_1S_2}]_{S_1}\rangle]$
$= +_{S_1}\ S_1 \vdash \varphi_b$, for short.

This is the truth commitment expressed by an assertion. I assume that the second effect, proposition sharing, comes about as a conversational implicature of the truth commitment; recall that it can be cancelled by *believe it or not*. As conversational implicature, it needs no special operator. The full conversational effect of assertion then is as follows:

(24) $= +_{S1}\ S_1 \vdash \varphi_b\ +_{S1}\ \varphi_b$

We might also associate the second step with the nuclear stress H*, which indicates that the TP proposition is new in the discourse context (cf. Truckenbrodt 2012), which implies that it is added to the commitment state.

Let us now consider typical **reactions** to assertions. The **truth commitment** $+ S \vdash \varphi$ is typically immune to reactions. It can be targeted by comments like *Don't say that!* or *Don't be a fool*, but there is no grammaticized way to confirm or refute it. This reflects the fact that it is completely under the choice of the speaker to make it part of the commitment state. The second move, **proposition sharing** $+ \varphi$, can be targeted by the addressee by grammatical means. No reaction, or reactions like *uh-uh* or *okay* are understood as just accepting the proposal to share the proposition. They can be represented by an ACCEPT operator, defined as follows, where we have to indicate the participants that make the conversational move.

(25) $\langle ..., [C]_{S_1}\rangle +_{S_2} \text{ACCEPT} = \langle ..., [C]_{S_1}, [C]_{S_2}\rangle$

The commitment space does not change, but the same commitment space is added at the end of the CSD stack as a move by S_2.

Reactions like *Yes (he did)* or *No (he didn't)* are stronger because they express not only that the proposition is accepted to be part of the commitment state, but that the addressee as well declares a commitment towards it. I have proposed a model of how these

response particles work in Krifka (2013). In essence, the TP of the assertion introduces a propositional discourse referent that is taken up by *yes* or *no* as anaphoric elements, which either assert the proposition or assert its negation. This is, then, how the answer *yes* works; it is illustrated in Figure 8.

(26) Answer *yes*: S_2 picks up and asserts the same proposition:
$\langle ..., [C + S_1 \vdash \varphi]_{S_1}, [C + S_1 \vdash \varphi + \varphi]_{S_1} \rangle +_{S_2} S_2 \vdash \varphi$
$= \langle ..., [C + S_1 \vdash \varphi]_{S_1}, [C + S_1 \vdash \varphi + \varphi]_{S_1}, [C + S_1 \vdash \varphi + \varphi + S_2 \vdash \varphi]_{S_2} \rangle$

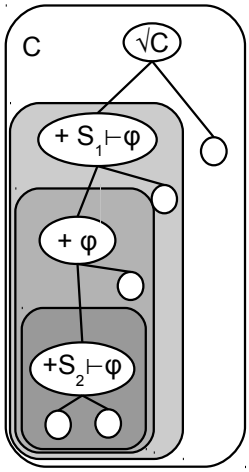


Figure 8: Answer *yes*

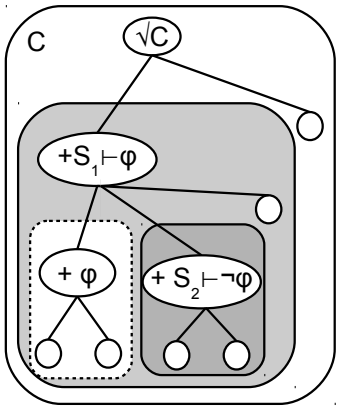


Figure 9: Answer *No*

The answer *no* is more complex. It asserts the negation of φ, but this cannot be done directly, as the resulting commitment state would end up with the proposed proposition φ and the proposition $S_2 \vdash \neg\varphi$, that one of the participants is committed to the falsity of ¬φ. While this is not a logical contradiction, it is a pragmatic contradiction, and cannot be entertained in a commitment state. That is, we assume that the following is a pragmatic rule for consistent commitment states:

(27) For no admissible commitment state c does it hold that
$\varphi \in c$ and $S \vdash \neg\varphi \in c$, for a participant S.

For this reason, the last move of proposition sharing of φ has to be rejected by S_2 before $S_2 \vdash \neg\varphi$ can be added. After the rejection operation $\mathfrak{R}$, cf. (16), S_2 can assert the negaton of φ:

(28) Answer *no*: S_2 picks up and negates the proposition;
for consistency, this requires a previous $\mathfrak{R}$ operation:
$\langle ..., [C + S_1 \vdash \varphi]_{S_1}, [C + S_1 \vdash \varphi + \varphi]_{S_1} \rangle +_{S_2} \mathfrak{R} +_{S_2} S_2 \vdash \neg\varphi$
$= \langle ..., [C + S_1 \vdash \varphi]_{S_1}, [C + S_1 \vdash \varphi + \varphi]_{S_1},$
$[C + S_1 \vdash \varphi]_{S_2}, [C + S_1 \vdash \varphi + S_2 \vdash \neg\varphi]_{S_2} \rangle$

See Figure 9 for illustration. Note that *no* itself does not reject, but enforces a prior rejection. This is as it should be, because in case the antecedent clause is negated, as in (29), the answer *no* does not necessarily reject. See Krifka (2013) for an argument that a negated TP introduces a non-negated propositional discourse referent.

(29) S_1: *Ed didn't meet Beth.*
S_2: *No, he didn't.*

4. Constituent Questions

We now turn to **questions**, and will first address constituent questions, also called *wh*-questions due to the typical way how they are expressed in English. Let us first look at the sentence radicals of questions, which occur in questions embedded under predicates like *know* or *find out*. I will model them as **sets of propositions**, following a line of thought originating in Hamblin (1973). For example, the embedded question *who Ed met* is supposed to form a CP with the wh-constituent in specifier position, and a set of propositions as interpretation.

(30) $[\![[_{CP}\ who\ [_{TP}\ Ed\ met\ t_{who}]]]\!]^{S_1S_2}$
$= \{\lambda i[\text{Ed stole x in i}] \mid x \in \text{PERSON}\}$
$= \{\lambda i[\text{Ed met Ann in i}],$
$\lambda i[\text{Ed met Beth in i}], \lambda i[\text{Ed med Carla in i}]\}$
$= \{\varphi_a, \varphi_b, \varphi_c\}$

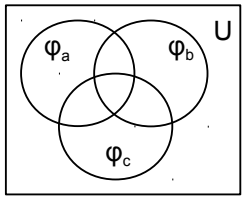
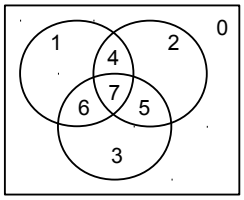


Figure 11: Constituent question radical



$\overline{\cap}\{\varphi_a,\varphi_b,\varphi_c\}$

Figure 10: Exhaustification

Figure 11 gives a representation by a Venn diagram. Groenendijk & Stokhof (1982) have proposed an alternative representation, in which questions denote a **partition** of the set of possible worlds. They propose a different interpretation algorithm, but the partitional analysis can be derived from the Hamblin meaning by an optional pragmatic exhaustification operation denoted by $\overline{\cap}$:

(31) Let M be a set of sets drawn from a universe U,
then $\overline{\cap}M = \{X|\exists M' \subseteq \overline{M}[X = \cap M' \wedge X \neq \varnothing \wedge \neg\exists M'' \subseteq \overline{M}[\cap M'' \subset \cap M']]\}$,
where $\overline{M} = \{X|X \in M \vee \overline{X} \in M\}$, and $\overline{X} = U - X$

Figure 10 shows the result of exhaustification of the situation in Figure 11. Note that without the minimization clause $\neg\exists M'' \subseteq \overline{M}[\cap M'' \subset \cap M']$ we would get all Boolean combinations of the original propositions φ_a, φ_b, φ_c.

Assuming an optional pragmatic exhaustification operation means that we have a weak literal interpretation of questions that can be strengthened pragmatically. This is different from Groenendijk & Stokhof's approach, who assume a strong literal interpretation that can be weakened for pragmatic reasons.

Question radicals occur as embedded questions, as in the following example (here without exhaustification):

(32) $[\![[_{TP}\ Dan\ knows\ [_{CP}\ who\ [_{TP}\ Ed\ met\ t_{wh}]]]]\!]^{S_1S_2}$
$= \lambda i \forall p \in [\![[_{CP}\ who\ [_{TP}\ Ed\ met\ t_{wh}]]\!]^{S_1S_2}[p(i) \rightarrow [\![know]\!](i)(p)([\![Dan]\!])]$
$= \lambda i \forall p \in \{\varphi_a, \varphi_b, \varphi_c\}[p(i) \rightarrow \text{Dan knows that p in i}]$

This is a proposition that is true at indices i for which it holds that for all questions φ_a, φ_b, φ_c, if they are true in i, then Dan knows that they are true in i.

Just as a TP was the truth-conditional semantic core of an assertion, an interrogative CP is the truth-conditional semantic core of a question act. I assume an operator "?" as head of the ActP of a question act. This has to be identified by the finite auxiliary verb moving into this position. Thus, we have the following structure:

(33) $[_{\text{ActP}}\ \textit{who}\ [_{\text{Act}^{\circ}}\ ?\textit{-did}\ [_{\text{CP}}\ t_{\text{who}}\ [_{\text{TP}}\ \textit{Ed}\ t_{\text{did}}\ \textit{meet}\ t_{\text{who}}]]]]]$

What does a question mean, as a speech act? We do not have to invent a new basic move, as questions try to elicit other speech acts, typically assertions, and we already have a way to represent assertions. We can understand questions as **projected assertions**, typically addressed to the other speaker. We can model the effect of this conversational move with the help of commitment spaces, which after all model possible future moves. Hence, question turn out as meta speech acts in which all immediate continuations that do not form a congruent answer are excluded:

(34) $\langle ..., [C]_{...} \rangle +_{S_1} [\![[_{\text{ActP}}[[?]\ [_{\text{CP}} ...]]]]\!]^{S_1S_2}$

$= \langle ..., [C]_{...}, [\cup \{\{\sqrt{C}\} + S_2 \vdash p \mid p \in [\![[_{\text{CP}} ...]]\!]^{S_1S_2}\}]_{S_1} \rangle$

$= \langle ..., [C]_{...},$
$[\{\sqrt{C}\} \cup \cup \{C + S_2 \vdash p \mid p \in [\![[_{\text{CP}} ...]]\!]^{S_1S_2}\}]_{S_1} \rangle$

$= \langle ..., [C]_{...},$
$[\{\sqrt{C}\} \cup \cup \{C + S_2 \vdash p \mid p \in \{\varphi_a, \varphi_b, \varphi_c\}\}]_{S_1} \rangle$

$= \langle ..., [C]_{...}, [\{\sqrt{C}\} \cup C + S_2 \vdash \varphi_a$
$\cup C + S_2 \vdash \varphi_b$
$\cup C + S_2 \vdash \varphi_c]_{S_1} \rangle$

$= \langle ..., [C]_{...}, [C']_{S_1} \rangle$

Notice, first, that this is a conversational move by the speaker S_1, as indicated in the resulting CSD. It consists of proposing a commitment space that consists of the root of the original commitment space, $\sqrt{C}$, updated by truth commitments of the **other** speaker, S_2, for each of the propositions in the set denoted by the question radical. The root of the commitment space does not change, so this is a meta speech act. The formation of this question is illustrated in Figure 12.

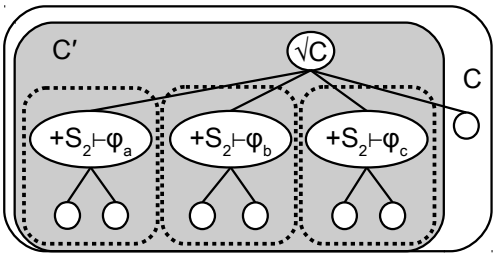


Figure 12: Constituent Question

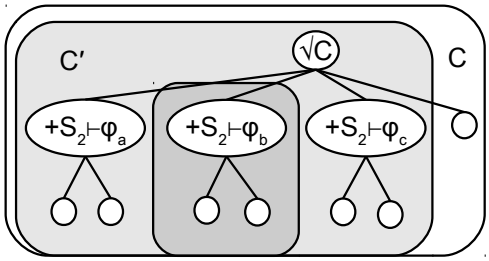


Figure 13: Fully congruent answer

The question operator ? itself is interpreted as follows; recall that S_1 refers to the speaker, hence the move is initiated by S_1 but asks for assertions by S_2. Here, P is a variable over sets of propositions.

(35) $[\![?]\!]^{S_1S_2} = \lambda P\, \lambda \langle ..., [C]_{...} \rangle\, \langle ..., [C]_{...}, [\cup \{\{\sqrt{C}\} + S_2 \vdash p \mid p \in P\}]_{S_1} \rangle$

What are the possible reactions to a question? In a fully congruent answer, the addressee simply performs one of the proposed assertions, thus restricting the commitment space (cf. Figure 13).

(36) Fully congruent answer:
(34) + $[\![[_{\text{ActP}}\ [\ [_{\text{Act}^0}\ .\ ]\ [_{\text{TP}}\ \textit{Ed met Beth}]]]]\!]^{S_2S_1}$
$= \langle ..., [C]_{...}, [C']_{S_1}\rangle +_{S_2} S_2 \vdash \varphi_b$
$= \langle ..., [C]_{...}, [C']_{S_1}, [C' + S_2 \vdash \varphi_b]_{S_2}\rangle$

We often understand answers to constituent questions exhaustively. One way in which this can be achieved is by exhaustification $\overline{\cap}$ at the level of the CP. In this case, the proposed assertions are propositions like 'Ed met only Beth', or 'Ed met only Ann and Beth'. Hence, a fully congruent answer would be *Ed met only Beth*. The answer *Ed met Beth* would not be quite congruent, but it would be entailed by exactly one of the congruent answers, and this is the answer selected. For another way of achieving exhaustivity, see section 5.

Questions can also be rejected, e.g. by *I don't know* or *I won't tell you.* This refusal to answer requires a prior reject operation, which undoes the effect of the last speech act. This is illustrated in example (37), and in Figure 14. Here, $\neg B\varphi$ stands for 'S_2 does not believe that φ'

(37) Refusal to answer, e.g.: *I don't know.*
$= \langle ..., [C]_{...}, [C']_{S_1}\rangle +_{S_2} \mathfrak{R} +_{S_2} S_2 \vdash [\![[_{\text{TP}}\ \textit{I don't know who Ed met}]]\!]^{S_2S_1}$
$= \langle ..., [C]_{...}, [C']_{S_1}, [C_{S_2}]\rangle +_{S_2} S_2 \vdash \lambda i[\forall p \in \{\varphi_a, \varphi_b, \varphi_c\}[p(i) \rightarrow \neg S_2 \text{ knows p at i}]]$
$= \langle ..., [C]_{...}, [C']_{S_1}, [C]_{S_2}, [C + S_2 \vdash \neg B\varphi_a \wedge \neg B\varphi_b \wedge \neg B\varphi_c]_{S_2}\rangle$

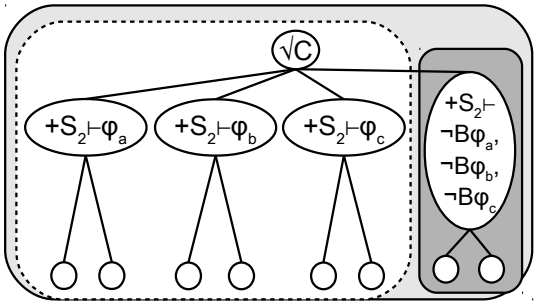


Figure 14: Refusal to answer

There are many possible reactions to questions that are neither fully congruent answers, nor refusals to answer, but answer a question partially, by excluding certain options – e.g. *Ed met Ann or Beth*, or *Ed met Ann, but not Beth.* Let us look as an example at the answer *Ed didn't meet Beth*. In case the question radical is exhaustive, this would mean that Ed met Ann and Carla and nobody else. We will consider the case in which the question radical is not exhaustive, which leaves the options that Ed met Ann or Beth. How can we model such excluding answers? One option is to assume a $\mathfrak{R}$ operation, followed by the assertion that Ed did not meet Beth. But there is another option as well. First, notice that update of (34) with the assertion *Ed didn't meet Beth* is possible, even though this is not a move that is proposed as an initial move after the root.

(38) $C' + [\![[_{\text{ActP}}\ [[.]\ \textit{Ed didn't meet Beth}]]]\!]^{S_2S_1}$
$= \{c \in C \mid \sqrt{C} + S_2 \vdash \neg\varphi_b \subseteq c\}$
$= C''$

This adds to each of the proposed assertions the truth commitment $S_2 \vdash \neg\varphi_b$, cf. Figure 15. As this is not compatible with the proposed assertion $+S_2 \vdash \varphi_b$, the branch that started with this assertion

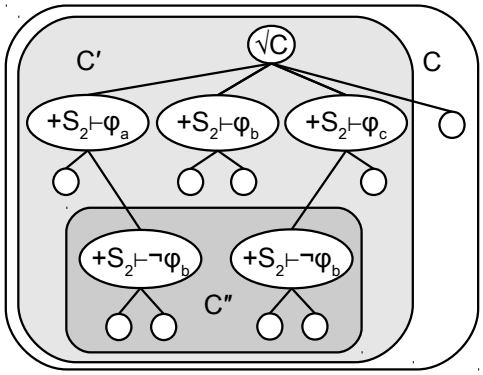


Figure 15: Excluding one alternative.

is discontinued; that is, as C only consists of coherent commitment states, there is no successor of $+S_2\vdash\varphi_b$ that would contain $S_2\vdash\neg\varphi_b$.

But there is a problem: The resulting set of commitment state is not a commitment space, as it lacks a root: It has two, not just one, minimal commitment states. I would like to propose that in case an update results in a non-rooted set of commitment states, there is a pragmatic rescue operation of **re-rooting**, which can be defined as follows:

(39) Re-rooting operation:
$\circ C = \{\cap C\} \cup C$

This adds to C the commitment state that is the intersection of all commitment states in C. If this intersection $\cap C$ is not empty, then it is the root of $\circ C$. In the case at hand, we have $\cap C'' = \surd C + S_2\vdash\neg\varphi_b$, which becomes the root of the resulting commitment space:

(40) $\circ C'' = \{\surd C + S_2\vdash\neg\varphi_b\} \cup C''$
$= C'''$

As Figure 16 illustrates, after re-rooting we get a commitment space in which the remaining question is *Who did Ed meet?*, where *Ed met Beth* has been eliminated.

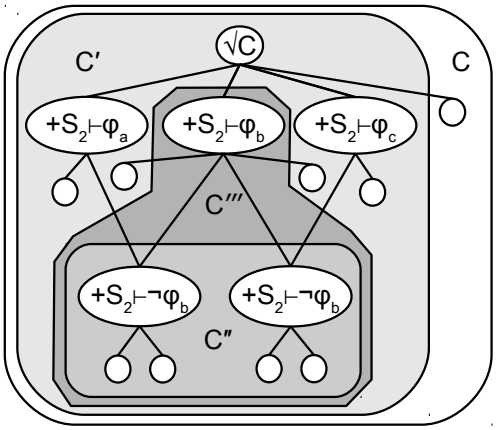


Figure 16:
Commitment space after re-rooting

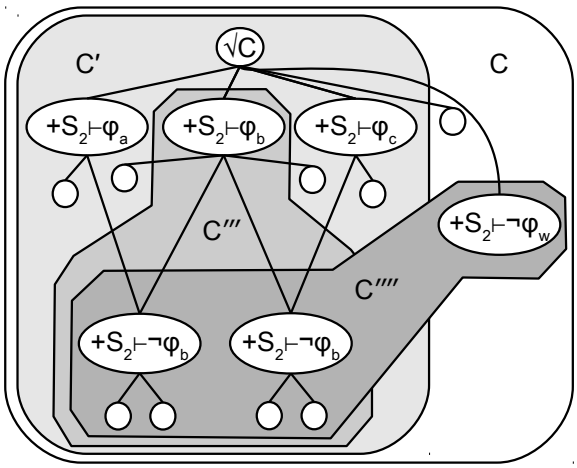


Figure 17:
Asserting another proposition, with re-rooting

This question could be answered in the next move, as in *Ed met Ann.* But more likely it will not be answered, as S_2 could have answered the initial question directly in this way. Other continuations, like *The weather was nice.* as an assertion by S_2, can be treated by a similar update of the resulting commitment state C‴ and a re-rooting operation, as illustrated in Figure 17. In this way, the commitment space keeps track of questions that remained unanswered.

We actually do not have to assume re-rooting as a rescue operation. We can integrate the rooting operator $\circ$ in the definition of updates, as we have for rooted commitment states C that $\circ C = C$. In particular, we can redefine (17)(b) as follows:

(41) $C + \mathfrak{A} = \mathfrak{A}(C)$,
where $\mathfrak{A} = \lambda C\,[\circ\{c \in C \mid \surd C + \mathfrak{A} \subseteq c\}]$

In closing this session, it should be stated that this treatment of questions and answers is not entirely new. For example, in the dialogue games of Carlson (1983), questions are

set-up moves whereas answers are pay-off moves. Similarly, Farkas & Bruce (2010) have the notion of putting a proposition on the table, which requires a reaction by the addressee. The notion of commitment space that might be narrowed down by asking a question appears to be more flexible than these alternative notions It is tool to capture long-term effects, as suggested with the notion of common ground management, cf. Krifka (2008).

5. Focus and question/answer congruence

We now turn to question-answer congruence, as in the following case:

(42) S_1: *Who did Ed meet?*
S_2: *Ed met BETH*$_F$

Having started with a Hamblin-style representation of questions, it is plausible to make use of **alternative semantics** as modeling the role of **focus in answers** (cf. Rooth 1992). This is what we get on the TP level, where ⟦...⟧ specifies the ordinary semantic value, and ⟦...⟧$_f$ the focus-induced set of alternative meanings. The alternative φ_d was added here because the focus alternatives are not necessarily restricted to persons, as was the case with the *who* question – it could be an object.

(43) a. $[\![[_{TP}\ \textit{Ed met BETH}_F]]\!]^{S_2S_1} = \lambda i$[Ed met Beth in i]
b. $[\![[_{TP}\ \textit{Ed met BETH}_F]]\!]_f^{S_2S_1} = \{\lambda i$[Ed met x in i] | x∈ THING$\} = \{\varphi_a, \varphi_b, \varphi_c, \varphi_d\}$

These propositional alternatives are used for speech acts. This has already been proposed by Jacobs (1984), who conceived of illocutionary operators as binding the focus within their sentences. Here, I assume that the alternatives spread to the ActP level, leading to sets of alternative illocutionary acts, and that these alternative acts are used to check certain features of the context – to be specific, the commitment space, and the commitment space development – at which a speech act is to be performed.

The projection of focus to the level of speech acts is accomplished by the general rule how focus spreads from subexpressions to superexpressions, here illustrated with the assertion operator.

(44) $[\![[.]\ [_{TP}\ \ldots]]\!]_f = \{[\![.]\!](p) \mid p \in [\![[_{TP} \ldots]]\!]_f\}$

The following example illustrates the result of this focus projection. Recall that $+_{S_2}S_2 \vdash \varphi_a$ is shorthand for a function, $\lambda\langle ..., C_{...}\rangle\ \langle ..., C_{...}, [C + S_2 \vdash \varphi_a]_{S_2}\rangle$.

(45) a. $[\![[_{ActP}\ [[.]\ [_{TP}\ \textit{Ed met BETH}_F]]]]\!]^{S_2S_1} = +_{S_2}\ S_2 \vdash \varphi_b$
b. $[\![[_{ActP}\ [[.]\ [_{TP}\ \textit{Ed met BETH}_F]]]]\!]_f^{S_2S_1} = \{+_{S_2}S_2 \vdash \varphi_a, +_{S_2}S_2 \vdash \varphi_b, +_{S_2}S_2 \vdash \varphi_c, +_{S_2}S_2 \vdash \varphi_d\}$

The pragmatic rule for act $\mathfrak{A}$ with alternatives $\mathfrak{A}_f$ is then as follows (to be modified later, cf. (80)), defined with re-rooted generalized speech act disjunction (cf. (13) for speech act disjunction).

(46) $C + \mathfrak{A}$ is defined only if $C = \circ \bigvee_{A \in \mathfrak{A}_f} C + A$

In words, for updating a commitment space C with a speech act $\mathfrak{A}$ that comes with a set of alternatives $\mathfrak{A}_f$ the input commitment space C should be identical to the commitment

space $\circ\cup\{C+A \mid A\in\mathfrak{A}_f\}$ that we get by forming the union of all the commitment spaces that can be generated by updating C with the alternatives A of $\mathfrak{A}$, and by re-rooting that union of commitment spaces.

To show that (45) satisfies this requirement in the context (34) after the question *Who did Ed meet?* we have to show the following:

(47) $C' = \circ\cup\{C'+A \mid A\in \{+S_2\vdash\varphi_a, +S_2\vdash\varphi_b, +S_2\vdash\varphi_c, +S_2\vdash\varphi_d\}\}$
where $C' = \{\surd C\} \cup C+S_2\vdash\varphi_a \cup C+S_2\vdash\varphi_b \cup C+S_2\vdash\varphi_c$

This is indeed the case, as Figure 19 illustrates. In particular, notice that $C' + S_2\vdash\varphi_d$ does not introduce additional commitment states, as $\surd C' \cup \{S_2\vdash\varphi_d\}$ is not in C', and all other continuations of $\surd C'$ in C' occur in one of the three continuations that are already specified.

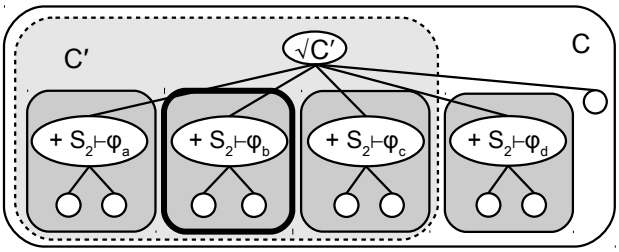


Figure 19: Answering a question, with answer alternatives

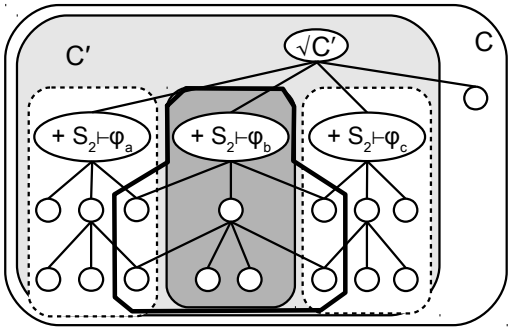


Figure 18: Pragmatic exhaustification by scalar implicature.

The alternative assertions generated by focus do not only check the context in which they are uttered, they also induce a **scalar implicature**, namely that the assertion that is actually made is the only one that can be made. We can express this scalar implicature nicely in the framework developed here, by assuming that all the other assertion alternatives within C' are **denegated**. We can define an update strengthened by implicature, for which we write ++, and which is defined as follows (this uses the concept of speech act conjunction, which will officially be introduced below).

(48) Scalar implicature,
triggered by assertion $\mathfrak{A}$ with alternatives $\mathfrak{A}_f$:
$C ++ \mathfrak{A} = [C + \mathfrak{A}] \cap \bigcap \{C + {\sim}A \mid A \neq \mathfrak{A} \wedge A \in \mathfrak{A}_f\}$

Figure 18 is an attempt to illustrate this. In a first step, S_1 reduces C to C', which elicits assertions like $S_2\vdash\varphi_a$, $S_2\vdash\varphi_b$, $S_2\vdash\varphi_c$. S_2 chooses $S2\vdash\varphi_b$; this is the area with the bold circumference. The alternative assertions are denegated; this is indicated by the dotted areas. By denegation, future assertions of φ_a and φ_c are ruled out, and we end up with the dark area in the middle as the new commitment space. Notice that this is different from the case in which S_2 would explicitly assert $\neg\varphi_a$, or $\neg\varphi_c$, and commit to these propositions. All that S_2 has done is to abstain from asserting φ_a and φ_c. No conflict would arise if another participant would assert φ_a or φ_b. Furthermore, as a change of the continuations of a commitment space should be achieved more easily than a change of the commitment state of the root itself, it would even be possible for S_2 to assert φ_a later. This is different from the semantic exhaustivity that would be achieved by exhaustifying the

underlying question radical (cf. discussion after (36)). Thus, the proposed model offers a way to express the difference between asserted meanings and scalar implicatures.

To conclude this section, it should be mentioned that focus-induced alternatives on illocutionary acts may also **accommodate** an appropriately restricted input commitment space. These are the implicit questions assumed in many frameworks.

6. Polar Question and Alternative Question Radicals

We now turn to polar questions, also known as yes/no-questions due to the typical way how they are answered in English. We again first look at the question radicals that appear in embedded questions, in particular at questions with the complementizer *whether*. The standard account of *whether* questions is that they denote a proposition and its negation:

(49) $[\![[_{CP}$ *whether* $[_{TP}$ *Ed met Beth*$]]]\!]$
$= \{[\![[_{TP}$ *Ed met Beth*$]]\!], \neg[\![[_{TP}$ *Ed met Beth*$]]\!]\}$,
$= \{\varphi_b, \neg\varphi_b\}$

The problem with this representation of *whether* questions is that it assigns the same meaning to the following CPs:

(50) a. $[_{CP}$ *whether Ed met Beth*].
b. $[_{CP}$ *whether Ed didn't meet Beth*].
c. $[_{CP}$ *whether Ed met Beth or not*].

This might be not much of a problem when we look at these CPs in the context of *Dan found out* $[_{CP}$ …], which arguably would lead to the same truth conditions. But the truth conditions are subtly different under *wondered,* and clearly distinct under *doubt*, where (c) would be anomalous. There are suggestions for distinct representations of the clauses in (50), such as Biezma & Rawlins (2012), who propose that (a) denotes a proposition with its negation as a salient alternative, and (c) denotes a set of two propositions.

Here I will propose that *whether* is an operator that, just like other wh-elements, creates an interrogative meaning, as usual of the type of a set of propositions. But it does so by creating a **singleton** set of propositions, resulting in what I would like to call a **monopolar** question radical.

(51) $[\![[_{CP}$ *whether* $[_{TP}$ *Ed met Beth*$]]]\!] = \{[\![[_{TP}$ *Ed met Beth*$]]\!]\} = \{\varphi_b\}$

We could assign *whether* the meaning $\lambda p\{p\}$ that would achieve this interpretation. – As we have seen in the case of constituent questions, cf. (31), question meanings can be pragmatically strengthened by exhaustification. In the case of a *whether*-question, this leads to the usual representation as a set containing two propositions, one being the negation of the other, which we will call the **bipolar** interpretation.

(52) $\overline{\cap}\{\varphi_b\} = \{\varphi_b, \neg\varphi_b\}$

Of course, exhaustifying $[_{CP}$ *whether Ed didn't meet Beth*] leads to exactly the same result. Hence while (50)(a) and (b) are semantically different, they are pragmatically equivalent after exhaustification.

Questions like (50)(c) belong to the paradigm of alternative questions, and for that we also have to consider examples like the following:

(53) $[_{CP}$ *whether* $[_{TP}$ $[_{TP}$ *Ed met* $ANN_F]$ *or* $[_{TP}$ *Ed met* $BETH_F]]]$

These questions have obligatory focus on the disjuncts; this holds for (50)(c) as well (with focus on [*Ed met Ann*] and [*not*]). We assume, as usual, that focus induces alternatives, and that the alternatives of the constituents of coordinations are constrained by each other (mediated by Rooth's squiggle operator ~, similar as in his case of *an* $AMERICAN_F$ *farmer met a* $CANADIAN_F$ *farmer*, cf. Rooth 1992). For our example, this means that we have the following focus alternatives on the TP level:

(54) a. $[\![[_{TP}$ *Ed met* $ANN_F]]\!]_f = \{\varphi_a, \varphi_b\}$
b. $[\![[_{TP}$ *Ed met* $BETH_F]]\!]_f = \{\varphi_a, \varphi_b\}$
c. $[\![[_{TP}$ $[_{TP}$ *Ed met* $ANN_F]$ *or* $[_{TP}$ *Ed met* $BETH_F]]]\!]_f$
$= \{p \vee p' \mid p \in [\![[_{TP}$ *Ed met* $ANN_F]]\!] \wedge p' \in [\![[_{TP}$ *Ed met* $BETH_F]]\!]\}$
$= \{\varphi_a \vee \varphi_a, \varphi_a \vee \varphi_b, \varphi_b \vee \varphi_a, \varphi_b \vee \varphi_b\}$
$= \{\varphi_a, \varphi_b, \varphi_a \vee \varphi_b\}$
strengthened to $\{\varphi_a, \varphi_b\}$, as $\varphi_a \vee \varphi_b$ is entailed by φ_a and φ_b

The last step of pragmatic strengthening is well motivated; for example, one cannot refute the sentence *Ed met only BETH* by pointing out that Ed also met Beth or Ann. We get the same meaning with a more narrow-scope disjunction, as in [*Ed met* [ANN_F *or* $BETH_F$]]; in this case the focus interpretation spreads as usual from the embedded constituent to the clause.

The contribution of *whether* is to make the focus meaning the ordinary meaning; this corresponds to the Q operator in Beck (2006).

(55) a. $[\![[_{CP}$ *whether* $[_{TP}$ … $]]]\!] = [\![[_{TP}$ ...$]]\!]_f$
b. $[\![[_{CP}$ *whether* $[_{TP}$ $[_{TP}$ *Ed met* $ANN_F]$ *or* $[_{TP}$ *Ed met* $BETH_F]]]]\!] = \{\varphi_a, \varphi_b\}$

We can apply this interpretation also to (50)(c). I assume that focus is on the whole TP, and that *not* is an anaphoric element picking up an antecedent proposition and negating it (cf. Krifka 2013). We then get the following interpretation:

(56) a. $[\![[_{TP}$ $[_{TP}$ *Ed met* $BETH]_{i,F}$ *or* $[_{TP}$ $NOT]_{i,F}]]\!]_f = \{\varphi_b, \neg\varphi_b\}$
b. $[\![[_{CP}$ *whether* $[_{TP}$ $[_{TP}$ *Ed met* $BETH]_F$ *or* $[_{TP}$ $NOT_F]]]]\!] = \{\varphi_b, \neg\varphi_b\}$

Interestingly, the interpretation of *whether* in (55)(a) can also induce monopolar question meanings if we assume that the TPs of such questions do not have a focus that is used by *whether*. Recall that it is generally assumed in Alternative Semantics that for expressions without focus, the focus interpretation is the singleton set of the ordinary value.

(57) a. $[\![[_{TP}$ *Ed met Beth*$]]\!]_f = \{\varphi_b\}$
b. $[\![[_{CP}$ *whether* $[_{TP}$ *Ed met Beth*$]]]\!] = \{\varphi_b\}$

This reading is similar to the embedded constituent question *who Ed met*, where the range is restricted to alternatives of Beth.

The question radicals we have derived can occur as embedded questions, just as the case with constituent questions. We illustrate this with the following case of an alternative question:

(58) ⟦[$_{TP}$ *Dan knows* [$_{CP}$ *whether* [[$_{TP}$ *Ed met BETH*]$_{F}$ *or* [*NOT*]$_{F}$]]]⟧
= λi ∀p∈ {φ_b, ¬φ_b} [p(i) → Dan knows that p in i]

The monopolar question would have a different literal interpretation:

(59) ⟦[$_{TP}$ *Dan knows* [$_{CP}$ *whether* [$_{TP}$ *Ed met Beth*]]]⟧
= λi ∀p∈ {φ_b} [p(i) → Dan knows that p in i]

Assume that φ_b is not true in i, then this says nothing about Dan's epistemic state towards φ_b. However, we typically understand this sentence as saying that Dan then knows that ¬φ_b. This stronger reading can come about by exhaustification of ⟦[$_{TP}$ *Ed met Beth*]⟧$_f$, which gives us $\overline{\cap}${φ_b} = {φ_b, ¬φ_b}, and hence the same interpretation as (58). We can argue that the non-exhaustified reading in (59) is blocked because in case φ_b is true at i, then the same meaning can be expressed by the simpler *Dan knows that Ed met Beth*, and in case φ_b is false at i, the quantificational domain would be empty.

Before concluding, I should point out that the way we constructed the meaning of *whether*-questions from focus also gives us a reading for (60)(a), which is similar to the embedded constituent question *who Ed met*, where the range is restricted to alternatives of Beth.

(60) a. ⟦[$_{CP}$ *whether* [$_{TP}$ *Ed met BETH*$_F$]]⟧ = ⟦[$_{TP}$ *Ed met BETH*$_F$]⟧$_f$ = {φ_a, φ_b, φ_c}
b. ⟦[$_{TP}$ *Dan knows* [$_{CP}$ *whether Ed met BETH*$_{F]}$]⟧
= λi ∀p∈ {φ_a, φ_b, φ_c}[p(i) → Dan knows that p in i]

The sentence with embedded question (60)(b) is predicted to mean that Dan knows which of the alternatives of Beth (including Beth) Dan knows. And indeed, there is a difference between (59) and (60)(b) that at least points towards that direction.

In the following section, we turn to question acts made on the basis of polar questions, and we will see that the difference between monopolar and bipolar question acts is of great importance.

7. Polar Question Acts

Polar question acts can be derived in precisely the same way from their sentence radicals as with constituent questions, illustrated in (34). That is, we assume here an underlying *whether* CP that is turned into a question by the ? operator. Different from constituent questions, there is no overt wh-word in polarity questions. If we want to preserve maximal similarity with constituent questions, we can assume that *whether* is moved but not pronounced, arguably because it is not licensed as a constituent within the TP, and its effects are expressed by verb-initial syntax in English. In the conclusion I will mention a different way of constructing the syntax/semantics mapping in which question speech acts are not derived from the embedded questions, and consequently no *whether* deletion is required.

We first consider **monopolar** question acts. They are derived from *whether* CPs without exhaustification. Figure 20 illustrates this with an example.

(61) ⟨..., [C]…⟩
$+_{S1}$ ⟦[$_{ActP}$ ~~*whether*~~ [[$_{Act^o}$?-*did*] [$_{CP}$ t_{wh} [$_{TP}$ *Ed* t_{did} *meet Beth*]]]]⟧^{S_1S_2}
= ⟨..., [C]…, [{√C} ∪ ∪ {C + S_2⊢p | p ∈ ⟦[$_{CP}$ ~~*whether*~~ [$_{TP}$ ...]]⟧^{S_1S_2}]$_{S_1}$⟩
= ⟨..., [C]…, [{√C} ∪ ∪ {C + S_2⊢p | p ∈ {φ_b}]$_{S_1}$⟩
= ⟨..., [C]…, [{√C} ∪ C + S_2⊢φ_b]$_{S_1}$⟩

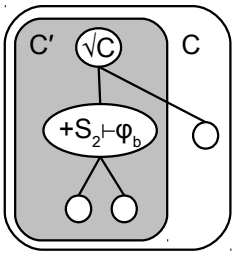


Figure 20:
Monopolar question

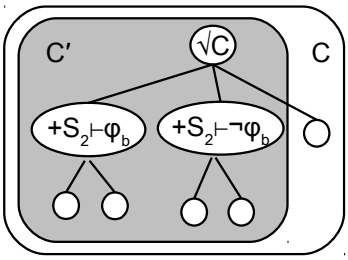


Figure 21: Bipolar question

Bipolar question are derived by the same underlying syntactic structure, after exhaustification. See Figure 21 for illustration.

(62) ⟨..., [C]…, [{√C} ∪ ∪ {C + S_2⊢p | p∈ $\overline{\cap}${φ_b}]$_{S_1}$⟩
= ⟨..., [C]…, [{√C} ∪ {C + S_2⊢p | p∈ {φ_b, φ_b}]$_{S_1}$⟩
= ⟨..., [C]…, [{√C} ∪ C + S_2⊢φ_b ∪ C + S_2⊢λi¬φ_b]$_{S_1}$⟩

The response particles *yes* and *no* are the standard ways to answer polar questions. I assume that they work in the same way as with assertions: They pick up the propositional discourse referent corresponding to the TP of the antecedent clause, φ = λi[Ed came in i] (cf. Krifka 2013).

(63) Congruent answers *yes*:

a. To bipolar question:
(62) $+_{S_2}$ ⟦*yes*$_\varphi$⟧^{S_2S_1}
= (62) $+_{S_2}$ S_2⊢φ_b

b. To monopolar question:
(61) $+_{S_2}$ ⟦*yes*$_\varphi$⟧^{S_2S_1}
= (61) $+_{S_2}$ S_2⊢φ_b

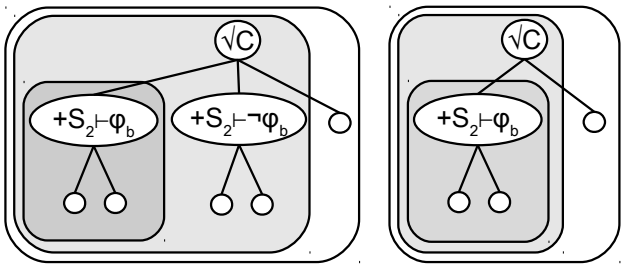


Figure 22: Response *yes*
after bipolar (left) and monopolar (right) question.

(64) Congruent answer *no*:

a. To bipolar question:
(62) $+_{S_2}$ ⟦*no*$_\varphi$⟧^{S_2S_1}
= (62) $+_{S_2}$ S_2⊢¬φ_b

b. To monopolar question:
(61) $+_{S_2}$ ℜ $+_{S_2}$ ⟦*no*$_\varphi$⟧^{S_2S_1}
= (61) $+_{S_2}$ ℜ $+_{S_2}$ S_2⊢¬φ_b.

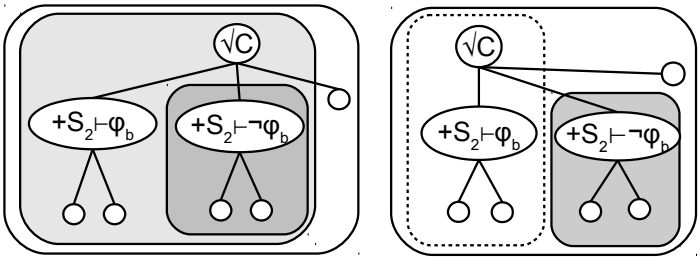


Figure 23: Response *no*
after bipolar (left) and monopolar (right) question

This captures the **bias** of monopolar questions, in comparison to bipolar questions: For

monopolar questions, the agreeing answer *yes* is a congruent answer, but the answer no requires a reject operation, and hence a more complex move. Hence the speaker can express a tendency towards one answer for strategic purposes.

I consider this an advantage over alternative attempts to characterize biased polar questions. For example, Roelofsen & Farkas (to appear) have to assume a separate "highlighting" of one of the two alternative propositions that is extraneous to the underlying framework of inquisitive semantics. Reese (2007) treats biased questions as a combination of a question and an assertion, using a speech act combination operator, the dot operator, within Segmented Discourse Representation Theory. Within the current theory, no such combination is necessary.

It should also be pointed out that the current proposals breaks with the usual representation of questions within the propositional representation frameworks (for a comparison with others, cf. Krifka 2011). For these frameworks, it is the essence of questions (in contrast to propositions) that they provide for two or more alternative propositions. For example, for Inquisitive Semantics (cf. Ciardelli e.a. 2013), questions are generated by a disjunction operator, which by necessity coordinates two or more meanings. In the current framework, monopolar questions are a simple extension (or rather, reductions) of bipolar questions, and still do not coincide with assertions.

It should be noted that the representation developed here extends to **alternative questions** in a straightforward way. They are derived just like polar questions by applying the ? operator to a *whether* question radical. They result in a meaning similar to a constituent question with two or more projected assertions, depending on the number of alternatives.

(65) $\langle ..., [C]_{...} \rangle +_{S_1}$
$[\![[_{ActP} [[_{Force0} ?\text{-}did] [_{CP} \sout{whether} [_{TP} Ed\ met [[t_{wh} [Ann]] or [t_{wh} [Beth]]]]]]]]]\!]^{S_1S_2}$
$= \langle ..., [C]_{...}, [\{\sqrt{C}\} \cup \cup \{C + S_2 \vdash p \mid p \in [\![[_{CP} \dots]]\!]^{S_1S_2}\}]_{S_1} \rangle$
$= \langle ..., [C]_{...}, [\{\sqrt{C}\} \cup \cup \{C + S_2 \vdash p \mid p \in \{\varphi_a, \varphi_b\}\}]_{S_1} \rangle$

The resulting situation is illustrated in Figure 24. In case the alternatives are formed by a disjunction of the TP and the anaphoric *or not*, we end up with a bipolar question, which is the same as the one that is illustrated in Figure 21.

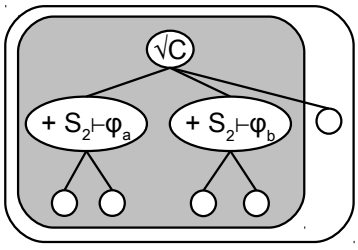


Figure 24: Alternative question

(66) $\langle ..., [C]_{...} \rangle +_{S_1} [\![[_{ActP} \sout{whether} [[_{Act^o} ?\text{-}did]$
$[_{CP} [_{CP} t_{wh} [_{TP} Ed\ t_{did}\ meet\ Beth]]\ or$
$[_{CP} t_{wh} [_{TP} not [_{TP} \sout{Ed\ t_{did}\ meet\ Beth}]]]]]]\!]^{S_1S_2}$
$= \langle ..., [C]_{...}, [\{\sqrt{C}\} \cup \{C + S_2 \vdash \varphi_b, C + S_2 \vdash \neg\varphi_b\}]_{S_1} \rangle$

This forces a bipolar reading, in contrast to the question *Did Mary meet Beth?*, which we argued above to be ambiguous between a monopolar reading and a bipolar reading.

8. Focus in Polarity Questions

We now turn to focus in polarity questions, as in the following examples:

(67) *Did Ed meet ANN*$_F$?
Was it ANN that Ed met?

I assume that focus in questions works just as focus in other cases, by introducing alternative meanings. For CPs of questions, which have sets of propositions as their regular meanings, this leads to sets of sets of propositions.

(68) a. $[\![[_{CP}\ \textit{whether}\ [_{TP}\ \textit{Ed met BETH}_F]]]\!]$
$= \lambda i$[Ed met Ann in i], $= \{\varphi_b\}$
b. $[\![[_{CP}\ \textit{whether}\ [_{TP}\ \textit{Ed met BETH}_F]]]\!]_f$
$= \{\lambda i$[Ed met x in i] | x$\in$ THING$\}$, $= \{\{\varphi_a\}\ \{\varphi_b\}, \{\varphi_c\}, \{\varphi_d\}\}$

Note that we work here with the monopolar readings of questions, not with the exhaustified bipolar readings. There are two reasons for this: First, this is the basic reading of polar question radicals, as exhaustification requires the application of an operator, $\overline{\cap}$. The second reason is more tentative. The alternatives should correspond to the regular meaning, so exhaustification should apply to them as well. So we would have to assume that focus projection permeates the application of the $\overline{\cap}$ operator, which may well be a constitute a general problem, as this is a pragmatic operator.

I assume that focus projects further to the level of the Act Phrase, leading to a monopolar question act as the interpretation proper, and as a set of monopolar question acts as the alternatives. They are represented as functions on commitment spaces.

(69) a. $[\![[_{ActP}\ \sout{\textit{whether}}\ [[?\textit{-did}]\ [_{CP}\ t_{wh}\ [_{TP}\ \textit{Ed}\ t_{did}\ \textit{meet BETH}_F]]]]]\!]^{S_1S_2}$
$= \lambda C[\{\sqrt{C}\}+S_2\vdash\varphi_b]$
b. $[\![[_{ActP}\ \sout{\textit{whether}}\ [[?\textit{-did}]\ [_{CP}\ t_{wh}\ [_{TP}\ \textit{Ed}\ t_{did}\ \textit{meet BETH}_F]]]]]\!]_f^{S_1S_2}$
$=\{\lambda C[\{\sqrt{C}\}+S_2\vdash\varphi_a], \lambda C[\{\sqrt{C}\}+S_2\vdash\varphi_b], \lambda C[\{\sqrt{C}\}+S_2\vdash\varphi_c], \lambda C[\{\sqrt{C}\}+S_2\vdash\varphi_d]\}$

Now observe what happens if this monopolar question act and its alternatives are applied to a commitment state development. We assume that the set of alternatives expresses the same restriction as in the case of assertions, cf. (46), where we imposed the condition that the input commitment space C is identical to $\circ\cup\{C+A \mid A\in\mathfrak{A}_f\}$

(70) $\langle ..., [C]_{...}\rangle +_{S_1} [\![[_{ActP}\ [?\ [_{CP}\ \ldots]]]]\!]^{S_1S_2} = \langle ..., [C]_{...}, [C + [\![[_{ActP}\ [?\ [_{CP}\ ...]]]]\!]^{S_1S_2}]_{S_1}\rangle$,
provided that $C = \circ\cup\{C+A \mid A\in [\![[_{ActP}\ [?\ [_{CP}\ \ldots]]]]\!]_f^{S_1S_2}\}$

For our example, this amounts to the following:

(71) $\langle ..., [C]_{...}\rangle +_{S_1} [\![[_{ActP}\ \sout{\textit{whether}}\ [[?\textit{-did}]\ [_{CP}\ t_{wh}\ [_{TP}\ \textit{Ed}\ t_{did}\ \textit{meet BETH}_F]]]]]\!]^{S_1S_2}$
$= \langle ..., [C]_{...}, [\{\sqrt{C}\}\cup\{C + S_2\vdash\varphi_b\}]_{S_1}\rangle$,
provided that
$C = \circ\cup\{\{\sqrt{C}\}\cup\{C+S_2\vdash\varphi_a\}, \{\sqrt{C}\}\cup\{C+S_2\vdash\varphi_b\}, \{\sqrt{C}\}\cup\{C+S_2\vdash\varphi_c\}, \{\sqrt{C}\}\cup\{C+S_2\vdash\varphi_d\}\}$
$= \{\sqrt{C}\} \cup \{C+S_2\vdash\varphi_a, C+S_2\vdash\varphi_b, C+S_2\vdash\varphi_c, C+S_2\vdash\varphi_d\}$

What form should the input commitment space C have in order to satisfy this restriction? It is satisfied if C is the result of the asking the question *Who did Ed meet?* Just as before, this question either has been asked explicitly before, or a commitment space to this effect is accommodated. The following example illustrates the case that the question is asked explicitly by S_1, as in the well-formed sequence *Who did Ed meet? Did he meet BETH*$_F$*?*

(72) a. $\langle ..., [C']_{...} \rangle +_{S_1} [\![[_{ActP}$ *who did Ed meet*$]]\!]^{S_1S_2}$
$= \langle ..., [C']_{...}, [\{\sqrt{C'} \cup C'+S_2\vdash\varphi_a \cup C'+S_2\vdash\varphi_b \cup C'+S_2+\varphi_c\}]_{S_1} \rangle$
$= \langle ..., [C']_{...}, [C]_{S_1} \rangle$

b. $\langle ..., C', C \rangle + (69) = \langle ..., [C']_{...}, [C]_{S_1}, [\{\sqrt{C}\} \cup C+S_2\vdash\varphi_b]_{S_1} \rangle$,
provided that $C = \{\sqrt{C}\} \cup C+S_2\vdash\varphi_a \cup C+S_2\vdash\varphi_b \cup C+S_2\vdash\varphi_c\}$

Figure 25 illustrates the effect of the question *Who did Ed meet?* Figure 25 then indicates how the alternatives of the monopolar question *Did Ed meet BETH*$_F$*?* introduce a condition that is satisfied by the commitment state C. In particular, the union of all updates of C with an alternative of this question yields the input commitment state C again. Notice that the question alternative $+S_2\vdash\varphi_d$ (which might ask for a non-person) does not have an effect, as C is restricted to updates to persons. It should be stressed here that we applied exactly the same rule for the exploitation of focus as with assertions.

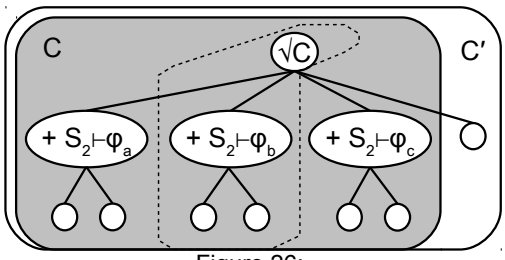


Figure 26:
Commitment state after *Who did Ed meet?*

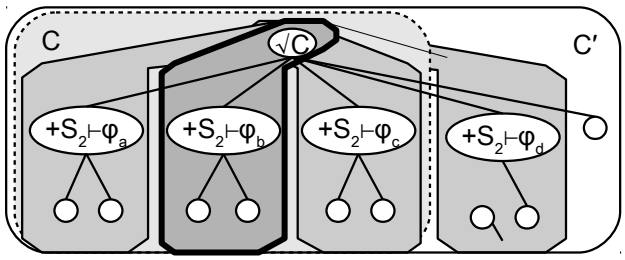


Figure 25:
Alternatives of monopolar question *Did Ed meet BETH*$_F$*?*

Let us now consider answers to monopolar questions with focus. The answer *yes*, asserting the proposition φ_b, is congruent with respect ot the monopolar question that was asked. The answer *no* asserts the negation of this proposition, $\neg\varphi_b$. As this is not compatible with the only option presented by the question, this necessitates a prior reject operation $\mathfrak{R}$. The rejection will put things back to the preceding commitment space, C, which is the commitment space after the question *Who did Ed meet?* After asserting $\neg\varphi_b$ with respect to this background, the effect of the question remains, as we have seen above with example (38)ff., and illustrated in Figure 16. This captures the appropriate reactions after answering a polar question with focus, in particular, that the answer *no* is felt to be an insufficient move.

(73) a. A: *Did Ed meet BETH*$_F$? B: *Yes*.
b. A: *Did Ed meet BETH*$_F$*?* B: *#No. / *B: *No, he met Ann.*

It was crucial for this analysis that the polar question with focus was analyzed as a monopolar question. We now turn to focus in other types of questions.

9. Contrastive Topics in Questions and Answers

As we have argued in the introductin, the other strategy for focus in questions that is applicable to non-polar questions, including constituent questions, involves a focus that expresses contrastive topic. Different from the type of focus in question discussed in the preceding section, which is expressed by a H* tone, this one is expressed by L+H*, just

as other cases of contrastive topics. The following example shows that the contrastive topic of the question corresponds to the contrastive topic of the answer:

(74) S_1: *I want to know who Ed and Dan met. Let's start. Who did* ED_{L+H^*} *meet* $_{H\%}$*?*
S_2: ED_{L+H^*} *met* $BETH_{H^*L\%}$ *, and* DAN_{L+H^*} *met* $ANN_{H^*\,L\%}$.

We find contrastive topics also in polar questions, as in the following examples:

(75) S_1: *I want to know who met Beth. Let's start. Did* ED_{L+H^*} *meet Beth* $_{H\%}$*?*
S_2: ED_{L+H^*} DID_{H^*} *meet* $Beth_{L\%}$*, but* DAN_{L+H^*} $DIDn't_{H^*\,L\%}$.

In the literature, contrastive topics are typically seen as a strategy of answering complex questions, e.g. conjoined questions (cf. van Kuppevelt 1995, Roberts 1996). They lead to questions under discussion that have a tree-like structure, so-called discourse trees (cf. Büring 2003).

(76) S_1: *Who did Ed and Dan meet?*
S_2: ED_{L+H^*} *met* $BETH_{H^*}$ *, and* DAN_{L+H^*} *met* $ANN_{H^*\,L\%}$.

Note that in this example there is no contrastive topic in the question. But we could easily provide it by explicitly splitting up the question into subquestions, as in *Who did* Ed_{CT} *meet? And, who did* Dan_{CT} *meat?* and then contrastive topics in questions appear.

The underlying idea that I would like to propose is the following: Contrastive topics indicate **alternative illocutionary acts** (cf. Krifka 2001, Tomioka 2010 for the idea that contrastive topics are interpreted on the speech act level). In particular, they are alternative illocutionary acts **that could be performed at the current point in conversation**. In this, they are similar to foci, which also indicate alternative illocutionary acts that could be performed, as we have seen before. The difference is the following: The **focus alternatives** are **explicitly not performed**. I have argued that they are even denegated. The assertion *Ed met* $BETH_F$ suggests that assertions like *Ed met Carla* will not be performed. The **contrastive topic alternatives**, however, are not ruled out. It is even suggested that they might be performed in the future, or that they have been performed already. The assertion Ed_{CT} *met* $BETH_F$ suggests that assertions like *Dan met ...* have been performed, or will be performed.

We need a way to represent speech acts with contrastive topics syntactically. I will work here with the following representation, illustrated by way of examples, where CTP stands for **contrastive topic phrase**, and CT for **contrastive topic**; the alternatives of the contrastive topic are indicated by a focus feature within the CT.

(77) a. $[_{CTP}\,[_{CT}$ (*as for*) $[Ed]_F]\,[_{ActP}$ *who did* he_{Ed} *meet*$]]$
b. $[_{CTP}[\,[Ed]_F\,[_{ActP}$ *who did* t_{Ed} *meet*$]]]$

The contrastive topic is contrastive, that is, it carries a focus, and hence it comes with alternatives. Furthermore, the interpretation of the rest of the sentence is dependent on the choice of the contrastive focus term. In the examples (77)(a,b) this dependency is expressed by coindexation with a pronoun, but there are other ways of how it can come about. Here I will assume that a speech act with a contrastive topic is dependent on a parameter that is identified by the contrastive topic. I will write such illocutionary acts with a parameter in the format $\mathfrak{A}$[...]. Technically, it is a function of contrastive topic meanings into illocutionary acts, $\lambda x[\mathfrak{A}[x]]$.

The performance of a speech act $\mathfrak{A}[\alpha]$ with a contrastive topic α and a set of alternatives ALT(α) consists in the following: $\mathfrak{A}[\alpha]$ is performed, and it is indicated that alternative speech acts $\mathfrak{A}[x]$, with $x \in$ ALT(α), are performed as well, either before or after the performance of $\mathfrak{A}[\alpha]$.

Discourse tree theorists typically illustrate contrastive topics with answers to conjoined questions that cannot be answered with one simple sentence. We follow this practice with the following leading question:

(78) *Who did Ed meet? And, who did Dan meet?*

As I argued in Krifka (2001), this is a case of speech act conjunction. We can express this with the help of the conjunction operation for speech acts, cf. (12). I will illustrate this under the assumption that there are two candidates that might be met, Ann and Beth.

(79) $C +_{S_1} [\![[_{\text{ActP}} [_{\text{ActP}}$ *who did Ed meet?*$]$ *and* $[_{\text{ActP}}$ *who did Dan meet?*$]]]\!]^{S_1S_2}$
$= [\![[_{\text{ActP}}$ *who did Ed meet?*$]]\!]^{S_1S_2}$ & $[\![[_{\text{ActP}}$ *who did Dan meet?*$]]\!]^{S_1S_2}$
$= [C + [\![[_{\text{ActP}}$ *who did Ed meet?*$]]\!]^{S_1S_2}] \cap [C + [\![[_{\text{ActP}}$ *who did Dan meet?*$]]\!]^{S_1S_2}]$
$= [\{\sqrt{C}\} \cup \cup\{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{ea} \subseteq c\} \cup \{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{eb} \subseteq c\}] \cap$
$[\{\sqrt{C}\} \cup \cup\{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{da} \subseteq c\} \cup \{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{db} \subseteq c\}]$
$= \{\sqrt{C}\} \cup \cup\{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{ea} \subseteq c + S_2 \vdash \varphi_{da} \subseteq c\}$
$\cup \cup\{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{ea} \subseteq c + S_2 \vdash \varphi_{db} \subseteq c\}$
$\cup \cup\{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{eb} \subseteq c + S_2 \vdash \varphi_{da} \subseteq c\}$
$\cup \cup\{c \subseteq C \mid \sqrt{C} + S_2 \vdash \varphi_{eb} \subseteq c + S_2 \vdash \varphi_{db} \subseteq c\}$
$= C'$

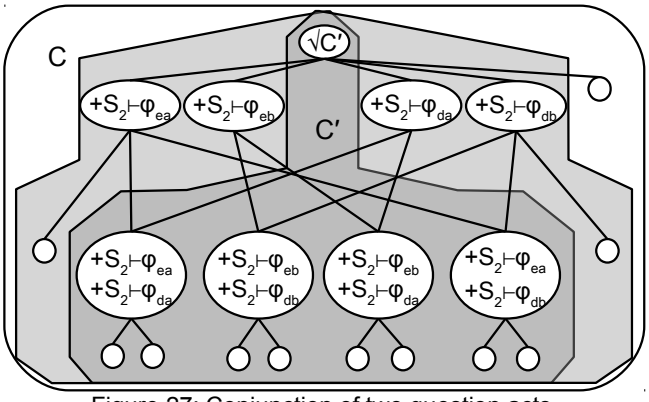


Figure 27: Conjunction of two question acts, *Who did Ed meet? And who did Dan meet?*

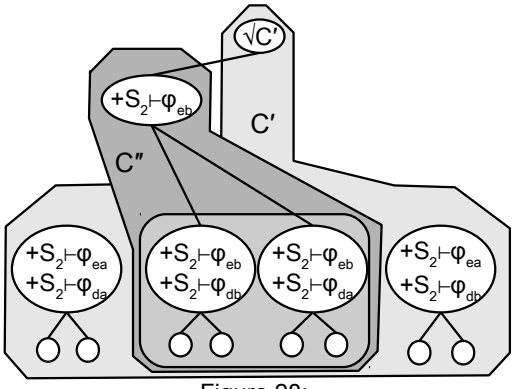


Figure 28: Assertion *Ed met Beth*

Figure 27 illustrates the conjunction of these two question acts. Notice that the **immediate** legal moves are complete **answers to both questions**, e.g. *Ed met Beth and Dan met Ann.* The simple answer *Ed met Beth* is not a congruent answer, but only a partial answer, as it does not answer this question in full. When asserted at $\sqrt{C'}$ it will lead to a non-rooted set of commitment states; this is indicated with the somewhat darker area in Figure 28. After re-rooting we get back a commitment space C'', indicated by the dark area.

Notice that after re-rooting, the remaining immediate legal moves are: S_2 commits to 'Dan met Ann', and S_2 commits to: 'Dan met Beth'. That is, we are in a discourse state

where the question *Who did Dan meet?* is asked. This is as it should be, as this is the question not answered so far.

We have not considered the focus in this assertion, *Ed met* $BETH_F$. As before, it expresses a condition for the focus alternatives (here, there is just one additional alternative, *Ed met Ann*) in relation to the input commitment space C′. Let us have a look at the configuration that holds between the disjunction of the focus alternatives and the input commitment space. They are illustrated in Figure 29. The gray area is the input commitment space, and the boldfaced area is the disjunction (the union) of the focus alternatives generated by the focus on *Beth*.

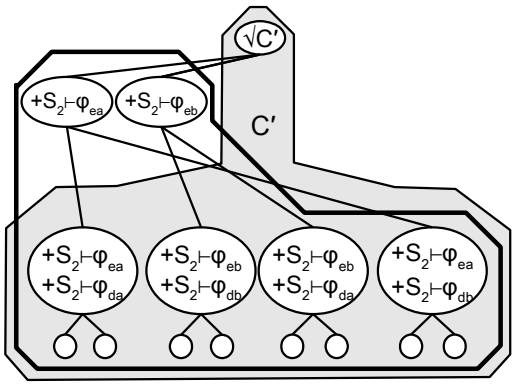


Figure 29:
Disjunction of alternatives of *Ed met* $BETH_F$

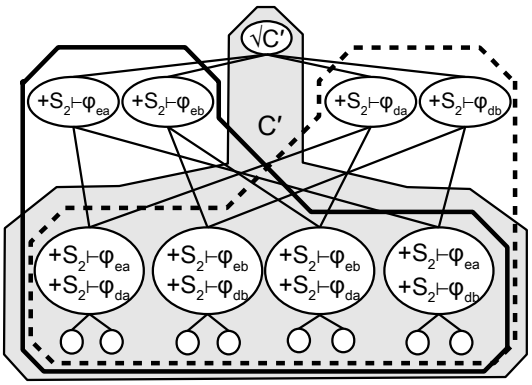


Figure 30: In addition,
disjunction of alternatives of *Dan met* $BETH_F$

Recall that we formulated a condition for the assertions with focus, cf. (46): The commitment space that resulted from the re-rooted disjunction of the focus alternatives should be identical to the input commitment space. In our example, this is not quite the case: The re-rooted disjunction of the focus alternatives contains the root √C′ due to re-rooting, but it also contains additional commitment states, namely $\surd C+S_2\vdash\varphi_{ea}$ and $\surd C+S_2\vdash\varphi_{eb}$, which are not part of the input commitment space C′. But we can tweak the condition (46) in such a way that it requires that the input commitment space is a **subset** of the re-rooted union of the focus alternatives. This change is benign for the cases we have discussed so far.

(80) Revised definition for contextual requirements of focus alternatives:
$C + \mathfrak{A}$ is defined only if $C \subseteq \circ\cup\{C+A \mid A\in\mathfrak{A}_f\}$

This way, the assertion *Ed met* $BETH_F$ is defined for the input commitment space C′.

We now consider the second focus in Ed_{CT} *met* $BETH_F$, the one expressed by the contrastive topic on *Ed*. The only alternative to Ed is Dan. Observe that assertions like *Dan met* ANN_F could have been performed as well, as they also satisfy the condition under (80). Hence we can assume that this is exactly what a contrastive topic expresses: The alternative speech acts that are generated by the alternatives of the contrastive topic must be admissible at the current point in conversation as well. This is illustrated in Figure 30 above, where the disjunction of the focus values of the alternative assertion are identified by a dotted line.

Generalizing from this example, we can formulate the contextual requirement expressed by contrastive topics as follows:

(81) $C + \mathfrak{A}[\mathfrak{a}]$ is defined only if for all $x \in ALT(\mathfrak{a})$, $C + \mathfrak{A}[x]$ is defined, following (80).

One might ask at this place: What happens with the second assertion after the first one – say, Ed_{CT} *met* $BETH_F$ – is made? In our example, a subsequent assertion like Dan_{CT} *met* ANN_F also has an F-feature indicating focus, and a CT feature indicating contrastive topics. The input commitment state at which this is interpreted is C″ in Figure 28. The focus alternatives are fully justified here. The contrastive topic alternative, which would indicate the alternative assertions *Ed met* ANN_F and *Ed met* $BETH_F$, are justified as well, as it holds that $C'' \subseteq \circ [\{C + S_2 \vdash \varphi_a\} \cup \{C + S_2 \vdash \varphi_b\}]$, and it is established already that $S_2 \vdash \varphi_a \in C''$. Of course, it would not be informative anymore at this point to assert that Ed met Ann, but the formal requirement for definedness, as required by contrastive topics, is satisfied.

Let us finally look at contrastive topics with questions. Except for the monopolar questions with focus discussed in section 8, questions have no focus alternatives. Or rather, their regular meaning already consists of alternatives. So, if the issue of definedness due to contrastive topics according to (81) comes up, then we would have to check whether the regular meaning satisfies the requirement in (80). Notice that the question *Who did Ed meet?* satisfies this requirement in the context of the conjoined question, *Who did Ed meet, and who did Dan meet?* This is illustrated in Figure 32.

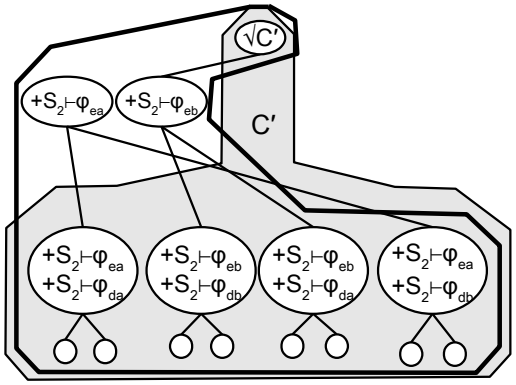


Figure 32:
Question *Who did Ed meet?* after conjoined question *Who did Ed meet, and who did Dan meet?*

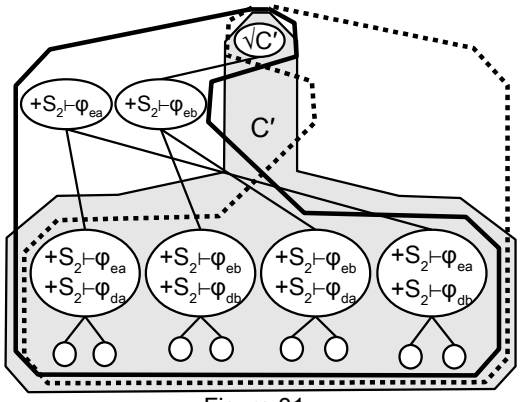


Figure 31:
Question *Who did Dan meet?* added.

Observe that the input commitment space C′ is a subset of the question meaning, hence the question *Who did Ed meet?* is defined according to (80). But also the contrastive topic alternative, *Who did Dan meet?* is defined, as shown in Figure 31.

10. Conclusion

In this paper, I have shown that within the framework of commitment spaces proposed in Cohen & Krifka (2014) conversational moves like questions and assertions can be modeled in a way that allows to explain how focus alternatives and contrastive topic alternatives work for such speech acts. Focus in assertions that answer questions has been modeled in plausible ways before (e.g., von Stechow 1990, Rooth 1992); this also holds for contrastive topics in assertions that answer a complex question (e.g., Büring 2003), But focus in certain kinds of polar questions (e.g. *Did* ED_F *meet Beth?*) and contrastive

topics in questions in general have not been united under a common theoretical perspective. I have tried to do this here. In essence, I have proposed two rules, (80) and (81), where the latter relates to the former, which explain the use of focus and contrastive topics both for assertions and for questions.

The most important novel aspect of the framework developed here is that it operates with commitment spaces, which are common grounds (or, commitment states) with a built-in component that represents the possible future developments. This notion was crucial for a distinctive modeling of assertions and questions: Questions are requests by one speaker to perform assertions by the other, and so their effect is to limit the future developments of the states within a commitment space. This allowed us to conceive of monopolar questions as questions that do not offer two or more propositions as continuations, but just one. They are biased questions for which one answer – the one that is projected – is easier to accomplish than the other – its negation.

One attractive feature of commitment spaces is that they allow for Boolean operations like denegation, conjunction and disjunction on the level of speech acts. This leads to novel ways of treating, for example, scalar implicatures induced by focus as denegations of the alternatives.

I should mention here that these operations also allow for new perspectives on the syntax/semantic interface on how questions are formed. Above, I have proposed a rather conservative way: There is a truth-functional core of a question, the question radical, that is then turned to a question act by the illocutionary operator ⟦?⟧. One problem of this view was that it necessitated the operation of *whether* deletion, as this complementizer does not occur in root questions. There is another option for the formation of root questions: The question operator ? is applied directly to the TP, without any formation of a CP (which applies for embedded questions only). Consequently, there is no complementizer *whether*.

(82) $[_{\text{ActP}}\ [[_{\text{Act}^{\circ}}\ ?\text{-}\textit{did}]\ [_{\text{TP}}\ \textit{Ed}\ t_{\text{did}}\ \textit{meet Beth}]]]$

We then can assume the following interpretation of the question operator that results in monopolar questions.

(83) a. $[\![[_{\text{Act}^{\circ}}\ ?\ ]]\!]^{S_1S_2} = \lambda p\ \lambda\langle ..., [C]_{...}\rangle\ \langle ..., [C]_{...}, [\{\surd C\} \cup \{C{+}S_2{\vdash}p\}]_{S_1}\rangle$
b. $[\![?]\!]^{S_1S_2}([\![[_{\text{TP}}\ \textit{Ed did meet Beth}]]\!]^{S_1S_2}) = \lambda\langle ..., [C]_{...}\rangle\ \langle ..., [C]_{...}, [\{\surd C\} \cup C{+}S_2{\vdash}\varphi_b]_{S_1}\rangle$

A bipolar reading could be generated by a variant of the ? operator, if required. What is interesting is that we now can generate alternative questions as disjunctions of monopolar questions. For example:

(84) $[\![[[_{\text{ActP}}\ ?\textit{-did Ed meet Ann}]\ \textit{or}\ [_{\text{ActP}}\ ?\textit{-did Ed meet Beth}]]]\!]^{S_1S_2}$
$= [\![[_{\text{ActP}}\ ?\textit{-did Ed meet Ann}]]\!]^{S_1S_2} \vee [\![[_{\text{ActP}}\ ?\textit{-did Ed meet Beth}]]\!]^{S_1S_2}$
$= \lambda\langle ..., [C]_{...}\rangle\ \langle ..., [C]_{...}, [\{\surd C\} + S_2{\vdash}\varphi_a]_{S_1} \cup [\{\surd C\} + S_2{\vdash}\varphi_b]_{S_1}\rangle$

This gets us to the representation illustrated in Figure 24. Constituent questions can be seen as generalized disjunctions over speech acts. For example, the question *Who did Ed meet?* can be analyzed as the conjunction of the monopolar questions *Did Ed meet Ann, or did Ed meet Beth, or did Ed meet Carla?* In this way, we get the interpretation illustrated in Figure 12.

(85) $[\![[_{\text{ActP}}\ \textit{who}\ [?\text{-}\textit{did}\ [_{\text{TP}}\ \textit{Ed meet}\ t_{wh}]]]]\!]^{S_1S_2} = \bigvee_{x \in \text{PERSON}} [\![[[_{\text{Act}^0}\ ?]\ [_{\text{TP}}\ \textit{Ed meet}\ t_x]]]\!]^{S_1S_2}$

$= \lambda\langle ..., [C]_{...}\rangle\ \langle ..., [C]_{...}, [\{\sqrt{C}\}+S_2 \vdash \varphi_a \cup \{\sqrt{C}\}+S_2 \vdash \varphi_b\} \cup \{\sqrt{C}\}+S_2 \vdash \varphi_c]_{S_1}]$

In this view, **interrogative pronouns** appear as **existential quantifiers over speech acts**. Thus, the well-known systematic ambiguity of wh-words in many languages as indefinites and as interrogatives (e.g., Bhat 2001) can be explained as a matter of existential indefinites having scope over the TP, or scope over the ActP.

Finally, I would like to point out that I distinguished between the performer of a speech act and the person that commits to a proposition. In questions, this diverges: A speaker S_1 performs an action that consists in making another speaker, S_2, responsible for a proposition. This provides an insightful way to explain the so-called **interrogative flip,** e.g. that evidentials locate their source with the speaker in assertions and the addressee with questions (cf. Faller 2002, Zimmermann 2004), which is similar to experiencer predicates and predicates of personal taste (Tenny 2006) or the speaker/addressee agreement features in languages with egophoric systems (e.g., Curnow 2002). These systems have in common that they target the position x in the representation of the speech act $x \vdash \varphi$, which is the speaker in assertions, and the addressee in questions. Speas & Tenny (2003) have coined the term "seat of knowledge" for this instance; I would rather suggest the term **commitment holder**, as I think knowledge is secondary to commitments in assertions and questions. Reference to a commitment holder can be incorporated into the interpretation framework by adding another parameter h, as in $[\![[...]]\!]^{s,a,h}$, where h is set to s or to a. Just as the tense operator binds a time parameter, the speech act operator binds the commitment holder parameter, and identifies it with the speaker in the case of assertions, and with the addressee in case of questions. Evidentials, experiencer or personal taste predicates, and conjunct forms in conjunct/disjunct marking languages, refer to that parameter.

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