Theme with Variations

A Context-based Analysis of Focus

Kata Balogh

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"Egyetlen érzés mindent elhomályosít.
Egyetlen hang mindent elsüketít.
Egyetlen szó mindent eltakar.
Mégis: érzésen, halláson, beszéden át vezet az út.

(Weöres Sándor: A teljesség felé)

to Betti and Zsolt

Contents

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Preface

The book you just opened forms the completion of a nice period of PhD research beginning with work on the semantics of questions, turning to investigations of the interpretation of Hungarian focus constructions and ending up with a context-based analysis of focusing. This latter topic forms the main subject of this dissertation, basically for English, but with a small by-pass to Hungarian at the end. But, what is 'focus'? The term is probably known for everyone who ever made some photographies or read some basics on photography. In geometrical optics focus or focal point is the point where a parallel beam of light converge after passing through a convex lens, forming a clear and sharply defined image on photos. In linguistics, the term 'focus' means something similar. An intuitive definition could be that the focus is the part of a sentence that is in a special way emphasized or highlighted. In this dissertation we will investigate 'focus' in linguistic terms. The intended reader of this book requires some background in formal analysis of language: formal semantics, pragmatics and discourse analysis. Hereby, my book, the sum of my results so far.

... looking forward to new challenges!
Kata Balogh
Amsterdam, July 2009

Chapter 1

Introduction

The central topic of the dissertation is a new semantic-pragmatic analysis of focus indirectly motivated by earlier work on the comparison of English focusing and Hungarian structural focus. The dissertation provides a context-based focus analysis in the theory of Inquisitive Semantics and Dialogue Pragmatics developed by Groenendijk (2008, 2009).[1] The main aim of the dissertation is twofold: firstly, I want to provide a context-based analysis of focusing and related phenomena such as question-answer relations, the notion of congruent answers, and exhaustification; and secondly, I want to provide a natural language application of the logical system of Groenendijk (2008, 2009). This system provides the core of a dialogue modeling: an inquisitive update semantics together with a dialogue pragmatics. The semantics (and the logic behind it) is constructed in such a way that sentences can both provide information and raise issues. The dialogue modeling is carried out by dialogue management rules, where the core notion is the *common ground* formally defined as a stack of (information) states. The core of the dissertation provides an extension of Groenendijk's system, with some changes required for the analysis of the natural language phenomenon: *focusing*.

1.1 The core phenomenon: focus

The notion of *focus* in the linguistic literature is rather diverse. According to the general view, focus is a discourse function, part of the information structure of a sentence/utterance, and as such, it is directly related to the underlying context.

[1] The framework of Inquisitive Semantics is still very much under construction. The thesis is based on an earlier version of the system. Recently, a 'generalized' version of Inquisitive Semantics has been developed. It is to be expected that the analysis of focus presented in this thesis can be lifted to generalized semantics, but this is left for further work. The most recent work on Inquisitive Semantics can be found on the website `www.illc.uva.nl/inquisitive-semantics`.

The realization of focus varies across languages. In most languages, focus is marked prosodically by a pitch accent. However, there are other ways to encode it in the grammar: by syntactic movement or morphological marking. In case of syntactic encoding, the focused constituent undergoes some transformation. The best known examples for such a structural focus marking are from Hungarian and Basque where the focused constituent moves to the immediate pre-verbal position. Consider, for example, Basque, which is an SOV language, thus in the "neutral" sentence the word order is *subject–object–verb* (1a). Focusing on the subject changes the word order to *object–subject–verb* (1b), since the focused constituent moves into the immediate pre-verbal position, as illustrated by the following example (from Arregi (2001)).[2]

(1) a. Jon Mirenek ikusi rau.
John$_{abs}$ Miren$_{erg}$ see AUX
'Miren saw John.'

b. Mirenek JON ikusi rau.
Miren$_{erg}$ John$_{abs}$ see AUX
'Miren saw JOHN.'

Focus can be encoded on the morphological level as well, like in the American Indian language *Chickasaw*[3] (Büring 2006), which has two focus marking suffixes: *–akot/–akō* and *–ho:t/–ho*, while it does not have any prosodic focus-marking; or in the Chadic language *Gúrúntúm*[4] (Büring 2006) and in the Niger-Congo *Byali*[5] (Reineke to appear), with a morphological focus-marker mostly appearing before the focused constituent.

Focus is a core notion of information structure, and has an effect both on the prosody and the semantics/pragmatics of an utterance. The notion of *information structure* goes back to the late '60s and early '70s in works of Michael Halliday. The notion refers to the organization of information in a sentence by special structuring.

> "*Thematic structure is closely linked to another aspect of the textual organization of language, which we may call* information structure. *This refers to the organization of a text in terms of the functions Given and New. These are often conflated with Theme and Rheme under the single heading topic and comment; (...)*"
> (Halliday: Language Structure and Language Function, (1970))

[2] In Basque, similarly to Hungarian, the main sentence stress falls on the constituent in the pre-verbal position.

[3] Spoken in the USA by the Chickasaw tribe, in Southeast Oklahoma.

[4] Spoken in Nigeria.

[5] Spoken in Benin and Burkina Faso.

Focusing leads to a division of the sentence, which has a direct effect on the interpretation. The core idea of structuring the sentence with respect to its information content dates back to the 19th century, to Hermann Paul, who first determined focus as the 'psychological object' versus the 'psychological subject' (Paul 1880)[6], and which is almost equivalent to the notion of the *theme* and *background* in the modern literature. Paul also observes the connection between focus and prosody, as well as the context-dependent nature of focus, in that it has a direct relation to wh-answers. A general test with a wh-question is used to determine the focus of the utterance. As is well-known, a wh-question requires an answer with a corresponding focus structure.

(2) Whom did Amy call?
   a. Amy called BEN.
   b. #AMY called Ben.

The communicational/functional perspective of language is the core idea of the Prague School of linguistics (Daňes, Firbas, Sgall, Hajičová et al.). According to the functionalist view sentence structure is driven by information structure, thus it has a direct effect on the grammatical component. An utterance is divided into two main parts, that are referred to as *topic* and *focus*. The most influential analysis along this line is the *Functional Generative Description* from Sgall and Hajičová (1975, 1995). They define the discourse notions *topic* and *focus* as discourse old versus discourse new material respectively. Topic is the part of the sentence that is immediately available for the hearer as old information, while focus is the part of the sentence that is new, asserted about the topic. Sgall and Hajičová's approach has certain similarities with Halliday's (1967) work on information structure. Halliday defines the notions of *given* versus *new information* as the internal parts of information units which build up the discourse. The notion *given* is defined as the information that is derivable from the preceding discourse. In each information unit there is a primary stress, or *phonological prominence*, which signals the *information focus*. Next to the discourse features *given* and *new*, Halliday introduces the notions of *theme* and *rheme* as inner structure of the utterance without relation to the previous discourse.

Regarding the interpretation effects of focusing the first influential work is from Jackendoff (1972). He introduces the *focus-feature*, a syntactic feature that gets a semantic and a phonological interpretation according to the Focus Assignment Rule and the Stress Assignment Rule respectively. The focus assignment creates formal objects (1) *focus*: the nodes carrying the f-feature; and (2) *presupposition*, where the focus is replaced by a variable. Then the presupposition-set

[6]The notions are originally introduced by *von der Gebelentz*.

is created, from which assertion and presupposition are derived. The presupposition set – $\lambda x Presupp_s(x)$ – is a well-defined, coherent set in the discourse, is amenable to discussion and is under discussion; while the assertion is that the focus is an element of the presuppositional set: $Foc \in \lambda x Presupp_s(x)$. Introducing the syntactic focus-feature, Jackendoff claims that there is a direct mapping between the placement of the focus and the grammatical representation of the sentence. This view is widely represented in the generative tradition; nevertheless we find various approaches that analyze the phenomenon of focus from different angles. Along these lines we can distinguish two main directions: approaches which investigate the relation between sentence prosody and sentence meaning (Rochemont 1986, Selkirk 1996, Schwarzschild 1999); and those which investigate the interpretational effects of focus in terms of syntactic and semantic/pragmatic considerations (Rooth 1985, Roberts 1996, Krifka 2004). The various approaches differ fundamentally with respect to how they determine the focus of the sentence, hence how they define the notion of focus.

1.1.1 Focus and prosody

The most representative approaches of *focus* in prosodic terms are from Selkirk (1996) and Schwarzschild (1999). The starting point is the general assumption that the element bearing the main stress is the focus in a given sentence. In most languages, the focus of the utterance carries a pitch accent. The main point of interest is the relationship between the sentence meaning and the sentence prosody. Distribution of pitch accents constrains the focus structure – and the sentence meaning – which leads to the core issue of prosodic approaches of focus: *Focus Projection*. Defining certain focus-projection rules determines which focus-marking patterns can be derived from a given syntactic structure. The best known and default definition of Focus Projection is due to Selkirk (1996):

Quotation 1.1 (Selkirk's Focus Projection)
Basic Focus Rule:
an accented word is F-marked
Focus Projection:
(i) F-marking of the head of a phrase licenses the F-marking of the phrase
(ii) F-marking of an internal argument of a head lincenses the F-marking of the head

Consider, for example, the following sentence where the constituent bearing the main accent is given by capitals.

(3) Amy called the DIRECTOR.
that licenses the following F-marking structures:
a. Amy called [the director]$_F$.
b. Amy [called [the director]$_F$]$_F$.
c. [Amy [called [the director]$_F$]$_F$]$_F$.

Based on the notion of Focus Projection Selkirk defines the *FOCus* of the sentence as an F-marked constituent that is not dominated by other F-marked constituents. According to this definition the *FOCus* of (3a) is the consituent 'the director', while in sentence (3b) the *FOCus* is the phrase 'called the director'. The former reading is also called *narrow focus*, versus the latter which is referred to as *broad focus*. The different focus structures determine for which question the given utterance counts as a congruent answer. The reading in (3a) counts as an answer to the constituent-question 'Whom did Amy call?', while (3b) answers the question 'What did Amy do?'.

By means of the above notions, the interpretation rules such as the *FOCus interpretation* and *F-interpretation* can be defined, where the latter says that constituents without F-marking should be considered as given, while F-marked constituents that are not *FOCus* are discourse new. The pair of notions *given* and *new*[7] has a central role in the approach by Schwarzschild (1999). Replying to the analysis of Selkirk and futher investigating the notions of *given* and *new*, Schwarzschild sets up a new theory of 'Givennes'. He argues that one notion can be eliminated from the analysis, since they are in complementary distribution. He keeps the notion of *given* referring to the information that is entailed by the prior discourse. Schwarzschild's definition of the property of *givennes* says that an utterance is given if and only if it has a salient antecedent, and in case the utterance is an entity (has the type e), then it has to corefer with its antecedent, and in case the utterance has a type other than e, then its antecedent must entail its 'Existential F-closure'. This closure provides propositions by replacing the focused constituent by a variable (of the same type) and binding the result with an existential quantifier. See, for example, the existential F-closure of the utterances in (3'a) and (3'b).

(3') a. Amy called [the director]$_F$. $\rightsquigarrow \exists x_e.called'(Amy, x)$
b. Amy [called [the director]$_F$]$_F$. $\rightsquigarrow \exists P_{\langle e,t\rangle}.P(Amy)$

In his analysis, Schwarzschild introduces two further constraints on the basis of F-marking rules from Selkirk (1996). The constraint of *GIVENnes* states that if a constituent is not F-marked, then it must be given; while the constraint of *AvoidF* requires F-marking as little as possible without violating *GIVENnes*.

[7] As we have seen these concepts are originally from Halliday (1967).

With his new theory of givenness Schwarzschild claims to give a unified account of different focus phenomena such as contrastive focus, presentational focus and focus in questions and answers.

This short glimpse into the field of phonology and its interaction with focus shows the most important issues to be focus-marking, focus projection and the given/new distinction in the interpretation. In my analysis, phonological considerations are not directly captured; however, one of my central points is (following Groenendijk (2008)) that the placement of the focal accent, thus the focus structure of the sentence, determines a special division into an interpretational *theme* and *rheme*.

1.1.2 The effects of focus on the sentential interpretation

In the other main direction of focus theories, the notion of focus is considered as a semantic/pragmatic one and the aim is to account for the semantic and pragmatic effects of focusing on the sentential interpretation. According such analyses, the theoretical notion of focus is introduced to explain natural language phenomena such as (1) the systematic correlation of discourse context and prosodic focusing; and (2) the impact of accent on truth conditions of sentences containig various focus particles such as 'only', 'even' and 'too'. Consequently, these semantic–pragmatic approaches deal with the core issues of the question–answer relation, the notion of congruent answer, association with focus and context dependence of focusing.

To provide a suitable account of the semantic–pragmatic effects of focusing two things are minimally required. First of all, a proper representation of focus should be given that assigns different semantic representations to different focus structures (different focus locations). Secondly, on the basis of these semantic representations, special semantic and pragmatic rules must be defined, both for focus sensitive particles (association with focus) and for special discourse configurations (question–answer relation). Among several other analyses, there are two highly influential competing theories in this tradition: the *Alternative Semantics* of Rooth (1985, 1992) and the *Structured Meaning Approach* from van Stechow (1991) and Krifka (1991, 2006). Both theories are concerned with the main issues mentioned above, and provide a representation of focus and the special interpretation rules of association with focus, as well as congruence. The relevant parts of Alternative Semantics and the Structured Meaning Approach will be introduced in more detail in chapter 3. Krifka (2007) further distinguishes the semantic and pragmatic use of focus relative to the core notion of the *Common Ground*. The semantic use is the content of the Common Ground, the truth-conditional information, while the pragmatic use concerns the management of the Common Ground, or how the content grows.

1.2 Structure of the thesis

In this thesis I investigate focus constructions in the tradition of the semantic-pragmatic approaches mentioned above. My main interest lies in the relation between focus and the underlying context of interpretation. The rest of the thesis is stuctured as follows. Chapter 2 introduces the core framework of my analysis: Inquisitive Semantics and Dialogue Pragmatics (Groenendijk 2008, Groenendijk and Roelofsen 2009). Chapter 3 provides an extension of the system of Inquisitive Semantics and introduces a new, uniform analysis of focus that gives an account of the most common discourse relations where focusing appears. The first part of chapter 3 introduces the representation of sentences containing narrow (free) focus which is marked prosodically in English. The second part of the chapter discusses the core dialogue relation where focusing occurs: the relation between questions and their answers and the notion of a congruent answer. Chapters 4 and 5 discuss the main issues of the exhaustive interpretation of answers and the special interpretation effects of the focus particle 'only'. In chapter 4 I introduce problems that have recently been raised around the exhaustive interpretation of answers and the phenomenon of scalar implicatures and propose a uniform pragmatic analysis. Chapter 5 investigates the use of 'only' in linguistic answers and proposes a new analysis following some ideas of Zeevat (2008) and of my earlier approach (Balogh 2005). In chapter 6 I turn to some issues around the interpretation of structural focus in Hungarian and give an analysis of its exhaustivity effects. Finally, the last chapter gives an overview of the thesis, summing up my main claims and results, and I list the most important loose ends of the analysis providing material for further research.

1.2.1 More detailed overview

The central matter of the dissertation is a context-based analysis of focus. Chapter 2 introduces the framework: Inquisitive Semantics and Dialogue Pragmatics (Groenendijk 2008). Groenendijk's theory provides a dialogue modeling system which consists of an inquisitive update semantics and pragmatics combined with inquisitive dialogue management rules. The semantics (and the logic behind it) is constructed in such a way that sentences can provide information and raise issues. The dialogue modeling proceeds in accordance with the dialogue management rules, where the core notion is the *Common Ground*, formally defined as a stack of states. In our update semantics, utterances change the common ground by adding new states to the stack. At first, every update is considered as provisional and the next turn of the responder determines to what extent these uptakes cause a change of the common ground. This formal architecture makes it possible to easily incorporate critical dialogue moves such as, e.g., *denial*. The

core of the dissertation is formed by the chapters 3 to 5, which provide an extension of Groenendijk's basic system to accommodate an analysis of focus in natural language.

A new focus analysis in Inquisitive Semantics

In chapter 3, I show that the semantics and dialogue management of Inquisitive Semantics provide us with an adequate and elegant analysis of discourse related phenomena around focus, such as: focusing in answers, question-answer relations, contrast in denial and specification by focusing.

Chapter 3 consists of two main parts. First I introduce my representation of focus and after that I give an analysis of its core dialogue relations. The kernel of my analysis is the formal definition of the theme/rheme division of sentences relative to their focal structure. I claim that focusing leads to specific ways of the division between theme and rheme, where the inherent question behind the utterance, hence the theme of it, is determined by the placement of the focus accent. As Groenendijk claims, the intonation pattern of the sentence in general determines the means of division and determines the theme that has an important role in our semantics. The second part of the chapter discusses the core dialogue relations where focusing occurs. The most important relation is that between questions and their answers, which is captured by the notion of a congruent answer. I provide an analysis of question-answer congruence that differs both from Rooth (1985, 1992) and Krifka (1991, 2006) in that in my system I do not need to define any separate rule or condition for congruent answers (such as the preference of minimal focus), but the system itself rules out non-congruent answers on the basis of the logical notion of compliance that is a core notion in the characterization of a coherent discourse.

Exhaustivity and 'only'

In chapter 4, I introduce the issues that have recently been raised around the exhaustive interpretation of answers in relation to the phenomenon of scalar implicatures in the ongoing debate between the global approaches of the neo-Gricean analyses and the localist view that proposes to make pragmatic implicatures part of the computational system of the grammar.

I propose an analysis of the exhaustive interpretation of answers as a pragmatic inference calculated at the sentential level. In my analysis exhaustive interpretation is due to the so-called secondary uptake of the utterance and is carried out technically by the operation of $[\mathcal{EXH}]$ which is an alternation and refreshment of the original definition of *alternative exclusion* in Groenendijk (2008). My new definition refers to the possible propositions that are singled out from

the possibilities in the context, and as such it captures formally the essence of the Quantity maxim, in excluding all strictly stronger possibilities from the actual context. This definition gives the intended interpretation for exhaustive answers and the scalar implicature of disjunctions by a uniform mechanism with no need to assume any additional special notions such as *innocently excludable* (Fox 2007) or minimal models (van Rooij and Schulz 2007).

In chapter 5 I turn to the interpretation of sentences containing the focus particle 'only' and its relation to exhaustivity by free focus in answers. The main claims are that the focus sensitive particle 'only' introduces a special issue 'and who else?' that corresponds to the expectation that Zeevat (2008) proposes to be the core of the semantic contribution of 'only'. I define the division that results from an 'only'-sentence as leading to a special theme corresponding to the expectation, while the rheme is the exhaustive statement. I also look at free focus and 'only' from a new angle and compare its behavior in the dialogue relation of denial. In my analysis I give an account of the main difference between free focus and 'only' with respect to denial.

Interpretation of structural focus in Hungarian

In chapter 6 I discuss some central issues around the interpretation of structural focus in Hungarian. With respect to exhaustivity and focusing strategies, Hungarian is a particularly interesting language. The most well-known characteristic of Hungarian is that it has a special position for the focused constituent right in front of the finite verb. This position is claimed to be associated with an exhaustive/identificational semantic interpretation. Investigating Hungarian structural focus and comparing it with focusing in English led me to the conclusion that — regarding its interpretation — Hungarian focus is not as special as has been assumed before. I claim that the system of Inquistive Semantics is a suitable framework to analyze the parallelisms of Hungarian and English focus in a uniform way, while also giving a straightforward means to show where Hungarian focus interpretation differs from English.

There are two important questions around focusing in Hungarian. Firstly, an explanation is required of what triggers the movement, and secondly, in connection with that, we have to explain the interpretational effects of it, with special attention to exhaustive listing. For the analysis of focusing in Hungarian I suggest that we can keep the analysis of the exhaustive interpretation via a pragmatic inference similarly to what is the case for English focusing, but there is also an important difference. In Hungarian, in case focusing is not triggered (by e.g., contrastive topic, stress avoiding verb), then focusing is used to signal that exhaustivity is obligatory, hence cannot be cancelled.

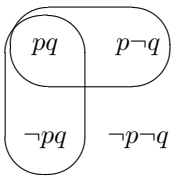
Chapter 2

Inquisitive Dialogue Analysis

In this chapter first I introduce the theory of Inquisitive Semantics as it was developed in Mascarenhas (2008) and Groenendijk (2009). Then I introduce Inquisitive Pragmatics and the system of Dialogue Management as introduced in Groenendijk (2008) and Groenendijk & Roelofsen (2009) that serves as the core framework of my analysis of the interpretation of focus constructions in the following chapters.

The main aim behind Inquisitive Semantics is to create a logical system that models the flow of coherent dialogue. The principal goal is to provide a model of information exchange as a cooperative process of raising and resolving issues. The main source of inquisitiveness in the system is *disjunction*. Consider, for example, the disjunction of two propositions: 'Amy bought a horse or Ben bought a cello.'. Such examples are naturally interpreted as not only providing the information that one of the two propositions is true, but also raising the issue *which one* of the two propositions is true. This observation can be illustrated by the following picture, where p and q stand for 'Amy bought a horse' and 'Ben bought a cello' respectively.

Example 2.1 (Disjunction)



Considering just the two propositions p and q there are four possible valuations. Uttering $p \vee q$ we consider the two possibilities that either p is the case or q is the case. In the illustration above, these two possibilites are represented by the two ovals, one that collects all valuations where p is true and the other

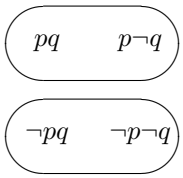
one that collects the valuations where q is true. The utterance $p \vee q$ provides the information that it is not the case that both propositions are false and next to this information it raises the issue which one of the two propositions is true. This picture of disjunction – as introducing possibilities – is already characterized by Grice (1989):

Quotation 2.1 (Grice on disjunction)

> "*A standard (if not* the *standard) employment of 'or' is in the specification of possibilities (one of which is supposed by the speaker to be realized, although he does not know which one), each of which is relevant in the same way to a given topic.*"
> (Grice, 1989: Indicative Conditionals, page 68)

Consider the meaning of a question. As the classical analyses (Hamblin 1973, Karttunen 1977, Groenendijk and Stokhof 1984) agree, the meaning of a question is the set of its (true/complete) answers, thus the meaning of the polar question 'Is it raining?' is identified by the set of two propositions 'It is raining.' and 'It is not raining.' and the questioner wants to know which one of the two is the case. This can be illustrated by the following picture where p stands for the proposition: 'it is raining'.

Example 2.2 (Polar question)



This picture provides two possibilities, one that correspond to the proposition p ('it is raining') and the other one that corresponds to $\neg p$ ('it is not raining'). Since the questioner is interested whether p or $\neg p$ is the case, the polar qustion $?p$ can be defined as the disjunction of its two possibilities: $p \vee \neg p$, hence in general questions can be defined in terms of disjunction. The main conclusion that can be drawn here is that like questions, disjunctions have the characteristic of introducing possibilities, hence they both should also get an alternative interpretation.

Groenendijk (2008) compares the sentence containing a disjunction (4a) and the corresponding question (4b).

(4) a. Alf or Bea will go to the party.
b. Will Alf or Bea go to the party?

The question in (4b) has two readings, it can be interpreted as a polar question that can be answered by 'Yes./No.' and it can also get an alternative reading that can be answered by 'Alf will go to the party/Bea will go to the party'. Groenendijk claims that similarly to the question in (4b), the sentence with a disjunction (4a) can also get both the alternative and the polar reading (with the right intonation pattern). In case the disjunction gets an alternative reading, it turns out to be something *inquisitive* as well. According to the alternative reading the sentence (4a) presents two alternatives, it is interested in the difference whether Alf will go or Bea will go. The polar reading of the same sentence, however, is not interested in that difference, there are no alternatives presented, it only provides the information that one of them will go. These examples are intended to illustrate Groenendijk's claim of defining questions as disjunctions. However, note, that the "special intonation pattern" that distinguishes the two readings is *focusing*, thus I assume that the picture is somewhat more complicated.

To further strengthen the motivations of the above claims Mascarenhas (2008) presents natural language examples of the connection between disjunction and questions. For example, in several languages, interrogative complementizers and disjunction are expressed by the same morpheme like the morpheme '-ka' in Japanese (5a-b) or 'of' in Dutch (5c).

(5) a. Hon ka?
book Q
'Is it a book?'

b. John-ka Bill-(ka)-ga hon-o katta.
John-Q Bill-Q-NOM books bought
'John or Bill bought books' (Hagström 1998)

c. Amy of Ben kwam. vs. Ik weet niet of ik kan komen.
Amy or Ben came I know not whether I can come
'Amy or Ben came.' 'I don't know if I can come.'

As illustrated in examples (5a-b), in Japanese the simple question marker '-ka' can be used to express disjunction. In Dutch (5c) the other way around: the connective morpheme 'of' *or* can be interpreted simply as a disjunction or in embedded positions as an interrogative complementizer.

Inquisitive Semantics versus the Logic of Interrogation

The theory of Inquisitive Semantics can be considered as an improvement of the *Logic of Interrogation*, (LoI), the earlier system of Groenendijk (1999). The two logics share certain characteristics, while at several important points, Inquisitive Semantics (InqS) is crucially different, resulting in a richer logical system. The most important property they share is the core purpose of modeling coherent

dialogue. Both systems are provided with an update semantics where sentences are interpreted as context change potentials: functions from contexts to contexts. Both systems model a context as a relation on the set of indices/worlds. The notions of *data* and *issue* can also be found in both systems. Data are sets of indices/worlds and issues are defined in terms of a relation of indifference. Two indices/worlds are related if we are not interested in the differences between the two. Take for example a model with two propositions p, q and four worlds w_1, w_2, w_3, w_4, where in w_1 both p and q are true, in w_2 p is true and q is false, in w_3 p is false and q is true and in w_4 both p and q are false. If relative to this model the question 'Is it the case that p?' is uttered, then we are not interested in the value of q, hence we are not interested in the differences between w_1 and w_2 and between w_3 and w_4, but we are only interested in whether the actual world is one of w_1, w_2 or one of w_3, w_4. Thus the worlds w_1, w_2 as well as w_3, w_4 stand in the relation of indifference relative to our given point of view. This can be illustrated in the pictures by connection the worlds that stand in the indifference relation.

Example 2.3 (Indifference)

$w_1 \text{ — } w_2$

$w_3 \text{ — } w_4$

One important difference considering the representation of contexts is that while in the Logic of Interrogation, the relation of indifference is defined as an equivalence relation on a set of worlds, in Inquisitive Semantics it is a reflexive and symmetric relation on a set of indices. Crucial difference is that the relation in InqS does not need to be transitive. Related to this point an important difference is that while in LoI the relation leads to a partition of the logical space with distinct blocks, in InqS the relation leads to possibilities that can overlap. By the equivalence relation in LoI, in case we are not interested in the difference between w_1 and w_2 and between w_2 and w_3, then we are also not interested in the difference between w_1 and w_3. In InqS this need not be the case, here we can have w_1 and w_2 being related and w_2 and w_3 being related and still w_1 and w_3 being unrelated, hence we are interested in the difference between between these latter two worlds.

Example 2.4 (Relation: LoI vs. InqS)

LoI:

$w_2 \text{ — } w_3$

$|$ /

w_1

InqS:

$w_2 \text{ — } w_3$

$|$

w_1

Another important difference is that while in the Logic of Interrogation there are two separate syntactic categories for assertions and questions, Inquisitive Semantics does not make this distinction, it has merely one syntactic category for both sentence types, the distinction is made in the semantics of the sentences. In InqS, assertions and questions are semantic categories instead of syntactic ones. One of the main innovations of this system of InqS is that the logical language is both syntactically and semantically *hybrid*, it does not have a separate category of questions, they are defined in terms of the semantic notions of *inquisitiveness* and *informativeness* (see section 2.1.3). To sum up the similarities and differences between the two systems I illustrate the main points in the following table:

Example 2.5 (Logic of Interrogation vs. Inquisitive Semantics)

LoI		InqS
modeling coherent dialogue	MAIN AIM	modeling coherent dialogue
different categories for questions and assertions	SYNTAX	one category for questions and assertions
update semantics	SEMANTICS	update semantics
syntactic categories	QUESTIONS/ ASSERTIONS	semantic categories
set of indices equivalence relation partitions	CONTEXT	set of indices reflexive + symmetric relation set of overlapping possibilities

2.1 Inquisitive Semantics

In the following I introduce the logical language of Inquisitive Semantics (Groenendijk 2009), then I provide an extension of the language to predicate logic that is required for my analysis later. First of all, the syntax of an inquisitive propositional language is defined as follows.

2.1.1 Syntax

Definition 2.1 (Inquisitive Propositional Syntax)
Let $\wp$ be a finite set of propositional variables. The sentences of $L_\wp$ is the smallest set such that:

1. if $p \in \wp$ then $p \in L_\wp$
2. if $\varphi \in L_\wp$ then $\neg\varphi \in L_\wp$
3. if $\varphi \in L_\wp$ and $\psi \in L_\wp$ then $(\varphi \vee \psi) \in L_\wp$
4. if $\varphi \in L_\wp$ and $\psi \in L_\wp$ then $(\varphi \wedge \psi) \in L_\wp$
5. if $\varphi \in L_\wp$ and $\psi \in L_\wp$ then $(\varphi \rightarrow \psi) \in L_\wp$

Differently from the language of the Logic of Interrogation the syntax of Inquisitive Semantics does not introduce questions as a syntactic category, nevertheless the language is inquisitive. In definition 2.2 the important notation conventions are introduced, in which the logical language of Inquisitive Semantics differs from the logical language of the Logic of Interrogation and other question semantics.

Definition 2.2 (Notation Conventions)

(a) non-inquisitive closure: $!\varphi = \neg\neg\varphi$

(b) non-informative closure: $?\varphi = (\varphi \vee \neg\varphi)$

An important fact, in which the logical language of InqS differs from the logical language of standard propositional logic, is that in Inquisitive Logic the law of double negation does not hold, thus $\neg\neg\varphi \neq \varphi$. In the semantics the expression $!\varphi$ results in the *non-inquisitive closure* of φ, that discards the (possible) issue raised by φ and singles out the information it provides. The expression $!\varphi$ refers to an assertion in case φ itself is informative. The second definition introduces the *non-informative closure* $?\varphi$ which refers to a question in case φ is informative. These matters regard the semantics of our system that will be discussed in more detail in section 2.1.2.

In the language of Inquisitive Logic we can express several kinds of questions such as the simple polar question (6a), the alternative question (6b) and the conditional question (6c).

(6) a. Will Amy come to the party? $\rightsquigarrow ?p$

b. Will Amy come, or Ben? $\rightsquigarrow ?(p \vee q)$

c. If Amy comes, will Ben come as well? $\rightsquigarrow p \rightarrow ?q$

Example (6a) is simple and intuitive, the translation $?p$ corresponds to the disjunction $p \vee \neg p$, thus it introduces the possibilities that *Amy will come* (p) and *Amy will not come* ($\neg p$). The alternative question in (6b) is somewhat more complex, the expression $?(p \vee q)$ corresponds to the disjunction $((p \vee q) \vee \neg(p \vee q))$ that introduces three possibilities p, q and $\neg(p \vee q)$; while the conditional question (6c) is interpreted in such a way that it introduces the possibilities *if Amy comes, then Ben will come as well* ($p \rightarrow q$), and *if Amy comes, then Ben will not come* ($p \rightarrow \neg q$).[1]

[1]The expression $p \rightarrow ?q$ corresponds to $p \rightarrow (q \vee \neg q)$ in the syntax, and has the same interpretation as $(p \rightarrow q) \vee (p \rightarrow \neg q)$ in the semantics. The analysis of conditional questions is one of the important motivations of the system of InqS, however, since conditional questions play no role in my analysis of focus, I leave them out of consideration.

2.1.2 Semantics

The semantics of the system is defined as an update semantics, thus the interpretation of a sentence is defined as a context change potential, a function from (information) states to (information) states. A state determines a subset of the set of indices I where each index is a function from atomic sentences to truth values. Indices can be seen as possible worlds or states of affairs, where each basic proposition is true or false.[2]

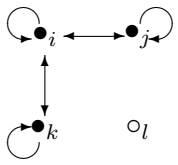
Definition 2.3 (Indices)
The set of indices I for $L_{\wp}$ is the set of functions i such that
$\forall p \in \wp : i(p) \in \{0, 1\}$

Definition 2.4 (States)
A state s is a reflexive and symmetric relation on a subset of the set of indices I.

A state is a reflexive and symmetric relation on a subset of the set of indices. The set of indices models the information contained in the information state. Two indices in a state can be connected or disconnected. When two indices are connected, they are considered to be related by *indifference* (see example 2.3) so we are not interested in the actual difference between the two. Obviously we are never interested in the difference between an index i and itself, so the state is a reflexive relation; and if we are not interested in the difference between indices i and j, then we are not interested in the difference between indices j and i, hence the state should be a symmetric relation. Differently from standard partition theories, a state need not be a transitive relation, thus if indices i and j are connected and j and k are connected, i and k do not need to be connected. Formally a state is defined as a set of pairs of indices where the pairs represent the connections, – relation of indifference – between the indices in the state. See the following example of a state s, where each arrow stands for a pair of indices. In the illustrations I represent indices that are in the state by a bullet ($\bullet$) and indices that are not in the state by a circle ($\circ$).

Example 2.6 (State)

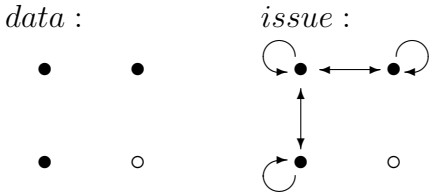
s : $s : \{\langle i, i\rangle, \langle j, j\rangle, \langle k, k\rangle, \langle i, j\rangle, \langle j, i\rangle, \langle i, k\rangle, \langle k, i\rangle\}$



[2]Inquisitive Semantics takes *indices* instead of *possible worlds* mainly because of the way in which the predicate logical version is defined (see later in section 2.1.4), where indices are defined as a combination of variable assignments and a first-order interpretation function. To refer to this difference we use indices $i, j, k, ...$ instead of worlds $w_1, w_2, w_3, ...$

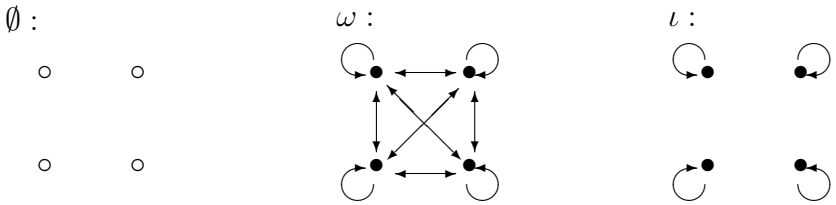
In a state the *data* is represented by a subset of the set of indices, while the *issue* is given by a relation on this set. Example 2.7 below illustrates the data and issue in a state, where the relation on the set of indices is represented as before together with arrows that stand for the relation of indifference between indices.

Example 2.7 (State: data, issue)



There are three special states as shown in example 2.8 below, where I consider just two atomic sentences, hence four indices suffice (otherwise the pictures get not transparent enough). In the *empty state*, $\emptyset$, all indices have been eliminated, this is the absurd state we obviously do not want to reach; in the *state of ignorance and indifference*, ω, all indices are present and all of them are connected, hence it contains no data and no issues; and finally in the *initial state*, ι, all indices are present, and all of them are disconnected – this is the state that is "interested in everything". The initial state ι can also be considered as a maximal partition on the logical space where each block contains a single index.[3] Relative to two proposition letters and four indices, the illustration of these special states is the following.

Example 2.8 (Special states)



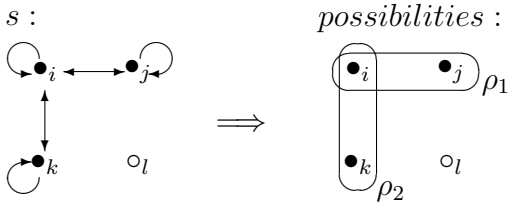
There is also an alternative way to represent states, viz, as a set of *possibilities*. In a state, defined as a set of pairs of indices, we can single out maximal sets of indices where all of them are connected. These maximal sets are called the *possibilities* in a state. Possibilities correspond to propositions and are formally defined as sets of indices.

[3]That ι is considered as the initial state will be significant later in the discussion of the dialogue modeling. Here I only want to illustrate it as one of the special states.

Definition 2.5 (Possibilities)
ρ is a possibility in s iff
1. $\rho \subseteq I$; and
2. $\forall i, j \in \rho \ : \ \langle i, j\rangle \in s$; and
3. $\neg\exists \rho' : \rho'$ satisfies 1. and 2. & $\rho \subset \rho'$

A possibility ρ in a state s is a subset of the set of indices, and if index i is in the possibility ρ and index j is also in ρ, then i and j are connected (the difference between them is not relevant), furthermore the set is maximal: it cannot be the case that there is an index k that is not in ρ but connected with all other indices in ρ. To illustrate the definition of possibilities consider the following example, where the possibilities are $\rho_1 : \{i, j\}$ and $\rho_2 : \{i, k\}$.

Example 2.9 (Possibilities)



In the semantics of our system sentences can eliminate indices, thus providing data, or disconnect indices, thus creating an issue. We give the update rules on the states defined as an indifference relation between the indices. This is the most suitable notion, because it immediately gives the standard fact of update semantics that $s[\varphi] \subseteq s$, thus for all states it holds that s updated with φ is a subset of s.[4]

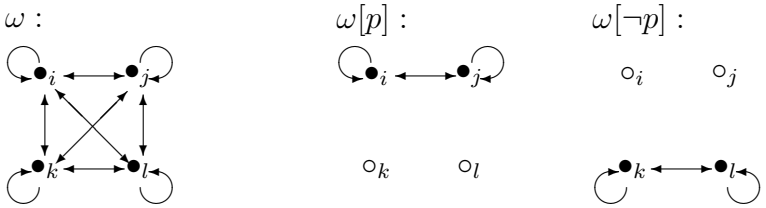
Definition 2.6 (Inquisitive Propositional Update Semantics)
1. $s[p] = \{\langle i, j\rangle \in s \mid i(p) = 1 \ \& \ j(p) = 1\}$
2. $s[\neg\varphi] = \{\langle i, j\rangle \in s \mid \langle i, i\rangle \notin s[\varphi] \ \& \ \langle j, j\rangle \notin s[\varphi]\}$
3. $s[\varphi \vee \psi] = s[\varphi] \cup s[\psi]$
4. $s[\varphi \wedge \psi] = s[\varphi] \cap s[\psi]$
5. $s[\varphi \rightarrow \psi] = \{\langle i, j\rangle \in s \mid \forall \pi \in \{i, j\}^2 : \pi \in s[\varphi] \Rightarrow \pi \in s[\varphi][\psi]\}$

Updating a state with an atomic sentence p results in a new state where for all pairs of indices $\langle i, j\rangle$ it holds that p is true both in i and j: $i(p) = 1$ and $j(p) = 1$. Pairs of indices where the above condition does not hold are eliminated. Updating s with the negated expression $\neg\varphi$ keeps the pairs of indices in s where at both connected indices φ is not true. To provide the examples of these updates

[4]In the following I will refer often to the possibilities, but note, that the definition of states remains as sets of pairs of indices.

consider the basic model of two proposition letter p and q and the set of indices $I = \{i, j, k, l\}$ where $i(p) = 1, i(q) = 1; j(p) = 1, j(q) = 0; k(p) = 0, k(q) = 1; l(p) = 0, l(q) = 0$. In the following examples, updates are carried out on the state of indifference ω, the special state that contains no data and no issues. Looking at the update of the expressions relative to the state of indifference provides us with the denotation of the sentences.

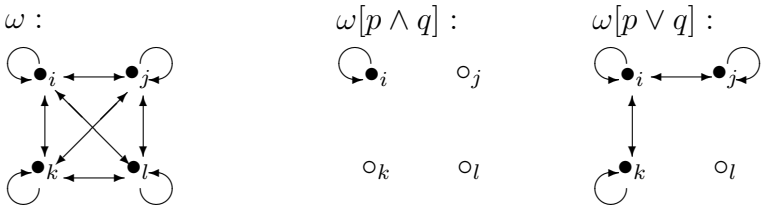
Example 2.10 ($\omega[p]$ and $\omega[\neg p]$)



Updating the state of indifference, ω, with the proposition p keeps the pairs of which at both indices p is true. In the example above, the valuations $k(p)$ and $l(p)$ are false, consequently all pairs containing k and l, hence the indices themselves get eliminated.[5] Updating ω with the negation of p keeps the pairs that connect indices in ω that are not in $\omega[p]$. In the example, $\omega[\neg p]$ eliminates the pairs that contain the indices i and j, while it keeps all the pairs containing k and l.

As usual disjunction is defined as union and conjunction is defined as intersection. Updating a state s with a disjunction $\varphi \vee \psi$ takes the union of the sets of pairs in $s[\varphi]$ and in $s[\psi]$, while updating a state s with a conjunction $\varphi \wedge \psi$ takes the intersection of the sets of pairs in $s[\varphi]$ and in $s[\psi]$.

Example 2.11 ($\omega[p \wedge q]$ and $\omega[p \vee q]$)



The update $\omega[p \wedge q]$ eliminates from ω all indices and their connections where either p or q is false. Consequently, in $\omega[p \wedge q]$ only the index i and the pair $\langle i, i \rangle$ remains, indices k, l and j are eliminated. Updating ω with $(p \vee q)$ takes the union of the updates $\omega[p]$ and $\omega[q]$. In $\omega[p]$ the indices i, j and their connections remain, and in $\omega[q]$ the indices i, k and their connections. Taking the union of

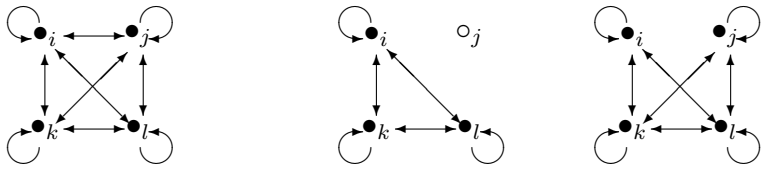
[5]Note, that elimination of an index i is represented by removing the pair $\langle i, i \rangle$. Furthermore, if and index is eliminated then all pairs it belongs to get eliminated as well.

these two updates results in the state where the pairs $\langle k, j\rangle$ and $\langle j, k\rangle$ and all the pairs containing l are out. In the picture of $\omega[p \vee q]$ we can see that states in Inquisitive Semantics are not transitive relations, since as the picture of $\omega[p \vee q]$ shows, it can be the case that j is connected to i and i is connected to k, while j is not connected to k, which is a crucial difference from partition theories.

And finally, updating the state s with the implication $\varphi \to \psi$ keeps all pairs $\langle i, j\rangle$ in s of which it holds that for all pairs formed from i and j (i.e. $\langle i, i\rangle$, $\langle j, j\rangle$, $\langle i, j\rangle$, $\langle j, i\rangle$) if such a pair is in $s[\varphi]$ it is also in $s[\varphi][\psi]$. Consider the following example of the state ω updated with the conditional $p \to q$ and with the conditional question $p \to ?q$ that is the same as $p \to (q \vee \neg q)$.

Example 2.12 ($\omega[p \to q]$)

ω : $\omega[p \to q]$: $\omega[p \to ?q]$:

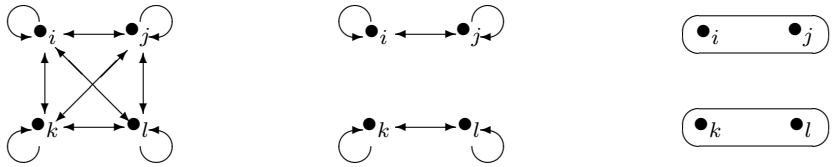


The pairs containing the index j are eliminated in $\omega[p \to q]$, because the pair $\langle j, j\rangle$ (thus the index itself) is in $\omega[p]$ but it is not in $\omega[p][q]$. And similarly, the pairs $\langle i, j\rangle$ and $\langle j, i\rangle$ are eliminated from $\omega[p \to ?q]$ because these pairs of indices are in $\omega[p]$ but not in $\omega[p][(q \vee \neg q)]$.

There is one more important update I want to show in detail here, namely updating with $?p$. As I already discussed in section 2.1.1, the expression $?p$ is not a separate category in the syntax of the logical language. According to the notation convention $?p$ is defined in terms of disjunction as: $?p = p \vee \neg p$.

Example 2.13 ($\omega[?p]$)

ω : $\omega[?p] = \omega[p \vee \neg p]$: *possibilities* :



Questions are defined in terms of disjunction, thus the update by the polar question $\omega[?p]$ equals to the update with the disjunction $\omega[(p \vee \neg p)]$. Similarly to the previous example, disjunction takes the union of the updates $\omega[p]$ and $\omega[\neg p]$. The update effect of $?p$ is disconnecting indices where the valuation of p is different. Note furthermore, that the polar question $?p$ relative to ω introduces two possibilities that correspond to the propositions p and $\neg p$ respectively.

2.1.3 Inquisitiveness and informativeness

As I already mentioned before, the system is developed in such a way that sentences can provide data and raise issues which is captured by the basic notions of *informativeness* and *inquisitiveness*. In terms of these two notions three meaningful sentence types can be defined: *assertions*, *questions* and a special type of *hybrids*. These sentence types are *semantic categories* as opposed to the syntactic categories of 'question' and 'assertion' in the Logic of Interrogation. We can define informativeness and inquisitiveness of an utterance relative to a given state.

Definition 2.7 (Informativeness and Inquisitiveness)
Let $\varphi \in L$ and s an arbitrary state.

1. φ is informative in s iff $\exists\langle i,i\rangle \in s$ such that $\langle i,i\rangle \notin s[\varphi]$
2. φ is inquisitive in s iff $\exists\langle i,j\rangle \in s$ such that
   $\langle i,i\rangle \in s[\varphi]$ and $\langle j,j\rangle \in s[\varphi]$ and $\langle i,j\rangle \notin s[\varphi]$

An utterance is informative in a given state if it eliminates some indices from that state, while the utterance is inquisitive if it disconnects some of the indices of that state, thus if it creates a new issue. A special instance of the notions of informativeness and inquisitiveness is when we look at the update effects of a given utterance in ω, the state of indifference. Relative to ω we can define the semantic category (question, assertion or hybrid) of the utterance.

Definition 2.8 (Semantic sentence categories)

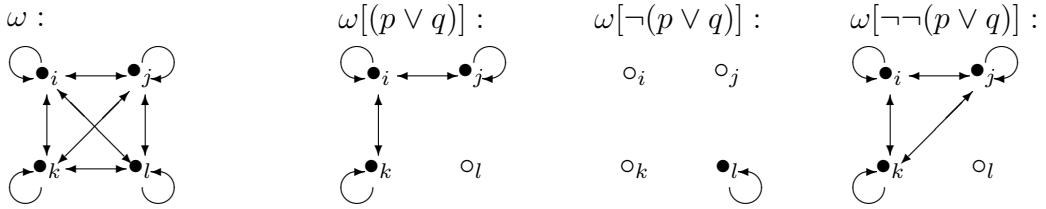
1. φ is a question iff φ is inquisitive and not informative in ω
2. φ is an assertion iff φ is not inquisitive and informative in ω
3. φ is a hybrid iffφ is inquisitive and informative in ω

Given the way in which negation is defined the update of a state s with $\neg\varphi$ can only eliminate indices from s but cannot disconnect them. Consequently, a negation $\neg\varphi$ can never be inquisitive, that also means that double negation $\neg\neg\varphi$, and hence $!\varphi$ (see definition 2.2) cannot be inquisitive.

Fact 2.1 (Non-inquisitive closure)
$s[!\varphi] = \{\langle i,j\rangle \mid \langle i,i\rangle \in s[\varphi] \& \langle j,j\rangle \in s[\varphi]\}$

The important effect of the non-inquisitive closure by '!' can be illustrated by the update of $!(p \vee q)$ on ω, where the expression $(p \vee q)$ is inquisitive. As given by the notation conventions (definition 2.2) $!\varphi$ is defined as $\neg\neg\varphi$, thus the update $\omega[!(p \vee q)]$ equals $\omega[\neg\neg(p \vee q)]$.

Example 2.14 ($\omega[!(p \vee q)]$)



Following the definition of updating with a negation, first we take $\omega[\neg(p \vee q)]$, that keeps the pairs from ω that do not contain any index present in $\omega[(p \vee q)]$. As it is shown in the example above, the state $\omega[\neg(p \vee q)]$ consists of the single pair $\langle l, l\rangle$. Then, following the definition, the update $\omega[\neg\neg(p \vee q)]$ keeps the pairs from ω that do not contain any index present in $\omega[\neg(p \vee q)]$. This will lead to the state shown above, where the indices i, j, k and all their connections are present. The example illustrates that the rule of double negation does not hold, the update with $\neg\neg(p \vee q)$ is different from the update with $(p \vee q)$.

The example shows further the crucial difference between the two, namely that in $\omega[\neg\neg(p \vee q)]$, hence in $\omega[!(p \vee q)]$, the indices i and k are connected, they are considered to be related, hence we have only one possibility. As an important consequence, the issue in $\omega[(p \vee q)]$ disappears, hence it keeps only the *data* in it making the state *indifferent* where all present indices are connected. Note, however, that '!' or double negation has only an effect if it is applied relative to a sentence raising an issue.

Definition 2.8 implies that questions, assertions and hybrids are utterances that have an update effect on ω, hence they are not tautologies. This condition filters out expressions such as $!(p \vee \neg p)$ and $?!(p \vee \neg p)$ that are tautologies, since they have no update effect relative to ω.

Example 2.15 ($\omega[!(p \vee \neg p)]$ and $\omega[?!(p \vee \neg p)]$)

(a) $\omega[!(p \vee \neg p)] = \omega$, because
$(p \vee \neg p)$ in ω disconnects some indices and does not eliminate any of them,
while the effect of '!' is connecting all indices in $\omega[(p \vee \neg p)]$ that gives back ω

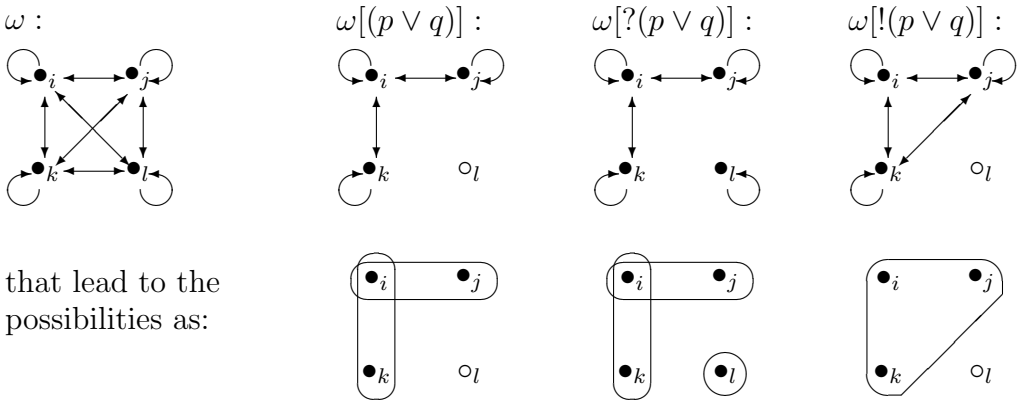
(b) $\omega[?!(p \vee \neg p)] = \omega[!(p \vee \neg p) \vee \neg!(p \vee \neg p)]$ (definition 2.2)
that equals to $\omega[!(p \vee \neg p)] \cup \omega[\neg!(p \vee \neg p)]$ (definition 2.6)
that equals to $\omega \cup \emptyset$ (see (a) above)
that equals to ω

According to definition 2.8, a sentence is a question if it disconnects some indices in ω and does not eliminate any of them; it is an assertion if it does not disconnect any indices in ω, and eliminates some of them; and it is a hybrid if it both disconnects and eliminates some indices in ω. Consequently, a question

raises an issue, an assertion provides data and a hybrid raises an issue and provides data at the same time. Such a hybrid utterance in inquisitive semantics is, for example, the disjunction $(p \vee q)$ which eliminates some indices from ω, the indices where both p and q are false, while it also disconnects some other indices.

Consider the following examples for illustration. Example 2.16 provides the pictures of the hybrid utterance $(p \vee q)$, the alternative question $?(p \vee q)$ and the assertion $!(p \vee q)$ via their update effects on ω.

Example 2.16 (Sentence types)



As discussed under definition 2.2, $?\varphi$ is only a question if φ is neither a tautology nor a contradiction, and $!\varphi$ itself is only an assertion if φ is informative (hence $!\varphi$ does not lead to a tautology). In what follows, I will ignore the borderline cases, and will refer to $?\varphi$ as a question and to $!\varphi$ as an assertion.

2.1.4 Extension to Predicate Logic

For an analysis of focused sentences an extension of the language to a first-order system is required. The syntax is extended with a set of terms TERM — that is formed by the set of variables VAR, and the set of constants CON —, the predicates PRED, and the two quantifiers $\exists$ and $\forall$. First of all the notion of indices should be redefined as first order models together with an assignment of values to variables.

Definition 2.9 (Indices)
Consider the model $M = \langle D, I \rangle$, where D is a finite[6] domain of entities and I is the set of functions (indices) i such that

$\forall P^n \in$ PRED: $i(P^n) \subseteq D^n$; and $\forall t \in$ TERM: $i(t) \in D$

[6]It is still being investigated how the semantics should be characterized in order to deal with infinite domains as well, since that may have consequences for the definition of the notion of possibilities in a state that is one of the core notions in the system of Inquisitive Semantics. For my purposes in this dissertation it suffices to consider only finite domains.

Definition 2.10 (States)
A state s is a reflexive and symmetric relation on a subset of the set of indices I; $s \subseteq I^2$; and for all $i, j \in s$ and for all $t \in$ Term : $i(t) = j(t)$

The definition of a *state* remains as before, with the addition that constants and variables are rigid designators[7], thus for all $i, j \in I$ if $\alpha \in$ Con then $i(\alpha) = j(\alpha)$, and similarly if $x \in$ Var then $i(x) = j(x)$. The variable assignment goes as follows:

Definition 2.11 (Variable assignment)
Let i, j be indices from I, s a state, $x \in$ Var, $d \in D$:
1. $i[x/d] = i'$ which is like i except for the possible difference that $i'(x) = d$
2. $\langle i, j\rangle[x/d] = \langle i[x/d], j[x/d]\rangle$
3. $s[x/d] = \{\langle i, j\rangle[x/d] | \langle i, j\rangle \in s\}$

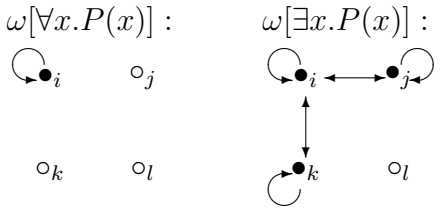
The semantics of the first-order version of the logic is extended with the update effects of atomic formulas $R(t_1, ..., t_n)$ and quantified expressions $\exists x\varphi$ and $\forall x\varphi$.

Definition 2.12 (First-order update semantics)
1. $s[R(t_1, ..., t_n)] = \{\langle i, j\rangle \in s \mid \langle i(t_1), ..., i(t_n)\rangle \in i(R)\ \&\ \langle j(t_1), ..., j(t_n)\rangle \in j(R)\}$
2. $s[\exists x\varphi] = \bigcup_{d\in D}\{\langle i, j\rangle \in s \mid \langle i, j\rangle[x/d] \in s[x/d][\varphi]\}$
3. $s[\forall x\varphi] = \bigcap_{d\in D}\{\langle i, j\rangle \in s \mid \langle i, j\rangle[x/d] \in s[x/d][\varphi]\}$

The update of s with an atomic formula $R(t_1, ..., t_n)$ goes similarly to the standard definition in update semantics. The update $s[R(t_1, ..., t_n)]$ keeps the pairs of indices $\langle i, j\rangle$ where both at i and j the interpretation of the terms $t_1, ..., t_n$ are elements of the interpretation of the predicate R. Existential quantification follows the pattern of disjunction in that it is defined in terms of union, and universal quantification follows the pattern of conjunction in that it is defined in terms of intersection. To illustrate the update effect of the first-order formulas $\forall x.P(x)$ and $\exists x.P(x)$ on the state ω, I give the simplest model with a domain of two individuals and only one one-argument predicate. In this way we get very similar pictures as for the propositional cases, that makes it easy to survey important parallelisms. Consider a model $M = \{D, I\}$ of $D = \{d, d'\}$ and $I = \{i, j, k, l\}$ where $i(P) = \{d, d'\}, j(P) = \{d\}, k(P) = \{d'\}, l(P) = \varnothing$. The update effects on the state of indifference ω with $\forall x.P(x)$ and $\exists x.P(x)$ are the following.

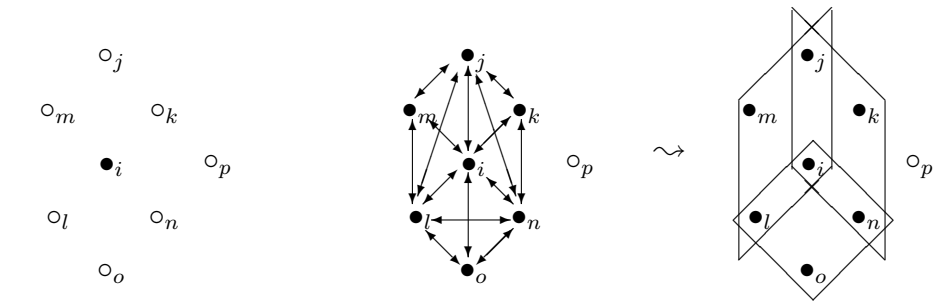
[7]Rigidity of constants is assumed to make the system simpler.

Example 2.17 (Update ω with $\forall x.P(x)$ and $\exists x.P(x)$)



These examples illustrate the updates with an existentially and a universally quantified expression relative to a domain with two individuals, that lead to the same type of pictures as shown in example 2.11 in the propositional language. Lets consider now the update of the same expressions over a domain with three individuals $D = \{a, b, c\}$. Then we have a set of eight indices $I = \{i, j, k, l, m, n, o, p\}$, where the interpretation of the predicate P are $i(P) = \{a, b, c\}, j(P) = \{a, b\}, k(P) = \{a\}, l(P) = \{b, c\}, m(P) = \{b\}, n(P) = \{a, c\}, o(P) = \{c\}, p(P) = \varnothing$. The updates $\omega[\forall x.P(x)]$ and $\omega[\exists x.P(x)]$ over D leads to the following states.[8]

Example 2.18 ($\omega[\forall x.P(x)]$ and $\omega[\exists x.P(x)]$ over $D = \{a, b, c\}$)



(to make the pictures more readable we skip the arrows of the pairs as $\langle i, i\rangle$, the indices $\bullet_x$ should be interpreted as having an arrow around them)

We have to point out here that similarly to disjunctions, existentially quantified expression in the predicate logical language are also inquisitive. As disjunctions come with an issue whether one of the disjuncts is case, the existential expression $\exists x.\varphi$ leads to the issue whether $\varphi[x/d_1]$, $\varphi[x/d_2]$, ..., $\varphi[x/d_n]$ is the case relative to a model with a domain of individuals $D = \{d_1, \ldots, d_n\}$. The inquisitiveness of the expression is captured by the (overlapping) possibilities that its picture leads to.

[8] These are very simple cases, the picture with more predicate letters provide us more complicated states. However, these simple examples are sufficient to illustrate the update effect of the quantifiers $\forall$ and $\exists$ and their similarities with disjunction and conjunction in the propositional logical language.

2.2 Dialogue Modeling

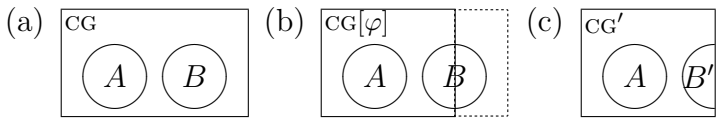
The main aim of the framework of Inquisitive Semantics is to provide a suitable system of dialogue modeling to analyze how co-operative agents manage and reach a coherent dialogue. The system of the dialogue management models a dynamic process of raising and resolving issues. The model is rather flexible, since critical dialogue moves are included as well. At first, I introduce the pragmatics of the system in the spirit of Groenendijk & Roelofsen (2009), the inquisitive version of the conversational principles that drives the flow of a coherent dialogue. After that I introduce the dialogue management system and its special operations, originally from Groenendijk (2008).

2.2.1 Common Ground and Dialogue Principles

The central component of the architecture of our dialogue modeling is the common ground, taken to be a public entity that is constantly changed by the dialogue moves of the participants. Next to the common ground, participants have their own information states, that effect their dialogue moves. By an utterance both the common ground and the participants' information states are assumed to be simultaneously updated, however we can only follow publicly the changes of the common ground. Let me illustrate by the following picture (example 2.19) a successful update on the common ground. Consider the set CG being the actual common ground and the sets A and B the participants' own information states (take the set A as the information state of the *speaker/initiator*, and the set B as the information state of the *hearer/responder*). To make my illustrations transparent the pictures of the examples in this section only consider the information, not the issues. The pragmatic theory behind Inquisitive Semantics and the inquisitive dialogue principles capture both informativeness and inquisitiveness. Later on, at the formal modeling of the common ground stack all update steps will be stored, hence next to the information, we will also keep track on the issues that are raised.

In order to have a common ground it is required that both information states A of the speaker and B of the hearer are subsets of CG (see example 2.19a). In this common ground, the speaker uttering φ has the following update effect shown in example 2.19.

Example 2.19 (Simultaneous update)



Next to the update of the CG, the information states A should be supported and B should be updated with φ. As the illustration shows, the utterance should be supported (see more later) by the information state of the speaker, hence the set A remains unchanged and included in CG, while updated with φ it preferably provides new information for the hearer. Consequently, the common ground and the hearer's information state are updated with φ that leads to a new common ground CG$'$ and a new information state B' respectively.

The flow of a coherent discourse is driven by certain dialogue principles that assume cooperativity between the dialogue participants. The core principle is cooperativity between the dialogue participants that requests a common aim of the participants to enhance the common ground. This main aim of a cooperative dialogue is further driven by other principles, that can be regarded as the inquisitive versions of the gricean maxims of Quality, Quantity and Relation.

The first principle is *Maintain the common ground!* that corresponds to the gricean maxim of Quality. This principle requires that all dialogue moves keep the Common Ground, so after updating with φ, both A and $B[\varphi]$ must remain subsets of $CG[\varphi]$. The first dialogue principle has two sides, at first, the speaker should not utter anything that is not supported by her own information state (*Be truthful!*) and the hearer should not update her state with φ if it would lead to inconsistency, and she has to announce this rejection explicitly.

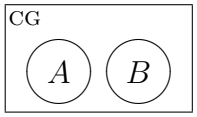
Definition 2.13 (Quality)
Maintain the common ground!

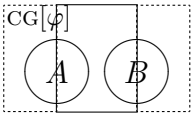
(a) *speaker:* Avoid utterances that your information state does not support!

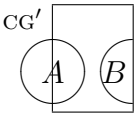
(b) *hearer:* Keep your state consistent!; and Announce non-acceptance!

The principle of maintaining the common ground means for the speaker that her utterances should be supported by her own information state. An utterance φ is supported in a state σ if it does not eliminate any indices, hence if φ is not informative in σ.Thus, the speaker's utterance should not have an update effect of her own information state ($A[\varphi] = A$). Consider now an example where the speaker violates the first dialogue principle and her utterance is not supported by her own information state.

Example 2.20 (Non supported utterance)

(a) 

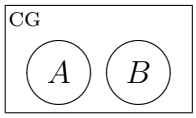
(b) 

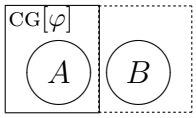
(c) 

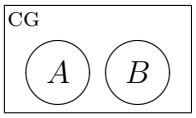
In such a situation the hearer updates her information state, as well as the common ground is updated, while the utterance φ is not supported by the

speaker's information state, updating the common ground with φ results in a new common ground CG' that does not contains A any more, consequently, the common ground is lost. The hearer's side of the quality principle has two parts. The hearer must update her information state, but only if it does not lead to inconsistency, hence if the update does not lead to a new common ground that her information state is not part of any more. In case the hearer cannot (avoiding inconsistency) or does not want to update, she has to reject the proposed update and publicly announce it. This dialogue principle captures the critical dialogue move of *denial*. The following example illustrates this.

Example 2.21 (Announce non-acceptance!)

(a) 

(b) 

'NO!' (c) 

Here, in the actual common ground CG (example 2.21a), the initiator utters φ that is supported by her own information state but the hearer does not update her state avoiding the absurd state. Hence, if CG gets updated with φ, while B does not, that would lead to the situation that the responders information state is not part any more of the (new) common ground $CG[\varphi]$ (example 2.21b). In such cases the responder must publicly announce that according to her own state the proposed update is not possible. After the responder's objection against the proposed update the common ground will be as it was before the initiator uttered φ (example 2.21c).

The second dialogue principle in the pragmatics of the system captures both the maxim of Quantity and Relation.

Definition 2.14 (Quantity and Relation)
Be as compliant as you can!

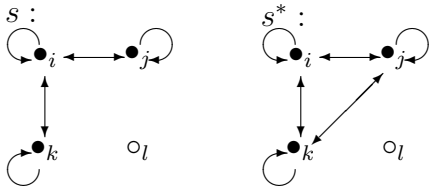
This dialogue principle refers to the core logical notion of *Compliance* defined between an utterance and the underlying common ground. Compliance checks whether a dialogue move is strictly related after another one. The logical relation of Compliance is assumed for coherent dialogue moves, however, it can be – and certainly is sometimes – overruled. The responder can make non-compliant moves, but always with a reason which we assume to be possible to figure out.

Before we can turn to the definition of Compliance, two operation should be introduced: the *indifferentiation* of a state and *restriction* of a state with the information in another state. Applying the operation of *indifferentiation* on a state s, we are only concerned with the information contained in it. The operation ignores the current issues in s by connecting all indices, that results in

one single possibility formed from the possibilities in s. Indifferentiation defined on states corresponds to the effect of '!' that is defined on the level of utterances both annulling the actual issue of the sentence and the state respectively.

Definition 2.15 (Indifferentiation)
The indifferentiation of state s is $s^* = \{\langle i,j\rangle \mid \langle i,i\rangle \in s \wedge \langle j,j\rangle \in s\}$

Example 2.22 (Indifferentiation)

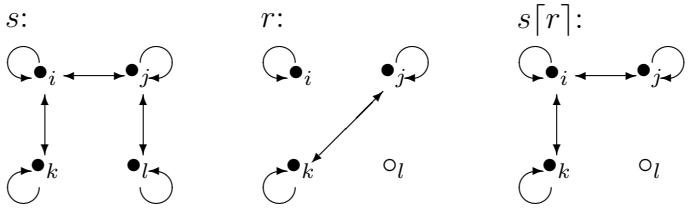


By the operation of indifferentiation the underlying issues in the state s and the issues φ leads to in s can be compared, since s^* disregards the issues in s while updating it with φ gives the issues added by φ to it. The operation of *restriction* ($s\lceil r\rceil$) operates on the information in two states. By this operation the information in a state r can be included in another state s.

Definition 2.16 (Restriction)
The restriction of s by r; $s\lceil r\rceil$ is: $s\lceil r\rceil = \{\langle i,j\rangle \in s | \langle i,i\rangle \in r \wedge \langle j,j\rangle \in r\}$

Restriction provides an update of s by the information present in r, since it keeps only the pairs of indices in s such that the indices are also in r. By restriction of s with the infromation in r ($s\lceil r\rceil$) the issue in s may be partly resolved. Take, for example, the following two states s and r:

Example 2.23 (Restriction)



The notion of *Compliance* between an utterance φ and a given state s is defined in terms of the notion of *Relatedness* between the states $s^*[\varphi]$ and s (see Groenendijk & Roelofsen (2009)).

Definition 2.17 (Relatedness)
State r is related to state s; $r \propto s$ iff
(a) every possibility in r is the union of a subset of the possibilities in s; and
(b) every possibility in the restriction of s by r is included in a possibility in r

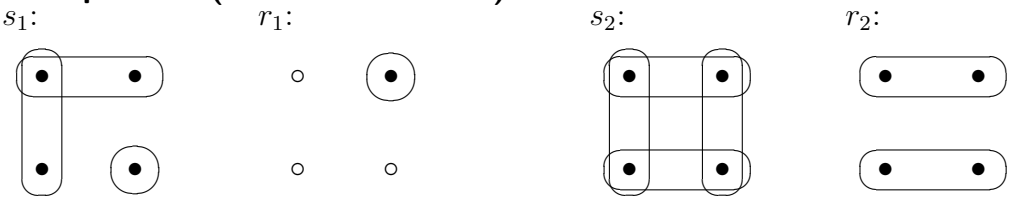
A given utterance φ is compliant (strictly) to the state s where it is uttered, if s without its own issues (indifferentiation) updated with φ is related to s. It investigates the relatedness between the two states: the state s where φ is uttered and the state $s^*[\varphi]$ that consists of the issues raised by φ as such relative to the data in s.

Definition 2.18 (Compliance)
Utterance φ is compliant to state s iff $s^*[\varphi]$ is related to s.

The core dialogue moves captured by the notion of Relatedness are a *partial answer* and a *sub-question*. In a coherent dialogue there are two standard ways of resolving an issue: the responder either provides a partial answer or if she cannot come up with an answer, she can replace the original issue by a sub-issue, that is supposed to be easier to answer and as such it may indirectly help to resolve the original issue.

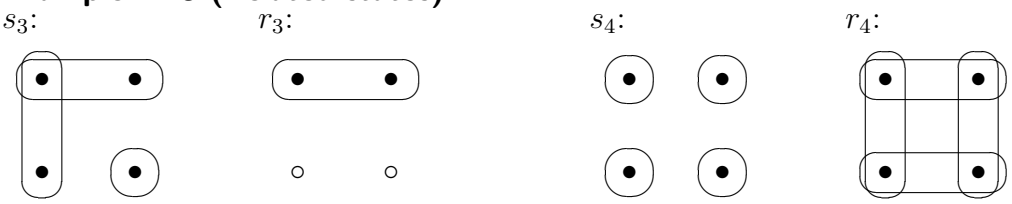
The formal definition of Relatedness between a state r and another state s compares the issues and data in r and s. The notion of relatedness is defined between the two states and refers to the operation of restriction I introduced above. It implies, that the state r being related to another state s (1) r is equally or more informative than s – the (a) condition in definition 2.17 implies that every index in r (the data in r) must be present in s as well; and (2) r is equally or less inquisitive than s – as implied by the (b) condition of definition 2.17. For an illustration, consider example 2.24 where r_1 is not related to s_1, since it violates the first condition, and r_2 is not related to s_2, because it violates the second condition. The (a) condition of the definition captures the relation of partial answerhood, while the (b) condition applies between two inquisitive states, hence when the original issue is replaced by a sub-issue.

Example 2.24 (Non-related states)



The state r_1 is not related to s_1, because the possibility in r_1 is not a possibility or union of possibilities in s_1 (see definition 2.17a), and r_2 is not related to s_2, because restricting s_2 by r_2 does not have an effect, $s_2\lceil r_2\rceil = s_2$, and two possibilities in s_2 are not present in r_2 (see definition 2.17b). Example 2.25 shows states that are related.

Example 2.25 (Related states)



In this example r_3 is related to s_3 as well as r_4 is related to s_4, since both conditions are fulfilled. The possibility in r_3 is also a possibility in s_3, and the the possibility in $s_3\lceil r_3\rceil$ is part of a possibility in r_3 (actually the same here). Similarly, all possibilities in r_4 are unions of possibilities in s_4, and all possibilities in $s_4\lceil r_4\rceil$ ($= s_4$) are included in a possibility in r_4.

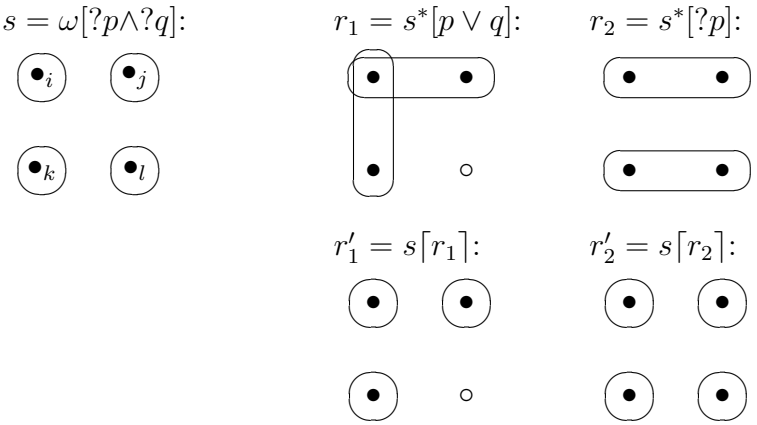
An utterance φ is compliant to a state s if the update effect of φ on the state without its own issues leads to a new state that is related to s. Hence, we can define compliance of a given utterance in its underlying state as a special case of relatedness and formulate the definition as the following.

Example 2.26 (Compliance of φ in s)
Utterance φ is compliant to state s iff
(a) every possibility in $s^*[\varphi]$ is the union of a subset of the possibilities in s; and
(b) every possibility in the restriction of s by $s^*[\varphi]$
is included in a possibility in $s^*[\varphi]$

Following from the notion of relatedness the logical notion of Compliance can be summed up as it requires a coherent dialogue move by an utterance φ that leads to an equally or less inquisitive state ($s^*[\varphi]$) relative to the data in the underlying state s and φ does not create a different (new) issue that is not in s. Hence, for φ to be compliant to s, the possible issue it provides must be a sub-issue of the issue in s, a sub-issue that is easier to answer.

Consider, for example, the question $?p\wedge ?q$, after which the propositions $p \vee q$ and the question $?p$ are both compliant, hence $p \vee q$ counts as a (partial) answer and $?p$ counts as a sub-question of it. Example 2.27 illustrates these cases (where, as before, $i(p) = 1$, $i(q) = 1$, $j(p) = 1$, $j(q) = 0$, $k(p) = 0$, $k(q) = 1$, $l(p) = 0$ and $l(q) = 0$).

Example 2.27 (Compliance: partial answer and sub-question)



The question $?p \wedge ?q$ leads to the state s as illustrated above. In this state, the proposition $p \vee q$ and the question $?p$ are both compliant, since all possibilities in $s^*[p \vee q]$ ($=r_1$) and in $s^*[?p]$ ($=r_2$) are unions of possibilities in s, and all possibilities in the restrictions of s by r_1 ($=r'_1$) and by r_2 are included in a possibility in s. Consequently, $p \vee q$ is a partial answer and $?p$ is a sub-question of $?p \wedge ?q$.

To formalize our second dialogue principle *Be as compliant as you can!* we need another pragmatic notion that compares compliant responses and makes choices between different them. This new notion is *Comparative Compliance* which is based on the logical notion of *Compliance* introduced above. If in a given state several compliant utterances are possible, Comparative Compliance may determine what the preferred/most compliant response is.

Definition 2.19 (Comparative Compliance)
φ is equally or more compliant to s than ψ iff
(a) both φ and ψ are compliant to s;
(b) all indices in $s^*[\varphi]$ are also in $s^*[\psi]$;
(c) if two indices are (present and) disconnected in $s^*[\varphi]$ then they are also disconnected in $s^*[\psi]$

From two compliant responses φ and ψ, Comparative compliance prefers the one that is *more informative* (other things being equal) – condition (b); and the one that is *less inquisitive* (other things being equal) – condition (c). The second dialogue principle *Be as compliant as you can!* captures the essence of the maxim of Relation as it requires compliance, hence related dialogue moves; and it also captures the essence of the maxim of Quantity (extended to the issues as well), since it prefers the more informative and the less inquisitive utterances. Optimally compliant responses are those that precisely single out a single possibility.

2.2.2 Dialogue Management

After the introduction of the pragmatic principles of a coherent dialogue, in this section I turn to the Dialogue Management system provided with Inquisitive Semantics. I present here the representation of the common ground and define the rules of the updates with questions and assertions.

In the dialogue management system, the common ground is formally defined as a stack of states that is called the 'common ground stack' (CG-stack). A stack of states is defined as follows.

Definition 2.20 (Stack of states)
The common ground is defined as a stack of states, where the set of stacks is the smallest set such that:

1. $\langle\rangle$ is a stack
2. if s is a state and σ is a stack, then $\langle\sigma, s\rangle$ is a stack.

In a stack all changes made to the common ground are stored, hence differently from the CG-set discussed in the previous section[9] the CG-stack contains not only information but also keeps track of the issues raised during the dialogue.

Each utterance or dialogue move will push the stack, adding a new state on the top of it. Important in the architecture is the possibility to pop the stack and remove states from it as well, that has the advantage of to allow critical moves in dialogue. A new utterance in the dialogue gets uptaken in the Common Ground-stack by adding new states to it, however each update is regarded as provisional, and will only become definitive in case the responder accepts it. If she cannot update her own information state by the proposed steps, she has to explicitly signal it, and thereby cancel the provisional updates (that is required by the dialogue principle to keep the Common Ground). In our dialogue management system we distinguish two main steps, the *uptake* of the sentence in the Common Ground and the effect of the *reaction* of the responder. As we mentioned before, the update effects of an utterance are first provisional, they get definitive if the responder accepts them, or they get canceled if the responder rejects them based on her own information state. The *uptake* of an utterance consist of two main parts the *primary uptake* or the update of the semantic content and the *secondary uptake* or the calculation of the pragmatic inferences, that always blindly follows the primary uptake. Pragmatic inferences are always calculated parallel with the semantic part and are driven by the third pragmatic principle introduced in the previous section.

[9] In section 2.2.1 I introduced and illustrated the dialogue principles by the "classical" representation of the Common Ground as regarding only information.

Primary Uptake

The primary uptake of an utterance is not just a simple update of the common ground with the sentence as such. It is assumed that all propositions have an inherent issue and during the primary uptake that issue gets first added to current issue in the common ground-stack. This inherent issue is the question behind the utterance and is considered to be the *theme* of it. The logical fact of *division* by default determines that all utterances can be divided into two parts: a *theme* and a *rheme*.

Fact 2.2 (Division)
$\forall\varphi \in L : \varphi \Leftrightarrow ?\varphi \wedge !\varphi$

The fact 2.2 above states that by '?' we can single out the question $?\varphi$ behind the utterance φ, while '!' takes the information content of it. As I already illustrated in section 2.1.3 (example 2.14), this operation '!' has the effect of removing the issues from the utterance – if there are any – and keeps only the information, similarly to the operation of *indifferentiation* on states (see definition 2.22). Consider, for example, the utterance 'It is raining.' that comes with the inherent question as 'Is it raining?' and the information content 'It is raining.'. In this case, the rheme is the same as the utterance itself, since it is an assertion, and as such, '!' has no effect on it, since there is no inherent issue to discard. Note, that '!' has an effect in case we deal with a hybrid sentence type.

For natural language examples, defining the theme and the rheme by the operations '?' and '!' only gives the right result for so-called "neutral" sentences, without a special intonation pattern on it. I claim that the main effect of focusing is to determine a special theme-rheme division. I keep the core idea behind the logical fact of division that every sentence comes with an underlying issue, the theme of it, hence every sentence can be divided into a theme and a rheme. I will discuss the representation of focus in chapter 3, where we also provide a rule of division for focused sentences.

In the dialogue management system, first the theme of the utterance (determined by division) is added to the current issue on top of the common ground-stack. This operation is called *thematizing* and is defined as follows:

Definition 2.21 (Thematizing φ: $\sigma[\varphi]^?$)
$\langle\sigma, s\rangle[\varphi]^? = \langle\langle\sigma, s\rangle, s \cup s^*[?\varphi]\rangle$

The operation of thematizing adds a new state to the top of the common ground stack. This new state, $s \cup s^*[?\varphi]$ is the union of s that contains the current issue and $s^*[?\varphi]$ that adds the issue raised by the theme of the utterance.[10] $?\varphi$ is

[10] To define thematizing by adding the state $s \cup s^*[?\varphi]$ to the stack instead of adding simply $s[?\varphi]$ is motivated, among other, by conditionals propositions like $p \rightarrow q$.

a question, thus inquisitive and not informative, and s^* is the same as s except that s^* ignores the issue of s, thus updating s^* with $?\varphi$ concentrates on the issues raised by the theme of φ and combines it with s. This will lead to an extension of the issue in s with the issue raised by φ. Thematizing becomes important when the provisional updates by the utterance get canceled by the responder. Take, for example, the utterance 'It is raining.', that is assumed to have the question 'Is it raining?' as theme behind it. In case the responder cannot accept the sentence uttered, he has to cancel the updates and utter 'No, it is not raining.' where 'No' does the canceling and 'it is not raining' is related to the underlying issue of the original utterance. Hence, it is important that we add that issue to the common ground. After the inherent issue is added to the stack, we make a provisional update of the common ground with our utterance. This second operation is called *Assume*.

Definition 2.22 (Assume φ: $\sigma[\varphi]^!$)
$\langle \sigma, s\rangle[\varphi]^! = \langle\langle \sigma, s\rangle, s[\varphi]\rangle$

This operation adds a new state on the top of the stack with the state that is the result of updating the current state on the top by the utterance. The two operations, *Thematize* and *Assume*, form together the primary uptake (def. 2.23), hence the semantic component of our dialogue system.

Definition 2.23 (Primary Uptake)
$\langle \sigma, s\rangle[\varphi]^{\Uparrow 1} = \langle \sigma, s\rangle[\varphi]^?[\varphi]^!$;
that leads to the following:
$\langle\langle\langle \sigma, s\rangle, s \cup s^*[?\varphi]\rangle, (s \cup s^*[?\varphi])[\varphi]\rangle = \langle\langle\langle \sigma, s\rangle, s \cup s^*[?\varphi]\rangle, s^*[\varphi]\rangle$

In the definition we have the equality: $(s \cup s^*[?\varphi])[\varphi] = s^*[\varphi]$ that can be shown by the following. Following from definition 2.2 $?\varphi = \varphi \vee \neg\varphi$ and from the update definition of disjunction we have $(s \cup s^*[?\varphi])[\varphi] = (s \cup s^*[\varphi] \cup s^*[\neg\varphi])[\varphi]$ that leads to $s[\varphi] \cup s^*[\varphi][\varphi] \cup s^*[\neg\varphi][\varphi]$ where $s^*[\varphi][\varphi] = s^*[\varphi]$ and $s^*[\neg\varphi][\varphi] = \emptyset$, consequently it reduces to $s[\varphi] \cup s^*[\varphi]$. Given that $s \subseteq s^*$ it holds that $s[\varphi] \subseteq s^*[\varphi]$, hence $s[\varphi] \cup s^*[\varphi] = s^*[\varphi]$.

A special case is the primary uptake of an initial utterance at the beginning of a dialogue. The uptake of an initial utterance is carried out relative to the *initial stack*: $\langle\langle\rangle, \iota\rangle$, with the special state ι, the initial state, on the top that was already introduced in section 2.1.2 (example 2.8). At the beginning of a dialogue, the first utterance is interpreted relative to the initial state, that does not contain any information (all indices are present) and raises the issue that is interested in everything (no two different indices are connected). This special state can be seen as a version of the 'Big Question' (Roberts 1996): to get to know how the (actual) world is. The initial state is a full partition on all the possible indices, where all

blocks of the partition, hence – in our terms – all *possibilities* contain one single index. Completely resolving/answering the 'Big Question' means to end up with one single index (possibility) by a long sequence of updates. As mentioned earlier we can resolve the original issue by replacing it with a sub-issue that is easier to answer or by resolving all its sub-issues. For example if the original issue is 'Who came to the concert?' it is easier to answer the sub-issues 'Did Amy come to the concert?', 'Did Ben come to the concert?' and so on, for all the individuals in the given domain. Note, that all questions we can utter are sub-issues of the 'Big Question'.

Example 2.28 (Initial Primary Uptake)
$\langle\langle\rangle, \iota\rangle[\varphi]^{\Uparrow 1} = \langle\langle\langle\langle\rangle, \iota\rangle, \iota \cup \iota^*[?\varphi]\rangle, \iota^*[\varphi]\rangle$
that is the same as: $\langle\langle\langle\langle\rangle, \iota\rangle, \omega[?\varphi]\rangle, \omega[\varphi]\rangle$

The initial primary uptake adds two new states on the top of the stack. First, $\iota \cup \iota^*[?\varphi]$, by thematizing φ and the second one, $\iota^*[\varphi]$, by assuming φ. In the definition, the indifferentiation of the initial state – ι^* – is equivalent to the state of ignorance and indifference ω, because in ι all indices are present and disconnected, and since the operation of indifferentiation (*) connects all indices, it leads to ω. Consequently $\iota^*[\varphi] = \omega[\varphi]$ and $\iota \cup \iota^*[?\varphi] = \iota \cup \omega[?\varphi]$, where $\iota \subset \omega[?\varphi]$, hence $\iota \cup \iota^*[?\varphi] = \omega[?\varphi]$.

Secondary Uptake

The second component of a complete uptake of an utterance is the calculation of the pragmatic implicatures via the rule of secondary uptake: *alternative exclusion*.[11] The pragmatic implicature captured by the operation of *alternative exclusion* is triggered, for example, when the responder utters p in the context of the hybrid disjunction $p \vee q$. Responding with p in the context of $p \vee q$ will lead to the pragmatic exclusion of the index where p and q are both true.

The source of this implicature is Comparative Compliance introduced in definition 2.19. I will discuss the pragmatic implicature and alternative exclusion in detail in chapter 4. By way of introduction, in this section, I only discuss the technical definition of the operation and only provide a simple version of it as introduced by Groenendijk (2008). In chapter 4, I provide a new, extended definition of *alternative exclusion* with certain changes that are necessary for my analysis of natural language examples with focus. The dialogue management rule of *alternative exclusion* ($[EXCLA]$) is applied blindly after the primary uptake

[11] Groenendijk (2008) proposes another rule of secondary uptake, *block exclusion*, however the motivation behind it and its status are weak, hence I only make use of the other implicature rule and skip block exclusion. I introduce his proposal of block exclusion in the Appendix.

of the utterance is carried out. Alternative exclusion refers to the *alternatives* in a stack which are defined in the system as follows.

Definition 2.24 (Alternatives in a stack)
ρ is an alternative in the stack $\langle\langle\langle\sigma, s\rangle, t\rangle, u\rangle$ iff
(i) u is related to s[12]; and
(ii)ρ is a possibility in t and ρ is not a possibility in u

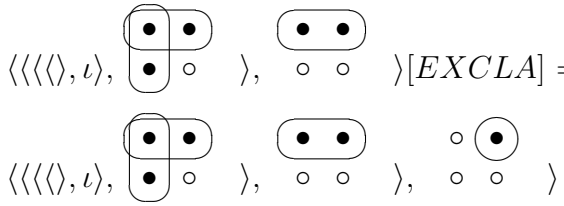
The last state, u, is the state the response leads to, while the state below it, t, is the state containing the current issue. Alternatives are the possibilities that are present in t but no longer present in u. Consider the following example.

Example 2.29 (Alternatives in a stack)

Definition 2.25 (Alternative Exclusion)
Let A be the union of the alternatives in $\langle\langle\sigma, s\rangle, t\rangle$.
$\langle\langle\sigma, s\rangle, t\rangle[EXCLA] = \langle\langle\langle\sigma, s\rangle, t\rangle, u\rangle$ where $u = \{\langle i, j\rangle \in t \mid i, j \notin A\}$

Alternative exclusion eliminates full possibilities that are considered to be alternatives. The context of the disjunction $p \vee q$ has two possibilities ρ_1 and ρ_2, where ρ_1 is the proposition p and ρ_2 is the proposition q. As the response is p, the possibility ρ_2 is considered as an *alternative*. Alternative exclusion will eliminate all indices from the top state that belongs to the *alternative*, to ρ_2.

Example 2.30 (Alternative Exclusion)
$\langle\langle\langle\langle\rangle, \iota\rangle, \omega[p \vee q]\rangle, \omega[p]\rangle[EXCLA]$



Example 2.30 illustrates the calculation of the pragmatic implicature by the the operation of *alternative exclusion* ($[EXCLA]$) in case p is uttered relative to the common ground-stack with the state $\omega[p \vee q]$ on the top. After $[EXCLA]$ is carried out, a new state is added on the top of the stack. In this state (added by $[EXCLA]$) the indices are no longer present which are present in p and also belong to an *alternative* in $\omega[p \vee q]$.

[12]In the following I ignore checking this condition, since in my examples it is always fulfilled. We will meet an example where this condition is relevant in section 4.2.5 in the discussion of indefinites.

2.2.3 Absorption

A full uptake of an utterance builds a new common ground stack, however, at this point all the uptake operations are still provisional. The reaction of the responder determines whether these updates get more definitive. This architecture of the dialogue management system makes it possible to make critical dialogue moves. According to the system the responder has not only the possibility, to *accept* the information provided by the uptake, she can also *cancel* it. According to the dialogue principle – *Keep your state consistent!* – the responder is supposed to resist updates that would make her own information state inconsistent, and in addition the reactions must be explicitly announced (as required by the principle of keeping the common ground). In case the responder announces acceptance, the information in the topmost state of the common ground stack percolates down. In case the responder cannot accept the suggested updates and cancels them, the last informative steps in the stack will be deleted, and we go back to the last inquisitive state: to the last issue provided. After cancellation, there is always an issue on the top of the common ground-stack.

The definition of *Acceptance* uses the operation of Restriction (see definition 2.16) that guides the percolation of the information content from one state to the other. In the full picture of absorption there are more options assumed relative to the possible responses. Here I merely introduce the two basic operations that are minimally required for accepting or rejecting a proposed update. Groenendijk (2008) introduces a third operation, *Support*, that captures the fact that the responder signals that she could have proposed the updates herself as well, because her information state already supported the proposed update from the initiator. *Support* is similar to *Acceptance* with the difference that the information in the top state percolates all the way down, also after an inquisitive state has been met – which is where acceptance stops – the information percolates further down. I skip here the technical details of *Support*, since I will not use it in the rest of my analysis. After a proposed update by an utterance (after the primary and secondary uptake is carried out) a response is expected from the hearer. In case she cannot update her own information state, she has to announce it explicitly and reject the proposed update. This rejection is formally carried out by the operation *Cancellation* which removes the last informative updates (dialogue moves) and gets us back to the last issue in the common ground-stack. The recursive definition deletes the indifferent states on the top till it reaches the first non-indifferent state, hence the first issue. In indifferent states all indices are connected, hence they do not contain an issue. In a non-indifferent state there are some indices disconnected that represent an issue.[13]

[13] I will revise this notion at the end of chapter 5.

Definition 2.26 (Cancellation)

$\langle\langle\sigma, s\rangle, t\rangle[\bot] =$

$\langle\sigma, s\rangle$ if s is not indifferent

$\langle\sigma, s\rangle[\bot]$ otherwise

In case the responder can update her information state, she has to do it, that goes parallel with updating the common ground. Updating the common ground is captured by the operation *Acceptance* which has the effect that the information in the top state percolates down via restriction (definition 2.16), until it results in a state that is not indifferent, hence contains an issue.

Definition 2.27 (Acceptance)

$\langle\langle\sigma, s\rangle, t\rangle[\Diamond] =$

$\langle\langle\sigma, s\rangle, t\rangle$ if $s = s\lceil t\rceil$

$\langle\sigma, s\lceil t\rceil\rangle$ if $s \neq s\lceil t\rceil$ and $s\lceil t\rceil$ is not indifferent

$\langle\sigma, s\lceil t\rceil\rangle[\Diamond]$ otherwise

In chapter 5 I will revise these notions and add a third possible operation: the notion of *implicature cancellation*.

2.3 Summing up

In the previous section I introduced a new framework, Inquisitive Semantics, for dialogue analysis developed by Groenendijk (2008). The system provides a complete dialogue modeling with an inquisitive update semantics and pragmatics together with inquisitive dialogue management rules. In this section, I provided a simple 'proto-type' version of the system and illustrated the main structure of the dialogue modeling system without representing the details of the implementation.

The semantics (and the predicate logic behind it) is constructed in the way that sentences can not only provide information but also raise issues. The representation of dialogues is according to a dialogue management system, where the core notion is the *Common Ground* that is defined as a stack of states. All uptake operations are defined on this common ground-stack. The inclusion of the semantic and pragmatic information of an utterance is defined by the process of primary and secondary uptake, where the computation of the pragmatic implicatures always obligatorily follows the uptake of the semantic content. First all uptakes are considered as provisional and the next turn of the responder determines whether these uptakes get definitive. This set up makes it possible to easily incorporate critical dialogue moves as well. In the following chapters of the dissertation, I will propose an implementation of *focus* in the system of Inquisitive Semantics. My analysis requires certain extensions of the core system introduced in this chapter. These changes will be discussed in the following chapters.

Appendix to chapter 2

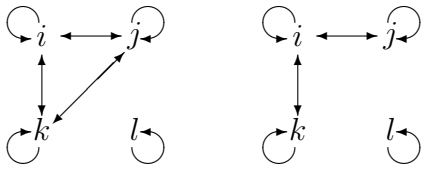
Block exclusion by Groenendijk (2008)

First, I illustrate the motivation behind the operation of *block exclusion* as Groenendijk (2008) assumes it. Alternative questions — as the reading 7a — are interpreted with the pragmatic implicature that at least one of the alternatives is true. Hence $?(p \vee q)$ has the implicature that $\neg p \wedge \neg q$ is excluded.

(7) Did Amy play Bach or Mozart?
   a. alternative reading: $?(p \vee q)$
   b. polar reading: $?!(p \vee q)$

The source of the implicature is *comparative compliance* introduced in definition 2.19. The question (7) has two possible interpretations, of whom the polar reading (7b) is preferred by comparative compliance, because it is more compliant to the context than the alternative reading. Let us take the initial stack as the underlying context. It holds that $?!(p \vee q)$ is more compliant to $\langle\langle\rangle, \iota\rangle$ than $?(p \vee q)$, since $?!(p \vee q)$ is less inquisitive in ι.

Example 2.31 (Pictures of $\iota^*[?!(p \vee q)]$ and $\iota^*[?(p \vee q)]$)



$\iota^*[?!(p \vee q)]$ $\iota^*[?(p \vee q)]$

$i = p \wedge q, j = p \wedge \neg q, k = \neg p \wedge q, l = \neg p \wedge \neg q$

In case $?(p \vee q)$ is choosen above $?!(p \vee q)$, then it is the most compliant utterance (following from the third dialogue principle). Comparative compliance prefers more informative and less inquisitive utterances. Thus, $?(p \vee q)$ can only be the most compliant if we assume that $?!(p \vee q)$ is not inquisitive at all, and that can only be if we assume that $\neg p \wedge \neg q$ (index l) is excluded.

The dialogue management rule that captures this type of implicatures is called *block exclusion* and defined as in definition 2.30. The definition uses two notions that have to be introduced: the *Euclidean closure* merges overlapping possibilities in a state, and possibilities that survive after this operation are called *blocks*.

Definition 2.28 (Euclidean closure)

Let s be a state.

The Euclidean Closure of $s^{\div}$ of s is the smallest set s' such that

$s \subseteq s'$ and $\forall i, j, k : \langle i, j\rangle \in s' \wedge \langle i, k\rangle \in s' \Rightarrow \langle j, k\rangle \in s'$

Definition 2.29 (Block)
ρ is a block in s iff
(i) $s \neq s^{\div} \wedge s^{\div} \neq s^{*}$
(ii) ρ is a possibility both in s and $s^{\div}$

Definition 2.30 (Block exclusion)
$\langle \sigma, s \rangle [EXCLB] = \langle \langle \sigma, s \rangle, t \rangle$
where $t = \{\langle i, j \rangle \in s \mid i, j \notin B\}$ where B is the union of blocks in s.

The operation of block exclusion adds a new state t to the top of the common ground stack $\langle \sigma, s \rangle$, where t excludes the *blocks* of s. In our example, $\omega[?(p \vee q)]$ contains one block, the possibility that belongs to index l, since this is the only possibility that is also a possibility in the eucledian closure of $\omega[?(p \vee q)]$ that is actually equivalent to $\omega[?!(p \vee q)]$. Thus applying block exclusion here adds a new state to the common ground stack, that is equivalent to $\omega[p \vee q]$.

The uptake of the alternative question $?(p \vee q)$ in the initial stack is as follows:

Example 2.32 (Operation of [EXCLB])
$\ldots, \omega[?(p \vee q)]\rangle, \omega[?(p \vee q)]\rangle [EXCLB] = \ldots, \omega[?(p \vee q)]\rangle, \omega[?(p \vee q)]\rangle, \omega[(p \vee q)]\rangle$

Note, however, that the motivation behind the operation of block exclusion is rather weak. The example (7) taken to illustrate this kind of implicature is questionable, since in such examples intonation has a crucial role to distinguish the two proposed interpretations. This intonation is actually the focus structure of the sentence. The alternative reading is available in case the two components of the disjunction get accent – hence are focused. Then we do not deal with competing interpretations any more that have to be compared with respect to compliance.

(8) Did Amy play BACH or MOZART? $\rightsquigarrow ?(p \vee q)$

The same interpretation difference can be found in Hungarian, that provides a more emphatic focusing by involving movement next to intonation. The disjunction within a question can be uttered preverbally (9a) or postverbally (9b).

(9) a. Kávét vagy teát kérsz?
coffee.acc or tea.acc will.2sg
'Do you want COFFEE or TEA? [either one or the other]'

b. Kérsz kávét vagy teát?
will.2sg coffee.acc or tea.acc
'Do you want coffee or tea? [or both]'

The first question (9a) is interpreted as the alternative question as asking if you want either of the two drinks, while the second question includes the possibility to have both coffee and tea as well.

Chapter 3

Focus and Context

After introducing the framework of Inquisitive Semantics in chapter 2, in this chapter I turn to the central matter of the dissertation: a context-based analysis of focus. Chapter 3 is devoted to the general points of my proposed focus analysis in the system of Inquisitive Semantics. The main aim here is to show the importance of context-dependence of focusing and to provide a new analysis of the interpretation of focused sentences along this view. First of all I give the representation of focusing in the formal system of Inquisitive Semantics. This extension requires some changes to the core system of Groenendijk (2008), which I will make explicit later.

An adequate theory of focusing must account for the phenomena concerning the question-answer relation (question-answer congruence; exhaustification of answers) and the association with focus. I will investigate these phenomena and propose an analysis within the system of Inquisitive Semantics and Dialogue Management. The current chapter is devoted to the analysis of free focus and its context-dependence, while I discuss the phenomenon of exhaustification of answers in chapter 4, and association with focus in chapter 5. I believe that the framework of Inquisitive Semantics gives a great opportunity to analyze several phenomena related to focusing in a uniform way. As one of the main arguments of the dissertation I analyze a focused sentence within the scope of a given context or common ground. In this spirit I will also consider the role of focusing in denials, contrast, and specification. These phenomena have received little attention so far (for exceptions see (Roberts 1996, Schwarzschild 1997)).

As I already mentioned, the scope of this chapter is restricted to the analysis of free focus constructions, and the role of free focus in dialogue for question-answer congruence, contrast in denials, and specification. In section 3.1 I present a short overview of the two most influential theories of focusing; in section 3.2 I propose an analysis of focusing in the framework of Inquisitive Semantics, while in section 3.3 I turn to the investigation of free focus in dialogue.

3.1 Focus analyses

As I already mentioned in the introduction (section 1.1.2), focus theories that define focus in terms of semantic/pragmatic interpretation vary depending on whether they assign a truth-conditional impact or context-dependent properties of focusing. Thus we can further distinguish interpretation-based focus-theories as pragmatic versus semantic. Pragmatic theories define the notion of focus as a linguistic tool to define certain relations between utterances and contexts (Roberts 1996, Schwarzschild 1997), while semantic theories define the notion of focus as it has direct influence on the truth-conditions of the utterance (Krifka 2004, Rooth 1985). The notion of focus is intended to give an explanation of two phenomena related to emphasis by accent: the relation between accent and context, and the truth-conditions of sentences containing particles (called focus-sensitive) such as 'only', 'even', or 'too'. In this respect we can make a distinction between focus analyses that deal with *free focus* and its relation to context, and those that investigate *association with focus*.

3.1.1 Association with focus

Classical focus theories rely mostly on the observation that focusing can influence the truth-conditions of a sentence, as illustrated with sentences containing the focus-sensitive particle 'only'. The well-known examples in (10) illustrate that the domain of 'only', hence the truth-conditions of the sentence, depends on the location of the accent (and thus the focusing).

(10) a. Amy only introduced Ben to CLAIRE.
b. Amy only introduced BEN to Claire.

According to the general view, the main function of focusing is to introduce or indicate an alternative set that serves as the quantificational domain for focus-sensitive operators such as 'only' or 'even'.

However, although they share the idea of a direct relation between focusing and the presence of alternatives, we can find different theories. The most prominent ones are the *Alternative Semantics* (AS) of Rooth (1985, 1992) and the *Structured Meaning Approach* (SMA) of Krifka (2004, 2006). Each focus theory can be directly related to one of the question-analyses: Rooth's Alternative Semantics has certain parallelisms with the Hamblin/Karttunen-style semantics of questions (Hamblin 1973, Karttunen 1977), while the Structured Meaning Approach for focus is directly related to the functional view of question meanings (von Stechow 1991, Krifka 2004).

Rooth (1985, 1992) and Krifka (2004, 2006)

The Hamblin/Karttunen semantics of question – also known as the proposition set approach – identifies the meaning of a question with a set of propositions. In Hamblin's (1973) analysis the meaning of a question is the set of propositions that consists of its possible (congruent) answers. In Hamblin's analysis the question 'Who came?' gets interpreted as follows: $[\![\text{Who came?}]\!]^v = \lambda p.\exists x[PERS(x)(v) \wedge p = \lambda w.came'(x)(w)]$. The main idea behind his analysis is that question phrases denote sets of possible short answers, for example, the wh-pronoun 'who' denotes a set of individuals. In Karttunen's (1977) analysis the meaning of a question is the set consisting of its *true* possible answers. Karttunen creates *proto-questions* on the syntax-semantics interface, that get interpreted via the 'Proto-question Rule' that provides a set of propositions. The rule defines that if φ translates φ' then the question $?\varphi$ translates to $\hat{p}[^{\vee}p \wedge p =^{\wedge} \varphi']$ that is practically the same as $\lambda w \lambda p[p(w) \wedge p = \lambda v.\varphi'(v)]$.[1]

The AS approach of Rooth (1985, 1992) uses the above structures to represent focus. Rooth provides a two-valued semantics for focused sentences, where next to the ordinary semantic value, $[\![\alpha]\!]^0$, another one, the focus semantic value, $[\![\alpha]\!]^f$, is determined as well. The focus semantic value is a set of denotations of the same type as the ordinary semantic value. Take, for example, the utterance 'BEN read my book.' that has its focus semantic value the set of propositions of the form 'Amy read my book', 'Ben read my book', 'Cecile read my book' etc.

Example 3.1 (Focus semantic value)

$[\![\text{BEN}_F \text{ read my book}]\!]^f$ = the set of propositions of the form 'x read my book'

According to Rooth's analysis focusing introduces the alternative-set, that is further used in the interpretation of focus-sensitive operators such as 'only' and for the definition of congruent answers.

Example 3.2 (Overview: Alternative Semantics)

(i) **Representation of focus**

every utterance α has two semantic values

(a) the ordinary semantic value $[\![\alpha]\!]^0$: a proposition

(b) the focus semantic value $[\![\alpha]\!]^f$: a set of alternative propositions

(ii) **Definition of 'only'**

only$(\phi) \rightsquigarrow$ *assertion:* $\forall p[(p \in [\![\phi]\!]^f \wedge {}^{\vee}p) \rightarrow p = [\![\phi]\!]^0]$

presupposition: ϕ

[1] Among the proposition set views, we also have to mention the Partition Theory of questions by Groenendijk and Stokhof (1984, 1991). Though somewhat different, the Partition Theory identifies question meanings as sets of propositions as well: as a partition of the logical space, where each block in the partition corresponds to a complete answer to the question.

(iii) **Definition of congruence**
answer A is congruent after question Q iff $[\![Q]\!]^H \subseteq [\![A]\!]^f$
where $[\![Q]\!]^H$ is the Hamblin-denotation of Q

The Structured Meanings Approach (Krifka 2004, Krifka 2006) provides a functional interpretation of focus and questions. According to this theory focusing divides the sentence into a background and a focus, where applying the background to the focus we get the ordinary interpretation. Next to the background and focus, the alternative set is also given, that consists of the focus itself and at least one more element. The SMA claims that focus-sensitive operators (like 'only') should have access to the focus part, the background part, and the alternative set as well.

Example 3.3 (Focus-background structure)
(a) $\langle F, B\rangle \rightsquigarrow B(F)$
(b) $[\![\text{AMY}_F \text{ came.}]\!] = \langle \text{AMY}, \mathit{Alt}, \lambda x.\mathit{came}'(x)\rangle$

The interpretation of questions in the functional tradition runs entirely parallel with the focus interpretation illustrated above. Similarly to the focus-background structure, the interpretation of a question leads to an ordered pair as well. The basic idea is that the meaning of a question is a function, which when applied to the meaning of a congruent answer, yields a proposition. Next to the function, its domain is given and together they form an ordered pair.

Example 3.4 (Structured question)
$[\![\text{Who came?}]\!] = \langle \lambda x.\mathit{came}'(x), \mathit{PERSON}\rangle$

A possible (short) answer to the question above must be an element of the set PERSON. Take a (short) possible answer like 'Amy.'. Applying the (translation of) the answer to the function $\lambda x.\mathit{came}'(x)$ yields the proposition $\mathit{came}'(\mathit{amy})$. This parallel interpretation of focused constructions and question certainly has advantages, especially if we turn to the relation between questions and answers and want to give an analysis of congruent answers.

Example 3.5 (Overview: Structured Meanings Approach)
(i) **Representation of focus**
focus intonation divides the sentence into a background-focus structure:
$\langle B, F\rangle$
(ii) **Definition of 'only'**
$\text{only}(\langle B, F\rangle) \rightsquigarrow$ *assertion:* $\forall x[B(x) \rightarrow x = F]$
presupposition: $B(F)$
(iii) **Definition of congruence**
Let $[\![Q]\!] = \langle B_Q, R\rangle$ and $[\![A]\!] = \langle B_A, F\rangle$;
answer A is congruent after question Q iff $B_A = B_Q$ and $F \in R$

3.1.2 Free focus and context: van Leusen and Kálmán (1993)

Next to the classical focus theories I will discuss a paper on free focus by van Leusen and Kálmán. This article had an important influence on my work in that it gives ideas on how free focus and its clear context-dependence should be analyzed. As van Leusen and Kálmán (1993) points out sentences with a focused-marked constituent (or more focused constituents) can appear in different contexts and depending on the different relations to that context, focusing has rather different functions. Their main claim is that free focus constructions must be analyzed differently from bound (associated) focus constructions on the basis of their different behavior in context. The claim is that licensing contexts for free focus constructions are much more restricted than for bound focus constructions. Investigating sentences with free focus is a quite suitable way to point out and strengthen the discourse-dependent nature of focusing. The most common occurrences of a focused sentence (with free focus) are as 1) a congruent answer to a constituent question, 2) contrast in denials, 3) specification and 4) an "out-of-the-blue" utterance signaling something remarkable or unexpected. From now on I will signal narrow focus on a constituent simply with capitals, and I use brackets and labels, $[\ldots]_F$, only if it is needed (broad focus etc.).

(11) a. congruent answer:
Who arrived yesterday? AMY arrived yesterday.

b. contrast in denials:
Ben arrived yesterday. No, AMY arrived yesterday.

c. specification:
Somebody arrived yesterday. Yes, AMY arrived yesterday.

d. "out of the blue":
(Guess what!) AMY arrived yesterday.

Almost the same examples are discussed in van Leusen and Kálmán (1993) on the interpretation of free focus. Their context-dependent analysis of free focus constructions fulfills our criterion of interpreting focus in terms of discourse analysis. They define three contextual restrictions that are necessary for the context to license sentences with free focus:

1. **Salient Remnant Condition** (SRC): The discourse referent corresponding to the function which results from abstracting over the focus must be salient in the current context.

2. **Kinship Condition** (KC): The focus and its antecedent must refer to concepts that are akin to each other in some respect of their meanings, while they are distinct or contrastive in some other aspect. The focus and its antecedent must have a *common domain*.

3. **Exhaustivity Condition** (EXC): The context in which the focused sentence is uttered must entail the existence of an exhaustive (unique and maximal) entity for which the remnant holds.

The SRC says that the background/remnant information must be given in the context, however it can still be implicit. Their example (with small irrelevant changes):

(12) (Context: the mother of John and Peter comes home and finds the teapot in pieces on the kitchen floor. She calls John.)
— John?! (John comes in and says:) — PETER broke the teapot.

According to KC it holds both for corrective replies and for specification replies that the focus must have the same domain as its antecedent, while for specification replies it further holds that the focus must be a sub-class of its antecedent. These conditions can explain the following examples, where the b. replies are infelicitous:

(13) So, Ben visited Amy.
   a. No, he visited MY PARENTS.
   b. # No, he visited OUR DEPARTMENT.

(14) So, Ronald bought a new car.
   a. Yes, he bought a MERCEDES.
   b. # Yes, he bought a SONY.

According to the third, very important, condition (EXC), sentences with bare focus presuppose exhaustivity that can be accommodated in certain cases. The exhaustivity condition rules out (15), while the reply in (16) is felicitous.

(15) a. Karl is a vegetarian.
   b. # No, IRMGARD is.

(16) a. Karl is the director.
   b. No, IRMGARD is.

To support the claim that exhaustivity is presupposed rather than asserted they give an example where the context explicitly signals non-exhaustivity. If exhaustivity were asserted then we could not explain the infelicity of the response:

(17) – So you also invited the teachers.
– # No, I invited the STUDENTS.

Although these examples are interesting and the (informal) explanations from van Leusen and Kálmán (1993) are correct, they do not offer a proper formal analysis. The most serious problem for them is the update effect of a corrective reply, since the semantics they use does not have the possibility to reject some

previous information. Inquisitive Semantics can handle corrective replies; according to its main concept it concentrates on dialogue moves, allowing all kinds of responses including critical moves such as *denial*.

In the following I give a more discourse-oriented analysis of focusing, however I keep the presence of the alternative set in the interpretation. A crucial difference is the origin of the alternatives, since I claim that alternatives are required for the interpretation of focused sentences, rather than introduced/evoked by focusing. My claim is that in order to interpret a focused sentence we need an appropriate context that already contains the alternatives. The most natural way to get such a context is via questions. In the following I give an analysis of focus related to context according to the theory of Inquisitive Semantics and Dialogue Management introduced in chapter 2 (section 2.2).

3.2 Focus analysis in Inquisitive Semantics

The theory of Inquisitive Semantics provides a logical language where expressions both provide *data* and raise *issues*; these are the basic components of communication. Together with its dialogue management system (which deals with dialogue pragmatics) Inquisitive Semantics is a suitable and elegant framework for discourse analysis. Hence, I expect it to be successfully applicable to the discourse properties of focusing. First of all I provide the representation of sentences with one or more focused constituents in the framework of Inquisitive Semantics and give an analysis following its Dialogue Management system. At this point I am only concerned with narrow focus constructions, the analysis of broad focus and focus projection remains further work. As I already discussed in the introduction, the realization of focus varies across languages, however, the most widely taken view is that focus is marked prosodically – usually by a pitch accent. As a starting point I will give a general analysis of focusing on the basis of English examples with prosodic focus marking. Later, in chapter 6, I will investigate the interpretation of Hungarian focus constructions concentrating on the comparison with focusing in English. In English, narrow focus is marked merely by prosody; no morphological or syntactic strategies are involved. In example (19) either (or both) of the two arguments of the transitive verb can be focused. Merely prosody distinguishes the different information structure of the so called neutral sentence (18) versus the focused sentences (19).

(18) Amy called Ben.

(19) a. AMY called Ben.
b. Amy called BEN.
c. AMY called BEN.

In the generative tradition (following Jackendoff) as well as in the Structured Meaning Approach, focusing leads to a division of the sentence into a *background* and a *focus* part. In our examples (19a-c) we can find three different divisions created by the different focus marking. In (19a) the subject 'Amy' is the focus and the remnant 'called Ben' (or 'x called Ben') is the background, while in (19b) the object is the focus and the background is 'Amy called x'; finally in (19c) we have both constituents in focus and the background is 'x called y'. According to this division, focusing splits up the sentence relative to which part contributes new information and which part contributes old or derivable information. I will follow this view and claim that the core contribution of *focusing* to the sentence meaning is indeed a special division into *theme* and *rheme*. The following section introduces my proposal to focus representation and division by focusing. Note that the terminology of theme/rheme, focus/background etc. is not used uniformly in the literature, which can lead to serious confusion. Here and later on I use the terms *theme* and *rheme* following the terminology of Groenendijk (2008) as introduced in chapter 2. These terms in his usage refer to interpretational theme and rheme, and as such are nearly equivalent to background and focus in the sense of, for example, Krifka (2004, 2006).

3.2.1 Representation of focus

In the logical language of Inquisitive Semantics all utterances are claimed to be divided into a *theme* and a *rheme* (see fact 2.2), where the rheme corresponds to the information content of the given utterance and the theme to the issue that the utterance addresses. Next to the parallelisms with the distinction of new from old information in the generative view, an important difference is that in my system I do not split the sentence itself into two parts, rather I define a way to signal the inherent theme (issue) of the utterance and the information it provides. In the following I will refer to the theme of an utterance α as $TH(\alpha)$ and to the rheme as $RH(\alpha)$. The theme of an utterance is always a question, thus the theme is always inquisitive and non-informative.

First I provide the representation of polar questions and constituent questions in the framework of Inquisitive Semantics. I assume the standard translation of a constituent question to be of the form $?\exists x.\varphi$, while the translation of a polar question as $?!\varphi$[2].

(20) a. Who called Ben? $\mapsto ?\exists x.C(x, b)$
b. Did Amy call Ben? $\mapsto ?C(a, b)$

[2] $?\varphi$ is a polar question if φ is an assertion, while $?!\varphi$ is always a polar question, since $!\varphi$ is always an assertion.

A constituent question is interpreted as a set of possibilities, corresponding to its possible answers. I give a Hamblin-style interpretation of questions as sets of propositions, however with the crucial difference that in my analysis the set contains the proposition 'nobody is P' as well. The wh-question 'Who came?' is translated as $?\exists x.C(x)$ which is the same as the disjunction of the propositions $C(d_1) \vee C(d_2) \vee \ldots \vee C(d_n)$ relative to the given domain of individuals. The corresponding polar question 'Did anybody come?' translates as $?!\exists x.C(x)$ which is crucially different from $?\exists x.C(x)$. The former provides two possibilities, corresponding to the answers 'Yes./No.', while the latter provides many possibilities relative to the number of individuals in the given domain.

An important theoretical (and practical) question is what linguistic phenomena give rise to the theme/rheme division and how we can determine in a formal way the theme of an utterance. The original definition of the theme of an utterance states that the theme is the inherent issue of the given utterance, a background question that is answered by the rheme. In case of so-called neutral sentences[3] the theme factored out by division is the corresponding polar question and the rheme is the utterance itself. For example, the neutral sentence 'Amy called Ben.' has as its theme (or inherent question) 'Did Amy call Ben?'. I claim that sentences with a narrow focus lead to a special theme/rheme division. According to Inquisitive Semantics, in general, intonation (and/or prosody) is responsible for the different theme/rheme divisions. In this chapter I will investigate focusing, which is one case that determines a special theme.[4]

In order to derive the special theme and the rheme of a focused sentence I define the *Rule of Division* as the following.

Definition 3.1 (Rule of Division)
Let α be an utterance in natural language, α' the standard translation of α in the language of Inquisitive Semantics and $\natural$ the following operation:

$\varphi^{\natural} = \psi$ if $\varphi = ?\psi$, otherwise $\varphi^{\natural} = \varphi$.

Every utterance α is divided into a theme and rheme: $TH(\alpha); RH(\alpha)$ where

$TH(\alpha) = ?\exists\vec{x}(\alpha'[\vec{a_F}'/\vec{x}])^{\natural}$; and $RH(\alpha) = \alpha'$

The rheme of the utterance α is its standard logical translation α' (in the language of Inquisitive Semantics). Take, for example, the focused sentence 'AMY called Ben' that has its rheme as $C(a, b)$. The theme of an utterance α translates in the logical language as the results of the following operations.

[3] With neutral sentence intonation.

[4] I claim that other intonational patterns, for example *contrastive topic*, lead to different theme/rheme divisions.

Example 3.6 (Translation of $TH(\alpha)$)
(1) First we take α', the standard translation of α, and replace the standard translation of every focused constituent in α by a variable: $\alpha'[\vec{a_F}'/\vec{x}]$;
(2) Then we apply to this open formula the operation $\natural$;
(3) Then we take the existential closure of the expression: $\exists\vec{x}(\alpha'[\vec{a_F}'/\vec{x}])^{\natural}$;
(4) And finally, by '?' we take the non-informative closure of the expression.

Consider again the focused sentence 'AMY called Ben'. Its standard translation is $C(a, b)$ where we replace a (the translation of the focused constituent in the sentence) by variable x, so we get the expression $C(x, b)$ on which we apply $\natural$ that gives back $C(x, b)$. Then we take the existential closure $\exists x.C(x, b)$, and finally we take the non-informative closure of it that results in the theme of α as $?\exists x.C(x, a)$. This theme corresponds to the constituent question 'Who called Ben?'.

An important result is the theme/rheme division of questions containing a focused constituent. Consider the example 'Who called $[\text{BEN}]_F$?'. According to definition 3.1 first we take the standard translation of the utterance that is $?\exists x.C(x, b)$, then we replace the standard translation of every focused constituent in the utterance by a variable that results in the expression $?\exists x.C(x, y)$. On this formula we apply the operation $\natural$ which gets a rid of the question mark and then we take the existential closure that provides us $\exists y\exists x.C(x, y)$. Finally we take the non-informative closure of this existential expression that gives us the question: $?\exists y\exists x.C(x, y)$. In this way we derive the theme of 'Who called BEN_F?' as the multiple constituent question 'Who called whom?' and its rheme as 'Who called Ben?', the same singular question without focusing.

Let me also illustrate the division of a so-called 'neutral sentence' without focused constituents, that has its theme as the corresponding polar question. Take the sentence 'Amy called Ben', that gets the standard translation as $C(a, b)$ where we do not substitute any constituents (no focus) and neither $\natural$ nor the existential closure has an effect. Then finally we take its non-informative closure that results in the question $?C(a, b)$.

Both the theme and the rheme of a natural language question are its standard logical translation – just as it is supposed to be. The theme/rheme division of the constituent question 'Who called Ben?' goes as follows. Since there are no focused constituents in this question the rule of division determines both its theme and rheme as $?\exists x.C(x, b)$.

Example 3.7 (Divison of questions)
α: 'Who called Ben?' $\rightsquigarrow$ $TH(\alpha)$:$?\exists x.C(x, b)$; $RH(\alpha)$:$?\exists x.C(x, b)$

The equivalence of the theme and the rheme has an impact on the primary uptake of a question, since according to the general rules, thematizing and assuming an utterance add two states to the common ground stack. In case of a

question, however, these two states are the same, thus we get a redundant copy of the same state, which will be immediately removed from the stack.

By means of the Rule of Division (definition 3.1), we can straightforwardly obtain the theme and the rheme of sentences without focusing (example 3.8a), as well as sentences containing one or more focused constituents (example 3.8b–e).

Example 3.8 (Division by focusing)
(a) Ben called Amy. $\rightsquigarrow$ TH: $?C(b,a)$; RH: $C(b,a)$
(b) Ben called $[\text{AMY}]_F$. $\rightsquigarrow$ TH: $?\exists x.C(b,x)$; RH: $C(b,a)$
(c) $[\text{BEN}]_F$ called Amy. $\rightsquigarrow$ TH: $?\exists x.C(x,a)$; RH: $C(b,a)$
(d) $[\text{BEN}]_F$ called $[\text{AMY}]_F$. $\rightsquigarrow$ TH: $?\exists x\exists y.C(x,y)$; RH: $C(b,a)$
(e) Who called $[\text{BEN}]_F$? $\rightsquigarrow$ TH: $?\exists x\exists y.C(x,y)$; RH: $?\exists x.C(x,b)$

In examples (3.8a–d) the rheme, hence the semantic content, is always the same ($C(b,a)$), while the themes of the sentences differ by reason of the prosody, in this case determining the focus structure of the sentence. The different themes determine in which contexts the sentences are felicitous. In this way we can easily capture the context dependence of focusing.[5]

By the special theme/rheme division of focusing its context-dependence is already captured, since first the theme of an utterance gets taken up in the actual context. According to the general view of the dialogue management, each uptake step requires compliance between the actual common ground and the expression. Compliance is the logical notion that drives the flow of a coherent discourse, hence it is checked by the dialogue moves. However, it is claimed that compliance as such can be violated if there is a reason (usually a pragmatic one). In case of focused sentences I claim that they are not allowed to violate compliance. They have a stricter (logical) relation to the actual context, hence the theme must always be compliant. On the basis of this strict logical relation I assume the *focus requirement* to be the following.

Definition 3.2 (Focus requirement)
The theme of a focused utterance must be compliant to the actual common ground.

[5]I claim that by the same mechanism we can capture the theme/rheme division of broad focus and indefinites in focus as the following:
Ben called [a FAGOTTIST]$_F$. $\rightsquigarrow$ TH: $?\exists x.C(b,x)$; RH: $\exists x.C(b,x) \wedge F(x)$
Ben [called AMY]$_F$. $\rightsquigarrow$ TH: $?\exists X.X(a)$; RH: $C(b,a)$
However, these above divisions do not follow directly from the current, simplified definition. The proper treatment of these examples requires a higher-order logic and is left for further investigation.

Primary uptake captures the update effect of the semantic content of the utterance in the common ground. Thematizing is one of the operations in the primary uptake of the utterance in the current context (see chapter 2). In the dialogue management of Inquisitive Semantics the common ground is represented as a stack of states. The operations of update with the semantic content (primary uptake) and with pragmatic implicatures (secondary uptake) add certain new states to the stack, which is followed by the absorption of the reaction from the other discourse participant. The definition of primary uptake of an utterance by Groenendijk (2008) consists of two operations: (1) *thematizing* adds the theme of the utterance to the common ground stack, while (2) by *assume* we hypothetically update the current state by the utterance itself. I claim that the definition of primary uptake should be slightly changed for natural language utterances as the operation of *assume* updates the current state by the rheme of the utterance.

Definition 3.3 (Primary uptake revised)
$\langle \sigma, s \rangle [\alpha]^{\Uparrow 1} = \langle \sigma, s \rangle [TH(\alpha)]^{?} [RH(\alpha)]^{!}$
where
$\langle \sigma, s \rangle [TH(\alpha)]^{?} = \langle \langle \sigma, s \rangle, s \cup s^{*}[TH(\alpha)] \rangle$; and
$\langle \sigma, s \rangle [RH(\alpha)]^{!} = \langle \langle \sigma, s \rangle, s[RH(\alpha)] \rangle$

Both operations add a new state to the stack. By thematizing we add the theme/inherent issue of the utterance to the common ground stack, while by assuming we hypothetically update the current state by the rheme of the utterance. The focus requirement stated above can be formally defined in the rules of primary uptake of the utterance.

Definition 3.4 (Primary uptake of focused sentences)
Let α be an utterance containing one or more focused constituents.

$$\langle \sigma, s \rangle [\alpha]^{\Uparrow 1} = \begin{cases} \langle \sigma, s \rangle [TH(\alpha)]^{?} [RH(\alpha)]^{!} & \text{if } TH(\alpha) \text{ is compliant to } s \\ \text{undefined} & \text{otherwise} \end{cases}$$

This definition captures the claim that focused sentences come with the requirement that the theme must be compliant to the underlying common ground. First this requirement is checked and in case it is fulfilled, the primary uptake of the utterance can be carried out, otherwise the focused sentence is not interpretable.

3.3 Free focus in dialogue

In this section I turn to the analysis of the most common relations that focus can have in a dialogue. Three discourse relations will be investigated here (answers,

contrast and specification)[6] that must all be handled by a proper analysis of focusing. I claim that with my analysis of (free) focus in Inquisitve Semantics we get a rather straightforward treatment of these phenomena thanks to its special architecture, involving questions and assertions at the same time, as well as the flexible model of dialogue that allows to make critical responses. I will provide an analysis within the dialogue management system of Inquisitive Semantics.[7]

3.3.1 Focus in answers

Very regularly the antecedent of a focused sentence is a corresponding wh-question. The "question test" is frequently used to detect the focused part of the sentence. A proper focus analysis must involve the *question-answer relation* and phenomena that directly follow from it, such as question-answer congruence and the exhaustive interpretation of answers. The latter will be discussed in chapter 4.

According to my analysis focusing on one or more constituents determines the theme, which is a question formed by existential closure as given in definition 3.1. The interpretation of a focused sentence requires that its theme is compliant to the actual common ground (definitions 3.2, 3.4). Note, that the theme of the focused sentence is in all cases an expression of the form $?\exists\vec{x}.\varphi$ that leads to overlapping possibilities that can be seen as alternatives in the sense of Rooth (1985, 1992) and Krifka (2004) as well. However, the term 'alternatives' in Inquisitive Semantics is used in a different (though closely related) way in the definition of pragmatic implicature via alternative exclusion (see in chapter 4).

In the following I will derive the uptake of the wh-question 'Who came?' and its answer 'AMY came.' with narrow focus on the subject. These sentences lead to the following theme/rheme division in our system.

(21) Who came? $\rightsquigarrow$ TH: $?\exists x.C(x)$; RH: $?\exists x.C(x)$
AMY came. $\rightsquigarrow$ TH: $?\exists x.C(x)$; RH: $C(a)$

The full derivation of this mini-dialogue begins with the primary uptake of the wh-question, that is followed by the secondary uptake, giving the pragmatic inferences if any. The uptake of the question provides the actual common ground stack for the reaction, the answer. Then relative to this stack provided by the question the primary uptake and immediately the secondary uptake of the focused sentence follows. The result of these operations is a hypothetical update of the common ground, that gets more definitive after the reaction, which can be either

[6] There is also a fourth possible occurrence of focusing, when the sentence is uttered "out of the blue" as in '(Guess what!) AMY arrived yesterday'. This indicates that 'Amy's arriving' is somehow special: it is not expected or her arrival is the relevant one.

[7] My system can handle the occurence of focus in "out of the blue" utterances as well, however, I claim that this usage is different from focusing in answers, contrast or specification.

cancellation or acceptance. In case the response is positive, acceptance makes the hypothetical updates real ones.

I interpret the wh-question as dialogue-initial here, thus relative to the initial context represented as the stack $\langle\langle\rangle, \iota\rangle$ where $\langle\rangle$ is the empty stack and ι is the inital state (see section 2.1.1). According to the dialogue management system first the primary uptake of the question is calculated. The theme and rheme of a question are both its standard translation, hence the primary uptake of the wh-question 'Who came?' leads to the following:

Example 3.9 (Primary uptake of 'Who came?')
Let α be the natural language question 'Who came?'.
$\langle\langle\rangle, \iota\rangle[\alpha]^{\Uparrow 1} = \langle\langle\rangle, \iota\rangle[?\exists x.C(x)]^{?}[?\exists x.C(x)]^{!}$

First we thematize and then we assume the question 'Who came?'. Thematizing leads to the following common ground stack:

Example 3.10 (Thematize 'Who came?')
$\langle\langle\rangle, \iota\rangle[?\exists x.C(x)]^{?} = \langle\langle\langle\rangle, \iota\rangle, \iota \cup \iota^*[?\exists x.C(x)]\rangle = \langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle$

The state $\iota \cup \iota^*[\varphi]$ is identical with the state $\omega[\varphi]$, thus the update of the state of indifference by the theme of the question. In the expressions ι stands for the initial state, where all indices are disconnected. The indifferentiation of ι, referred to as ι^*, is the same as the state of indifference, ω, where all indices are connected. The union of ι and $\iota^*[\varphi]$ is simply $\iota^*[\varphi]$, because the connected indices in ι are a subset of the connected indices in $\iota^*[\varphi]$. Since ι^* is the same as ω, the state added to the initial stack is $\omega[\varphi]$. Thematizing the question is followed by the operation *assume*, which is carried out relative to the common ground stack provided by thematizing.

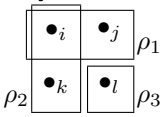
Example 3.11 (Assume 'Who came?')
$\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle[?\exists x.C(x)]^{!} = \langle\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle, \omega[?\exists x.C(x)]\rangle$

The operation 'assume' adds a copy of the state on top provided by thematizing, since the definition of assume says that we have to update the result state of thematizing with the utterance itself. In case of an initial question this leads to a trivial and redundant update $\omega[\varphi][\varphi]$ which is immediately reduced to $\omega[\varphi]$. Consequently the full primary uptake of the question 'Who came?' provides the common ground stack: $\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle$ which serves as the actual context for the answer 'AMY came'.

The uptake of a wh-question $?\exists x.P(x)$ always adds to the stack a state that has the possibilities: $P(d_1)$, ..., $P(d_n)$, $\neg\exists x.P(x)$ relative to the domain of individuals. These possibilities corresponds to the propositions 'Amy came', 'Ben

came', ..., 'nobody came'. For illustration we analyze our example question 'Who came?' relative to the same simple model as before, with two individuals $Amy \mapsto a$ and $Ben \mapsto b$ and one predicate $CAME \mapsto C$. Relative to this model, the state $\omega[?\exists x.C(x)]$ on the top of the stack has three possibilities: ρ_1, ρ_2, ρ_3 that corresponds to the propositions $C(a), C(b), \neg\exists x.C(x)$ respectively. The picture of $\omega[?\exists x.C(x)]$ is the following, where the indices are $i(C) = \{a, b\}$, $j(C) = \{a\}$, $k(C) = \{b\}$ and $l(C) = \varnothing$.

Example 3.12 (Picture of $\omega[?\exists x.C(x)]$)



The possibility ρ_1 corresponds to the proposition $C(a)$, in ρ_1 for all indices i it holds that $a \in i(C)$ and all these indices are connected.

Then uptake of the focused answer 'AMY came.' takes place relative to the common ground stack $\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle$ provided by the uptake of the question. In the primary uptake we refer to the theme and the rheme of the utterance. The focused sentence 'AMY came.' is divided into its theme as $?\exists x.C(x)$ and its rheme as $C(a)$. Before we can carry out the primary uptake of the utterance, according to the focus requirement it has to be checked if the theme of the utterance is compliant to the underlying context. In this particular example the theme of the utterance is identical to the wh-question, thus compliance is straightforward. As the focus requirement is fulfilled, the primary uptake can be carried out. The primary uptake of the sentence begins with thematizing it.

Example 3.13 (Thematize 'AMY came.')

$\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle[?\exists x.C(x)]^? = \langle\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle, \omega[?\exists x.C(x)]\rangle$

The operation adds the state $\omega[?\exists x.C(x)]$ on the top of the stack; this is the result of the union of the top state in the common ground and the issue provided by the theme of the utterance: $\omega[?\exists x.C(x)] \cup \omega[?\exists x.C(x)]^*[?\exists x.C(x)]$. The indifferentiation $\omega[?\exists x.C(x)]^*$ is equivalent to ω, because in $\omega[?\exists x.C(x)]$ ω is updated with a question, thus it creates issues by disconnecting indices, while it does not eliminate any of them. The indifferentiation of $\omega[?\exists x.C(x)]$ removes the issues connecting all indices again. $\omega[?\exists x.C(x)] \cup \omega[?\exists x.C(x)]$, which is equivalent to $\omega[?\exists x.C(x)]$. Consequently, thematizing here will add a copy of the state $\omega[?\exists x.C(x)]$ to the top of the common ground stack. At this point the focus requirement is satisfied, since the theme $?\exists x.C(x)$ of the answer is compliant to the state $\omega[?\exists x.C(x)]$ provided by the wh-question. This is trivial in this example, since the underlying wh-question is equivalent to the theme of the focused utterance.

After thematizing and checking the focus requirement (compliance of the theme), we can turn to assuming the rheme of the utterance. This operation is carried out relative to the common ground stack resulted by thematizing.

Example 3.14 (Assume 'AMY came.')
$\langle\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)]\rangle[C(a)]^! =$
$\langle\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)]\rangle,\omega[C(a)]\rangle$

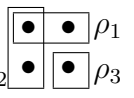
Assuming the rheme of the utterance we hypothetically update the actual common ground by the rheme/information content. The operation adds a new state on the top, that is the result of updating $\omega[?\exists x.C(x)]$ by $C(a)$. The new state on the top, hence the result of the hypothetical update is $\omega[?\exists x.C(x)][C(a)]$ that eliminates all indices where a is not an element of the predicate C and as a result we end up with the single possibility ρ_1 (see example 3.12) that corresponds to the proposition $C(a)$. The result of the primary uptake of the focused answer in the context of the question is the common ground stack in example (3.15a) that can be illustrated by the pictures in example (3.15b).

Example 3.15 (Primary uptake of the focused answer)
a. $\langle\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)][C(a)]\rangle$

b. $\langle\langle\langle\langle\rangle,\iota\rangle,$  $\rangle,$  $\rangle,$  $\rangle$
$\langle\langle\langle\langle\rangle,\iota\rangle,question\rangle,theme\rangle,rheme\rangle$

After the primary uptake, the secondary uptake and hence the pragmatic inference is calculated (see section 2.2.2). Here the alternative exclusion (definition 2.25) applies, since $\omega[?\exists x.C(x)]$ has overlapping possibilities and $\omega[?\exists x.C(x)][C(a)]$ is informative after $\omega[?\exists x.C(x)]$. The alternatives in the current common ground stack are the possibilities in $\omega[?\exists x.C(x)]$ (the state by the theme) that are not possibilities in $\omega[C(a)]$ (the state by the rheme). In this case we have two such possibilities, thus the alternatives are: ρ_2 and ρ_3.

Example 3.16 (Alternatives)

$\omega[?\exists x.C(x)]$: 

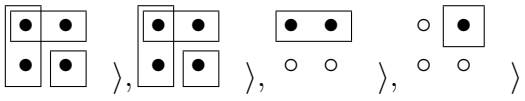
$\omega[C(a)]$: 

The effect of applying alternative exclusion to $\omega[C(a)]$ after $\omega[?\exists x.C(x)]$ is the exclusion of all indices that belong to the alternatives ρ_2 and ρ_3. The operation adds a new top to the stack of states:[8]

[8]Here I apply Groenendijk's original definition of alternative exclusion introduced in chapter 2 (definition 2.25), however, in the next chapter, I will propose a new version of it that is essentially the same for this example but technically more suitable for several cases of exhaustive interpretation in natural language examples.

Example 3.17 (Alternative exclusion)

$\langle\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)]\rangle,\omega[C(a)]\rangle,\omega[\forall x.C(x)\leftrightarrow x=a]\rangle$

$\langle\langle\langle\langle\rangle,\iota\rangle,$  $\rangle$

$\langle\langle\langle\langle\rangle,\iota\rangle,question\rangle,theme\rangle,rheme\rangle,excl\rangle$

The state on the top of the common ground stack corresponds to the exhaustive answer that the only individual who came (from the current domain) is Amy. The exhaustivity of the focused answer is the consequence of the pragmatic inference of alternative exclusion. Thus, as such it can be cancelled. After the uptake – primary and secondary – of the answer the information provided can be either *accepted* or *cancelled* depending on the next dialogue move. If the responder accepts the information (that is, she does not protest), the provisional updates will become definitive by means of the recursive definition of *acceptance* (example 3.18). By means of acceptance the information on the top of the stack will percolate down and resolve the actual question.

Example 3.18 (Accept)

$\langle\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[C(a)]\rangle,\omega[\forall x.C(x)\leftrightarrow x=a]\rangle[\Diamond]$
$\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[\forall x.C(x)\leftrightarrow x=a]\rangle[\Diamond]$
$\langle\langle\rangle,\iota\rangle,\omega[\forall x.C(x)\leftrightarrow x=a]\rangle[\Diamond]$
$\langle\rangle,\iota[\forall x.C(x)\leftrightarrow x=a]\rangle$

If the responder cannot accept the information then she has to announce this publicly, and as the effect of her cancellation the last informational steps will be removed, returning to the last issue (example 3.19).

Example 3.19 (Cancel)

$\langle\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)]\rangle,\omega[C(a)]\rangle,\omega[\forall x.C(x)\leftrightarrow x=a]\rangle[\bot]$
that results in: $\langle\langle\langle\rangle,\iota\rangle,\omega[?\exists x.C(x)]\rangle,\omega[?\exists x.C(x)]\rangle$

The cancellation works fine in cases like the sequence of sentences in (22).

(22) (Who came?) — AMY came. — No, BEN came.

The uptake of the question and its answer goes as shown before, then the denial of the next turn is carried out by the operation of *cancellation*, whereby the last informational steps got withdrawn, and we get back to the last issue. Then the next focused sentence gets interpreted, with both primary and secondary uptake.

3.3.2 Question–answer congruence

In felicitous discourses there is always a correlation between the location of the wh-word in the question and the placement of the focus in the answer. The wh-question determines what answers count as *congruent* to it. This special relation between questions and answers is an important issue for semantic theories of focus. On the basis of question-answer congruence rules the infelicity of misplaced focus (23b), overfocused (23c) or underfocused (23d) answers should be ruled out.

(23) a. Right focusing:
Q: Who called Ben?
A: AMY called Ben.

b. Misplaced focus:
Q: Who called Ben?
A: #Amy called BEN.

c. Overfocused anwer:
Q: Who called Ben?
A: #AMY called BEN.

d. Underfocused anwer:
Q: Who called whom?
A: #AMY called Ben.

Both Alternative Semantics (Rooth 1985, Rooth 1992) and the Structured Meaning Approach (Krifka 2001) provide congruence rules and conditions for the above examples.

Congruence by Rooth

In the theory of Alternative Semantics to define the criteria of congruent answers Rooth (1985, 1992) relates two sets of propositions, namely the meaning of a question and the alternative semantic value of the focused sentence. The meaning of the question is taken to be a set of propositions in accordance with Hamblin (1973), where the set contains the propositions that count as possible answers to the given question. The focus semantic value is calculated by use of the alternative set introduced by the focused constituent. This alternative set, however, can be taken either broadly or restrictively. To simplify for the moment, we consider the second way, thus the alternative set is restricted to a given domain. Then the main requirement of congruence is that the interpretation of the question must be a subset of the focus semantic value of the answer: $[\![Q]\!]^H \subseteq [\![A]\!]^f$. Example 3.20 shows a simple case of a congruent answer:

Example 3.20 (Congruence by Rooth)
Who went to the concert?
$[\![Q]\!]^H = \{went(x)(concert) \mid x \in PERSON\}$
$[\![Q]\!]^H = \{went(amy)(concert), went(ben)(concert), \ldots\}$
AMY went to the concert.
$[\![A]\!]^f = \{went(x)(concert) \mid x \in E\}$
$[\![A]\!]^f = \{went(amy)(concert), went(ben)(concert), went(mydog)(concert), \ldots\}$

In this example the answer is congruent, the meaning of the question is a subset of the focus semantics value of the answer. Both sets consist of propositions of the form 'x went to the concert', and in $[\![A]\!]^f$, x is an element of the set of entities E, while in $[\![Q]\!]^H$, x is an element of the set of persons $PERSON$, and $PERSON \subseteq E$. Consider now an other answer with a misplaced focus (ex. 3.22), where this requirement fails: $[\![Q]\!]^h \not\subseteq [\![A]\!]^f$.

Example 3.21 (Congruence by Rooth: misplaced focus)
Who went to the concert?
$[\![Q]\!]^H$=$\{went(x)(concert) \mid x \in PERSON\}$ (as above)
Amy went to the CONCERT.
$[\![A]\!]^f$=$\{went(amy)(x) \mid x \in E\}$
$[\![A]\!]^f$=$\{went(amy)(concert), went(amy)(cinema), went(amy)(hospital), \ldots\}$

The condition of Rooth also correctly predicts that underfocused answers are not congruent. As is illustrated in the following example, there are propositions in $[\![Q]\!]^H$ that are not in $[\![A]\!]^f$, hence the conguence requirement $[\![Q]\!]^H \subseteq [\![A]\!]^f$ fails.

Example 3.22 (Congruence by Rooth: underfocused answer)
Who went where?
$[\![Q]\!]^H$=$\{went(x)(y) \mid x \in PERSON \wedge y \in LOCATION\}$
$[\![Q]\!]^H$=$\{went(amy)(concert), went(amy)(cinema), \ldots,$
$went(ben)(concert), went(claire)(cinema), \ldots\}$
Amy went to the CONCERT.
$[\![A]\!]^f$=$\{came(amy)(x) \mid x \in E\}$
$[\![A]\!]^f$=$\{went(amy)(concert), went(amy)(cinema), went(amy)(hospital), \ldots\}$

Note, however, that the focus semantic values of these two examples overlap at the proposition $went(amy)(concert)$. Because of this possibility an additional criterion has to be added. Both sets should contain more than one element, otherwise it can be the case that $[\![Q]\!]^H \subseteq [\![A]\!]^f$, also if the answer is not congruent. Furthermore the rules have to be extended with one more condition: that the two sets must have at least two elements in common ($|[\![Q]\!]^H \cap [\![A]\!]^f| \geq 2$). All these conditions together correctly rule out answers with misplaced focus or underfocus, but the overfocused answer still remains a problem. Consider the question-answer pair in example 3.23, where all conditions are satisfied, hence the overfocused answer is wrongly taken to be congruent:

Example 3.23 (Congruence by Rooth: overfocused answer)
Who went to the concert?
$[\![Q]\!]^H$=$\{went(x)(concert) \mid x \in PERSON\}$ (as above)
AMY came to the CONCERT.

$[\![A]\!]^f = \{came(x)(y) \mid x \in E \wedge y \in E\}$
$[\![A]\!]^f = \{came(amy)(concert), came(amy)(cinema), \ldots,$
$came(mydog)(concert), \ldots, came(ben)(cinema), \ldots\}$

A possible solution is introducing one more principle, the preference for *minimal focus* as proposed by Schwarzschild (1999) and Büring (2002). According to this condition, an answer is congruent if there is no alternative answer with less focus marking that satisfies the first two conditions. This solution is rather stipulative and furthermore faces the problem of determining what counts as "less focus marking". It certainly gets problematic if we also consider broad focus.

Congruence by Krifka

Krifka (2001) proposes another analysis of congruent answers in the Structured Meaning Approach. He claims that his analysis does not face the problems that Alternative Semantics does. In the Structured Meaning Approach questions are interpreted as functions that when applied to a short answer yield a proposition. A question is represented as an ordered pair formed by the function (called the (question-)background) and a restriction that sets the question domain. Focusing on one or more constituents divides the sentence meaning into a background and a focus part, represented also as an ordered pair of the (focus-)background and the focus.

Example 3.24 (Structured meanings)
$[\![\text{Who came to the concert?}]\!] = \langle \lambda x.came(x, concert), PERSON \rangle$
$[\![\text{AMY came to the concert.}]\!] = \langle \lambda x.came(x, concert), Amy \rangle$

This example shows already that there is a quite straightforward way to define congruent answers in this framework, since there is a clear correspondence between the question-background and the focus-background, as well as between the question restriction and the focus. Then the definition of congruent answer is given as: an answer is congruent after a question, if and only if the question-background (B_Q) is the same as the focus-background (B_A) and the focus is an element of the question restriction.

Example 3.25 (Congruence by Krifka)
Let $[\![Q]\!] = \langle B_Q, R \rangle$ and $[\![A]\!] = \langle B_A, F \rangle$.
A is congruent after Q iff $B_Q = B_A$ and $F \in R$

As Krifka claims this definition of congruent answer can correctly predict all four cases of right focusing, misplaced focus, and over- and under-focused answers as we illustrate in example 3.26.

Example 3.26 (Congruence by Krifka)

(a) Who came to the concert? $\rightsquigarrow \langle \lambda x.came(x, concert), PERSON \rangle$
  (a′) AMY came to the concert. $\rightsquigarrow \langle \lambda x.came(x, concert), Amy \rangle$
  (a″) Amy came to the CONCERT. $\rightsquigarrow \langle \lambda x.came(Amy, x), concert \rangle$
  (a‴) AMY came to the CONCERT. $\rightsquigarrow \langle \lambda x \lambda y.came(x, y), \langle Amy, concert \rangle \rangle$

(b) Who came where? $\rightsquigarrow \langle \lambda x \lambda y.came(x, y), PERSON \times PLACE \rangle$
  AMY came to the concert. $\rightsquigarrow \langle \lambda x.came(x, concert), Amy \rangle$

The right focusing in example 3.26a′ is correctly taken as congruent, since the question-background is identical to the focus-background and 'Amy' is an element of the set of persons. The misplaced focus (example 3.26a″), the overfocused (example 3.26a‴) and underfocused (example 3.26b) answers, however, are ruled out as congruent, since in all these cases the focus-background is different from the question-background and furthermore in all these cases the focus is not an element of the set determined by the question restriction.

Comparing the two approaches, the Structured Meanings Account with its more fine-grained architecture provides a more elegant analysis of question-answer congruence, since it can handle all four cases with one congruence rule and does not require additional conditions as the restriction on the sets or the minimal focus preference in Alternative Semantics.

Although Krifka's approach is rather convincing and elegant, I propose a different analysis in the framework of Inquisitive Semantics. I claim that my proposal is even more elegant, since in the system of Inquisitive Semantics the logical relatedness of a coherent dialogue already rules out sentences with wrong focus structures. The core notion of *compliance* that refers to the notion of *logical relatedness* filters out answers with a theme that is not compliant to the underlying context (hence the state on the top of the actual common ground stack). That is, my system filters out the non-congruent answers without introducing any separate congruence rule or condition. In all four cases of (23) we have to compare the common ground provided by the wh-question and the theme of the focused sentence. The theme must be compliant to the top state in the stack in order to form a logically related dialogue move according to the focus requirement. I repeat here the notion of *Compliance* that was introduced already in chapter 2:

Example 3.27 (Compliance of φ in s) (= example 2.26)
Utterance φ is compliant to state s iff
(a) every possibility in $s^*[\varphi]$ is the union of a subset of the possibilities in s; and
(b) every possibility in the restriction of s by $s^*[\varphi]$
  is included in a possibility in $s^*[\varphi]$

Before I turn to the illustration that in all three cases of wrong focus the theme fails to be compliant to the context, I give the representation of the multiple wh-question and the sentence with two focused constituents. Similarly to the singular

constituent questions, the standard translation – thus the theme and the rheme – of the multiple wh-question 'Who called whom?' is $?\exists x \exists y.call(x, y)$ which leads to possibilities that correspond to the propositions $C(a, a), C(a, b), C(b, c), \ldots$ relative to a given domain. The representation of sentences with multiple foci goes parallel with the singular focus in accordance with the definition of division. The sentence 'AMY called BEN' has its theme as $?\exists x \exists y.C(x, y)$ and its rheme (information content) as $C(a, b)$.

Let us now look at the above examples in technical detail, provided with the pictures of the states. (Where it is feasible I provide pictures, however some cases are too complicated to draw.) For the complicated pictures I only give the possibilities as $\rho = \{i_1, i_2, \ldots, i_n\}$, where $i_1, i_2, \ldots, i_n$ are all connected indices. Take the same simple model M, with a domain consisting of two individuals: Amy $\mapsto a$ and Ben $\mapsto b$, a predicate CALL $\mapsto C$ and a set of indices I.

Example 3.28 (Model)
$M = \{D, I\}$; $D = \{a, b\}$; $Pred = \{C\}$; $I = \{i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, z\}$

$i(C) = \{\langle a, a\rangle, \langle a, b\rangle, \langle b, b\rangle, \langle b, a\rangle\}$
$j(C) = \{\langle a, a\rangle, \langle a, b\rangle, \langle b, b\rangle\}$
$k(C) = \{\langle a, b\rangle, \langle b, b\rangle, \langle b, a\rangle\}$
$l(C) = \{\langle a, a\rangle, \langle a, b\rangle, \langle b, a\rangle\}$
$m(C) = \{\langle a, a\rangle, \langle b, b\rangle, \langle b, a\rangle\}$
$n(C) = \{\langle a, b\rangle, \langle b, b\rangle\}$
$o(C) = \{\langle a, a\rangle, \langle a, b\rangle\}$
$p(C) = \{\langle a, b\rangle, \langle b, a\rangle\}$
$q(C) = \{\langle a, a\rangle, \langle b, b\rangle\}$
$r(C) = \{\langle b, b\rangle, \langle b, a\rangle\}$
$s(C) = \{\langle a, a\rangle, \langle b, a\rangle\}$
$t(C) = \{\langle a, b\rangle\}$
$u(C) = \{\langle b, b\rangle\}$
$v(C) = \{\langle a, a\rangle\}$
$w(C) = \{\langle b, a\rangle\}$
$z(C) = \varnothing$

The questions 'Who called Ben?' and 'Who called whom?' provide respectively the contexts whose top states are shown in example 3.29:

Example 3.29 (Contexts)
(a) context by 'Who called Ben?': $\langle \ldots, \omega[?\exists x.C(x, b)]\rangle$
(b) context by 'Who called whom?': $\langle \ldots, \omega[?\exists x \exists y.C(x, y)]\rangle$

The state $\omega[?\exists x.C(x, b)]$ provided by the question 'Who called Ben?' has three possibilities (relative to our domain $D = \{a, b\}$) ρ_1, ρ_2 and ρ_3 that correspond to the propositions 'Amy called Ben', 'Ben called Ben'[9] and 'Nobody called Ben' respectively. The question 'Who called whom?' leads to the state $\omega[?\exists x \exists y.C(x, y)]$ on the top of the stack, with five possibilities $\rho'_1 \ldots \rho'_5$ corresponding to the propositions 'Amy called Ben', 'Ben called Ben', 'Amy called Amy', 'Ben called Amy' and 'Nobody called anybody'.

[9]It is quite unnatural to say that Ben called himself, but choosing a domain with more individuals would lead to too complicated a picture, which I want to avoid for the moment.

Example 3.30 (The possibilities)

In the picture of $\omega[?\exists x.C(x,b)]$:
$\rho_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho_2 = \{i,j,k,m,n,q,r,u\} \rightsquigarrow C(b,b)$
$\rho_3 = \{s,v,w,z\} \rightsquigarrow \neg\exists x.C(x,b)$

In the picture of $\omega[?\exists x\exists y.C(x,y)]$:
$\rho'_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho'_2 = \{i,j,k,m,n,q,r,u\} \rightsquigarrow C(b,b)$
$\rho'_3 = \{i,j,l,m,o,q,s,v\} \rightsquigarrow C(a,a)$
$\rho'_4 = \{i,k,l,m,p,r,s,w\} \rightsquigarrow C(b,a)$
$\rho'_5 = \{z\} \rightsquigarrow \neg\exists x\exists y.C(x,y)$

To check if the answer is congruent we have to see if the theme of the answer is *compliant* to the actual top state in the common ground stack provided by the question.

In the case of the misplaced focus in (23b) the actual common ground has the state $\omega[?\exists x.C(x,b)]$ on the top with the possibilities $\rho_1 \ldots \rho_3$ (see example 3.30) and the theme of the answer is $?\exists x.C(a,x)$. The answer is a coherent dialogue move if the theme $?\exists x.C(a,x)$ is compliant to the state $\omega[?\exists x.C(x,b)]$. According to the definition of compliance, this holds if and only if the indifferentiation of the state provided by the question updated with the theme is related to the state provided by the question.

Example 3.31 (Compliance: misplaced focus)

The theme $?\exists x.C(a,x)$ is compliant to the state $\omega[?\exists x.C(x,b)]$ iff
$\omega[?\exists x.C(x,b)]^*[?\exists x.C(a,x)]$ is related to $\omega[?\exists x.C(x,b)]$
(where $\omega[?\exists x.C(x,b)]^*[?\exists x.C(a,x)]$ equals to $\omega[?\exists x.C(a,x)]$)
thus iff
(1) every possibility in $\omega[?\exists x.C(a,x)]$ is the union of a subset of possibilities in $\omega[?\exists x.C(x,b)]$; and
(2) every possibility in $\omega[?\exists x.C(x,b)]\lceil\omega[?\exists x.C(a,x)]\rceil$ is included in a possibility in $\omega[?\exists x.C(a,x)]$

The state $\omega[?\exists x.C(x,b)]^*[?\exists x.C(a,x)]$ is equivalent to $\omega[?\exists x.C(a,x)]$, because $\omega[?\exists x.C(x,b)]^*$, the indifferentiation of $\omega[?\exists x.C(x,b)]$ is equivalent to ω. In the example of a misplaced focus both requirements of compliance fail, because (1) none of the possibilities in $\omega[?\exists x.C(a,x)]$ are possibilities or unions of possibilities in $\omega[?\exists x.C(x,b)]$; and (2) the restriction of the underlying state $\omega[?\exists x.C(x,b)]$ with the information in $\omega[?\exists x.C(a,x)]$ equals to the state itself, and it is not the case that all possibilities in $\omega[?\exists x.C(x,b)]$ are included in a possibility in $\omega[?\exists x.C(a,x)]$. Hence, the theme of the sentence with a misplaced focus is not compliant to the underlying wh-question, and as such it is ruled out as a congruent answer.

Example 3.32 (Pictures of $\omega[?\exists x.C(a,x)]$ and $\omega[?\exists x.C(x,b)]$)

The picture of $\omega[?\exists x.C(a,x)]$:
$\rho_1 = \{i,j,l,m,o,q,s,v\} \rightsquigarrow C(a,a)$
$\rho_2 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho_3 = \{r,u,w,z\} \rightsquigarrow \neg\exists x.C(a,x)$

The picture of $\omega[?\exists x.C(x,b)]$:
$\rho_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho_2 = \{i,j,k,m,n,q,r,u\} \rightsquigarrow C(b,b)$
$\rho_3 = \{s,v,w,z\} \rightsquigarrow \neg\exists x.C(x,b)$

It is already predictable intuitively that a reaction with a misplaced focus structure is not compliant to the question, because it has an inherent theme that is not related to the question in any way.

Now I turn to the more interesting cases of over- and underfocused answers. Let us first consider the overfocused answer in (23c):

(23c) Who called Ben? #AMY called BEN.

Here the top state of the common ground stack is $\omega[?\exists x.C(x,b)]$ as a result of the uptake of the wh-question 'Who called Ben?'. The theme of the answer is $?\exists x\exists y.C(x,y)$. Thus we need the following:

Example 3.33 (Compliance: overfocused answer)
The theme $?\exists x\exists y.C(x,y)$ is compliant to the state $\omega[?\exists x.C(x,b)]$ iff
$\omega[?\exists x\exists y.C(x,y)]$ is related to $\omega[?\exists x.C(x,b)]$
(where $\omega[?\exists x\exists y.C(x,y)] = \omega[?\exists x.C(x,b)]^*[?\exists x\exists y.C(x,y)]$)
Thus iff
(1) every possibility in $\omega[?\exists x\exists y.C(x,y)]$ is the union of a subset of possibilities in $\omega[?\exists x.C(x,b)]$; and
(2) every possibility in $\omega[?\exists x.C(x,b)]\lceil\omega[?\exists x\exists y.C(x,y)]\rceil$ is included in a possibility in $\omega[?\exists x\exists y.C(x,y)]$

In this example again, both compliance requirements fail, since (1) ρ_3, ρ_4 and ρ_5 are not the union of a subset of the possibilities $\rho'_1, ..., \rho'_3$, and (2) the possibility ρ'_3 is not included in any of the possibilities of $\rho_1, ..., \rho_5$ (see below). Hence, the theme of the overfocused answer is not compliant, and the answer is not congruent. It is already predictable intuitively as well, since the theme of the overfocused answer is more inquisitive than the underlying question.

Example 3.34 (Pictures of $\omega[?\exists x\exists y.C(x,y)]$ and $\omega[?\exists x.C(x,b)]$)

the picture of $\omega[?\exists x\exists y.C(x,y)]$:
$\rho_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho_2 = \{i,j,k,m,n,q,r,u\} \rightsquigarrow C(b,b)$
$\rho_3 = \{i,j,l,m,o,q,s,v\} \rightsquigarrow C(a,a)$
$\rho_4 = \{i,k,l,m,p,r,s,w\} \rightsquigarrow C(b,a)$
$\rho_5 = \{z\} \rightsquigarrow \neg\exists x\exists y.C(x,y)$

the picture of $\omega[?\exists x.C(x,b)]$:
$\rho'_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho'_2 = \{i,j,k,m,n,q,r,u\} \rightsquigarrow C(b,b)$
$\rho'_3 = \{s,v,w,z\} \rightsquigarrow \neg\exists x.C(x,b)$

The under-focused answer in (23d) gives an inverse picture to the over-focused answer just discussed.

(23d) Who called whom? #AMY called Ben.

Here the state on the top of the common ground is $\omega[?\exists x\exists y.C(x,y)]$ and the theme of the answer is $?\exists x.C(x,b)$. For a compliant answer we need the following.

Example 3.35 (Compliance: underfocused answer)
The theme $?\exists x.C(x,b)$ is compliant to the state $\omega[?\exists x\exists y.C(x,y)]$ iff
$\omega[?\exists x.C(x,b)]$ is related to $\omega[?\exists x\exists y.C(x,y)]$
(where $\omega[?\exists x.C(x,b)] = \omega[?\exists x\exists y.C(x,y)]^*[?\exists x.C(x,b)]$)
Thus iff
(1) every possibility in $\omega[?\exists x.C(x,b)]$ is the union of a set of possibilities in $\omega[?\exists x\exists y.C(x,y)]$; and
(2) every possibility in $\omega[?\exists x\exists y.C(x,y)]\lceil\omega[?\exists x.C(x,b)]\rceil$ is included in a possibility in $\omega[?\exists x.C(x,b)]$

Again, the first requirement fails, because in $\omega[?\exists x.C(x,b)]$ there is a possibility that is not a possibility or a union of possibilities in $\omega[?\exists x\exists y.C(x,y)]$, namely ρ'_3 (see illustration in example 3.34), and the other requirement fails also, because ρ_3 and ρ_4 are possibilities that are not included in any of $\rho'_1, ..., \rho'_3$.

The logical notion of compliance also correctly rules out the special case of underfocused answers, when a wh-question receives a reply without any focused constituents.

(24) Who called Ben? #Amy called Ben.

The question leads to the state $\omega[?\exists x.C(x,b)]$ while the theme of the reply is the polar question $?C(a,b)$. Then I show that in this case as well, the theme of the reply is not compliant to the context by the question.

Example 3.36 (Compliance: no focus)
The theme $?C(a,b)$ is compliant to the state $\omega[?\exists x.C(x,b)]$ iff
$\omega[?C(a,b)]$ is related to $\omega[?\exists x.C(x,b)]$
(where $\omega[?C(a,b)] = \omega[?\exists x.C(x,b)]^*[?C(a,b)]$)
Thus iff
(1) every possibility in $\omega[?C(a,b)]$ is the union of a subset of possibilities in $\omega[?\exists x.C(x,b)]$; and
(2) every possibility in $\omega[?\exists x.C(x,b)]\lceil\omega[?C(a,b)]\rceil$ is included in a possibility in $\omega[?C(a,b)]$

Again, the theme of the reply, $?C(a,b)$, fails to be compliant to the state $\omega[?\exists x.C(x,c)]$, because one of the possibilites in $\omega[?C(a,b)]$, namely ρ_2 is not a possibility or union of possibilities in $\omega[?\exists x.C(x,b)]$ and ρ'_2 and ρ'_3 are not included in any of ρ_1 and ρ_2.

Example 3.37 (Pictures of $\omega[?C(a,b)]$ and $\omega[?\exists x.C(x,b)]$)

The picture of $\omega[?C(a,b)]$:	The picture of $\omega[?\exists x.C(x,b)]$:
$\rho_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$	$\rho'_1 = \{i,j,k,l,n,o,p,t\} \rightsquigarrow C(a,b)$
$\rho_2 = \{m,q,r,s,u,v,w,z\} \rightsquigarrow \neg C(a,b)$	$\rho'_2 = \{i,j,k,m,n,q,r,u\} \rightsquigarrow C(b,b)$
	$\rho'_3 = \{s,v,w,z\} \rightsquigarrow \neg\exists x.C(x,b)$

I illustrated above that the notion of compliance between the theme of the focused answer and the underlying common ground provided by the uptake of the wh-question is sufficient to rule out non-congruent answers. A significant advantage of this system is that it does not require further notions or restrictions to give an account of question-answer congruance. The analysis of Rooth (1985, 1992) needs extra conditions to correctly filter out an answer with a misplaced focus or an over-focused answer. My system does not have this problem, since it is build upon a logical system where not only *information* but also *issues* are involved. The problem with the over-focused answer 'AMY called BEN.' after the question 'Who called Ben?' does not lie in the informational part, since this answer provides the necessary information that *Amy called Ben*, but it lies in the fact that the inherent theme or inherent issue of the focused answer is not suitable in the underlying context created by the question. Krifka (2001) provides an elegant analysis also without extra conditions, but my system is more straightforward in that there is no need to define a separate congruence rule. In my analysis, non-congruent answers are ruled out on the basis of the dialogue principle that states that coherent dialogue moves must be compliant to the common ground and the focus requirement that compliance cannot be violated.

Sequence of questions and compliance

In the above section we checked the logical relation of compliance between the theme of a focused answer and the context by the underlying wh-question. Since we analyze focused utterances having a theme as the inherent question, by checking congruence, we practically check compliance between different questions. I showed above that in this way we can correctly rule out misplaced focus, over-focused and underfocused answer. It suggests that in the following sequences of questions the second ones are not compliant to the first ones.

(25) a. Who called Ben? – Whom did Amy call?
b. Who called Ben? – Who called whom?
c. Who called whom? – Who called Ben?

Our definition of compliance rules out all these three sequences, however, the third sequence seems to be one that should be judged as a coherent one.

This kind of sequences of questions can appear in answering strategies, where the goal is to resolve a question, which can be reached via answering its (easier) sub-questions. Following Roberts (1996) the question 'Who called whom?' can be resolved by the strategy of replacing the question with its sub-questions as shown below.

Example 3.38 (Answering strategy via sub-questions)

$$\text{Who called whom?} \longrightarrow \begin{cases} \text{Who called Amy?} \longrightarrow & \text{Did Amy call Amy?} \\ & \text{Did Ben call Amy?} \\ & \ldots \\ \text{Who called Ben?} \longrightarrow & \text{Did Amy call Ben?} \\ & \text{Did Ben call Ben?} \\ & \ldots \\ \ldots & \end{cases}$$

Following Roberts (2006) I claim that a sub-question is only felicitous if it is appropriately focused. Consequently, in the answering strategy above the question 'Who called whom?' can be followed by sub-questions such as 'Who called AMY_F?'. The sequence in (25c) is not felicitous, hence correctly ruled out by our notion of compliance. According to my analysis of the theme/rheme division of focused utterances the sequence in (26) is felicitous, since the theme of the second question is compliant to the first one.

(26) Who called whom? – Who called AMY_F?

According to definition 3.1 the question 'Who called AMY_F?' has its theme as $?\exists x \exists y.C(x, y)$ and its rheme as $?\exists x.C(x, a)$, its standard translation (see also the examples in 3.2.1). Consequently, the question 'Who called AMY_F?' is felicitous after the multiple question 'Who called whom?' since its theme is equivalent to it, hence it is compliant.[10]

[10] In the examples so far we had compliance because the theme of the answer/sub-question was identical to the underlying question. However, I claim that compliance is required instead of simply identity. The classical examples that cannot be analyzed by identity are from 'which-questions', consider the following example: 'Which girl did Ben call? Ben called AMY_F.'

3.3.3 Contrast and specification

Contrast

Focusing appears in many cases as a signal of contrast or correction together with denial (27). In the examples of correction by focusing, the denial is required, the corrective sentence without 'No,' is out (27b). The possibility of critical dialogue moves in the system of our dialogue management suggests that a denial as in (27) can be analyzed without additional rules.

(27) AMY came (to the concert).
  (a) No, BEN came.
  (b) #BEN came.

Example (27) gets a rather straightforward analysis in our dialogue system. I suppose that the utterance in (27) has already provisionally updated the common ground, thus it fulfilled the focus requirement. It can be concluded from this that the wh-question 'Who came (to the concert?)' $\mapsto ?\exists x.C(x)$ is present in the immediate context of the first focused sentence. This context is the stack of states: $\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle$. In the analysis of (27), first the uptake of the utterance in (27) is carried out, which leads to the *provisional update* of the common ground. The architecture of our dialogue management system is set up in such a way that all updates on the common ground by the utterances of the stimulator are at first *provisional* and whether they become definitive updates or will be cancelled depends on the reaction of the responder. In case of our example, the responder explicitly signals denial. This is captured by the operation of cancellation ($[\bot]$) of the provisional update of the previous utterance. After denial/cancellation has been carried out the uptake ($\Uparrow$) of the second/corrective sentence follows.

Example 3.39 (Correction)
Take the natural language utterances α: 'AMY came' and β: 'BEN came'.
$\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.CAME(x)]\rangle[\alpha]^{\Uparrow}[\bot][\beta]^{\Uparrow}$

The first step here, the uptake of the focused sentence in (27), goes as we saw in section 3.2.1. The first sentence — containing a narrow focus on the subject — leads to the theme/rheme division of the sentence: $TH(\alpha) = ?\exists x.C(x)$ and $RH(\alpha) = C(a)$. The focus requirement says that the theme of the utterance must be compliant to the actual common ground; that requirement is fulfilled. Then we can carry out the provisional update by the rheme $C(a)$. As before, the primary uptake is followed by the pragmatic implicature via alternative exclusion. The full (primary and secondary) uptake of the utterance in (27) results in the following common ground stack:

Example 3.40 (Uptake of the corrective utterance)
$\langle \ldots, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle, \omega[\forall x.C(x) \leftrightarrow x = a]\rangle$

$\langle \ldots,$  $\rangle,$  $\rangle,$  $\rangle$
$\langle \ldots, theme\rangle, rheme\rangle, excl\rangle$

All these updates are provisional at this point, waiting for the reaction of the responder. This is here a denial, thus we have to apply the operation of *cancellation*, which discards the informative updates on the top of the common ground stack and we get back to the last issue. The rule of *cancellation* is defined recursively; it removes the last suggested update on the top of the common ground stack then continues to do so until it reaches an inquisitive state in the stack, hence the last issue in the common ground (see definition 2.26).

In this example the last issue is the state provided by the theme as $\omega[?\exists x.C(x)]$. After the cancellation we get back to the common ground as follows:

Example 3.41 (Cancellation)
$\langle \ldots, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle, \omega[\forall x.C(x) \leftrightarrow x = a]\rangle[\bot]$
$\langle \ldots, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle[\bot]$
$\langle \ldots, \omega[?\exists x.C(x)]\rangle$

After the denial and the operation of cancellation we get back to the last issue as the immediate context for the sentence of correction. I skip the details here, since the analysis of the second focused sentence (27b) goes completely parallel to the first sentence, resulting in the following common ground after the full (primary and secondary) uptake is carried out.

Example 3.42 (Uptake of correction)
Take β: 'BEN came'.
$\langle \ldots \omega[?\exists x.C(x)]\rangle[\beta]^{\Uparrow} = \langle \ldots \omega[?\exists x.C(x)]\rangle, \omega[C(b)]\rangle, \omega[\forall x.C(x) \leftrightarrow x = b]\rangle$

In these examples we had a focused constituent in the first sentence, which constituent was contrasted with the focused element of the second sentence. In this respect I followed the view that is captured by the exhaustivity condition of van Leusen and Kálmán (1993). However, there is still a discussion about whether the first sentence must contain a focus or not. Some analyses accept the following dialogue also as coherent, without any explicit marking — focusing — of the constituent that gets contrasted.

(28) Amy came to the concert. No, BEN_F came.

In van Leusen and Kálmán's (1993) analysis, in these cases the focus on the contrasting constituent gets accommodated according to what is focused in the second sentence.

(29) AMY$_F$ came to the concert. No, BEN$_F$ came.

I agree with this view, since the neutral sentence in (28) provides a theme, the polar question $?C(a)$, which serves as the last issue that has no relation to the theme of the second focused sentence. The operation of *cancellation* goes back to the issue $?C(a)$ that is provided by the theme of the first utterance in (28). The notion of compliance captures this fact: the theme of the second sentence is not compliant to the issue provided by the first sentence. Our conclusion is that examples like (28) need accommodation of focusing for the constituent that is put in contrast, otherwise the interpretation of the second sentence fails.

These kinds of examples are typical for illustrating contrastive focus and are distinct from so-called regular focus. However, these examples are more of the type of correction, a special type of contrastive relation in discourse. According to Umbach (2004) both regular focus and contrastive focus involve some kind of contrast following from the presence of alternatives. Contrastive focus further involves a different kind of contrast: via exclusion. On the basis of different exclusions Umbach also distinguishes contrastive focus from 'only'-phrases as contrast vs. correction relation. Contrastive focus and the relation of correction excludes the alternatives except the focus, while 'only'-phrases and the relation of contrast exclude the possibility that some alternatives makes the proposition true in addition to the 'only'-phrase.

Specification

Another relation that comes up by focusing is *specification*, which has a somewhat simpler picture. The phenomenon I call 'specification by focusing' can be illustrated with the following example:

(30) Somebody called Amy. (Yes,) BEN called her.

According to Inquisitive Semantics, in such cases the first sentence provides a context that contains a set of possibilities, and the focus in the second sentence restricts that set to one of them being true.

Both in contrast and specification the requirement of focusing in the second utterance is fulfilled. In both cases thematizing the theme of the second sentence does not change the actual issue, i.e. the common ground. In the examples of contrast this is trivial, since the actual issue in the common ground is the question that is the same as the theme of the response. In case of specification as in (30) the focus requirement is also fulfilled, since the second utterance is

compliant to the top state in the actual common ground, provided by the first sentence. The first utterance leads to the common ground stack with the state $\omega[\exists x.C(x,a)]$ on top. The requirement for compliance says that $?\exists x.C(x,a)$ (the theme of the second sentence) is compliant to the state $\omega[\exists x.C(x,a)]$ (created by the first sentence) iff $\omega[\exists x.C(x,a)]^*[?\exists x.C(x,a)]$ is related to $\omega[\exists x.C(x,a)]$. Since $\omega[\exists x.C(x,a)]^*[?\exists x.C(x,a)]$ is equivalent to $\omega[\exists x.C(x,a)]$, compliance is straightforward in this case. After checking the focus requirement, the theme $?\exists x.C(x,a)$ gets thematized first in the context provided by the first utterance.

Example 3.43 (Specification: thematizing)
$\langle \ldots, \omega[\exists x.C(x,a)]\rangle[?\exists x.C(x,a)]^?$
$\langle\langle \ldots, \omega[\exists x.C(x,a)]\rangle, \omega[\exists x.C(x,a)]^*[?\exists x.C(x,a)]\rangle$
$\langle\langle \ldots, \omega[\exists x.C(x,a)]\rangle, \omega[\exists x.C(x,a)]\rangle$
that reduces to: $\langle \ldots, \omega[\exists x.C(x,a)]\rangle$

After thematizing, the operation *assume* of the semantic content of the specification follows, and after that we apply the secondary uptake. The full uptake of the second sentence goes similar to the previous examples with (free) focus. Similar examples of specification can be analyzed along these lines.

(31) a. Ben called a musician. (Yes,) he called AMY.
b. Amy bought a cello. (Yes,) she bought a TESTORE.

In cases of specification as in (30) and (31) the first sentence contains an existential expression that provide an inquisitive context introducing more possibilities that makes it a sufficient context for the following focused sentence.

3.4 Summary

In this chapter I proposed an analysis of sentences containing free focus in the framework of Inquisitive Semantics. My main aim here was to provide a uniform analysis in our system that gives an account of the most common discourse relations where focusing appears. I claim that semantics and dialogue management of Inquisitive Semantics is sufficient to give an elegant analysis of discourse-related phenomena involving focus such as: focusing in answers, question-answer relations, contrast in denial and specification by focusing.

In section 3.2.1 I introduced the representation of sentences containing narrow (free) focus, which is marked by prosody in English. The kernel of my analysis is introduced in definition 3.1, that provides a formal definition of the theme/rheme division of sentences relative to their focus structure. I claim that focusing leads to a special division, where the inherent question behind the utterance, hence

the theme, is determined by the placement of focus. The theme of a focused sentence is the corresponding wh-question, translated in the logical language as the question formed by the existential closure of the open expression formed from the utterance without the focused constituent. I claim that the intonation pattern determines how the sentence is divided into theme and rheme, and our semantics gives an important role to the theme.

The second part of the chapter discusses the core dialogue relations where focusing occurs. The most important relation is answering and the relation between questions and their answers, which is captured by the notion of congruent answer. This latter issue is an important one for any semantic analysis of focusing, and is discussed by Rooth (Rooth 1985, Rooth 1992) in Alternative Semantics and by Krifka (2001) in the Structured Meanings Account. I provided an analysis of question-answer congruence that differs from these two as in my system I do not need to define any separate rule or condition for congruent answers, but the system itself rules out non-congruent answers on the basis of logical relatedness (a core notion in the development of a coherent discourse). In the Alternative Semantics by Rooth (1985, 1992) congruence is defined in terms of the subset relation between the question meaning and the focus semantic value of the answer, both being a set of propositions. The disadvantage of Rooth's analysis is that in order to capture all cases it requires several additional (and stipulative) criteria such as restrictions on the size of the sets and a preference for minimal focus. Krifka (2001) provides an elegant analysis with merely one congruence rule without any additional restrictions. His analysis gives the right results, accepting correct focusing and ruling out misplaced focus as well as the under- and over-focused sentences. My analysis (introduced in section 3.3.2) goes further in that I do not even need such a special congruence rule: the system itself rules out the non-congurent answers.

Chapter 4

Linguistic answers and exhaustivity

In the current literature on syntax, semantics and pragmatics, *focus*, '*only*' and *exhaustivity* form a major group together into a single subject of study. There are several proposals for the semantics and pragmatics of *focus*, and several focus-sensitive particles such as 'only', 'even', 'also'.[1] In this chapter I turn from the general analysis of focusing to the more specific issue of the exhaustive interpretation of answers, concentrating on the main phenomenon of exclusiveness of free focus constructions.

In this chapter I investigate the phenomenon of exhaustivity in English. I will discuss the interpretation effects of the focus-sensitive particle 'only' separately in chapter 5. Later, in chapter 6 I discuss examples from Hungarian, which is known as special among the European languages regarding exhaustivity, because of its structural focus position that is often claimed to express exhaustive listing.

4.1 Exhaustive interpretation

It is widely agreed that narrow focus constructions in sentential answers, as well as short answers, given to a wh-question are interpreted exhaustively. Let me first illustrate the phenomenon of *exhaustivity*, the core issue in this chapter. Consider the following question-answer pairs:

(32) Who came to the concert yesterday?
   a. Amy and Ben.
   b. [AMY and BEN]$_F$ came to the concert yesterday.

[1] Already mentioned in chapter 3, the most influential theories of focusing and focus-sensitive operators are the Alternative Semantics of Rooth (1985, 1992) and the Structured Meanings Account by von Stechow (1991) and Krifka (2001, 2004). Furthermore the focus interpretation via an existential presupposition as proposed by Geurts and van der Sandt (2004) and the pragmatic account of Roberts (1996)) should be mentioned here.

Both the short answer (32a) and the long answer (32b) with narrow focus on the subject mean that Amy and Ben came to the concert, and in addition, both cases are interpreted as implying that besides them nobody else came. Hence, both the short answer and the narrow focus in the long answer provide an exhaustive listing of the individuals of whom the question predicate holds.

Groenendijk and Stokhof

The most prominent analysis of exhaustification of answers is given by Groenendijk and Stokhof (1984, 1991) in their influential work on the semantics of questions and the semantics/pragmatics of answers. They define an answer formation rule for the semantics of linguistic answers introducing a semantic *exhaustivity operator* (EXH^n), which gives the minimal elements from a set of sets.

Definition 4.1 (Groenendijk and Stokhof's rule of answer formation)
If α' is the interpretation of an n-place term, and β' is the relational interpretation of an n-constituent interrogative, the interpretation of the linguistic answer based on α in the context of the interrogative β is $(EXH^n(\alpha'))(\beta')$, where EXH^n is defined as follows (generalized rule):
$EXH^n = \lambda\mathcal{R}^n\lambda R^n[\mathcal{R}^n(R^n) \wedge \neg\exists S^n[\mathcal{R}^n(S^n) \wedge R^n \neq S^n \wedge \forall\vec{x}[S^n(\vec{x}) \rightarrow R^n(\vec{x})]]]$

The semantic operator (EXH) of exhaustivity takes a generalized quantifier, hence a set of sets, and selects the minimal elements in it. Proper names are taken as generalized quantifiers as well, as the set of sets in which the given individual is included. Thus the proper name 'Amy' gets interpreted as $[\![\text{Amy}]\!] = \lambda P.P(a)$ that provides the collection of the sets containing the individual *Amy*. Consider a domain of three individuals: Amy, Ben and Claire, then the denotation of 'Amy' is the set of sets: $\{\{a\}, \{a, b\}, \{a, c\}, \{a, b, c, \}\}$. Applying the exhaustivity operator on this set of sets will select the minimal elements and gives back the set containing one set with the single element a: $\{\{a\}\}$. According to Groenendijk and Stokhof (1984, 1991), if the answer 'Amy.' is given to the question 'Who came?', then it is interpreted as 'Only Amy came.': $(EXH(\lambda P.P(a)))(\lambda x.came'(x))$. The formula $(EXH(\lambda P.P(a)))$ here gives the set $\{\{a\}\}$ that is applied to the question predicate, hence the interpretation of the sentence is that Amy came and besides her nobody else came (in the relevant domain of individuals).

Applying this exhaustivity operator on an indefinite term like 'a girl' also gives the intended interpretation as exactly one individual came and that individual is a girl. Let us see this example also in detail. Consider a domain of five individuals $D = \{a, b, c, d\}$ of whom a, c are girls and b, d are non-girls. The denotation of the term 'a girl' is $\lambda P.\exists x(G(x) \wedge P(x))$, the set of sets that contain at least one girl (and possibly one or more non-girls): $\{\{a\}, \{c\}, \{a, b\}, \{a, c\}, \{a, d\}, \{a, b, c\}, \ldots, \{a, b, c, d\}\}$. The exhaustivity operator applied on this set selects the minimal

elements, hence we get the set of sets: $\{\{a\},\{c\}\}$. Thus the interpretation of the sentence 'A girl came.' as an answer to the question will be that exactly one person came and that person is a girl. Thus, either only Amy came, or only Claire came, or only Diana came. This is indeed the right result.

The operation is also applicable for compositions such as 'Amy or Ben' and 'Amy and Ben' as well as for other plural expression, for example, 'at least two girls'. In case of disjunction the expression 'Amy or Ben' denotes the set of sets $\lambda P.P(a) \vee P(b)$, and applying the exhaustivity operator on it leads to the set $\{\{a\},\{b\}\}$. Hence, 'Amy or Ben came.' as an answer to 'Who came?' is interpreted as either only Amy came or only Ben came. The conjunction 'Amy and Ben' denotes $\lambda P.P(a) \wedge P(b)$ which by exhaustivity leads to $\{\{a,b\}\}$.

In my proposal in section 4.2 I will investigate these core examples: the exhaustive interpretation of singulars, conjunction, disjunction and indefinites. Differently from the classical analysis of Groenendijk and Stokhof (1984, 1991), I propose an analysis of the exhaustive interpretation of answers as a pragmatic inference. I claim that for these core cases my analysis provides the same interpretational results.

Despite its elegant treatment of the exhaustive interpretation of several natural language examples, Groenendijk and Stokhof's (1984, 1991) exhaustivity operator has its shortcomings. As they already point out themselves, the operation gives wrong results for downward entailing quantifiers, such as 'few girls' or 'no girls'. Applying exhaustivity to downward entailing quantifiers leads to the interpretation that 'nobody is P', for example, the exhaustification of 'few girls came' leads to the interpretation that nobody came. To properly handle such cases, and plural terms in general, Groenendijk and Stokhof propose a plural analysis, where they assume the denotation to be a set of sets of sets. For example, the denotation of the plural term 'at least two girls' is defined as the set:$\{X|\{G\} \subseteq X$, where $|G| \geq 2\}$.

This set contains sets of sets containing two or more girls and possibly one or more non-girls. Take the same domain as above with three girls: a, c, d and two boys b, e. Then, the denotation of 'at least two girls' is the set:

Example 4.1 (Denotation of 'at least two girls')
$\{\{\{a,c\},\{a,d\},\{c,d\},\{a,c,d\}\},$
$\{\{a,c\},\{a,d\},\{c,d\},\{a,b,c\},\{a,c,d\}\},$
$\{\{a,c\},\{a,d\},\{c,d\},\{a,b,c\},\{a,c,e\},\{a,c,d\}\},\ \ldots\ \}$

The exhaustification will give back the set $\{\{\{a,c\},\{a,d\},\{c,d\},\{a,c,d\}\}\}$ that applied to the question predicate will lead to the interpretation that the group of individuals who came consists of two or more girls and no boys. Similarly the exhaustification of the term 'at most two girls' will give us a set of sets of sets

$\{\{\{\}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}\}\}$ (relative to the same domain), hence it gives the interpretation that *not more than two girls and no non-girls.*

The above plural analysis solves the problem of plural terms in general, as well as the problem of downward entailing quantifiers, however, it raises other problems. First of all, by this plural analysis the exhaustification of the conjunction 'Amy and Ben' goes wrong, while it went alright before. Furthermore, as Schulz and van Rooij (2006) points out, this solution is inappropriate at several other points hence it cannot be considered as a suitable one.[2]

4.1.1 Exhaustive interpretation and pragmatics

The analysis of Groenendijk and Stokhof (1984, 1991) is taken up and refined by several approaches such as Schulz and van Rooij (2006) and Spector (2007). In the theory of Groenendijk and Stokhof exhaustive interpretations are calculated by the semantic operator EXH^n, while recently, other important contributions consider exhaustivity rather as a pragmatic phenomenon, an enrichment of the semantic meaning. Such approaches to exhaustive interpretation take the foundational work of Grice (1975) as a starting point.

Implicatures: Grice (1975)

In the foundations of modern pragmatics H. P. Grice (1975) has made an important contribution: dividing sentence meanings into what is said and what is implicated, hence into the semantic meaning and the speaker meaning. Grice investigates the general principles of successful conversation, and argues for *Cooperativity* as the main principle. In order to get a successful conversation the cooperativity principle requires the interlocutors in a dialogue to observe a set of conventions.

Quotation 4.1 (The Principle of Cooperativity)

> "*Make your conversational contribution such as is required, at the stage at which it occurs, for the accepted purpose or direction of the talk exchange in which you are engaged.*" (Grice, 1975)

[2] Another significant problem of the analysis by Groenendijk and Stokhof as they point out themselves is posed by mention-some questions (which should not receive exhaustive interpretations), since the exhaustivity operator is applied in all cases. In this way it is not possible to give an account of the non-exhaustive interpretation of answers given to mention-some questions such as 'Who has a light?' or 'Where can I buy an Italian newspaper?' — just to mention the classical examples of mention-some questions. This issue is also discussed by Schulz and van Rooij (2006). Since I will not touch upon this particular problem in my analysis, I leave mention-some questions for further investigation.

A cooperative dialogue is driven by certain conversational norms, that Grice defines as the four *Conversational Maxims*:

Example 4.2 (The Conversational Maxims)

I. **Quantity**: Be not less and not more informative than necessary!
   (1) Make your contribution as informative as is required.
   (2) Do not make your contribution more informative than is required.

II. **Quality**: Try to make your contribution one that is true!
   (1) Do not say what you believe to be false.
   (2) Do not say that for which you lack adequate evidence.

III. **Relation**: Be relevant!

IV. **Manner**: Be perspicuous!
   (1) Avoid obscurity of espression.
   (2) Avoid ambiguity.
   (3) Be brief (avoid unnecessary prolixity).
   (4) Be orderly.

Using the conversational maxims Grice derives certain parts of the sentence meaning that do not belong to the truth-conditional/semantic contribution of the given utterance, but are inferred by the hearer on the basis of its use in a certain context. These inferred meanings are called *conversational implicatures*, distinguished from other kinds of implicatures such as the *conventional implicatures* that are directly associated with certain expressions instead of being derived in a given conversation.

Following the conversational maxims of Grice we can infer, for example, the "and then" interpretation of the sentence 'Peter went to the canteen and ate a sandwich.', while the truth-conditional meaning does not care about the order of the acts of Peter. Another well-known example of inferred meanings is associated with the use of 'some' interpreted as 'some but not all'. The utterance 'Peter ate some of the pancakes.' is usually interpreted as meaning that Peter ate some but not all of the pancakes. However, the truth-conditional meaning of 'some' does not involve this upper bound, it is merely implicated. This latter example is an instance of a special group of conversational implicatures: the *scalar implicatures*. Scalar implicatures are special quantity implicatures making use of an *implicational scale*. These scales are also called Horn scales after Horn (1972). In a Horn scale elements asymmetrically entail each other. Take an arbitrary Horn scale $X < Y < Z$, where X is a logical consequence of Y ($Y \models X$) and Y is not a logical consequence of X ($X \not\models Y$), and similarly $Z \models Y$ while $Y \not\models Z$. In this scale Y is logically (or informationally) stronger than X, and Z logically stronger than Y. In case an informationally weaker element of the scale is uttered, the hearer infers that the informationally stronger utterances are excluded. The term

'some' is involved in such a Horn scale: *some* < *most* < *all*. In case the term 'some' is uttered, the hearer pragmatically excludes the logically stronger alternatives 'all', 'most' and 'many'. This inference is derived from the maxim of quantity, that assumes that the sentence uttered containing 'some' is the maximally informative one. The work of Grice, and in particular the distinction between what is said and what is implicated, has influenced many later works in pragmatics. Here I will not go into the theory of implicatures in general, thus I will not discuss phenomena such as conventional, particularized and generalized implicatures. We stay within the scope of conversational implicatures and discuss in particular the phenomenon of *exhaustive interpretation*, analyzing it as a conversational implicature that provides us with certain *scalar implicatures*.

Pragmatic analyses of exhaustive interpretation all share the claim that scalar implicatures are closely related to the phenomenon of exhaustification and should be analyzed in terms of it. There are also important differences among them regarding the status of the pragmatic operator of exhaustivity. In this respect these approaches can be divided into two groups, often referred to as the *globalist* versus *localist* approaches. In this ongoing debate Chierchia (2004) and Fox (2007) point out certain shortcomings of the globalist Gricean analysis and propose rather a localist approach. Instead of calculating implicatures globally at the sentential level, they argue that implicatures can be derived compositionally, parallel to the computation of the truth-conditional meaning. One of the main arguments in favor of local implicatures is the fact that they can appear in embedded positions.

Localist view

The localist view of implicatures is developed to analyze certain scalar implicatures. One of the most important representatives of this view is Chierchia (2004). In the following I present the main claims of the localist view according to his approach. On the basis of scalar implicatures Chierchia claims that implicatures are not necessarily computed after the truth-conditions of the sentence, but rather parallel with it. One of his main claims in favour of the local computation of scalar implicatures is the possibility of embedding them.

(33) a. John believes that some students are waiting for him.
b. $\rightsquigarrow$ John believes that not every student is waiting for him.
c. $\not\rightsquigarrow$ John does not believe that every student is waiting for him.

Sentence (33a) implicates (33b) and not just (33c) which would be computed according to the neo-Gricean (global) view. Chierchia gives more examples to strengthen his claim, such as numerals in embedded clauses, factive verbs, and interaction with sentential connectives. He claims that a local notion of implicatures can solve all these problematic cases.

In Chierchia's system two semantic values are computed in a compositional way: the *plain* semantic value $[\![.]\!]$ and the *strengthened* value $[\![.]\!]^S$ that is provided by the grammar. By default the strengthened meanings are taken, but as soon as this would lead to a contradiction, the system goes back to the plain value. In a nutshell, the computation of the strengthened/scalar value of ϕ goes as follows. First, we identify the relevant alternatives $[\![\phi]\!]^{ALT}$, a set of expression of the same type as ϕ. Then, the system singles out the immediate stronger one, for example, if we have the scalar expression 'some', the immediate stronger one is 'many' on the scale *some* < *many* < *most* < *every*:

Example 4.3 (Immediate stronger alternative (Chierchia))
$S_{some}([\![some]\!]^{ALT}) = many$

The next step is to define the strong semantic values: (i) for lexical items the strong value equals the plain value; and (ii) if ϕ is a scope site, then the strengthened value is the plain value plus the negation of the weakest member from the alternative set that assymmetrically entails ϕ, thus the immediate stronger one in the scale:

Example 4.4 (Strengthened semantic value (Chierchia))
$[\![\phi]\!]^S = [\![\phi]\!] \wedge \neg S([\![\phi]\!]^{ALT})$

The computation of the strong value is subject to the *Strength Condition*, that says that the strong value cannot be weaker than the plain value. With this constraint *Strong Application* can be defined as functional application except if the plain value is downward entailing. In that case the strong value from the argument is removed:

Example 4.5 (Strong Application (Chierchia))

$$[\![[\alpha_{<a,b>}\beta_{<a>}]]\!]^S = \begin{cases} [\![\alpha]\!]^S([\![\beta]\!]^S) & \text{if } [\![\alpha]\!] \text{ is not DE} \\ [\![\alpha]\!]^S([\![\beta]\!]) \wedge \neg S([\![\alpha]\!](\beta^{ALT})) & \text{otherwise} \end{cases}$$

Globalist view

On the basis of several empirical arguments, Chierchia (2004) argues for locality in the computation of scalar implicatures. He shows that several phenomena can be easily captured by a local analysis, however he does not show that they cannot be captured by a globalist analysis, computing them on the sentential level. As Spector (2007) shows, Chierchia's examples can be captured by a globalist account as well if the alternatives are chosen properly. Van Rooij & Schulz (2004) and Spector (2007) claim that both exhaustivity and scalar implicatures can be derived

by a globalist approach, there is no need for a local pragmatic process. Another important globalist response comes from Geurts and Pouscoulous (forthcoming) where they illustrate experimental evidence against the localist approach. They challenge one of the main claims of the localist view, that scalar implicatures appear in embedded positions (for example, in the scope of 'believe'). Geurts and Pouscoulous carry out experiments where they investigate scalar implicatures in the scope of 'think', 'all' and deontic 'must' in comparison with a non-embedded example as the control condition. Consider one example from their experiment:

(34) a. *control condition:*
Fred heard some of the Verdi operas.
$\rightsquigarrow_{loc}$ He did not hear all of them.

b. *in the scope of 'all':*
All students heard some of the Verdi operas.
$\rightsquigarrow_{loc}$ None of the students heard them all.

The result of the experiment shows that the implicature predicted by the localist view arises significantly less often in the scope of 'think', 'all' and 'must' than in the control example with no embedding. In case of embedding under 'all' it occurs 27%, while in the non-embedded position 93%. On the basis of these convincing results and the results of two other experiments, Geurts and Pouscoulous conclude that the localist view is basically on the wrong track and the results of their experiments strengthen the position of Gricean reasoning against the localist view.

Further representatives of the globalist view such as Schulz and van Rooij (2006) and Spector (2007) follow the reasoning of the Gricean analysis in the calculation of exhaustive interpretations. Schulz and van Rooij take exhaustivity as the basis and claim that scalar implicatures can be derived as a subclass. Spector takes a different position and claims that on the basis of Gricean reasoning both exhaustivity and scalar implicatures can be derived.

My proposal takes the position of the globalist analyses in the sense that the mechanism for the computation of inferences operates after the semantic content is computed. In my analysis I introduce the issues that have recently been raised around the exhaustive interpretation of answers in relation to the phenomenon of scalar implicature in the ongoing debate between the global and local views introduced above. In section 4.2 I propose an analysis of the exhaustive interpretation of answers as a pragmatic inference calculated at the sentential level. In my analysis, exhaustive interpretation is due to the so-called secondary uptake of the utterance and is carried out technically by the pragmatic operation of *alternative exclusion*, which is an alteration of the original idea of Groenendijk (2008). My definition captures formally the essence of the Quantity maxim, in excluding all strictly stronger possibilities from the actual context. By my definition I obtain

the intended interpretation for exhaustive answers and the scalar implicature of disjunctions by a uniform mechanism. My analysis is in the narrow sense a globalist one, since I first calculate the semantic contribution of the utterance and the implicature calculation follows as a separate step. Nevertheless, the mechanisms in Inquisitive Semantics are developed in such a way that semantics and pragmatics has not a sharp division.

4.1.2 Exhaustivity and scalar implicatures

As I touched upon before the pragmatic analyses of exhaustive interpretation claim that it is closely related to the phenomenon of scalar implicatures, hence the main aim of such pragmatic approaches is to provide a uniform mechanism, that calculates both the exhaustive listing and the scalar implicature. One of the core issues in this respect is *disjunction*. There are several interesting problems that occur in the discussion in connection with the matters of exhaustivity and scalar implicatures. In my proposal I emphasize problems that have a direct connection with focusing. I will discuss in detail the phenomenon of exhaustivity, as well as focus on disjunction and its interpretational effects. There are two special issues in relation to the implicature calculation of disjunctions. In case we have an answer where the disjunction of constituents is focused, we get not only the exhaustive interpretation, but also the scalar implicature. Moreover, next to the scalar implicature, also an ignorance (or clausal) implicature is drawn.

(35) a. Who came to the concert yesterday?

b. $[\text{AMY or BEN}]_F$ came. $[A \vee B]$
$\rightsquigarrow$ *exhaustivity:* and nobody else came $[\neg C]$
$\rightsquigarrow$ *scalar implicature:* and not both came $[\neg(A \wedge B)]$
$\rightsquigarrow$ *ignorance implicature:* speaker does not know if A or B $[\Diamond A \wedge \Diamond B]$

In example (35) the answer is interpreted exhaustively as besides Amy and Ben nobody else came. Furthermore, the answer leads to the scalar implicature that it is not the case that both Amy and Ben came, as well as to the ignorance implicature, that the speaker does not know that Amy came and she does not know that Ben came, hence it is possible that Amy came and it is possible that Ben came. On the basis of these phenomena, I claim that an analysis is desirable that provides a mechanism that captures all three inferences: exhaustivity, scalar implicature and ignorance implicature.

Comparing several different approaches to this particular issue, we run into three basic problem that generally occur. The three important issues we discuss in detail are (1) what count as alternatives of the given utterance; (2) the epistemic step; and (3) the functionality problem.

Choosing the alternatives

The first problem that occurs is how to choose the alternative set, hence what count as alternatives of the given utterance. The core problem here, as pointed out by Sauerland (2004), Spector (2007) and Fox (2007), is that in case of a disjunction $A \vee B$, if A and B are both members of the alternative set, this leads to a problem. If we take both A and B as alternatives of $A \vee B$, then exhaustivity applied to $A \vee B$ will derive that $(A \vee B) \wedge \neg A \wedge \neg B$ is the case, hence it excludes both alternatives, A and B, which leads to a contradiction. There are several proposals in the recent literature to solve this problem. Sauerland (2004) modifies the alternative set by a technical trick: he introduces two special connectives $\mathbb{L}, \mathbb{R}$ and replaces A and B with $A \mathbb{L} B$ and $A \mathbb{R} B$ respectively; $A \mathbb{L} B$ is semantically equivalent to A and $A \mathbb{R} B$ is semantically equivalent to B, but by using the connectives they remain distinct objects.

To avoid the same problem concerning the alternative set, Fox (2007) – similarly to Gazdar (1979) – introduces the notion of innocently excludable alternatives, which takes care that A and B are not excluded from the alternative set. Fox (2007) assumes a covert exhaustivity operator that is responsible not only for the exhaustive listing but for the scalar implicatures as well. This covert exhaustivity operator takes the utterance p and the alternative set A, and provides the interpretation, that it is asserted that p is true and every member of the alternative set that is entailed by p is false.

Example 4.6 (Exhaustivity operator (Fox))

$[\![\text{exh}]\!](A_{<s,t>})(p_{st})(w) \Leftrightarrow p(w) \wedge \forall q \in NW(p, A) : \neg q(w)$

The alternative set A is determined by the placement of focus. There is another set introduced in the definition, $NW(p, A)$: the set of no-weaker alternatives of p from the alternative set A. This set contains the propositions in A that are not entailed by p, hence the real alternatives of p. According to the definition, it takes the alternative set and the proposition p and gives the worlds where p is true and all non-weaker alternative propositions are false. However, as Fox points out, this definition still faces a problem, coming basically from the formulation of the alternative set. If we assume that the above definition of the exhaustivity operator is right, the answer 'AMY or BEN came' after the wh-question 'Who came?' would give the wrong result. The alternative set of this answer is the set of propositions of the form *x came*. According to the definition of exhaustivity, the proposition p ='Amy or Ben came' should entail the propositions 'Amy did not come' and 'Ben did not come', which is clearly not the case. Let us see this latter example in detail. The final goal is to get the inference that either Amy or Ben came, but it is not the case that they both came. In our example the proposition p is the disjunction 'Amy or Ben came' translated as $C(a) \vee C(b)$. Take a domain

of two individuals $D = \{amy, ben\}$. Then, the alternative set is derived from the answer as the set of propositions of the form x *came*, where x is replaced by 'amy or ben', 'amy', 'ben', 'amy and ben' based on the Horn set of the scalar item 'or'. Thus our alternative set is $A = \{(C(a) \vee C(b)), C(a), C(b), (C(a) \wedge C(b))\}$. The set of non-weaker alternatives is the set of alternatives in A that are not entailed by p. In our case $NW(p, A) = \{C(a), C(b), C(a) \wedge C(b)\}$, the elements from A that are not entailed by $C(a) \vee C(b)$. Then, according to the definition, applying the exhaustivity operator we get the following, which is clearly a wrong result:

Example 4.7 (Exhaustivity operator (Fox))
$[\![\text{exh}]\!](A)(p)(w) = (C(a) \vee C(b))(w) \wedge \neg C(a)(w) \wedge \neg C(b)(w)$

One possible solution to this problem is introducing and adding to the definition the notion of minimal worlds $MIN(w)$.[3] This step solves the actual problem, however, Fox (2007) still disregards it. He claims that free-choice interpretations should be derived by the same computational system as scalar implicatures and this latter modification contradicts free-choice. He suggests another solution and introduces the notion of *innocently excludable* alternatives. Given the alternative set A, the alternative q is innocently excludable if there is no other alternative q' in A not entailed by p such that if $p \wedge \neg q$ holds than q' holds as well.

Example 4.8 (Innocently excludable alternatives (Fox))
Definition $I\text{-}E(p, A)$: q is innocently excludable given A if
$\neg\exists q' \in NW(p, A)[p \wedge \neg q \Rightarrow q']$

On the basis of the definition of innocently excludable alternatives Fox proposes a different modification of the original definition 'exh' that is claimed to handle correctly both scalar implicatures and exhaustive interpretation.

Example 4.9 (Exhaustivity operator with $I\text{-}E(p, A)$ (Fox))
$[\![\text{exh}]\!](A_{<s,t>})(p_{st})(w) \Leftrightarrow$
$p(w) \wedge \forall q \in NW(p, A)[q$ is innocently excludable given $A \rightarrow \neg q(w)]$

Applying this definition to our example we get the interpretation $(C(a) \vee C(b))(w) \wedge \neg(C(a) \wedge C(b))(w)$, which says that either Amy came or Ben came but not both of them. In our example above the only innocently excludable element from the set $NW(p, A)$ is the alternative $C(a) \wedge C(b)$. $C(a)$ and $C(b)$ are not innocently excludable, because for both of them there is another alternative q' in $NW(p, A)$ of which it holds that if $p \wedge \neg q$ then q'. $C(a) \wedge C(b)$ is innocently excludable, since none of $C(a)$ and $C(b)$ is a logical consequence of $(C(a) \vee C(b)) \wedge \neg(C(a) \wedge C(b))$.

[3] See, for example, Schulz and van Rooij (2006) and Spector (2007).

$(C(a) \vee C(b)) \wedge \neg C(a) \Rightarrow C(b)$
$(C(a) \vee C(b)) \wedge \neg C(b) \Rightarrow C(a)$
$(C(a) \vee C(b)) \wedge \neg(C(a) \wedge C(b)) \not\Rightarrow C(a)$
$(C(a) \vee C(b)) \wedge \neg(C(a) \wedge C(b)) \not\Rightarrow C(b)$

The other solution by interpretation in minimal models is most prominently represented by the approach of Schulz and van Rooij (2006).[4] Schulz and van Rooij propose a uniform analysis based on interpretation in minimal models, that are selected by a certain ordering on the set of all models (possible worlds).[5] They take the definition of exhaustive interpretation by Groenendijk and Stokhof (1984) as a starting point and intend to provide a modification that overcomes its shortcomings. They first define the standard operation of exhaustive interpretation by the operator exh^W_{std} that makes use of an order on the set of models (worlds), providing an *interpretation in minimal models* as the model-theoretic version of predicate circumscription from artifical intelligence (McCarthy 1980). The ordering on the worlds in W is defined as $v <_P w$, relative to a question predicate P, that says that v is more minimal than w relative to P if they are exactly the same except for the interpretation of P, and $[P](v)$ is a proper subset of $[P](w)$. The definition of the operation exh^W_{std} provides the set of P-minimal models of the answer A: $exh^W_{std}(A, P) = \{w \in A \mid \neg\exists v \in [A]^W \ : \ v <_P w\}$. The operator takes an answer A to a question with question-predicate P and provides the set of $P-$minimal worlds from A. This modified definition is almost the same as the exhaustivity operator of Groenendijk and Stokhof, but a crucial difference is that the definition of exh^W_{std} is sensitive to certain restrictions of the context (e.g. meaning postulates), since W is not necessarily the set of all models (worlds), but a set provided by the context.

Yet another mechanism to determine the alternative set is proposed by Alonso-Ovalle (2008) in the framework of alternative semantics. Alonso-Ovalle investigates the puzzle by McCawley (1981) and Simons (1998), that points out another problem disjunction leads to regarding how we determine the alternative set. The puzzle concerns disjunctions with more than two disjuncts, as in example 36.

(36) Sandy is reading Moby Dick or Huckleberry Finn or Treasure Island.

According to the standard mechanisms based on binary disjunctions, for $M \vee H \vee T$ above the alternatives are derived as the set: $\{(M \wedge H) \vee T, (M \vee H) \wedge$

[4]This paper is closely related to their earlier paper: van Rooij and Schulz (2004).

[5]The uniformity of their approach is the use of minimal models, however, they provide three independent interpretation functions with three independent notions of ordering: $<_P$, $<^{rel}_P$ and $\preceq_{P,A}$ that all minimize the set of models in different ways: based on the interpretation of the predicate P in different worlds ($<_P$), or based on the notion of *relevance* ($<^{rel}_P$) or on the notion of *knowledge over P in a given world* ($\preceq_{P,A}$).

$T, (M \wedge H) \wedge T\}$ from which we cannot infer that Sandy is not reading more than one book. Based on this particular problem, Alonso-Ovalle (2008) proposes a different mechanism to determine the alternatives of disjunctions. Generating the alternatives for disjunctions Alonso-Ovalle takes the intersection of their meanings. The alternative set of a disjunction S is $[\![S]\!]_{ALT_\cap} = \{p \mid \exists\mathscr{B}[\mathscr{B} \in \wp([\![S]\!]) \wedge \mathscr{B} \neq \varnothing \wedge p = \cap\mathscr{B}]\}$. With this definition Alonso-Ovalle generates the alternative set for $M \vee H \vee T$ in (36) as $\{M, H, T, (M \wedge H), (H \wedge T), (M \wedge T), (M \wedge H \wedge T)\}$ that does not face the problem of the McCawley-Simons puzzle. However, Alonso-Ovalle uses the mechanism of Innocent Exclusion of Fox (2007) to prevent the exclusion of the atomic disjuncts that are elements of the alternative set.

In section 4.2 I will introduce my proposal, which is in certain respects on the same track as the analysis of Alonso-Ovalle. In my approach the alternatives of a disjunction are determined by the underlying wh-question — explicitly or implicitly by the theme — that provides or determines several possibilities. This way I can provide a non-stipulative solution to the problem of choosing the right alternatives. A crucial property of my analysis is that in our system possibilities can overlap, so indices (valuations) can belong to two or more possibilities simultaneously. On the basis of these possibilities and their overlaps I define possible propositions that correspond to the alternatives (or competitors) in the standard approaches in terms of alternative semantics. In my proposal, overlapping parts of the possibilities, hence their intersections, count as possible propositions/alternatives. Note, however, that in my approach intersections are already in the picture of the state being introduced by the question, thus involving them in the analysis is not an ad hoc step.

The epistemic step

The second problem I address is the problem of the *epistemic step* introduced by Sauerland (2004). According to Gricean reasoning, if the speaker utters 'Peter ate some pancakes.' then the hearer takes this as the optimally informative utterance the speaker could have chosen, hence she concludes that the speaker does not know that Peter ate all of the pancakes. Unfortunately, this inference — called the 'primary implicature' — is not enough, since we want to infer that the speaker knows that Peter did not eat all the pancakes. Deriving this latter, secondary implicature needs an extra step called *the epistemic step*. This phenomenon is crucial in approaches that provide an epistemic analysis for scalar implicatures. In case a disjunction $A \vee B$ is uttered, according to Gricean reasoning we can only infer the weak implicature that the speaker does not know that $A \wedge B$, while we want to infer the strong implicature that the speaker knows that not $A \wedge B$.

Example 4.10 (Epistemic step)
following Grice: $A \vee B \Rightarrow \neg\mathbb{K}A; \neg\mathbb{K}B \Rightarrow \neg\mathbb{K}(A \wedge B)$
epistemic step: from $\neg\mathbb{K}(A \wedge B)$ to $\mathbb{K}\neg(A \wedge B)$

Sauerland (2004) claims that the secondary implicature can be derived from the primary implicature and its logical consequences. First, the set of the primary implicatures is extended with their logical consequences and then the secondary implicature can be inferred in case it does not contradict the elements of this derived set. Accordingly, given the primary implicature $\neg\mathbb{K}\varphi$ from which we cannot derive $\neg\mathbb{K}\neg\varphi$, we can infer the secondary implicature as $\mathbb{K}\neg\varphi$.

Schulz and van Rooij (2006) derives the strong implicature by adding a competence order on top of their pragmatic interpretation function $grice^C(A, p)$. First of all they provide the function $grice^C(A, p)$, an extension of their basic definition of exhaustivity. In a question-answer relation it captures the assumption that a cooperative speaker, given the knowledge she has, does not withhold information that helps resolving the question. Hence, the new definition of the pragmatic interpretation, $grice^C(A, P)$, makes reference to the knowledge of the speaker: $grice^C(A, P) = \{w \in [\mathbf{K}A]^C \mid \forall w' \in [\mathbf{K}A]^C \ : \ w \preceq_{P,A} w'\}$. The definition $grice^C(A, P)$ is mainly based upon the ordering $\preceq_{P,A}$ that captures the concept of how much the speaker knows about the predicate in a given model. The interpretation function $grice^C(A, P)$ works as follows: from all models where the speaker knows the answer A ($[\mathbf{K}A]^C$) it selects the ones where she knows the least about ($\preceq_{P,A}$) the question predicate P, that is, she knows of the least number of individuals that they have property P. The definition captures that if the speaker had known more about the question predicate, she would have said so, as the Gricean maxim states it. To capture the secondary implicature, Schulz and van Rooij introduce an additional ordering, that compares the speakers competence.[6] With this new ordering relation ($\sqsubseteq_{P,A}$) they propose a strengthened version of the pragmatic interpretation function: $eps^C(A, P) = \{w \in grice^C(A, P) \mid \forall w' \in grice^C(A, P) \ : \ w \not\sqsubset_{P,A} w'\}$. Based on the new competence ordering, the function $eps^C(A, P)$ further selects from the set of models given by $grice^C(A, P)$ the ones where the speaker is maximally competent. Notice that this selection comes on top of the interpretation by $grice^C(A, P)$, so it is very hard to compute what it does as long as it is not so clear intuitively how $\preceq_{P,A}$ and $\sqsubseteq_{P,A}$ relate.

In Fox's (2007) analysis the problem of the epistemic step does not arise, since the mechanism works without belief operators. My proposal is also a non-epistemic approach, where the strong inference of the scalar implicature of disjunctions is directly derived. Hence, my proposal also does not raise the issue of

[6]The idea of maximizing the competence at the interpretation of answers is already introduced in van Rooij and Schulz (2004).

the epistemic step.

As for the ignorance implicature, the approach by Fox (2007) needs an extra rule. Following Gazdar (1979), Fox introduces the extra rule to capture that the speaker does not know which one of the disjuncts is true ($\neg\mathbb{K}A \wedge \neg\mathbb{K}B$ or $\Diamond A \wedge \Diamond B$). My analysis supports the ignorance implicature without any special mechanisms, so it can be incorporated it in a natural way.

The functionality problem

Next to the problems of the alternative set and the epistemic step, there is another issue I would like to mention as an instance of the functionality problem. The notion is introduced by Bonomi and Casalegno (1993) for the phenomenon that in classical analyses terms like 'a boy' versus 'one or more boys' get the same denotation, while they are not freely interchangeable, except in distributive contexts. The same problem arises for disjunctions such as 'A or B' versus 'A or B or both'. In classical semantic analyses these two utterances get the same semantic representation, which gives rise to the same pragmatic inferences. However, a proper analysis should be able to account for the crucial difference that the derived implicature of 'A or B or both' is that either only A or only B or both A and B is the case. We can distinguish different strategies towards solving this problem. One solution is to assign different semantic representations to the two utterances. We find approaches along this line in Aloni (2007), Schulz and van Rooij (2006) and Alonso-Ovalle (2008). Another way is to go local, choosing a local pragmatic operator as Chierchia (2004) proposed. In this way the scalar implicature of A or B is derived before the third disjunct is calculated: $((A \vee B)[excl] \vee (A \wedge B))$.

4.2 The proposal: responses and implicatures

In the following parts of this chapter I will further investigate the interpretation of linguisitic answers and provide an analysis in the framework of Inquisitive Semantics. I present my proposal of exhaustive interpretation derived as a pragmatic inference in question-answer relations. My analysis is mainly based on the general principles of Gricean pragmatics, applied to and restated according to the logical language of Inquisitive Semantics.

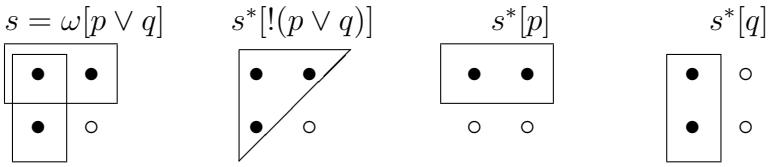
4.2.1 Groenendijk (2008) on exclusiveness

In this section I turn to the inquisitive version of the exclusiveness implicature that is introduced in (Groenendijk 2008). First I show Groenendijk's reasoning on the pragmatic inference carried by disjunction, and I argue that his reasoning

needs some reconsideration. However, I believe that the core idea behind his definition is correct. Groenendijk (2008) claims (as do many others) that the expression $p \vee q$ comes with the pragmatic inference of exclusion of $(p \wedge q)$. He derives this implicature using the notion of *comparative compliance* based on the dialogue principle *Be as compliant as you can!* (see section 2.2.1), which is regarded as the inquisitive version of the Gricean Maxim of Quantity. The full definition of Compliance and comparative compliance can be found in chapter 2, we only repeat here the essence of it informally (for the exact definitions see: Def. 2.17, Def. 2.18 and Def. 2.19). An expression ϕ is compliant to the state s in case it holds that (1) every possibility in $s^*[\phi]$ (the state that is a result of updating the indifferentiation of s by ϕ) are possibilities or unions of possibilities in s, and (2) the state $s^*[\phi]$ is equally or less inquisitive than s.

In Groenendijk's version the reasoning process of the responder, hence the calculation of the implicature $\neg(p \wedge q)$, goes as follows. If we take the expression $(p \vee q)$ as dialogue initial starting at the initial state $\langle\langle\rangle, \iota\rangle$, then the primary uptake of its semantic content the disjunction $(p \vee q)$ leads to the state $s = \omega[p \vee q]$ with two overlapping possibilities ρ_1 and ρ_2, where ρ_1 corresponds to the proposition p and ρ_2 to q. Relative to this state s there are three possible compliant responses: $!(p \vee q)$, p and q. Updating s^* with any of these possible responses will result in a state that is not less informative and not more inquisitive than s — hence these responses are compliant to the given state s.

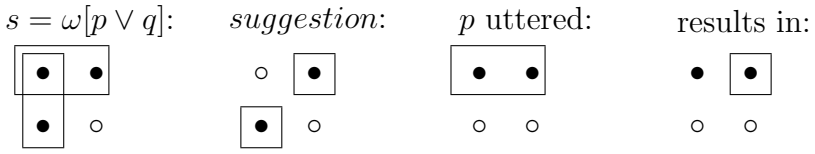
Example 4.11 (Compliant responses)



From the three expressions p and q are both more compliant to s than $!(p \vee q)$, since p and q eliminate more indices, thus they are more informative. The propositions p and q are equally compliant here. The expression $(p \wedge q)$ is not a compliant response, since $s^*[(p \wedge q)]$ is not related to s, because relatedness requires that each possibility in $s^*[(p \wedge q)]$ is the union of a subset of the set of possibilities in s and that is not the case. Because of this fact the initiator who uttered $(p \vee q)$ has made a *suggestion*, that $(p \wedge q)$ does not count as a response to his utterance. Then the responder utters p; thereby he accepts the *suggestion* of the initiator, that $(p \wedge q)$ is excluded. As I illustrated in chapter 2, the dialogue management in our system is built up in such a way that all uptakes (primary, secondary) are first provisional updates, that get either accepted or canceled by the response. If the actual update conflicts with the responder's own information state, she has to cancel some (or all) of the provisional updates, and this cancellation must be

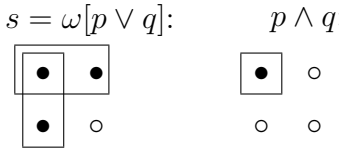
explicitly signaled. In case she does not cancel, she accepts the updates including the pragmatic inferences (if any); for more details, see section 3.

Example 4.12 ("Suggestion")



According to Groenendijk (2008) the responder can utter $(p \wedge q)$ in case she explicitly signals that she is aware of the fact that her response is not compliant to the immediate context. She gives that signal by uttering, for example, 'Well, actually, p and q'. In case the response goes against the suggestion, and this is explicitly signaled, the suggestion will be discarded and the response gets interpreted in the original state s without the exclusion.

Example 4.13 (Against the suggestion)

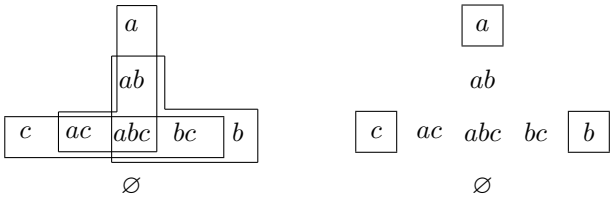


In the same way we can conclude that the corresponding first-order formula $\exists x.P(x)$ relative to a domain of two individuals a, c has the implicature that $P(a) \wedge P(c)$ does not hold. Just as the disjunction $p \vee q$ in examples 4.11 and 4.12 $\exists x.P(x)$ (over $D = \{a, c\}$) has two overlapping possibilities, corresponding to $P(a)$, $P(b)$. The compliant responses are: $!\exists x.P(x)$, $P(a)$ and $P(c)$. Here as well the conjunction $P(a) \wedge P(c)$ is not a compliant response, thus it is excluded. But of course if we take a bigger domain that says more. Let us now take a domain of three individuals $D = \{a, b, c\}$.[7] Then we intend to conclude that the expression $\exists x.P(x)$ means that either only a is P or only b is P or only c is P, hence we exclude $P(a) \wedge P(b)$, $P(a) \wedge P(c)$, $P(b) \wedge P(c)$, as well as $P(a) \wedge P(b) \wedge P(c)$. Then the picture of $\omega[\exists x.P(x)]$ (over $D = \{a, b, c\}$) has three overlapping possibilities, corresponding to the propositions $P(a)$, $P(b)$ and $P(c)$, that are the most compliant responses as well. Other, less compliant, responses are $!\exists x.P(x)$, $(P(a) \vee P(b))$, $!(P(a) \vee P(b))$ etc. Again, updating $\omega[\exists x.P(x)]^*$ with $P(a) \wedge P(b)$, $P(a) \wedge P(c)$, $P(b) \wedge P(c)$ or $P(a) \wedge P(b) \wedge P(c)$ would lead to a non-compliant state, hence these propositions are out.

[7] Of course even more individuals would be more interesting, but for practical reasons, I keep it to three. The pictures relative to this domain are still nicely drawable, while four or more individuals would make these pictures so complicated that they are not readable any more. For my purposes here three individuals are sufficient.

Example 4.14 (Suggestion)

$\omega[\exists x.P(x)]$: suggestion:



In this context, with the suggestion, if $P(a)$ is uttered we mean that only a is P. The suggestion or implicature excluded the indices that belong to the overlapping area of the possibilities in the state $\omega[\exists x.P(x)]$. In fact, these overlapping parts single out further propositions, that are not compliant responses in this state, but can be derived from the possibilities that refer to (the most) compliant propositions. Again, the three possibilities are the following: ρ_1 that corresponds to the proposition $P(a)$, ρ_2 that corresponds to $P(b)$ and ρ_3 that corresponds to $P(c)$. The area where ρ_1 and ρ_2 are overlapping refers to the proposition $(P(a) \wedge P(b))$, and similarly the overlap of ρ_1 and ρ_3 to $(P(a) \wedge P(c))$, the overlap of ρ_2 and ρ_3 to $(P(b) \wedge P(c))$ and where all three possibilities overlap to $(P(b) \wedge P(b) \wedge P(c))$.

However, although the intuition behind the approach (that the overlapping parts of the possibilities are pragmatically excluded) is correct, the above reasoning has its shortcomings and needs some reconsideration. First of all, the reasoning is counter-intuitive, since it suggests that existential expressions such as 'someone came' — $\exists x.C(x)$ — are themselves interpreted as pragmatically meaning that only one individual came. That is, the expression carries the suggestion by itself instead of looking at the relation between it and the response to it. Secondly, Groenendijk (2008) argues that in case of $p \vee q$ the response $p \wedge q$ is not compliant — and by this *not relevant* —, thus it should not count. However, the original Gricean reasoning says that *relevant* propositions that are strictly stronger are pragmatically excluded.

I agree with Groenendijk (2008) that overlapping possibilities are special, and claim furthermore that all overlapping parts correspond to a proposition that counts as a legitimate response. In the next section I will define these overlapping parts as the set of *possible propositions* in a state, and redefine the operation of 'alternative exclusion' as the new operation of *exhaustification* ($[\mathcal{EXH}]$) that is responsible for certain quantity implicatures.

4.2.2 Exhaustification

To formulate the new definition of *exhaustification* I first define the notion of *possible propositions* in a state. In our semantics the context or common ground is defined as a stack of states, where all states consist of one or more *possibilities*. Possibilities are defined as maximal sets of indices, such that all indices are connected to each other. In some cases the possibilities can overlap, where the overlapping part is special, belonging to two or more possibilities at the same time. By the definition of *possible propositions* we can refer to these special overlapping parts that correspond to propositions different from the ones formed by the possibilities. The set of possible propositions of the state σ is the set of possibilities in σ closed under *intersection*. By means of possible propositions in a state we can redefine the rule of *exhaustification* in a way that provides exhaustivity and the implicature of scalar expressions such as *A or B* as well.

Definition 4.2 (Possible propositions)
Let P_s be the set of possibilities in s.
Π_s is the set of *possible propositions* in s that is defined as follows:
Π_s is the biggest set of possibilities (set of indices) such that
if $\rho_1, \ldots, \rho_n \in P_s$ and $\rho_1 \cap \ldots \cap \rho_n \neq \emptyset$
then $\rho_1 \cap \ldots \cap \rho_n \in \Pi_s$

Definition 4.3 (Exhaustification)
Let P_t be the set of possibilities in t
and Π_s be the set of possible propositions in s.
$\langle\langle\sigma, s\rangle, t\rangle[\mathcal{EXH}] = \langle\langle\langle\sigma, s\rangle, t\rangle, u\rangle$, where
$u = \{\langle i, j\rangle | \exists\rho \in P_t : i, j \in \rho \wedge \neg\exists\alpha \in \Pi_s : \alpha \subset \rho \wedge i \in \alpha \text{ or } j \in \alpha\}$

Definition 4.2 defines the set of possible propositions in a state, such that it contains all the possibilities in the state and all the possible propositions (set of indices) determined by their overlapping parts. For example, in case we have three overlapping possibilities ρ_1, ρ_2 and ρ_3, the set of possible propositions is the following: $\{\rho_1, \rho_2, \rho_3, \rho_1 \cap \rho_2, \rho_1 \cap \rho_3, \rho_2 \cap \rho_3, \rho_1 \cap \rho_2 \cap \rho_3\}$.

The operation of exhaustification $[\mathcal{EXH}]$ on the current common ground stack $\langle\langle\sigma, s\rangle, t\rangle$ adds a state u on the top, where u contains all indices i from t that do not belong to any *possible proposition* α in s that is strictly stronger than any possibility ρ in t. Both possible propositions and possibilities refer to propositions, and they are both defined as sets of indices. As such, entailment is defined on sets in terms of the subset relation: α entails ρ if it is a subset of it, $\alpha \subseteq \rho$. A possible proposition is strictly stronger than a possibility if it asymmetrically entails it, hence if α is a proper subset of ρ, $\alpha \subset \rho$

The definition of $[\mathcal{EXH}]$ captures formally the essence of the gricean quantity maxim, since it says that every strictly stronger possible proposition is ruled out. Exhaustification looks at the relation between the last two states in the common ground stack, where the state s is considered as the actual context for the utterance ϕ, and t is the state as the result of updating s with the semantic content of ϕ. The state s contains the possible propositions that can be singled out from the overlapping possibilities of s and each of them corresponds to a strictly stronger proposition as the ones determined by the possibilities. According to the definition of $[\mathcal{EXH}]$, after the uptake of the semantic content of ϕ, the indices that belong to a possible proposition in s which is stronger than *phi* will be excluded.

4.2.3 Possible propositions and possible answers

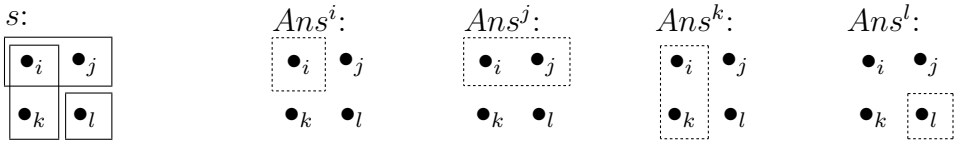
Singling out and making use of the possible propositions in the operation of exhaustification is motivated by the notion of *true answer* at an index. The core of the idea is to assume that the responder who is expected to answer the question of the initiator is indeed an expert, hence the answer she gives is the true answer. I assume that in order to achieve a successful conversation the speaker poses a question to somebody she believes to know the answer. Of course, it may be that the speaker is wrong and the responder is not an expert, which she may correctly signal with a response such as 'I don't know'. In case the responder gives an answer, the speaker believes that she plays according to the rules of a coherent dialogue and her answer is indeed the true answer. Then the speaker concludes that in case the responder gave an answer — taken to be the true answer — the other possible answers are out. This reasoning is captured formally by my new definition of exhaustification in definition 4.3. To make the motivation complete, first of all I define the notion of *true answer* at an index relative to the state determined by the underlying question.

Definition 4.4 (True answer at an index)
Let s be the state determined by the question ($s = \omega[?\varphi]$) and ρ a possibility in s ($\rho \in P_s$). The true answer at index i (Ans^i) is defined as:

$$Ans^i = \cap\{\rho \in P_s \mid i \in \rho\}$$

The true answer at index i after $?\varphi$ is the intersection of the possibilities in s ($=\omega[?\varphi]$) that contain the index i. Let me give some examples for illustration. Consider the question $?(p \vee q)$ that provides three possibilities ρ_1, ρ_2, ρ_3.

Example 4.15 (True answer at indices)



The possible true answers in the state s are $p \wedge q$ at index i, p at index j, q at index k and $\neg p \wedge \neg q$ at index l. Index i is in ρ_1 and ρ_2 that have an overlap (intersection) as illustrated above. Indices j, k and l are included in the possibilities ρ_1, ρ_2 and ρ_3 respectively. In case the information state of the responder consists of the pair $\langle k, k\rangle$ (or the index k), then she provides the true answer by uttering q. The speaker will then infer that $q \wedge \neg p$ is the case on basis of assuming the responder is an expert. In case responder knows that the actual index is i, then she has to utter $(p \wedge q)$ to provide the true answer. Motivated by the notion of true answers, I define the set of propositions that count as an answer to the actual question. The set of possible true answers in a state is exactly the same as the set of possible propositions in a state introduced in section 4.2.2.[8]

By the notion of (true) answer and possible answers we can offer a solution to the problem of plural answers that our analysis (and Inquisitive Semantics itself) ran into, since it filtered the responses by the logical notion of compliance. As I noted before the answer $p \wedge q$ is not compliant after $?(p \vee q)$, hence it should be ruled out. Similarly, on the basis of the notion of compliance 'AMY and BEN came.' should be ruled out as an answer after the question 'Who came?' that we translate as $?\exists x.C(x)$; nevertheless this answer is perfectly in order linguistically.

One question is still open at this point regarding the relation between the logical notion of compliance and my notion of possible answers (based on pragmatic reasoning). The notion of (true) answer considers $(p \wedge q)$ as a good response after the question $?(p \vee q)$. However, it is not compliant according to our logical system that should filter it out.

4.2.4 Examples

Let us look at some examples in detail. In this section I will illustrate that by my definition of exhaustification ($[\mathcal{EXH}]$) we get the right results for the exhaustive interpretation of (37a) and (37b), as well as for the scalar implicature of the disjunction in (37c).

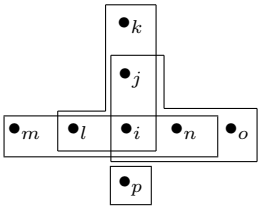
(37) Who came yesterday?
   a. AMY (came). → inferred: and nobody else
   b. AMY and BEN (came). → inferred: and nobody else
   c. AMY or BEN (came). → inferred: and not both; and nobody else

All three answers are interpreted in the context of the same wh-question translated as $?\exists x.C(x)$, that provides the common ground $\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle$; the state on the top contains three possibilities $\rho_1, \ldots, \rho_4$:

[8] The definition of true answer is also interesting, for example, in cases of conditional questions such as $p \rightarrow ?q$.

Example 4.16 (Picture of $\omega[?\exists x.C(x)]$)

$i(C) = \{a, b, c\}$ $m(C) = \{c\}$
$j(C) = \{a, b\}$ $n(C) = \{b, c\}$
$k(C) = \{a\}$ $o(C) = \{b\}$
$l(C) = \{a, c\}$ $p(C) = \{\}$



$\rho_1 \rightsquigarrow P(a)$
$\rho_2 \rightsquigarrow P(b)$
$\rho_3 \rightsquigarrow P(c)$
$\rho_4 \rightsquigarrow \neg\exists x.P(x)$

According to my definition of possible propositions, these four overlapping possibilities provided by the semantic content determine eight possible propositions $\alpha_1, \ldots, \alpha_8$:

Example 4.17 (Possible propositions in $\omega[?\exists x.C(x)]$)

$\alpha_1 = \rho_1 \rightsquigarrow$ the proposition: $C(a)$
$\alpha_2 = \rho_2 \rightsquigarrow$ the proposition: $C(b)$
$\alpha_3 = \rho_3 \rightsquigarrow$ the proposition: $C(c)$
$\alpha_4 = \rho_1 \cap \rho_2 \rightsquigarrow$ the proposition: $C(a) \wedge C(b)$
$\alpha_5 = \rho_1 \cap \rho_3 \rightsquigarrow$ the proposition: $C(a) \wedge C(c)$
$\alpha_6 = \rho_2 \cap \rho_3 \rightsquigarrow$ the proposition: $C(b) \wedge C(c)$
$\alpha_7 = \rho_1 \cap \rho_2 \cap \rho_3 \rightsquigarrow$ the proposition: $C(a) \wedge C(b) \wedge C(c)$
$\alpha_8 = \rho_4 \rightsquigarrow$ the proposition: $\neg\exists x.C(x)$

After the primary uptake of the semantic content of the answers in (37) is completed the operation of exhaustification ($[\mathcal{EXH}]$) applies. This operation belongs to the secondary uptake of the utterance, which instantiates the pragmatic inferences. The operation of $[\mathcal{EXH}]$ applies in all cases blindly after the primary uptake, however the actual effect of it depends on the relation of the top states in the common ground stack. Exhaustification has an effect only in certain cases where there is a special relation between the top states. It does not do anything, for example, when there are no overlapping possibilites in s in the stack $\langle\langle\sigma, s\rangle, t\rangle$. For the examples in (37) we have to apply exhaustification relative to the following common ground stacks respectively:

Example 4.18 (Contexts for exclusion)

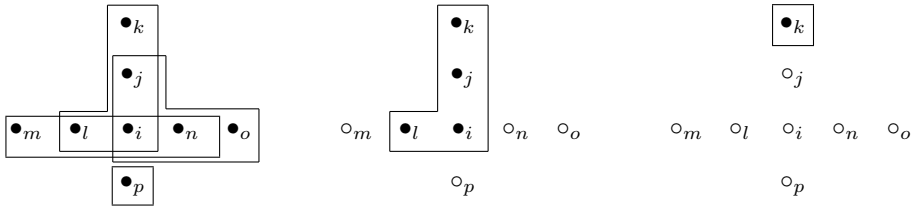
(a) $\langle\langle\langle\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle[\mathcal{EXH}]$
(b) $\langle\langle\langle\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a) \wedge C(b)]\rangle[\mathcal{EXH}]$
(c) $\langle\langle\langle\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a) \vee C(b)]\rangle[\mathcal{EXH}]$

The operation of exhaustification will provide us with the right results for all three cases in example 4.18. In (4.18a) we get as a result a single possibility containing a single index where only Amy came. In this example the primary uptake, hence the semantic content of the answer, provides a state with a single

possibility ρ that corresponds to the proposition $C(a)$. This proposition consists of four indices (relative to our domain), of which after $[\mathcal{EXH}]$ the indices survive that do not belong to any of the possible propositions $\alpha_{1\ldots8}$ in $\omega[?\exists x.C(x)]$ that are strictly stronger than the proposition corresponding to the possibility ρ. Hence, we have to consider here $\alpha_4, \ldots, \alpha_8$, since these propositions are all strictly stronger than ρ (they all entail ρ but not the other way around). After excluding the indices from $\omega[C(a)]$ that belong to any of $\alpha_{4\ldots8}$ in $\omega[?\exists x.C(x)]$ we end up with the single possibility containing the single index where only Amy came. By the definition of $[\mathcal{EXH}]$ we excluded the three other indices where besides Amy, Ben and/or Claire came as well.

Example 4.19 (Exhaustification: singular term)
$\langle\langle\langle\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle[\mathcal{EXH}] =$
$\langle\langle\langle\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle, \omega[\forall x.C(x) \leftrightarrow x = a]\rangle$

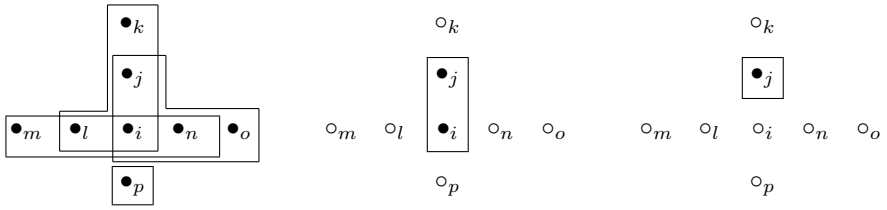
$\omega[?\exists x.C(x)]$: $\omega[C(a)]$: $\omega[\forall x.C(x) \leftrightarrow x = a]$:



The operation in (4.18b) goes similarly: in this case the indices from $\omega[C(a) \wedge C(b)]$ which do not belong to $\alpha_5, \ldots, \alpha_8$ survive. We do not have to consider $\alpha_1, \ldots, \alpha_4$, since they are possibilities in one of the two states. The result is again a single index, namely the one where only Amy and Ben came, hence we excluded the index from $\omega[C(a) \wedge C(b)]$ where besides Amy and Ben, Claire came as well. The resulting common ground consists of the following states:

Example 4.20 (Exhaustification: conjunction)
$\langle\langle\langle\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a) \wedge C(b)]\rangle, \omega[\forall x.C(x) \leftrightarrow (x = a \vee x = b)]\rangle$

$\omega[?\exists x.C(x)]$: $\omega[C(a) \wedge C(b)]$: $\omega[\forall x.C(x) \leftrightarrow (x = a \vee x = b)]$:

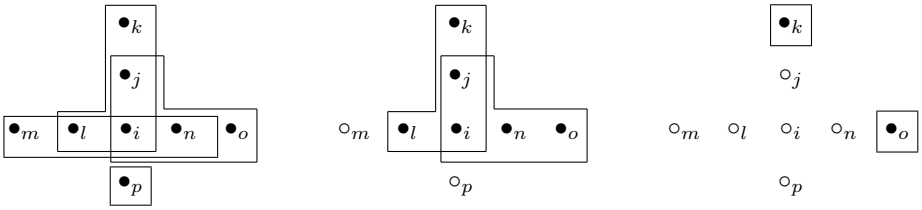


The operation in (4.18c) on the answer by disjunction will give us the intended result: we end up with two possibilities, each of them consisting of a single index.

One possibility contains the index where only Amy came, and the other possibility contains the index where only Ben came. Hence, we get the interpretation that either only Amy came or only Ben came, with the right inference that not both of them came. Here, the indices from $\omega[C(a) \vee C(b)]$ that are not in $\alpha_4, \ldots \alpha_8$ survive. The resulting common ground is as follows:

Example 4.21 (Exhaustification: disjunction)
$\langle\langle\langle \ldots \rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a) \vee C(b)]\rangle, s\rangle$

$\omega[?\exists x.C(x)]$: $\omega[C(a) \vee C(b)]$: s :



The above example illustrates an important result of my analysis. With the naive notion of disjunction applying the gricean reasoning results in the empty set, because $C(a)$ is stronger than $C(a) \vee C(b)$ as well as $C(b)$ is stronger than $C(a) \vee C(b)$. By our – independently motivated – richer notion of disjunction this problem does not occur and by applying 'grice' we get the right result of the exhaustive interpretation without any extra rules like, for example, the notion of 'innocently excludable' proposition.[9]

4.2.5 Some notes on indefinites

In this section I turn to an interesting problem: focused indefinites in answers. Indefinites in answers pose several interesting questions in general and also for my analysis. Consider the following short dialogue.

(38) Who came (yesterday)? A GIRL came.

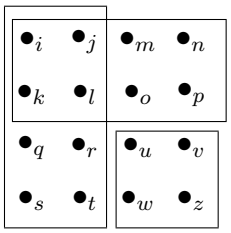
The focused indefinite expression in the answer is interpreted exclusively: only one individual came and it was a girl. I assume that the theme/rheme division of the answer here leads to the theme as the question $?\exists x.C(x)$ while the rheme as the proposition $\exists x.C(x) \wedge G(x)$ – the standard translation of an utterance with an indefinite expression.[10]

[9] Note furthermore, that with our representation of the polar reading of disjunction as $!(\varphi \vee \psi)$ we correctly do not derive the exhaustive interpretation.

[10] As already pointed out in Footnote 4 in section 3.2.1 the proper definition to capture this division requires a higher-order system.

To illustrate this example, I consider a model with two predicates $G(irl), C(ame)$ and — to make it as simple as possible — a domain of two indiviuals a, b. In this model our logical space consists of 16 indices from i to z. The uptake of the question leads to the stack: $\langle\langle\langle\rangle, \iota\rangle, \omega[?\exists x.C(x)]\rangle$ where the picture of $\omega[?\exists x.C(x)]$ in our given model is the following:

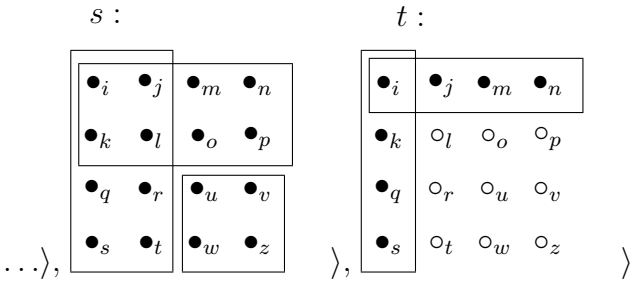
Example 4.22 (Indefinites: picture of $\omega[?\exists x.C(x)]$)



$i(C) = \{a, b\}, i(G) = \{a, b\}$ $\quad$ $q(C) = \{b\}, q(G) = \{a, b\}$
$j(C) = \{a, b\}, j(G) = \{a\}$ $\quad$ $r(C) = \{b\}, r(G) = \{a\}$
$k(C) = \{a, b\}, k(G) = \{b\}$ $\quad$ $s(C) = \{b\}, s(G) = \{b\}$
$l(C) = \{a, b\}, l(G) = \{\}$ $\quad$ $t(C) = \{b\}, t(G) = \{\}$
$m(C) = \{a\}, m(G) = \{a, b\}$ $\quad$ $u(C) = \{\}, u(G) = \{a, b\}$
$n(C) = \{a\}, n(G) = \{a\}$ $\quad$ $v(C) = \{\}, v(G) = \{a\}$
$o(C) = \{a\}, o(G) = \{b\}$ $\quad$ $w(C) = \{\}, w(G) = \{b\}$
$p(C) = \{a\}, p(G) = \{\}$ $\quad$ $z(C) = \{\}, z(G) = \{\}$

The theme of the answer in (38) is identical to the wh-question, thus it fulfills the requirement of focusing. The uptake of the rheme $\exists x.C(x) \wedge G(x)$ of the focused sentence 'A GIRL came.' adds a new state to the stack; it eliminates the indices where there is no individual who is both in the set of girls and in the set of persons who came. By this uptake we get a common ground stack $\langle\langle\langle\ldots\rangle, s\rangle, t\rangle$, where s and t are the following:

Example 4.23 (Indefinites: uptake of 'A GIRL came')



According to the dialogue management rules (in the original system of Groenendijk (2008)) the operation of alternative exclusion ($[EXCLA]$) applies, however this original definition of $[EXCLA]$ by Groenendijk does nothing here, because t is not related to the underlying question[11] and gives back the stack as in example 4.23 above. This is clearly not the intended result.

Note, however, that the intuition behind the definition of alternative exclusion is correct, as it excludes the indices that were included in the overlapping part of the possibilities in the immediate context, hence the state s provided by the underlying question. If we follow this intuition, we get the intended result as adding the state u with two possibilities, each having indices where exactly one individual came and that individual is a girl – as shown in the following example.

[11] This is the case where the first condition of Definition 2.24 gets important.

Example 4.24 (Indefinites: exclusion)
u :

$$\ldots\rangle, \begin{array}{|cc|cc} \circ_i & \circ_j & \bullet_m & \bullet_n \\ \circ_k & \circ_l & \circ_o & \circ_p \\ \hline \bullet_q & \circ_r & \circ_u & \circ_v \\ \bullet_s & \circ_t & \circ_w & \circ_z \\ \hline \end{array} \rangle$$

My operation of exhaustification ($[\mathcal{EXH}]$) intends to capture the intuition mentioned above, namely that those pairs of indices in the state created by the rheme should be removed that belong in the theme to the overlapping part of the possibilities, hence to a stronger possible proposition. However, the way I formulated it, the operation of $[\mathcal{EXH}]$ in section 4.2.2 gives the wrong result for the examples of indefinites. Let me repeat the proposed definition of $[\mathcal{EXH}]$ here.

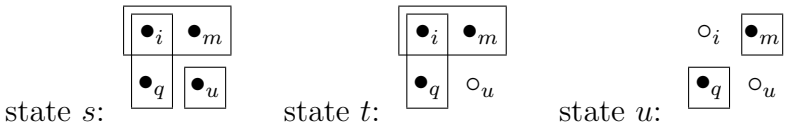
Definition 4.5 (Exhaustification) (= Def. 4.3)
Let P_t be the set of possibilities in t
and Π_s be the set of possible propositions in s.
$\langle\langle\sigma, s\rangle, t\rangle[\mathcal{EXH}] = \langle\langle\langle\sigma, s\rangle, t\rangle, u\rangle$, where
$u = \{\langle i, j\rangle | \exists\rho \in P_t : i, j \in \rho \wedge \neg\exists\alpha \in \Pi_s : \alpha \subset \rho \wedge i \in \alpha \text{ or } j \in \alpha\}$

For our example above this definition gives the following. Consider the states s and t as given in example 4.23. The definition 4.5 states that the operation $[\mathcal{EXH}]$ adds a new state u where the pairs $\langle i, j\rangle$ from t are kept for which it holds that there is a possibility in t containing both i and j and there are no stronger possible propositions in s to which either i or j belongs. Since in this particular example none of the possible propositions in s are stronger than any of the possibilities in t, the operation of $[\mathcal{EXH}]$ as defined in 4.5 keeps all indices from t, consequently exhaustification does not have an effect.

One way out of this problem is to assume that we know who the girls are. Suppose we know that both a and b are girls. As soon as we know this, our logical space (relative to the same model as before) is reduced to the four indices: i, m, q, u from the previous example. In this way the example is the same as my previous examples with definites. As soon as we know who the girls are, and answer by the indefinite 'a girl', this is equivalent to answering with the disjunction 'Amy or Bea' (if these are the only girls). The wh-question leads to a state with three possibilities as before, but each possibility consists of much less indices (see state s in Ex. 4.25). The uptake of the expression $\exists x.C(x) \wedge G(x)$ will eliminate the indices where no girl is such that she came, hence u in our example (state t below). The operation of $[\mathcal{EXH}]$ applies after these two states and gives the right result, excluding the index where both of the girls came. Hence we get

the intended meaning, that exactly one individual came and that it is a girl (state u in Ex. 4.25). Why the responder uses an indefinite in such a case should be explained by independent reasons.

Example 4.25 (Indefinites: exclusion)



To provide another solution without assuming to know who the girls are, I propose an alternative definition of exhautification that I refer to as $[\mathcal{EXH}]_*$. This operation is defined as follows.

Definition 4.6 (Exhaustification: an alternative)
Let Π_s be the set of possible propositions in s.
$\langle\langle\sigma, s\rangle, t\rangle[\mathcal{EXH}]_* = \langle\langle\langle\sigma, s\rangle, t\rangle, u\rangle$, where
$$u = \{\langle i, j\rangle \in t \mid \forall\alpha \in \Pi_s : i, j \in \alpha \Rightarrow \neg\exists\beta \in \Pi_s : \beta \subset \alpha \wedge i \in \beta \text{ or } j \in \beta\}$$

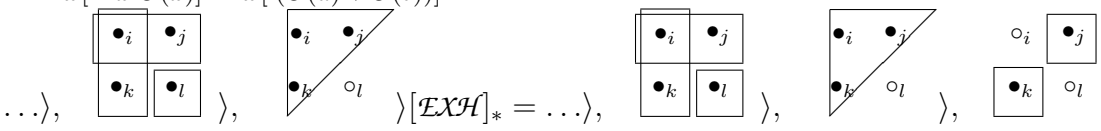
The essence of the definition is the same, since it also removes the pairs of indices $\langle i, j\rangle$ of which it holds that i or j belongs to a stronger possible proposition. The difference is subtle. The definition of $[\mathcal{EXH}]$ (see Def 4.5) compares the possibilities in t and the possible propositions in s where the indices in the pairs are present with respect to strength, while the definition of $[\mathcal{EXH}]_*$ compares only the possible propositions in s where the given indices from t are present as such with respect to strength. In the core examples discussed in section 4.2.4 this does not make a difference, because for all those cases it holds that the possibilities in t are elements of the set of possible propositions in s. Hence, for those examples we can apply both $[\mathcal{EXH}]$ and $[\mathcal{EXH}]_*$ providing us with the same result. The advantage of the new definition $[\mathcal{EXH}]_*$ is that while it captures essentially the same for the basic cases discussed in section 4.2.4 (examples 4.19, 4.20 and 4.21) it also gives the right result for focused indefinites as 'a girl'.

However, this alternative definition of exhaustification raises another essential issue. In case the question 'who came' ($?\exists x.C(x)$) is answered by the non-inquisitive interpretation $!(C(a) \vee C(b))$ of the disjunction 'Amy came or Ben came', the definition of $[\mathcal{EXH}]_*$ derives the same scalar implicature as it derives for the inquisitive version $C(a) \vee C(b)$.[12] Consider the following illustration:

[12] Accordingly, applying $[\mathcal{EXH}]_*$ to the sentence 'It is not the case that neither Amy nor Ben came' derives the scalar implicature.

Example 4.26 (Applying $[\mathcal{EXH}]_*$ on polar reading)

$\omega[?\exists x.C(x)]:$ $\omega[!(C(a) \vee C(b))]:$



The first proposed definition of exhaustification as $[\mathcal{EXH}]$ does not have this result. In case we apply $[\mathcal{EXH}]$ after the state $\omega[!(C(a) \vee C(b))]$ it would remove all indices, resulting in the absurd state. Following Gazdar (1979), in case an implicature would lead to inconsistency it should not be carried out. Consequently, since in this example $[\mathcal{EXH}]$ would lead to inconsistency, it is not carried out. Hence, with the first definition of exhaustification we do not derive a scalar implicature in such cases of the non-inquisitive interpretations.

Note that this example faces similar problems to the two reading of which-questions such as, for example, 'Which student called the director?' which shows differences depending on if we know who the students are and if we do not. Further discussion on this de dicto/de re interpretation is certainly very interesting and challenging for our framework, but I leave it out of consideration in this dissertation.

4.3 Summing up

In section 4.2 I introduced the recent problems concerning the exhaustive interpretation of answers and the phenomenon of scalar implicatures, as a hot topic in the ongoing debate between the global approaches of the neo-Gricean analyses and the localist view that proposes to make pragmatic implicature part of the computational system of the grammar.

In section 4.2.2 I provided an analysis of the exhaustive interpretation of answers in the framework of Inquisitive Semantics, based on the original idea of *alternative exclusion* of Groenendijk (2008). In the framework of Inquisitive Semantics, exhaustive interpretation of answers is due to the secondary uptake of the utterance and carried out technically by the operation of alternative exclusion. Keeping the orginal intuititon I provided a new definition of this operation, $[\mathcal{EXH}]$, that fixes some shortcomings that are faced by the proposal of Groenendijk (2008) and better fits the Gricean reasoning. My operation $[\mathcal{EXH}]$ gives the right results not only for the exhaustive interpretation but also for the scalar implicature of disjunctions. The alternative exclusion refers to the possible propositions that are singled out from the possibilities in the context. Each overlapping part of two or more possibilities determines a proposition. The definition of alternative exclusion captures formally the essence of the Quantity maxim, since it excludes all strictly stronger answers from the actual context.

Hence, my position is clearly among the neo-Gricean global analyses, that calculate implicatures at the sentential level. In our dialogue management system as well, the exclusive implicature is calculated after the uptake of the semantic content. Different from the classical Gricean reasoning is that our system applies the operation of [$\mathcal{EXH}$] in all cases right after the uptake of the semantic content of the utterance. However, [$\mathcal{EXH}$] does not have an effect in all cases, only in case of special relations between the states on the top of the common ground stack. These special states are the ones that have one or more overlapping possibilities, where the overlapping parts are considered to be special. These areas make an important contribution determining the possible propositions that count as an answer and as such can be seen as the alternative set on which the inference of exclusiveness is carried out.

I showed in some detail the recent analyses of Chierchia, Fox and Spector that provide different solutions based on different arguments. All of them give an analysis of the scalar implicatures in terms of exhaustification. In this respect my analysis seems to be as effective as the others, however our framework has important advantages. First of all, regarding the problem of the definition of the alternative set, which is investigated by Spector as well as by Fox: in my system I do not need to stipulate what counts as the alternative set, as it is directly determined by the underlying issue that can be — and often is — an explicit wh-question or the theme of the utterance itself. Furthermore, I do not need to assume a special notion like *innocently excludable* (Fox 2007), or minimal models. I can infer the intended interpretation for exhaustive answers and the scalar implicature of disjunctions by a single mechanism, viz. the operation [$\mathcal{EXH}$] based on the possible propositions given by the context.

Chapter 5

'Only'

In the previous chapter I discussed the interpretational effects of sentences with free focus, with special interest in exhaustive interpretation. In this chapter I turn to another challenging issue that is directly related to the phenomenon of focusing, as well as to exhaustive interpretation. The issues of focusing, exhaustivity and the focus-sensitive particle 'only' are interrelated both from a semantic-pragmatic and a broader linguistic perspective. My particular interest in this chapter goes to the interpretation of the focus particle 'only', which is widely taken to be an explicit exhaustivity operator. I am particularly interested here in the special interpretation of 'only', its relation to free focus constructions, and the differences between the two with respect to their context dependence. I will not investigate the phenomenon of association with focus in general, hence I will not discuss other focus particles such as 'even', 'also' and so on.

Meaning components

To give a proper analysis of the interpretation of 'only' remains a rather challenging issue. It is widely agreed upon that the contribution of 'only' to the sentence meaning is twofold, and the two meaning components are distinguished as (1) the *host* of 'only': the proposition which is the standard translation of the focused utterance modified by 'only', and (2) the *exclusive statement*. Consider the following example:

(39) Only AMY went to Rotterdam.
(1) *host:* Amy went to Rotterdam
(2) *exclusive statement:* besides Amy nobody went to Rotterdam

It is widely taken that the exclusive statement — the second meaning component — is asserted, while the status of the host proposition is still under discussion. There are several opinions on this issue: the host is regarded as *entailed*

(Atlas 1996) or taken as a pragmatic inference (a *presupposition* (Horn 1969, Rooth 1992)[1] or an *implicature* (McCawley 1981, van Rooij and Schulz 2007)).

In their recent paper, van Rooij and Schulz (2007) claim that from the two parts of the meaning contribution the exclusive statement, what they call the *negative contribution*, is the semantic content, while the host or in their terms the *positive contribution* is the result of a pragmatic inference. Among other arguments they point out that in case of negation the positive contribution does not get canceled, which shows that it is not part of the semantic contribution of the utterance. The same holds for denial as well. Consider the following conversation, where the response does not deny that Amy came, it merely denies that Amy was the only one who went to Rotterdam.

(40) Only AMY went to Rotterdam. No, BEN went (to Rotterdam), too.

Apart from the crucial differences between the approaches mentioned above regarding the status of the meaning components of an 'only'-sentence, they all give an interpretation of 'only' as an exhaustivity operator, meaning: "to the exclusion of others".

Relation with focusing

The use of 'only' has a direct relation with the focus structure of the sentence, as is shown by the classical examples in (41) where the placement of focus has a truth-conditional effect on the sentence meaning.

(41) a. John only introduced BILL to Sue.
b. John only introduced Bill to SUE.

This is a core example in the focus analysis of, for example, Rooth (1985, 1992) who claims that in such constructions focus identifies the quantificational domain for 'only'. The question raised regarding the analysis of 'only' is the relation of an 'only'-sentence with its counterpart containing free focus. In the classical analyses of Rooth (1985, 1992) and Krifka (2006) 'only' quantifies over the alternatives introduced by the focusing of the sentence. As a result the sentence gets the interpretation that from the alternative set proposition p (the ordinary meaning of the sentence) is true while all other alternatives are false. For example, in the Roothian analysis (Rooth 1985, Rooth 1992), in the sentence 'Only AMY came.' focusing on the subject introduces the alternative set Alt = {Amy came, Ben came, Claire came, Dan came, ...} and 'only' quantifies over this set, providing us the meaning that the proposition 'Amy came' is true and all other propositions in

[1] An analysis of a weaker presupposition is given by Horn (1996), while Geurts & van der Sandt (2004) argue for an existential presupposition.

the alternative set are false (see (3.2b) in chapter 3). Hence, we get the exhaustive interpretation that Amy and nobody else came.

In the Structured Meaning Account of Krifka (2006) the focus-sensitive particle 'only' is analyzed as an operator which takes a focus-background structure and results in an exhaustive interpretation. Krifka's meaning rule for 'only' says that the proposition resulting from applying the background to the focus, hence the ordinary meaning of the sentence, is true, and that no other proposition is true from the alternative set (see (3.5b) in chapter 3).

Pragmatic effects

I claim that 'only' is not simply an overt version of the exhaustivity operator as, e.g., Fox (2007) has suggested (see chapter 4), but next to its exclusive meaning component, 'only' has the role of canceling expectations. I propose that similarly as Zeevat (2008) proposes[2] the interpretation of 'only' has a contribution like: "less than expected".

Zeevat repeats a nice example from Umbach (2005) to illustrate the phenomenon and to strengthen his claim of the presence of an expectation. Without the proposed expectation the contrast of (42a) versus (42b) cannot be explained.

(42) *(Things have changed in the Miller family.)*
   a. Yesterday, RONALD went shopping.
   b. Yesterday, only RONALD went shopping.

Zeevat claims that the semantic contribution of 'only' is the meaning component "less than expected", while the exhaustive interpretation remains an effect of focusing. In his analysis the sentence 'Only AMY went to Rotterdam' presupposes an expectation as 'besides Amy more persons went to Rotterdam', while the sentence asserts that this expectation is wrong. As for the host proposition 'Amy went to Rotterdam', it is taken to be presupposed, since it is part of the expectation. Hence, the role of 'only' is denying the (presupposed) expectation. This claim can be strengthened by examples from Hungarian, where a wh-question can also be posed in a plural form, explicitly stating the expectation, while the singular form stands for the default (neutral/underspecified) interpretation. The plural form of the question has different requirements for which answers are felicitous. Consider the two answers (43) with free focus and (44):

(43) AMY ment el Hágába.
Amy went VM Hague$_{ILL}$
'AMY went to The Hague.'

(44) Csak AMY ment el Hágába.
only Amy went VM Hague$_{ILL}$
'Only Amy went to The Hague.'

[2]See also Zeevat (1994, 2002, 2007).

(45) *question:* Ki ment el Hágába?
who went VM Hague$_{ILL}$
'Who went to The Hague?' [sg]

answer: (43) AMY ment el Hágába. / (44) Csak AMY ment el Hágába.

(46) *question:* Kik mentek el Hágába?
who$_{pl}$ went$_{3pl}$ VM Hague$_{ILL}$
'Who went to The Hague?' [pl]

answer: #(43) AMY ment el Hágába. / (44) Csak AMY ment el Hágába.

Example (46) explicitly signals the expectation that more persons went to The Hague, as opposed to the singular version, where this expectation is not explicitly present. From the two possible answers (43) and (44) the one with the free focus is infelicitous after the question posed in plural form (46), while the answer with 'only' is felicitous. This example strengthens the claim that 'only' has an additional function to cancel the expectation.

As we already mentioned before, the classical analyses treat 'only' as an exhaustivity operator. This view raises the question what is the difference in case we give an answer to a wh-question with or without 'only'. As Zeevat (1994) already points out, if the meaning of 'only' is simply defined as an exhaustivity operator, then the use of 'only' in answers would be rather superfluous, since an answer with free focus is already interpreted exhaustively. However, if we consider natural language examples, the use of 'only' is not at all redundant. To provide a convenient analysis of sentences with 'only' we have to explain the relation and differences between the same (focused) utterance with or without 'only'. This issue is related to another issue, that the context for free focus constructions is more restricted than the context for bound focus constructions (see more on this point after Def. 5.3). Related to this point I investigate the interpretations with negation as well as the possible responses with denial. Furthermore, I involve in my analysis the important pragmatic effect of 'only', namely that it requires some expectation as discussed by Zeevat (2008), who recently analyzed 'only' as a *mirative particle* that signals 'surprise' in the sense that the previous expectation is false.

In the rest of this chapter I will investigate examples concerning the felicity of the denial and contrast responses (47) and (48), which can help to explain the differences between 'only'-sentences and the corresponding sentences with free focus. Furthermore I will discuss the interpretation of 'only'-sentences containing a coordinated phrase in focus, as in (49). Among other arguments these latter sentences were considered by van Rooij and Schulz (2007) as examples of the shortcomings of focus alternative approaches like Horn's (1969) and Rooth's (1985, 1992) analyses.

(47) (Who went to Rotterdam?) AMY went to Rotterdam.
#No, BEN went to Rotterdam, too.
No, BEN went to Rotterdam.

(48) (Who went to Rotterdam?) Only AMY went to Rotterdam.
No, BEN went to Rotterdam, too.
#No, BEN went to Rotterdam.

(49) a. Amy only called BEN and CLAIRE.
b. Amy only called BEN or CLAIRE.

5.1 'Only' versus free focus

It is widely agreed upon that the information provided by the focused sentence with or without 'only' is the exhaustive answer to the corresponding wh-question. After the question 'Who came?' both 'AMY came.' and 'Only AMY came.' will communicate that it is the case that Amy came and besides her nobody else came. In my system both sentences lead to a common ground stack with a state on the top consisting of a single possibility, where at each index only Amy came. In case the sentence is accepted by the responder, this information will percolate down and resolve the underlying issue: 'who came'. The difference between the two sentences is the way in which we reach this state on the top: which intermediate states are added in case of a free focus construction and in case of an 'only'-sentence. Consider the previous examples repeated here as:

(47) (Who came?) AMY came.
a. #No, BEN came, too.
b. No, BEN came.

(48) (Who came?) Only AMY came.
a. No, BEN came, too.
b. #No, BEN came.

In the example with free focus (47), denial cannot be followed by an utterance containing the additive particle 'too', while example (48), with 'only', cannot be followed by free focus but must be followed by 'too'. These examples suggest that by denying an utterance containing 'only' we cancel the exclusive statement that nobody besides Amy came, but we do not cancel the host proposition that Amy came; while in case of the free focus it is the other way around: we cancel that Amy came, and cannot separately cancel the exhaustive statement. As I claimed before in chapter 4, the exhaustive interpretation of free focus in answers is due to implicatures. Consider the following example:

(50) (Who came?) AMY came. Well, BEN came, too.

Tipically, implicatures are never denied, but can be cancelled as shown by the above example, where instead denial by 'No,...' is out, but the response by 'Well,...' cancels the implicature.

In the spirit of the dialogue management rules of Inquisitve Semantics all kinds of responses can be given, which determine what happens to the provisional updates that were suggested by the utterance before. If the responder agrees with these suggestions, the information will percolate down, thereby turning suggestions into definitive changes of the common ground. The other possibility is that the responder does not accept the suggestion, because it goes against her own information state. Then she has to announce her objection, where in many cases a corrective utterance is provided. However, this denial can affect the whole information content or just cancel the implicatures. Signalling denial by 'No,...' is "stronger", in the sense that it cancels the whole information content and goes back to the last issue in the common ground. The response by 'Well,...' is "weaker": it only cancels the implicature.

The current definition of the operation of *cancellation* ($[\bot]$) as introduced in section 2.2.3 (Def. 2.26 repeated here as Def. 5.1) only captures the denial of the whole semantic content.

Definition 5.1 (Cancellation) (= Def. 2.26)
$\langle\langle \sigma, s\rangle, t\rangle[\bot] =$
$\langle \sigma, s\rangle$ if s is not indifferent
$\langle \sigma, s\rangle[\bot]$ otherwise

In order to capture the cancellation of the implicature we need to define an additional operation as follows.

Definition 5.2 (Implicature cancellation)
$\langle\langle \sigma, s\rangle, t\rangle[\bot_{impl}] =$
$\langle \sigma, s\rangle$ if t is more informative than s and s is more informative than σ
$\langle\langle \sigma, s\rangle, t\rangle$ otherwise

This definition removes the last informative state in case the state immediately before is also an informative one. In our architecture, two informative steps: adding s and t to the stack $\langle \ldots, \sigma\rangle$ where t is more informative than s and s is more informative than σ can only occur if the second state t is added by an implicature. The definition of implicature cancellation removes this second state t, hence it cancels the implicature. In case there is no implicature, then the state on top follows an inquisitive state by the theme which cannot be more informative than any state before, and so implicature cancellation does nothing.

5.1.1 Proposal: analysis of 'only'

I claim that the focus particle 'only' introduces a new issue, that corresponds to the expectation that besides the individual(s) in focus more individuals were expected to have the given property.

First of all, following Horn (1969), Rooth (1992) and Roberts (2006)[3] I take the host (or positive contribution) of the 'only'-sentence as presupposed. Without proposing a formal analysis of presupposition[4] in Inquisitive Semantics, in my analysis of 'only' I assume an underlying context where the presupposition, hence the positive contribution of the 'only'-sentence is supported. Thus, I assume that the presupposition is already added to the common ground, and relative to that context the uptake of the 'only'-sentence is carried out.

In the following I propose an analysis where 'only' is a semantic operator that takes a focused sentence β and operates on the theme and rheme of β, by this providing different interpretational results for different focus structures. Consider the natural language utterance 'Only AMY came' and its negated version 'Not only AMY came'. I propose an analysis which derives the following:

(51) a. Only AMY came.
presupposition: Amy came
theme: are there more persons besides Amy who came?
rheme: nobody else besides Amy came

b. Not only AMY came.
presupposition: Amy came
theme: are there more persons besides Amy who came?
rheme: it is not true that nobody else besides Amy came

In my analysis of 'only' the focal structure of β in the utterance 'only β' does not select contexts. In this respect my analysis is different from pragmatics accounts like, e.g., Roberts (2006) proposed. I analyze 'only' in semantic terms similarly to Krifka's (2006) proposal, where 'only' operates on a given focal structure and the embedded focal structure does not have further requirements on the underlying context (see also Beaver & Clark (2003)).

[3]Roberts (2006) compares the four competing views regarding the status of the host: the host/prejacent (1) is entailed, (2) is presupposed, (3) gives rise to an existential presupposition, and (4) is a conversational implicature. She investigates several tests and phenomena and concludes that the presuppositional view comes out as the best one. See her scorecard in Appendix 1.

[4]This raises several interesting issues around presupposition – accommodation, presupposition projection etc. –, but since this is not the scope of my analysis, I leave this for further research. I suppose that the framework of Inquisitive Semantics is suitable to provide an elegant formal analysis of these phenomena.

Definition 5.3 (Theme and rheme of an 'only'-sentence)
Let α be an utterance with 'only' that modifies the focused utterance β;
α = only β
$TH(\alpha) = ?(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)$
$RH(\alpha) = \mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle$

Definition 5.4 (Update rule of $\mathcal{ONLY}\langle\varphi;\psi\rangle$)
$s[\mathcal{ONLY}\langle\varphi;\psi\rangle] =$
$\{\langle i,j\rangle \in s[\psi] \mid \forall\alpha \in \Pi_{\omega[\varphi]} \ : \ i,j \in \alpha \Rightarrow \neg\exists\beta \in \Pi_{\omega[\varphi]} \ : \ \beta \subset \alpha \ \&\ (i \in \beta \text{ or } j \in \beta)\}$

In the definition φ stands for the theme of the focused sentence modified by 'only' and ψ stands for the rheme of it. This definition of $\mathcal{ONLY}$ is essentially the same as the operation of exhaustification[5] providing the exhaustive value of the rheme (standard translation) of the focused sentence. The crucial difference is that while exhaustification is considered to be a pragmatic operation, $\mathcal{ONLY}$ operates on the semantics, it provides the exhaustive semantic value of the rheme of the focused sentence (ψ) relative to the denotation of the theme of the focused sentence that is captured by looking at the state $\omega[\varphi]$ and the set of possible propositions in $\omega[\varphi]$ ($\Pi_{\omega[\varphi]}$).

The primary uptake of the 'only'-sentence goes according to the general rule and is carried out by the operations *thematizing* the theme and *assuming* the rheme of the 'only'-sentence as such. The semantic operator $\mathcal{ONLY}$ operates on the ordered pair formed by the theme and the rheme of the focused utterance that 'only' modifies. The primary uptake of 'only β' adds two states to the common grounds stack: (1) by thematizing 'only β' we add a state that captures its theme as the question 'are there more' and (2) the operation *assume* 'only β' adds a state by its semantic content as the exhaustive statement.

Example 5.1 (Primary uptake of 'only β')
$\langle\sigma, s\rangle$['only β']$^{\Uparrow 1}$ =
$\langle\sigma, s\rangle[?(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]^{?}[\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle]^{!}$

Note, that – as already mentioned – the rheme of the focused sentence is taken to be presupposed, and the primary uptake of the 'only'-sentence is assumed to be carried out relative to a context where this presupposition is supported.Consequently, in the above definition (and also in the following definitions)

[5]The definition of $\mathcal{ONLY}$ is defined parallel with the operation of $[\mathcal{EXH}]_*$ instead of the first proposed operation of $[\mathcal{EXH}]$. This choice is motivated by the fact, that $[\mathcal{EXH}]_*$ provides us with the right results for indefinities, hence $\mathcal{ONLY}$ defined parallel to that, it gives the right result for an utterance like 'Only a GIRL came'. On the other hand, the operation of $[\mathcal{EXH}]$ gave better results for the polar reading of the existential expressions, hence it would give better results for utterances like 'Only not AMY came'. I consider, however, that such sentences are not grammatical.

the state s on the top of the underlying context contains the information that the rheme of the focused sentence holds. Hence, in what follows I will illustrate my analysis with 'only' as the state s on the top of the underlying common ground stack equals $\omega[RH(\beta)]$ (where β stands for the focused sentence that is modified by 'only'). Furthermore, I claim that 'only'-sentences are special in that introducing a new issue (its special theme) it is not added to the underlying issue by combining two issues ($s \cup s^*[theme]$), but it is added on the top of it ($s^*[theme]$).

Definition 5.5 (Thematizing an 'only'-sentence)
$\langle \sigma, s \rangle [?(\mathcal{ONLY}\langle \varphi; \psi \rangle)]^? = \langle \langle \sigma, s \rangle, s^*[?(\mathcal{ONLY}\langle \varphi; \psi \rangle)] \rangle$

Examples 5.2 and 5.8 show the operation of thematizing and assuming the utterance 'Only AMY came', where β stands for the focused utterance β: 'AMY came' that has as its theme $?\exists x.C(x)$ and as its rheme $C(a)$.

Example 5.2 (Thematize 'Only AMY came')
$\ldots\rangle, \omega[C(a)]\rangle[?(\mathcal{ONLY}\langle ?\exists x.C(x); C(a)\rangle)]^?$
$\ldots\rangle, \omega[C(a)]\rangle, \omega[C(a)]^*[?(\mathcal{ONLY}\langle ?\exists x.C(x); C(a)\rangle)]\rangle$

Let me discuss the operation of thematizing in detail. Regarding the quite complicated definitions I fold out here all technical steps. As shown in example 5.2, thematizing the sentence 'Only AMY came' adds to the common ground stack the state $\omega[C(a)]^*[?(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$ where $?(\mathcal{ONLY}\langle \ldots \rangle)$ is the theme of the 'only'-sentence. The state $\omega[C(a)]^*$ equals $\omega[C(a)]$, because $\omega[C(a)]$ is indifferent. Then according to the notation conventions (Def. 2.2) we have to carry out the following update:

(i) $\omega[C(a)][(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle) \vee \neg(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$

The update semantics of disjunctions is defined in terms of union, that gives us:

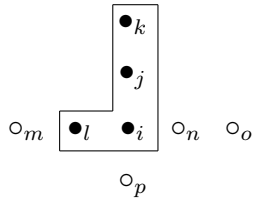
(ii) $\omega[C(a)][(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)] \cup \omega[C(a)][\neg(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$

Following definition 5.4 the update $\omega[C(a)][(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$ in (ii) results in the following state (set of pairs of indices):

(iii) $\{\langle i, j \rangle \in \omega[C(a)] \mid \forall \alpha \in \Pi_{\omega[?\exists x.C(x)]} \mid i, j \in \alpha \Rightarrow$
$\neg\exists \beta \in \Pi_{\omega[?\exists x.C(x)]} \mid \beta \subset \alpha \;\&\; (i \in \beta \text{ or } j \in \beta)\}$

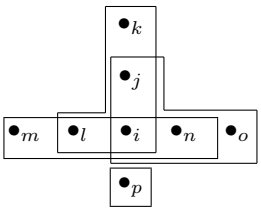
Here, the pairs of indices $\langle i, j \rangle$ in $\omega[C(a)]$ are kept for which it holds that if i and j are in a possible proposition in $\omega[?\exists x.C(x)]$ (by the theme of the focused sentence) then neither i nor j are in a strictly stronger possible proposition in $\omega[?\exists x.C(x)]$ (see the illustrations in examples 5.3 and 5.4).

Example 5.3 ($\omega[C(a)]$)



Example 5.4 ($\Pi_{\omega[?\exists x.C(x)]}$)

$\omega[?\exists x.C(x)]$

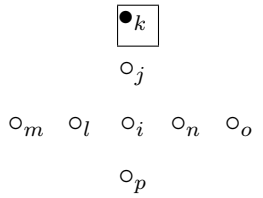


$\Pi_{\omega[?\exists x.C(x)]} = \{\pi_1, \ldots, \pi_8\}$

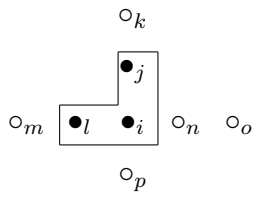
$\pi_1 = \rho_1 \rightsquigarrow C(a)$
$\pi_2 = \rho_2 \rightsquigarrow C(b)$
$\pi_3 = \rho_3 \rightsquigarrow C(c)$
$\pi_4 = \rho_1 \cap \rho_2 \rightsquigarrow C(a) \wedge C(b)$
$\pi_5 = \rho_1 \cap \rho_3 \rightsquigarrow C(a) \wedge C(c)$
$\pi_6 = \rho_2 \cap \rho_3 \rightsquigarrow C(b) \wedge C(c)$
$\pi_7 = \rho_1 \cap \rho_2 \cap \rho_3 \rightsquigarrow C(a) \wedge C(b) \wedge C(c)$
$\pi_8 = \rho_4 \rightsquigarrow \neg\exists x.C(x)$

Hence, the update $\omega[C(a)][(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$ in (ii) provides us with the state containing the single pair $\langle k, k\rangle$, that corresponds to the exhaustification of the rheme of the focused sentence. Following the update semantic rule of negation, the update $\omega[C(a)][\neg(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$ contains all pairs of indices from $\omega[C(a)]$ that do not survive the update $\omega[C(a)][(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$.

Example 5.5 ($\omega[C(a)][(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$)

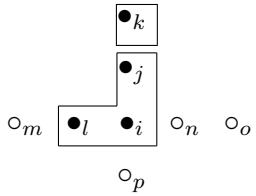


Example 5.6 ($\omega[C(a)][\neg(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$)



Then following (i) above, thematizing the sentence 'Only AMY came' adds the state to the stack that is the result of the union of the states in examples 5.5 and 5.6. This state is shown in example 5.7.

Example 5.7 ($\omega[C(a)][?(\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle)]$**)**



The state illustrated in example 5.7 is the state that thematizing the sentence 'Only AMY came' adds to the common ground stack. The state raises the issue whether more persons besides Amy came. My main claim here is that the focus sensitive particle 'only' introduces this additional (or new) issue corresponding to the question 'are there more?'. This issue can be considered as the inquisitive version of the expectation that is proposed, for example, by Zeevat (2008). I analyze this special issue or expectation as raised by the theme of the 'only'-sentence. Thematizing the sentence 'Only AMY came' provides us with the common ground stack: $\ldots\rangle, \omega[C(a)]\rangle, \omega[?(\neg\exists x.C(x) \wedge x \neq a)]\rangle$that serves as the underlying stack for the operation 'assume'.

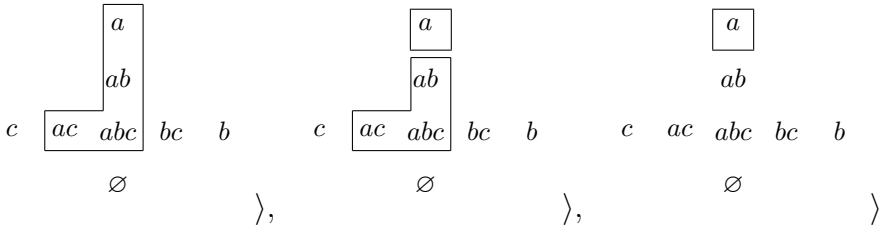
Example 5.8 (Assume 'Only AMY came')

$\ldots\rangle, \omega[C(a)]\rangle, \omega[?(\neg\exists x.C(x) \wedge x \neq a)]\rangle[\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle]^! =$
$\ldots\rangle, \omega[C(a)]\rangle, \omega[?(\neg\exists x.C(x) \wedge x \neq a)]\rangle,$
$\omega[?(\neg\exists x.C(x) \wedge x \neq a)][\mathcal{ONLY}\langle TH(\beta); RH(\beta)\rangle]\rangle$

The operation of assume adds the state $\omega[\neg\exists x.C(x) \wedge x \neq a]$ on the common ground stack.

In 'only'-sentences the theme/rheme division is affected by the focus structure, since the operator $\mathcal{ONLY}$ takes the theme/rheme division of the utterance with free focus it modifies. In the theme/rheme division of an 'only'-sentence the rheme is the exhaustive statement or negative contribution and the theme is the issue corresponding to the question 'are there more?'. Example 5.9 illustrates the states added to the common ground stack by the primary uptake of the sentence 'Only AMY came'. For easier reading I simply write from now on *abc* etc. instead of the indices, where *abc* stands for $i(C) = \{a, b, c\}$ and so on.

Example 5.9 (Primary uptake of an 'only'-sentence)



In the pictures above the first state supports the presupposition and corresponds to the proposition $C(a)$; the second state is the theme of the utterance that corresponds to the question *are there more besides Amy who came*; and finally the third state is the rheme of the utterance that corresponds to the exhaustive statement that *besides Amy nobody came*. To emphasize again, the important contribution of 'only' is introducing the special issue 'are there more' that I consider to be the inquisitive version of the expectation of more persons having the given property, in this particular example more persons coming.

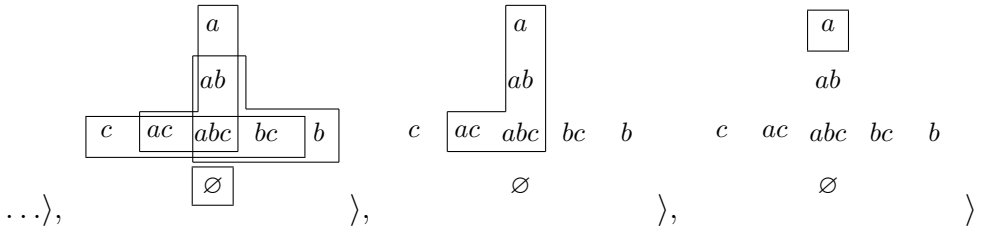
5.1.2 Examples of denial

Let us get back to the denial by 'No,...' of both free focus constructions and 'only'-sentences. Denials in this form appear often as a test to detect the semantic content. It is also important to look at free focus constructions and 'only'-sentences from this special angle to show the important differences between the discourse effects of the two. My analysis provides a straightforward solution to denials of both. First we look at the free focus in example (47).

(47) AMY came. #No, BEN came, too. / No, BEN came.

The provisional update of the focused sentence 'AMY came.' adds two states on the top of the common ground stack (see section 3.2.1 for the uptake of sentences with free focus in general). First, we add the theme of the utterance as the question 'who came', then we add the state of the semantic content with the information that 'Amy came' and finally we add the state by the pragmatic implicature (by $[[\mathcal{EXH}]]$) that 'besides Amy nobody came'. After these provisional uptakes by the focused utterance, the common ground that is waiting for the response is: $\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle, \omega[\forall x.C(x) \leftrightarrow x = a]\rangle$. This common ground stack can be illustrated by the following pictures (over $D = \{a, b, c\}$).

Example 5.10 (Common ground by free focus)



Relative to this common ground the utterance of the denial 'No, BEN came.' is uttered. The explicitly signaled denial by 'No' corresponds to the operation of *cancellation* ($[\bot]$) (see section 2.2.3) that is followed by the uptake of the corrective utterance. According to the recursive definition of *cancellation* ($[\bot]$)

the last informational updates are removed from the common ground stack and we get back to the last issue:

Example 5.11 (Cancellation of free focus)
$\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle, \omega[\forall x.C(x) \leftrightarrow x = a]\rangle[\bot]$
$\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(a)]\rangle[\bot]$
$\ldots\rangle, \omega[?\exists x.C(x)]\rangle[\bot]$
$\ldots\rangle, \omega[?\exists x.C(x)]\rangle$

Getting back to the last issue, the common ground for the corrective sentence 'BEN came.' is $\ldots\rangle, \omega[?\exists x.C(x)]\rangle$. The uptake of this correction goes the same way as any other utterance with free focus (see section 3.2), and leads to a common ground stack where the top state contains the single possibility that besides Ben nobody came:

Example 5.12 (Uptake of the correction)
$\ldots\rangle, \omega[?\exists x.C(x)]\rangle, \omega[C(b)]\rangle\omega[\forall x.C(x) \leftrightarrow x = b]\rangle$

In example (47) if the denial by 'No,' is followed by an utterance containing the additive particle 'too' we get an infelicitous response. My explanation of it is that denial by 'No,...' removes the last informational updates, thus it removes both the exhaustive statement and the semantic content that 'Amy came' and gets back to the last issue of 'who came' (see above). The common ground stack provided by these steps of the operation *cancellation* ($[\bot]$) is not appropriate for the utterance with the additive particle. We take 'too' as a presupposition trigger, see e.g. Beaver (1997), so in our example 'No, BEN came, too.' presupposes that somebody different from Ben came. In my analysis presupposition means that the context presupposes ϕ if updating the top state of the common ground stack with ϕ does not have an effect: $s[\phi] = s$. In the example here cancellation provides the common ground stack with the issue 'who came' on the top, and this context does not support the presupposition of the corrective utterance with the additive particle 'too'.

If we deny an utterance with 'only' (48), the additive particle 'too' in the response is felicitous, while free focus is out.

(48) Only AMY came. No, BEN came, too. / #No, BEN came.

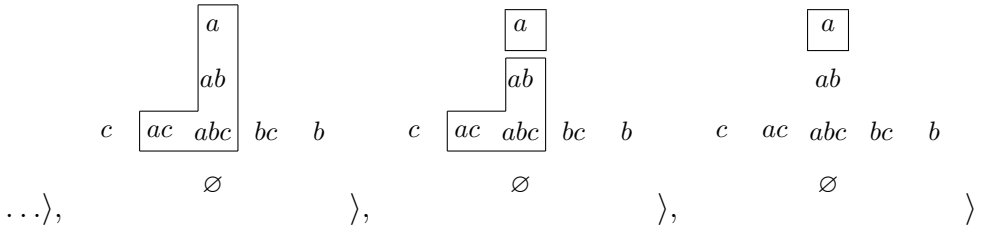
In my proposed analysis, next to its semantic effects, 'only' introduces a special issue that corresponds to an expectation. In our example the sentence 'Only AMY came' comes with the special theme, that asks whether besides Amy somebody else came as well. Through the uptake of this sentence first the presupposition (C(a)) is added to the common ground, and then the theme of the 'only'-sentences,

that is the issue corresponding to the expectation, and finally the rheme of the utterance, the exhaustive statement that besides Amy nobody else came (see details in section 5.1.1). By these steps of the primary uptake we get the following common ground stack:

Example 5.13 (Common ground by an 'only'-sentence)
$\ldots\rangle, \omega[C(a)]\rangle, \omega[?\neg\exists x.(C(x) \wedge x \neq a)]\rangle, \omega[\neg\exists x.(C(x) \wedge x \neq a)]\rangle.$

This common ground stack can be illustrated as before by the following pictures — over $D = \{a, b, c\}$ again.

Example 5.14 (Common ground by an 'only'-sentence)



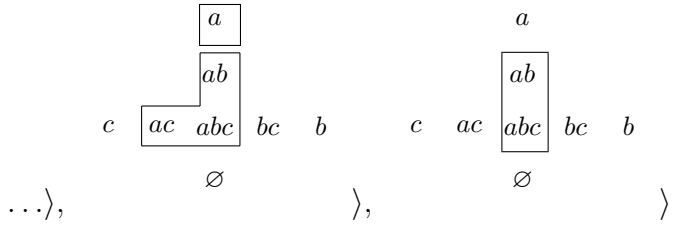
Denial by 'No,' removes the last informative steps, in this case the exhaustive contribution and gets back to the last issue in the stack that is $C(a) \wedge ?\exists x.(C(x) \wedge x \neq a)$, the theme of 'Only AMY came'. In this way in our example the denial does not remove the information that Amy came, only the exhaustive part that besides her nobody else came. The corrective sentence 'BEN came, too' is interpreted relative to the common ground stack with the state $\omega[C(a) \wedge ?\exists x.(C(x) \wedge x \neq a)]$ on the top, that provides the information that Amy came and raises the issue asking who else came. The presupposition $\exists x.C(x) \wedge x \neq b$ triggered by 'too' is supported by this state since updating it with the presupposition does not have an effect:

Example 5.15 (Presupposition)
$\omega[C(a) \wedge ?\exists x.(C(x) \wedge x \neq a)][\exists x.(C(x) \wedge x \neq b)] = \omega[C(a) \wedge ?\exists x.(C(x) \wedge x \neq a)]$

Then the uptake of the information 'Ben came' can be carried out, which adds the state $\omega[C(a) \wedge ?\exists x.(C(x) \wedge x \neq a)][C(b)]$ on the top of the stack that is equivalent to the state $\omega[C(a) \wedge C(b)]$. So we get the following common ground stack:

Example 5.16 (Uptake of the correction)
$\ldots\rangle, \omega[C(a) \wedge ?\exists x.(C(x) \wedge x \neq a)]\rangle, \omega[C(a) \wedge C(b)]\rangle$

Example 5.17 (Uptake of the correction)



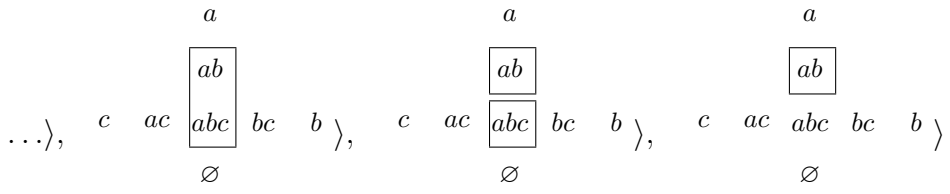
The next step in the investigation of denial is to look at examples with a coordinated phrase in focus. The analysis introduced above can be applied to conjunctions in focus as in (52) and it gives the same results with respect to denial.

(52) Only [AMY and BEN]$_F$ came. No, CLAIRE came, too.

The first sentence, (52), communicates that Amy and Ben both came and besides the two nobody else came. This sentence can be followed by the denial 'No, CLAIRE came, too.' meaning that Amy, Ben and Claire came.

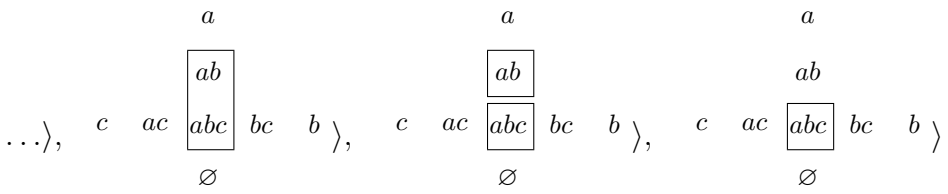
In (52) the additional issue introduced by 'only' is 'who else came besides Amy and Ben' and is expressed by the formula $C(a) \wedge C(b) \wedge ?\exists x.(C(x) \wedge x \neq a \wedge x \neq b)$ that eliminates on the one hand the indices where it is not the case that both Amy and Ben came, and on the other hand creates an issue with more possibilities corresponding to the propositions 'Amy and Ben and nobody else came', 'Amy and Ben and d_1 came' …'Amy and Ben and d_n came' relative to the domain $d_1, \ldots, d_n$. The new issue raised by 'only' contains the indices where both $C(a)$ and $C(b)$ holds and creates an issue by $?\exists x.C(x) \wedge x \neq a \wedge x \neq b$ that captures the question 'and who else'. The uptake of sentence (52) leads to the following common ground stack (relative to $D = \{a, b, c\}$):

Example 5.18 (Common ground by (52))



The denial by 'No, CLAIRE came, too.' removes the top state from the common ground stack, and then the utterance 'CLAIRE came too' is to be taken up. Again, parallel to the example with only one individual focused, the presupposition triggered by 'too' is satisfied, so we can take up the proposition $C(c)$ that eliminates the indices where Claire did not come and adds a new state on the top, $\omega[C(a) \wedge C(b) \wedge C(c)]$.

Example 5.19 (Uptake of correction)



Problems with disjunction

In chapter 4, I provided a uniform analysis of exhaustive interpretation in answers that gives the correct results both for a conjunction 'Amy and Ben' and a disjunction 'Amy or Ben' in focus. Our definition of alternative exclusion correctly derives the interpretation that either (only) Amy or (only) Ben came in case of an answer with a disjunction like 'AMY or BEN came'. Nevertheless, if we apply our analysis of 'only' and denial to answers with disjunction, some interesting problems occur, that clearly indicate that disjunction is special. First of all, let us look at the examples of conjunction and disjunction.

(53) a. AMY and BEN came.
No, CLAIRE came.
#No, CLAIRE came, too.

b. Only AMY and BEN came.
#No, CLAIRE came.
No, CLAIRE came, too.

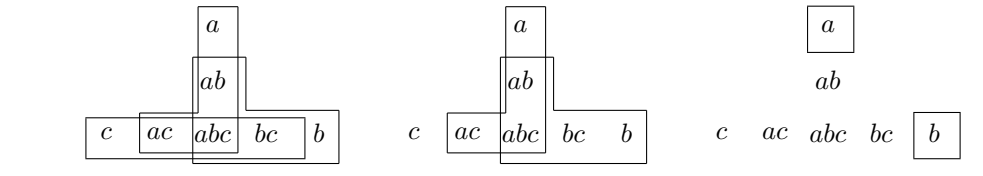
(54) a. AMY or BEN came.
No, CLAIRE came.
No, CLAIRE came, too.

b. Only AMY or BEN came.
#No, CLAIRE came.
No, CLAIRE came, too.

The denial of the conjunction in focus in (53) shows the same pattern as in case of singular constituents in focus, that we can correctly derive as shown above. On the other side, the denial of the disjunction in focus in (54) is different.

First of all, my analysis of denials above runs into problems in case of disjunction, even without the focus particle 'only'. According to my analysis, the uptake of the answer by the disjunction 'AMY or BEN came.' first adds the state to the common ground by the semantic content of the utterance as $C(a) \vee C(b)$,and then the pragmatic operation of alternative exclusion derives the interpretation that either Amy came or Ben came, and nobody else and not both of them. Hence, the common ground stack is as follows:

Example 5.20 (Common ground by disjunction)



Relative to this common ground, the denial of 'No, CLAIRE came.' is uttered. According to the definition of the critical dialogue move of denial, the last informational steps should be removed getting us back to the last issue in the common ground. However, in case of disjunction all steps are inquisitive; even after the pragmatic inference we have an issue. Hence, the operation of denial (cancellation; $[\bot]$) cannot be carried out the way it is defined.

There are two problems with the original definition of cancellation ($[\bot]$) as it is introduced in Groenendijk (2008). The definition runs as shown in definition 2.26 in section 2.2.3 (repeated here as 5.6).

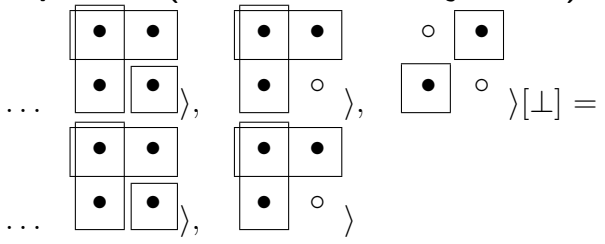
Definition 5.6 (Cancellation)

$\langle\langle\sigma, s\rangle, t\rangle[\bot] =$
$\langle\sigma, s\rangle$ if s is not indifferent
$\langle\sigma, s\rangle[\bot]$ otherwise

The recursive definition $[\bot]$ removes the top state t and stops in case s (the state one below t) is not indifferent (that is, it contains an issue). The operation applies again in case s is an indifferent state (it has only one possibility).

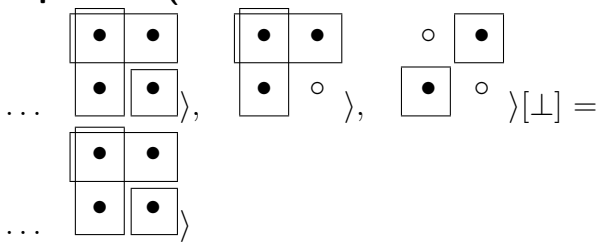
The problem occurs when we apply Groenendijk's definition of *cancellation* ($[\bot]$) as the denial of answers by a disjunction. In such cases both the primary uptake (semantics) and the secondary uptake (pragmatics) add a non-indifferent state to the common ground, since disjunctions are hybrids (see chapter 2) and as such they contain an issue. Applying cancellation on a common ground stack provided by the uptake of a disjunction removes the top state and immediately stops, keeping the semantic content of the disjunction in the stack. Nevertheless, that state provided by the semantic content should be removed as well.

Example 5.21 (Cancellation of disjunction)



Hence, the operation removes the top state, that is added by the pragmatic operation of alternative exclusion (see section 4.2.2). However, the intended effect of cancellation should be removing both states on the top, thus also the one added by the semantic content of the utterance, and going back to the underlying issue of the theme.

Example 5.22 (Intended effect of cancellation of a disjunction)



The essence of the definition of *cancellation* is removing the last informational steps and going back to the theme of the utterance. Groenendijk's definition captures this by looking for the last inquisitive state in the stack. However, it can be the case that the semantic content of an utterance provides states that are inquisitive as well. This is the case by uttering a disjunction that is a hybrid: both inquisitive and informative. The definition should be redefined in the way that it looks for informative steps instead of only the inquisitiveness of the states. Uttering a hybrid sentence adds a state to the stack that is still inquisitive but more informative than the state by the theme. Since the theme is always a question, the state added by the theme of the utterance cannot be informative after any other states. Consequently, the definition of *cancellation* should be redefined in such a way that it looks for the last non-informative state instead of the last inquisitive one. In this way we can get back to the theme of the utterance both in case we cancel an answer by an assertion and by a hybrid.

Definition 5.7 (Cancellation redefined)

$\langle\langle\sigma, s\rangle, t\rangle[\bot] =$

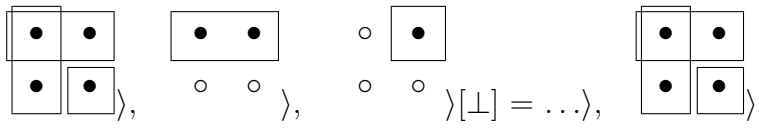
$\quad\langle\langle\sigma, s\rangle, t\rangle$ if t is not more informative than s

$\quad\langle\sigma, s\rangle[\bot]$ otherwise

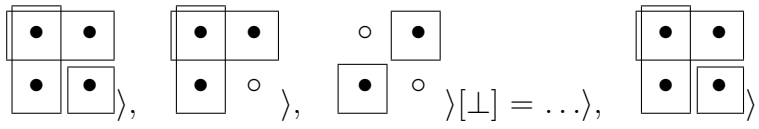
Consider again our previous examples in 5.22. Both states added by the rheme of the utterance and by the implicature are removed by $[\bot]$, because the state added by the implicature is more informative than the state added by the rheme, as well as the latter one is more informative than the state added by the theme. The revised definition of cancellation provides the intended results for all of the following four sentences.

Example 5.23 (Cancellation)

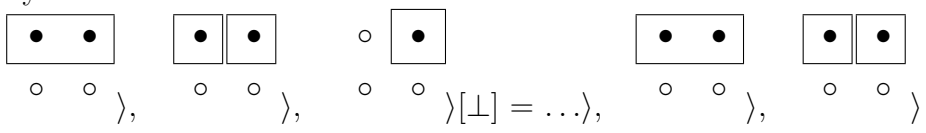
(a) 'AMY came.'



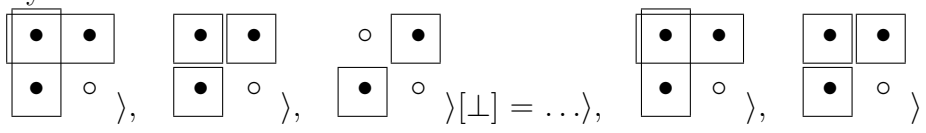
(b) 'AMY or BEN came.'



(c) 'Only AMY came.'



(d) 'Only AMY or BEN came.'



5.2 Summary

In this chapter I proposed an analysis of 'only' following the ideas of Zeevat (2008) and my earlier approach (Balogh 2005). The main claims are that the focus sensitive particle 'only' introduces a special issue 'are there more' that corresponds to the expectation proposed by Zeevat (2008). In my proposal 'only' corresponds to a semantic operator that takes the theme/rheme division of a focused sentence. Then the theme and the rheme of the 'only'-sentence ϕ is calculated straightforwardly according to the division fact of our logical language, hence the theme is the question $?\phi$ and the rheme is the assertion $!\phi$. Following from my definition the division of an 'only'-sentence leads to a special theme, the question corresponding to the expectation, while the rheme is simply the exhaustive statement (the negative contribution by the 'only'-sentence) that can be considered as resolving the actual issue introduced by the sentence. The other meaning component of the 'only'-sentence, the host or prejacent, is assumed to be presupposed similarly to Roberts (2006), Horn (1969) or Rooth (1992).

I investigated free focus and 'only' from a new angle comparing their behavior in the dialogue relation of denial. According to my analysis I can straightforwardly give an explanation of the facts, that denial of a free focus sentence will remove the semantic content:

(55) AMY came. No, $\ldots \rightsquigarrow$ denial removes that 'Amy came'

Denial of an 'only'-sentnce, however, does not remove the host:

(56) Only AMY came. No, ...$\rightsquigarrow$ denial does not remove that 'Amy came'

The analysis gives an account of the canceling/not canceling of this meaning component, and can also explain the examples where after the denial of the 'only'-sentence the "corrective" sentence should contain the additive particle 'too', while it is not felicitous after the denial of the free focus construction.

Appendix to chapter 5

Roberts' (2006) scorecard

The following scorecard of Roberts (2006) compares four analyses regarding the status of the host/prejacent of 'only'. From this comparison she concludes that the presupposition analysis comes out as the best one.

	Prejacent Entailed	Prejacent Presupp.	Existential Presupp.	Conv. Implicature	Notes:
NPI occurrence	#	√	√	√	a
Outcome of Horns bet	#	√ prima facie #	√	?	d
Negation is prejacent hole	#	+	#	√	a,b
Plural NP Focus	√	√	#	√	b
Hey wait a minute! test	#	+	+	√/?	a
Suspending the prejacent	#	√ prima facie #	#	# prima facie √	a,b,c,d
Prejacent not cancellable	√	√	√	#	c
PROJECTION BEHAVIOR:					
Prejacent fails to project	√	√ prima facie #	#	# prima facie √	b,c,d
Occurrence after questions	√	√ prima facie #	√ prima facie #	√	d
Infelicitous local satisf.	+	√ prima facie #	√	√	d

#: problem
√: no problem
+: positive argument in favor
a: Robust evidence against entailment
b: Robust evidence against weak presupposition accounts
c: Strong argument against a conversational implicature account
d: Merely apparent evidence against presupposition of the prejacent

Chapter 6
Hungarian structural focus and exhaustivity

With respect to exhaustivity and focusing strategies Hungarian is a particularly interesting language. The most well-known characteristic of Hungarian is that it has a special position for the focused constituent directly in front of the finite verb. Hungarian uses both movement and intonation (accent) to mark focus. The focused constituent moves to a pre-verbal focus position that is often associated with an exhaustive/identificational semantics. According to several approaches, in Hungarian, focus marking by movement is primary, while the prosodic considerations are claimed to be secondary. There are two important questions about focusing in Hungarian. Firstly, an explanation of the focus movement is required, and secondly, in connection with this, we have to explain interpretational effects, with special attention to exhaustive listing.

There are several analyses of the Hungarian focus position; most of them, however, are motivated by syntactic considerations. Next to many syntactic theories, semantic issues are mainly discussed by Szabolcsi (1981, 1994), while pragmatic matters on the interface with syntax are investigated by Szendrői (2001, 2003) and Wedgwood (2006). Movement to the special pre-verbal position is mostly analyzed as triggered by a syntactic feature, the focus-feature, or by a covert operator of exhaustivity/identification. Szendrői goes against the focus-feature view and provides an elegant analysis in which movement is driven by prosodic rules. She points out several reasons why the syntactic focus feature is not necessary in the analysis of Hungarian focus. As for interpretation effects of the structural focus in Hungarian there is an ongoing debate as to whether the exhaustive interpretation assigned to the pre-verbal focus position is due to a covert semantic operator (Szabolcsi 1994, Horváth 2007); whether it should be considered as the consequence of semantic underspecification (Wedgwood 2006, Wedgwood, Pethő and Cann 2006), or whether it is an implicature, as in English – as I will argue in this chapter.

In this chapter I propose an analysis in the framework of Inquisitive Semantics,

and I claim that exhaustive interpretation is not due to a covert operator, but can be derived as a pragmatic implicature, similarly to what I proposed for English. However, the status of exhaustivity in Hungarian is different to that of English.[1] In order to explain in which instances Hungarian focus interpretation is different from English focus I introduce the notion of an *obligatory implicature* that appears in Hungarian but not in English.

The structure of this chapter is as follows. First I provide some general facts about Hungarian in a nutshell[2], after that I turn to the illustration of focus structures and the most important theories of Hungarian focus from the GB/Minimalist (Bródy 1990, Horváth 2007) tradition, on the syntax-semantics interface (Szabolcsi 1981, Szabolcsi 1994, É. Kiss 1998) and on the syntax-phonology interaction (Szendrői 2001). Then I propose a new analysis in the system of Inquisitive Semantics and Dialogue Management. I provide a pragmatic account emphasizing the need for context dependence in the analysis of Hungarian structural focus as well. I will investigate the similarities and differences with English focus interpretation.

6.1 Some facts about Hungarian

Hungarian language has a special status among the languages of Europe. For linguistic analysis it is interesting, because it is not related to the languages of Central/Western Europe which serve as a basis for modern (western) linguistic research. Hungarian belongs to the Finno-Ugric language family and thus differs in most respects from the indo-european languages. For our perspective, the most important differences are *flexible word order* and *agglutination*.

Agglutination

Hungarian uses the morphological process of agglutination, attaching affixes to the base word. These affixes in Hungarian are mainly suffixes, adding them after the base word or other morphemes. Hungarian does not use prepositions like English, but suffixes or postpositions. The suffixes code most grammatical information: case marking and agreement. Similarly to Latin, Hungarian marks the arguments with case marking suffixes, and there are approximately 19 of these. As example (57) shows, the subject has a nominative case with a zero-suffix, and the direct object has an accusative case with the suffix *-t*.

[1] Comparisons along this line are also available in É. Kiss (1998), Wedgwood et al. (2006) and Bende-Farkas (2006).

[2] Primarily meant for the readers who know little about Hungarian.

(57) Claire bemutatta Bent Amynek.
Claire introduced Ben.*acc* Amy.*dat*
'Claire introduced Ben to Amy.'

The finite verb must agree in person and number with the subject and in definiteness with the direct object.

(58) a. A majom evett egy banánt.
the monkey ate a banana.*acc*
'The monkey ate a banana.'

b. A majmok ettek egy banánt.
the monkey.*pl* ate.*pl* a banana.*acc*
'The monkeys ate a banana.'

c. A majom ette a banánt.
the monkey ate the banana.*acc*
'The monkey ate the banana.'

Another important characteristic of the Hungarian language is the rich system of verbal particles and verbal prefixes. They are in the default case directly in front of the finite verb, and are mostly considered as perfectivizers. Verbal particles change the meaning of the finite verb. In some cases this means a subtle difference, but in other cases they can create totally new concepts. Verbal particles are quite interesting to investigate in Hungarian, but for our purpose we will only look at them in relation to focusing, since they occupy the same syntactic position. Verbal particles stand in the immediate pre-verbal position in the default case, but they move behind the verb in some special cases: when the sentence has a narrow focused constituents, in case of sentential negation, when the sentence expresses continuous event, and also in imperative mood.

Free word order

Hungarian is a so-called free (or flexible) word order language, so changing the order of words in a sentence has no effect on the semantic content. All permutations of the three words in (59) express that 'Amy frightened Ben'. The grammatical relations are not coded by word order rules like in English, but by a rich morphology.

(59) a. Amy megijesztette Bent.
Amy frightened Ben.*acc*
b. Megijesztette Amy Bent.
frightened Amy Ben.*acc*
c. Megijesztette Bent Amy.
frightened Ben.*acc* Amy
d. Bent megijesztette Amy.
Ben.*acc* frightened Amy
e. Amy Bent megijesztette.
Amy Ben.*acc* frightened
f. Bent Amy megijesztette.
Ben.*acc* Amy frightened
'Amy frightened Ben.'

However, although we use the term *free word order* language, it is not the case that Hungarian can freely change the word order without consequences for the interpretation. The free or unconstrained order of the words in a sentence concern only the grammatical functions such as subject or object. Those functions need not be coded by the word order as in English, as they are coded by the rich morphology. Even so, word order has a linguistic importance in Hungarian as well — not from a grammatical perspective, but from the perspective of discourse-semantics.

Discourse configurationality

Hungarian belongs to the group of *discourse configurational (DC) languages* studied by several authors. See, for example (É. Kiss, 1995). The common characteristic of this type of language is that sentence articulation is driven by discourse-semantic functions such as *topic* or *focus*. Within the DC-languages we can further distinguish different types by virtue of which functions are encoded via phrase structure configurations. Some languages mark only the focus on the surface structure: a language of this type is, for example, the African language Aghem[3]. Others, for example Japanese, encode in the surface only the topic and not the focus, and still others encode them both. Hungarian belongs to the latter type, with distinct positions for both topic and focus. In languages with topic prominence, the grammatical subject differs from the subject of predication (topic/notional subject), and the latter has a surface coding. Further characteristics are that these languages can form grammatical sentences without a subject or an "empty" subject[4]; and they do not have (or have very marginally) passive

[3]Spoken in Cameroon.
[4]Like *'it'* in English, e.g., *It is raining.*

structures. Focus prominent languages have a structural position for focused constituents. Hungarian is not unique in Europe in this respect, since several other European languages have this feature, such as Basque, Catalan, Bulgarian and Russian. The investigation of the focus position in these languages is of great importance for syntactic studies. While in early work the main question was the status of this special position and the analysis of the movement, in later work from the '80s and '90s we find an explanation of why this movement is triggered in some languages and not in others. In the following I will concentrate on Hungarian, where topic, focus and also certain quantifiers have a distinct syntactic position, which is reached by the arguments via movement/transformation.

Hungarian sentence articulation and focus

With respect to its information structure, a Hungarian sentence can be divided into a post-verbal and a pre-verbal field, where the latter area consists of argument positions, for which the word order is free.

(60) a. Bemutatta Claire Bent Amynek.
introduced Claire Ben.*acc* Amy.*dat*
b. Bemutatta Amynek Bent Claire.
introduced Amy.*dat* Ben.*acc* Claire
both meaning: 'Claire introduced Ben to Amy.'

The pre-verbal field is the host of the functional projections (discourse-semantic functions) whose order is fixed. The focus of the sentence is placed in the immediate pre-verbal position, topics are sentence initial, and between them quantifiers are placed. Topics and quantifiers can be iterated, but there is always only a single focus in the pre-verbal position.

(61) Topic* < Quantifier* < Focus < Verb ...

(62) Amy_T mindenkit_Q Benhez_F küldott.
Amy everyone.*acc* Ben.*all* sent
'Amy sent everyone to BEN.'

(63) Bent_T Amy_T mindig_Q mindenkinek_Q titokban_F mutatta be.
Ben.*acc* Anne always everyone.*dat* secretly introduced VM
'Amy always SECRETLY introduced Ben to everyone.'

As for defining the notion of focus and its syntactic position in Hungarian, Horváth (1986) gives the following genaralisation.

Quotation 6.1 (Horváth's generalisation)

> "*A constituent (other than V or a projection of V) can be interpreted as the FOCUS of its clause in Hungarian if and only if, it itself occupies an immediately pre-verbal position, or is contained in a phrase that does so.*"

However, the immediate pre-verbal position can host other elements, such as sentential negation, verbal particles or bare nouns, all in complementary distribution. In neutral sentences (unmarked utterances) the immediate pre-verbal position is occupied by the verbal modifier (verbal particles, bare nouns etc.). In case this position is filled by negation or focus, and the verbal modifier and the verb have an inverse order.[5]

(64) a. Amy meglátogatta Bent.
Amy VM_{meg}-visited Ben.*acc*
'Amy visited Ben.'

b. Amy nem látogatta meg Bent.
Amy not visited VM_{meg} Ben.*acc*
'Amy did not visit Ben.'

c. Amy BENT látogatta meg.
Amy Ben.*acc* visited VM_{meg}
'It is Ben whom Amy visited.'

In her early papers from the late '70s and early '80s, É. Kiss establishes the distinction between topic and focus positions in the syntactic representation on the basis of communicative articulation. This distinction also motivated Szabolcsi's (1981) analysis on topic-focus articulation, giving formal reasons for the syntactic distinction of these communicative functions. In the late '90s É. Kiss proposed an analysis on the basis of syntactic and semantic considerations of structural focus, where she distinguishes two types, *identificational* and *informational* focus (É. Kiss 1998). She claims that these types are different both syntactically and semantically, and encode identificational focus varies among languages. Her claims are based mainly on Hungarian data where the two types occupy distinct syntactic positions and are never interpretational variants. The most important difference between the two types is that while information focus merely marks the unpresupposed information, identificational focus expresses exhaustive identification. Besides this it is significant that the latter involves movement, takes scope and cannot host all constituents, while the former stays in situ whilst stressed, does not take scope and can host any constituent.

[5]The verbal modifier–verb order also changes in case of imperatives or progressive aspect.

(65) a. Mari egy KALAPOT nézett ki magának.
Mary a hat.*acc* picked part$_{out}$ herself.*dat*
'It was a hat that Mary picked for herself.'

b. Mari kinézett magának egy KALAPOT.
Mary VM$_{out}$-picked herself.*dat* a hat.*acc*
'Mary picked herself a HAT.'

According to É. Kiss both types can function as an answer to a wh-question, supporting the focus nature of them. The choice between the two of them depends on whether the answer is intended to be exhaustive or not. Her example is the following:

(66) Hol jártál a nyáron?
where went.2*sg* the summer
'Where did you go in the summer?'

a. OLASZORSZÁGBAN jártam.
Italy.*loc* went.1*sg*
'It was Italy where I went.'

b. Jártam OLASZORSZÁGBAN.
went.1*sg* Italy.*loc*
'I went to Italy. [among other places]'

On the basis of such examples she claims that Hungarian structural focus is similar to English it-clefts, hence identificational focus in English appears in the it-cleft constructions.

The most conspicuous characterestic of focus in Hungarian is the *movement* to this special pre-verbal position, where the focused constituent gets the main stress (*pitch accent*) and is assigned an *exhaustive interpretation*. Sentence (64c) means that Amy visited Ben and he did not visit anyone else, so it gives an *exhaustive listing* of the set of persons whom Amy visited. In the current syntactic, semantic and pragmatic literature, focus and exhaustivity have been widely investigated. Hungarian has a special position within this research, since because of its special focus position syntactic, semantic, pragmatic and phonological considerations play a role simultaneously.

6.2 Theories on Hungarian structural focus

In the diverse linguistic investigations of Hungarian structural focus, the three main questions are the following: (1) in which syntactic position should we assume the focused constituent, (2) what triggers the focus movement, and (3) what interpretation should we assume for a sentence with focus? The earlier work on Hungarian focus investigated the first two questions (Horváth 1986, Bródy 1990),

while in later research we can find more on questions (2) and (3), particularly on the interpretational effects (Szabolcsi 1994, É. Kiss 1998, É. Kiss 2006a, Horváth 2007). This latter issue falls also in the scope of our interests, particulary the status of exhaustivity assigned to the pre-verbal focus position in Hungarian. In the next section, I will challenge the claim that exhaustive interpretation is due to a semantic operator, a view which is strongly present in the literature, — see for example, Szabolcsi (1981, 1994) and Horváth (2007). Before I turn to my analysis, in the next section I present an overview of the main ideas of these analyses.

6.2.1 Focus-feature approaches

As we already mentioned, earlier studies discuss which syntactic position we should assume the focused constituent to take, and what triggers the movement. The two important analyses we want to emphasize here are from Horváth (1986) and Bródy (1990). These analyses are developed in the tradition of the Government and Binding Theory (GB) and the Minimalist Program. According to these studies, focus is directly represented in the syntactic structure of the sentence. Both analyses I will discuss here assume the presence of a formal focus-feature that is responsible for the focus movement.

Horváth (1986) claims that the movement of the focus constituent to the pre-verbal position is similar to case assignment.[6] She claims that in languages with a structural focus position, the focus-feature is, similarly to case-marking, assigned by the verb under government. The movement is triggered by the fact that the constituent with a focus-feature must be in the governing domain of the verb. An important advantage of this analysis is that it can account both for pre-verbal focus languages like Hungarian and for post-verbal focus languages like Chadic languages, since Government shows the same directionality effects.

The most influential work in the Minimalist tradition is Bródy (1990), which assumes an overt movement of the focus constituent to a designated focus-position. Of great importance in Bródy's approach is the fact that he introduces a new functional position for the focused constituent, called *Focus Phrase* (FP), which is generated immediately above the verbal projection (VP). Bródy also assumes a formal feature [+f], which triggers focus-movement similarly to the [+wh]-feature and wh-movement in English. The F-head (the head of FP) is the host of a focus

[6] In English there are designated positions that can be assigned a particular case. The required structural relation for case assignment is *Government* that says that a functional head governs its NP specifier and its NP complement and the NP specifier of an $IP_{[-fin]}$ complement. According to the GB principle, NPs must have case at the surface-structure, hence if they do not receive case in the deep-structure they undergo movement whereby they reach a position to receive a structural case at the surface-structure.

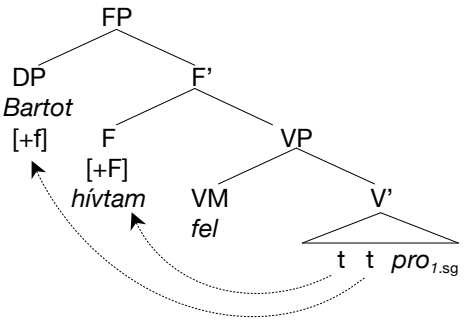
operator which bears the feature [+F]. The movement of the focused constituent to the specifier of the FP is explained by feature checking in accordance with the Minimalist Program (Chomsky 1993). The focused constituent undergoes an overt movement to the specifier of FP, which is triggered by the *Focus-Criterion*, similar to the Wh-criterion (Rizzi 1991) in English.

Example 6.1 (Bródy's Focus-Criterion)

(i) at the surface-structure and at the logical form (LF) the specifier of a functional projection with the feature [+F] must contain a phrase bearing the feature [+f]
(ii) at the LF all phrases with a [+f]-feature must be in the specifier of a functional projection bearing a [+F]-feature

The focus-feature [+f] is assumed to be a strong feature in Hungarian, similar to the [+wh]-feature in English, that results in overt movement. Bródy assumes also verb-raising to the F-head, indicated by the reverse order of the verbal modifier and the verb in focused sentences.

(67) BARTOT hívtam fel.
Bart.acc called.1sg Vpart_{up}
'It is Bart whom I called.'



The example illustrates that both the focused constituent (the object here) and the finite verb are generated under V′. The functional head (F) of the focus projection (FP) bears the formal feature [+F], while the focused constituent *Bartot* 'Bart.acc' bears the focus feature [+f]. According the Focus-criterion in 6.1 above, the movement of the focused consituent to the specifier of FP is triggered to establish a checking relation with the [+F]-feature of the focus operator in the head of FP. Furthermore, as Bródy also assumes, the finite verb *hívtam* 'called.1sg' moves to the head of the focus projection, resulting in reverse ordering of the verbal particle and the finite verb. The FP-theory assumes focus movement in other languages as well; the difference is the overt vs. covert status of it.

Both theories introduced above give an explanation of the structural focus in Hungarian on the basis of a syntactic focus-feature. They are important in providing an analysis regarding the pre-verbal position and the movement of the focused constituent, but they lack the analysis of the interpretational effects related to it. Furthermore, the impact of intonation is secondarily derived from the syntactic representation.

Stress driven focus movement

Before I turn to the analyses with a semantic operator, I want to introduce briefly the innovative and elegant analysis of Szendrői (2001, 2003) as a response to the focus-feature approaches. Szendrői argues that movement to the pre-verbal focus position is not triggered by feature checking but by stress. She applies the Stress-Focus Correspondence Principle (SFC) of Reinhart (1995):

Example 6.2 (Stress-Focus Correspondence; SFC)

> "*The focus of a clause is any syntactic constituent that contains the main stress of the intonational phrase corresponding to the clause.*"

Considering the Hungarian nuclear stress rule (NSR), namely that the nuclear stress falls on the *leftmost* phonological phrase in the intonational phrase and the phrasal stress falls on the leftmost phonological word in the phonological phrase, the neutral stress position is on the left edge of the verbal phrase. In the unmarked case the main stress falls either on the verb, or on the verbal particle, which forms one phonological word with the verb situated to the immediate left of it.

(68) a. ′Amy ″szerette ′Bent.
Amy loved Ben.*acc*
'Amy loved Ben.'

b. ′Amy ″megszerette ′Bent.
Amy VM$_{meg}$-loved Ben.*acc*
'Amy got to like Ben.'

The focused constituent wants to have the main stress, according to the SFC-principle, and this can be assigned in the immediate pre-verbal position, according to the NSR. In case of verb focusing, the verb does not need to move, because it is already in the main stress position.

(69) a. ″Amy szerette meg Bent.
Amy loved VM$_{meg}$ Ben.*acc*
'It is Amy who got to like Ben.'

b. ′Amy ″megszerette Bent.
Amy VM$_{meg}$-loved Ben.*acc*
'Amy [got to like]$_F$ Ben.'

Next to the stress-requiring movement, according to Szendrői, movement can also be triggered to avoid stress. A support of this claim is the class of *climbing verbs* like *hagy* 'leave' in the following example.

(70) a. *Amy hagyott egy könyvet az iskolában.
Amy left a book.*acc* the school.*loc*

b. Amy egy könyvet hagyott az iskolában.
Amy a book.*acc* left the school.*loc*
'Amy left a book in the school.'

The main characteristic of these verbs is that they cannot get sentential stress, so they want to avoid nuclear stress in the unmarked case. The issue is solved by movement: they trigger movement to another constituent immediately in front of them.

6.2.2 Analyses by a semantic operator

A very important aspect of several analyses of structural focus in Hungarian is the assumption that a covert semantic operator is responsible for the exhaustive interpretation of the focused consituent. We will emphasise here the analyses of Szabolcsi (1981, 1994) and Horváth (2007), both of whom claim that focus-movement to the immediate pre-verbal position has a truth-conditional effect, and as such it has to be built into the semantics of pre-verbal focus in Hungarian.

A highly influental initiative in the research on Hungarian focus position is the early paper of Szabolcsi (1981) on the semantics of topic-focus articulation. In this paper she introduces a grammar-minded approach to topic-focus articulation in Hungarian. She claims that certain word-order rules affect the truth-conditions of a sentence. Such a rule is the focus movement to the immediate pre-verbal position where the focused constituent gets a pitch accent and is assigned an exhaustive interpretation. Szabolcsi claims that bare focus (in the pre-verbal position) makes a semantic contribution, namely *exhaustive listing*. According to her analysis exhaustivity is the predominant semantic characteristic of focus in Hungarian. She extends Montague-grammar in such a way that exhaustivity is involved on the syntax-semantics interface as a direct consequence of focusing in Hungarian. According to this approach the semantic interpretation of the focused sentence (71a) is (71b), expressing exhaustive listing:

(71) a. AMYT látta Ben.
Amy.*acc* saw Ben
'It is Amy whom Ben saw.'

b. $\forall x[saw_*(ben)(x) \leftrightarrow x = amy]$

In her 1981 paper, Szabolcsi presents several observations regarding the exhaustive interpretation of structural focus in Hungarian. In favour of assuming exhaustivity as a direct effect of pre-verbal focus she shows that biconditionals

in Hungarian are expressed by focusing (72), which can only be explained by exhaustivity.

(72) AKKOR megyek veled, ha cilindert veszel.
then go.1*sg* you.*with* if top-hat.*acc* take-on.2*sg*
'I will go with you only if you put on a top-hat.'

Another observation concerns entailment relations between different focused sentences. This observation returns in many other investigations as *Szabolcsi's exhaustivity-test*. In this test two sentences with pre-verbal focus are compared. The first sentence has a coordinate phrase in the focus position, while in the second sentence one constituent from the coordination is dropped. If the second sentence is not a logical consequence of the first one, there is exhaustivity involved.

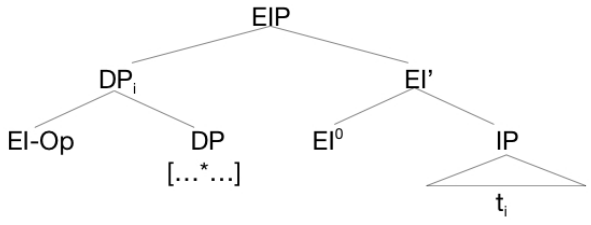
Example 6.3 (Szabolcsi's exhaustivity test)
if $[\alpha$ and $\beta]_F VP \models [\alpha]_F VP$ then there is no exhaustivity
if $[\alpha$ and $\beta]_F VP \not\models [\alpha]_F VP$ then there is exhaustivity

(73) AMY és BEN_F látta Cleot. $\not\models$ AMY_F látta Celot.
Amy and Ben saw Cleo.*acc* Amy saw Cleo.*acc*
'It is Amy and Ben who saw Cleo.' $\not\models$ 'It is Amy who saw Cleo.'

In her 1994 paper, however, she modifies her position on this issue, and claims that the main characteristics of the focus position is *identification*, while exhaustivity is presupposed. Szabolcsi claims that the semantics of the structural focus in Hungarian involves a ι-operator which presupposes the presence of a unique individual for whom the background property holds, and focusing identifies this individual with the one in the focus position.

In her recent (2007) paper, Horváth presents a minimalist analysis opposed to the feature assignment approach. She claims that movement to the pre-verbal position is not triggered by a focus-feature, but is due to a quantificational exhaustive identification operator (EI-Op).

Example 6.4 (Horváth's EI-Phrase)



In Horváth's analysis there is an EI-Phrase in front of the IP (before the verb), and the functional head EI^0 hosts an uniterpretable EI-Op feature: this

feature cannot be interpreted at the interfaces, it only triggers the movement. an EI-Op phrase moves to the Spec-EIP, triggered by the functional head to check the feature. EI^0 has furthermore an EPP feature, requiring checking in a Spec-Head configuration. This feature is responsible for the overt status of the movement. Horváth mentions two pieces of evidence in favor of her claim: the 'entailment-test' from Szabolcsi (see later in (6.3)) and the 'denial-test' as in (74).

(74) A: Amy BENT hívta fel.
Amy Ben.*acc* called.3*sg* VM_{up}
'It is Ben whom Amy called.'

B: Nem igaz. Amy Cleot is felhívta.
not true Amy Cleo.*acc* also VM_{up}-called
'Not true. Amy also called Cleo.'

The EI-Op analysis accounts for the bare pre-verbal focus and its exhaustive interpretation in Hungarian, and also offers a straightforward analysis of 'only'-sentences. The focus-sensitive particle 'only' is also an operator with an EI-Op feature. In the case of a bare focus we have a null EI-operator with the same feature. These two operators are in complementary distribution, hence this theory is claimed to be able to account for the similarities and the differences between sentences with bare pre-verbal focus and sentences with 'only'. According to the EI-Op analysis, there is a direct correspondence between the pre-verbal position and the exhaustive interpretation of the focused constituent.

6.2.3 The predicative approach

However, although the evidence in favor of the truth-conditional effect of the pre-verbal focus seem to be quite strong one can still doubt this claim. As É. Kiss points out in her recent papers (É. Kiss 2004, É. Kiss 2006a) the pre-verbal focus position is not necessarily associated with exhaustive listing. Using Szabolcsi's exhaustivity test (6.3) she reveals that it is possible to have the pre-verbal focus position filled, while exhaustivity is not involved. This happens if the identificational focus is an indefinite and the verb has no particle. Interestingly, in cases where the verb has a particle, but with the same indefinites in focus position, exhaustive interpretation is required.

(75) Amy egy ALMÁT és egy BANÁNT evett.
Amy an $apple_{acc}$ and a $banana_{acc}$ ate
'Amy ate an apple and a banana.'
$\models$
Amy egy ALMÁT evett.
Amy an $apple_{acc}$ ate
'Amy ate an apple.'

(76) Amy egy ALMÁT és egy BANÁNT evett meg.
Amy an apple$_{acc}$ and a banana$_{acc}$ ate VM
'Amy ate an apple and a banana.'
$\not\models$

Amy egy ALMÁT evett meg.
Amy an apple$_{acc}$ ate VM
'Amy ate an apple.'

É. Kiss (É. Kiss 2004, É. Kiss 2006a) provides a new theory of structural focus against the FP-theory where she assumes a predicate phrase *PredP* in front of the VP. The specifier of *PredP* can host verbal particles, bare nominals and the focus constituent, all of which receive predicate interpretation in this position. She argues that verbal particles and bare nominals are secondary predicates and that the focused constituent is a specificational predicate. Her analysis is influenced by earlier work of Higgins (1973) on nominals. Higgins claims that a nominal can function as a predicate. Higgins distinguishes three types of nominal predicates: predicational, identificational and specificational predicates. A predicational predicate simply predicates a property of a referential subject; a identificational predicate gives the name of a subject, while a specificational predicate identifies the members of the domain that are given by the subject of the predication. É. Kiss uses this distribution and claims that definite and specific indefinite noun phrases in focus position get a specificational predicate interpretation, implying exhaustivity, while the non-specific indefinites can be ambiguous between a specificational and a predicational reading, so exhaustivity is non-obligatorily implied, but the presence of a verbal particle enforces the specific, and thus exhaustive, reading.

6.3 Semantic operator or not?

All theories introduced above provide important results on the syntax and semantics of Hungarian structural focus. In the following, however, we will concentrate on investigation of interpretational issues. In this section we will mainly challenge the claim that the immediate pre-verbal position is assigned an exhaustive interpretation by a semantic operator.

In section 6.2.2 the leading views on the Hungarian focus position and its exhaustive interpretation where the exhaustive interpretation is due to a syntactic/semantic operator were introduced. In these views focus in Hungarian has an effect on the truth-conditional meaning of the sentence and the exhaustive interpretation of the focus should be encoded in the grammar. This establishes a direct contact between the syntactic structure and the semantics of focused sentences.

In this section I will argue for a different analysis, one where the exhaustive interpretation of the focused consitutent is due to some pragmatic inference rather than a semantic operator. As for the explanation of the movement to the preverbal position, we take the analysis of Szendrői (2001, 2003) on basis of prosodic considerations and henceforth we will concentrate on its interpretation regarding exhaustivity.

In contrast to the approaches of a covert syntactic/semantic operator, Wedgwood (2006, 2007) claims that the exhaustivity of Hungarian pre-verbal focus should be analyzed as of a pragmatic nature. Wedgwood agrees with É. Kiss (2006a) that the pre-verbal position is an encoded predicative position, hence there is a certain predicative procedure. However, Wedgwood claims the exhaustive interpretation is an inference, that is not encoded in the grammar. There are several examples to support both sides of this debate. Several linguistic tests are used to give support for the approaches of a semantic operator such as the "entailment-test" from Szabolcsi (1981) introduced in the previous section (see 6.3). Even stronger is the "denial-test" (77), that suggests that exhautivity is part of the truth-conditional meaning, since we can deny the *'nobody else'* part (hence the exhaustive statement) of the interpretation. Denial – as a special type of negation – in general is taken to affect the semantic content.

(77) Amy BENT hívta fel. Nem igaz, Amy CLEOT is felhívta.
Amy Ben.*acc* called VM$_{fel}$ not true Amy Cleo.*acc* also VM$_{fel}$-called
'It is Ben whom Amy called.' 'No, Amy called Cleo, too.'

Another test by means of additive particles is used to argue that exhaustivity in Hungarian focus cannot be an implicature, since it cannot be cancelled. One of the most important properties of implicatures is that they can be cancelled. Examples of this "implicature-test", such as (78) below, are often used to argue that sentences with a structural focus in Hungarian cannot be followed by a sentence with an additive particle, hence the exhaustive listing of the structural focus cannot be cancelled.

(78) Amy BENT hívta fel tegnap. #És CLEOT is.
Amy Ben.*acc* called VM$_{fel}$ yesterday and Cleo.*acc* too
'It is Ben whom Amy called yesterday.' #'And Cleo, too.'

On the other side of this debate there are several examples which go against the covert syntactic/semantic operator approach. Consider, first, example (79), created by a slight change of the implicature-test above, and which provides a different result. Example (79) shows that the exhaustive statement can be cancelled, for example, by the use of modals.

(79) Amy BENT hívta fel tegnap. És talán CLEOT is.
Amy Ben.*acc* called VM$_{fel}$ yesterday and maybe Cleo.*acc* too
'It is Ben whom Amy called yesterday.' 'And maybe Cleo too.'

Furthermore, we can also cancel exhaustivity within the same clause, by adding the modifier 'among others', that carries non-exhaustive meaning. If we assume a covert operator that contributes the exhaustive meaning and the non-exhaustive modifier at the same time, it should lead to contradiction. This is, however, not the case, as we can see in (80) below.[7]

(80) A nagykövet tegnap többek között HÁGÁBA látogatott el.
the ambassador yesterday others among The Hague.loc visited VM$_{el}$
'The ambassador yesterday went to visit, among others, THE HAGUE.'

Bende-Farkas (2006) provides further evidence against the covert operator approach. One of her main arguments is that Hungarian shows Weak Crossover Effects similar to these seen in English, where focus does not involve an operator.

(81) a. *If he$_i$ loses his$_i$ keys JOHN$_i$ gets upset.
b. *Ha elveszíti a kulcs-á$_i$-t, JÁNOS$_i$ dühös.
if loses the key.*poss*3*sg.acc* John angry
(examples from Bende-Farkas, judgments from myself)

This argument can be further strengthened by the observations from Postal (1993) who shows that *'only'* and *'even'* can repair Weak Crossover Effects, while focusing itself cannot. If we assume the presence of an 'only'-like covert operator involved in the interpretation of Hungarian structural focus, this asymmetry should not be present. Another important argument from Bende-Farkas is that Hungarian free focus does not license negative polarity items in the background, while *'only'* does. Again, if Hungarian focus would involve an 'only'-like operator in the interpretation, we would expect it to license NPIs in the background.

(82) a. Only AMY has any money left.
b. *JÁNOS volt valaha Párizsban.
John was ever Paris.*loc*
c. Csak JÁNOS volt valaha Párizsban.
only John was ever Paris.*loc*
'Only John has ever been to Paris.'

On basis of several examples from written Hungarian texts Wedgwood et al. (2006) propose an analysis in which the exhaustive interpretation of focusing in

[7] É. Kiss (2006b) mentions a similar example and claims that it does not go against an exhaustive operator analysis, however her explanation is not convincing enough.

Hungarian is due to pragmatic inferences, rather than some syntactic/semantic operator. They claim that structural focus should get an underspecified semantics, while the exhaustive interpretation is derived by pragmatic inferences.

Via a range of examples such as (83) they illustrate that constituents in the pre-verbal focus position do not necessarily get an exhaustive interpretation.

(83) *context:*
Igaz, menetlevelet kell vezetni, de ez enyhe büntetés a dízel ÁFÁ-jának visszaigénylési lehetősége fejében.
'Yes, you have to write a waybill, but this is a small price to pay for being able to claim the VAT on diesel back.'

Az én autómat 10 hónapos korában [SVÁJCBAN élő rokonság]$_F$
the my car.*acc* 10 months age.*il* Switzerland.*loc* living relatives
segítségével szereztük be, s mindosszesen kb. 2,5 millioba
help.*poss*3*sg.instr* got.1*pl* VM, and all-in-all about 2,5 million.*loc*
került, amiből – lévén teherautó – az ÁFA visszajött.
cost which.*elat* – being van – the VAT came back
'We got my car when it was 10 months old [with the help of relatives who live in Switzerland]$_F$, and it cost about 2.5 million in total, of which – it being a van – the VAT was refunded.'

This example shows that the filled pre-verbal focus position does not necessarily get exhaustive interpretation. Here, the Swiss relatives do not need to be the only ones who helped buying the truck. As Wedgwood et al. are also aware of, there is something special happening in this example. In the second sentence a new discourse topic is introduced by a topic shift using contrastive topic intonation on 'the my car'. Since we have a contrastive topic in the sentence it requires an 'associate' (Gyuris 2002), namely there must be a focused constituent as well. Hence, in this example the presence of a contrastive topic requires focusing of another constituent, which forms according to our claim, the reason of the lack of exhaustivity, since the presence of focus serves another purpose. With some slight modification of the above example we can show that the presence / lack of exhaustivity depends on the context. Consider the same context as above, where we discuss the positive and negative sides of being a truck-driver. Then, both in (83) and (84) below, the sentence makes a topic shift, and there is a contrastive topic that requires focusing of the other constituent. In this case we do not necessarily get exhaustive interpretation of the focused constituent and continuations by 'No, ...' (operation of *cancellation*; [$\perp$] in Def. 2.26) and 'Well, ...' (operation of *implicature cancellation*; [$\perp_{impl}$] in Def. 5.2) are both equally good.

(84) context1: as above (see 83)

Az autóját [SVÁJCBAN élő rokonság]$_F$ segítségével
the car.*poss*3*sg.acc* Switzerland.*loc* living relatives help.*poss*1*pl.ins*
szerezték be.
got.2*pl* VM$_{be}$
'They got his car with help from relatives from Switzerland.'

a. Nem, a cég vezetése is benne volt.
'No, the direction of the company helped, too.'

b. Hát, a cég vezetése is benne volt.
'Well, the direction of the company helped, too.'

As soon as we change the context to one which already introduces the truck as the discourse topic we do not have a topic shift, hence we do not have a contrastive topic in the second sentence which would require focusing of the 'help of the Swiss relatives'. The difference is clear: here we get the exhaustive interpretation of the focused constituent and furthermore the continuation by 'Well, ...' is not felicitous any more.

(85) *context2:*
A fiam kamionsofőr, egy utánfutós mercedes kocsija van.
'My son is a truck-driver, he has a mercedes van with a trailer.'

[SVÁJCBAN élő rokonság]$_F$ segítségével szerezték be.
Switzerland.*loc* living realtives help.*poss*1*pl.instr* got.2*pl* VM$_{be}$
'They got it with help from relatives from Switzerland.'

a. Nem, a cég vezetése is benne volt.
'No, the direction of the company helped, too.'

b. # Hát, a cég vezetése is benne volt.
'Well, the direction of the company helped, too.'

The most important conclusion of the above examples is that focusing of certain constituents can be required by other linguistic phenomena, such as the presence of a contrastive topic. It suggests that there is no semantic operator directly assigned to the pre-verbal position. The exhaustive interpretation of focus is missing in many cases, a phenomenon that we cannot explain if we assume the presence of an exhaustivity operator.

There are several more examples where the focus position is filled, but the interpretation need not be exhaustive. Certain sentential adverbials are required to be focused. See, for example, the adverbials *hitelre* 'on credit' or *igéret fejében* 'against a promise' that modify the verbs *megvesz* 'buy' and *kölcsönad* 'lend' respectively. In our examples both verbs contain a verbal modifier (meg- / kölcsön-) that clearly indicates the adverbial occupying the focus position.

(86) a. Az autómat [HITELRE]$_F$ vettem meg.
the car.*poss*1*sg.acc* on credit bought VM$_{meg}$
'I bought my car on credit.'
*Az autómat megvettem hitelre.
the car.*poss*1*sg.acc* VM$_{meg}$-bought on credit

b. Az autómat [ÍGÉRET fejében]$_F$ adtam kölcsön.
the car.*poss*1*sg.acc* promise gave VM.*loan*
'I lent my car on promise.'
*Az autómat kölcsönadtam igéret fejében.
the car.*poss*1*sg.acc* VM.*loan*-gave promise against

There is also a verb class called *stress avoiding verbs* in Hungarian, that behave similarly to the above examples. These verbs do not want to stand in a position where the main stress falls. In Hungarian the neutral stress position is on the left edge of the verbal phrase; this should mean that these verbs also get the sentential stress in the 'neutral sentences'. However, since they want to avoid stress, these verbs will trigger some element to the immediate pre-verbal position. Hence, the focus position can be filled without any special interpretation effects. Such a stress-avoiding verb is, for example, *tartozik* 'belongs somewhere' as illustrated in the following example.

(87) a. Az intézetünk [a FILOZÓFIA TANSZÉKHEZ]$_F$ tartozik.
the institute.*poss*3*pl* the philosophy department.*all* belongs-to
'Our institute belongs to the philosophy department.'

b. *Az intézetünk tartozik a filozófia tanszékhez
the institute.*poss*3*pl* belongs-to the philosophy department.*all*

The verb *tartozik* wants to avoid stress that triggers the movement of its argument to the pre-verbal focus position getting the main sentential stress (87a). The sentence becomes agrammatical when the argument stays in situ in its argument position (87a). Sentences with a stress-avoiding verb contain a focused constituent that need not be interpreted exhaustively. Such a sentence can be followed by, for example, *'And to the science department, too'* canceling the exhaustive meaning that was not possible in other examples:

(88) a. Az intézetünk [a FILOZÓFIA TANSZÉKHEZ]$_F$ tartozik.
the institute.*poss*3*pl* the philosophy department.*all* belongs-to
És a matematika tanszékhez is.
and the mathematics department.*all* too
'Our institute belongs to the philosophy department. And to the mathematics department, too.'

b. (=78) Amy BENT hívta fel tegnap. #És CLEOT is.
Amy Ben.*acc* called VM$_{fel}$ yesterday and Cleo.*acc* too
'It is Ben whom Amy called yesterday.' #'And Cleo, too.'

Wedgwood et al. (2006) also mention adverbials that associate with focus, while they are inherently non-exhaustive. Such adverbials are, for example, *jórészt* 'mostly' or *elsősorban* 'primarily'. These adverbials require a focused constituent, which is problematic for an analysis that assumes an exhaustivity operator. In such an analysis sentences like (89) should be out, since by movement to the pre-verbal focus position it should get exhaustive interpretation, while the adverbial explicitly states non-exhaustivity.

(89) Jórészt a tervasztalon dől el a projektek sikere.
mostly the plan-table (is-)decided VM the projects success.*poss*3*sg*
'The success of the projects are decided mostly on the plan-table.'

The main question at this point is how we can handle both cases with one analysis of Hungarian structural focus. Do we have to choose between the semantic approach and the pragmatic approach? One serious option is to consider an analysis involving a *local pragmatic operator*, following the main ideas of Chierchia (2004). Such an analysis would suggest that the exhaustive interpretation is calculated as an implicature, however locally, parallel with the computation of the semantic content. This would solve the problem of cancelling the exhaustive meaning such as in (90), since the operator is a pragmatic one, hence cancellable. However, such an analysis via a local pragmatic operator still cannot give an explanation of the examples where focusing is triggered by another element or linguisitic tool, whereby exhaustivity becomes optional.

6.3.1 The proposal: obligatory implicature

In this section, I introduce my proposal for the analysis of the exhaustivity effects of Hungarian structural focus. I claim that the exhaustive interpretation of focusing in Hungarian can be analyzed as a pragmatic inference parallel with English focus, as discussed in chapter 4. On the other hand I do not claim that focusing in Hungarian behaves in the very same way as focusing in English. Certain important differences in the grammar of Hungarian cause focusing in Hungarian to have some different properties than its English counterpart. In the following I propose an analysis in the framework of Inquisitive Semantics. In this way we can give a uniform analysis of Hungarian and English focusing, thus we can better reveal their similarities and differences.

As our semantics is an update semantics, the interpretations of sentences are taken to be context change potentials: we represent how a sentence changes

the actual context. In the architecture of dialogue modeling both the semantic content and the pragmatic inferences (if any) change the context by adding a new state on the top of the stack. In this way there is a less sharp separation of the semantic and pragmatic contribution. After all we are interested in the changes the sentence makes to the context, hence the changes made by these two components together. For the analysis of focusing in Hungarian I suggest that we can keep the analysis of the exhaustive interpretation via a pragmatic inference, as for English focusing, while at the same time there is an important difference. In Hungarian, when focusing is not triggered by something else (contrastive topic, stress avoiding verb etc.), focusing is used to signal that exhaustivity is obligatory, hence cannot be cancelled.

Example 6.5 (Obligatory implicature)
(a) in example (84): topic shift by contrastive topic $\rightsquigarrow$ focus triggered by CT
$\Rightarrow$ no (obligatory) exhaustivity
denial: both 'No, ...' and 'Well, ...' are felicitous
(b) in example (85): no topic shift $\rightsquigarrow$ focus is not triggered by anything else
$\Rightarrow$ obligatory exhaustivity
denial: 'No, ...' is felicitous, while 'Well, ...' is out

The motivation behind this analysis is, on the one hand, the collection of convincing examples from both sides, both for and against the operator approach, and on the other, the fact that focusing in Hungarian is more marked than in English. In Hungarian, next to the focus accent, movement to a special position is used as well.

On the formal side of my analysis in Inquisitive Semantics, the modeling of the uptake of an Hungarian sentence with focus involves the same dialogue moves as in the English examples illustrated in chapter 4. Exhaustivity is analyzed as a pragmatic inference, formally carried out by the pragmatic operation of exhaustification ($[\mathcal{EXH}]$). In case focusing is not triggered by other linguisitic phenomena it is used to signal an *obligatory implicature*.

I assume that the information in the state added to stack by an obligatory implicature immediately percolates down to the state by the rheme of the utterance. This provides a different stack than a sentence with a non-obligatory implicature, hence the possibilities for responses are also different.

Example 6.6 (Obligatory implicature)
$\langle\langle\langle\langle\sigma, s\rangle, QUEST\rangle, THEME\rangle, RHEME\rangle[\mathcal{EXH}]_{obl}$
$\Longrightarrow \langle\langle\langle\langle\sigma, s\rangle, QUEST\rangle, THEME\rangle, RHEME\lceil RHEME_{EXH}\rceil\rangle$

The obligatory implicature is different from the "general" implicature in that it percolates down before the response is given. By applying $[\mathcal{EXH}]_{obl}$ first the

implicature as defined for the operation $[\mathcal{EXH}]$ is carried out, adding a new state ($RHEME_{EXH}$) on the top of the common ground stack. But since this operation is obligatory, the information (the exhaustive meaning) in $RHEME_{EXH}$ immediately *restricts* the state by the rheme. The obligatory implicature only restricts the state by the rheme of the utterance; the operation stops where it reaches an inquisitive state, hence the theme of the utterance. After we have restricted the rheme with the exhaustive meaning the response on the utterance can follow.

Thus I claim that exhaustivity in Hungarian can be considered to be of a pragmatic nature, and hence can be analyzed in parallel with examples in English. However, certain natural language examples suggest that the status of exhaustivity in Hungarian at some point differs from exhaustivity in English. I capture this fact by the notion of "obligatory implicature" that occurs in connection with the Hungarian structural focus in cases when focusing / the use of the special pre-verbal position is not triggered by other linguistic tools. With this approach we can uniformly analyze Hungarian structural focus examples both with and without exhaustive interpretation.

Consider two of our examples from above. In example (78) focusing is not triggered by anything else, thus we have an obligatory implicature $[\mathcal{EXH}]_{obl}$. The uptake (primary and secondary) of the utterance leads to the following common ground stack.

Example 6.7 (Obligatory implicature; sentence (78))
$...\rangle, ?\exists x.CALL(a,x)\rangle, CALL(a,b)\rangle, \forall x.CALL(a,x) \leftrightarrow x = b\rangle$

Since we have an obligatory implicature, its information percolates down before we get any response to the utterance, leading to the following stack.

Example 6.8 (Obligatory implicature; sentence (78))
$...\rangle, ?\exists x.CALL(a,x)\rangle, \forall x.CALL(a,x) \leftrightarrow x = b\rangle$

This latter common ground stack is the immediate context for the response given to the sentence in (78). Consequently, responding by the utterance 'And CLEO, too', hence canceling the implicature, is not possible.

Consider on the other hand the sentence with a stress-avoiding verb as in example (87). Here, focusing of the constituent is triggered by the stress-avoiding verb and the implicature is not obligatory. This sentence is not necessarily interpreted exhaustively, the implicature can be canceled similarly to the examples in English. Here, the pragmatic implicature by $[\mathcal{EXH}]$ is carried out as we proposed for English: the information on top (the exhaustive meaning) percolates down after the response of acceptance is given. However, the response can cancel the implicature, thus removing the exhaustive meaning. The uptake of sentence (88a) leads to the following stack.

Example 6.9 (Implicature by $[\mathcal{EXH}]$; sentence (88a))
$...\rangle, ?\exists x.BEL(inst, x)\rangle, BEL(inst, phil)\rangle, \forall x.BELONG(inst, x) \leftrightarrow x = phil\rangle$

This stack is the underlying context for responses such as 'And to the mathematics department, too' which is possible in this case. We can cancel the implicature that removes the last informational step, providing a stack where the uptake of the additive sentence can be carried out and resulting in the common ground stack as follows.

Example 6.10 (Implicature by $[\mathcal{EXH}]$; sentence (88a))
$...\rangle, ?\exists x.BEL(inst, x)\rangle, BEL(inst, phil) \wedge BEL(inst, math)\rangle$

As illustrated in the above examples, in case focusing is triggered by some other linguistic tool (e.g., a stress avoiding verb here) exclusiveness is derived pragmatically, and as such it can be canceled by the reaction (88a). However, it can also be accepted, that finally leads to the exhaustive interpretation. On the other hand, in case focusing is not triggered, I assume an *obligatory implicature*, that cannot be canceled (78), hence it leads in all cases to an exhaustive interpretation.

A further evidence for the analysis via a pragmatic implicature is the fact, the exhaustivity can also be canceled within the same clause such as in the example with the sentential adverb *'among others'* (90).

(90) Az elnök többek között HÁGÁBA látogatott el.
the president among others Hague.*ill* visited VM$_{el}$
'The president visited, among others, THE HAGUE.'

In this example the primary uptake of the sentence adds two states to the common ground stack, the theme and the rheme, where in the state by the rheme the indices where the president visited only The Hague are eliminated. Hence, applying the operation $[\mathcal{EXH}]$ here cannot lead to the exhaustive interpretation of the focused constituent.

6.4 Summary

In this chapter I investigated the interpretation of Hungarian structural focus, paying special attention to its exclusive meaning. With respect to exhaustivity and focusing strategies, Hungarian is a particularly interesting language. The most well-known characteristic of Hungarian is that it has a special position for the focused constituent right in front of the finite verb, a characteristic that is widely claimed to be associated with an exhaustive semantic interpretation.

I investigated the claim that the structural focus position (pre-verbal focus) in Hungarian is assigned an exhaustive semantic interpretation (Szabolcsi 1981, Szabolcsi 1994, Horváth 2007). I showed that the pre-verbal focus position can be filled for other reasons than being exclusive. Focusing can be triggered by other linguistic tools such as, for example, contrastive topic (83) and stress-avoiding verbs (87). In such cases the pre-verbal focus position is filled, but the exhaustive interpretation is merely optional. In other cases where focusing is not triggered, it is mostly obligatorily interpreted as exhaustive (78). However, it is still possible to use the sentential adverb *'among others'* signaling non-exhaustivity in combination with pre-verbal focus (80). From these fact I conclude that the exhaustive interpretation of the Hungarian pre-verbal focus is not due to a semantic operator assigned to the position, since there are several cases when the constituent(s) in this position are interpreted optionally exhaustive, and the use of *'among others'* in combination with pre-verbal focus does not lead to contradiction. Hence, I claim that constituents in the pre-verbal focus position are not necessarily interpreted as exhaustive. However, what is still special about Hungarian is that exhaustive interpretation is not possible outside of this position. This explains the fact that when focusing is not triggered, it is used to signal exhaustivity that is not cancelable (78).

To put all this together, I claim that the interpretation of Hungarian pre-verbal focus can be analyzed via a pragmatic implicature as introduced for English focusing in chapters 3 and 4. Nevertheless, there is also an important difference in that the inference of exhaustivity in Hungarian is in certain cases not cancelable. To give an account of this difference, I suggest the presence of an obligatory implicature in Hungarian for the utterances where focusing is not triggered by other linguistic tools, but is assumed to signal exhaustivity. Exhaustivity provided by this obligatory implicature cannot be canceled.

Appendix to chapter 6: Multiple focus In Hungarian

In this appendix, I illustrate the phenomenon of multiple focus that is particularly interesting in Hungarian. This topic is nor considered as the core of the discussion of the thesis, but stays central among the purposes of further research of investigating special focus constructions and the syntax-semantic interface.

In case of sentences containing two (or more) prosodic foci there are two possible interpretations available in Hungarian and English as well. The two foci can form an ordered pair like in (91a). Here semantically *a pair of constituents* is in focus. Krifka (Krifka 1991) calls this type *complex focus* to distinguish it from other multiple focus constructions. The other type is one involving *real multiple foci* (Krifka 1991). In this case there are two focus operators and the first focus takes scope over the second one.

(91) a. John only introduced BILL to SUE. (Krifka 1991)
b. Even$_1$ JOHN$_1$ drank only$_2$ WATER$_2$. (Krifka 1991)

The interesting of Hungarian is, that next to the two available readings, due to the linguistic tool of focus movement, there are also different syntactic structures available. There is a special structure called "mirror-focus" that is associated with the complex-focus reading. In these sentences the second constituent in focus must be place at the end of the sentence. In this case, the interpretation goes as there is a pair of individuals in focus.

(92) BEN vádolta meg tegnap lopással AMYT.
Ben accused VM yesterday stealing$_{instr}$ Amy$_{acc}$
'BEN accused AMY of stealing yesterday.'
reading: it is the Ben, Amy pair of whom the first accused the second of stealing yesterday

The other reading, the real multiple focus is different in structure, as É. Kiss suggests, the second focus moves to a lower focus position (FP), that provides the interpretation that the second focused constituent is in the scope of the first one.

(93) Csak BEN vádolta csak AMYT meg tegnap.
only Ben accused only Amy$_{acc}$ VM yesterday
'Only BEN accused only AMY yesterday.'
reading: the others accused more persons or nobody

A similar distinction can be found in Hungarian multiple constituent questions. In multiple wh-questions there are two possible word orders that lead to two different meanings.

(94) a. Ki kit hívott fel?
who whom called VM
'Who called whom?'
(pair-list)

b. Ki hívott fel kit?
who called VM whom
'Who called whom?'
(complex)

(94a) requires a pair-list answer, while (94b) is a restricted question where both the questioner and the answerer already know that there is only one pair of whom the "call-relation" holds.[8]

Nevertheless there are two different word orders possible, syntactic structure does not disambiguate the two readings in Hungarian. While the complex focus reading is associated with the mirror-focus construction, we can get the scope-reading (real multiple foci) also when the second focus stays in situ. Hence, we have the examples as (95) where both readings are available.

(95) Csak BEN hívta fel csak AMYT.
only Ben called VM only Amy_{acc}
a. 'Only Ben called only Amy.' [the others nobody or more persons] b. 'It is the Ben, Amy pair of whom the first called the second.'

The issues regarding multiple focus in Hungarian are rather complex, we are interested in the question what linguistic factors play a role to disambiguate between the two meanings. next to the syntactic structure, intonation and the appearance of 'only' play a crucial role as well. For sentence (91b) two different intonation patterns lead to two meanings.

(96) Csak BEN hívta fel csak AMYT. (=95)

a. Csak Ben hívta fel csak Amyt.
H*-L L L-H% H*-L $\Longrightarrow$ complex / *scope
'It is the Ben, Amy pair of whom the first called the second.'

b. Csak Ben hívta fel csak Amyt. $\Longrightarrow$ *complex / scope
H*-L L L L H*-L
'Only Ben called only Amy. [the others more or nobody]'

Intonation has the role to yield the intended meaning, however, there is no one-to-one correspondence between intonation patterns and meanings, as can be seen in the following examples where we drop one or both of the *'only'*s.

[8]The question can have a *strict* and a *loose* meanings (Lipták 2000). In the case of the strict meaning there are two specific individuals – e.g. Anne and Bart – under discussion, and the question is just about the theta-roles of the individuals: either Anne was calling and Bart was called or the other way around, hence the only pair in the interpretation of 'call' is either the pair $\langle a, b\rangle$ or the pair $\langle b, a\rangle$. In the case of the loose meaning there is a specific set of pairs of individuals, and the questions wants one element from this set.

(97) Csak BEN hívta fel AMYT.

a. Csak Ben hívta fel Amyt.
H*-L L L-H% H*-L ⟹ complex / *scope

b. Csak Ben hívta fel Amyt.
H*-L L L H*-L ⟹ *complex / *scope

(98) BEN hívta fel AMYT.

a. Ben hívta fel Amyt.
H*-L L L-H% H*-L ⟹ complex / *scope

b. Ben hívta fel Amyt.
H*-L L L H*-L ⟹ *complex / *scope

In (97) and (98) the "pair-intonation" leads to the complex focus reading, but the "scope-intonation" leads either to the complex focus reading again or to ungrammaticality. Interestingly, only for structure (95) we can get the scope-reading (real multiple foci), for the structures in (97) and (98) the scope-reading is out. This suggests that the scope-reading is only possible with 'only'-phrases. We cannot even ask *Who is that, who called Emil and nobody else?* by using (99a), but we can get it by using (99b). Thus it seems that to express scope-meaning without 'only' we need a special syntactic structure.

(99) a. *Ki hívta fel Emilt?
(who called VM Emil.acc)
'Who called Emil (and nb. else)?'

b. Ki hívta Emilt fel?
(who called Emil.acc VM)
'Who called Emil (and nb. else)?'

There are more elegant syntactic analyses that assign a different syntactic structure for the complex focus reading. For example, É. Kiss (1998) claims that F(ocus)P(hrase) iteration is possible. Accordingly, the second focused constituent also moves to an FP position, while the verb moves to the first F-head going through the second one, resulting in a word order as: (only) – focus_1 – verb – (only) – focus_2 – verbal-modifier – (...). This syntactic analysis supports the cases where we have semantically two focused elements, hence two focus/exhaustivity operator where the first takes scope over the second one.

The disadvantage of such analyses is that they suggest a correspondence between the readings and the structures respectively. However, the picture is not as simple as that, since it can be the case that the structure proposed by É. Kiss gets the complex focus reading. Consider, for example, the following example

where we have the word order proposed by É. Kiss, but with a strong intonation we can get the complex focus reading as well.

(100) BEN hívta AMYT fel.
Ben called Amy_{acc} VM

a. Ben hívta Amyt fel.
H*-L L-H% H*-L L%$\Longrightarrow$ complex focus reading

b. Ben hívta Amyt fel.
H*-L L H*-L L% $\Longrightarrow$ scope-reading (real multiple foci)

There are at least three factors that play a role in the interpretation of multiple focus constructions: the use of different intonation patterns, different word order and the occurence of 'only'. Hence, it is a great challenge to investigate this phenomenon in the framework of Inquisitive Semantics.

Chapter 7

End note: summary and the future

7.1 Summary

In this dissertation I proposed a new, context-based analysis of focusing in the framework of Inquisitive Semantics (Groenendijk 2008). The logical system of Groenendijk's framework is introduced for modeling dialogues and motivated by this aim it is defined in such a way that it can handle both questions and assertions in a uniform way. In the syntax of inquisitive logic there is no separate category for questions. Questions are defined in terms of disjunction which is motivated by certain similarities observed in natural language examples. As Grice (1975) already pointed out, the natural language 'or' is mostly used to introduce two alternatives of whom the speaker considers one to be true, but does not know which one. With this alternative interpretation disjunctions turn out to be inquisitive.

In chapter 2 I introduced the framework of Inquisitive Semantics in detail. The semantics is an update semantics where utterances are interpreted as context change potentials, functions from (information) states to (information) states. States are defined as reflexive and symmetric relations on a subset of the set of indices. Indices are functions from atomic sentences to truth values. The core notion in the definition of states is the relation of indifference. Indices in a state are connected in case we are not interested in the difference between them. Utterances can eliminate indices form the state or disconnect some of them, hence they can provide data or raise an issue. Based on these effects the crucial notions of *informativeness* and *inquisitiveness* can be defined. A sentence is informative in a state, in case updating the state with the utterance eliminates some indices, while it is inquisitive if it disconnects some of them. In terms of these two notions we can distinguish three sentence types: *assertions*, that are informative and not inquisitive, *questions*, that are inquisitive and not informative, and *hybrids*, that

are both informative and inquisitive. The syntax and semantics of this inquisitive logic is presented in sections 2.1.1 and 2.1.4.

The language of Inquisitive Semantics is provided with a dialogue management system that is developed in order to model coherent dialogues between co-operative agents. The dialogue moves are driven by the dialogue principles that are motivated by the main lines of gricean pragmatics.

1. Maintain a common ground!
    (a) Avoid utterances that your information state does not support!
    (b) Keep you state consistent! & Announce non-acceptance!
2. Be as compliant as you can!

The second dialogue principle refers to the core logical notion of the system: *compliance*, that is defined between and utterance and a state. An utterance is compliant to a given state if updating the state with the utterance leads to a new state that is not less informative and not more inquisitive and all possibilities in the new state are possibilities or union of possibilities in the underlying state. The central component of the dialogue management is the Common Ground, technically defined as a stack of information states. Each utterance is considered as a dialogue move, that changes the Common Ground by pushing the stack, adding new states on the top of it. These changes of the Common Ground are defined by special operations that correspond to the inclusion of the semantic and pragmatic components of the utterance. The inclusion of these information are defined by the process of *primary* and *secondary uptake* respectively, where the computation of the pragmatic inferences (secondary uptake) obligatorily follows the computation of the semantic content (primary uptake). The pragmatic operation is always carried out, however it only has an effect in special cases. At first, all uptakes (primary and secondary) are considered as provisional and the next turn of the responder determines whether these uptakes actually change the Common Ground. This set-up, the inclusion of the responses makes it possible to easily incorporate critical dialogue moves in the system. The details of the dialogue management system can be found in section 2.2, where section 2.2.2 concentrates on the technical details of the operations of primary and secondary uptake, and section 2.2.3 introduces the absorption rules, the modeling of the responses.

The core of the dissertation can be found in chapters 3 to 5, where I propose a new, context-bases analysis of focus, applying and extending the system of Inquisitive Semantics. In chapter 6 I further extend my proposed analysis to the interpretation of Hungarian structural focus. In order to provide an adequate theory of focusing I provide an analysis for the phenomena of question-answer relation: the notion of congruence, exhaustification of answers; and the focus sensitive particle *'only'*. The kernel of my analysis is the claim that the focus structure of the utterance leads to a special theme/rheme division. The theme of a focused sentence is an inherent question, that is determined by the placement

of focus. I claim that the intonation pattern of the sentence determines the way of division and determines the theme that has an important role in our semantics. The theme of the focused utterance has a strong link to the actual context, that is determined by the focus requirement as the theme of a focused sentence must be compliant to the actual common ground. On the basis of my representation of focus I can straightforwardly give an analysis of question-answer congruence, contrast in denials and specification. Chapter 3 was devoted to the representation of focus in Inquisitive Semantics (section 3.2.1), the analysis of question-answer congruence (section 3.3.2) and the dialogue relations of contrast and specification (section 3.3.3).

I also introduced the recent issues of the exhaustive interpretation of answers. I provided an analysis where the exhaustive interpretation of a focused answer is due to a pragmatic inference that is technically carried out by the secondary uptake of the utterance, the pragmatic operation of *exhaustification*.

I also proposed an analysis of 'only' in chapter 5. My main claim is that the focus sensitive particle 'only' introduces a special issue in addition which corresponds to the expectation of more individuals having the given property (Zeevat 2008, Balogh 2005). I capture this idea by the division of an 'only'-sentence that leads to a theme as the question *'are there more?'*, and the rheme as the exhaustive statement. In my proposal 'only' corresponds to the semantic operator $\mathcal{ONLY}$ that takes the theme/rheme division of the focused utterance it modifies. In this way I capture the fact that different focus structures lead to different semantic interpretations. As for the meaning components of an 'only'-sentence that form an ongoing debate, I propose that the host/positive statement is presupposed (Roberts 2006, Horn 1969, Rooth 1992), the theme corresponds to the expectation and the exhaustive/negative statement is asserted as the rheme.

(101) Only AMY came yesterday.
presupposed: Amy came yesterday
theme: are there more besides Amy who came yesterday?
rheme: besides Amy nobody came yesterday

After having proposed my approach of focus, in chapter 6 I investigated the interpretation of Hungarian structural focus with special attention to the a well known phenomenon that this structural focus is interpreted exhaustively. The pre-verbal focus position in Hungarian is widely claimed to be associated with an exhaustive/identificational semantic interpretation. I suggest a different analysis, and claim that we can apply the analysis of the exhaustive interpretation via a pragmatic inference similarly as proposed for English focusing. Nevertheless, there is a crucial difference that in Hungarian, in case focusing is not triggered by other linguistic devices (contrastive topic, stress avoiding verb etc.) then focusing signals an obligatory implicature of exclusiveness that cannot be cancelled.

7.2 Main results

The most important result of my proposal is that it provides a uniform analysis of focusing based on and motivated by discourse-semantic considerations. I introduced an application of the logical system of Inquisitve Semantics on this particular natural language phenomenon. To carry out my analysis I achieved certain changes and extensions of the original system of Groenendijk (2008), in this way offering a natural and uniform way of defining congruent answers, explaining discourse relations as contrast, specification and denial, analyzing the exhaustive interpretation of (focused) answers, and last but not least, providing a new analysis of the focus particle 'only'. Furthermore, the analysis is also extendable to the special case of Hungarian structural focus and the interesting question of the status of its exhautive interpretation.

Congruent answers

In the relation of questions and their answers, one of the most important notions is that of a congruent answer. An adequate definition of congruence is required by any semantic analysis of focusing, and as such it is discussed by Rooth (1985, 1992) and Krifka (2001) as well. Rooth's congruence rules in Alternative Semantics rule out answers with misplaced focus and underfocused structures, but the overfocused answers face a problem. To solve this, an additional condition, preference for less focusing should be introduced that is stipulative and it is not clearly defined what counts as "less focused". Krifka's rule of congruence in the Structured Meaning Approach requires correspondence between the question-background and the focus-background that correctly predicts all cases of non-congruent answers.

I provided an analysis of congruent answers that differs from these two as in my system I do not need to define any separate congruence rule and additional conditions. Our dialogue management system rules out the non-congruent answers on the basis of the logical notion of compliance that is a core notion in the development of a coherent discourse.

Contrast and specification

Since the architecture of the dialogue management assumes that all updates are first provisional, critical dialogue moves and corrections by contrast and specification can be analyzed straightforwardly without any additional rules or conditions.

Denials

Related to contrast and specification, I also looked at the dialogue relation of *denial* in more detail. I investigated focusing and *'only'* from this new angle comparing their behavior in denials. In my analysis I can give a straightforward explanation of the natural language examples, that denial of a free focus sentence removes the semantic content, while in 'only'-sentences it is not the case. I can also give an account of asymmetry regarding the 'corrective' utterance after the denial (see 102).

(102) a. AMY came. No, BEN came. / #No, BEN came, too.
$\rightsquigarrow$ denial cancels that 'Amy came'

b. Only AMY came. #No, BEN came. / No, BEN came, too.
$\rightsquigarrow$ denial does not cancel that 'Amy came'

The analysis gives an account of the canceling/not canceling of the meaning component by the host proposition/positive contribution, and can also explain the examples that after the denial of the 'only'-sentence the "corrective" sentence should contain the additive particle *'too'*, while it is not felicitous after the denial of the free focus construction.

Exhaustivity

As the core of chapter 4, I proposed an analysis of the exhaustive interpretation of (focused) answers. In my analysis I take exhaustivity as a conversational implicature, technically carried out by the secondary uptake of the utterance, the operation of *exhaustification*. My definition is based on Groenendijk's (2008) original definition of this operation, however I formulated a new version of it, since the operation defined by Groenendijk still faces some problems regarding natural language examples and focusing. My new definition fixes some of these shortcomings and fits better to the general view of the gricean reasoning, as it formally captures the essence of the gricean Quantity Maxim: it excludes all strictly stronger possibilities from the actual context. By my new operation of exhaustification I can provide the exhaustive interpretations of answers with singular focus and compositions (conjunction, disjunction) in focus, as well as the scalar implicature of disjunctions.

(103) Who came to the concert yesterday?

a. AMY came. $\rightsquigarrow$ and nobody else

b. AMY and BEN came. $\rightsquigarrow$ and nobody else

c. AMY or BEN came. $\rightsquigarrow$ and nobody else + and not both

Section 4.2.2 discusses exhaustification in detail and provide a uniform analysis where we get the intended interpretations of these examples.

'Only'

My analysis of 'only'-sentences based on the special division of its theme and rheme influenced by the theme/rheme division of the focused utterance modified by 'only'. I provide a formal analysis where on the one hand 'only' corresponds to a semantic operator that provides the exhaustive statement, and on the other hand also the pragmatic effect of the presence of an expectation is incorporated. Next to this advantage I want to emphasize again, that my analysis can give an account of the difference of denial of a sentence with free focus and the denial of the corresponding 'only'-sentence.

7.3 Further research

This dissertation provides several promising results of a context-based focus analysis of focus, however, there is place for improvements and further research. The analysis should be extended at more places to cover as much as of the natural language examples around the phenomenon of focusing. First of all, an extension of the logical language is required to be able to analyze examples with indefinites and plurals in focus, as well as to analyze broad focus. I believe that some extension of the logical language with types and higher-order quantification together with the general motivations and architecture of the system we can provide an analysis of these examples as well. Another way of extension I want to make in the future is incorporating more of the focus sensitive operators, such as 'even', 'too' and 'always'.

As the source of modeling a coherent dialogue, one of the claims of Inquisitive Semantics is that different intonation patterns lead to different theme/rheme division. This claim opens a new perspective of this research, to investigate the interface of semantics and pragmatics with phonology. This interesting direction links also to my wish to extend the system to analyze broad focus.

Next to phonology, another interface should be investigated as well, looking at the interaction with syntax. To begin with, I want to further refine my representation of focus in order to provide a compositional analysis. Or at least to explain to what extent I can make this analysis compositional. Closely related to the syntax-semantics interface, I want to give a proper analysis of multiple focus constructions, too. I slightly touched upon this direction while analyzing question-answer congruence, where I provided some examples with multiple wh-questions and multiple foci. However, the phenomenon of multiple focus evokes many more interesting issues, such as the difference of pair-list interpretations and complex focus, as well as the intonation related issues of second occurance focus.

Samenvatting

In dit proefschrift heb ik een nieuwe contextgevoelige analyse van focusing voorgesteld binnen het raamwerk van de Inquisitieve Semantiek (Groenendijk 2008). Het logisch systeem van Groenendijk's raamwerk is ontwikkeld om dialogen na te bootsen, en voor dit doel is het zo gedefiniëerd dat het zowel vragen als beweringen op een eenvormige manier kan behandelen. In de syntaxis van de inquisitieve logica bestaat er geen aparte categorie van vragen. Vragen zijn gedefiniëerd in termen van disjuncties, hetgeen gemotiveerd wordt door een aantal overeenkomsten die men in voorbeelden van de natuurlijk taal kan aantreffen. Zoals Grice (1975) al heeft aangetekend, wordt 'of' meestal gebruikt om alternatieven te introduceren, waarvan de spreker weet dat er één waar is, maar niet welke van de twee. Onder deze 'alternatieven'-interpretatie worden disjuncties inquisitief.

In hoofdstuk 2 heb ik het raamwerk van de Inquisitieve Semantiek en detail gepresenteerd. De semantiek is een 'update'-semantiek waarbinnen uitingen worden geïnterpreteerd als context change potentials (context veranderende potentialen), functies van (informatie-)toestanden naar (informatie-)toestanden. Toestanden zijn gedefiniëerd als reflexieve en symmetrische relaties op deelverzamelingen van indices. Indices op hun beurt zijn functies van atomaire zinnen naar waarheidswaarden. Het kernbegrip in de definitie van toestanden is de 'onverschilligheids'-relatie. De indices in een toestand zijn met elkaar verbonden precies wanneer we niet geïnteresseerd zijn in het verschil tussen de twee. Uitingen kunnen indices afvoeren uit een toestand, of ze van elkaar losmaken, en aldus kunnen zij data toevoegen, of een issue inbrengen. De cruciale noties van *informativiteit* en *inquisitiviteit* zijn gebaseerd op deze twee effecten. Met betrekking tot een of andere toestand is een zin informatief, wanneer de update van die toestand met de uiting sommige indices uit de toestand verwijdert, terwijl hij inquisitief is wanneer de uiting sommige van die indices ontbindt. In termen van deze twee noties kunnen we drie zinstypes onderscheiden: *beweringen*, die informatief, maar niet inquisitief zijn; *vragen*, die inquisitief zijn, maar niet in-

formatief; en *hybriden*, die zowel informatief als inquisitief zijn. De syntaxis en de semantiek van deze inquisitieve logica is gepresenteerd in de secties 2.1.1 en 2.1.4.

De Inquisitieve Semantiek is tevens uitgerust met een systeem voor dialoog management dat is ontwikkeld met het doel om samenhangende dialogen tussen coöperatieve deelnemers te modelleren. Dialoogzetten worden aangestuurd door dialoogprincipes die zijn ingegeven door de volgende regels van de griceaanse pragmatiek.

1. Onderhoudt een gemeenschappelijke grond ('common ground')!
   (a) Vermijdt uitingen die niet door uw informatietoestand ondersteunt worden!
   (b) Houdt uw toestand consistent! & Maak niet-acceptatie publiek!
2. Wees zo inschikkelijk ('compliant') als u maar kunt!

Het tweede principe relateert aan de logische notie *inschikkelijkheid* ('compliance') van het systeem, die gedefiniëerd is als een relatie tussen uitingen en toestanden. Een uiting is 'compliant' met een gegeven toestand als de update van die toestand met de uiting een nieuwe toestand oplevert die niet minder informatief en ook niet meer inquisitief is — bovendien moeten alle mogelijkheden in de nieuwe toestand mogelijkheden zijn van de oorspronkelijke toestand, of verenigingen daarvan. Een centraal onderdeel van het dialoog management systeem is de gemeenschappelijke grond ('Common Ground'), technisch een bepaalde stapel ('stack') van informatietoestanden. Elke uiting wordt opgevat als een dialoogzet die de Common Ground verandert door de stapel op te hogen, door er een of meer nieuwe toestanden op te zetten. Zulke veranderingen van de Common Ground komen tot stand door speciale bewerkingen die te maken hebben met de opname van de semantische en pragmatische inhoud van de uiting. De opname van deze inhoud bestaat uit, respectievelijk, het *primaire* en *secundaire inbegrip* ('uptake'), waarbij de verwerking van de pragmatische inferenties (secundair inbegrip) verplicht de verwerking van de semantische inhoud (primair inbegrip) volgt. Deze pragmatische operatie wordt altijd uitgevoerd, alhoewel het alleen effect sorteert in speciale gevallen. In eerste instantie is ieder inbegrip (primair en secundair) voorlopig, en pas met de volgende beurt van de respondent wordt bepaald of deze vormen van ingebrip ook daadwerkelijk de Common Ground veranderen. Met deze opzet, is het mogelijk en eenvoudig om kritische dialoogzetten in het systeem in te bouwen. De details van het systeem van dialoog management kunnen gevonden worden in sectie 2.2; sectie 2.2.2 concentreert zich op de technische details van de operaties van primair en secundair inbegrip; sectie 2.2.3 behandelt de absorptieregels, het model van de responsen.

De kern van het proefschrift treft u aan in de hoofdstukken 3 tot 5, waarin ik een nieuwe, contextgevoelige analyse van focus heb voorgesteld door de toepassing en uitbreiding van het systeem van Inquisitieve Semantiek. (In hoofdstuk 6 heb ik de door mij voorgestelde analyse uitgebreid met een interpretatie van structurele focus in het Hongaars.) Om tot een adequate theorie van focusing te komen heb ik een analyse gegeven van het verschijnsel van de vraag-antwoord verhouding: de notie van congruentie, exhaustificatie van antwoorden, en het focusgevoelige partikel *'only'*. De kern van mijn analyse houdt in dat de focus structuur van een uiting een speciale verdeling in thema en rhema oplevert. Het thema van een zin met focus is een inherente vraag, die bepaald is door de plaatsing van de focus. Mijn claim is dat het intonatiepatroon van een zin de verdeling bepaalt, en ook het thema zelf, dat een belangrijke rol in onze semantiek speelt. Het thema van de uiting in focus staat in een nauw verband met de feitelijke context, een door de focus bepaald verband, omdat het thema van de gefocuste zin compliant moet zijn met de feitelijk Common Ground. Op basis van mijn focus representatie kon ik een gerede analyse geven van congruentie tussen vraag en antwoord, van contrast in ontkenningen en van specificatie. Het derde hoofdstuk is gewijd aan de representatie van focus in de Inquisitieve semantiek (sectie 3.2.1), de analyse van vraag-antwoord congruentie (sectie 3.3.2), en de dialoog relaties van contrast en specificatie (sectie 3.3.3).

Ook de meer recente kwestie betreffende de exhaustieve interpretatie van antwoorden kwam aan de orde. Ik heb een analyse gegeven volgens welke de exhaustieve interpretatie van een gefocust antwoord valt toe te schrijven aan een pragmatische gevolgtrekking die technisch gesproken wordt voltrokken door het secundaire inbegrip van de uiting, de pragmatische operatie van *exhaustification*.

In hoofdstuk 5 heb ik tevens een analyse van 'only' voorgesteld. Mijn voornaamste stelling is dat het focusgevoelige partikel 'only' een toegevoegd, speciaal, issue introduceert dat overeenstemt met de verwachting dat meer individuen de gegeven eigenschap hebben (Zeevat 2008, Balogh 2005). Dit idee ligt uitgewerkt in de verdeling van een 'only'-zin die als thema de vraag oplevert *'zijn er meer?'*, en als rhema de exhaustieve bewering. Volgens mijn voorstel correspondeert 'only' met de semantische operator $\mathcal{ONLY}$ toegepast op de thema/rhema verdeling van de gefocuste uiting die het modificeert. Op deze manier geef ik een verantwoording van het feit dat verschillende focus-structuren verschillende semantische interpretaties opleveren. Voor wat betreft de betekenis-onderdelen van een 'only'-zin die onderwerp zijn van lopend debat, stel ik voor dat de begeleidende of positieve bijdrage is voorondersteld (Roberts 2006, Horn 1969, Rooth 1992), dat het thema overeenkomt met de verwachting en dat de exhaustieve/negatieve bijdrage als rhema beweerd wordt.

(104) Alleen AMY is gisteren gekomen.
voorondersteld: Amy is gisteren gekomen
thema: is er gisteren behalve Amy nog iemand gekomen?
rheme: behalve Amy is er gisteren niemand gekomen

Na mijn benadering van focus uitgelegd te hebben heb ik in hoofdstuk 6 de interpretatie van structurele focus in het Hongaars onderzocht, met speciale aandacht voor het welbekende verschijnsel van een exhaustieve interpretatie hiervan. Algemeen wordt beweerd dat de Hongaarse preverbale focuspositie geassociëerd wordt met een exhaustieve/identificerende semantische interpretatie. Ik stel een andere analyse voor, en claim dat we de exhaustieve interpretatie middels een pragmatische inferentie kunnen verkrijgen, net als voorgesteld voor focusing in het Engels. Evenzogoed is er een cruciaal verschil omdat in het Hongaars, als focusing niet ontlokt is door ander talige middelen (zoals contrastief topic, accentvermijdend werkwoord, enz.), dan geeft focusing een verplichte implicatuur van exclusiviteit aan die niet ingetrokken kan worden.

Voornaamste resultaten

Het belangrijkste resultaat van mijn proefschrift is dat het een uniforme analyse van focusing geeft die is gebaseerd op, en gemotiveerd door, overwegingen van discourse-semantische aard. Ik heb het logische systeem van de Inquisitieve Semantiek toegepast op juist dit verschijnsel in de natuurlijke taal. Om mijn analyse gestalte te geven heb ik het originele systeem van Groenendijk (2008) veranderd en uitgebreid, waardoor het een natuurlijke en uniforme manier geeft om congruente antwoorden te definiëren, discourse relaties zoals contrast, specificatie en ontkenning te verklaren, een analyse te geven van de exhaustieve interpretatie van (gefocuste) antwoorden, en, allerminst onbelangrijk, een nieuwe analyse van het focus partikel 'only'. De analyse valt bovendien uit te breiden naar het special geval van structurele focus in het Hongaars, en de interessante vraag naar de exhaustieve interpretatie daarvan.

Congruente antwoorden

Wat betreft de verhouding van vragen tot hun antwoorden is één van de belangrijkste begrippen het begrip van een congruent antwoord. Een geschikte notie van congruentie is vereist in elke semantische analyse van focusing, en in die hoedanigheid is het bediscussiëerd door zowel Rooth (1985, 1992) als Krifka (2001). De congruentie regels in Rooth's 'Alternatieven Semantiek' sluiten antwoorden met een verkeerde geplaatste focus uit, alsmede 'onder-gefocuste' structuren, maar 'over-gefocuste' antwoorden blijven een probleem. Om dit prob-

leem op te lossen moet een extra conditie toegevoegd worden, een voorkeur voor 'minder focusing', maar deze conditie is stipulatief, en het blijft onduidelijk wat "minder gefocust" precies betekent. In de 'Gestructureerde Betekenis Benadering' hanteert Krifka een congruentie-regel, die correspondentie verlangt van de vraag-achtergrond en de focus-achtergrond, om alle gevallen van niet-congruente correct te beschrijven.

De hier geboden analyse van congruente antwoorden verschilt van deze twee, omdat men in dit systeem geen aparte congruentie-regel hoef te definiëren, en geen behoefte heeft aan bijkomende condities. Het dialoog management systeem sluit niet-congruente antwoorden uit op basis van de logische notie van compliance, een notie die cruciaal is voor de ontwikkeling van een samenhangend discourse.

Contrast en specificatie

Omdat de inrichting van het dialoog management er van uitgaat dat alle updates allereerst voorlopig zijn, kunnen kritische dialoogzetten, en correcties door middel van contrast en specificatie, recht toe recht aan behandeld worden zonder de behoefte aan enige extra regels of condities.

Ontkenningen

In verband met contrast en specficatie heb ik ook in meer detail gekeken naar de dialoog-relatie van *ontkenning*. Vanuit dit nieuwe perspectief heb ik focusing en *'only'* onderzocht en hun gedrag in ontkenningen vergeleken. Met mijn analyse kan ik een directe verklaring geven van het verschijnsel, in de natuurlijke taal, dat de ontkenning van een zin met vrije focus de semantische inhoud ervan intrekt, terwijl dit bij 'only'-zinnen niet het geval is. Dit verklaart ook de asymmetrie met betrekking tot de corrigerende uiting achter een ontkenning als in 105.

(105) a. AMY kwam. Nee, BEN kwam. / #Nee, BEN kwam ook.
$\rightsquigarrow$ de ontkenning trekt in dat 'Amy kwam'

b. Alleen AMY kwam. #Nee, BEN kwam. / Nee, BEN kwam ook.
$\rightsquigarrow$ de ontkenning trekt niet in dat 'Amy kwam'

De analyse verantwoordt het intrekken/niet-intrekken van de betekenis-component van de begeleidende of positieve bijdrage, en kan ook verklaren dat na de ontkenning van de 'only'-zin de correctie het additieve partikel *'ook'* moet bevatten, terwijl dit niet gepast is na een ontkenning van een constructie met vrije focus.

Exhaustiviteit

De analyse die ik heb voorgesteld van de exhaustieve interpretatie van (gefocuste) antwoorden vormt de kern van hoofdstuk 4. In mijn analyse vat ik exhaustiviteit op als een conversationele implicatuur, die technisch gesproken tot stand wordt gebracht door het secundaire inbegrip van de uiting, de *exhaustificatie*-operatie. Mijn definitie is gebaseerd op de originele definitie van Groenendijk (2008), maar ik heb een nieuwe versie geformuleerd omdat Groenendijk's operatie bepaalde problemen heeft met voorbeelden uit de natuurlijke taal en met focusing. Mijn nieuwe definitie lost een aantal van deze gebreken op, en doet ook meer recht aan het algemene beeld van griceaans redeneren, omdat hij formeel de essentie vat van het griceaans Maxime van Kwantiteit: hij sluit alle strikt gesproken sterkere mogelijkheden in de actuele context uit. Met deze nieuwe exhaustificatie-operatie kunnen wij voorzien in de exhaustieve interpretaties van antwoorden met enkelvoudige focus, en samenstellingen (conjunctie, disjunctie) in focus, alsmede de 'scalaire' implicaturen van disjuncties.

(106) Wie kwamen er gisteren naar het concert?
   a. AMY kwam. $\rightsquigarrow$ en verder niemand
   b. AMY en BEN kwamen. $\rightsquigarrow$ en verder niemand
   c. AMY of BEN kwam. $\rightsquigarrow$ en verder niemand + en niet allebei

Sectie 4.2.2 behandelt exhaustificatie in detail en geeft een uniforme analyse die de bedoelde interpretatie van deze voorbeelden oplevert.

'Only'

Mijn analyse van 'only'-zinnen is gebaseerd op hun eigen verdeling in thema en rhema, die is medebepaald door, maar niet identiek met, de thema/rhema verdeling van de gefocuste zin die wordt gemodificeerd door 'only'. Ik bied een uniforme analyse waarbij, aan de ene kant, 'only' overeenkomt met een semantische operator die een exhaustieve bewering oplevert, en waarbij, aan de andere kant, ook het pragmatische effect wordt opgenomen van de aanwezigheid van een verwachting. Naast deze voordelige aspecten wil ik tevens, en nogmaals, benadrukken dat deze analyse ook recht doet aan het verschil tussen de ontkenning van een zin met vrije focus, en de ontkenning van de overeenkomstige 'only'-zin.

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