Scope Oddity

On the semantic and pragmatic interactions of modified numerals, negative indefinites, focus operators, and modals

Published by

LOT
Kloveniersburgwal 48
1012 CX Amsterdam
The Netherlands

phone: +31 20 525 2461
e-mail: lot@uva.nl
http://www.lotschool.nl

Cover illustration: *Scope Oddity* by Clarinde Wesselink

ISBN: 978-94-6093-322-6
NUR: 616

Scope Oddity

On the semantic and pragmatic interactions of modified numerals, negative indefinites, focus operators, and modals

Bereiksrariteit

Over de semantische en pragmatische interacties tussen gemodificeerde nummers, negatieve indefinieten, focusoperatoren en modalen

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor
aan de Universiteit Utrecht
op gezag van de rector magnificus, prof. dr. H.R.B.M. Kummeling,
ingevolge het besluit van het college voor promoties
in het openbaar te verdedigen op
vrijdag 7 juni 2019 des middags te 16:15

door

Dominique Blok

geboren op 1 juli 1989
te Amsterdam

Promotor: Prof. Dr. H.E. De Swart
Co-promotor: Dr. R.W.F. Nouwen

Voor papa en mama

Contents

Acknowledgements

I am writing this on one of the first sunny spring days of the year, in the garden of *Café de School* in Amsterdam, on an early afternoon that still feels like morning. I've postponed writing these acknowledgements until the very last minute, perhaps because it makes the end of the PhD stage of my life so final.

And what a great phase of my life this has been. I would like to thank Rick Nouwen for being a great supervisor. Rick, what I appreciated most was the freedom you gave me to explore my own interests rather than pushing me in any particular direction and the fact that you really listened to what I said during our meetings and then gave your input, following my lead rather than taking the lead yourself, even at times when I wasn't sure where I was going. Throughout this process I always looked forward to our meetings because they were often inspiring and I felt that I could discuss anything I wanted with you without being judged.

I would also like to thank my promotor Henriette de Swart. Henriette, there have been times when we disagreed or didn't understand each other's point of view but we were always able to discuss these disagreements in a way that was challenging and interesting. Your input forced me to think more clearly about the assumptions I was making and to write my dissertation for a wider audience. I also really like you as a person and I've always felt respected and taken seriously by you as a linguist and researcher.

I want to thank the other members of the ROSE project, Yaron McNabb, Stavroula Alexandropoulou, and Sofia Bimpikou, for many fruitful meetings and fun conferences. I really enjoyed the workshop in the castle, going to SALT at Stanford, MXPRAG in Berlin, and XPRAG in Chicago together, the workshop we organised in Utrecht, the ROSE talks, and the many lunches, dinners, and post-talk drinks we shared, and during which we discovered that we were all food, beer, and wine snobs.

I am grateful to the members of my committee, Liz Coppock, Jenny Doetjes, Yoad Winter, and Marjo van Koppen, for taking the time to read this book and for their helpful comments. A committee member who deserves special mention is Malte Zimmermann, who not only took the time to talk to me about my work on several occasions but also offered me a job in Potsdam, which I am hugely excited about.

The Utrecht linguistics PhD students are an amazing bunch of people, and I've loved working alongside them and sharing our ups and downs. Thank you Myrthe Bergstra, Desiree Capel, Marta Castella, Marjolein van Egmond, Jorik van Engeland, Heimir van der Feest Viðarsson, Ileana Grama, Alexia Guerra Rivera, Mirjam Hachem, Mengru Han, Carolien van den Hazekamp, Anna Sara Hexeberg Romøren, Marko Hladnik, Jet Hoek, Brigitta Keij, Suzanne Kleijn, Heidi Klockmann, Anne van Leeuwen, Zenghui Liu, Sandrien van Ommen, Liv Persson, Anne-France Pinget, Eva Poortman, Erin Pretorius, Andrea Santana Covarrubias, Assaf Toledo, Anna Volkova, Hanna de Vries, and Yipu Wei.

A special thanks goes to my officemates Maartje Schulpen, Franca Wesseling, Anqi Yang, Luying Hu, Jolien Scholten, Anja Goldschmidt, and especially

Björn 't Hart, who was not only my Utrecht officemate but also my remote Amsterdam officemate on several occasions, and who is one of the kindest and funniest people I know. Outside of Utrecht I want to thank Lotte Hendriks and Lena Karvovskaya for sharing the PhD experience with me (and, in the case of Lena, a memorable New Year's Eve) and being my friends.

I would like to thank our PhD coach Simone Veld for being great at her job and for giving me renewed energy and inspiration every time I talked to her.

I couldn't have done this research without the help of all people who so kindly filled out questionnaire after questionnaire of difficult questions about their language. Thank you Jeremy Kuhn, Lelia Glass, Todd Snider, James Collins, Juliet Stanton, Liz Coppock, Matthew Mandelkern, Ryan Bochnak, Heather Burnett, Elizabeth Bogal-Allbritten, Amanda Pogue, Peter Sutton, Peter Klecha, Tammi Stout, Aaron Steven White, Brian Buccola, Anna Sara Hexeberg Romøren, Heimir van der Feest Viðarsson, Kristin Klubbo Brodahl, Kristina Svensen, Michael Nguyen, Nathalie Scherf, Anthea Schöller, Siri Gjersøe, Evelyn Bosma, Sune Just Christensen, Sarah Rosenbech Nielsen, Jessica Waywell, Rickard Ramhöj, Karin Friberg Heppin, and Per Erik Solberg.

This dissertation benefited from conversations with many linguists who graciously took their time to share their thoughts with me: Liz Coppock, Eddy Ruys, Hedde Zeijlstra, Bernhard Schwarz, Lisa Bylinina, Marjo van Koppen, Valentine Hacquard, Peter Alrenga, Susi Wurmbrand, Daniel Büring, Ora Matushansky, Eric Reuland, Jeroen van Craenenbroeck, Hadas Kotek, Yasutada Sudo, and Sabine Iatridou.

Thank you to my lovely paranymphs Marlijn Meijer and Arno Straver for agreeing to be by my side when I defend this dissertation and hopefully making me a bit less of a nervous wreck on that day. Marlijn, you're one of my closest friends and sharing the PhD experience with you, albeit from a distance, has made me so much happier throughout this process. I've loved talking on the phone with you, visiting you in Berlin and in Cologne and seeing you in Amsterdam. I hope we'll stay as close as we are for the rest of our lives, until the day you're a 'reading aloud granny' (this doesn't work as well in English as it does in Dutch) and I'm a rock granny. Arno, you're one of the strongest people I know and I'm proud to be your cousin. I'm so happy that we've grown as close as we have, you're a bit like the brother I've always wished I had. I hope we'll have many more drinks, dinners, and talks together in the years to come!

I want to thank the many amazing, funny, and kind people I met at the Google Amsterdam office. You've all been great (you know who you are) and I so much enjoyed having lunch with you, having Friday afternoon (or evening, or night...) drinks together, playing fussball (or attempting to, in my case), and having drinks at Market 33. I had so much fun at the 90s Christmas party with all of you, and the day we all danced together on the Google boat at Gay Pride was one of the most fun days of my life. I will miss you all, but of course I will especially miss my fellow linguists: Margot Kraaikamp, Bibi Janssen, Roos Genet, and Dieke Oele. Bibi and Roos, I will never forget the trip we took to Porto to meet linguists from all over Europe. Margot and Bibi, it was great

to talk to you every day and to discuss the ups and downs of our lives with each other and support each other through what were turbulent times for all of us. Dieke, you're the kindest badass ever, thanks for helping me when I had a last minute LaTeX dissertation panic attack and starting a mini computational linguistics reading group with me. I'm looking forward to increasing our wine snobbery together this spring! And last but not least, Per Erik, our GVC coffees were the best and it was great to meet you in real life in Porto. You're my very first GVC friend, and I hope we'll stay friends, if not GVC friends then Skype friends or, even better, real life friends, for many years to come.

Eva Wissenburg and Marjolein Wennekers, we haven't been seeing as much of each other lately as I would have liked, but when we do meet I really appreciate the conversations we have, which somehow always turn out to be deeper and more personal than I expect. Julia Keers, the 'friend I met at a wedding', you've been the best writing retreat buddy! Thank you for sharing those experiences with me, allowing me to vent, reassuring me when I was getting stressed out, and making fun of the *treiterpater* with me. I'm also grateful that you introduced this city girl to 'your woods' but also spent many nights with me in Amsterdam, *Roodkapje* or otherwise.

I want to thank my friends from my feminist reading group Lieke bij 't Vuur, Eva van Viegen, and Roos Deen for all the lovely afternoons and evenings we spent together, strolling around the Sunday Market and having mulled wine and beer, discussing feminist literature only some of the time and our lives most of the time.

Indira Wakelkamp and Lea ter Meulen, I don't know what I would have done without you these past years. Thank you for introducing me to new music and new life experiences, for always being there for me, for your amazing sense of humour and for being so incredibly lovely and sweet. Indira, you've been one of my closest friends since we met during the Utrecht summer school when we immediately bonded over things like donkeys and happy endings. I will never forget those days together in the master, especially the day I tried to escape by running the wrong way and... well, we both know how that ended. You're one of the few people in my life I feel I can always call when I need someone (and yes, I know I don't do that enough!) and I hope I can be there for you as much as you're there for me.

Lea, I always felt like you were the one who got away until we suddenly became friends overnight. I will always remember the morning (or, let's be honest, afternoon) when we had breakfast after that night and we shared things with each other we rarely share with people. Whenever I talk to you I always feel like I grow a bit wiser and I feel like we understand each other effortlessly when we share our thoughts with one another (though we should really stop sharing other things than thoughts). You're a fantastic friend to have, and I'm not letting you get away again!

Annemarie van Dooren, we don't see each other a lot now that you're in the US, but whenever we do it seems like no time has passed and we can pick up our friendship (acquaintanceship?) from where we left off. You're one of the few people who laughs at all my stupid jokes and every time I see you it feels like coming home. I hope that wherever we both are in the world, we will always keep meeting somewhere and returning to just being us. If you're not sure how to respond to this with words, I'm sure you'll find 'other ways to make your intentions clear'.

Jeroen De Mol, I have now left the garden and am sitting at home, about to leave to have dinner with you at *Spirit*, and of course already feeling anxious about being called out for being late (though we both know you're the one who's always late). Even though you're now bald and look increasingly threatening, I'm so happy you're still in my life. When I'm with you I don't have to censor my mind to the degree that I normally do because I know you like our terrible and often disgusting jokes as much as I do. After everything that happened you feel like family to me, and no matter what happens, you will always be one of the people who matters most in my life.

I want to thank everyone in my family, and a special thanks goes to opa and oma. Opa, je bent de liefste, en ik hoop dat je net zo van mijn promotie geniet als je had gehoopt. Oma, you're not here to read this, but I hope that when you were still with us, you knew that I am standing on your shoulders. You had to give up your job and your dreams when you got married because you were a woman, but you always kept encouraging your daughter, my mother, and me to do what you weren't given the opportunity to do. I will never forget you and I will pass on what you gave me to future generations of women.

Papa en mama, dit boek is natuurlijk voor jullie. Ik pink een traantje weg nu ik dit schrijf omdat ik zoveel liefde voor jullie voel. Het is niet altijd makkelijk geweest maar ik ben jullie zo dankbaar dat jullie me het leven hebben gegeven, dat jullie altijd van me hebben gehouden, altijd in me hebben geloofd, me zelfvertrouwen en kracht hebben gegeven, met me hebben gepraat, me de vrijheid hebben gegeven om alles met jullie te delen.

Papa, je weet alles al, maar ik zeg het toch. Ik ben zo blij dat we zo'n hechte band hebben. We lachen wat af en hebben de grootste lol samen, op een manier die bij anderen nog weleens tot gefronste wenkbrauwen leidt, maar je begrijpt me ook als geen ander en als ik er doorheen zit weet ik dat jij me zult troosten en dat je precies de dingen weet te zeggen die me geruststellen en me beter doen voelen. En Hildegarde, dankzij jouw Alexanderlesjes ben ik mijn PhD met rechte rug doorgekomen. Je bent natuurlijk ook een allerliefste schat, en ik hou van je! Ik heb tijdens dit proces zoveel steun gehad aan de gesprekken met jullie in de Olympiadekeuken, onder het genot van biologische wijn en gebakken aardappeltjes, in huisjes in België, in Mahal met papa en de Waaghals met jullie allebei. Elke keer als er iets was plozen we dat samen helemaal uit. Jullie vroegen stevig door en maakten grapjes, en altijd ging ik met een lichter hoofd en een blijer hart weer weg. Ik weet niet wat ik zonder jullie zou doen.

Mama, het is zo fijn dat het zo goed is tussen ons, en je bent de liefste mama van de wereld. Ik ben je er superdankbaar voor dat je er alles aan hebt gedaan om me te helpen in het leven, natuurlijk door bijvoorbeeld het huis maar nog veel meer door het goede voorbeeld te geven met je eigen succes en door me altijd goed advies te geven. Ik vind het altijd heerlijk om met je te bellen over hoe het met ons allebei gaat, lekker met je rond te hangen op de boot en om samen leuke dingen te doen in Rotterdam of in Amsterdam en om reisjes met je te maken. Je bent er helemaal voor me en ik ben heel blij dat ik je altijd kan bellen met vrolijke dingen of minder vrolijke dingen, en dat je dan altijd met liefde en wijsheid reageert. Arnold, je bent superlief en ik waardeer het enorm dat je er altijd bent om me te helpen als ik weer eens hulpeloos naast een doorgeslagen stop sta. Ik ben blij dat je bij mijn moeder bent omdat ik haar zo'n lieverd gun als jij maar ook omdat ik het zelf heel fijn vind dat je in mijn leven bent!

Papa en mama, ik hou van jullie.

CHAPTER 1

Introduction

1.1 Scope and its importance in the study of language

A central idea in formal semantics is the principle of Compositionality (Partee, 1984; Szabó, 2017). This principle states that the meaning of a natural language expression depends on the meaning of its parts and the way these parts are combined. For instance, the meaning of (1) depends on the meanings of words such as *cat*, *won*, and *lottery*, but also on the position each of these words occupy. The fact that *a cat* is in subject position and *the lottery* is in object position ensures that we know that *a cat* is the winner and *the lottery* is what is being won.

(1) A cat won the lottery.

An important question in the study of semantics is how to square Compositionality with the existence of ambiguous sentences like (2). (2) can mean that there is a cat, say that this cat is called Nemo, and this cat is the winner of every lottery. (2) also has the reading that every lottery was won by a cat, but not necessarily by the same cat. For instance, Nemo won the Money Mewers lottery, Miep won the Cash for Carnivores lottery, and Moos won the Wealthy Whiskers lottery. If we assume the first reading, then the sentence is only true if one and the same cat is the winner of all the lotteries. If we assume the second reading, the sentence can also be true if different cats won different lotteries, as long as no non-cat won a lottery.

(2) A cat won every lottery.

If the meaning of a sentence does indeed depend on the meaning of its parts and the way the parts are combined, it is not clear how a sentence like (2) can have two meanings. After all, it only has one form and it is not obvious how its parts, the words, could be ambiguous in a way that would result in these two readings.

A first step towards a solution to this problem is to describe the nature of the ambiguity. The ambiguity in (2) is an instance of quantifier scope ambiguity: we obtain the first meaning when *a cat* takes scope over *every lottery*, as in (3-a), and the second one when the scopal relation is reversed, as schematised in (3-b).

(3) a. A cat x: x won every lottery y
b. Every lottery y: a cat x won y

There are different ways to account for quantifier scope ambiguity. One way is syntactic in nature: sentences like (2) actually have two syntactic structures. In the surface scope structure, *a cat* occurs higher in the structure than *every lottery*, yielding the reading that there is one single cat who won every lottery. In the inverse scope structure, *every lottery* occurs higher than *a cat*. This creates the reading that every lottery was won by a cat, but not all the lotteries were necessarily won by the same cat. The mechanism responsible for the inverse scope structure is Quantifier Raising or QR: the operation of moving the lower quantifier to a higher position at the syntactic level of representation responsible for interpretation (Chomsky, 1976; May, 1977). This approach entails that one sentence can have multiple underlying structures, and this accounts for the ambiguity of examples like (2). If we adopt this solution, Compositionality is a principle that does not operate on words in the order in which we pronounce them but rather on these underlying structures.

Another way to account for scope ambiguities is semantic in nature: we can say that the quantifiers *every* and *a* can have different meanings. Quantifiers can undergo type shifting operations, and their semantic type determines the order in which they are interpreted (Partee & Rooth, 1983; Hendriks, 1993). The quantifier that is interpreted last ends up taking scope over the other quantifier. When no type shifting occurs, we derive the surface scope reading. Shifting the type of the object quantifier or the verb of a sentence like (2) can yield the inverse scope reading illustrated in (3-b).[1]

Scope interactions have been widely studied (e.g. Chomsky, 1976; May, 1977; Partee & Rooth, 1983; Hendriks, 1993; Szabolcsi, 1997; Fox, 2000; Reinhart, 2006a). This is not surprising, because scope ambiguities can tell us a great deal about the nature of the linguistic system.

Let us first consider the option that the operation responsible for scope ambiguities is type shifting. This raises the question of where these type shifts take place. The first option is that they take place in the lexicon. Going down this route forces us to take a closer look at what the lexicon is: it is not simply a list of lexical items but rather a system in itself that comprises operations on these lexical items as well. The second option is that they take place at the level of syntax. This means that there must be covert operations on lexical items that take place during syntactic derivations. One way to do this is to assume the existence of covert operators in the syntax. These operators must come from somewhere, and this brings us back to the lexicon: even if type shifts happen at the level of syntax and not in the lexicon itself, the lexicon can provide the necessary operators to yield type shifts. It is clear that language users are able to get both readings of ambiguous sentences like (2). On a type shifting view, regardless of the level at which type shifts take place, this likely entails that the lexicon comprises not only lexical items and a means to combine them, but also operations on these lexical items. In other words, type shifting leads us to let go of the idea that the lexicon consists only of a list of words and morphemes. It can thus tell us something about the relationship between the lexicon and the syntax-semantics interface.

If we assume the existence of covert movement operations like QR, then scope ambiguities illustrate that meaning is not only affected by structure but

[1] There are yet other ways to account for scope ambiguities that I will not go into: Quantifying-in (Montague, 1973) and Cooper storage (Cooper, 1975, 1979, 1983)

that it can also reveal what structure looks like. For a sentence like (2), we can use the fact that it has two meanings to derive the information that it has two syntactic structures. If we assume the existence of covert movement, this means that there is no one-to-one mapping between form and meaning. Not only can one meaning be expressed by multiple forms, one surface form can also have multiple meanings, even if none of its lexical items are ambiguous and there is no ambiguity in constituency structure. Going down the syntactic route, the fact that speakers have the ability to use sentences that have multiple meanings and understand which meanings these sentences do and do not have shows that covert movement is part of the linguistic knowledge of language users. We cannot fully understand this linguistic knowledge if we do not understand the nature of covert movement.

However we analyse them, scope ambiguities show us that Compositionality cannot be a simple function from words and constituency structure to meaning. Instead, the relationship between utterances and meanings Compositionality identifies must be an indirect one: we either have to go through a type shifting process or we have to generate several different structures before we can compute meaning. To save Compositionality, we have two options: we can tamper with the words or with the structure. The first option involves positing that seemingly unambiguous words such as quantifiers are actually ambiguous: they can have several different semantic types. The second option entails that sentences that have one surface structure can have multiple different underlying structures. Thus, regardless of whether we assume type shifting or covert movement, the fact that a doubly quantified sentence can have two meanings leads us to deep questions about the linguistic system that involve the syntax-semantics interface and possibly its relation with the lexicon.

Understanding scope ambiguities is important for another reason: they do not only affect the semantics. According to some theories, their effects permeate all the way up to the level of pragmatics (e.g. Schwarz, 2013; Kennedy, 2015). This is something I will discuss in detail in chapter 4, but to get a feeling for what I mean, consider (4).

(4) The cat is required to spend at most 50 € a day.

This sentence has two readings. One of the readings is the one where the cat is not allowed to spend more than 50 € a day. This reading corresponds to the meaning of (5).

(5) The cat is allowed to spend at most 50 € a day.

The second reading is the reading that there is some minimum amount of money the cat must spend each day, and that minimum is between zero and fifty euros. Thus, every day the cat is required to spend some amount of money, and this amount of money is fifty euros or less. This reading carries an additional meaning component: there is the inference that the speaker does not know exactly what the minimum amount the cat has to spend is. This can be seen more clearly in (6).

(6) I don't know how much the cat is required to spend in a day, but I know it's at most 50 €.

For (7) the reading with the ignorance inference is the most prominent reading.

(7) If you park your car around here, you have to pay a fine of at most 200 €.

The speaker is not trying to say that the person who parks her car must not pay more than 200 € in fines. Instead, she wants to convey that it is not certain how high the fine will be, but the maximum possible fine is 200 €.

The meaning component of uncertainty as to what the exact number is is often considered to be a pragmatic inference (Büring, 2008; Coppock & Brochhagen, 2013; Schwarz, 2013; Kennedy, 2015). In the same literature, the ambiguity of examples like (4) is often attributed to scope. This ambiguity involves a scope shift of a different kind of quantifier than the types of quantifiers we have seen up to now, namely a quantifier over degrees (this is explained in detail in chapter 2).

The reading of (4) that resembles (5) — the reading that the cat cannot spend more than fifty euros a day — is taken to be a surface scope reading. The ignorance reading brought out in (6) is analysed as an inverse scope reading. Pragmatic ignorance inferences are said to be calculable from the inverse scope semantics but not the surface scope semantics. That is, we can only derive the ignorance inference of the second reading if we first apply a scope shifting operation (I discuss this in detail in section 3 of chapter 4).

Thus, the assumption is that the scope shift not only affects the semantics of a sentence; it indirectly affects its pragmatics as well. It yields two (and sometimes more) different scope configurations for one sentence, and these two scope configurations have two different meanings. These different meanings can in turn give rise to different pragmatic inferences. In this case, one meaning yields the inference that the speaker is uncertain about the precise amount under discussion and the other does not yield this inference.

In sum, studying scope is crucial for our understanding of how language works in that it is a key part of understanding how form and meaning, both semantic and pragmatic, are mapped to one another. Scope thus plays an important role not only at the syntax-semantics interface but also at the semantics-pragmatics interface.

1.2 This dissertation: constraints on scope taking

It is known that inverse scope readings are not always attested and that therefore, scope shifting operations must be restricted somehow (e.g. Carlson, 1977;

Beghelli, 1993, 1995; Beghelli & Stowell, 1997; Szabolcsi, 1997; Fox, 2000; Reinhart, 2006a, 2006b; Ruys & Winter, 2010; Iatridou & Sichel, 2011; Mayr & Spector, 2012). For example, the negative quantifier *no lotteries* cannot take scope over *every cat* in (8).

(8) Every cat won no lotteries.

If it did, we would get the meaning represented in (9): for no lotteries is it the case that every cat won it. So: for all lotteries there was at least one non-cat winner. This can be true in a scenario where every cat won a lottery but no cat won all the lotteries.

(9) For no lotteries x: every cat won x

(8) does not have this reading. Instead, it only has the stronger surface scope reading that for every cat it is the case that she did not win a lottery. In other words, no cat won any lotteries.

The example in (10) is similar: it means that there is some cat, and this cat won no more and no fewer than two lotteries.

(10) Some cat won exactly two lotteries.

A scope shift would result in the reading illustrated in (11): there are exactly two lotteries for which it is the case that they were won by some cat.

(11) For exactly two lotteries x: some cat won x

Say that there are three lotteries. The surface scope reading can then be true in a situation where all of the three lotteries were won by a cat, as long as one of these cats won exactly two lotteries. The inverse scope reading is false in this scenario, because three lotteries were won by a cat; not two. In a situation where two out of the three lotteries were won by a cat and all cats won only one lottery, the inverse scope reading is true. The surface scope reading is false, because no cat won exactly two lotteries. Intuitively, only the surface scope reading is an attested reading of (10).

Many authors have observed that scope interactions are severely restricted in cases like (8) and (10) as well as other types of cases (such as cases of degree quantifier movement, Kennedy, 1997; Heim, 2000, see sections 3.5 and 5.5 for elaborate discussions of this constraint). Nevertheless, these restrictions are rarely taken into account in studies that are not specifically about such restrictions. Throughout the literature, the default assumption is that when there are two or more operators in a sentence, there are also two possible scope configurations. What I will do in this dissertation is to show that this assumption is incorrect. We need to be far more careful when we propose analyses for sentences with multiple operators. When we look closely at the semantics such sentences can and cannot have, we can see that scope ambiguities are a much rarer phenomenon than they are thought to be throughout the literature on syntax, semantics, and pragmatics.

To make this point, I will consider three specific cases where scope ambiguities are thought to exist but where the relevant readings are not actually attested. In all of these cases, we either fail to observe certain readings that we would expect to see if we were dealing with a scope ambiguity or we see a different kind of ambiguity that we cannot explain by simply assuming QR or type shifts.

The first case, which will be discussed in chapter 3, is the case of split scope. Split scope sentences are sentences where it seems as though a quantified DP takes scope partly over and partly under some other operator. As I will show, these are cases where inverse scope readings, readings where the entire object DP takes wide scope, are not attested. If we assume that QR or type shifts are available for object DPs in these constructions, we wrongly predict that inverse scope readings do exist. Instead, we observe split scope readings. Thus, this is a case where the availability of scope shifts leads us to expect a certain type of ambiguity — surface scope or inverse scope — but where we instead see a different kind of ambiguity: surface scope and split scope. Recent theories of split scope (De Swart, 2000; Abels & Martí, 2010) assume that split scope readings are special kinds of inverse scope readings. To derive split scope readings, they must therefore assume that DP scope shifts are available. The lack of inverse scope readings shows that these mechanisms are in fact unavailable in these cases, which means that we need to think of a different way to account for split scope readings: one that does not rely on the unavailable inverse scope configuration.

The second case, in chapter 4, involves modified numerals. As mentioned earlier, sentences where a modified numeral co-occurs with a modal such as (4) are ambiguous between a reading that carries an ignorance inference and a reading that does not. In the literature on modified numerals, this ambiguity is taken to be linked to a scope ambiguity (Büring, 2008; Coppock & Brochhagen, 2013; Schwarz, 2013; Kennedy, 2015). The received wisdom is that in these types of sentences, the modified numeral can either take scope under the modal or undergo a scope shifting operation — degree QR — that lets it take scope over the modal. The semantics of the inverse scope configuration can then be used to calculate pragmatic ignorance inferences. The ambiguity we observe, then, is dependent on the availability of two possible scope configurations. I will show that the possible scope configurations sentences with modals and modified numerals have are more limited than the literature suggests. It is not the case that modified numerals can always take scope either under or over a modal: whether or not certain scope configurations are available depends on the kind of modal and the kind of modified numeral used. Because scope ambiguities are so restricted, we need to find a different way to account for the pragmatic ambiguity we observe. The availability of scope shifts implicates the existence of a surface scope reading and an inverse scope reading, but instead, the ambiguity that is actually manifested is an ambiguity between a reading that has ignorance inferences and a reading that does not. As in the split scope case, the simple expectation that we can either apply a scope shift or not leads us to expect a certain kind of ambiguity, but instead, there is a different kind of ambiguity that is not dependent on scope.

The third and final case has to do with relatively simple doubly quantified sentences like (2), (8), and (10). I discuss these in chapter 7. Here I show that two common assumptions made by linguists who work on syntax and semantics give rise to the prediction that inverse scope readings for these types of sentences are always available. The relevant assumptions are QR for type reasons and the Copy Theory of Movement. Our assumptions about the nature of the linguistic system predict that for any doubly quantified sentence, we get both a surface scope reading and an inverse scope reading, contrary to fact. This is thus a case where the unconstrained availability of scope shifts leads us to expect a certain type of ambiguity but where this ambiguity does not actually exist. The problem here is not only that current theories predict scope ambiguity but that they have no way to prevent scope ambiguities from arising: it is impossible to formulate such a constraint in the present system.

The cases I discuss in this dissertation cover the full range from syntax through semantics all the way to pragmatics. In this sense, they appear to have very little to do with one another. But the nature of all these problems is the same: in all three cases, scope ambiguities are assumed to be more prevalent than they are. In conjunction with other common and well-motivated assumptions in that particular area (syntactic assumptions, semantic assumptions, or pragmatic assumptions), this leads to incorrect predictions. Sometimes we predict ambiguity where there is none and sometimes we predict a different kind of ambiguity than the ambiguity that we see. Each time, my aim is to lay bare the relevant problems and to show that these problems are caused by the notion that scope shifts are freely available.

This study differs from existing work on restrictions on scope in two ways. First, I show that constraints on scope shifts exist in a much wider range of areas in the grammar than has thus far been observed. It is known that there are certain constraints on scope in the domain of quantifiers over individuals and negation, but constraints on scope interactions between other types of operators, such as modified numerals, modals, and negative indefinites, are less well-studied. This dissertation lays bare a number of scope constraints in these domains. In addition, it shows that certain phenomena in these areas have been given analyses that are built on non-existent scope configurations. I show that we need to take constraints on scope into account in our theories of these phenomena: we need analyses that give us the right semantics and pragmatics without relying on scope configurations that are not there. In addition, I show that even in the well-studied examples with two quantifiers over individuals such (2), (8), and (10), modern assumptions about the syntax-semantics interface predict the existence of far more scope ambiguity than is actually observed.

Second, unlike much of the work on restrictions on scope, such as Beghelli and Stowell (1997), the goal of this dissertation is not to explain why certain scope configurations are attested while others are not. Instead, what I do here is point out cases where scope ambiguities are wrongly assumed to exist. I then show that theories that build on the existence of these non-existent scope configurations cannot work. In other words: I lay bare certain scope constraints and show that this leads to problems for our accounts of certain phenomena, but I do not attempt to explain why the scope constraints are as they are. My goal is to show that in these cases we should not and cannot rely on run-of-the-mill scope shifts as a mechanism to explain the phenomenon and to offer an alternative explanation that avoids predicting unattested ambiguities.

The three cases where scope is more restricted than traditionally assumed are the common thread of this book. But, given that I point out many problems that these overgeneralisations lead to, I also feel compelled to offer some solutions. Chapter 5 and 6 contain a theory of both split scope and modified numerals. This theory is a way to account for the phenomena at hand without relying on any scope configurations that are not attested. I will argue that the readings we observe in these two areas are due to one and the same operation: movement of focus-sensitive elements; elements whose meaning contribution depends on certain prosodic properties of other words in the sentence. This unified analysis accounts for split scope readings as well as the ambiguity we see in the domain of modified numerals. Without needing any unavailable scope configurations, the analysis explains how split scope readings come about and why they come about in certain cases but not in others (chapter 5) and how different, both semantic and pragmatic, readings with modified numerals arise (chapter 6). Chapter 7, the chapter about sentences with two quantifiers over individuals, contains not only a description of the problem, it also contains a solution to it. In a nutshell, the solution I propose is that the mechanism we use to resolve type clashes must be different to the mechanism we use for scope shifts.

Aside from the wealth of new example sentences with cats, I believe that this dissertation contains two important contributions. The first is that we need to shun the default assumption that when a sentence has two operators, it also has two possible scope configurations. We need to carefully evaluate which meanings do and do not exist before we make any assumptions about the existence of certain scope configurations. This is true in a variety of different domains: split scope sentences, sentences with modals and modified numerals, and run-of-the-mill doubly quantified sentences. The second contribution of this dissertation is a theory that it brings together the areas of split scope and negation on the one hand and degree quantifiers and modified numerals on the other hand. This theory offers a focus-based, unified theory for the phenomena we see in these domains, and one that is not based on any non-existent scope configurations.

1.3 How to read this dissertation

The structure of the content chapters of this dissertation is given in table 1.1. The categories are defined below.

Ch.	Topic	Cat.
3	The problem with relying on DP scope shifts to account for split scope readings	1
4	The problem with relying on scope to derive readings and inferences for sentences with modals and modified numerals	2
5	A focus-based unified theory of split scope and the semantics of modified numerals	1,2
6	Enriching the focus-based theory with inquisitive semantics to account for the pragmatics of modified numerals	2
7	The overgeneration problem with QR for type reasons and the Copy Theory of Movement	3

Table 1.1: Structure of the dissertation

Category 1: Split scope
Category 2: Modified numerals
Category 3: QR and the Copy Theory of Movement

Although I have tried to include enough information in every chapter so that it can be read on its own, the reader who is interested in a particular subject can use the categories to pick out a set of chapters they wish to read.

Chapters 3, 4, and 7 all contain a discussion of one of the cases discussed above where scope interactions are more restricted than thus far assumed. The account that solves the problems in chapters 3-4 is in chapters 5-6. Chapter 7 also contains a solution to the problem discussed there.

In the next chapter I will give some background information on scope shifting operations. First I will briefly discuss how QR and type shifting work. Then I will discuss scope interactions involving degree quantifiers and specifically modified numerals, which will be a much discussed kind of scope interaction in this dissertation.

CHAPTER 2

Scope shifting operations

2.1 Introduction

This chapter contains a brief overview of different operations that can yield inverse scope readings. In the next section I will discuss how inverse scope readings come about in the domain of nominal quantifiers. This will play a role in my discussion of split scope in chapter 3 and in the more general discussion of inverse scope with nominal quantifiers in chapter 7. In section 2.3 I discuss how inverse scope readings can be created in the domain of degree quantifiers. This method will be used in large parts of this dissertation, mostly in discussions about modified numerals in chapters 4 and 6 but also briefly in my discussion of split scope in chapter 3.

2.2 Scope interactions with nominal quantifiers

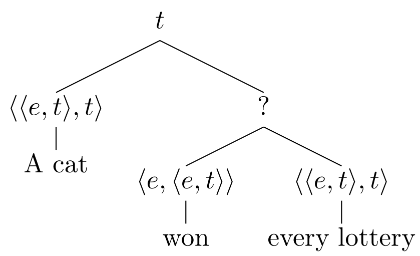
2.2.1 Quantifier Raising

The first mechanism that can be used to create inverse scope is Quantifier Raising. Quantifier Raising is a covert movement operation that allows quantifiers to move to higher positions in the structure. To begin, let us reconsider (1), repeated from the introduction.

(1) A cat won every lottery.

The syntactic structure of this sentence with the types of each constituent is given below.

(2)



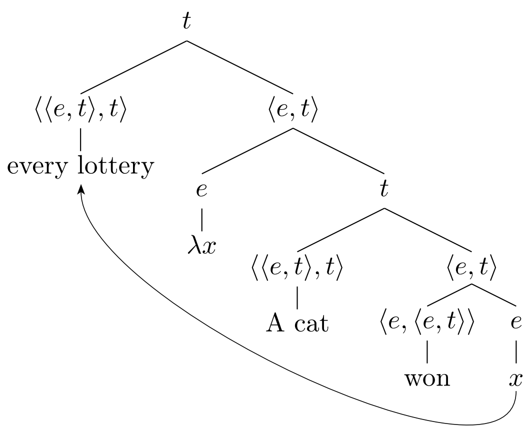
(2) is a vP. A central notion in modern generative syntax is the vP-internal subject hypothesis: the idea that a subject starts off in the vP and later moves up to the specifier position of the TP (Hale, 1978; see also McCloskey, 1997 for an overview of works on this). (2) thus represents the subject in its initial, vP-internal position.

This sentence is uninterpretable as it is because of the type clash between the predicate and the object quantifier. Before we can generate the inverse scope structure, therefore, we need to resolve this type clash. Quantifier Raising can be used for this. QR is an adjunction operation that consists of three components:

1. The object quantifier moves up and adjoins to a node of type t
2. In doing so, it leaves behind a trace of type e
3. The sister of the moved quantifier is abstracted over, with the trace being interpreted as a variable bound by the lambda operator

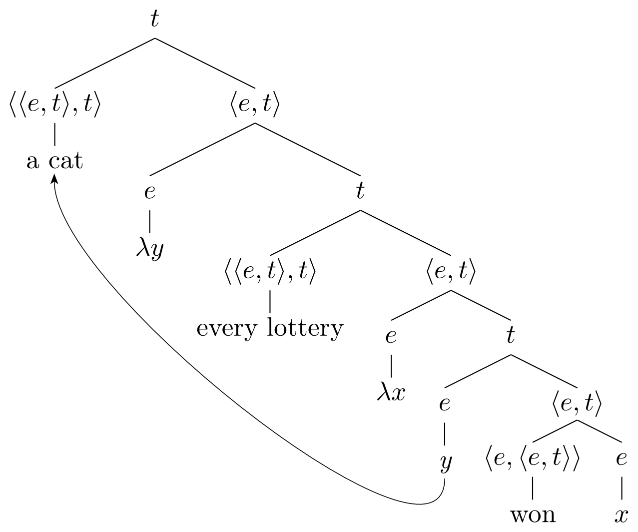
These steps are exemplified below. The quantifier *every lottery* moves up to a higher position and creates a lambda abstract, leaving behind a trace that is interpreted as a variable bound by the lambda abstract. By abstracting over the proposition *a cat won x*, a node of type $\langle e, t\rangle$ is created. The denotation of this node can be taken as an argument by *every lottery*, resolving the type clash.

(3)



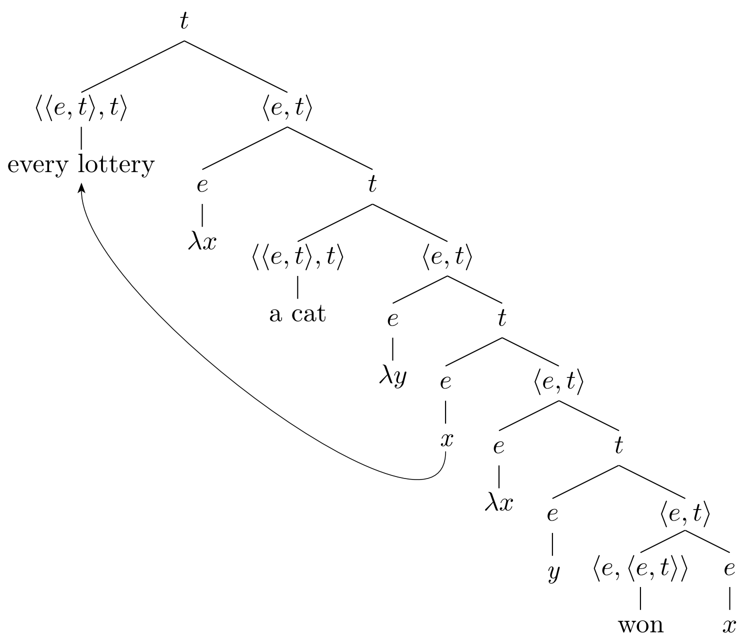
Afterwards, the subject *a cat* needs to move from its original position in the vP in (3) to its final position in the TP, as described above. In doing so, it ends up above the object quantifier *every lottery*. This step is shown below.

(4)



The overt movement of the subject quantifier to its position in the specifier of the TP gives it scope over the object quantifier. If we want to generate an inverse scope structure, another instance of QR is needed.[1] This is shown in (5).

(5)



[1] A more modern approach is reconstruction: interpreting the subject *a cat* in its lower position. See chapter 7 for discussion.

The structure in (5) is the structure from which we can derive the inverse scope reading. To see this, consider the traditional denotations of the quantifiers *a cat* and *every lottery* below. *A cat* takes a set and says that there exists a cat who is in this set. *Every lottery* also takes a set and says that all lotteries are in this set.

(6) $[\![\text{a cat}]\!] = \lambda P\ .\ \exists y[\text{cat}(y) \wedge P(y)]$

(7) $[\![\text{every lottery}]\!] = \lambda Q\ .\ \forall x[\text{lottery}(x) \rightarrow Q(x)]$

Given these denotations, the surface scope reading of (1) is (8): there exists a cat y such that for all lotteries x, this cat won x. Thus, one single cat, for example the cat Nemo, won all of the lotteries.

(8) $\exists y[\text{cat}(y) \wedge \forall x[\text{lottery}(x) \rightarrow \text{won}(y, x)]]$

The inverse scope reading is given in (9). This says that for all lotteries x, there exists some y that won x. In this case, it is still possible that Nemo won all of the lotteries, but it is also possible that Nemo won only one lottery and other cats won other lotteries, as long as every lottery was won by some cat.

(9) $\forall x[\text{lottery}(x) \rightarrow \exists y[\text{cat}(y) \wedge \text{won}(y, x)]]$

Thus, we can use covert movement to explain quantifier scope ambiguity. Moving the object quantifier two times — once for type reasons and once for scope reasons — creates an inverse scope reading. We assume that one surface string can have two underlying structures: one where the object quantifier only undergoes QR once and one where it undergoes QR twice. The first structure corresponds to the surface scope reading and the second yields the inverse scope reading.

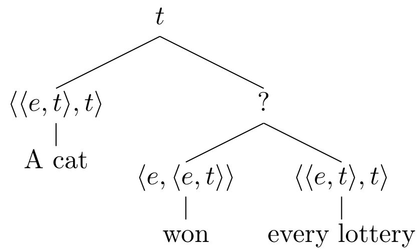
QR is the tool I will use to generate inverse scope readings throughout this dissertation, primarily because this is done in most of the preceding literature on which this dissertation is built and also because it provides an easier way to illustrate scope ambiguities. However, I am not tied to this particular way of thinking about scope shifting, and I believe that most, if not all, of my observations and analyses can be translated to a type shifting framework, which I will discuss in the next section. In chapter 7 QR will be my object of study itself. There I will claim that the fact that one and the same mechanism is used for resolving type clashes and creating inverse scope readings is problematic under modern syntactic assumptions.

2.2.2 Type shifting

Now let us consider the method of type shifting to obtain inverse scope readings. I will use Hendriks's (1993) type shifting account to illustrate this framework. We again start off with the sentence in (1) and the structure with the type clash in (2), repeated below.

(1) A cat won every lottery.

(2)



Now the type clash can be resolved through type shifts. In Hendriks's work, this type shift is applied to the predicate *won*. The relevant type shift is given in (10).

(10) Surface scope type shift
$\lambda R_{\langle e,\langle e,t\rangle\rangle}\lambda Q_{\langle\langle e,t\rangle,t\rangle}\lambda P_{\langle\langle e,t\rangle,t\rangle}.P(\lambda y.Q(\lambda x.R(y,x)))$

This type shift turns a two-place predicate over individuals, of type $\langle e,\langle e,t\rangle\rangle$, into a predicate over quantifiers, of type $\langle\langle\langle e,t\rangle,t\rangle,\langle\langle\langle e,t\rangle,t\rangle,t\rangle\rangle$, as below.

(11) $[\![\text{win}]\!] = \lambda Q_{\langle\langle e,t\rangle,t\rangle}\lambda P_{\langle\langle e,t\rangle,t\rangle}.P(\lambda y.Q(\lambda x.\text{win}(y,x)))$

Win can now take *every lottery* as an argument. This resolves the type clash and generates the surface scope reading, repeated below.

(8) $\exists y[\text{cat}(y) \wedge \forall x[\text{lottery}(x) \rightarrow \text{won}(y,x)]]$

Type shifts can also be used for scope shifting. If we use the type shift in (12) instead of the one in (10), we generate the inverse scope reading.

(12) Inverse scope type shift
$\lambda R_{\langle e,\langle e,t\rangle\rangle}\lambda Q_{\langle\langle e,t\rangle,t\rangle}\lambda P_{\langle\langle e,t\rangle,t\rangle}.Q(\lambda y.P(\lambda x.R(y,x)))$

This type shift again turns *win* into a predicate over quantifiers, but now the object quantifier is interpreted after the subject quantifier, as below.

(13) $[\![\text{win}]\!] = \lambda Q_{\langle\langle e,t\rangle,t\rangle}\lambda P_{\langle\langle e,t\rangle,t\rangle}.Q(\lambda y.P(\lambda x.\text{win}(y,x)))$

This yields the inverse scope reading in (9).

(9) $\forall x[\text{lottery}(x) \rightarrow \exists y[\text{cat}(y) \wedge \text{won}(y,x)]]$

In sum, type shifting is another method we can use to generate inverse scope readings. In this case, we can save the Compositionality Principle — the meaning of a sentence depends on the meaning of its parts and the way these parts are combined — by saying that the parts of a doubly quantified sentence are subject to type shifts and are therefore ambiguous. The ambiguity of the parts yields ambiguous sentences. In Hendriks's account, the ambiguous part is the predicate. Another possibility is to let the quantifiers themselves be ambiguous (e.g. Partee & Rooth, 1983).

Type shifting is similar to QR in that both mechanisms result in the quantifier being interpreted high and there being a bound variable in the lower position where the quantifier is pronounced. The difference between the two kinds of operations lies in the fact that for QR a separate representational level is needed that forms the basis for interpretation. In the type shifting framework, there is only one representational level, with systematised lexical ambiguities yielding different interpretations.

Type shifting will play a role in two places in this dissertation: in my discussion of de Swart's (2000) account of split scope in chapter 3 and in chapter 7, where I will propose an account of quantifier scope ambiguity that uses both QR and type shifting. Nevertheless, I will mostly use QR to create inverse scope readings in this dissertation. Given the fact that the result of both mechanisms is the same and that both mechanisms are thought to be generally available, my observations and analyses can generally be translated to a type shifting framework.

2.3 Scope interactions with degree quantifiers

2.3.1 Degree quantifiers

In this chapter so far I have only discussed scope interactions between quantifiers over individuals: quantifiers of type $\langle\langle e,t\rangle,t\rangle$. In this section I will consider a different kind of quantifier: quantifiers over degrees, of type $\langle\langle d,t\rangle,t\rangle$. Given their type, we expect degree quantifiers to be able to undergo QR or type shifts in parallel with quantifiers over individuals. Here I will delve into these kinds of cases: scope interactions between modals and quantifiers over degrees. A large part of this dissertation will be concerned with these types of scope interactions. Specifically, chapters 4 and 6 and to an extent also chapters 3 and 5 will be about scope interactions between modified numerals and modals. I will discuss these later in this section.

Before we get to the core data, let us start at the beginning and go over the notion of degrees and degree quantifiers. Degrees are often considered to constitute a separate type, type d, that exists alongside the e and t (and s) types. One area where degrees are thought to play a role is in the domain of gradable adjectives. For instance, the adjective *tall* can be defined as in (14) (Heim, 2000, see e.g. Kennedy, 1997; Kennedy & McNally, 2005; Kennedy, 2007 for other analyses). Here *tall* is a relation between degrees and individuals.

(14) $[\![\text{tall}]\!] = \lambda d \lambda x \;.\; tall(x,d)$

In (15), *that* denotes a degree of type d.

(15) [You have to be 1.40 tall to ride this rollercoaster.] Lucy is that tall.

Together, these assumptions yield the denotation in (16): Lucy's height reaches the degree 1.40.

(16) *tall*(Lucy,1.40)

This means that Lucy is 1.40m tall or taller. That is, the equivalence in (17) holds.

(17) $tall(x, d) \;\Leftrightarrow\; x$'s height $\geq d$

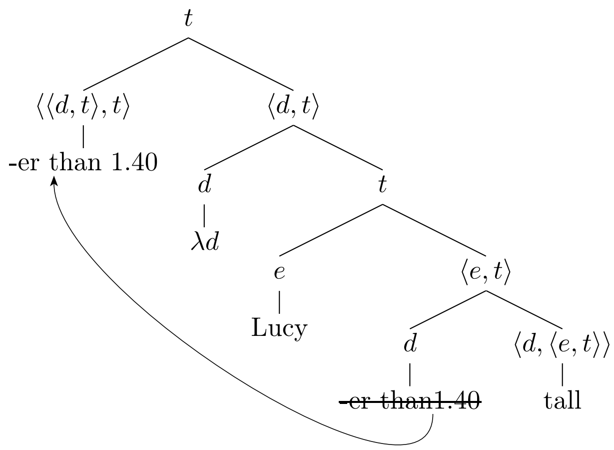
This is because if Lucy's height is anywhere above 1.40, her height still reaches 1.40. If her height is 1.50 or 1.60, for example, then we can still say that Lucy is tall to degree 1.40. If her height is 1.30, we cannot say that her height reaches 1.40. Therefore, (16) has an *at least* interpretation: Lucy is at least 1.40m tall.

So far, we have observed that natural language contains individuals of type e and quantifiers over individuals of type $\langle\langle e, t\rangle, t\rangle$. If language also has degrees of type d, the question that arises is whether we also have quantifiers over degrees of type $\langle\langle d, t\rangle, t\rangle$. Heim's (2000) answer to this question is that we do. According to Heim, sentences with comparative constructions like (18) involve degree quantification.

(18) [You have to be 1.40 tall to ride this rollercoaster.] Lucy is taller than that.

The structure of this sentence is shown in the tree in (19).

(19)



Heim (2000) takes the comparative morpheme *-er* to have the semantics given in (20).

(20) $[\![\text{-er}]\!] = \lambda d \lambda P \;.\; max\ (P) > d$

In a comparative construction like *taller than that*, *than that* fills the degree slot of *-er*, as in (21). *-er than that*$_{1.40}$ takes a set of degrees or degree predicate

P, of type $\langle d, t\rangle$, as an argument. It returns the proposition that the maximal degree in this set is higher than 1.40. *-er than that*$_{1.40}$ is thus a quantifier, but rather than being a quantifier over individuals of type $\langle\langle e, t\rangle, t\rangle$, it is a quantifier over degrees of type $\langle\langle d, t\rangle, t\rangle$.

(21) $[\![\text{-er than that}_{1.40}]\!] = \lambda P\ .\ \mathit{max}\ (P) > 1.40$

The maximality operator *max* is defined as in (22): it picks out the unique degree (signified by ιd) in the set P for which it is the case that all degrees d' in the set are either equivalent to d or lower than d.

(22) $\mathit{max}\ (P) = \iota d\ .\ P(d) \wedge \forall d'\ [P(d') \rightarrow d' \leq d]$

Now let us consider the syntactic derivation of (18). As shown in (19) above, the degree quantifier starts off being the sister of the adjective *tall*. Being of type $\langle\langle d, t\rangle, t\rangle$, it cannot be interpreted there. For this reason, it is thought to undergo QR and create lambda abstraction over degrees in doing so. As far as I know, type shifting hasn't caught on in the degree semantics world, and QR appears to be the mechanism of choice. Although it is undoubtedly possible to derive the same readings using type shifts, I will only discuss QR here and I will use degree QR throughout this dissertation. As mentioned earlier, the points I make about QR generally also hold for type shifting.

Having applied QR, we derive the meaning in (23): the maximal degree to which Lucy is tall is higher than 1.40.

(23) $[\![\text{Lucy is taller than that}_{1.40}]\!] = \mathit{max}\ (\mathit{tall}(\text{Lucy}, d)) > 1.40$

The reason why we talk about maximal degrees is that, as explained above, if Lucy is tall to degree 1.50, she is also tall to degree 1.40 or 0.35 or any other degree below 1.50. Thus, her height is the maximal number for which it can truthfully be said that Lucy is tall to that degree. For this reason, (23) simply means that Lucy's height exceeds 1.40.

When expressions of type $\langle\langle d, t\rangle, t\rangle$ occur under a modal, we expect their mobility to yield two separate readings: a surface scope reading and an inverse scope reading. Heim (2000) has shown that this is indeed the case. Her example is given in (24).

(24) [This draft is 10 pages.]
The paper is required to be less long than that.

(24) can have the two LFs in (25), where the degree quantifier *-er than that* takes scope either over or under the modal *required*.

(25) a. required [[less than that] [λd [the paper be d long]]]
b. [less than that] [λd [[required [the paper be d long]]]]

This creates the two denotations given in (26).

(26) a. $\Box[max\{d : \text{long}(p, d)\} < 10p]$
b. $max\ \{d : \Box\text{long}(p, d)\} < 10p$

(26-a) represents the surface scope interpretation: there is a certain requirement, and this requirement is that the paper be less long than ten pages. In other words, the paper cannot be ten pages or longer. The inverse scope interpretation in (26-b) is that the maximum number for which it is required that the paper have that many pages is lower than ten. That is, there is no need for the paper length to reach ten pages; less is fine too.

2.3.2 Modified numerals

Modified numerals are often considered to be degree quantifiers (Hackl, 2000; Nouwen, 2010; Schwarz, 2013; Kennedy, 2015). Analysing modified numerals as $\langle\langle d, t\rangle, t\rangle$ type expressions has profound consequences for the number of readings we can derive for sentences that contain modified numerals. For a sentence like (27), we now predict not only that the object DP *at most five vodkas* can take scope over the modal, the modified numeral *at most five* can also take wide scope by itself, leaving *vodkas* behind. As will become clear below, this leads to a different kind of wide scope reading.

(27) Lucy is required to drink at most five vodkas.

A large part of this dissertation will be concerned with these types of scope interactions between modified numerals and modals. Below I will discuss how these scope interactions work in accounts where modified numerals are discussed as degree quantifiers, although for the account I will present in chapters 5-6 I will argue that certain types of modified numerals are focus-sensitive operators rather than degree quantifiers.

To start, let us consider Kennedy's (2015) denotations of the comparative numeral modifiers *more than* and *less/fewer than*, given below.

(28) $[\![\text{more than}]\!] = \lambda d \lambda P\ .\ max\ (P) > d$

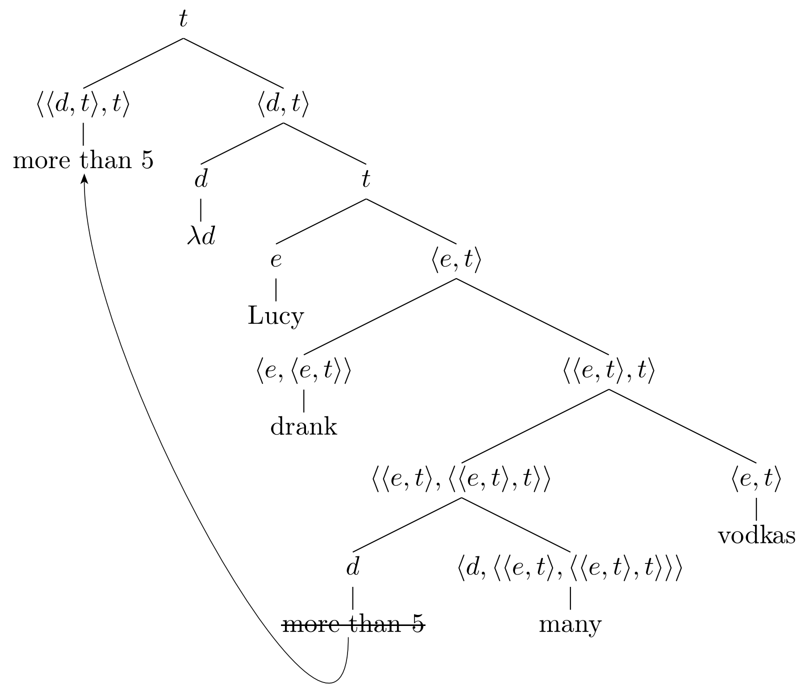
(29) $[\![\text{less/fewer than}]\!] = \lambda d \lambda P\ .\ max\ (P) < d$

Again, P is a degree predicate and d is a degree, making these comparative numeral modifiers of type $\langle d, \langle\langle d, t\rangle, t\rangle\rangle$. Modified numerals such as *more than 5*, where the numeral has filled the degree slot of the numeral modifier, are of type $\langle\langle d, t\rangle, t\rangle$.

To see how these denotation works, let us consider (30) and the corresponding structure in (31).

(30) Lucy drank more than five vodkas.

(31)



Since Hackl (2000) it has been assumed that a modified numeral combines with a 'counting quantifier' *many*, which has the denotation given below. What *many* does is to take a degree d and return a quantifier over individuals. The function of *many* is simply to turn a DP containing the modified numeral into a regular quantifier over individuals.

(32) $[\![\text{many}]\!] = \lambda d_d \lambda P_{\langle e,t\rangle} \lambda Q_{\langle e,t\rangle}.\exists x[\#x = d \wedge P(x) \wedge Q(x)]$

So let us begin at the bottom of the derivation. The quantifier *more than 5* cannot take *many* as an argument nor is it of the right type to be *many*'s argument. As above, the degree quantifier undergoes QR, leaving a degree variable d behind. The denotation of the object quantifier *d-many vodkas* is given in (33).

(33) $[\![d\text{-many vodkas}]\!] = \lambda Q_{\langle e,t\rangle}.\exists x[\#x = d \wedge \text{vodkas}(x) \wedge Q(x)]$

As can be seen in the tree, there is still a type clash between the predicate *drank* and the object quantifier *d-many vodkas*. One of the mechanisms discussed in the first section of this chapter can be used to resolve this, but I will ignore this here to avoid overcomplicating matters. Continuing the derivation and adding the lambda abstract, the sister of *more than 5* is (34).

(34) $\lambda d \,.\, \exists x[\#x = d \wedge \text{vodkas}(x) \wedge \text{drank}(x)(\text{Lucy})]$

(34) is of type $\langle d,t\rangle$ and can be the argument of *more than 5*. The denotation

of (30) is given below.

(35) $[\![$Lucy drank more than five vodkas$]\!] = max\,[\lambda d\,.\,\exists x[\#x = d \wedge \text{vodkas}(x) \wedge \text{drank}(x)(\text{Lucy})]] > 5$

In the rest of this dissertation I will use the more elegant notation in (36) and I will also frequently simplify the notation to (37).

(36) $max\ \{\ d \mid \exists x[\#x = d \wedge \text{vodkas}(x) \wedge \text{drank}(x)(\text{Lucy})]\ \} > 5$

(37) $max\ \{\ d \mid \text{Lucy drinks } d \text{ vodkas}\ \} > 5$

(35), (36), and (37) all mean the same thing. The set is the set of degrees d such that there is an x with cardinality d. This x is an individual or group of individuals and it has the following properties: x is a vodka and x is drunk by Lucy. So we have the set of degrees or numbers such that Lucy drank that many vodkas. Then we say that the maximum number in that set is higher than five. If Lucy drank four vodkas, then the relevant set of degrees is $\{1, 2, 3, 4\}$. If it is true that Lucy drank four vodkas, then it is also true that she drank three, two, and one vodkas, but it is not true that she drank five vodkas. So: the maximum number such that Lucy drank that number of vodkas is four. This number is not higher than five, so in this scenario, the sentence is false. If she drank seven vodkas, then the relevant set is $\{1, 2, 3, 4, 5, 6, 7\}$. The maximum of this set is seven. Seven is higher than five, so the sentence is true.

To see how this kind of degree QR can lead to scope ambiguities, it is easiest to look at superlative numeral modifiers like *at least* and *at most*. Kennedy's (2015) denotations of these expressions are given below. Aside from the non-strict comparison relation ($\leq$ / $\geq$) instead of the strict comparison relation, the denotations are the same as the denotations of the comparative numeral modifiers.

(38) $[\![\text{at least}]\!] = \lambda d \lambda P\ .\ max\ (P) \leq d$

(39) $[\![\text{at most}]\!] = \lambda d \lambda P\ .\ max\ (P) \geq d$

The derivation happens in exactly the same way as the derivation with *more than* above. A sentence like (40), then, has the structure in (41) and the truth conditions in (42): the maximum number of vodkas Lucy drank is five or lower.

(40) Lucy drank at most five vodkas.

(41) [at most 5 [λd [Lucy drank d -many vodkas]]]

(42) $max\ \{\ d \mid \text{Lucy drinks } d \text{ vodkas}\ \} \leq 5$

We have seen that QR of degree quantifiers, like QR in the domain of quantifiers over individuals, is thought to happen to resolve a type clash. Degree quantifier QR can also account for certain scope ambiguities (Heim, 2000). For instance, consider (27), repeated below.

(27) Lucy is required to drink at most five vodkas.

If we look at (27) with only an $\langle\langle e,t\rangle,t\rangle$ lens, we can derive two readings: a reading where the object quantifier *at most five vodkas* takes narrow scope and one where it takes scope over the modal *required*. In the latter case, the reading we derive is that there is a set of specific vodkas Lucy is required to read — say, an Absolute vodka and a Ketel One vodka — and this set contains fewer than five vodkas. The surface scope reading does not necessitate the existence of specific books Lucy can read.

Now let us consider what readings we can derive when we allow degree QR. This operation can move *at most 5* to a position under the modal, as in (43-a), or over the modal, as in (43-b). The resulting truth conditions are given in (44-a) and (44-b) respectively.

(43) a. [$\Box$ [at most 5 [λd [Lucy drinks d-many vodkas]]]]
b. [at most 5 [λd [$\Box$ [Lucy drinks d-many vodkas]]]]

(44) a. $\Box$ [*max* { d | Lucy drinks d vodkas } $\leq$ 5]
b. *max* { d | $\Box$ [Lucy drinks d vodkas] } $\leq$ 5

(44-a), where *at most* takes narrow scope with respect to the modal, says that what is required is that Lucy drinks no more than five vodkas. That is, she is not allowed to drink six or more vodkas. The inverse scope reading in (44-b) says that the maximum number for which it is required that Lucy drinks that many vodkas is five or lower. That is, Lucy is required to drink some number of vodkas. The speaker does not say how many vodkas she has to drink. Instead, she only says that the number of vodkas Lucy must drink is no higher than five. This is compatible with a situation in which Lucy has been told that she absolutely must drink three vodkas, or five, but it is not true in a situation where she has been told she must drink ten vodkas. However, nothing stops her from drinking ten vodkas. Just because she only has to drink between zero and five vodkas does not mean that she cannot drink more once she has drunk the required number of vodkas. As this reading does not necessarily concern specific types of vodka, it is distinct from the reading where the entire object DP takes wide scope. I will discuss scope ambiguities with modified numerals and modals in detail in chapter 4. There I will claim that the types of scope interactions discussed in this section are actually far more limited than thus far assumed, which has both semantic and pragmatic repercussions.

2.4 Conclusion and outlook

In this chapter I briefly laid out two mechanisms we use to derive scope ambiguities for sentences that contain two quantifiers over individuals: QR and type shifts. Then I discussed quantification over degrees and scope interactions between modals and degree quantifiers, focussing specifically on modified numerals.

Analysing modified numerals as degree quantifiers has become the standard in the literature on this topic (Nouwen, 2010; Coppock & Brochhagen, 2013; Schwarz, 2013; Kennedy, 2015). There are good reasons for this. As shown above, degree quantifiers are mobile, so this analysis has the advantage of enabling us to give the modified numeral scope over a modal. This way, we can derive readings we cannot obtain by moving the entire quantified DP the modified numeral is in.

In this dissertation, however, I will ultimately argue for a focus-based theory of certain kinds of modified numerals.[2] I will argue that apart from QR with quantifiers of type $\langle\langle e,t\rangle,t\rangle$ and $\langle\langle d,t\rangle,t\rangle$, there is another way of scope taking for the phenomena at hand, namely a focus sensitive operator attaching to a position that is not its surface position. This is the only way we can account for the data and at the same time express the necessary constraints on scope shifting. The claim I will make is that the modified numerals that are focus-sensitive form a natural class with negative indefinites in split scope languages, and that split scope is the same phenomenon as that which results in readings where these modified numerals take scope over a modal.

There is a precedent for such an approach in the domain of modified numerals: Krifka (1999) and Geurts and Nouwen (2007), too, treat numeral modifiers as focus-sensitive operators. In these accounts, the DP in (27) has the structure in (45).

(27) Lucy is required to drink at most five vodkas.

(45) [at most [five vodkas]]

Thus, the numeral *five* and the noun *vodkas* form a constituent, with the numeral modifier *at most* c-commanding this constituent. This is distinct from the degree modifier-based accounts I discussed above, where the numeral forms a constituent with the numeral modifier (see e.g. (41)). As in the theory I will propose in this dissertation, the focus-sensitive numeral modifier is mobile in these accounts. This means that in examples with modals like (45), the numeral modifier can end up in a position above or below the modal, yielding scope ambiguities. There are well-documented semantic problems with these theories that I will not discuss here. In this dissertation I will ultimately follow the constituency structure and the focus-sensitivity aspect of these theories and propose a different semantics. In addition, I will claim that negative indefinites in split scope languages behave the same way as these focus-sensitive numeral modifiers.

The line of argumentation I use to reach this conclusion is as follows: in chapter 3, I discuss split scope. Here I argue that accounts of split scope that are based on DP movement overgenerate: by letting the entire DP take wide scope, the prediction is that wide scope readings exist as well as split scope readings. I show that this prediction is not borne out, which means that we need an

[2] To be precise: the modified numerals Nouwen (2010) calls Class B modified numerals.

account of split scope that moves only the determiner, not the DP as a whole. I show that Blok, Bylinina, and Nouwen's (2017) analysis of split scope does that. This account uses the mechanism of degree quantifier movement, discussed above, to generate split readings. Chapter 4, however, will show that Blok et al.'s analysis and degree quantifier accounts in general still overgenerate: they predict split scope readings and surface scope readings for all degree quantifiers. I show that not all alleged degree quantifiers are created equal. For instance, *at most* behaves very differently from *fewer than*.

In chapters 5 and 6 I present my analysis of split scope and modified numerals, which, as I've said, is not based on degree semantics but rather on focus semantics. I analyse negative indefinites in scope splitting languages and modified numerals such as *at least* and *at most* as focus-sensitive operators, which, I argue, take scope in a different way from other kinds of operators. This allows me to formulate restrictions on scope that existing accounts lack, and results in an analysis of split scope and modified numerals that does not overgenerate. Adding inquisitive semantics to the mix accounts for the epistemic inferences we sometimes see with these modified numerals, which I mentioned in the introduction of this book.

Thus, in chapter 3 and 4 I point out two ways in which current accounts of split scope and modified numerals overgenerate — predicting scope configurations that do not exist — and in chapter 5 and 6 I provide a focus-based account that explains the phenomena at hand without this overgeneration. In chapter 7 I zoom back out and point out that a similar, third overgeneration problem occurs in the more well-studied kind of doubly quantified sentences that only contain quantifiers over individuals. Throughout this dissertation, it is never my aim to explain why certain scope configurations do not exist. Instead, my goal is to present a theory that takes the relevant restrictions into account and is not built on the assumption that all possible scope configurations are available. The next chapter concerns the first of three cases of overgeneration I discuss in this dissertation: the case of split scope.

CHAPTER 3

Restrictions on split scope

3.1 Introduction

This dissertation covers three cases where scope ambiguities are more restricted than thus far assumed. In this chapter I discuss the first case where an ambiguity that our theories predict to exist is not actually attested. Instead, we get a different reading that corresponds neither to the surface scope reading nor to the inverse scope reading: the split scope reading. To set things up, let us consider example (1).

(1) Every student attended no parties.

While quite unnatural in English, (1) clearly has a surface scope reading but not an inverse scope reading. The surface scope reading is that for every student, it is the case that they did not attend any parties. The inverse scope reading would be the reading that for no parties it is the case that every student attended them. So: there was no party where every student was present. The inverse scope reading is entailed by the surface scope reading, and the sentence only has the stronger surface scope reading. It is judged as false in a scenario where every student attended some parties, but no single party was attended by every student.

The same facts are true for other Germanic languages such as Dutch and German. With a neutral intonation, the Dutch sentence in (2) only has the strong reading that no singer sang any song. If *geen lied* were able to take scope over *iedere zanger*, we would expect to see the weaker reading that there is no song that every singer sang. This reading is not attested.[1]

(2) Iedere zanger zong geen lied.
Every singer sang no song.
'Every singer did not sing a song.'

If we use the modal *mocht* instead of the nominal quantifier *iedere*, *geen lied* is still unable to take wide scope. Although this intuition may not be clear immediately, (3) does not have an inverse scope reading: it cannot mean that there is no specific song that the singer was allowed to sing.

(3) De zanger mocht geen lied zingen.
The singer may-PAST no song sing.
'The singer was not allowed to sing a song.'

Instead, (3) has what is referred to as a split scope reading. The sentence means that the singer was not allowed to sing any songs. As I will discuss in detail below, this reading is stronger than the inverse scope reading, which only says that there is no specific song the singer has been given permission to sing. The

[1] If we pronounce (2) with the so-called *hat contour* intonation, we get the reading 'not every singer sang a song' (Büring, 1997; Krifka, 1998). I will have more to say on this in chapter 5.

reason the split reading is called a split reading is because it seems as though the negative indefinite *geen* has been split up into two parts: a negative part and an existential part, where the negative part scopes over the modal and the existential part scopes under it. This can be seen in the English translation of the split reading: *the singer was <u>not</u> <u>allowed</u> to sing <u>a</u> song.*

In this chapter, I will show in detail that sentences like (3) have split readings but lack inverse scope readings. This constitutes the first case I discuss in this dissertation where the availability of scope shifts leads us to expect two readings, but where we only observe one of these readings. In the split scope cases, we expect to see an inverse scope reading and a surface scope reading. Instead, an unexpected third reading pops up, and the inverse scope reading does not exist at all.

This is the new focus I bring to the debate on the semantics of split scope: an account of split scope must therefore generate the split reading in a way that is independent from the inverse scope reading. If the split reading is obtained by first generating an inverse scope structure and then adding some extra machinery for the split reading, we expect both the inverse scope reading and the split reading to exist, contrary to fact. As I discuss in section 3.3, recent accounts of split scope do build split scope on top of inverse scope (De Swart, 2000; Abels & Martí, 2010).

Having established that split scope constitutes a case where inverse scope is not available even though it is predicted to be available, I will discuss an account of split scope that appears to be in line with the absence of inverse scope, namely the account of Blok et al. (2017). Blok et al. analyse split scope as a degree phenomenon where words like *geen* are analysed as quantifiers over degrees. These degree quantifiers can move up by themselves to create split readings, which removes the necessity to move up the whole DP and generate a non-existent inverse scope reading before the split reading can be derived. Thus, Blok et al.'s account, unlike De Swart (2000) and Abels and Martí (2010), can generate split scope readings without making the incorrect prediction that inverse scope readings exist as well. They do this by using determiner movement instead of DP movement.

However, the last two sections of this chapter show that this is still not enough. Blok et al. predict that all degree quantifiers can create split scope readings in the same way. There are good reasons for treating these expressions in the same way. As I explain in section 3.5, they are all constrained by the same scope constraint: the Heim-Kennedy Generalisation. Nevertheless, a closer look at the data reveals that there are differences within the class of quantifiers that Blok et al. single out as scope splitting expressions: not all degree quantifiers behave the same way with respect to split scope. In other words, the degree quantifier movement mechanism used by Blok et al. (2017) still overgenerates: it predicts more split scope readings than we actually observe. In particular, it predicts that all degree quantifiers can in principle give rise to split scope readings, contrary to fact. This will serve as the basis for chapter 4, where I will discuss the second case where scope shifts are more restricted than previously thought: the case of degree quantifier movement of modified numerals.

3.2 No inverse scope readings

Let us first consider what exactly split scope is. Split scope is a phenomenon in certain Germanic languages where an object quantifier seems to take scope partly under and partly over some other operator (Rullmann, 1995a; Jacobs, 1980, 1991; Kratzer, 1995; Geurts, 1996; Zeijlstra, 2004; Penka & Zeijlstra, 2005; De Swart, 2000; Abels & Martí, 2010; Penka, 2011). Consider the Dutch sentence given in (4).

(4) Petronella wil geen koopman trouwen.
Petronella wants no merchant marry.
'Petronella does not want to marry a merchant.'

If we simply assume that the object quantifier *geen koopman* can take scope either above or under the modal *wil*, two readings can be derived. The surface scope reading is a very odd reading, namely the reading that what Petronella wants to do is to marry no merchant. Thus, she has a desire to do something, and that thing is 'marry no merchant'. The inverse scope reading, where *geen koopman* takes scope over *wil*, would be the reading that there is no specific merchant whom Petronella wants to marry. The most salient reading, however, is the split reading: Petronella does not want to marry any merchant. This reading is called a split reading because it seems as though the word *geen*, 'no', has been split up into two elements; negation and an existential quantifier, that each take scope in a separate position. As is schematically shown in (5), the relevant reading is the reading where the negation part of *geen* takes scope over the modal while its existential component takes scope under the modal. As mentioned above, this ordering corresponds to the surface order of the most natural English translation of the sentence: *Petronella does* ***not want*** *to marry* ***a*** *merchant.* The three readings of (4) I have discussed are schematised in (6).[2]

(5) $\neg$ [$\Box$ [$\exists x$ [x is a merchant and Petronella marries x]]]

(6) a. Surface scope: what Petronella wants to do is to marry no merchant
$\Box > \neg\exists$
b. Inverse scope: there is no specific merchant Petronella wants to marry
$\neg\exists > \Box$
c. Split scope: Petronella does not want to marry a merchant
$\neg > \Box > \exists$

Negative indefinites are not the only expressions that give rise to split scope

[2]The way I schematised the readings in (5) and in (6) is for illustrative purposes only. I do not wish to claim that these three readings are all attested readings, nor do I want to commit to any particular theory of split scope.

readings. Other expressions that have been argued to create split readings are *at most*, *maximally*, *fewer than*, and *exactly*. In the following chapters I will argue that the class of scope splitting expressions is actually different from what has been assumed until now. For that reason, I will focus on split readings with negative indefinites and *at most* for now and leave the rest for later. An example of a split scope reading with *at most* is given in (7). The three theoretically possible readings of (7) are illustrated in (8).

(7) Marin is allowed to read at most five books.

(8) a. Surface scope: Marin has permission to do this: to read between zero and five books
$\Diamond >$ *at most five books*
b. Inverse scope: The highest number of specific books Marin has been given permission to read is five
at most five books $> \Diamond$
c. Split scope: The most Marin is allowed to read is five books
at most $> \Diamond >$ *five books*

Again, simply assuming an optional scope shift gives us two possible readings, the surface scope reading is a reading that merely gives Marin permission to read between zero and five books. That is, she can read five books or less, but nothing stops her from reading more than five books. This is not an attested reading, as I will discuss briefly at the end of this chapter and at length in the next chapter. The inverse scope reading, where the entire DP *at most five books* takes scope over *allowed*, is the reading that the highest number of specific books Marin is allowed to read is five. This is true, for instance, if she has been given permission to read the three specific books *To Kill a Mockingbird*, *1984*, and *The Color Purple*. The most prominent reading of (7) is the split reading: the maximum number of books Marin is allowed to read is five.

Now that we have a feel for what split scope is and how split scope readings differ from surface scope readings and inverse scope reasons, let us turn to the main point of this chapter: sentences that give rise to split scope readings do not have inverse scope readings.

Let us reconsider (4) and the three readings in (6). Say that Petronella knows five merchants. She is not particularly drawn to any of them, so she definitely does not want to marry any of them. However, if she were to meet a merchant she did fall in love with, she would be happy to marry that merchant. In this scenario, the inverse scope reading is true: since Petronella does not know any merchants she would like to marry, it is true that there is no specific merchant Petronella wants to marry. The split reading, which says that Petronella does not want to marry any merchant, is false: she has no objections to the idea of getting married to a merchant. Intuitively, sentence (4) is false in the scenario: if there is no specific merchant Petronella wants to marry but she is not averse to the idea of marrying a merchant, then (4) cannot truthfully be uttered. This shows that the sentence has a split reading but not an inverse scope reading.

Now let us turn to (7) and its theoretically possible readings in (8). A scenario where the split scope reading is false and the inverse scope reading is true is a scenario where Marin is a child who loves to read but she has to ask permission from her parents when she wants to read a book. So far, she has only been given permission to read, say, the three specific books mentioned above: *To Kill a Mockingbird*, *1984*, and *The Color Purple*. At the same time, her parents encourage her to read and want her to read as many books as possible. In this context, Marin has been given permission to read less than five specific books, but it is not the case that the upper bound of the number of books she is allowed to read is five. (7) does place an upper bound on the number of permitted books, and is therefore judged as false in this scenario. This is thus another case where the split scope reading is attested but the inverse scope reading is not.

We now turn to an example with *geen* and an existential modal. As shown in (12) the predicted surface scope reading of (9) is the reading that gives Vera permission to not watch a film. The inverse scope reading is that there is no specific film Vera has been given permission to watch. The split reading is the reading that Vera is not allowed to engage in any film-watching.

(9) Vera mag geen film kijken
Vera may no film watch.
'Vera is not allowed to watch a film.'

(10)
a. Surface scope: Vera has permission to do this: to not watch a film
$\Diamond > \neg\exists$
b. Inverse scope: there is no specific film Vera has been given permission to watch
$\neg\exists > \Diamond$
c. Split scope: Vera is not allowed to watch a film
$\neg > \Diamond > \exists$

Again, let us consider a scenario where the inverse scope reading is true and the split scope reading is false. Say Vera has to ask permission from her parents before she watches a film. She has not done this yet, so there is no film she has been given permission to watch. But she is in principle allowed to watch films. This means that there is no specific film Vera is allowed to watch, but she is allowed to watch a film. Again, if we consider the sentence, we can see that it is false in this scenario. It only has the split scope reading that Vera cannot watch any films and lacks the inverse scope reading that merely states that there is no specific film for which it can be said that Vera is allowed to watch it. This shows that the sentence does not have an inverse scope reading.

Now let us consider an example with *geen* and the universal modal *hoeven*, given in (11), with the three theoretically possible readings in (12).

(11) Bij het examen hoeft er geen docent aanwezig te zijn.
At the exam must-NPI there GEEN teacher present to be.
'There does not have to be a teacher present at the exam.'

(12) a. Surface scope: *It must be the case that there is no teacher present at the exam
$*\Box > \neg\exists$
b. Inverse scope: There is no specific teacher who has to be present at the exam
$\neg\exists > \Box$
c. Split scope: There does not have to be a teacher present at the exam
$\neg > \Box > \exists$

The surface scope reading, while perhaps also a bit strange in some of the other examples in this section, is not attested in the case of (11). This is because *hoeven* is an NPI that needs to be licensed by *geen*. The inverse scope reading says that it is not the case that any specific teacher needs to be present at the exam, while the split reading simply says that it is not necessary for a teacher to be present at the exam. Again, we will consider a context where the inverse scope reading is true but the split scope reading is false. Say that the school regulations dictate that at least one teacher has to be present at every exam. It does not matter which teacher goes, as long as there is a teacher there. For this particular exam, it has not been determined which teacher will be there. This means that there is no particular teacher who has the obligation to be present at the exam, but there does have to be a teacher at the exam. In this scenario, sentence (11) is intuitively false. If the sentence had an inverse scope reading, it should have a true reading in this scenario. The fact that it does not shows that (11) lacks an inverse scope reading.

We have seen examples where *geen* occurs with a universal modal and an existential modal and an example with *at most* and an existential modal. Finally, let us consider an example with a universal modal and *at most* for good measure. A version of (11) with *at most* is given in (13). Its three readings are schematised below the example.

(13) Bij het examen hoeven hoogstens vijf docenten aanwezig te zijn.
At the exam must-NPI at most five teachers present to be.
'There need to be at most five teachers present at the exam.'

(14) a. Surface scope: *It must be the case that there are five or fewer teachers present at the exam
$*\Box >$ *at most five teachers*
b. Inverse scope: The highest number of specific teachers who have to be present at the exam is five
at most five teachers $> \Box$
c. Split scope: The maximum number such that that many teachers have to be present is five or lower

at most $> \Box >$ *five teachers*

Again, the surface scope reading is unattested because of the NPI modal. The inverse scope reading is the reading that there are no more than five specific teachers who need to be present at the exam, while the split reading is that it is not necessary for more than five teachers to be present. Now consider the following scenario. The school regulations dictate that at least six teachers have to be present at every exam. It does not matter which teachers go, as long as there are at least six teachers. For this particular exam, it has not been determined which teachers will be there. So: there is no particular teacher or group of five or fewer teachers who have the obligation to be present at the exam, but there do have to be six teachers at the exam. In this scenario, the inverse scope reading is true and the split reading is false. As the sentence is intuitively false in the scenario, the split reading is again the only attested reading. These facts are the same for the English translation in the third line of (13).

As an aside, it should be noted that when we use downward entailing expressions like *geen* and *at most*, split readings entail inverse scope readings. For example, let us reconsider (9). The split reading is that Vera is not allowed to watch a film. The inverse scope reading is that there is no specific film she is allowed to watch. If she is not allowed to watch any films, it follows that there is no specific film she has permission to watch. Put differently, if there is no accessible world where Vera watches a film, then there is no film that Vera watches in an accessible world. Hence, the split reading entails the inverse scope reading. Because split readings in these cases are strictly stronger than inverse scope readings, we would not even be able to tell if split readings were separate readings if it weren't for the absence of inverse scope readings. Say that both inverse scope readings and split scope readings were attested. Then split scope readings could simply be stronger versions, or subcases, of inverse scope readings. We would not need to derive a separate split reading, because we could say that in certain contexts, the inverse scope reading is pragmatically strengthened to a split reading. In reality we cannot say this because the inverse scope readings are actually not there. This is why we know that split readings are real readings. These considerations are absent from the literature on split scope. Instead, the existing literature simply assumes the existence of three readings: a surface scope reading, an inverse scope reading, and a split reading, without rigorously testing which readings are attested and whether or not the readings are independent of one another.

In this section I have discussed a number of different split scope cases with the negative indefinite *geen* and the modified numeral *at most n* and with different existential and universal modals. In each of these cases, there is a split scope reading but no inverse scope reading. If we assume that the scope shifting operations discussed in the previous section, which simply move one DP over another, are available in these cases, we expect a sentence like (9) to be ambiguous between the surface scope reading in (10-a) and the inverse scope reading in (10-c). Instead, the sentence has a third reading: the split reading in (2-b). The existing literature on split scope focuses on ways to derive split scope readings but not on whether or not the other two predicted readings are actually attested. In the next section I will discuss two of these accounts: Abels and Martí (2010) and De Swart (2000). In both of these studies, the analysis of split scope is built on top of the inverse scope configuration. I will show that taking the present considerations into account forces us to formulate a different kind of account of split scope that does not rest on the existence of inverse scope configurations.

3.3 Current accounts of split scope

There are two kinds of accounts of split scope: decompositional accounts and compositional accounts. Decompositional accounts (Rullmann, 1995a; Jacobs, 1980, 1991; Zeijlstra, 2004; Penka, 2011) derive split readings by literally splitting up the negative indefinite. In these analyses, negative indefinites are taken to consist of negation and an existential quantifier, which can take scope separately. In other words, such accounts would give (4) the syntactic structure in (5), with *geen* being split up into ¬ and ∃.

(4) Petronella wil geen koopman trouwen.
Petronella wants no merchant marry.
'Petronella does not want to marry a merchant.'

(5) $\neg\ [\Box\ [\exists x\ [x \text{ is a merchant and Petronella marries } x]]]$

This splitting mechanism allows the negative part of *geen* to take scope over the modal *wil* while the existential part stays below it, generating split readings.

The other kind of analyses are the compositional ones proposed by De Swart (2000) and Abels and Martí (2010). These accounts both have a way of obtaining the same readings as the decompositional ones without actually decomposing the negative indefinite. It is these compositional accounts that I am interested in here.

De Swart (2000) and Abels and Martí (2010) both assume that split scope readings are special kinds of inverse scope readings. Given that the data show that inverse scope readings do not exist in these cases, this is problematic: both accounts predict that if split scope readings exist, inverse scope readings must exist as well. Here I will discuss both accounts and give more details on the way in which these accounts predict the existence of inverse scope readings. I will discuss these accounts non-chronologically for expository purposes: Abels and Martí's account uses syntactic movement and therefore corresponds more closely to the material I have been discussing in this dissertation up to now. De Swart's mechanism of choice is type shifting. The two accounts have a similar issue, but it will be easier to see that this issue arises in De Swart (2000) by first seeing it in Abels and Martí (2010).

3.3.1 Abels & Martí

Abels and Martí (2010) derive split scope reading by assuming that natural language quantifiers are quantifiers over choice functions, following Sauerland (1998, 2004a). Let us see how this works. In Abels and Martí's account *kein* has the meaning in (15).

(15) $[\![\text{kein}]\!]^w = \lambda R_{\langle\langle et,e\rangle,t\rangle}\ .\ \neg\exists f\ [\mathrm{CF}(f) \wedge R(f) = 1]$

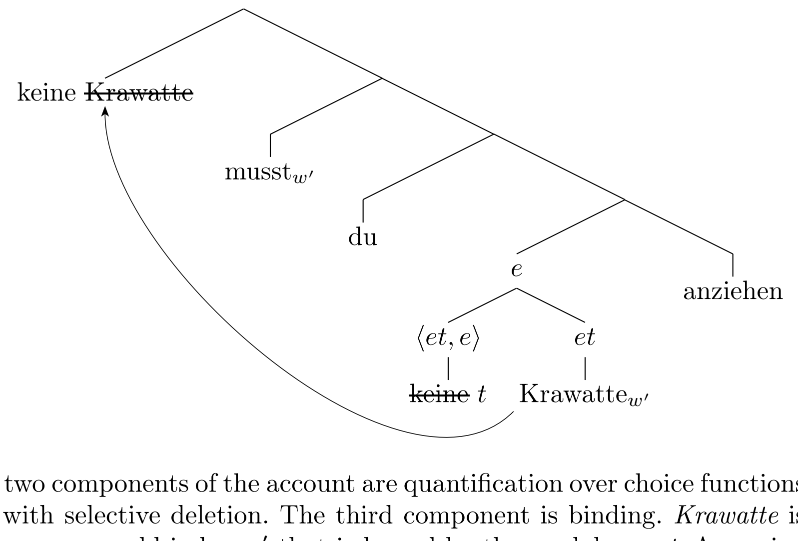
Kein takes a set of choice functions R and gives back a truth value. R is thus the set of choice functions that makes the proposition true.

To see how this derives split readings, let us move on to the next component of the account: QR and selective deletion. Abels & Marti assume that (16) has the structure in (17).

(16) Zu dieser Feier musst du keine Krawatte anziehen.
To this party must you no tie wear.
'To this party you don't have to wear a tie.

Keine Krawatte undergoes QR to a position above the modal *musst.* Then selective deletion (Sauerland, 1998, 2004a) applies. This mechanism deletes the high copy of *Krawatte* and the low copy of *kein.* The result is that the quantifier *kein* is interpreted high and *Krawatte* is interpreted low. *Kein* leaves a trace of type $\langle et, e\rangle$: the type of a choice function. This choice function then takes the set of ties denoted by *Krawatte* as an argument and picks a tie out of the set.

(17)



The first two components of the account are quantification over choice functions and QR with selective deletion. The third component is binding. *Krawatte* is taken to carry a world index w' that is bound by the modal *musst.* Assuming that *musst* simply denotes universal quantification over worlds, the meaning of (16) is as in (18). This says that there is no choice function that in all accessible worlds picks a tie that you wear in that world. In other words, there are worlds where you do not wear a tie. This is the split reading of (16).

(18) $[\![(16)]\!] = \neg\exists f\ [\mathrm{CF}(f) \wedge \forall w'[\mathrm{wear}(f(\mathrm{tie}_{w'}))(\mathrm{you})(w')]]$

To see how this meaning comes about, consider what (18) would say without the negation. In every world there is a set of ties and a way of picking a tie so that you wear that tie in that world. This is just a roundabout way of saying that you wear a tie in every deontically accessible world. (18) says that this is false: you do not wear a tie in every world.

The reason why this derives split readings is that *Krawatte* has a world index that is bound by the modal, so that the set of ties varies from world to world.[3] This enables the choice function to pick out a different tie in every accessible world. Without this mechanism, we would derive an inverse scope reading: there is no specific tie that you must wear to the party. This is because the choice function would get the same set of ties for each world, and therefore it would pick the same tie in each world. Because the ties the choice function picks can vary from world to world, we get the stronger reading that you do not have to wear any tie to the party.

As I mentioned earlier, Abels & Martí follow Sauerland in assuming that natural language quantifiers are all quantifiers over choice functions rather than over individuals. They show that for upward entailing quantifiers, this is harmless; the machinery they use simply derives a *de dicto* reading. For sentences where the downward entailing *fewer than* and the non-monotone *exactly* occur under a modal, split readings are derived. As I restrict my attention to *geen/kein* and *at most* in this chapter, I will not discuss *fewer than* or *exactly* here.

For cases with *at most* such as (19), the surface scope reading would be the reading that you have permission to buy no ties, one tie, or two ties. The split reading is the reading that the maximum number of ties you can buy is lower than three. That is: you cannot buy three or more ties.

(19) You can buy at most two ties.

Thus, the mechanism Abels & Martí propose consists of QR, selective deletion, quantification over choice functions, and the binding of a world index. It derives surface scope readings for upward monotone quantifiers and split scope readings for downward entailing and non-monotone quantifiers.

Now let us consider the fact that split scope sentences do not have inverse scope readings. This is problematic for Abels & Martí: in their account, split scope is derived by first applying QR and then selective deletion and binding. This means that they first generate an inverse scope reading, where the entire object DP takes wide scope, and then add additional mechanisms to derive the split reading. We have seen that the inverse scope reading does not exist, which indicates that there is no inverse scope configuration. But Abels & Martí are

[3] This part of the account is inspired by Kratzer's (1998) account of the 'pseudoscope' of indefinites, where binding simulates wide scope.

not able to rule out this inverse scope reading. The data show that there is some (unknown) constraint blocking the inverse scope configuration. In Abels & Martí's analysis, this constraint should also block the split scope reading. After all, their split reading is simply a special kind of inverse scope reading.

One way out for Abels & Martí would be to say that the selective deletion and world binding mechanisms are obligatory. That is, as soon as QR takes place, selective deletion and world binding automatically follow. This way, they would derive only split scope readings and no inverse scope readings. However, the selective deletion mechanism has to be optional. The reason for this is that applying the split scope mechanism to upward entailing quantifiers yields a *de dicto* reading. If selective deletion were obligatory after QR, we would not be able to derive inverse scope, *de re*, readings with upward entailing quantifiers; we would lose all of our *de re* readings. Given that the selective deletion mechanism must be optional, it follows that we could also simply apply QR without selectively deleting afterwards. This means that the prediction is that all inverse scope readings exist as well. As we have seen, this is an incorrect prediction.

As an aside, note that (20), unlike (11), repeated below, does have a true reading in the scenario sketched in section 3.2.

(20) Geen docent hoeft aanwezig te zijn bij het examen.
No teacher must-NPI present to be at the exam.
'No teacher is required to be present at the exam.'

(11) Bij het examen hoeft er geen docent aanwezig te zijn.
At the exam must-NPI there GEEN teacher present to be.
'There does not have to be a teacher present at the exam.'

This was a scenario where no specific teacher has the obligation to be present at the exam, but there is a rule that at least one teacher has to attend each exam, making the inverse scope reading true and the split scope reading of (11) false. The fact that (20) can be true in this scenario shows that semantically, there is nothing wrong with the inverse scope reading. It is not the case that moving *geen docent* in (11) over *hoeft* yields some kind of a semantic problem, ruling out the inverse scope reading. If this *were* the case, the data would be compatible with a scenario in which the syntactic operation of QR is in principle available, but applying it in the particular case of (11) leads a semantically anomalous sentence. Instead, what rules out the inverse scope configuration in (11) is a constraint on QR. This is a problem for Abels & Martí, who rely on QR for deriving split readings.

The fact that scope shifts are impossible here indicates that what we need in order to derive split readings is not a scope shift and an additional mechanism to create a split scope reading. Instead, we need an analysis where we do not generate an inverse scope reading at all, which means we need an analysis without QR. One way to do this is to let the determiner take wide scope on its own, without the rest of the DP. Abels & Martí themselves suggest that an alternative way to devise a unified account of split scope is to extend Hackl's (2000) account of split readings with *fewer than* to other expressions like negative indefinites (p.468). Hackl's account is based on the assumption that *fewer than* is a degree quantifier that can undergo QR without the rest of the DP. Extending this approach to negative indefinites is precisely what Blok et al. (2017) have done. I discuss this idea later in this chapter.

In sum, Abels and Martí's account of split scope predicts that inverse scope readings exist as well. Without the existence of a structure that yields inverse scope readings, Abels & Martí cannot generate split scope readings. Thus, this is an instance where two scope configurations — surface scope and inverse scope — are assumed to be available, contrary to fact.

3.3.2 De Swart

In the split scope analysis proposed by De Swart (2000), a similar problem arises. De Swart uses type shifting where Abels & Martí use QR, but in her account, too, split scope readings are special kinds of inverse scope readings. De Swart derives split readings by giving the object DP wide scope and letting the negative indefinite quantify over properties. This means that, like Abels & Martí, the split scope mechanism is built on top of an inverse scope configuration.

To set the scene, we will first consider how De Swart derives surface scope and inverse scope readings for a sentence like (21), where the dominant reading is a split reading.

(21) Hanna sucht kein Buch.
Hanna seeks no book.
'Hanna is not looking for a book.'

The inverse scope reading is given in (22): there is no specific book that Hanna is seeking. Though De Swart does not spell this out, this reading is presumably obtained simply by applying a type shift that resolves the type clash between the verb and the object quantifier, as discussed in the previous section. This automatically lets the quantifier scope over the intensional verb *seek*, so no extra work needs to be done to obtain this reading.

(22) $\neg\exists x[\text{book}(x) \wedge \text{seek}(\text{Hanna}, x)]$

The surface scope reading, on the other hand, necessitates a special operation. De Swart uses Partee's (1987) BE type shift on the quantified object to obtain the property of not being a book, as shown below.

(23) BE (no book) = $\lambda x[\neg\text{book}(x)]$

Adding the intensional verb *seek* and the subject creates the surface scope reading in (24): Hanna is seeking something that is not a book. This is the *de dicto* reading.

(24) seek[Hanna,$^\wedge\lambda x\neg$book(x)]

To derive the split reading, De Swart follows Zimmermann (1993) in assuming that quantifiers can be interpreted as either traditional quantifiers over individuals or quantifiers over properties. For example, *nothing* can be interpreted as in (25), where $\mathcal{P}$ is of type $\langle\langle e,t\rangle,t\rangle$.

(25) $[\![\text{nothing}]\!] = \lambda\mathcal{P}\ .\ \neg\exists P[^\vee\mathcal{P}(P)]$

No book, then, is interpreted as in (26), with *book* being the property that is quantified over. According to (26), *no book* takes a set of properties, and it says that there is no property in that set that is the property of being a book.

(26) $[\![\text{no book}]\!] = \lambda\mathcal{P}\ .\ \neg\exists P[P =^\wedge \lambda y[\text{book}(y)] \wedge^\vee \mathcal{P}(P)]$

Giving a quantifier over properties like (26) wide scope over an intensional quantifier leads to split scope readings. For (21), this is shown in (27).

(27) $\neg\exists P[P = {}^\wedge\lambda y[\text{book}(y)] \wedge \text{seek}(\text{Hanna}, P)]$

(27) says that there is no property P for which is is the case that P is the property of being a book and Hanna seeks P. So, Hanna is not looking for something that has the property of being a book. This meaning is also represented in (28): it is not the case that Hanna is seeking something that has the book-property. This is the split scope reading.

(28) $\neg$seek[Hanna, $^\wedge\lambda y$(book(y))]

Thus, de Swart's method of letting negative indefinites quantify over properties in conjunction with giving them wide scope yields a semantics where the negative operator takes wide scope, followed by the intensional verb, which is in turn followed by the property that is quantified over. The same mechanism can be applied to other scope-splitting operators. Let us consider an example with *at most*, given in (29).

(29) Tom needs at most two blankets.

De Swart proposes that *at most two blankets* can have the meaning in (30), where this quantifier, too, quantifies over properties rather than individuals.

(30) $[\![\text{at most two blankets}]\!] = \neg\exists P[P = {}^\wedge\lambda y[\text{blanket}(y) \wedge \text{more than two}(y)]]$

If we give this property quantifier *at most* scope over *needs*, the meaning we derive for (29) is as in (31): there is no property P that is the property of being blanket, of being more than two, and of being needed by Tom.

(31) $\neg\exists P[P = {}^\wedge\lambda y[\text{blanket}(y) \wedge \text{more than two}(y) \wedge \text{need}(\text{Tom}, P)]]$

This can be simplified to (32): it is not the case that Tom needs something that has the properties of being a blanket and that has a cardinality of two or higher.

(32) $\neg$ need[Tom, $^\wedge\lambda y$[blanket(y) $\wedge$ more than two(y)]]

Again, we derive a semantics where the intensional operator ends up taking scope between the negation and the relevant properties (in this case: having the blanket property and having a higher cardinality than two). This is the split scope reading of (29).

In the case of *kein* as well as the case of *at most*, then, a split scope denotation is derived using two building blocks. First, the quantifier is interpreted as a quantifier over properties and not as a quantifier over individuals. Second, the quantifier is given scope over the other operator in the sentence. Together, these two building blocks yield a reading where negation outscopes the intensional verb, which in turn outscopes the relevant property. This configuration gives us the split scope reading.

De Swart's mechanism is reminiscent of the building blocks in Abels & Martí's analysis of split scope. Abels & Martí's use wide scope for the object DP and selective deletion plus binding, and De Swart uses wide scope for the object DP and quantification over properties. In both cases, the split scope reading is derived from the inverse scope configuration. In De Swart's account as well as in Abels & Martí's account, the split scope reading is a special kind of inverse scope reading. It is created by giving the object quantifier scope over the operator it interacts with; in this case an intensional operator, and an additional mechanism: quantification over properties. Thus, like Abels & Martí, De Swart builds split scope on top of inverse scope. By making the split scope an inverse scope reading, she predicts that regular, non-split inverse scope readings are also available. We have seen that this is not the case. In other words, if there is a constraint on the inverse scope configuration, which the data show that there is, De Swart can no longer generate a split scope reading. We have seen that the split scope reading exists but the inverse scope reading does not. Therefore, the split scope reading must be derivable without the inverse scope reading. De Swart, like Abels & Martí, is unable to do this.

In sum, both accounts discussed in this section cannot derive split readings without wrongly predicting the existence of inverse scope readings. This is the first overgeneration case I address in this dissertation. If you simply assume that sentences with two quantified DPs α and β can have the scope configurations $\alpha > \beta$ and $\beta > \alpha$, you predict the existence of non-attested inverse scope readings. This is the kind of assumption that is frequently made in literature that is not specifically concerned with constraints on scope taking. The existence of both $\alpha > \beta$ and $\beta > \alpha$ is regarded as the default situation, and theories are constructed with this assumption in mind. Careful consideration of which readings are and which readings are not attested challenges this default notion. The domain of split scope is a prime example of this. In the next section I will discuss an account of split scope that is not based on this kind of DP movement: Blok et al. (2017).

3.4 A degree quantifier account of split scope

Blok et al.'s (2017) account is based on the idea that negative indefinites in languages where these expressions consistently yield split scope readings are degree quantifiers. Split scope readings come about when these expressions undergo degree QR, moving over the modal and leaving the rest of the DP behind. In other words, the account is based on determiner movement rather than movement of an entire quantified DP. This way, the account derives split readings without deriving inverse scope readings, and it does not overgenerate the way the analyses discussed in the previous section do. This way, the account enables us to formulate constraints on DP movement without also blocking the movement that creates split scope readings. Nevertheless, as will become clear later in this chapter, this account still suffers from overgeneration of a different kind, and is therefore not my final analysis. Instead, it is a stepping stone that shows that split scope must result from determiner movement rather than DP movement. The analysis of split scope I propose can be found in chapter 5 of this dissertation.

Before I delve into the details of the account, I will first discuss one of the main reasons why Blok et al. propose a degree quantifier analysis of scope splitting negative indefinites: in languages where negative indefinites can split their scope, these negative indefinites can also modify numerals. In this way, negative indefinites behave exactly like a different kind of degree quantifier: a numeral modifier such as *at least* or *at most*, whose semantics was discussed in chapter 2. After having discussed this correlation I will give a detailed account of Blok et al.'s analysis. In the final section of this chapter I will argue that although this account does not predict non-existent wide scope readings like Abels & Martí and De Swart do, it still overgenerates. After having discussed more relevant data in chapter 4, I solve this overgeneration problem in chapter 5.

3.4.1 Crosslinguistic data

In this section, I will present Blok et al.'s main argument for claiming that scope splitting negative indefinites are degree quantifiers: across languages, they behave eerily like modified numerals. To set things up, we need to look at a contrast between Dutch and German on the one hand and English on the other hand.

Two kinds of scope splitting expressions

So far I have only used data from Dutch and German to exemplify the phenomenon of split scope. Some authors have said that split scope also exists for *no* in English (Potts, 2000; Alrenga & Kennedy, 2013). The example that is usually given to illustrate this is (33), with the NPI modal *need*. Here the most prominent reading seems to be the reading that it is not the case that the company needs to fire an employee: a split reading.

(33) The company need fire no employees.

But, as observed by Blok et al. (2017), split scope with the English negative indefinite *no* is extremely rare. When you change the modal from an NPI to the neutral *have to*, as in (34), the split reading disappears. (34) cannot mean that the company does not have an obligation to fire any employees. Instead, though it is quite unnatural, it has the surface scope reading that what the company must do is to fire no employees.

(34) ?The company has to fire no employees.

This is different from the German data. As we saw above in (16), using the neutral universal modal *müssen* in German creates a split scope reading.[4] The example is repeated below.

(16) Zu dieser Feier musst du keine Krawatte anziehen.
To this party must you no tie wear.
'To this party you don't have to wear a tie.'

Translating this example to English, as in (35), fails to result in a split reading.

(35) ?At this party you have to wear no tie.

Similarly, translating other split scope examples from this chapter to English lead to degraded examples that do not clearly have a split reading, such as the pairs (4)-(36) and (9)-(37) below.

(4) Petronella wil geen koopman trouwen.
Petronella wants no merchant marry.
'Petronella does not want to marry a merchant.'

(36) ?Petronella wants to marry no merchant.

(9) Vera mag geen film kijken
Vera may no film watch.
'Vera is not allowed to watch a film.'

(37) ?Vera may watch no film.

In the case of (36), the surface scope reading is the reading that Petronalla has a particular desire, and that desire is to 'marry no merchant'. For (37), the surface scope reading is that Vera has permission to not watch a film. The surface scope reading of (36) is quite bizarre and the surface scope reading of (37) is very weak. For this reason, there may be some pragmatic effects at play:

[4] The comparison with Dutch is more difficult, as Dutch does not have any neutral universal modals. It only has the NPI modal *hoeven* and the PPI modal *moeten*, see also Iatridou and Zeijlstra (2013).

for (36), interpreting the negation higher results in a meaning that makes more sense, and for (37) it results in a stronger meaning. But the sentences remain unnatural, and it is clear that English favours the structures in (38) and (39), where *not* and *a* are used separately instead of *no*.

(38) Petronella does not want to marry a merchant.

(39) Vera may not watch a film.

This is in stark contrast with the Dutch and German data, where the split readings are entirely natural and available with a wide variety of different intensional verbs; not just one NPI modal.

There are two things a theory of split scope must account for: the fact that English *no* generally does not split its scope and the fact that there are exceptions, like (33). Blok et al. focus on accounting for this first observation. They conclude from this contrast between Dutch and German on the one hand and English on the other that *no* does not have the general scope splitting ability that *geen* and *kein* have. The case in (33), where an NPI modal is used, is an exception, and possibly a pragmatically strengthened wide scope reading, although this idea needs to be researched more thoroughly before we can draw any definitive conclusions. For now, the conclusion is that *geen* and *kein* have the general ability to split their scope while *no* does not. From now on, I will only refer to expressions that have this general ability as scope-splitting expressions.

As has also been noted by Blok et al. (2017), this difference between Dutch and German on the one hand and English on the other is part of a broader dichotomy in Germanic languages: negative indefinites in Dutch, Frisian, German, and Icelandic split their scope. Negative indefinites in Danish, English, Norwegian, and Swedish do not. (40) and (41) are split scope sentences in Frisian and Icelandic respectively.[5]

(40) Marie mei gjin boeken lêze.
Mary may no books read.
'Mary isn't allowed to read any books.'

(41) María má engar bækur lesa.
Mary may no books read.
'Mary isn't allowed to read any books.'

As shown in the translation, both of these sentences have the split reading that Mary does not have permission to read any books.

Below are examples from Danish, Norwegian, and Swedish (in that order). None of these negative indefinites can create split scope readings.

[5]The data in this chapter were collected through questionnaires. My informants are 13 speakers of English, three speakers of Swedish, five speakers of Norwegian, three speakers of Danish, one speaker of Icelandic, and one speaker of Frisian. Data on Dutch are mostly my own judgments and the German judgments are from the literature and two informants.

(42) ?Mary må læse ingen bøger.
Mary may read no books.
Intended: 'Mary isn't allowed to read any books.'

(43) ?Mary har lov til å lese ingen bøker.
Mary has permission to read no books.
Intended: 'Mary isn't allowed to read any books.'

(44) ?Mary får läsa inga böcker.
Mary may read no books.
Intended: 'Mary isn't allowed to read any books.'

Like the English examples discussed earlier in this section, sentences with object DPs that contain a negative indefinite in these languages are unnatural and do not give rise to split readings. Instead, again like English, these languages favour a construction like *not ... any*, where with negation and an existential quantifier are overtly present in the syntax.

This dichotomy is visible not only in examples with deontic modals but also other types of modals, such as ability modals. For instance, the Dutch example in (45) contrasts with the Swedish example in (46).

(45) Mary kan geen Franse boeken lezen.
Mary can no French books read.
'Mary cannot read French books.'

(46) #Mary kan läsa inga franska böcker.
Mary can read no French books.
Intended: 'Mary cannot read French books.'

In addition, they hold not only for existential modals but also for universal modals. This is illustrated for deontic universal modals in (47) and (48). Here the German example is perfectly felicitous and allows a split scope reading while the Danish example sounds odd and unnatural.

(47) Mary muss keine Bücher lesen.
Mary must no books read.
'Mary doesn't have to read any books.'

(48) #Mary skal ingen bøger læse.
Mary must no books read.
Intended: 'Mary doesn't have to read any books.'

Finally, bouletic universal modals display the same pattern, as attested by the contrast between the Frisian example in (49) and the Norwegian example in (50).

(49) Mary wol gjin boeken lêze.
Mary wants no books read.
'Mary doesn't want to read any books.'

(50) #Mary ønsker å lese ingen bøker.
Mary wants to read no books.
Intended: 'Mary doesn't want to read any books.'

In all of these cases, the preferred option in the non split scope languages is to use sentential negation. For instance, the natural way to convey (50) in Norwegian is (51).

(51) Mary ønsker ikke å lese noen bøker.
Mary wants not to read any books.
'Mary doesn't want to read any books.'

These data indicate that there are two kinds of negative indefinites in Germanic languages: those that give rise to split scope readings across the board, regardless of what modal is used, and those that do not.

The numeral modifier generalisation

Armed with this knowledge, we are ready for the next step. Blok et al. found that there is a correlation between being a scope splitting negative indefinite and having the ability to modify numerals. They call this the *numeral modifier generalisation*.

(52) **The numeral modifier generalisation**
Whenever a negative indefinite can modify numbers, it can create split scope readings

We have seen that the languages that have split scope with negative indefinites are Dutch, Frisian, German, and Icelandic. The languages that do not have this are Danish, English, Norwegian, and Swedish. As shown below, the negative indefinites in the former group of languages can modify numbers.

(53) Nigella heeft geen twintig taarten gebakken.
Nigella has GEEN twenty cakes baked.
'Nigella has not baked twenty cakes.' Dutch

(54) Jan is gjin twa meter lang.
Jan is GJIN twa metres tall.
'Jan is not two metres tall.' Frisian

(55) Peter hat keine drei Kinder.
Peter has KEIN three children.
'Peter does not have three children.' German

(56) Jón er engir tveir metrar á hæð.
Jon is ENGINN two metres in height.
'Jon is not two metres tall.' Icelandic

A sentence like (53) is ambiguous between two readings. The first reading is that it is not true that Nigella baked exactly twenty cakes. So, the number of cakes she baked is in the interval [0,19] or [21,∞). The second reading is that the number of cakes she baked did not reach twenty. This means that she baked fewer than twenty cakes, so, assuming that one can only bake whole cakes, the number of cakes she bakes is in the [0,19] interval.

In the latter group of languages, negative indefinites lack the ability to modify numbers, as can be seen in (57)-(60).[6]

(57) *Vi har ingen to biler.
We have no two cars.
Intended: 'We do not have two cars.' Danish

(58) *Peter has no three children. English

(59) *Jeg har ingen to biler.
I have INGEN two cars.
Intended: 'I do not have two cars.' Norwegian

(60) *Fredrik är ingen två meter hög.
Fredrik is INGEN two meters high.
Intended: 'Fredrik is not two meters tall.' Swedish

Thus, there is a correlation between numeral modification and split scope. This is summarised in table 3.1.

		Can modify numerals?	Split scope?
Dutch	*geen*	yes	yes
Frisian	*gjin*	yes	yes
German	*kein*	yes	yes
Icelandic	*enginn*	yes	yes
Danish	*ingen*	no	no
English	*no*	no	no
Norwegian	*ingen*	no	no
Swedish	*ingen*	no	no

Table 3.1: The numeral modifier generalisation

This fact forms the foundation of Blok et al.'s account, where negative

[6]There is a subject-object asymmetry for sentences with *no* in English, where *no* sounds better in subject position than in object position (De Swart, 2010). In subject position, unlike in object position, *no* can also precede a numeral:

(i) No two students can work together.

However, these readings are collective readings: no pair of two students can work together. These readings are only available with collective predicates. (ii) shows that replacing the predicate by a non-collective one results in ungrammaticality.

(ii) *No five children are playing in the park.

Thus, sentences like (i) constitute a separate phenomenon.

indefinites like *geen* are essentially treated as numeral modifiers. If, as Blok et al. propose, split scope is a degree phenomenon and negative indefinites that split their scope are of the same type as numeral modifiers such as *at most*, then the prediction is that scope splitting negative indefinites are able to modify numerals. The data corroborate this prediction. Let us now consider this proposal in more detail.

3.4.2 Analysis

Blok et al. propose that negative indefinites in scope splitting languages are degree quantifiers. They are of the same type as modified numerals in a degree analysis, which were discussed in chapter 2 of this dissertation. Like modified numerals, they can undergo degree QR without their DP complement, and it is this movement that yields split scope readings.

Let us go through how this works. An expression like *geen*, when it modifies a number, has the two possible denotations in (61) and (62).

(61) $[\![\text{geen}_{=}]\!] = \lambda n_d \lambda P_{\langle dt \rangle}.\neg max(P) = n$

(62) $[\![\text{geen}_{\geq}]\!] = \lambda n_d \lambda P_{\langle dt \rangle}.\neg P(n)$

As has been proposed for bare numerals, *geen* is ambiguous between an *exactly* reading and an *at least* reading. Recall that (53) and its equivalents in other split scope languages have this ambiguity: (53) can mean that Nigella baked some number of cakes other than twenty or that the number of cakes she baked is lower than twenty, or in other words, it is not at least twenty. The *exactly* version it the one in (61). This *geen* takes a number n and a set of degrees P and says that the maximum number in the set equals n. The *at least* version is in (62). This *geen* also takes a number n and a degree set P, and it says that n is not in P. To see how these two definitions work, let us consider the derivation of (53). The structure of (53) is given in (63).

(63) [geen 20 [Nigella baked [[[~~geen 20~~] many] cakes]]]

This structure is exactly the same as the structure with modified numerals analysed in a degree semantics framework, shown in chapter 2. As also explained in that chapter, *many* takes a degree and returns a generalised quantifier over individuals, as illustrated in the denotation below. Here * is Link's (1983) plural star operator.

(64) $[\![\text{many}]\!] = \lambda n_d \lambda P_{\langle e,t \rangle} \lambda Q_{\langle e,t \rangle}.\exists x[\#x = n \wedge\ {*P(x)}\ \wedge\ {*Q(x)}]$

Geen 20 is a degree quantifier, so it is of type $\langle\langle d,t\rangle,t\rangle$. *Many* needs an argument of type d, and to resolve the type clash, *geen* moves up and creates the degree property in (65) in doing so.[7]

[7] I will argue in chapter 7 of this dissertation that QR should be optional. It should happen only for scope and not for type reasons. Though this argument was based on data

(65) $[\![\text{Nigella baked } n \text{ many cakes}]\!] = \lambda n_d.\exists x[\text{*baked(Nigella}, x) \wedge \text{*cake}(x) \wedge \#x = n]$

Applying *geen 20* to this property yields the denotation in (66) if we use the *exactly* version of *geen* and (67) if we use the *at least* version.

(66) $[\![\text{Nigella baked geen}_= \text{ 20 cakes}]\!] =$
$\neg max\{n | \exists x[\text{*baked(Nigella}, x) \wedge \text{*cake}(x) \wedge \#x = n]\} = 20$

(67) $[\![\text{Nigella baked geen}_\geq \text{ 20 cakes}]\!] =$
$\neg\exists x[\text{*baked(Nigella}, x) \wedge \text{*cake}(x) \wedge \#x = 20]$

(66) says that the maximum number such that Nigella baked that number of cakes is not twenty. This means that she did not bake exactly twenty cakes. After all, if she baked, say, 15 cakes, then the maximum number such that she baked that many cakes would be 15. If she baked 25, then the maximum number such that she baked that many cakes would be 25. (67) says that there's no group of cakes x with cardinality 20 that Nigella baked. This means that she baked fewer than twenty cakes. If she baked 15 cakes, then this means there is no group of 20 cakes that were baked by Nigella. But if she baked 25 cakes, then there would still be a group of 20 cakes that she baked. These two denotations correspond to the two intuitive readings of (53): the reading in (66) is the *exactly* reading: the statement that Nigella baked exactly 20 cakes is false. (67) is the *at least* reading: the statement that Nigella baked at least 20 cakes is false.

Following Landman (2011), Buccola and Spector (2016), and Bylinina and Nouwen (2017), Blok et al. assume that pluralised predicates $*P$ include the bottom element $\perp$. This means that the domain of individuals looks as in figure 3.1. This assumption is necessary, because otherwise (66) and (67) would be false in a scenario where Nigella did not bake any cakes, contrary to fact.

Numeral modifier *geen* can also yield split readings. (68) means that Nigella does not have to bake twenty cakes.

(68) Nigella hoeft geen 20 taarten te bakken.
Nigella must-NPI GEEN 20 cakes to bake
'Nigella doesn't have to bake 20 cakes.'

This sentence, too, is ambiguous between an *exactly* and an *at least* reading. It can mean that it is not true that she is obligated to bake exactly twenty cakes, which can be true in a situation in which she has the obligation to bake, say, 25 cakes. It can also mean that she is not obligated to bake as many as twenty cakes: it is fine if she bakes fewer. This reading is false in a scenario where she has to bake 25 cakes. The structure of (68) is given in (69).

with quantifiers over individuals and not quantifiers over degrees, it is not a problem for Blok et al. even if the same can be said for quantifiers over degrees. Blok et al.'s account also works if there is a mechanism available that allows *geen* to be interpreted *in situ*, as long as there is also an option for *geen* to move.

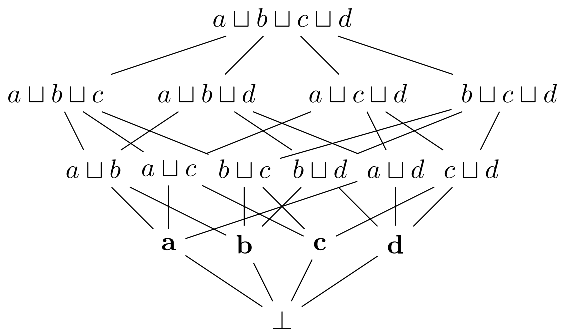


Figure 3.1: The domain of entities

(69) [geen 20 [Nigella [must [bake [[[~~geen 20~~] many] cakes]]]]]

Using degree quantifier movement, as above, yields the denotation in (70) for the *exactly* version and the denotation in (71) for the *at least* version.

(70) $[\![\text{Nigella must bake geen}_= \text{ 20 many cakes}]\!] =$
$[\![\text{ geen}_= \text{ 20}]\!](\lambda n.\Box\exists x[\text{*bake(Nigella}, x) \wedge \text{*cake}(x) \ \wedge \ \#x = n]) =$
$\neg max\{n \mid \Box\exists x[\text{*bake(Nigella}, x) \wedge \text{*cake}(x) \ \wedge \ \#x = n]\} = 20$

(71) $[\![\text{Nigella must bake geen}_\geq \text{ 20 many cakes}]\!] =$
$[\![\text{geen}_\geq \text{ 20}]\!](\lambda n.\Box\exists x[\text{*bake(Nigella}, x) \wedge \text{*cake}(x) \ \wedge \ \#x = n]) =$
$\neg\Box\exists x[\text{*bake(Nigella}, x) \wedge \text{*cake} \wedge \#x = 20]$

(70) says that it is not the case that the maximum number of cakes Nigella has to bake is twenty. This means that the maximum can be, say, 11, or it can be 45. This is the *exactly* reading: Nigella is not required to bake exactly twenty cakes. (71) represents the *at least* reading: it is not the case that Nigella is obligated to bake twenty cakes. This means that she is also not obligated to bake 21 or 22 cakes, because being obligated to bake 21 cakes entails being obligated to bake 20 cakes.

Thus, we derive split scope readings by assuming that *geen 20* is a degree quantifier and QR'ing it to a position above the modal. This way of deriving split readings corresponds exactly to how we derive readings where a numeral modifier takes scope over a modal. For (72), repeated from the previous chapter, the relevant structure is given in (73).

(72) Lucy is required to drink at most five vodkas.

(73) [at most 5 [λd [$\Box$ [Lucy drinks d-many vodkas]]]]

Like *geen*, the degree quantifier *at most* n takes scope over the modal without the rest of the DP *vodkas*. This yields the reading in (74): the maximum number of vodkas Lucy is required to drink is five or lower. In this light, (74) can be seen as a split reading, just like (70) and (71).

(74) max { d | $\Box$ [Lucy drinks d vodkas] } ≤ 5

Now let us turn to split scope cases where *geen* does not modify a numeral, like (75).

(75) Je hoeft geen stropdas te dragen.
You must-NPI GEEN tie to wear.
'You do not have to wear a tie.' tie.

Blok et al. assume that when it does not modify a numeral, *geen* incorporates the numeral *one*, which has the form 'één' in Dutch and is phonetically contained in *geen*. Filling the degree slot with the number one yields the two denotations given below.

(76) $[\![\text{geen}^1_=]\!] = \lambda P_{\langle dt \rangle}.\neg max\{m|P(m)\} = 1$

(77) $[\![\text{geen}^1_\geq]\!] = \lambda P_{\langle dt \rangle}.\neg P(1)$

Let us consider the derivation of (75) with both *geen*s to see what we get. The structure is shown in (78).

(78) [geen [you [must [wear [[~~geen~~ many] tie]]]]]

Letting the 'at least' *geen* in (77) undergo degree QR gives the denotation in (79): it is not the case that in all possible worlds there is a group of ties with cardinality 1 that you wear. This means that you do not wear a tie in every world, and so it corresponds to the split reading of (75).

(79) $[\![\text{You must wear geen}_\geq \text{ tie}]\!] =$
$[\![\text{geen}^1_\geq]\!](\lambda n.\Box\ \exists x[\text{*wear (you}, x) \wedge \text{*tie}(x)\ \wedge\ \#x = n])$
$= \neg\Box\exists x[\text{*wear(you}, x)\wedge\text{*tie}(x) \wedge \#x = 1]$

Thus, the idea behind the account is that degree quantifiers are part of a larger DP but can undergo degree QR by themselves. If *geen* is a degree quantifier, we can use this mechanism to give *geen* wide scope. *Many* contributes an existential quantifier to the meaning, and this existential quantifier stays low. This is how we get a split reading.

But what about the 'exactly' *geen*? If we use this *geen* with incorporated 1 for (75), we derive (80).

(80) $[\![\text{You must wear geen}_= \text{ tie}]\!] =$
$[\![\text{geen}^1_=]\!](\lambda n.\Box\ \exists x[\text{*wear (you}, x) \wedge \text{*tie}(x)\ \wedge\ \#x = n])$
$= \neg max\{n \mid \Box\exists x[\text{*wear(you}, x) \wedge \text{*tie}(x)\ \wedge\ \#x = n]\} = 1$

(80) says that it is not true that the maximum number of ties you wear in every world is one. So, you don't have to wear exactly one tie. This means you can wear no tie at all or you can wear more than one tie. This is not an attested reading of the sentence. To rule out (80), the authors appeal to the idea that lexical meanings should be convex or connected (e.g. Chemla,

2017). *Geen* in (76) yields the meaning *none or more than one*, which does not represent a connected interval. Blok et al. claim that this is what rules out the *exactly* version of *geen* with an incorporated numeral 1. Note that this convexity requirement applies to lexical items only and not to larger phrases. This is why the *exactly* reading is ruled out when 1 is incorporated but not when *geen* combines with a non-incorporated numeral.

More evidence for the convexity requirement comes from the data in (81) and (82).

(81) Ze heeft geen één boek gelezen, maar twee.
She has GEEN one book read but two
'She didn't read one book, she read two'.

(82) Ze heeft geen-één boek gelezen, #maar twee.
She has GEEN-one book read but two
'She didn't read one book, she read two'.

As can be seen in these sentences, it is possible to use *geen* with an overt numeral *one*. When *geen* and *één* are pronounced as two separate entities, the resulting meaning is the non-convex meaning we do not get for bare *geen*: *ze heeft geen één boek gelezen* in (81) means that she read zero books or two or more books. When *geen* and *één* form a prosodic unit, acting like a single lexical item, the picture changes. (82) means that she did not read any books at all, just like the sentence would mean with bare *geen*. This is why the addition of *maar twee* is felicitous in (81) but not in (82). This shows that when *geen* and *één* start to behave like one lexical item, the convexity condition comes into play, and the non-convex 'zero or at least two' meaning is ruled out.

Importantly, this account does not overgenerate in the way that Abels and Martí (2010) and De Swart (2000) do. We saw that for de Swart, the split reading is an inverse scope reading where the quantified DP is interpreted as a quantifier over properties. Similarly, Abels & Martí use QR to generate an inverse scope configuration and subsequently apply selective deletion and binding of the world index for the split reading. In both cases, split readings are readings where the entire object DP takes scope over the subject DP. This means that both accounts make the incorrect prediction that inverse scope readings are also available. Put differently, inverse scope readings, for some unknown reason, are unavailable, so we want to be able to exclude them. What we do not want is that this exclusion of inverse scope readings also removes all split readings. After all, split readings, unlike inverse scope readings, are attested readings.

Blok et al.'s analysis, like Abels & Martí's, relies on QR, but it is a different kind of QR: QR of a degree quantifier. When a negative indefinite such as *geen* modifies a number, as in (68), *geen 20* quantifier raises to a position above the modal. In cases where *geen* does not modify a number, like (75), *geen* QRs by itself. The DPs *geen 20 taarten* and *geen stropdas*, on the other hand, do not have to move in order for the split scope configuration to arise. The key difference is that the determiner moves by itself rather than as part of the entire DP. This way, Blok et al.'s account can derive split scope readings without simultaneously deriving unattested inverse scope readings. It is therefore compatible with a restriction on DP scope shifts.

To sum up, Blok et al.'s analysis of split scope is not dependent on the existence of inverse scope readings, unlike the other accounts discussed in this chapter. Blok et al. do not predict that inverse scope readings are impossible but their analysis is compatible with an independent constraint on scope shifts that prohibits inverse scope configurations. I will discuss such general constraints on scope shifts in chapter 7 of this dissertation, where I will claim that the existence of these constraints pose problems for modern theories of syntax. But even though Blok et al. does not incorrectly predict the existence of inverse scope readings, it still overgenerates. This is what I will talk about next.

3.5 Cliffhanger

Given that split scope results from degree quantifier movement in Blok et al.'s analysis, their prediction is that all degree quantifiers can yield split readings. In this section I will first show that there is a good argument to back up this claim: the Heim-Kennedy Generalisation. I will then show that this assumption still leads to overgeneralisation. As a matter of fact, not all degree quantifiers give rise to split readings. This means that despite the fact that Blok et al. do not suffer from the same overgeneralisation problem of Abels & Martí and De Swart, they still predict non-existent readings. But first things first: let us consider the argument for the claim that split scope is a property of all degree quantifiers.

3.5.1 The Heim-Kennedy Generalisation

The argument I will discuss here has to do with the Heim-Kennedy Generalisation (Kennedy, 1997; Heim, 2000). The Heim-Kennedy Generalisation states that degree quantifiers are able to move over modals but not over nominal quantifiers.[8] Consider first (83), from Heim (2000).

(83) John is 1.80m tall. Every girl is less tall than that.

According to Heim, the comparative is a degree quantifier that sets an upper bound using a maximality operator. This notion of maximality in degree sentences was explained in the second chapter of this dissertation: a sentence like (84) means that the maximum degree of height of the girl is 1.80. Her height reaches 90cm, it reaches 1.20m. and it also reaches 1.80m., but it does not reach

[8] This phrasing is less precise than Heim's (2000, p.10) original way to state the constraint: 'If the scope of a quantificational DP contains the trace of a DegP, it also contains that DegP itself'. This way of phrasing the constraint is necessary to account for certain cases where DPs take scope inside an argument of the graded adjective. These cases are not relevant here.

1.81m. Therefore, the maximum number for which it can be said that the girl is that tall is 1.80.

(84) The girl is less tall than 1.80m.

Now let us go back to (83). If we continue to think of degrees and maximality as above, then the second sentence of (83) is predicted to have two meanings: one where *every* takes scope over the maximality operator and one where it takes scope under it. These two possibilities are sketched below.

(85) a. Every girl: her maximum degree d of height is 1.80
b. The maximum degree d such that every girl is tall to degree d is 1.80

The surface scope reading, with wide scope for *every*, is in (85-a): for every girl, it is the case that her maximum height is 1.80. This corresponds to what the sentence intuitively means. The inverse scope reading is described in (85-b). Here the maximality operator scopes over *every*, and the resulting reading is that the maximum number such that every girl is that tall is 1.80. What this actually means is that the shortest girl is 1.80. This is because if one of the girls is only 1.75m tall, then the maximum height for which it can be said that all girls reach this height is 1.75, even if all other girls are 1.80 or taller. (85-b) cannot mean that the shortest girl is 1.80, so the inverse scope reading, with wide scope for the maximality operator, is not attested.

Now consider (86), also from Heim (2000). Here the comparative interacts with a modal rather than with a nominal quantifier.

(86) The draft is 10 pages long. The paper is allowed to be less long than that.

The two possible readings for this sentence are schematised in (87).

(87) a. There is a permissible world in which the maximum length of the paper does not reach 10 pages
b. the maximum number of pages such that there is a permissible world in which the paper has that many pages is 10

(87-a) is the surface scope reading: it is allowed for the paper to be shorter than 10 pages. This is an attested reading. (87-b) is the inverse scope reading, where the maximality operator scopes over the modal *allowed*. Now the meaning is that the maximum number of pages the paper is allowed to have is lower than ten. That is, the paper cannot be ten pages or longer. Unlike the inverse scope reading of (84), this reading actually seems to be attested.[9] This is the phenomenon that the Heim-Kennedy generalisation describes: a degree quantifier can outscope a modal but not a nominal quantifier.

[9] Although the reading is easier to get with *at most*: *the paper is allowed to be at most that long*. More in this in chapters 4 and 5.

Now consider (88), where *at most*; often considered to be a degree quantifier, occurs under the modal *has to*. The surface scope reading of this sentence is that the cat has the obligation to eat no more than fifty grams of food. In other words, she is not allowed to eat more. This is the reading that is prominent in (89). In (90) we get the reading where *at most* takes scope over *has to*: the most the cat has to eat is fifty grams of food. In other words, there is some amount of food the cat has to eat, and this amount is somewhere below fifty grams. This corresponds to the split reading: as I will discuss in detail in chapter 5, the readings we derive when we let degree quantifiers take wide scope are split scope readings.

(88) The cat has to eat at most fifty grams of food.

(89) The cat really needs to lose weight. She has to eat at most fifty grams of food each day.

(90) This cat is tiny; she doesn't need to eat much. I'm not sure how much she eats exactly, but I think she only has to eat at most fifty grams of food a day to feel full.

Now compare this to (91), where *at most* occurs under a nominal quantifier. The surface scope reading is the attested reading: for every cat it is the case that she ate no more than fifty grams of food. The reading where *at most* outscopes *every* is the reading that the highest number of grams of food for which it is the case that every cat ate that much food is fifty. This means that the cat who ate the least amount of food ate fifty grams of food. This is because if different cats ate different amounts of food and the cat who ate the least ate fifty grams, then the highest number for which we can say that all cats ate that much is fifty. It is not fifty-one, because not all cats ate fifty grams of food. It is not forty-nine, because this is not the highest number such that all cats ate that number of grams of foods; the highest number is fifty. (91) cannot mean that the cat who ate the least ate fifty grams of food, so the split reading; the reading where *at most* outscopes *every*, is not attested.

(91) Every cat ate at most fifty grams of food.

The contrast between (88) and (91) is captured by the Heim-Kennedy Generalisation: *at most* can take scope over the modal *has to* but not over the nominal quantifier *every*.

As already observed by Abels & Martí, the Heim-Kennedy Generalisation also holds for the negative indefinite *kein* in German. Consider their example in (92) (Abels & Martí, 2010, p.458).

(92) Genau ein Arzt hat kein Auto.
Exactly one doctor has no car.
'Exactly one doctor has no car.

The surface scope reading is the only available reading for this sentence: for exactly one doctor it is the case that she has no car. The split reading is the reading that it is not the case that exactly one doctor has a car. *Kein*, like *geen*, gives rise to split readings with modals, as shown in (16) (also from Abels & Martí, repeated from above). The split reading is that the hearer does not have the obligation to wear a tie to the party.

(16) Zu dieser Feier musst du keine Krawatte anziehen.
To this party must you no tie wear.
'To this party you don't have to wear a tie.'

Hence, *kein* can take scope over the modal *musst* but not over the quantificational DP *genau ein Arzt*. The example in (93) makes the same point for *geen*. Pronounced with a neutral intonation, (93) only has a surface scope reading: for every doctor, it is true that she does not own a car. The split reading that it is not the case that every doctor owns a car is not attested. *Geen*, too, can move over modals but not over nominal quantifiers.[10]

(93) Iedere arts heeft geen auto.
Every doctor has no car.
'Every doctor doesn't have a car.'

The fact that split scope readings of negative indefinites appear to be constrained by the Heim-Kennedy Generalisation, a constraint on degree quantifiers, is mysterious if we take negative indefinites like *geen* to be fundamentally different from expressions like *at most*. Both types of expressions give rise to split scope readings and both do so only across intensional verbs. This indicates that we are dealing with one and the same phenomenon. Therefore, an analysis of split scope must be unified: it must generate split readings not only for negative indefinites but also for expressions such as *at most*. Blok et al. analyse *geen* and its kin as degree quantifiers. In their analysis *geen* can undergo degree QR to yield split readings in exactly the same way that an expression like *at most* can. Therefore, the Heim-Kennedy Generalisation is an argument for the account: the fact that *geen* is constrained by the Heim-Kennedy Generalisation means that it acts like a degree quantifier. This benefit is shared by De Swart and Abels and Martí, both of whom analyse split scope with negative indefinites and degree quantifiers in the same way. All three accounts predict that negative indefinites and downward entailing degree quantifiers alike can give rise to split scope readings whenever they occur under an intensional operator. However, as we will see below, all degree quantifiers are not created equal. Although the data discussed in this section show that it is good to analyse *geen* and its kin on a par with degree quantifiers, we may not want to give it an analysis that is on a par with *all* degree quantifiers. Let us see why.

[10]See footnote 1 and chapter 5 for a discussion of cases where prosody enables this reading.

3.5.2 We're not there yet

Consider (94) and (95). For both sentences, the split reading would be the reading that Aïcha is not allowed to submit more than two papers. The predicted surface scope reading is that Aïcha has permission to submit no papers, one paper, or two papers. This says nothing about whether or not she is allowed to submit three or more papers.

(94) Aïcha is allowed to submit at most two papers.

(95) Aïcha is allowed to submit fewer than three papers.

What is striking here is that split reading is not equally strong for both sentences. For (94), the split reading is the only available reading. This can be seen by considering (96). The continuation is compatible with the surface scope reading but not with the inverse scope reading of (94). The fact that this continuation is infelicitous shows that the surface scope reading does not exist.

(96) Aïcha is allowed to submit at most two papers. #She can also submit more.

For (95), on the other hand, the split reading seems much weaker, and the surface scope reading is more prominent. This is why the continuation in (97) is fine.

(97) Aïcha is allowed to submit fewer than three papers. She can also submit more.

If we take both *at most* and *fewer than* to be degree quantifiers that have the ability to undergo degree quantifier movement, we predict that they behave the same way. We do not predict that *at most* gives rise to split scope readings much more easily than *fewer than*, yet this is the case in the world we live in. As will be shown in chapter 5, these data have been confirmed by an experiment. The above contrast shows that the last word about split scope has not been said, and that Blok et al.'s account cannot explain all the facts.

That is, Blok et al. do not need to generate inverse scope readings where the entire object DP takes wide scope in order to yield split readings. It is therefore compatible with a constraint on such inverse scope readings and does not automatically create them in the process of generating split readings. In this sense, it does not overgenerate like De Swart and Abels & Martí do. But by treating *geen* as a degree quantifier and deriving split scope readings through degree QR, the prediction is that all degree quantifiers create split scope readings in exactly the same way. The data above illustrate that this picture is not correct.

3.6 Conclusion

So what do we have? Blok et al. manage to avoid generating non-existent inverse scope readings for split scope sentences. They do this by assuming that it is not entire DP that moves but only the determiner, using the mechanism of degree quantifier movement. Treating expressions like *geen* as degree quantifiers, it turns out, is not a bad idea: not only can *geen* take degree arguments, it also behaves like other degree quantifiers in that it abides by the Heim-Kennedy generalisation. In addition, the modified numeral generalisation supports a degree analysis of negative indefinites in split scope languages. But despite the fact that the account is compatible with the lack of inverse scope readings, it turns out that we still generate too many readings. The contrast between (94) and (95) shows that not all degree quantifiers yield split readings to the same degree. So what should be the next step?

Before I present a solution to this problem, I will first put the contrast between (94) and (95) in a broader perspective. In the next chapter I will show that the domain of modified numerals is another area where different scope configurations are assumed to be more prevalent than they actually are. This constitutes the second of three cases where this happens that I discuss in this dissertation. The next chapter concerns only cases of degree quantifier movement. Thus, even if we restrict ourselves to movement of the determiner alone rather than movement of entire DPs, there is still overgeneration taking place.

After having discussed this overgeneration on a deeper level in chapter 4, I will present a unified analysis of split scope and the interactions between modified numerals and modals in chapter 5. This analysis incorporates the insight that split scope must result from determiner movement rather than DP movement and, unlike Blok et al., it correctly predicts that some but not all modified numerals yield split readings.

CHAPTER 4

Restrictions on the scope of modified numerals

4.1 Introduction

This chapter covers the second case I discuss in this dissertation where we see fewer scope configurations than we would expect if we simply assume the optional availability of scope shifts. This time, the relevant data concern interactions between modified numerals and modals, such as the ones at the end of the previous chapter. I will show that these interactions are much more limited than most authors assume. There is a certain type of ambiguity in sentences where numeral modifiers co-occur with modals, but it is not the one we expect to see if the ambiguity is a scope ambiguity.

In chapter 2 I introduced the notion of degree semantics and I explained that it has become the consensus in the literature on modified numerals to analyse modified numerals as quantifiers over degrees (Schwarz, 2013; Kennedy, 2015). In their capacity as quantifiers, modified numerals are expected to be able to undergo scope shifts. In particular, in sentences with modals and a modified numeral, the modified numeral is thought to be able to QR to a position above or below the modal, yielding a scope ambiguity. This prediction is borne out for (1), which has a reading where *at most* takes scope under *required* — the surface scope reading — and a reading where it takes scope over it: the split scope reading.

(1) Sunny was required to interview at most five people.

The two readings are summarised in (2).

(2) a. Surface scope: It must be the case that Sunny interviews five or fewer people
$\Box >$ *at most five people*
b. Split scope: The maximum number such that Sunny has to interview that many people is five or lower
at most $> \Box >$ *five people*

The surface scope reading is the reading that Sunny is not allowed to interview more than five people. The less obvious split scope reading is the reading that there is some minimum number of people Sunny is required to interview, and that number is in the [0-5] range. Under this reading, the sentence can be true, for instance, if Sunny's editor has told her she must interview at least four people. It is false if her editor has told her to interview at least six people; the number of people she is required to interview is no higher than five.

These readings are familiar from the previous chapters. Something I have not discussed in detail so far is that with modified numerals, the split reading comes with an additional meaning component: it implies that the speaker is not sure what exactly the minimum number of people Sunny is required to interview is. The surface scope reading, which prohibits her from interviewing more than five people, lacks this meaning component. (3) is designed to better illustrate the ignorance reading of (1).

(3) I'm not sure how many people Sunny is required to interview, but I know she's required to interview at most five.

This meaning component of uncertainty is generally considered to be a pragmatic inference, and current theories of modified numerals link this inference to scope (Schwarz, 2013; Coppock & Brochhagen, 2013; Kennedy, 2015). The idea is that the epistemic inference only arises when the modified numeral takes scope over the modal — the split scope configurations — and not when they are interpreted below the modal. Schwarz (2013) and Kennedy (2015) use the Gricean Quantity maxim (Grice, 1975) to calculate the relevant inferences. Coppock and Brochhagen (2013) use a different method based on the Gricean Quality maxim and in Nouwen's (2010) account the ignorance component is regarded as part of the semantics rather than the pragmatics, but all accounts rely on scope to generate the two readings: the reading with and the reading without the epistemic inference.

In this chapter I show that, although most authors derive the right readings for the example in (1), using scope to generate the two readings we observe is nevertheless problematic. Assuming that modified numerals can always take scope either over or under a modal both overgenerates and undergenerates, creating non-existent readings and failing to obtain certain readings that do exist. I will show that when you abstract away from the pragmatics and look closely at the semantics of sentences with modals and modified numerals, it becomes clear that not all scope configurations are in fact possible. Specifically, certain kinds of modified numerals must take scope over existential modals. Thus, in these cases, only the inverse scope configuration is attested.

This observation is slightly different from the one we have seen before in that it is perhaps surprising that it is the inverse scope configuration rather than the surface scope configuration that is the only one available. Therefore, the current issue cannot be attributed to a restriction on scope shifts. If anything, it would be a case of an obligatory scope shift. The point I make is a more general one, however: in a model where we assume that scope shifts can either apply or not, we expect to see scope ambiguities. While sentences with existential modals and modified numerals such as *at most* are ambiguous, the ambiguity they display is not a scope ambiguity. Therefore, we must account for the ambiguity we see in a way that is independent of scope. This is how this case is similar to the other case we have seen: the fact that we have two operators in the sentence leads us to expect a scope ambiguity, but we do not see this ambiguity, which indicates that not all possible scope configurations exist. Building our theories of the pragmatics of sentences with modified numerals on the assumption that two scope configurations are always available is therefore a strategy that cannot work, just like building a theory of split scope on top of a non-existent inverse scope configuration does not work.

What I will show below is that not all modified numerals are alike. Specifically, some modified numerals give rise to split readings far more easily than others, and in fact only have a split reading in some cases. These are the modified numerals such as the superlative modified numerals *at least n* and *at most n*: the modified numerals Nouwen (2010) calls Class B modified numerals. Nouwen's Class A modified numerals, among them the comparative modified numerals *more than* and *fewer than*, have trouble getting split readings. I will conclude two things from this observation. The first is that Blok et al.'s (2017) account, discussed in the previous chapter, still overgenerates. It predicts split readings for all modified numerals, but only a subset of modified numerals consistently give rise to them. A part of this contrast between class A and class B modified numerals will be shown below, while another will be discussed in chapter 5.

The second conclusion will be that our theory of the pragmatic ambiguity of sentences with modals and modified numerals must be altered to not rely on scope. As we will see, we do not observe all possible scope configurations but we do always observe an ambiguity between a reading with and a reading without an epistemic inference. This shows that our theory of these inferences must be independent of scope. I follow up on the first conclusion in chapter 5, where I present a focus-based account of split scope that arrives at the right readings without overgenerating. In chapter 6 I address the second point and provide a scope-independent theory of the pragmatics of modified numerals. This theory builds on the split scope theory of chapter 5, enriching the focus-based theory with inquisitive semantics.

For clarity, note that this chapter is only about scope interactions between modified numerals and modals (and in some cases nominal quantifiers). None of the examples are about scope interactions between modals and DPs that contain modified numerals. In other words, all readings that I refer to as inverse scope readings in the remainder of this chapter are the readings I called split scope readings in the previous chapter. They are readings where the modified numeral takes wide scope, not readings where a DP takes wide scope. As another aside, I do not discuss split scope readings with negative indefinites here because they do not give rise to the pragmatic inferences that some modified numerals have.

This chapter is organised as follows. In the next section I will discuss the relevant data. Here I lay out in detail what kinds of implicatures modified numerals can give rise to in different environments. In section 4.3 I discuss the way degree quantifier accounts of modified numerals generate these readings and where the problems of these accounts lie. I show in section 4.4 that the cause of these problems is the assumption of non-existent scope configurations. In section 5 I argue that given that the number of scope configurations we can generate is more limited than we thought, we must find a different way to calculate the two different kinds of implicatures we observe; we cannot assume that one kind always arises from a surface scope configuration and the other always arises from an inverse scope configuration. Section 4.6 concludes.

4.2 Modified numerals and implicatures

Geurts and Nouwen (2007) were the first to notice that the superlative numeral modifiers *at least* and *at most* behave differently from the comparative numeral modifiers *more than* and *fewer/less than* in a number of ways. One key difference is that superlative numeral modifiers give rise to rather strong epistemic readings. Consider (4).

(4) Neptune has at least ten moons.

On a purely mathematical level, (4) simply means that the number of moons Neptune has is ten or higher. But it also gives rise to the inference that the speaker does not know the exact number of moons Neptune has. This is why the follow-up sentence in (5), which contradicts this inference, is odd.

(5) Neptune has at least ten moons. #Fourteen moons, to be exact.

Now, one might be tempted to think that this says nothing about the semantics of *at least*. Perhaps the epistemic flavour of (4) simply comes from the fact that its speaker chose to give a range of possible options (ten or higher) rather than mentioning the precise number of moons. If she had known the precise number, surely she would have mentioned this number. Similarly, perhaps the continuation in (5) is odd simply because it makes the first sentence redundant. Why mention that the number of moons is in the range $[10\text{-}\infty)$ and then say that it is in fact fourteen instead of just saying that Neptune has fourteen moons?

But this cannot be the whole story. First, (6) intuitively does not give rise to an ignorance inference of the same strength as (4) even though it also raises multiple options as to what the precise number of moons of Neptune is. This intuition is corroborated by (7). Here it seems perfectly fine to use a follow-up sentence in which you state the precise number of moons, thereby demonstrating your knowledge of this fact. When you use the comparative numeral modifier *more than* instead of the superlative numeral modifier *at least*, you do not get the same epistemic effect.

(6) Neptune has more than ten moons.

(7) Neptune has more than ten moons. Fourteen moons, to be exact.

(8) makes the same point. On a numeric level, both sentences convey the same thing: the number of children the speaker has is in the range $[3\text{-}\infty)$. But (8-a) sounds rather strange because it suggests that the speaker does not know how many children he (or a very inattentive she) has, while (8-b), which could theoretically give the same impression, does not necessarily indicate that the speaker is unaware of the number of children they have.

(8) a. ?I have at least three children.

b. I have more than two children.

Nouwen (2010) observes that this contrast holds not only between superlative and comparative modifiers but also between numeral modifiers that fall outside of these two classes. The modified numerals that give rise to epistemic inferences include not only *at least* n and its negative counterpart *at most* n but also *minimally* n, *maximally* n, n *or more*, n *or less* and *up to* n. The modified numerals that do not give rise to these strong inferences include not only *more than* n and *fewer than* n but also *over* n and *under* n. Nouwen calls the modified numerals that give rise to strong epistemic inferences Class B modified numerals. He calls the other ones Class A modified numerals.

As the examples below show, only class A modified numerals are compatible with precise knowledge of the number under discussion.

(9) Class A:
I know exactly how many books are in this library, and it's { more than / less than / under / over } ten million.

(10) Class B:
I know exactly how many books are in this library, #and it's { at least / at most / minimally / maximally / up to } ten million.

When class B modifiers occur in a sentence with a modal, the epistemic inference they give rise to optionally disappears. First let us consider the baseline without a modal in (11). Here we get an epistemic reading: the speaker conveys that Nemo ate no more than 40 grams of food, but the speaker does not know exactly how many grams of food Nemo ate.[1]

(11) Nemo ate at most 40 grams of food.

Now let us move our attention to (12). Here the most prevalent reading is a reading where the speaker has full knowledge of the situation. The speaker knows that Nemo is not allowed to eat more than 40 grams of food and also that she is allowed to have a certain amount of food at or below 40 grams. On this reading, the speaker knows precisely what is and what is not allowed.

(12) Nemo is allowed to eat at most 40 grams of food.

This non-epistemic reading comes with an additional inference often called a *free choice* or a *variation* inference: multiple numbers from zero to 40 are possibilities. This means that as long as she stays within the [0-40] range, Nemo can choose freely between different number of grams of food she wishes to eat. In other words, (12) carries te inference that it is not the case that there is one specific number of grams of foods Nemo is allowed to eat. You could not say (12), for instance, if Nemo were allowed to eat exactly twenty grams of food

[1] Nemo is a cat, not a fish or a human on a crash diet.

(no more and no less), even though (12) would be true in such a context.[2]

(12) also has an epistemic reading, though this reading is less prevalent than the non-epistemic reading described above. This is the reading that there is some upper bound to the number of grams of food Nemo is allowed to have, but the speaker does not know exactly what this upper bound is. The text in (13) is designed to clarify this intuition.

(13) The vet mentioned that we need to put Nemo on a diet. I don't remember exactly how much food she said Nemo is allowed to have, but I know it was at most 40 grams.

Thus, under this reading there is not a variety of options that are valid choices of numbers of grams of food for Nemo to eat. Instead, there is only one right option (for instance: the vet said that Nemo must eat 30 grams of food daily) but the speaker is uncertain about what exactly this right option is. The variety lies in the epistemic possibilities considered by the speaker rather than in Nemo's food options.

I will refer to these two readings as the authoritative reading and the epistemic reading. The epistemic reading is also commonly referred to as the *speaker insecurity* reading (Büring, 2008), the *modal concord* reading (Geurts & Nouwen, 2007) or the *ignorance* reading (e.g. Kennedy, 2015).

Another example of this ambiguity with a different modal and numeral modifier is given in (14).

(14) Nemo is required to eat at least 40 grams of food.

Here the authoritative reading is that Nemo is not allowed to eat between zero and 39 grams of food, but she is allowed to eat some number of grams of food in the $[40\text{-}\infty)$ range. The variation inference is that she is allowed to choose between different numbers of grams of food in this range. This is the most prevalent reading of (14). The less obvious epistemic reading is the reading that the speaker knows that there is some lower bound to how much food Nemo should eat and that this lower bound is forty or higher, but he does not know where exactly this lower bound is.

So far we have seen that when we combine the existential modal *allowed* with the numeral modifier *at most* or the universal modal *required* with the numeral modifier *at least*, this yields an authoritative reading with a variation inference and a reading with an ignorance inference. In both cases, the authoritative reading is by far the most prevalent reading. Now let us briefly turn to the other two possible combinations.

The authoritative reading of (15) is quite similar to the authoritative reading

[2]But Nemo cannot necessarily choose *any* number of grams of food between zero and 40. Say that Nemo's food comes in tiny bags of five grams each and that Nemo can only eat multiples of five grams of food. In this scenario, Nemo can have 10 or 25 or 30 grams of food but not 17 or 26 grams. Intuitively, (12) can still be used in such a context (Nouwen, 2015).

of (12).[3]

(15) Nemo is required to eat at most forty grams of food.

It says that Nemo cannot eat more than forty grams of food and seems to also have the variation inference that any amount under forty grams is acceptable. The epistemic reading is the reading that the speaker knows that Nemo is required to eat some minimum number of grams of food and she does not know how much exactly, but she knows it is forty or less. As far as the authoritative reading is concerned, (15) is a far less natural way to express this reading than (12): the combination of *at most* with a universal modal is less natural than *at most* with an existential modal. The epistemic reading is more obvious here.

The final possible combination is an existential modal and *at least*, as in (16).

(16) Nemo is allowed to eat at least forty grams of food.

While the *required/at most* combination is already a bit less natural than *allowed/at most* and *required/at least*, the *allowed/at least* combination seems to be the least natural one of the four. The authoritative reading, if it exists, would be the rather weak reading that gives Nemo permission to eat forty grams of food or more, again with the inference that multiple numbers over thirty-nine are acceptable. This reading is weak because it does not exclude any number of grams of foods: allowing forty or more grams does not mean disallowing numbers under forty. The epistemic reading is the reading that there is an upper bound to the number of grams of food Nemo is allowed to eat, and this upper bound is forty or higher. I will discuss this reading in more detail later in this chapter. The epistemic reading is much more present here than for the natural combinations in (12) and (14).

So: class B numeral modifiers such as *at least* and *at most* give rise to epistemic inferences. When they occur with modals, other readings become available. There are two very natural combinations of class B numeral modifiers and modals: *at most* and an existential modal, as in (12), and *at least* and a universal modal, as in (14). For these natural combinations, the epistemic reading is still there, but it fades into the background. Only very specific contexts can bring it out (e.g. (13)). Instead, sentences with these natural combinations of modals and modified numerals have an authoritative reading: a reading that conveys which options are allowed or required without any ignorance on the part of the speaker. These readings come with a variation inference: more than one option is available.

Then there are the two less natural combinations: *at most* with a universal modal, as in (15), and, the most unnatural one, *at least* with an existential modal, exemplified in (16). The authoritative reading is less obvious for these

[3] It is difficult to pinpoint the difference. To me, it seems as though (15) requires Nemo to eat food, whereas (12) gives her the possibility to eat nothing. I have not tested this intuition in any way.

examples than for the more natural ones and seems even to be absent for (16). The epistemic readings are stronger than for the natural examples, particularly for the case with *at least* and an existential modal.

There are thus four possible combinations of modals and modified numerals and eight theoretically possible readings. In the next section I will discuss the mechanisms degree quantifier accounts of modified numerals use to derive these eight readings.

4.3 Degree quantifier accounts

Schwarz (2013) and Kennedy (2015) assume that *at least* and *at most* are degree quantifiers. In sentences with modals, these degree quantifiers can quantifier raise to a position above or below the modal. These two different scope configurations yield different kinds of quantity implicatures, and this is what derives the variation readings and epistemic readings. In this section I will discuss Schwarz's analysis. I will show that it yields the right predictions for sentences with universal modals but fails in the case of existential modals.

Schwarz takes the lexical entries of *at least* and *at most* to be as in (17) and (18) respectively. Both numeral modifiers take a numeral of type d as their first argument. This is the numeral they modify. Then they take a degree predicate P. Their meaning is that the highest number for which P holds is greater than or equal to (*at least*) or less than or equal to (*at most*) the number they modify.

(17) $[\![\text{at least}]\!] = \lambda d_d \lambda P_{\langle d,t\rangle}.max\{n \mid P(n)\} \geq d$

(18) $[\![\text{at most}]\!] = \lambda d_d \lambda P_{\langle d,t\rangle}.max\{n \mid P(n)\} \leq d$

where $max(P) = \iota n \,.\, P(n) \wedge \forall n' \; [P(n') \rightarrow n' \leq n]$ (Heim, 2000)

I will briefly illustrate the workings of these definitions with a sentence without a modal. (19) has the truth conditions in (20): the maximum degree n such that Nemo ate n grams of food is forty or higher. This is true if she ate, for instance, fifty grams. In this case, it is true that she ate one gram of food, that she ate two grams of food, ... , that she ate forty-nine grams of food, and that she ate fifty grams of food, but she did not eat fifty-one grams of food. Therefore, the highest number for which it is true that Nemo ate that number of grams of food is fifty. As fifty is in the set of numbers that are forty or higher, the sentence is true. If she ate thirty-five grams of food, then the maximum number for which it can be truthfully said that she ate that number of grams of food is thirty-five. This number is lower than forty, so the sentence is false.

(19) Nemo ate at least forty grams of food.

(20) max $\{ n \mid \text{Nemo ate } n \text{ grams of food} \} \geq 40$

Schwarz assumes that in the calculation of quantity implicatures for these types of sentences, the alternatives that enter into the calculation consist of alternatives where the numeral has been replaced by another numeral and alternatives where the modifier has been replaced by another modifier. He assumes that this latter set consists of *at least*, *at most*, and *exactly*. The two relevant Horn sets are given in (21). For completeness, the denotation of *exactly* is given in (22). This definition is the same as the definitions of *at least* and *at most* except for the = where the other two modifiers have ≥ / ≤.

(21) a. { 1, 2, 3, 4, 5, ... }
b. { at least, exactly, at most }

(22) $[\![\text{exactly}]\!] = \lambda d_d \lambda P_{\langle d,t\rangle}.max\{n \mid P(n)\} = d$

With these assumptions in hand, let us consider what happens when we calculate the quantity implicatures of (20). Using the two Horn sets from (21), the two relevant stronger alternatives are the ones in (23). In (23-a), *at least* has been replaced by *exactly* and in (23-b) the numeral *forty* has been replaced by a higher numeral.

(23) a. max { n | Nemo eats n grams of food } = 40
b. max { n | Nemo eats n grams of food } ≥ 41

Following the 'standard recipe' view of implicatures (Sauerland, 2004b; Geurts, 2010), this yields the so-called primary implicatures in (24), where 'B' stands for 'the speaker believes that'.

(24) a. ¬ B [max { n | Nemo eats n grams of food } = 40]
b. ¬ B [max { n | Nemo eats n grams of food } ≥ 41]

The reasoning behind these primary quantity implicatures goes as follows. The alternatives in (23) are both stronger than the assertion in (20). As the Quantity Maxim dictates that one should be as informative as possible, stronger alternatives are in principle preferred to weaker ones. Nevertheless, the speaker chose to utter (20) instead of one of the stronger alternatives in (23), so she must have had a reason for that. The most plausible reason is that she does not hold the belief that the stronger alternatives are true, as conveyed in (24). This is how primary implicatures are calculated.

If we make the so-called Competence assumption; that is: we assume that the speaker has an opinion on whether or not the stronger alternatives in (23) are true, we can derive secondary implicatures. In the standard recipe for implicature calculation we use here, the idea is that we can always assume Competence unless this leads to contradictions. The resulting secondary implicatures are given in (25).

(25) a. B ¬ [max { n | Nemo eats n grams of food } = 40]
b. B ¬ [max { n | Nemo eats n grams of food } ≥ 41]

The secondary implicatures are calculated by combining Competence with the primary implicatures. If the speaker has an opinion on whether the stronger alternative in (23-a) is true or not and, as stated in (24-a), she does not hold the belief that (23-a) is true, then she must hold the belief that it is in fact false. Parallel reasoning can be applied to the stronger alternative in (23-b) and the primary implicature in (24-b).

But if we take a closer look at the secondary implicatures, we can see that they are not consistent with the assertion. The speaker asserts that Nemo ate at least forty grams of food, but she believes that Nemo did not eat forty grams of food and she also believes that Nemo did not eat 41 or more grams of food. This is not a consistent world view. In other words, the stronger alternatives in (25) are symmetric: negating both alternatives yields a contradiction to the assertion (Sauerland, 2004b). Since it was the Competence assumption that gave us the secondary implicatures in (25), we must conclude that we should not have assumed Competence, and stick with the primary implicatures in (24). What we have is that the speaker believes that the number of grams of food Nemo ate is forty or higher, but she does not hold the belief that it is forty, nor does she hold the belief that it is higher than forty. In other words, she leaves both options open. This is represented in (26), where P stands for 'the speaker considers it possible that'.

(26) a. P max { n | [Nemo eats n grams of food] } $= 40$
b. P max { n | [Nemo eats n grams of food] } ≥ 41

To put it more precisely, (26-a) follows from the assertion in (20) and the primary implicature in (24-b): if you believe the maximum is forty or higher but you do not hold the belief that it is higher than forty, then you must consider it possible that it is exactly forty. Similarly, (26-b) follows from (20) and (24-a).

The final step is shown in (27), where ? stands for 'the speaker does not know whether'. This follows from (26): if the speaker considers both stronger alternatives to be possible, it follows that he does not know which of them is true.

(27) a. ?max { n | $\Box$ [Nemo eats n grams of food] } $= 40$
b. ?max { n | $\Box$ [Nemo eats n grams of food] } ≥ 41

These implicatures are epistemic implicatures, and in combination with the assertion this yields the epistemic reading: the speaker believes that Nemo ate at least forty grams of food, but he is not sure whether Nemo ate exactly forty grams of food or forty-one or more grams of food.

4.3.1 Universal modals

Now that we have seen how epistemic implicatures come about in sentences without modals, let us turn to the core data with modals, starting with universal modals. (28) has the two possible LFs in (29).[4] In (29-a) the modal takes wide scope and in (29-b) the modified numeral does. I will refer to (29-a) as the surface scope LF and to (29-b) as the inverse scope LF, and to the corresponding readings as surface scope and inverse scope readings (despite the fact that the degree quantifier obligatorily quantifier raises for type reasons in both cases, so there is no real surface scope reading).[5]

(28) Nemo is required to eat at least forty grams of food.

(29) a. [□ [at least 40 [λd [Nemo eats d-many grams of food]]]]
b. [at least 40 [λd [□ [Nemo eats d-many grams of food]]]]

These LFs yield the two denotations given in (30). (30-a) says that in all deontically accessible worlds, Nemo eats forty grams of food or more. This simply means that Nemo has the obligation to eat no fewer than forty grams of food. (30-b) says that the highest amount of food she eats in all deontically accessible worlds is forty or more. This means that there is a certain number n, and Nemo is required to eat n grams of food. We cannot tell from the denotation which number n is, but we can tell that it is forty or somewhere above forty.

(30) a. $\Box$ [max { n | Nemo eats n grams of food } $\geq$ 40]
b. max { n | $\Box$ [Nemo eats n grams of food] } $\geq$ 40

In quantity implicature based accounts of modified numerals, surface scope configurations yield authoritative readings and inverse scope configurations yield epistemic readings. Thus, (30-a) generates a variation inference and (30-b) generates an epistemic inference. Let us see how this works.

I will first consider what happens when we calculate the quantity implicatures of (30-a). Using the two Horn sets from (21), the two relevant stronger alternatives are the ones in (31). In (31-a), *at least* has been replaced by *exactly* and in (32-b) the numeral *forty* has been replaced by a higher numeral.

(31) a. $\Box$ [max { n | Nemo eats n grams of food } = 40]
b. $\Box$ [max { n | Nemo eats n grams of food } $\geq$ 41]

This yields the primary implicatures in (32).

(32) a. $\neg$ B $\Box$ [max { n | Nemo eats n grams of food } = 40]
b. $\neg$ B $\Box$ [max { n | Nemo eats n grams of food } $\geq$ 41]

Making the Competence assumption yields the secondary implicatures in (33). The speaker believes that Nemo is not required to eat exactly forty grams of food and that she is not required to eat more than forty grams of food. This

[4] *Many* turns the object into a proper quantifier of type $\langle\langle e,t\rangle,t\rangle$, as explained in chapter 2 and 4.

[5] It is worth mentioning again that *inverse scope* in this chapter refers to inverse scope of the modified numeral and not of the entire DP. In the previous chapter, I referred to these readings as split scope readings.

is consistent with the assertion that she is required to eat at least forty grams of food, so this time we do not have to throw away the secondary implicatures. Note again that according to the standard recipe, we always make the Competence assumption unless this assumption leads to contradictions.

(33) a. B $\neg\Box$ [*max* { n | Nemo eats n grams of food } $= 40$]
b. B $\neg\Box$ [*max* { n | Nemo eats n grams of food } ≥ 41]

So we are able to generate both primary and the stronger secondary implicatures for (30-a), the surface scope reading of (28). The assertion in (30-a) in combination with the secondary implicatures in (33) yields the authoritative reading: the speaker believes that Nemo is required to eat forty or more grams of food but she is not required to eat exactly forty grams of food and she is not required to eat more than forty grams of food. The secondary implicatures thus correspond to the variation inference discussed above: neither forty nor some number above forty is a required number of grams of food for Nemo to eat, so multiple numbers in the [40-∞) range are possibilities.

Now let us turn to the inverse scope reading of (28), which is given in (30-b). Using the sets of alternative lexical items in (21), we can generate the two relevant stronger alternative propositions in (34).

(34) a. *max* { n | $\Box$ [Nemo eats n grams of food] } $= 40$
b. *max* { n | $\Box$ [Nemo eats n grams of food] } ≥ 41

From these stronger alternatives we can derive the primary implicatures in (35): the speaker does not have the belief that the highest number of grams of food Nemo eats in all permissible worlds is forty, and she does not have the belief that this number is higher than forty.

(35) a. $\neg$ B *max* { n | $\Box$ [Nemo eats n grams of food] } $= 40$
b. $\neg$ B *max* { n | $\Box$ [Nemo eats n grams of food] } ≥ 41

The corresponding secondary implicatures would be the ones in (36). But let us consider the belief state the speaker is in if we calculate these secondary implicatures. The speaker believes the assertion that the maximum number of grams of food Nemo is required to eat is forty or higher. At the same time, he believes that this maximum is not forty and it is also not a number above forty. Our poor speaker must be very confused, because his assertion and the implicatures it generates contradict each other. As in the case without modals, the alternatives are symmetric. We can conclude from this that it is not possible to assume Competence and to calculate secondary implicatures.

(36) a. B $\neg$ *max* { n | $\Box$ [Nemo eats n grams of food] } $= 40$
b. B $\neg$ *max* { n | $\Box$ [Nemo eats n grams of food] } ≥ 41

Exactly as above, if we are left with primary implicatures only, it follows that the speaker considers both options possible. This is illustrated in (37).

(37) a. P max { n | □ [Nemo eats n grams of food] } = 40
b. P max { n | □ [Nemo eats n grams of food] } ≥ 41

Given that the speaker considers both options to be possible, she must not know which option is true. This yields the epistemic implicatures given in (38).

(38) a. ?max { n | □ [Nemo eats n grams of food] } = 40
b. ?max { n | □ [Nemo eats n grams of food] } ≥ 41

So, the speaker believes that Nemo is required to eat at least forty grams of food, but he is not sure whether Nemo is required to eat exactly forty grams of food or forty-one or more grams of food. Put differently, there is some minimum amount of food Nemo has to eat. The speaker does not know this number, but he knows that it is in the [40-∞) range.

The account works in exactly the same way for sentences with *at most* and a universal modal. I will briefly go through both readings for completeness. (39) has the two possible LFs in (40) and the two corresponding denotations in (41).

(39) Nemo is required to eat at most forty grams of food.

(40) a. [□ [at most 40 [λd [Nemo eats d-many grams of food]]]]
b. [at most 40 [λd [□ [Nemo eats d-many grams of food]]]]

(41) a. □ [max { n | Nemo eats n grams of food } ≤ 40]
b. max { n | □ [Nemo eats n grams of food] } ≤ 40

Let us first consider the surface scope denotation in (41-a). This says that in all deontically accessible worlds Nemo eats no more than forty grams of food. The Horn sets in (21) give us the two relevant stronger alternatives in (42), the primary implicatures in (43), and, assuming Competence, the secondary implicatures in (44).

(42) a. □ [max { n | Nemo eats n grams of food } = 40]
b. □ [max { n | Nemo eats n grams of food } ≤ 39]

(43) a. ¬ B □ [max { n | Nemo eats n grams of food } = 40]
b. ¬ B □ [max { n | Nemo eats n grams of food } ≤ 39]

(44) a. B ¬□ [max { n | Nemo eats n grams of food } = 40]
b. B ¬□ [max { n | Nemo eats n grams of food } ≤ 39]

(41-a) combined with (44) yields the authoritative reading: Nemo has the requirement to eat forty grams of food or less, but within those constraints she is free to choose between forty grams and some amount below forty grams.

Finally, let us turn to the inverse scope denotation of (39) in (41-b). The stronger alternatives and corresponding primary implicatures are given below.

(45) a. max { n | □ [Nemo eats n grams of food] } = 40
b. max { n | □ [Nemo eats n grams of food] } ≤ 39

(46) a. $\neg$ B $max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} = 40$
b. $\neg$ B $max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} \leq 39$

As in the inverse scope configuration of the *at least* sentence above, the stronger alternatives are symmetric: the secondary implicatures in (47) contradict the assertion. It is not possible to believe that the maximum is forty or lower, but it is neither forty nor lower. Again using the same reasoning as in the *at least* case, we can conclude that the speaker considers both stronger alternatives possible, as illustrated in (48), and therefore that she does not know which one of them is true. This yields the epistemic inferences given in (49).

(47) a. B $\neg$ $max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} = 40$
b. B $\neg$ $max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} \leq 39$

(48) a. P $max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} = 40$
b. P $max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} \leq 39$

(49) a. $?max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} = 40$
b. $?max\ \{\ n \mid \Box\ [$ Nemo eats n grams of food $]\ \} \leq 39$

Thus, in the case where we see a universal modal and *at most*, we also derive the epistemic reading from the inverse scope LF: the maximum number of grams of food Nemo is required to eat is forty or lower, but the speaker does not know whether the maximum is exactly forty or lower than forty.

Summarising, Schwarz's quantity implicature based account derives two readings for sentences where *at least* and *at most* occur with a universal modal. The way this is done is by assuming that modified numerals can QR over the modal or they can QR to a position below the modal. If they stay under the modal, we can derive both primary and secondary quantity implicatures, yielding the variation inference. When they move over the modal, the stronger alternatives are symmetric. From the primary implicatures, we can then derive epistemic inferences. This is how the authoritative reading and the epistemic reading are derived. The box below summarises this.

Schwarz's account: interactions with universal modals

- Narrow scope for the modified numeral → no symmetry → secondary/scalar implicatures → non-epistemic reading
- Wide scope for the modified numeral → symmetry → no secondary implicatures → ignorance implicatures → epistemic reading

Note that no distinction is made between the prevalence of these readings: for both the natural combination with *at least* and the slightly less natural combination with *at most*, an epistemic reading and an authoritative reading are generated. All four readings are predicted to be equally available.

4.3.2 Existential modals

Schwarz's account works quite well for the cases with universal modals, deriving exactly the readings we observe. But for sentences with existential modals, it both generates non-existent readings and fails to generate existing readings. Let us go through the four possible derivations to see what happens.

Let us begin with *at least* again and consider (50). Assuming that *at least* can move to a position above or below the modal, we derive the two readings in (51).

(50) Nemo is allowed to eat at least forty grams of food.

(51) a. $\Diamond$ [*max* { n | Nemo eats n grams of food } ≥ 40]
b. *max* { n | $\Diamond$ [Nemo eats n grams of food] } ≥ 40

Let us go through the derivation of the surface scope reading in (51-a). (51-a) says that it is permitted for Nemo to eat a maximum of forty or more grams of food. So, there is a possible world where she eats forty grams of food or more. Using the Horn sets from the previous section, which allow us to generate stronger alternative propositions by replacing both the numeral and the modifier, we obtain the stronger alternatives in (53).

(52) a. $\Diamond$ [*max* { n | Nemo eats n grams of food } $= 40$]
b. $\Diamond$ [*max* { n | Nemo eats n grams of food } ≥ 41]

As before, we can use these alternatives to derive the primary implicatures in (53): the speaker does not hold the belief that Nemo has permission to eat exactly forty grams of food nor does he hold the belief that she has permission to eat more than that.

(53) a. $\neg$ B $\Diamond$ [*max* { n | Nemo eats n grams of food } $= 40$]
b. $\neg$ B $\Diamond$ [*max* { n | Nemo eats n grams of food } ≥ 41]

If we make the Competence assumption, we can generate the stronger secondary implicatures in (54).

(54) a. B $\neg$ $\Diamond$ [*max* { n | Nemo eats n grams of food } $= 40$]
b. B $\neg$ $\Diamond$ [*max* { n | Nemo eats n grams of food } ≥ 41]

Let us consider the meaning we have derived now. The speaker believes the assertion that there is a possible world in which the maximum number of grams of food Nemo eats is forty or higher. He also believes that there is no possible world where it is exactly forty and there is no possible world where it is 41 or higher. This is contradictory. Apparently, we cannot assume Competence here, so we are left with the primary implicatures in (53). Given that the speaker believes that it is possible that the maximum is forty or higher but holds neither the belief that it is forty nor the belief that it is higher, he must consider both of these options possible, as illustrated in (55).

(55) a. P $\Diamond$ [*max* { n | Nemo eats n grams of food } $= 40$]
b. P $\Diamond$ [*max* { n | Nemo eats n grams of food } ≥ 41]

This allows us to derive the epistemic implicatures in (56). In combination with these implicatures, the meaning of the sentence is that it is allowed for Nemo to eat forty or more grams of food, but it is not known whether forty is allowed or whether 41 or more is allowed. This reading is not attested.

(56) a. ?$\Diamond$ [*max* { n | Nemo eats n grams of food } $= 40$]
b. ?$\Diamond$ [*max* { n | Nemo eats n grams of food } ≥ 41]

There are two important facts to note here. First, due to the symmetry of the stronger alternatives, we were unable to derive secondary implicatures. As a result, we have derived epistemic implicatures rather than variation implicatures. The idea behind Schwarz's account is that surface scope leads to an authoritative reading, but that does not work in this case. Second, the epistemic reading we have derived is very weak: it says that forty or more is allowed and that the speaker knows neither whether exactly forty is allowed nor whether more than forty is allowed. As we will see now, the inverse scope reading leads to stronger implicatures.

So let us consider (51-b): there is some maximum number of grams of foods Nemo is allowed to eat, and that maximum is forty or higher. The stronger alternatives are the ones in (57).

(57) a. *max* { n | $\Diamond$ [Nemo eats n grams of food] } $= 40$
b. *max* { n | $\Diamond$ [Nemo eats n grams of food] } ≥ 41

The primary implicatures in (58) are that the speaker does not hold the belief that the stronger alternatives are true. When we strengthen these alternatives to secondary implicatures, as in (59), the conjunction of the implicatures and the assertion is contradictory: it is not possible for the maximum to be forty or higher and for it to be neither forty nor higher.

(58) a. $\neg$ B *max* { n | $\Diamond$ [Nemo eats n grams of food] } $= 40$
b. $\neg$ B *max* { n | $\Diamond$ [Nemo eats n grams of food] } ≥ 41

(59) a. B $\neg$ *max* { n | $\Diamond$ [Nemo eats n grams of food] } $= 40$
b. B $\neg$ *max* { n | $\Diamond$ [Nemo eats n grams of food] } ≥ 41

We are left with the primary implicatures alone, which yields the epistemic implicatures in (60).

(60) a. ?*max* { n | $\Diamond$ [Nemo eats n grams of food] } $= 40$
b. ?*max* { n | $\Diamond$ [Nemo eats n grams of food] } ≥ 41

This results in the following reading: the maximum number of grams Nemo is allowed to eat is forty or higher, but the speaker does not know whether this maximum is exactly forty or higher than forty.

While both readings are epistemic readings, this reading is much stronger than the reading associated with the surface scope configuration. What this reading says is that there is an upper bound to what is allowed, and there is some uncertainty about the precise number that is this upper bound. The surface scope reading does not presuppose the existence of such an upper bound. Instead, it merely says that forty or more is allowed, and that the speaker does not know whether forty is allowed or whether more is allowed.

There are two issues with respect to the predictions of this account for sentences with existential modals and *at least*. First, only the stronger inverse scope reading is attested. There is no surface scope reading. I will show this in the next section of this chapter. Second, the account only derives epistemic readings and no authoritative readings. It does not seem like (50) has an authoritative reading so for this sentence, this is not a problem. But, as we will see below, we get the same result for sentences with *at most* and an existential modal, and there this result is undeniably problematic.

So let us turn to such a case, given in (61), with the two sets of truth conditions in (62).

(61) Nemo is allowed to eat at most forty grams of food.

(62) a. $\Diamond$ [*max* { n | Nemo eats n grams of food } $\leq$ 40]
b. *max* { n | $\Diamond$ [Nemo eats n grams of food] } $\leq$ 40

We will again start with the surface scope reading in (62-a). This is a rather weak reading: it merely gives Nemo permission to eat forty grams of food or less, without prohibiting her from doing anything else. That is, if Nemo eats sixty grams of food, this does not mean that she has not followed the instructions in (62-a). This reading is not an attested reading of (61). As (63) illustrates, (61) sets an upper bound to what is allowed and does not merely give permission. It is therefore incompatible with numbers above forty.

(63) Nemo is allowed to eat at most forty grams of food, #but more is fine too.

Nevertheless, let us go through the implicatures we can derive from this reading. The stronger alternatives and corresponding primary implicatures are given below.

(64) a. $\Diamond$ [*max* { n | Nemo eats n grams of food } $=$ 40]
b. $\Diamond$ [*max* { n | Nemo eats n grams of food } $\leq$ 39]

(65) a. $\neg$ B $\Diamond$ [*max* { n | Nemo eats n grams of food } $=$ 40]
b. $\neg$ B $\Diamond$ [*max* { n | Nemo eats n grams of food } $\leq$ 39]

Thus, the speaker conveys that Nemo has permission to eat forty grams of food or less, but does not hold the belief that she has permission to eat exactly forty grams of food or the belief that she has permission to eat less than that. We cannot assume Competence and derive the secondary implicatures in (66): if one believes that there is a world where the maximum is forty or lower, as the assertion states, then this is incompatible with the conjunction of the secondary implicatures: the belief that there is no world where the maximum is forty and also no world where the maximum is lower.

(66) a. $\mathrm{B} \neg \Diamond$ [max { n | Nemo eats n grams of food } $= 40$]
b. $\mathrm{B} \neg \Diamond$ [max { n | Nemo eats n grams of food } ≤ 39]

From the assertion in (62-a) and the primary implicatures in (65) we can derive that the speaker considers both stronger alternatives possible, and therefore that she does not know which one of them is true, as shown in (67) and (68) respectively.

(67) a. $\mathrm{P} \Diamond$ [max { n | Nemo eats n grams of food } $= 40$]
b. $\mathrm{P} \Diamond$ [max { n | Nemo eats n grams of food } ≤ 39]

(68) a. $?\Diamond$ [max { n | Nemo eats n grams of food } $= 40$]
b. $?\Diamond$ [max { n | Nemo eats n grams of food } ≤ 39]

As in the *at least* case with an existential modal, we have derived an epistemic reading instead of an authoritative reading for the surface scope configuration. In addition, the epistemic reading we have derived is much weaker than the actual reading of (61): it merely states that Nemo has permission to eat less than forty grams of food and that the speaker does not know for the number forty or for the numbers below forty whether she is allowed to eat that number of grams of food. This is a case where Schwarz's account derives a non-existent reading.

Finally, let us consider the inverse scope reading of (61), shown in (62-b). (62-b) says that the maximum number of grams of food Nemo is allowed to eat is forty or lower. That is, unlike the surface scope reading, this reading caps what is allowed: if Nemo eats forty-five grams of food, she has definitely not followed the instructions in (62-b), though this could be attributed to the fact that cats generally have quite a poor understanding of predicate logic.

The two stronger alternatives and the primary implicatures associated with them are given below. The primary implicatures are that the speaker does not hold the belief that the upper bound to what Nemo can eat is forty and she also does not hold the belief that this upper bound is some number below forty.

(69) a. max { n | $\Diamond$ [Nemo eats n grams of food] } $= 40$
b. max { n | $\Diamond$ [Nemo eats n grams of food] } ≤ 39

(70) a. $\neg \mathrm{B}$ max { n | $\Diamond$ [Nemo eats n grams of food] } $= 40$
b. $\neg \mathrm{B}$ max { n | $\Diamond$ [Nemo eats n grams of food] } ≤ 39

The stronger alternatives are symmetric: negating both of them contradicts the assertion. This can be seen if we consider what the secondary implicatures would be. The implicatures, given in (71), are that the maximum is neither forty nor lower, which contradicts the assertion that it is forty or lower.

(71) a. B $\neg$ *max* $\{\, n \mid \Diamond$ [Nemo eats n grams of food] $\} = 40$
b. B $\neg$ *max* $\{\, n \mid \Diamond$ [Nemo eats n grams of food] $\} \leq 39$

Once again, we are left with only primary implicatures and the epistemic implicatures that result from them. The epistemic implicatures are in (72).

(72) a. ?*max* $\{\, n \mid \Diamond$ [Nemo eats n grams of food] $\} = 40$
b. ?*max* $\{\, n \mid \Diamond$ [Nemo eats n grams of food] $\} \leq 39$

The inverse scope reading is thus that the maximum amount of food Nemo has permission to eat is forty or lower, and the speaker is unsure whether the maximum is exactly forty or lower than forty. Like the inverse scope reading of sentences with existential modals and *at least*, this corresponds to an attested reading of the sentence. However, this reading is not the only reading of (61) and also not the most prevalent one. Instead, the most prominent reading is an authoritative reading that forbids Nemo from eating more than forty grams of food. That is: she is not allowed to eat more than forty grams of food, but is free to choose between different amounts of food under forty grams. The account does not derive this reading. I said above that it is not problematic that no authoritative reading can be derived for the *at least* sentence with an existential modal. In this case, the lack of an authoritative reading is a problem, because it is the most prominent reading of the sentence. Aside from this, the account derives two ignorance readings for (61), only one of which is actually attested. This is summarised in the box below.

Schwarz's account: interactions with existential modals

At least + $\Diamond$	*At most* + $\Diamond$
• 2 epistemic readings • Wide scope epistemic reading: attested • Narrow scope epistemic reading: not attested	• 2 epistemic readings • Wide scope epistemic reading: attested • Narrow scope epistemic reading: not attested • Reading this account does not generate: non-epistemic reading with a strong upper bound

We have seen that Schwarz's theory makes mostly correct predictions for sentences where class B modified numerals interact with universal modals but incorrect predictions for those where they interact with existential modals. For the cases with universal modals, the only problem is that no distinction is made between the more natural *at least-required* combination and the less natural *at most-required* combination, where the authoritative reading is more obvious in the former case and the epistemic reading is more obvious in the latter case.

For the cases with existential modals, the issues this account faces are far more serious. There are two main problems. The first is that the stronger alternatives of sentences with existential modals are always symmetric. For this reason, the only possible readings that can be derived are epistemic readings. Without secondary implicatures, there can be no authoritative readings. This is a problem of undergeneration that is problematic for the case with *at most*. The second problem is that for the surface scope LFs, the account derives very weak readings, and these readings are not actually attested. This is particularly striking in the *at most* case, where the account predicts that (61) can be used merely to give permission to eat forty or fewer grams of food. This is a problem of overgeneration. Below I will argue that the problem lies in the fact that two scope configurations are assumed to be possible, when in fact only one of them yields an attested reading.

4.4 Scope is the culprit

We have seen that accounts of the pragmatics of modified numerals that are based on the Gricean Quantity maxim run into a number of problems with respect to sentences with existential modals. I will argue that the root of these problems is the assumption that both scope configurations are possible for sentences with modals and modified numerals. If we closely consider the semantics associated with the surface scope and the inverse scope configuration of these types of sentences, however, we can see that not all scope configurations are possible. In particular, class B modified numerals cannot take scope under existential modals. Thus, while these modifiers can scope either over or under universal modals, they are less free in their interactions with existential modals, where they must take wide scope. This is schematised in (73).

(73) a. $\Box >$ *at least* / *at most*
b. *at least* / *at most* $> \Box$
c. $^*\Diamond >$ *at least* / *at most*
d. *at least* / *at most* $> \Diamond$

This is thus another case where assuming that when we have two operators in a sentence, we also have two possible scope configurations leads us to expect a type of ambiguity that we do not see. While it is perhaps surprising that it is the inverse scope reading rather than the surface scope reading that is the only reading available here, the nature of the problem is the same as the one in chapter 3: assuming an inverse scope configuration and a surface scope configuration leads to incorrect predictions. In this section I will give three arguments for the claim that class B modified numerals must take scope over existential modals.

The first argument comes from the judgment for (61) we have seen above. As discussed in the previous section, (61) sets an upper bound to what is allowed. On its authoritative reading, (61) has the meaning that Nemo is allowed to eat between zero and forty grams of food, and, crucially, that she is not allowed to eat more than that. If we let the existential modal take scope over *at most*, the reading we obtain will always be too weak. We would then predict that the sentence means that there is a permissible world in which Nemo eats between zero and forty grams of food. When we merely say that there is a permissible world in which something is the case, we leave open the possibility that there is another permissible world in which that thing is not the case. Here, we would leave open the possibility that in some other permissible world, Nemo eats sixty or seventy grams of food. The surface scope reading is not attested, and this signals that the surface scope LF is not a possible LF. If we assume that *at most* takes wide scope, its maximality operator restricts what is allowed, which yields the upper bound we observe for (61). Therefore, *at most* must outscope the existential modal.

(61) Nemo is allowed to eat at most forty grams of food.

The fact that *at most* must take wide scope here constitutes the first argument for the claim that class B numeral modifiers must outscope existential modals. Before I move on to the second argument, I will stop for an interlude about implicatures. Kennedy (2015) claims that the upper bound we observe in sentences like (61) is in fact an implicature. He argues that this works as follows. First, he derives a variation inference using 'exhaustified' alternatives. The exact nature of this technical mechanism is not relevant here, but what is important is that Kennedy derives the variation implicature for (61) that she is allowed to eat forty grams of food and that she is allowed to eat less than forty grams of food. He argues that the upper bound can then be calculated using the quantity maxim and gives an informal explanation of how this would work: if we assume that the speaker is knowledgeable with respect to how much food Nemo is permitted to eat, and this speaker makes the statement that zero to forty grams are permitted numbers, we can conclude that this is all that is allowed. If, say, 42 were an allowed number, she speaker would have known this, and could have made the statement in (74). This statement is stronger, so the quantity maxim dictates that if it can be truthfully made, the statement in (74) is to be preferred over (61). Given that the speaker chose not to make this stronger statement, we can conclude that it must be false. As this reasoning applies in all cases where we use an alternative proposition with a number over forty, we derive an upper bound of forty.

(74) Nemo is allowed to eat at most 42 grams of food.

One of the defining characteristics of implicatures is that they are cancellable. Consider the sentences in (75), where the modified numeral with *at most* has been replaced by a bare numeral, the class A modifier *fewer than*, the modifier *up to*, and the modifier *beween ... and ...* . All of these sentences convey an upper bound of forty (or lower than forty, in the case of (75-b)).

(75) a. Nemo is allowed to eat forty grams of food.

b. Nemo is allowed to eat fewer than 40 grams of food.
c. Nemo is allowed to eat up to 40 grams of food.
d. Nemo is allowed to eat between zero and forty grams of food.

(76) illustrates that this upper bound is cancellable. The continuations convey that higher numbers than forty are also permitted. The fact that these continuations are perfectly felicitous shows that there is no upper bound to what is allowed that is hard-wired in the semantics of the sentences in (75). It is fairly safe to conclude that the upper bound of these sentences is merely an implicature and not an entailment.

(76) a. Nemo is allowed to eat forty grams of food, but more is fine too.
b. Nemo is allowed to eat fewer than 40 grams of food, but more is fine too.
c. Nemo is allowed to eat up to 40 grams of food, but more is fine too.
d. Nemo is allowed to eat between zero and forty grams of food, but more is fine too.

Now compare the felicity of the continuations in (76) to the felicity of the continuation in (63).

(63) Nemo is allowed to eat at most forty grams of food, #but more is fine too.

Clearly, there is a contrast here. For the sentence with *at most*, it is not possible to cancel the upper bound. This is a clear signal that the upper bound in (61), quite unlike the upper bounds in (75), is semantic rather than pragmatic. For such a semantic upper bound to come about, *at most* must take scope over the existential modal.

The second argument for the claim that class B numeral modifiers must take scope over existential modals is that, on closer inspection of the judgments, we can see that the surface scope reading is also not attested in the *at least* case. Consider (77) and the two theoretically possible readings in (78).

(77) Marin is allowed to read at least five books.

(78) a. $\Diamond$ [*max* { n | Marin reads n books } ≥ 5]
b. *max* { n | $\Diamond$ [Marin reads n books] } ≥ 5

Semantically, the difference in meaning between the surface scope reading in (78-a) and the inverse scope reading in (78-b) is that only the inverse scope reading carries the presupposition that there is an upper bound to what is allowed. Thus, (78-a) merely conveys that there is a permissible world where Marin reads five or more books. (78-b) expresses that there is a maximum number of books Marin is allowed to read, and that maximum is five or higher. This presupposition that there is a maximum allowed number follows from the semantics of *max*. *max* picks the highest number out of the set, but if there is no highest number, this is not possible. In this case, *max* cannot pick any number. We get $? \geq 5$, and there is no way for us to test whether the sentence is true. Therefore, the only way for the sentence to receive a truth value is if there is a maximum number of books Marin is allowed to read.

Let us consider our judgments on (77) and compare them to our judgments on (79). (79) contains the class A modifier *more than* and is therefore predicted to have a surface scope reading, unlike (77). This is because *more than* is not a class B numeral modifier, and the claim I make here is that only class B numeral modifiers must outscope existential modals.

(79) Marin is allowed to read more than five books.

Intuitively, (77) is felicitous only in a situation where there is indeed some maximal number of books Marin can read, though the speaker does not know what this upper bound is. (79), on the other hand, does not seem to carry such a requirement. This indicates that the inverse scope reading is the only possible reading for (77). Just like sentences with expressions like *at most* and an existential modal, expressions like *at least* must take scope over the modal. The surface scope reading is not attested.

To clarify the intuition, let us consider the following scenario. Say Marin is a school child in a school with the following rules. The children in Year 4 are allowed to read as many books as they like during the school year. The children in Year 5, on the other hand, are expected to focus more on subjects such as maths and geography, and they have an upper limit to the number of books they can read at school. The exact upper limit varies from child to child and depends on the child's reading level and the child's grades for other subjects. In addition, new research has just been published that indicates that children who read 20 books a year or more have better vocabulary than those who read fewer than twenty books a year. One day, Marin's dad and another parent, David are talking about this new research. David wonders about Marin's vocabulary and asks the question in (80).

(80) David: Is Marin in Year 4 or in Year 5?

Let us first say that Marin is in year 5. This means that there is a limit to the number of books she is allowed to read. Fortunately for her vocabulary, the limit in Marin's particular case is 25, so it is higher than twenty. In this case, Marin's father can felicitously utter either (81-a) or (81-b). (81-a) presupposes that there is an upper bound to the number of books Marin can read, and as this is indeed the case, the utterance is unproblematic.

(81) a. Marin is in Year 5. She is allowed to read at least twenty books.
b. Marin is in Year 5. She is allowed to read more than twenty books.

Now let us consider a scenario where Marin is in Year 4. This means that Marin can read as many books as she wishes. In this case, only (82-b) is a felicitous answer to David's question. In (82-b), Marin's father states that Marin is in

Year 4, and as a result, she is allowed to read more than 20 books, which is good for her vocabulary. When we replace *more than* with *at least*, as in (82-a), the statement is no longer felicitous in the context. Given that Marin can read an unlimited number of books, it is very odd to state that she can read 'at least 20' books.

(82) a. Marin is in Year 4. #She is allowed to read at least twenty books.
 b. Marin is in Year 4. She is allowed to read more than twenty books.

If (82-a) were ambiguous between a surface scope reading and an inverse scope reading, it would be felicitous in the given context. Marin's father could then simply have intended the surface scope variation of the sentence. The proposition corresponding to the surface scope configuration does not carry the presupposition that there is an upper limit to what is allowed. Therefore, it should be as good as (82-b) in this scenario. The fact that it is not felicitous shows that the surface scope reading does not exist. Therefore, the surface scope LF that would yield this reading must not exist, either. Though the truth-conditional difference is harder to detect in this case, it is nevertheless real, and we can conclude that *at least*, like *at most*, must outscope existential modals.[6]

[6] At this point the reader may wonder if the same point can be made for interactions between *at least* and universal modals such as (i). The two possible denotations of (i) are given in (ii), with (ii-a) being the surface scope reading and (ii-b) being the split reading.

(i) Marin has to read at least five books.

(ii) a. $\Box$ [$\textsc{max}\ \{n \mid \exists x \wedge \#x = n \wedge \text{book}(x) \wedge \text{read(Marin}, x)\} \geq 5]$
 b. $\textsc{max}\ \{n \mid \Box[\exists x \wedge \#x = n \wedge \text{book}(x) \wedge \text{read(Marin}, x)]\} \geq 5$

These two denotations are truth-conditionally equivalent: both are true if and only if the lowest number of books Marin reads in all deontically accessible worlds is five. As in the case with existential modals, (ii-b) carries the presupposition that there is an upper bound. Here the presupposition is that there is an upper bound on what is required. Thus, there is a point where the number of books Marin has read is sufficient. That means that the only way the presupposition can fail is in a context in which it is known that the requirement has no limit. One scenario in which it is known that the requirement is infinite is in the myth of Sisyphus, who has been condemned to roll a rock up the hill only to watch it roll back down, repeating this action for eternity. To simplify the example, let us assume that the myth is slightly different: Sisyphus has an infinite number of rocks at his disposal, and he has to roll them all up the hill, only to watch them roll back down on the other side of the hill. Then (iii) should lead to a presupposition failure under the split reading. The presupposition is that there is an upper bound to what is required, but in this case, there is no such upper bound.

(iii) #Sisyphus must roll at least a million rocks up the hill.

This sentence does indeed sound quite bad in the given context, and it appears to be worse than (iv), where *more than* is used instead of *at least*.

(iv) ?Sisyphus must roll more than a million rocks up the hill.

However, we know that *at least* gives rise to epistemic inferences, and this may interfere with our judgments. If the speaker knows that there is no upper bound to the number of rocks Sisyphus must roll up the hill, then she is not ignorant about the precise number under

The third and final argument I will present for the statement that class B numeral modifiers must take scope over existential modals is a syntactic argument. Let us turn to (83) and (84). In these sentences, *more than* and *at least* occur in a finite clause under an modal. Finite clauses are known to be islands for QR (e.g. Reinhart, 2006a; Fox, 2000 and references cited therein; see also Büring, 2008 for an example with a finite clause island for degree QR). This means that in these examples, the relevant expressions are stuck below the modal. If class B numeral modifiers must outscope existential modals, this means that forcing them to be in the scope of existential modals is predicted to result in infelicity.

This prediction is borne out. As a baseline, consider (83) with a universal modal. Here, no problems arise: both the class A modifier *more than* and the class B modifiers *at least* can be used. When we consider similar cases with existential modals, however, we see a contrast. *More than* but not *at least* sits happily in the scope of the existential modal. Forcing *at least* under the modal leads to an infelicitous sentence. This indicates that *at least* cannot scope below an existential modal; it to scope above it. When this is not possible, the derivation crashes.[7]

(83) a. The government requires that organic chickens have more than 1000 cm^2 of space.
b. The government requires that organic chickens have at least 1000 cm^2 of space.

discussion. This may explain the contrast between (iii) and (iv). In addition, both sentences also suffer from a Quantity violation: why say that Sisyphus must roll a million rocks or more up the hill when you know that the amount is in fact infinite? Therefore, their oddness cannot be attributed to presupposition failure. We could change the examples to (v) to remedy this, but as *at least* is semantically vacuous in *at least an infinite number* and *more than an infinite number* is impossible, these sentences are also bad for independent reasons.

(v) a. #Sisyphus must roll at least an infinite number of rocks up the hill.
b. #Sisyphus must roll more than an infinite number of rocks up the hill.

In other words, it seems to me that it is impossible to test whether *at least* can outscope a universal modal in this way. However, as will become clear in this section, there is a syntactic test that indicates that *at least* can in fact take scope under universal modals.

[7] The sentence in (84-b) improves considerably in an echoic context, such as in the dialogue in (i).

(i) A: Are nurses allowed to work at least 40 hours a week?
B: Yes, new government regulations allow that nurses work { at least / minimally } 40 hours a week.

However, echoic contexts are not a good test for grammaticality or felicity in that they tend to allow things that are normally ungrammatical. For instance, the PPI *someone* is licensed under negation in the dialogue in (ii).

(ii) A: John saw someone.
B: No, he didn't see someone.

(84) a. New government regulations allow that nurses work more than 40 hours a week.
b. #New government regulations allow that nurses work at least 40 hours a week.

(85) and (86) make the same point for downward entailing modified numerals: the class A modifier *fewer/less than* does not mind taking scope under a universal modal or an existential modal. The class B modifier *at most*, on the other hand, only wants to take scope under a universal modal, and resists staying under an existential modal.

(85) a. The factory farm requires that the chickens have less than 1000 cm^2 of space.
b. The factory farm requires that the chickens have at most 1000 cm^2 of space.

(86) a. New government regulations allow that nurses work fewer than 40 hours a week.
b. #New government regulations allow that nurses work at most 40 hours a week.

In this section I have argued that class B numeral modifiers must take scope over existential modals. I have shown that not only *at most* but also *at least* fails to give rise to a surface scope reading when combined with an existential modal. A syntactic test using a QR island shows the same pattern.

We can now begin to understand why quantity based theories of modified numerals fail in the case of existential modals: they assume that there are two possible scope configurations, and therefore two denotations that can be used to calculate implicatures, when in fact there is only one. The issue is the assumption that both scope configurations are possible. In the next section, I will discuss the consequences of this finding for how we should build a theory of the semantics and pragmatics of modified numerals.

4.5 Towards a scope-independent theory of modified numerals

I have shown that class B numeral modifiers must take scope over existential modals. So, in sentences where modified numerals interact with an existential modal, only one scope configuration is possible: the inverse scope configuration. We have seen that at least with *at most*, these types of sentences do give rise to both an authoritative reading and an epistemic reading. Almost all accounts of modified numerals that are currently on the market assume that modified numerals can take scope either over or under modals, and use this assumption to derive the authoritative and epistemic reading. This includes Schwarz's (2013) and Kennedy's (2015) quantity implicature based accounts, but also Nouwen

(2010) and Coppock and Brochhagen (2013) (as far as I am aware, Geurts and Nouwen (2007) is the only exception). Given that we have seen that not all possible scope configurations are attested, we can no longer rely on scope to give us two different structures from which we can derive the two different sets of implicatures. Instead, we need a theory that gives us both readings without relying on scope, at least for the cases where modified numerals combine with existential modals. I will present such a theory in chapter 6 of this dissertation. In the rest of this chapter I will give two more reasons why we need a scope-independent theory to account for the two readings modified numerals give rise to when they occur with modals.

The first reason is that sentences with *at most* and the NPI universal modal *hoeven* in Dutch are also ambiguous. Consider (87). This sentence has two readings. It has the epistemic reading that there is some minimum amount of food Nemo is supposed to eat, the speaker does now know what this amount is, but she knows it is in the [0-50] range. In addition, it has an authoritative reading: Nemo does not need to eat more than fifty grams of food, and she can choose between eating fifty grams or less.

(87) Nemo hoeft hoogstens vijftig gram voer te eten.
Nemo must-NPI at most fifty grams food eat.
'Nemo only needs to eat at most fifty grams of food.'

Thus, this sentence has an epistemic reading and an authoritative reading, just like the English example with a universal modal and *at most*. Crucially, this sentence only has one possible structure: the inverse scope configuration. The downward monotone *at most* must take scope over the NPI *hoeven* in order to license it. Therefore, (87) is another case where we need to derive the epistemic reading and the authoritative reading with only one possible scope configuration. It thus presents another reason why we need a scope-independent theory of modified numerals and their pragmatics.

The second reason comes from examples with universal nominal quantifiers. Consider (88). If we assume that the modified numeral can take scope either over or under the universal quantifier, we predict the two possible scope configurations in (89). The surface scope structure is given in (89-a); the inverse scope structure is in (89-b).

(88) Every cat played with at most four toys.

(89) a. [Every cat [λx [at most 4 [λd [x plays with d toys]]]]]
b. [At most 4 [λd [every cat [λx [x plays with d toys]]]]]

This would yield the two possible denotations in (90).

(90) a. $\forall x$ [cat(x) $\rightarrow$ *max* { n | x plays with n toys } ≤ 4]
b. *max* { n | $\forall x$ [cat(x) $\rightarrow$ x plays with n toys] } ≤ 4

As has been amply discussed in the literature, only the surface scope denotation given in (90-a) corresponds to an attested reading. This is an instance of a more general constraint referred to as the Heim-Kennedy Generalisation (Kennedy, 1997; Heim, 2000), which I discussed in the previous chapter: degree quantifiers can move across modals but not across nominal quantifiers.

Let us make sure that the prediction of the Heim-Kennedy Generalisation is actually correct, and that (90-b) is indeed not a possible denotation. As a baseline, consider (90-a). What this says is that for every cat, it is the case that the maximum number of toys she played with is no higher than four. This corresponds quite nicely to what (88) intuitively means. The meaning in (90-b) is very different: it says that the maximum number of toys such that all cats played with that number of toys is four or lower. This means that the cat who played with the fewest toys played with four toys or fewer. To see why, consider a scenario where there are two cats: Nemo and Miep. Nemo played with three toys and Miep played with five toys. Now the maximum number such that all cats played with that number of toys is three. After all, all cats played with three toys — if you play with five toys, you also play with thirty toys — but not all cats played with, say, three toys: Nemo did not. The meaning conveyed by (90-b), therefore, is that the cat who played with the lowest number of toys played with four toys or less. In the Nemo-Miep scenario the sentence would then be true, even though Miep played with more than four toys. The fact that the sentence is intuitively false in this scenario shows that (90-b) is not a possible reading of (88). This means that we should not generate the structure in (89-b). Only the surface scope configuration in (89-b) gives rise to an attested reading.

We have established that we can again not assume the existence of two possible scope configurations; only one of them is possible. Now let us turn to the pragmatics of (88). As has been pointed out in the literature (I think Nouwen, 2010, was the first one to point this out), sentences where modified numerals occur with universal nominal quantifiers are ambiguous in a way that is analogous to the modal cases. (88) has both a non-epistemic reading and an epistemic reading. The non-epistemic reading is probably the most prevalent one: there are different cats who played with different numbers of toys, and no cat played with more than four toys. This reading is analogous to the non-epistemic, authoritative readings we see when modified numerals combine with modals. Like these authoritative readings, this non-epistemic reading also has a variation inference: the inference that it is not the case that all cats played with the same number of toys. (88) also has an epistemic reading. Under this reading, all cats did play with the same number of toys, but the speaker does not know how many. All he knows is that it is four or fewer. (91) perhaps brings about this intuition a little better.

(91) All the cats in the shelter were given the same number of toys to play with. I'm not sure how many toys every cat received, but I know that all cats got at most four toys.

Just like (87), (88) is a sentence where we observe both a non-epistemic reading with a variation inference and an epistemic reading, but where only one scope configuration is possible. Therefore, it presents another argument for a scope-independent theory of the observed ambiguity. Note that the epistemic reading does not result from wide scope of the whole DP *at most four toys*, as schematised in (92).

(92) [At most 4 [λd [d many toys [λy [Every cat [λx [x plays with y]]]]]]]]

(92) corresponds to the reading in (93). For comparison, a more detailed version of the semantics in (90-b), where only the modified numeral takes wide scope, is given in (94).

(93) $max\ \{\ n \mid \exists y[\#y = n \wedge \text{toys}(y) \wedge \forall x[\text{cat}(x) \rightarrow \text{play-with}(x, y)]]\ \} \leq 4$

(94) $max\ \{\ n \mid \forall x[\text{cat}(x) \rightarrow \exists y[\#y = n \wedge\ \text{toys}(y) \wedge \text{play-with}(x, y)]]\ \} \leq 4$

Whilst (94) merely states that the maximum number of toys every cat played with is four or lower, (93) says that the highest number such that there is a specific group of toys with that cardinality that every cat played with is four or lower. Consider a scenario where every cat played with five toys in total. There are two specific toys all cats played with: the toy mouse and the ball. Other than that, there was no overlap in the toys the cats played with. That is, the other three toys the cats played with were unique for each cat. In this case, (93) is true: the maximum number such that there is a specific group of toys with that cardinality that all cats played with is two, so it is lower than four. (94) is false: all cats played with five toys, so the maximum number of toys all cats played with is higher than four. Intuitively, (88) is false in this scenario. If all cats played with five toys, you cannot say that they all played with at most four toys. This shows that the reading where the whole object DP takes wide scope is not attested.

Hence, (88) has neither a reading where *at most* takes scope over the universal quantifier by itself nor a reading where the object DP takes wide scope. It does have an epistemic reading and a non epistemic (variation) reading. Therefore, this is another piece of data that illustrates the necessity for a scope-independent theory of the pragmatic ambiguities we see with modified numerals.

(95), with a temporal adverb instead of a nominal quantifier, makes the same point. It has the non-epistemic reading that at any given time, Malika teaches zero, one, two, or three courses, but it also has the epistemic reading that there is a specific number of courses she always teaches, but the speaker doesn't know what this number is. (96) clarifies this intuition.

(95) Malika always teaches at most three courses.

(96) Malika teaches a set number of courses every year. I'm not sure how many she teaches, but I know she always teaches at most three courses.

Thus, (95) has an epistemic reading and a non-epistemic reading but it lacks an inverse scope reading. This reading would be the reading that the maximum number of courses Malika always teaches is three. Parallel to the example with a nominal quantifier, this is a minimum reading: she always teaches three or more courses. This is not an attested reading of (95). The epistemic reading of (95) does not have to be about specific courses Malika always teaches, so it is not a reading where *at most three courses* takes wide scope as a whole. Hence, both (88) and (95) are cases where we observe an epistemic reading and a variation reading but where only one scope configuration is possible.

In sum, there are three cases where class B modified numerals interact with another operator, only one scope configuration is possible, but we nevertheless observe the variation/epistemic ambiguity. These are cases where modified numerals occur with existential modals, with NPI universal modals, and with non-modal universal quantifiers. This indicates that we need a theory that, unlike Schwarz's, Kennedy's, Nouwen's, and Coppock & Brochhagen's, does not make use of scope to yield the two observed readings.

4.6 Conclusion

In this chapter I have presented the second case out of the three cases I discuss in this dissertation where we do not observe the ambiguity we expect to see if a sentence with two operators also has two possible scope configurations. When existential modals co-occur with class B modified numerals, only the scope configuration where the modified numeral takes wide scope is attested. Instead of a scope ambiguity, there is a pragmatic ambiguity between an authoritative and an epistemic reading.

Along with the data on Dutch universal NPI modals and on universal nominal and temporal quantifiers, which are also restricted in the scope configurations they allow, this shows that we need to account for the pragmatics ambiguity of sentences with modified numerals and other operators in a way that is independent of scope. In chapter 3 I showed that it is necessary to create a theory of split scope without relying on the non-existent full inverse scope readings, where the whole object DP takes wide scope. The reason for that, I argued, is that inverse scope readings are not attested. Apparently, there is a restriction on inverse scope. Given that split scope readings are attested readings, we do not want this restriction on inverse scope to get rid of the split scope readings, too. For this reason, we cannot use the inverse scope configuration to derive split scope readings.

What I have done here is similar. In this case, it is the surface scope configuration where an existential modal scopes over a class B modified numeral that is not attested. This configuration is used to calculate authoritative readings. The authoritative readings are real but the surface scope configuration is not. Therefore, we must be able to exclude the surface scope configuration without excluding the authoritative reading. As things stand, we cannot. The problem

I laid bare in this chapter is worsened by the fact that the accounts that try to derive the pragmatic ambiguity using scope also fail to derive the correct readings, as explained in detail in section 4.3.2.

In sum, the data I have presented show that we need a scope-independent theory of modified numerals. They also indicate something else. In section 4.4 I pointed out that there are stark contrasts between class A and class B numeral modifiers besides the obvious contrast that this classification is based on: the fact that only class B numeral modifiers give rise to epistemic implicatures. These contrasts have to do with scope-taking. Class B modifiers have to outscope existential modals while class A modifiers do not. This shows that in terms of how they take scope, not all modified numerals are created equal. Recall that at the end of the previous chapter, I presented Blok et al.'s (2017) theory of split scope, which treats all cases of split scope as degree quantifier movement, both cases with negative indefinites and cases with modified numerals. Although their account is compatible with restrictions on DP scope, it is not compatible with restrictions on the scope of modified numerals. They predict that all modified numerals have a surface scope reading and a split scope reading, whether they be class A or class B. The data presented in this chapter show that there are actually contrasts between class A and class B numerals in how they take scope. This is a point I can only hint at now because I have not yet given all of the data that are needed to make it. In the next chapter I will discuss the relevant examples and make this point more precise.

Aside from these data, the next chapter contains a theory of split scope with negative indefinites and modified numerals that is based on the notion that only focus-sensitive operators create split scope readings. As I will argue there, this correctly singles out the class of expressions that give rise to split scope readings, both within languages and across languages, and it does not rely on any non-existent scope configurations. Again, my goal will not be to explain why certain scope configurations do not exist but rather to take those restrictions on scope as a given and build a theory that takes them into account. In chapter 6 I enrich my account with inquisitive semantics, which results in a theory of the pragmatics of modified numerals that does not make use of any unattested scope configurations. In addition, this theory, unlike the theory discussed in this chapter, correctly predicts which combinations of modified numerals and modals are the more natural ones (*at most* with an existential modal; *at least* with a universal modal) and that authoritative readings are more prevalent for these natural combinations, whereas epistemic readings are more obvious for the other two, less natural, combinations.

CHAPTER 5

Focusing on split scope

5.1 Introduction

In chapter 3 of this dissertation I showed that split scope sentences lack inverse scope readings. I argued that this indicates that we need a theory of split scope that does not rely on these non-existent inverse scope configurations. Blok et al. (2017) present such a theory. They propose that split scope results from degree quantifier movement, and that negative indefinites that can create split readings are degree quantifiers. This means that *geen* and other scope splitting expressions can move up to take scope over a modal by themselves, leaving the rest of the DP behind. This way, a split scope reading is generated without an inverse scope configuration where the DP takes wide scope as a whole.

Blok et al.'s account is a unified account of split scope: *geen* and all modified numerals are analysed as degree quantifiers that can undergo degree QR. At the end of chapter 3 and in chapter 4 I showed that the picture is slightly more complicated than this: not all modified numerals display the same scopal behaviour. In particular, when there is an existential modal in the sentence, split scope seems to be obligatory for class B modified numerals but not for class A ones.

In this chapter I will show that the difference between class A and class B numeral modifiers runs even deeper than that: not only is split scope obligatory for class B modifiers and not for class A modifiers in cases with existential modals, split scope for class A modifiers is actually very limited, both with existential and with universal modals. This means that Blok et al. still overgenerate by predicting split scope for all modified numerals.

Hence, there are two levels of overgeneration. The first is the creation of inverse scope readings and the second is the generation of split scope readings for all modified numerals. In this chapter I present an account that does not overgenerate. This means that the account creates split scope readings without creating inverse scope configurations. In addition, it creates split readings only for those operators that are actually scope-splitting operators.

My theory rests on what I call the *focus-sensitivity generalisation*: as I will show below, only focus-sensitive operators give rise to split scope readings. This generalisation singles out the correct scope splitting expressions both within and across languages. Within languages, only class B numeral modifiers fall into this category. Across languages, only those negative indefinites that are focus-sensitive reliably create split readings. Building on this observation, I will present a focus-based account of split scope. The idea is that focus-sensitive expressions have the capacity to covertly move to a position above the modal, leaving behind the rest of the DP. This is how split scope readings are derived without creating inverse scope readings.

This chapter is set up as follows. The next section contains a summary of the most important data I have discussed so far. In section 5.3 I will present the data that show that split scope is a focus phenomenon. Section 4 contains the analysis. In section 5 I discuss the consequences of my account for the status of degree quantifier movement. Two possible extensions of the account are discussed in section 5, and section 6 concludes.

5.2 Summary of the data

5.2.1 Observations from chapter 3

Here I will briefly review the three pieces of data on split scope I discussed in chapter 3. The first observation is the fact that split scope sentences lack inverse scope readings. Consider the Dutch sentence in (1) and its three theoretically possible readings in (3).

(1) Bij het examen hoeft er geen docent aanwezig te zijn.
At the exam must-NPI there GEEN teacher present to be.
'There does not have to be a teacher present at the exam.'

(2) a. Surface scope: *It must be the case that there is no teacher present at the exam
$*\Box > \neg\exists$
b. Inverse scope: There is no specific teacher who has to be present at the exam
$\neg\exists > \Box$
c. Split scope: There does not have to be a teacher present at the exam
$\neg > \Box > \exists$

The surface scope reading is ruled out because *hoeven* is an NPI that needs to be licensed by *geen*. The inverse scope reading is that no specific teacher has the obligation to be present at the exam. The only possible reading is the split reading: it is not necessary for there to be a teacher present at the exam. To see that the split reading is the only possible reading, consider the following scenario. There are three teachers: Mr. Malouf, Mrs. Cunningham, and Mrs. Van der Bilt. None of these teachers have to be present at the exam. However, the school regulations dictate that there must be at least one teacher present at each exam, though it does not matter which teacher. In this scenario, the inverse scope reading is true: there is no specific teacher who has to be present. The split reading is false: it's not the case that there does not need to be a teacher. Sentence (1) is intuitively false in this scenario, which shows that there is no inverse scope reading. As explained in chapter 3, this holds for split scope sentences generally.

The second piece of data is the Heim-Kennedy Generalisation: degree quantifier movement is possible across modals but not across nominal quantifiers. (3) exemplifies this: if the degree quantifier *at most fifty* were able to take scope over *every cat*, the resulting reading would be that the most every cat ate is fifty gram of food. Hence, the cat who ate the least ate fifty grams of food. This is not a possible reading.

(3) Every cat ate at most fifty grams of food.

I showed that this constraint also holds for split scope: it is possible across modals but not across nominal quantifiers. For instance, the German sentence in (4) lacks the inverse scope reading that it is not the case that exactly one doctor has a car.

(4) Genau ein Arzt hat kein Auto.
Exactly one doctor has no car.
'Exactly one doctor has no car.

The final piece of data I discussed in chapter 3 concerns the fact that not all languages have split scope readings with negative indefinites. Negative indefinites in Dutch, Frisian, German, and Icelandic consistently yield split readings as soon as they occur under a modal. In Danish, English, Norwegian, and Swedish, negative indefinites do not generally create split scope readings. For instance, none of the modals in (5) yield a split reading, while the Dutch modals in (6) all do.[1]

(5) a. You may wear no tie.
b. You are allowed to wear no tie.
c. You have to wear no tie.
d. You are required to wear no tie.

(6) a. Je mag geen stropdas dragen.
You may no tie wear.
'You are not allowed to wear a tie.'
b. Je hoeft geen stropdas te dragen.
You must-NPI no tie to wear.
'You don't have to wear a tie.'

5.2.2 Scope-splitting operators outscope existential modals

In chapter 4, I showed that *at least* and *at most* must take scope over existential modals. I will briefly repeat the core data below. Then I will show that this observation also holds for the scope-splitting negative indefinite *geen* in Dutch.

First, consider the contrast in (7). In each of these cases, the surface scope reading merely gives Marin permission to read between zero and five books. The inverse scope reading is the reading that Marin is not allowed to read more than five books. (7-a) only has the inverse scope reading, as attested by the fact that the continuation between parentheses is bad. (7-b) does have a surface scope reading, and this is why the addition between parentheses is good here. This indicates that *at most*, unlike *fewer than*, must take scope over existential modals.

[1] I have not used a neutral universal modal in the Dutch example because Dutch only has NPI and PPI universal modals.

(7) a. Marin is allowed to read at most five books (#and more is fine too).
b. Marin is allowed to read fewer than than six books (and more is fine too).

The same contrast holds between *at least* and *more than*, though the judgment is more subtle. (8-a) presupposes that there is an upper limit to the number of books Marin is allowed to read. There is some maximum number of books Marin is allowed to read, the speaker does not know what this maximum number is, but he knows that it is five or higher. (8-b) does not necessarily carry this presupposition and is felicitous in a context where Marin can read as many books as she likes. In chapter 4 I discuss a scenario that illuminates this contrast. The upper bound presupposition only arises if we assume that *at least* has a maximality operator in its semantics, and this maximality operator takes scope over the existential modal. The fact that the presupposition is obligatory indicates that *at least* must scope over the existential modal.

(8) a. Marin is allowed to read at least five books.
b. Marin is allowed to read more than four books.

Geen also takes scope over existential modals. Consider (9). This sentence only has a reading that prohibits the listener from eating biscuits. It lacks the weaker reading that gives the interlocutor permission to not eat biscuits.[2]

(9) Je mag geen koekjes eten.
You may GEEN biscuits eat.
'You're not allowed to eat any biscuits.'

The same can be observed for the example with the ability modal *kan* in (10): this can only mean that Joris is unable to knock over a rubbish bin. It cannot mean that Joris has the ability to not knock over a rubbish bin.

(10) Joris kan geen vuilnisvat omgooien.
Joris can no rubbish bin knock over.
'Joris cannot knock over a rubbish bin.'

These data hold for other scope-splitting languages too. Consider the data in (11)-(13) from German, Icelandic, and Frisian respectively.[3]

[2] We can force (9) to have a surface scope reading by adding the additive *ook*; 'also', as below, and stressing the negative indefinite.

(i) Je mag ook *geen* koekjes eten.
You may also GEEN biscuits eat.
'You may also not eat any biscuits.'

Ook is focus-sensitive so it is not surprising that it interferes with the behaviour of the focus-sensitive *geen* in some way. I will leave the details of an analysis of (i) for future research.

[3] These data were given to me by one informant for each of these languages.

(11) a. ?Mary darf keine Kekse essen, aber sie kann auch bestimmen
Mary may KEIN biscuits eat, but she can also decide
einige Kekse zu essen, falls sie will.
some biscuits to eat, if she wants.
'Mary is not allowed to eat any biscuits, but she can also choose to eat some biscuits if she wants.'

b. ?Mary kann keine französischen Bücher lesen, aber sie kann
Mary can KEIN French books read, but she can
sie auch lesen, wenn sie will.
them also read, if she wants.
'Mary is unable to read French books, but she can also choose to read them if she wants.'

(12) a. ?Hún má engar smákökur borða en hún getur ákveðið að
She may ENGINN cookies eat but she can decide to
borða einhverjar smákökur ef hún vill.
eat some cookies if she likes.
'Mary is not allowed to eat any biscuits, but she can also choose to eat some biscuits if she wants.'

b. ?María getur engar franskar bækur lesið en hún getur líka
Mary can ENGINN French books read but she can also
ákveðið að lesa þær ef hún vill.
decide to read them if she likes.
'Mary is unable to read French books, but she can also choose to read them if she wants.'

(13) a. ?Sy mei gjin koekjes ite, mar sy kin der ek foar kieze
She may GJIN biscuits eat, but she can there also for choose
om koekjes te ite at se dat graach wol.
to biscuits to eat if she that really wants.
'Mary is not allowed to eat any biscuits, but she can also choose to eat some biscuits if she wants.'

b. ?Mary kin gjin Frânske boeken lêze, mar se kin derfoar kieze
Mary can GJIN French books read, but she can for it choose
om se te lêze at se dat graach wol.
to them to read if she that really wants.
'Mary is unable to read French books, but she can also choose to read them if she wants.'

Here the a-sentences contain a deontic existential modal while the b-sentences have an ability modal. The second part (*but she can also...*) is compatible with the surface scope reading of the first part but not with the inverse scope reading. For instance, in (11-a), *aber sie kann auch bestimmen einige Kekse zu essen, falls sie will* is compatible with a reading of *Mary darf keine Kekse essen* where *darf* takes scope over *keine*: this is the reading that merely gives permission to not eat biscuits but does not prohibit anything. On the other hand, it is incompatible with a reading where *keine* scopes over *darf*, because this reading forbids Mary from having biscuits and therefore contradicts the statement that Mary can have some biscuits if she likes. The fact that the a-sentences all sound contradictory indicates that only a reading where the negative indefinite scopes over the existential modal is available.

The b-sentences are similar: in (13-b), for example, *mar se kin derfoar kieze om se te lêze at se dat graach wol* contradicts the split scope reading of the first part *Mary kin gjin Frânske boeken lêze*: if she is unable to read French books, then it is not the case that she can choose to read some French books if she likes. It does not contradict the surface scope reading of the first part: she has the ability to not engage in any French book reading. Again, the fact that (13-b) sounds contradictory indicates that only the reading where *gjin* takes scope over the existential modal is attested. These data show that across languages, scope splitting expressions must outscope existential modals.

To sum up this section, scope-spliting expressions yield split readings but not inverse scope readings, they abide by the Heim-Kennedy Generalisation, and they must outscope existential modals. In addition, only some negative indefinites in Germanic languages are scope splitting expressions. In the next section I will present the focus-sensitivity generalisation that my analysis is based on.

5.3 The focus-sensitivity generalisation

In the literature, split scope is considered to be a property only of negative indefinites (Penka & Zeijlstra, 2005; Penka, 2011) downward entailing quantifiers (De Swart, 2000; Abels & Martí, 2010) or degree quantifiers (Blok et al., 2017). In this section I will argue that split scope is actually a property of focus-sensitive operators. I will first demonstrate this correlation for English expressions like *at least* and *at most*. Then I will show that crosslinguistically, only negative indefinites that are focus-sensitive can create split scope readings.

5.3.1 The focus-sensitivity generalisation within languages

In the previous chapter I showed that the class B numeral modifiers *at least* and *at most* must take scope over existential modals, unlike their class A equivalents *more than* and *fewer than*. The contrast between these class A and class B numeral modifiers is actually even more drastic than that: class A modifiers do not seem to be able to take scope over existential modals and have trouble yielding split scope readings in general. Below I will present data supporting the claim that class A modifiers are not scope splitting expressions while the class B modifiers *at least* and *at most* are. I will then show that these class B modifiers are focus-sensitive while class A modifiers are not. Finally, I will show that the focus-sensitive expression *only* also gives rise to split scope readings.

Split readings

Let us first consider the contrast between *at most* and *fewer than.* I have already discussed that when these numeral modifiers combine with existential modals, *at most* obligatorily takes wide scope while *fewer than* does not. (14) is such a case. But if we look more closely at (14-b), we can see that the split scope reading is actually quite difficult to get there.

(14) a. Kouhouesso is allowed to direct at most three scenes.
b. Kouhouesso is allowed to direct fewer than three scenes.

Instead, (14-b) has a prominent surface scope reading: Kouhouesso has been given permission to direct zero, one, or two scenes.

In (15), the second part of the examples is incompatible with there being an upper bound to how many scenes Kouhouesso is allowed to direct. Therefore, this part is incompatible with the split reading but compatible with the surface scope reading. The fact that the addition of the second part sounds bad in (15) but very natural in (15-b) is evidence for the fact that the sentence with *fewer than* has a prominent surface scope reading while the sentence with *at most* does not have a surface scope reading.

(15) a. Kouhouesso is allowed to direct at most three scenes, #but he can also choose to direct more.
b. Kouhouesso is allowed to direct fewer than three scenes, but he can also choose to direct more.

The same point is made by the text in (16), where the context is compatible with the surface scope reading only. Again, this reading is available for *fewer than* but not available for *at most.*

(16) Kouhouesso is co-directing a film. He's very busy, so he asked the other director whether it would be OK for him to only direct a few scenes. Fortunately, the other director didn't mind. Kouhouesso is now allowed to direct { #at most / fewer than three scenes }.

The data we have seen so far show that the surface scope reading of *fewer than* is relatively easy to get, but they do not show that split scope readings are bad with *fewer than.* The text in (17) does demonstrate this. The context is only compatible with a split scope reading, and in this case, using *at most* is perfectly natural while using *fewer than* is quite odd.

(17) Kouhouesso is co-directing a film. Unfortunately, his co-director Paul is a bit of a control freak, and he wants to direct almost every scene himself. Paul has told Kouhouesso that if he really wants to, he can direct a few scenes too, but he is allowed to direct { at most / ??fewer than } three scenes.

Thus, the data show not only that split scope is obligatory for *at most*, they also show that split readings are difficult to get with *fewer than*. The contrast in (18) is similar: in order to forbid a child to have more than three sweets, a parent might utter (18-a) but not (18-b).

(18) a. You can have at most three sweets!
b. #You can have fewer than four sweets!

A second argument that split scope is severely limited with class A modifiers comes from a Dutch example with a universal modal, given in (19). The modal *hoeven* is an NPI. *Hoogstens*, 'at most', can license this NPI by taking scope over it. *Minder dan*, 'fewer than', cannot, yielding an infelicitous sentence.

(19) Je hoeft { hoogstens / #minder dan } drie cadeaus te kopen.
You must-NPI { at most / #fewer than } three presents to buy.
'You need to buy at most three presents.'

An experiment on Mechanical Turk confirmed these contrasts. In the experiment, participants were shown sentences like (20), with either *less/fewer than* or *at most*. They were then asked a question like (21).

(20) The meal is allowed to contain { less than / at most } 750 calories..

(21) Is the meal allowed to contain 800 calories?

There were three possible answers: *yes*, *no,* and *there is no way to tell*. If participants got a split scope reading, they would have to answer no: if the maximum number of calories the meal is allowed to contain is 750 calories, then 800 calories is not allowed. If they got a surface scope reading, the expected answer was *there's no way to tell*. This is because the surface scope reading only informs the listener that it is acceptable for the meal to contain fewer than 750 calories, but it does not say anything about numbers over 750 calories.

There were two items, two conditions, and 45 participants. Each participant got two test items and saw one condition per item. There were six control items, two of which were designed to elicit a *yes* answers, another two a *no* answer, and the final two a *there's no way to tell* answer. The control items worked well, with 87/90 *yes* answers for the *yes* control, 85/90 *no* answers for the *no* control, and 85/90 *there's no way to tell* answers for the *there's no way to tell* control. The results of the test items are given in table 5.1.

	No	There's no way to tell	Yes
At most	40	1	4
Fewer than	29	12	4

Table 5.1: Experimental results

As expected, the number of *there's no way to tell* items is far higher for *fewer than* than for *at most*, with *at most* having a higher number of *no* answers. These results were significant (χ^2= 11.061, df = 2, p = 0.003963). This shows that participants got fewer split scope readings for *fewer than* than for *at most*.

Split scope is thus far more limited for *fewer than* than for *at most*, but it seems that it is not impossible. This tallies with the fact that there are some examples of split scope with *fewer than* in the literature, most notably Hackl's (2000) example given in (22). (22) appears to have the split reading that one does not need to buy more than three books in order to get tenure.

(22) At MIT one needs to publish fewer than three books in order to get tenure.

There is a clear contrast between *at most* and *fewer than* in the availability of split readings, with split readings being far more prominent for *at most*. On the other hand, split readings seem to be available for *fewer than* in some cases. Both this contrast between *at most* and *fewer than* and the fact that *fewer than* sometimes but not always yields split readings need to be explained. To capture these data, I will propose the following. *At most* is a scope splitting expression. *Fewer than* is not, but split readings with *fewer than* may arise through the insertion of a covert exhaustivity operator. I will discuss this exhaustification mechanism in detail after I have presented my main analysis.

Now let us consider the upward entailing numeral modifiers *at least* and *more than*. As I argued in detail in the previous chapter, (23-a) only has a split scope reading: it is only felicitous in a context where there is an upper bound to what is allowed (but the speaker does not know exactly where this upper bound is). (23-b), on the other hand, can be used in a context where Marin is allowed to read as many books as she likes, without there being a limit to what is allowed. This shows that (23-b), unlike (23-a), has a surface scope reading.

(23) a. Marin is allowed to read at least five books.
b. Marin is allowed to read more than five books.

The second step is to show that the split reading is impossible with *more than*. This is not an easy feat, because while the surface scope reading does not carry the presupposition that there is a maximum to what is allowed, it is not incompatible with there being such a maximum. However, when we consider the scenario in (24), where there is a clear limit to what is allowed, we can see that *at least* sounds far better than *more than*.

(24) Little Louise is allowed to play video games every day, but there is a limit to how much time her parents allow her to play. This limit is different every day of the week, and it depends on how much homework she has. But she is allowed to play for { at least / ?more than } one hour each day.

Using *more than* here is not completely bad, but it seems to give less information than *at least*, and intuitively lacks the meaning component that there is a limit to how many hours Louise is allowed to play video games. This indicates that *more than*, like *fewer than*, cannot yield split scope readings.

The picture that emerges is that the class B numeral modifiers *at least* and *at most* easily and consistently give rise to split scope readings, while split scope is very difficult with the class A modifiers *more than* and *fewer than*.

Focus-sensitivity

I have argued that *at least* and *at most*, unlike *more than* and *fewer than*, are scope splitting expressions. Here I will show that the former two expressions are focus-sensitive while the latter two are not. Let us begin with *at least*. Krifka (1999) already observed that *at least* is sensitive to the placement of focus. He gives the example in (25). In (25-a), the focus is on the numeral modified by *at least*. In (25-b) the stress is on *boys*, and the most natural reading of the sentence is one where the focus is on the entire DP *three boys*.[4]

(25) a. At least [three]$_{\mathrm{F}}$ boys left.
b. At least [three BOYS]$_{\mathrm{F}}$ left.

The distinction between (25-a) and (25-b) is that (25-a) means that the number of boys that left is three or higher, whereas (25-b) means that the people that left included three boys. As Krifka puts it, only (25-a) is a felicitous answer to the question 'how many boys left?' whilst only (25-b) is a felicitous answer to the question 'who left?'.

This difference cannot be observed if we use *more than* instead of *at least*, as illustrated in (26).

(26) a. More than [three]$_{\mathrm{F}}$ boys left.
b. #More than [three BOYS]$_{\mathrm{F}}$ left.

At first glance, (26-b) does not even appear to be felicitous, quite unlike (25-b). The only way in which it could be used is if the focus is interpreted as contrastive focus on *boys*, as in the dialogue in (27).

(27) A: I heard that more than three girls left.
B: No, you must have misheard. More than three [BOYS]$_{\mathrm{F}}$ left; the girls all stayed here.

In B's response, *more than* still modifies the number *three*. The focus on *boys* is only used to contrast it with *girls*. (26-b) cannot be used to mean 'three boys left, and other people left too', which is what it would mean if it could associate with the entire DP.

Now let us turn to *at most*. Consider (28). When the focus is on the numeral *three*, as in (28-a), this sentence only conveys something about the number

[4] I use the subscript F to indicate that something is in focus. Small capitals indicate stress.

of vodkas Maggie drank: this number is no higher than three. When *vodkas* is focused, as it is in (28-b), a different meaning emerges. The sentence is now more broadly about what Mary drank. The maximum she drank, the sentence expresses, is three vodkas, and nothing else. This means that (28-a) is compatible with Maggie having drunk other beverages besides vodka, such as wine, but (28-b) is not.

(28) a. Maggie drank at most [three]$_F$ vodkas.
$\rightsquigarrow$ Maggie drank no more than three vodkas (she possibly drank wine too)
b. Maggie drank at most [three VODKAS]$_F$.
$\rightsquigarrow$ All Maggie drank is three vodkas (she didn't drink anything else)

In this configuration, *at most* behaves very similarly to *only*, resulting in almost parallel meanings. In (29), too, focus on the numeral leads to a meaning where Maggie may have drunk other things besides vodka, whereas focus on the entire DP yields the reading that all Maggie drank is three vodkas.

(29) a. Maggie drank only [three]$_F$ vodkas.
$\rightsquigarrow$ Maggie drank no more than three vodkas (she possibly drank wine too)
b. Maggie drank only [three VODKAS]$_F$.
$\rightsquigarrow$ All Maggie drank is three vodkas (she didn't drink anything else)

When we compare these cases to their counterparts with *fewer than*, we observe the same contrast as the one between *at least* and *more than*. Shifting the stress from the numeral to the noun *vodkas* leads to an infelicitous sentence, again unless we assume a contrastive reading. *Fewer than* cannot modify anything besides the numeral, and we do not get the reading for (30-b) that the total amount Maggie drank comes down to fewer than three vodkas.

(30) a. Maggie drank fewer than [three]$_F$ vodkas.
$\rightsquigarrow$ Maggie drank no more than two vodkas (she possibly drank wine too)
b. #Maggie drank fewer than [three VODKAS]$_F$.
$\not\rightsquigarrow$ All Maggie drank is less than three vodkas (she didn't drink anything else)

So, *at least* and *at most* have the ability to associate with different elements in their c-command domain, and the placement of focus determines what they associate with. *Fewer than* and *more than* do not have this ability. This shows that *at least* and *at most*, unlike *more than* and *fewer than*, are focus-sensitive.

Only

Here I will show that *only* also falls within the focus-sensitivity generalisation. It is a well-known fact that *only* is sensitive to the placement of focus. For instance, the sentence in (31) can have different meaning depending on what *only* takes as an argument. If *apple* is in focus, as in (32), *only* associates with it, and the sentence means that Nathan did not buy anything except an apple. If *bought* is in focus, as it is in (33), *only* takes *bought* as an argument, and the resulting meaning is that Nathan did not do anything else with the apple, such as eating it.[5]

(31) Nathan only bought an apple.

(32) Nathan only bought an [apple]$_F$.
$\rightsquigarrow$ he didn't buy anything else

(33) Nathan only [bought]$_F$ an apple.
$\rightsquigarrow$ he didn't do anything else with it

Only also gives rise to split readings. Consider (34).

(34) Hayat is allowed to interview only three candidates.

(34) has the three theoretically possible readings in (35). The surface scope reading merely gives Hayat permission to interview no more than three candidates. The inverse scope reading is that for only three specific candidates is it the case that Hayat can interview them. The split reading, where *only* scopes over the modal but *three candidates* stays under it, restricts the number of candidates Hayat can interview. It says that she does not have permission to interview more than three candidates. This is a split reading in the sense that a part of the DP takes scope over the modal and a part of the DP takes scope under it. It corresponds to the split reading of the same sentence with *at most*, given in (36).

(35) a. Surface scope: Hayat has permission to do this: to interview between between zero and three candidates
$\lozenge >$ *only three candidates*

[5] So far I have mostly used relatively simple sentences with a number as part of a DP, where either the number or the entire DP can be focused. But note that the focus-sensitive expressions under discussion can associate with more deeply embedded elements than that. In (i), for example, *at least*, *at most* and *only* associate with an element that is in the PP *of the vice president*, which in turn is part of the DP *the shoes of the vice president*.

(i) a. He polished at least the shoes of the [VICE president]$_F$.
b. He polished at most the shoes of the [VICE president]$_F$.
c. He polished only the shoes of the [VICE president]$_F$.

If we assume the scale [senator, vice president, president], (i-a) means that he polished the shoes of either the vice president or the president. (i-b) then means that he polished the shoes of the vice president or a senator, but not the president, and (i-c) means that he polished the shoes of the vice president and no-one else.

b. Inverse scope: There are only three specific candidates Hayat can interview
only three candidates $> \Diamond$

c. Split scope: Hayat only has permission to interview three candidates
only $> \Diamond >$ *three candidates*

(36) Hayat is allowed to interview at most three candidates.

Note that (34), like the other split scope cases, does not have an inverse scope reading. Say that Hayat can in principle interview as many candidates as she likes, but she has to coordinate this with the other interviewers to make sure that everyone interviews roughly the same amount of candidates. She has just talked to the other interviewers and they have agreed that she can interview the three candidates Richard, Ali, and Mathilde. Later in the day, she will interview other candidates, but the precise arrangements have not been made yet. Then it is true that there are no more than three specific candidates Hayat has been given permission to interview, but it is false that she cannot interview more than three. The surface scope reading is true while the split scope reading is false. The sentence is intuitively false in this scenario, which shows that there is no inverse scope reading.

The fact that split scope cases with *only* lack inverse scope readings shows two things. First, it shows that the split reading is real. If there were also an attested inverse scope reading, the split reading could be merely a specific instance of the inverse scope reading. This is because the split reading entails the inverse scope reading. Second, it shows that *only* patterns with other scope splitting expressions in that it yields split scope readings but not inverse scope readings.

Another example of split scope with an expression like *only* is the Dutch example in (37) with the NPI modal *hoeven* and its English translation with *need*. The three readings are illustrated in (38). Here the surface scope reading would be that in all accessible worlds, Hayat convinces no more than five people. This prohibits her from convincing six or more people. This reading is not attested because *only* must outscope *hoeven* to license it. The inverse scope reading is the reading that there are only five specific people Hayat needs to convince. The split reading says that Hayat does not have to convince more than five people.

(37) Hayat hoeft maar vijf mensen te overtuigen.
Hayat must-NPI only five people to convince.
'Hayat needs to convince only five people.'

(38) a. *Surface scope: Hayat must do this: to convince between between zero and five people
$\Box >$ *only five people*

b. Inverse scope: There are only five specific people Hayat has to convince *only five people* $> \Box$

c. Split scope: Hayat only has to to convince five people
only $> \Box >$ *five people*

Again, there is no inverse scope reading: if there are five specific people Hayat has to convince but she has to convince ten people in total (she can randomly choose the other eight), the sentence is false.

So, *only* is also focus-sensitive, and it is also a scope splitting expression. Therefore, it patterns with *at least* and *at most* and exemplifies the split scope generalisation. As expected, it does not give rise to inverse scope readings.

Another reason to group *only* with *at least* and *at most* is that it also has to outscope existential modals. (34), like (36), cannot mean that Hayat has permission to interview three candidates or fewer, leaving open the option that she interviews more. Instead, it only has the stronger reading that she does not have permission to interview more than three people.

(39) makes the same point: it can only mean that you're not allowed to eat anything except biscuits.[6] It does not have the surface scope reading that you have permission to not eat anything but biscuits. *Only* restricts what is allowed.

(39) You're allowed to eat only biscuits.

The facts are different when we consider cases where *only* attaches to the VP, as in (40). Here it seems to be easier to get the surface scope reading that merely gives Hayat permission to interview between zero and three candidates.

(40) Hayat is allowed to only interview three candidates.

But when we consider (41), we see that the same observation holds for VP-adjacent *at most*. The weaker surface scope reading appears to be easier to get for (41) than for (36).

(41) Hayat is allowed to at most interview three candidates.

Thus, something about the syntax of the VP-adjacent placement of these expressions changes the scope facts (see von Stechow, 1991). The fact that *only* and *at most* also pattern with each other in this way is another sign that they should be grouped together.

A final reason to categorise *only* with *at least* and *at most* is that the Heim-Kennedy Generalisation holds for *only*. Consider the contrast between (42) and (43). (42) has a reading where *only* takes scope over *may*: the only kinds of apples you may buy are green apples. If *only* were to scope over *everyone* in (43), we would get the reading that the only kinds of apples everyone bought are green apples. This can be true in a scenario where some but not all people bought red apples and everyone bought green appels. (43) does not have this

[6]Note that I accidentally illustrated this phenomenon in the prose with *can only mean*.

reading.[7]

(42) You { may / can / are allowed to } buy only green apples.

(43) Everyone bought only green apples.

The same thing can be said for (44), which cannot have the reading that the only kinds of apples Jess always bought are green apples. In parallel to the example above, this can be true in a scenario where she sometimes bought red apples but she always bought green apples as well.

(44) Jess always bought only green apples.

The same facts hold for the existential nominal and temporal quantifiers. (45) cannot mean that only some people bought green apples. If it could, (45) would be true in a situation where no-one bought only green apples. For instance, some people bought both green and red apples and some people bought only red apples.

(45) Some people bought only green apples.

Similarly, (46) does not have the reading that Jess only sometimes bought green apples. If it did, it would be true in a scenario where she always bought red apples and sometimes she also bought a few green ones, contrary to fact.

(46) Jess sometimes bought only green apples.

In sum, this section has shown that *only* behaves exactly like the other scope-splitting expressions *at least* and *at most*. Earlier in this section I showed that *at least* and *at most* are focus-sensitive and readily yield split readings. *Fewer than* and *more than* are not focus-sensitive and they are not scope-splitting expressions. This supports the claim that it is focus-sensitive operators that yield split readings. The table below summarises the data.

[7]Readings with wide scope for *only* seem more difficult to get with universal modals such as *must*, *have to* and *required*, in (i).

(i) You { must / have to / are required to } buy only green apples.

Here the most prevalent reading is the reading that you are not allowed buy anything else than green apples or that you may buy no other kinds of apples than green apples, depending on which constituent is focused. The readings that the only thing or the only kinds of apples you must buy are green apples are more difficult to get. I will leave this contrast as an open question, but note that it does not affect the point I make here, which is that *only* in principle has the ability to take scope over modals but not over nominal quantifiers.

	Split scope?	Focus-sensitive?
At least	yes	yes
At most	yes	yes
Only	yes	yes
Fewer than	no	no
More than	no	no

Table 5.2: The focus-sensitivity generalisation within languages

In the next section I will consider negative indefinites across languages and show that the focus-sensitivity generalisation holds there, too.

5.3.2 The focus-sensitivity generalisation across languages

I showed in chapter 3 that negative indefinites in Dutch, Frisian, German, and Icelandic give rise to split scope readings. Negative indefinites in Danish, English, Norwegian, and Swedish do not. Here I will show that only the former group of expressions are focus-sensitive.[8]

Kobele and Zimmermann (2012) argue that *kein* in German is focus-sensitive. (47) is a Dutch translation of one of their German examples. The argument these authors make for German can also be made for Dutch. *Geen* targets the focused *kelder*; 'basement', rather than its sister *fiets*. This is evidenced by the fact that *hem*; 'it', can refer back to *fiets*; 'bicycle'. If the existence of a bicycle were negated by *geen*, the sentence would be infelicitous. The fact that *geen* has the ability to target the focused *kelder* rather than *fiets* is evidence for its focus-sensitivity.

(47) Wie geen fiets [in de KELDER]$_F$ heeft, heeft hem op het balkon.
Who GEEN bicycle in the basement has, has him on the balcony.
'If you don't have a bicycle in the basement, you have it on the balcony.'

Now compare this to the English example in (48). This example is bad, which indicates that *no* is unable to target the focused *basement*. Instead, it can only negate the existence of a bicycle.

(48) #Everyone who has no bicycle [in the BASEment]$_F$ has it on the balcony.

This contrasts with simple negation in English, which does seem to be focus-sensitive and is also felicitous in an example analogous to (48), shown in (49).

(49) Everyone who doesn't have a bicycle [in the BASEment]$_F$ has it on the balcony.

[8]The data in this section were provided by 8 speakers of English, 3 speakers of Norwegian, 2 speakers of Danish, 3 speakers of Swedish, 1 speaker each of Icelandic and Frisian, and 1 speaker of German (in addition to German observations from the literature).

(50), where there is no pronoun referring back to *bicycle*, sounds slightly odd, but much better than (48). This suggests that it is the inability of *it* to refer back to *bicycle* in (48) that is the problem rather than some independent issue with the structure.

(50) (?)Everyone who has no bicycle in the basement has to drive to work.

The observations above all indicate that *geen* is focus-sensitive and *no* is not. Kobele and Zimmermann's original example is given below. Like the Dutch example above, this example is felicitous, and it shows that *kein* is focus-sensitive.

(51) Wer kein Fahrrad [im KELLER]$_F$ hat, hat es auf dem Balkon.
Who KEIN bicycle in the basement has, has it on the balcony.
'If you don't have a bicycle in the basement, you have it on the balcony.'

The same facts hold for the negative indefinites *gjin* in Frisian and *enginn* in Icelandic. This is shown in (52) and (53) below.

(52) Wa gjin fyts [yn de KELDER]$_F$ hat, hat him op it balkon.
Who GJIN bicycle in the basement has, has him on the balcony.
'If you don't have a bicycle in the basement, you have it on the balcony.'

(53) Ef þú átt ekkert hjól í kjallaranum, ertu með það á
If you own ENGINN bicycle in the cellar are you with it on
svölunum.
the balcony.
'If you don't have a bicycle in the basement, you have it on the balcony.'

A Danish, Norwegian, and Swedish translation are given in (54), (55), and (56) below. These languages pattern with English: the negative indefinites are not able to target *basement*. For this reason, the pronoun in the second part of the sentence does not have anything to refer back to, and the sentences are bad.

(54) #Dem som ingen cykel har [i KÆLDEREN]$_F$, har den på balkon.
Every that INGEN bicycle has in basement, has it on balcony.
Intended: 'If you don't have a bicycle in the basement, you have it on the balcony.'

(55) #Noen som har ingen sykkel [i KJELLEREN]$_F$ har den på
Every that INGEN bicycle has in basement, has it on
balkongen.
balcony.
Intended: 'If you don't have a bicycle in the basement, you have it on the balcony.'

(56) #Den som ingen cykel [i KÄLLAREN]$_F$ har, har den på
Every that INGEN bicycle in basement has, has it on
balkongen.
balcony.

Intended: 'If you don't have a bicycle in the basement, you have it on the balcony.'

More generally, whenever you try to use a word like *no* in Germanic languages to interact with focus alternatives, this works in Dutch, German, Frisian, and Icelandic, but not in English, Danish, Swedish, and Norwegian. Another example of this phenomenon, in Dutch, is given in (57).

(57) a. Niet een DOCENT$_F$ maar een STUDENT$_F$ las het materiaal.
Not a teacher but a student read the material.
'Not a teacher but a student read the material.'
b. Geen DOCENT$_F$ maar een STUDENT$_F$ las het materiaal.
GEEN teacher but a student read the material.
'Not a teacher but a student read the material.'

As can be seen in this example, both constituent negation *niet* and the negative indefinite *geen* can be used to associate with *docent*; 'teacher'. The a-sentence and the b-sentence mean exactly the same thing: it is not a teacher who read the material but rather a student. (57-b) contrasts with (58).

(58) Geen docent las het materiaal.
GEEN teacher read the material.
'No teacher read the material.'

In (58) there is no focused constituent, so the focus projects and the sentence means that it is not the case that a teacher read the material. In other words, no teacher at all read the material. (57-b) does not necessarily have this implication. Instead, it means that in the relevant context, it was not a teacher but a student who read the material. This is because in (57-b) but not in (58), *geen* associates with *docent*.

This is in stark contrast with the behaviour of *no* in English, illustrated in (59).

(59) a. Not a TEACHER$_F$ but a STUDENT$_F$ read the material.
b. #No TEACHER$_F$ but a STUDENT$_F$ read the material.

While (59-a) with *not* behaves exactly like (57-a), (59-b) with *no* cannot do what (57-b) does. If we want to invoke the focus alternatives of *teacher* and convey that it was not a teacher but a student who did the reading, we must use *not*. English *no* cannot interact with the focus alternatives *teacher* and *student* in this way, which is why (59-b) sounds bad with the indicated stress pattern.

As shown below, Frisian, German, and Icelandic pattern with Dutch. In these languages, both sentential negation and negative indefinites can associate with *teacher*, which indicates that these expressions are focus-sensitive.

(60) a. Net in learaar mar in studint lies it materiaal.
Not a teacher but a student read the material.

‘Not a teacher but a student read the material.’
b. Gjin learaar mar in studint lies it materiaal.
GJIN teacher but a student read the material.
‘Not a teacher but a student read the material.’

(61) a. Nicht ein LEHRER$_F$ sondern ein SCHÜLER$_F$ las das Material.
Not a teacher but a student read the material.
‘Not a teacher but a student read the material.’
b. Kein LEHRER$_F$ sondern ein SCHÜLER$_F$ las das Material.
KEIN teacher but a student read the material.
‘Not a teacher but a student read the material.’

(62) a. Ekki KENNARI heldur NEMANDI las efnið.
Not a teacher but a student read the material.
‘Not a teacher but a student read the material.’
b. Enginn KENNARI heldur NEMANDI las efnið.
ENGINN teacher but a student read the material.
‘Not a teacher but a student read the material.’

In Danish, Norwegian, and Swedish, on the other hand, the negative indefinite *ingen* is unable to do this, unlike sentential negation in these languages. *Ingen* thus patterns with *no*.

(63) a. Ikke en LÆRER$_F$ men en STUDERENDE$_F$ læste materialet.
Not a teacher but a student read the material.
‘Not a teacher but a student read the material.’
b. #Ingen LÆRER$_F$ men en STUDERENDE$_F$ læste materialet.
INGEN teacher but a student read the material.
Intended: ‘Not a teacher but a student read the material.’

(64) a. Ikke en LÆRER$_F$, men en STUDENT$_F$ leste stoffet.
Not a teacher but a student read the material.
‘Not a teacher but a student read the material.’
b. #Ingen LÆRER$_F$, men en STUDENT$_F$ leste stoffet.
INGEN teacher but a student read the material.
Intended: ‘Not a teacher but a student read the material.’

(65) a. Inte en LÄRARE$_F$ men en STUDENT$_F$ läste materialet.
Not a teacher but a student read the material.
‘Not a teacher but a student read the material.’
b. #Ingen LÄRARE$_F$ men en STUDENT$_F$ läste materialet.
INGEN teacher but a student read the material.
Intended: ‘Not a teacher but a student read the material.’

The same phenomenon can be observed in (66): in Dutch, both sentential negation *niet* and the negative indefinite *geen* can be used to convey that it was not a teacher but a student who read the material. There is no real difference between these two sentences: both sound perfect.

(66) a. Een DOCENT$_F$ las het materiaal, niet een STUDENT$_F$.
A teacher read the material, not a student.
'A teacher read the material, not a student.'
b. Een DOCENT$_F$ las het materiaal, geen STUDENT$_F$.
A teacher read the material, GEEN student.
'A teacher read the material, not a student.'

Here the contrast with English is even stronger. While using *not*, as in (67-a), leads to a perfectly felicitous sentence that conveys the intended meaning, (67-b) is bad.

(67) a. A TEACHER$_F$ read the material, not a STUDENT$_F$.
b. #A TEACHER$_F$ read the material, no STUDENT$_F$.

Again, this indicates that *not* can associate with *student* while *no* cannot, and again, this contrast is part of the same wider crosslinguistic pattern. (68)-(70) show that Frisian, German, and Icelandic pattern with Dutch.

(68) a. In LEARAAR lies it materiaal, net in STUDINT.
A teacher read the material, not a student.
'A teacher read the material, not a student.'
b. In LEARAAR lies it materiaal, gjin STUDINT.
A teacher read the material, GJIN student.
'A teacher read the material, not a student.'

(69) a. Ein LEHRER$_F$ hat das Material gelesen, nicht ein SCHÜLER$_F$.
A teacher has the material read, not a student.
'A teacher has read the material, not a student.'
b. Ein LEHRER$_F$ hat das Material gelesen, kein SCHÜLER$_F$.
A teacher has the material read, KEIN student.
h 'A teacher has read the material, not a student.'

(70) a. KENNARI las efnið, ekki NEMANDI.
A teacher read the material, not a student.
'A teacher read the material, not a student.'
b. KENNARI las efnið, enginn NEMANDI.
A teacher read the material, ENGINN student.
'A teacher read the material, not a student.'

(71)-(73) show that Danish, Norwegian, and Swedish pattern with English.

(71) a. En LÆRER$_F$ læste materialet, ikke en STUDERENDE$_F$.
A teacher read the material, not a student.
'A teacher read the material, not a student.'
b. #En LÆRER$_F$ læste materialet, ingen STUDERENDE$_F$.
A teacher read the material, INGEN student.
Intended: 'A teacher read the material, not a student.'

(72) a. En LÆRER$_F$ leste stoffet, ikke en STUDENT$_F$.
A teacher read the material, not a student.
'A teacher read the material, not a student.'
b. #En LÆRER$_F$ leste stoffet, ingen STUDENT$_F$.
A teacher read the material, INGEN student.
Intended: 'A teacher read the material, not a student.'

(73) a. En LÄRARE$_F$ läste materialet, inte en STUDENT$_F$.
A teacher read the material, not a student.
'A teacher read the material, not a student.'
b. #En LÄRARE$_F$ läste materialet, ingen STUDENT$_F$.
A teacher read the material, INGEN student.
Intended: 'A teacher read the material, not a student.'

Further evidence that negative indefinites in split scope languages are focus-sensitive comes from data like the Dutch (74).

(74) a. Jana heeft geen vijf RINGEN$_F$ gevonden.
Jana has GEEN five rings found.
'Jana has not found five rings.'
b. Jana heeft geen VIJF$_F$ ringen gevonden.
Jana has GEEN five rings found.
'Jana has not found five rings.'

Here the placement of focus yields a truth-conditional difference between the a-sentence and the b-sentence. In a situation where Jana found no rings at all, (77-a) can be felicitously uttered. In fact, this is exactly what the focus on *ringen*; 'rings', conveys in (77-a): Jana didn't find five rings, but she found five units of something else (perhaps five bracelets). (77-b), on the other hand, cannot be used in this situation. (77-b), where the focus is placed on the numeral, conveys that Jana found not five rings, but some other number of rings. If she found no rings at all (77-b) is intuitively false. (77-a) is true.

Sentential negation in English behaves the same way, as shown below.

(75) a. Jana didn't find five RINGS$_F$.
b. Jana didn't find FIVE$_F$ rings.

Only when the focus is placed on *rings* can the sentence be true if Jana found no rings at all.

The prediction is that *no* and *ingen* cannot be used in this way, given that these expressions are not focus-sensitive. It is impossible to check this, however, as these expressions cannot be combined with numerals (the numeral modifier generalisation from Blok et al. (2017)). As I will discuss below, however, this very fact indicates a lack of focus-sensitivity. What we can check is whether other focus-sensitive negative indefinites behave like *geen* in this respect. The Frisian and German data show that they do. In (76) and (77), only the a-sentences can be true if Jana did not find any rings.[9]

(76) a. Jana fûn gjin fiif RINGEN.
Jana found GJIN five rings.
'Jana didn't find five rings.
b. Jana fûn gjin FIIF ringen.
Jana found GJIN five rings.
'Jana didn't find five rings.

(77) a. Jana hat keine fünf RINGE$_F$ gefunden.
Jana has KEIN five rings found.
'Jana has not found five rings.'
b. Jana hat keine FÜNF$_F$ Ringe gefunden.
Jana has KEIN five rings found.
'Jana has not found five rings.'

These facts indicate a correlation between focus-sensitivity and split scope. In those Germanic languages where a negative indefinite gives rise to split scope readings, this negative indefinite is focus-sensitive. In languages where negative indefinites cannot create split scope readings, these negative indefinites are not focus-sensitive.

The split scope generalisation encompasses Blok et al.'s (2017) numeral modifier generalisation, presented in chapter 4. Blok et al. show that whenever a negative indefinite can modify a numeral, it has the general ability to create split scope readings. Negative indefinites cannot modify numerals also do not yield split readings. An example from Dutch and its English translation are repeated below.

(78) Nigella heeft geen twintig taarten gebakken.
Nigella has GEEN twenty cakes baked.
'Nigella has not baked twenty cakes.'

(79) *Nigella has baked no twenty cakes.

We know that in general, focus-sensitive operators are flexible in that they can associate with a variety of different kinds of expressions. For instance, *only* in (80) can attach to the proper name *Martha*, the VP *danced with some men*, the verb *danced* or the quantifier *some men*, just to name a few possibilities.

[9] In these particular sentences, Icelandic behaves differently in that the examples below are bad. I will leave this matter for future research.

(i) a. ??Jana fann enga fimm HRINGI.
Jana found ENGINN five rings.
'Jana didn't find five rings.
b. ??Jana fann enga FIMM hringi.
Jana found ENGINN five rings.
'Jana didn't find five rings.

(80) a. Only $[\text{Martha}]_F$ danced with some men.
b. Martha only $[\text{danced with some men}]_F$.
c. Martha only $[\text{danced}]_F$ with some men.
d. Martha danced only with $[\text{some men}]_F$.

We saw in earlier examples in this chapter that *only* can also modify numbers. The fact that the ability to modify numbers correlates with split readings is explained by the focus-sensitivity generalisation. Focus-sensitive expressions are generally able to associate with a multitude of different kinds of expressions, and numerals are one such type of expression.

In sum, there is a correlation between focus-sensitivity and split scope, both within languages and across languages. Table 1 from chapter 3, which reflected Blok et al.'s numeral modifier generalisation, can therefore be updated with another column for focus-sensitivity, as shown in table 5.3. In the next section I will present my analysis.

		Modify numerals?	Split scope?	Focus-sensitive?
Dutch	*geen*	yes	yes	yes
Frisian	*gjin*	yes	yes	yes
German	*kein*	yes	yes	yes
Icelandic	*enginn*	yes	yes	yes
Danish	*ingen*	no	no	no
English	*no*	no	no	no
Norwegian	*ingen*	no	no	no
Swedish	*ingen*	no	no	no

Table 5.3: The focus-sensitivity generalisation across Germanic languages

5.4 Analysis

This section contains my account of split scope, which is based on the focus-sensitivity generalisation. I will first discuss my basic assumptions and framework. Then I will show how split readings can be generated in my analysis, and finally I will show how those readings with *fewer than* that look like split scope readings can be derived in this account.

5.4.1 The basics

I formalise my analysis in the framework of Beaver and Clark (2008), inspired by Coppock and Beaver (2013) and Coppock and Brochhagen (2013). The lexical entries I propose are given below.[10]

[10] (83) is considered by Coppock and Brochhagen (2013), before moving to an analysis in inquisitive semantics and changing the denotations. (84) is from Coppock and Beaver (2013). The other two denotations are my own.

(81) $[\![\text{geen}]\!]^S = \lambda p \ . \ [\exists p'[p' \in CQ_S \wedge p']] \ . \ \neg(p)$

(82) $[\![\text{at least}]\!]^S = \lambda p \lambda w \ . \ \exists p'[\text{MAX}_S(p')(w) \wedge p' \geq_S p]$

(83) $[\![\text{at most}]\!]^S = \lambda p \ . \ \text{MAX}_S(p)$

(84) $[\![\text{only}]\!]^S = \lambda p \ . \ \text{MIN}_S(p) \ . \ \text{MAX}_S(p)$

where:

(85) $\text{MIN}_S(p) = \lambda w \ . \ \exists p' \in CQ_S[p'(w) \wedge p' \geq_S p]$

(86) $\text{MAX}_S(p) = \lambda w \ . \ \forall p' \in CQ_S[p'(w) \rightarrow p \geq_S p']$

First a bit of notational housekeeping: the dot notation in the lexical entries of *geen* and *only* indicate that the part before the dot is a presupposition and the part after the dot is an assertion.[11] p and p' are variables over propositions of type $\langle s,t \rangle$. CQ stands for the 'current question under discussion'. S stands for 'information state'. The information state is an ordered version of the CQ. This ordering can be either an entailment ordering or a pragmatic ordering, as will become clear below. I use the notation MAX_S to signify a maximality operator on propositions. The notation *max* is used in this dissertation for a maximality operator on degrees, as defined in chapter 2.

I will now briefly explain what the expressions above mean in prose just to give an overview of what the definitions do. The exact workings of the semantics will become clear below as I go through an example for each expression. First, *geen* takes a proposition and says that it is false. It presupposes that some other proposition in the CQ is true. *At least* takes a proposition p and returns the worlds that are in $\text{MAX}_S(p')$, where p' is a proposition that is ordered as high as or higher than p by S. As defined in (86), $\text{MAX}_S(p')$ takes a proposition p and returns the proposition containing only those worlds that are either in p or in propositions ranked lower than p by S; it gets rid of all worlds that are in higher ordered propositions than p. *At most* simply uses this MAX_S: it takes a proposition p and returns $\text{MAX}_S(p)$. *Only* takes a proposition and says that this proposition is the highest ordered true proposition. The presupposition, using the minimality operator MIN, says that there is some true alternative that is at least as strong as the proposition.[12]

The link between focus marking and the CQ is made by the Focus Principle, given in (87). What this principle comes down to for our current purposes is that the CQ must be a subset of the Rooth-Hamblin alternatives of an expression.

(87) **Focus Principle**

[11] I believe that this notation goes back to Heim and Kratzer (1998). Here I don't mean to indicate that the part after the dot is a partial function that is only defined if the part before the dot is true (although this would come down to the same thing) but just that the part before the dot is presupposed and the part after it is asserted.

[12] Coppock and Beaver (2013) provide arguments for this scalar analysis of *only*. I will merely use this definition to derive split readings, but I believe this would also be possible with a non-scalar analysis of *only*.

a. Some part of a declarative utterance should give an answer to the CQ
b. If Q is a set of Rooth-Hamblin alternatives, and A is a natural language expression, then A gives an answer to Q if the focus value of A is a subset of Q

To see these definitions and the focus principle in action, let us first consider a few derivations without modals, starting with the example with *geen* given in (88). For ease of exposition, I will assume for now that focus-sensitive expressions take sentence scope. As will become clear in the next section, this assumption is not necessary.

(88) Marie at geen $[\text{appels}]_F$.
Mary ate GEEN apples.
'Mary didn't eat any apples.'

Appels is focused, so the set of alternatives are as in (89): the set of propositions of the form *Marie at x*, with *x* being replaced of expressions of the same type (Hamblin, 1971; Rooth, 1985, 1992).

(89) $[\![\text{Marie at } [\text{appels}]_F]\!]^A = \{ \text{ Marie at } P \mid P \in D_{\langle e,t\rangle} \}$[13]

The CQ is a subset of this set, as illustrated below. Hence, the Focus Principle is satisfied.

(90) $\text{CQ} \subseteq \{ \text{ Marie at } P \mid P \in D_{\langle e,t\rangle} \}$

The denotation of (88) is given in (91). This says that the proposition *Mary ate apples* is false but that some other proposition in the CQ is true. Thus, she did not eat apples, but she did eat something else. This corresponds to the intuitive meaning of (88).

(91) $[\![(88)]\!] = [\exists p'[p' \in CQ_S \wedge p']] \;.\; \neg([\![\text{Marie at appels}]\!])$

Before turning to the definitions of the lexical items, I will first consider what MIN_S and MAX_S do. Let us apply MIN_S to (92), as in (93).

(92) Jane is an $[\text{associate professor}]_F$.

(93) MIN_S [Jane is an $[\text{associate professor}]_F$]

The expression *associate professor* is focused in (92), which results in a CQ of the form given in (94).

(94) $CQ \subseteq \{ \text{ Jane is a } P \mid P \in D_{\langle e,t\rangle} \}$

Let us assume that the specific relevant alternatives in this case are the ones

[13]Here *Marie at* P is shorthand for the proposition that Mary ate *P*; the alternatives in the CQ are propositions and not sentences. I use this notation here to improve legibility.

given in (95).

(95) CQ = { Jane is an assistant professor, Jane is an associate professor, Jane is a full professor }

The information state S orders the alternatives, as in (96). In this case, the ordering is a pragmatic ordering rather than an entailment ordering.

(96) S = { ⟨Jane is a full professor, Jane is an associate professor⟩, ⟨Jane is an associate professor, Jane is an assistant professor⟩, ... }

What MIN_S does is to take a proposition p and return a proposition consisting of all worlds such that these worlds are in a proposition p' that is ordered as high as p or higher than p in S. In (93), it takes the proposition that Jane is an associate professor and returns the worlds in this proposition as well as those in all higher propositions. In this case, the only higher proposition is the proposition that Jane is a full professor. Thus, MIN_S returns the proposition that Jane is an associate professor and the proposition that she is a full professor.

Applying MAX_S to (92), as is done in (97), gives the opposite result.

(97) MAX_S [Jane graded five papers]

MAX_S takes a proposition p and returns a proposition with the set of of worlds w such that for all propositions p', if w is in p', p' must not be ordered higher than p. So: all worlds in higher propositions than p are discarded. In the case of (97) we get the proposition that Jane graded zero papers, one paper, two papers, ... , five papers, but we exclude the proposition that Jane graded six papers, seven papers, etc.

Now let us move on to an example with *at least*, given in (98).

(98) Mary at least [participated]$_F$.

Let us assume that Mary went to a game night, and that the relevant alternatives in the CQ are *showing up*, *participating*, and *winning*, as in (99).

(99) CQ = { Mary showed up, Mary participated, Mary won }

This is a subset of the set of Rooth-Hamblin alternatives in (100), as dictated by the Focus Principle.

(100) $[\![\text{Marie [participated]}_F]\!]^A = \{ \text{Mary } P \mid P \in D_{\langle e,t\rangle} \}$

We now have the ordered information state S in (101).

(101) S = { <Mary won, Mary participated>, <Mary participated, Mary showed up>, etc. }

Winning is ranked highest, and participating is ranked above showing up. This is a case where the ordering of S is an entailment ordering, assuming one cannot win without participating and one cannot participate without showing up. The denotation of the sentence is given below.

(102) $[\![(98)]\!] = \lambda w \;.\; \exists p'[\textsc{max}_S(p')(w) \wedge p' \geq_S [\![\text{Mary participated}]\!]]$

This says that there is a highest ranked true proposition in S that is ranked at least as high as $[\![$Mary participated$]\!]$. Thus, either Mary only participated or she also won. For this sentence, the denotation is equivalent to the simpler denotation in (103), with the minimality operator defined as in (85) (Coppock & Beaver, 2013; Coppock & Brochhagen, 2013). This minimality operator says that there is a proposition p' that is as strong as or stronger than its argument p. Thus, (103) also means that Mary either participated or she also won.

(103) $\textsc{min}_S([\![\text{Mary participated}]\!])$

The reason why we need the slightly more complex denotation in (102) is that it enables us to derive an upper bound implicature when *at least* combines with an existential modal, which, as we saw in the last chapter, is what we need. The details will become clear later in this section.

Now consider *at most*. We have the sentence in (104) and the corresponding denotation in (105).

(104) Mary at most [participated]$_F$.

(105) $[\![(104)]\!] = \textsc{max}_S([\![\text{Mary participated}]\!])$

This says that $[\![$Mary [participated]$]\!]$ is the highest ranked true proposition in S. Thus, Mary showed up and perhaps she also participated, but she did not win.

Finally, let us consider the example with *only* given in (106) and its denotation in (107).

(106) Mary only [participated]$_F$.

(107) $[\![(106)]\!] = \textsc{min}_S([\![\text{Mary participated}]\!]) \;.\; \textsc{max}_S([\![\text{Mary participated}]\!])$

The assertion is that $[\![$Mary participated$]\!]$ is the highest true proposition in S. This means that Mary did not win. The presupposition is that $[\![$Mary participated$]\!]$ or some higher ranked proposition is true. Given that we know that the higher alternative is false, this means that $[\![$Mary participated$]\!]$ is true.

Now that we have a feel for how these definitions work, let us move on to the core data with modals.

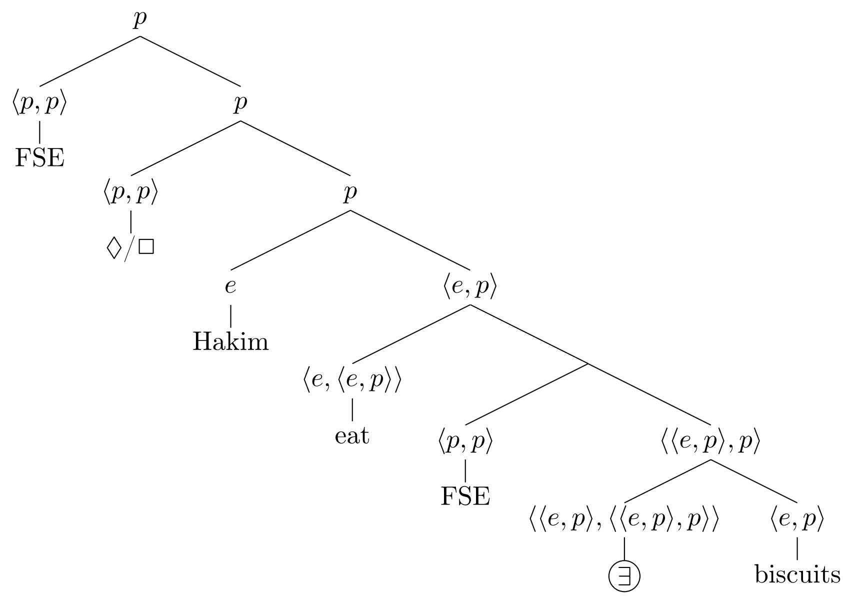
5.4.2 Deriving split readings

I propose the syntactic structure in (109) for sentences where scope-splitting expressions occur without a numeral such as (108).

(108) Hakim is { allowed / required } to eat { *geen* / at least / at most / only } biscuits$_F$.

Here ∃ stands for a covert existential quantifier, as in Geurts and Nouwen (2007) or some other way to add existential force, such as Partee's (1987) A type shift. The type p stands for $\langle s, t\rangle$. FSE stands for focus-sensitive expression, and the two positions where FSE represent the two possible positions where the FSE can be interpreted. It can occur either low, for the surface scope reading, or high, for the split reading.

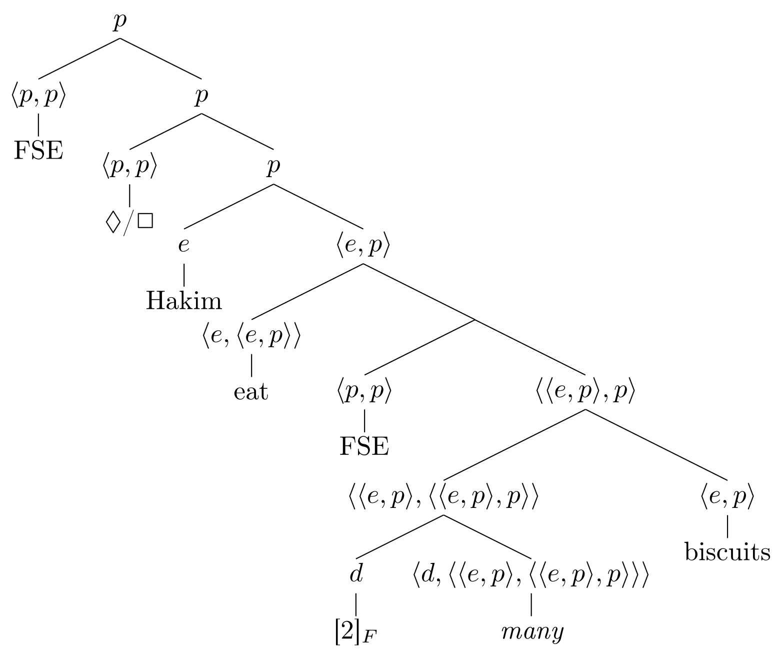
(109)



For sentences where these expressions occur with a numeral, like (110) I assume the very similar structure in (111).

(110) Hakim is { allowed / required } to eat { *geen* / at least / at most / only } [two]$_F$ biscuits.

(111)



As in earlier chapters, *many* is Hackl's (2000) counting quantifier, defined below. *Many* simply takes a degree and turns it into a regular generalised quantifier over individuals.

(112) $[\![\text{many}]\!] = \lambda d_d \lambda P_{\langle e,t\rangle} \lambda Q_{\langle e,t\rangle}.\exists x[\#x = d \wedge P(x) \wedge Q(x)]$

As a brief aside, note that the structure in (111) is not the standard structure assumed for sentences with modified numerals. Since Hackl (2000), it has become commonplace to assume the structure of the DP given in (113) (Hackl, 2000; Nouwen, 2010; Schwarz, 2013; Coppock & Brochhagen, 2013; Kennedy, 2015).

(113) [[at least [3 many]] biscuits]

In the structure in (113), *at least* does not c-command *biscuits* so it cannot associate with it. We know from examples earlier in this chapter that *at least* needs to be able to associate with other elements in the DP than the numeral. This is exemplified again in (114), where it associates with *biscuits.* Therefore, I believe that the DP structure in (111), also assumed by Krifka (1999) and Geurts and Nouwen (2007), also discussed in chapter 2 of this dissertation, is superior.

(114) Hakim ate at least [three BISCUITS]$_F$, and he probably had other things too.

But let us get back to business. The expressions in (81)-(84) are of type $\langle p,p\rangle$.

As can be seen in the trees above, this type is incompatible with the type of the sister of the scope splitting expression, which is $\langle\langle e,p\rangle,p\rangle$. Following Coppock and Beaver (2013), I assume that this type clash can be resolved by applying the Geach rule, given in (115).

(115) Geach rule:
$f_{\langle a,b\rangle} \Rightarrow \lambda R_{\langle c,a\rangle}.\lambda x_c.f(R(x))$

This type shift can turn a $\langle p,p\rangle$ expression to an expression of type $\langle\langle\langle e,p\rangle,p\rangle, \langle\langle e,p\rangle,p\rangle\rangle$. In this case a and b stand for type p. We take c to stand for $\langle e,p\rangle$. Applied to the denotations in (81)-(84) this yields the denotations in (116)-(119).

(116) $[\![\text{geen}]\!]^S = \lambda Q_{\langle\langle e,p\rangle,p\rangle}\lambda P_{\langle e,p\rangle}\ .\ [\exists p'[p' \in CQ_S \wedge p']]\ .\ \neg Q(P)$

(117) $[\![\text{at least}]\!]^S = \lambda Q_{\langle\langle e,p\rangle,p\rangle}\lambda P_{\langle e,p\rangle}\lambda w\ .\ \exists p'[\textsc{max}_S(p')(w) \wedge p' \geq_S Q(P)]$

(118) $[\![\text{at most}]\!]^S = \lambda Q_{\langle\langle e,p\rangle,p\rangle}\lambda P_{\langle e,p\rangle}\ .\ \textsc{max}_S Q(P)$

(119) $[\![\text{only}]\!]^S = \lambda Q_{\langle\langle e,p\rangle,p\rangle}\lambda P_{\langle e,p\rangle}\ .\ \textsc{min}_S Q(P)\ .\ \textsc{max}_S Q(P)$

The Geached expressions can be interpreted *in situ* and give rise to surface scope readings.

I propose that another way to resolve the type clash is for the focus-sensitive operators to move to a position above the modal. They can then attach to a node of type p, which is of the right type to serve as their argument. This is already shown in the trees above, where the focus-sensitive expression occupies the highest position. It is this movement operation that leads to split scope readings.

I take this movement to be a type of movement that is different from QR in two ways. First, the operator that moves is not a quantifier but a focus-sensitive operator. Second, the movement does not leave a trace.[14] Another important property of this kind of movement is that it is only a single expression that moves rather than an entire quantified DP. This, as we have seen, is essential: letting the scope splitting expression move by itself rather than as part of the DP prevents us from creating non-existent inverse scope readings.[15]

To see how split readings come about, let us start with a derivation with *geen* and a focused expression. In (120), *geen* needs to be higher than the NPI

[14] Phrased differently, this means that there are two copies of the focus-sensitive operator, where the higher one is interpreted and the lower one is pronounced. This configuration is in a way similar to reconstruction, where the higher copy is pronounced and the lower one is interpreted.

[15] An alternative analysis would be to follow Büring and Hartmann (2001) in assuming that all focus particles in German are adverbial and can be base-generated in a wide variety of positions. Under such an analysis, the focus-sensitive operators would be base-generated high rather than undergoing movement. This analysis could plausibly be extended to the syntactically similar Dutch and Frisian but may be more difficult to apply to the other languages under discussion. In addition, it would not work for *geen* and its kin, which are not adverbials.

modal *hoeven* to license it, so Geaching is not an option. Thus, we get only a split reading.

(120) Hakim hoeft geen [koekjes]$_F$ te eten.
Hakim must-NPI no biscuits to eat.
'Hakim is not required to eat any biscuits'.

The prejacent of *geen* is given in (121).

(121) $[\![$Hakim is required to eat [biscuits]$_F]\!] =$
$\Box\ [\exists x[\text{biscuits}(x) \wedge \text{eats}(\text{Hakim}, x)]]$

The CQ is a subset of the set of propositions where the focused *biscuits* has been replaced by expressions of the same type.

(122) $CQ \subseteq \{$ Hakim is required to eat $P \mid P \in D_{\langle e,t\rangle}\}$

The denotation of the sentence is given in (123).

(123) $[\![(120)]\!] = [\exists p'[p' \in CQ_S \wedge p']]\ .\ \neg[\Box\ [\exists x[\text{biscuits}(x) \wedge \text{eats}(\text{Hakim}, x)]]]$

The assertion is that the proposition that Hakim is required to eat biscuits is false. This is the split reading: it is not the case that Hakim is required to eat any biscuits. The sentence presupposes that some other proposition in the CQ is true. Thus, there is some other type of thing Hakim is required to eat. This corresponds to the intuitive meaning of the sentence with stress on *koekjes*, 'biscuits'.

When there is no element that is heavily stressed, we can say that the focus projects to the entire prejacent of *geen*. In this case, the sentence presupposes that some other proposition is true. This is a harmless presupposition.

When *geen* combines with a numeral, as in (124), the prejacent is as in (125).

(124) Hakim hoeft geen [twee]$_F$ koekjes te eten.
Hakim must-NPI no two biscuits to eat.
'Hakim is not required to eat two biscuits.'

(125) $[\![$Hakim is required to eat $[2]_F$ biscuits$]\!] =$
$\Box\ \exists x[\#x = 2 \wedge \text{biscuits}(x) \wedge \text{eats}(\text{Hakim}, x)]$

The sentence has the meaning in (126).

(126) $[\![(124)]\!] =$
$[\exists p'[p' \in CQ_S \wedge p'(w)]]\ .\ \neg[\Box\ [\exists x[\#x = 2 \wedge \text{biscuits}(x) \wedge \text{eats}(\text{Hakim}, x)]]]$

We can assume that the alternatives in the CQ are different numerals, as in (127). The numerals in the alternatives have an *at least* meaning rather than *exactly* meaning. This means that, for instance, the alternative *Hakim is required to eat five biscuits* can be true if he must eat five biscuits and is also allowed to eat more.

(127) $CQ \subseteq \{$ Hakim is required to eat n biscuits $\mid n \in D_d\}$

The sentence then asserts that it is not the case that it is required that Hakim eat two biscuits. This intuitively corresponds to a split reading with *geen* and a numeral: Hakim does not need to eat two biscuits. The presupposition is that some other alternative in the CQ is true. This means that there is some other number of biscuits Hakim needs to eat, which is something (125) indeed conveys with stress on the numeral. Without stress on the numeral, we again get the vacuous presupposition that some other proposition is true.

Now let us consider a case with *at least* and a universal modal. *At least* and *required* are more or less commutative except that wide scope for *at least* yields the presupposition that there is a limit to what is required (see footnote 5 in chapter 4). So, for variety, let us now consider how a surface scope is reading is derived with the Geached denotation of *at least*. For (128), we first derive the DP meaning in (129).[16]

(128) Camille is required to win at least a [SILVER]$_F$ medal.

(129) $[\![$at least a [silver]$_F$ medal$]\!] = \lambda P_{\langle e,p\rangle} \lambda w \,.\, \exists p'[\textsc{max}_S(p')(w) \wedge p' \geq_S [\exists x[\text{medal}(x) \wedge \text{silver}(x) \wedge P(x)]]]$

Merging in the verb, subject, and modal yields (130).

(130) $[\![(128)]\!] = \Box\ \lambda w \,.\, \exists p'[\textsc{max}_S(p')(w) \wedge p' \geq_S [\exists x\ [\text{medal}(x) \wedge \text{silver}(x) \wedge \text{wins}(\text{Camille}, x)]]]$

Let us assume the alternatives are the ones given in (131) and they are ordered as in (132).

(131) $CQ = \{$ Camille wins a bronze medal, Camille wins a silver medal, Camille wins a gold medal $\}$

(132) $S = \{$ $\langle$Camille wins a gold medal, Camille wins a silver medal$\rangle$, $\langle$Camille wins a silver medal, Camille wins a bronze medal$\rangle$, etc. $\}$

Then (128) returns the proposition containing the worlds for which there is a p' such that p' is a proposition that is ranked as high as or higher than the proposition that Camille wins a silver medal. Thus: it returns all worlds in the proposition that Camille wins a silver medal and all the worlds in the proposition that Camille wins a gold medal. Hence, Camille won a silver medal or she won a gold medal. Note that the ordering here is a pragmatic ordering. Winning a gold medal does not entail winning a silver medal, but it is ranked above winning a silver medal because of our world knowledge (see also Geurts & Nouwen, 2007).

[16] The insertion of $\exists$ is not necessary here because of the overt existential quantifier.

Now let us turn to an example with an existential modal and *at least.* Here the maximality operator will start to do some work. Consider (133). I will now consider the split scope reading where *at least* has moved up rather than the surface scope reading with the Geached version of *at least.* Consider (133).

(133) Camille is allowed to submit at least $[\text{one}]_F$ abstract.

The prejacent of *at least* is as in (134).

(134) $[\![\text{Camille is allowed to submit one abstract}]\!] = \Diamond\, \exists x[\#x = 1 \wedge \text{abstract}(x) \wedge \text{submits}(\text{Camille}, x)]$

Merging *at least* yields the split scope reading, given in (135).

(135) $[\![(133)]\!] = \lambda w\ .\ \exists p'[\textsc{max}_S(p')(w) \wedge p' \geq_S [\Diamond\, \exists x[\#x = 1 \wedge \text{abstract}(x) \wedge \text{submits}(\text{Camille}, x)]]]$

The alternatives are as in (136), with the ranking in (137).

(136) $CQ = \{$ Camille is allowed to submit zero abstracts, Camille is allowed to submit one abstract, Camille is allowed to submit two abstracts, ... $\}$

(137) $S = \{$ ⟨Camille is allowed to submit two abstracts, Camille is allowed to submit one abstract⟩, ⟨Camille is allowed to submit one abstract, Camille is allowed to submit zero abstracts⟩, ... $\}$

Recall that $\textsc{max}_S$ gets rid of all worlds in propositions that are ordered higher on S than the prejacent. Now (135) returns the set of worlds in $\textsc{max}(p')$, where p' is ordered at least as high as the proposition that Camille is allowed to submit one abstract. Let us call the proposition that she is allowed to submit one abstract p_1 Thus, for each p' in S that is ordered as high or higher than p_1 (p_1, p_2, p_3...), we take $\textsc{max}_S(p')$. That is, we take all worlds that are either in p' or in a proposition that is ordered lower than p', and we throw away worlds that are only in higher propositions than p'. For p_1, we take the worlds that are in p_1 but not in p_2, for p_2, we take the worlds that are in p_2 but not in p_3, etc. This is schematised in (138).

(138) p_1: $p_1 \wedge \neg p_2$
p_2: $p_2 \wedge \neg p_3$
p_3: $p_3 \wedge \neg p_4$
etc.

This means that the maximum number of abstracts Camille is allowed to submit is one or higher. There is a lower bound, in line with the intuitive meaning of *at least.* It also means that there is an upper bound to the number of abstracts she is allowed to submit. It is not the case that she is free to submit as many abstracts as she likes. After all, for any p_n, there will be a corresponding p_{n+1}. Thus, it follows from (135) that there is an upper bound to the number of abstracts Camille is allowed to submit. As I mentioned in chapter 4 and at the beginning of the present chapter, this is exactly the reading we want.

In this (135) is unlike (139), with a minimality operator, which merely states that Camille is allowed to submit one abstract or more and lacks the meaning component that there must be an upper bound to the number of abstracts Camille submits. This is why it is necessary to use a maximality operator rather than a minimality operator in the definition of *at least*.

(139) $\textsc{min}_S$ [$\Diamond$ [$\exists x[\#x = 1 \wedge \text{abstract}(x) \wedge \text{submits}(\text{Camille}, x)]]]$

The meaning component of maximality that (135) carries is the same as the presupposition of (140), which represents the reading we derive in a degree quantifier framework when *at least* takes scope over the modal.

(140) max { n | $\Diamond$ [Camille submits n abstracts] } ≥ 1

In (140), there must also be a maximum number of abstracts Camille submits. If there is no such maximum (in other words: If the set { n | $\Diamond$ [Camille submits n abstracts] } does not have a largest number), then the maximality operator over degrees *max* cannot pick out a number, and we cannot compare 1 to any other number to get a truth value.

Thus, we correctly derive the split reading with *at least* and an existential modal, which says not only that one or more is allowed, but also that there is a limit to what is allowed.

Now let us consider *at most.* (141) has the semantics in (142): the highest ranked true proposition in S is the proposition that Peggy is allowed pitch three ideas.

(141) Peggy is allowed to pitch at most three ideas.

(142) $[\![(141)]\!] = \textsc{max}_S(\Diamond[\exists x[\#x = 3 \wedge \text{ideas}(x) \wedge \text{pitches}(\text{Peggy}, x)]])$

Assuming that S consists of alternatives of the form *Peggy is allowed to pitch n ideas*, this means she is allowed to pitch no more than three ideas. This is the split reading of (141).

If we use a universal modal instead, we get (143) and (144).

(143) Peggy is required to pitch at most three ideas.

(144) $[\![(143)]\!] = \textsc{max}_S(\Box[\exists x[\#x = 3 \wedge \text{ideas}(x) \wedge \text{pitches}(\text{Peggy}, x)]])$

(144) says that the the highest ranked true proposition is the proposition that Peggy is required to pitch three ideas. Thus, the maximum number of ideas Peggy is required to pitch is three, meaning she is not allowed to pitch more than three ideas.

For completeness, the surface scope reading of (143) is given below. This says that in all possible worlds, the highest ranked proposition is the proposition that Peggy pitches three ideas. Thus, there is no possible world where she pitches more than three ideas.

(145) $[\![(143)]\!] = \Box\ [\textsc{max}_S(\exists x[\#x = 3 \wedge \text{ideas}(x) \wedge \text{pitches}(\text{Peggy}, x)]])$

Finally, let us turn to a split scope case with *only*. (146) has the spit reading given in (147).

(146) Mellap is allowed to buy only [FIVE]$_F$ biscuits.

(147) $[\![(146)]\!] = \textsc{min}_S[\Diamond[\exists x[\#x = 5 \wedge \text{madeleines}(x) \wedge \text{buys}(x)(\text{Mellap})]]]\ .$
$\textsc{max}_S[\Diamond[\exists x[\#x = 5 \wedge \text{madeleines}(x) \wedge \text{buys}(x)(\text{Mellap})]]]$

The sentence asserts that the highest ranked true proposition is the proposition that Mellap is allowed to buy five madeleines. The proposition that she is allowed to buy six madeleines is false. The sentence presupposes that she is allowed to buy at least five madeleines, which, combined with the assertion, means she is allowed to buy five madeleines and no more.

We have seen how we can derive split readings with negative indefinites, *at least*, *at most*, and *only* using this mechanism. In the next section, I will show how the apparent split readings with *fewer than* come about.

5.4.3 Exhaustified readings

We saw earlier that, while split readings are difficult to get with *fewer than*, something that looks like a split reading sometimes does arise with this expression. In particular, Hackl's sentence with a universal modal in (22) seems to be an example.

(22) At MIT one needs to publish fewer than three books in order to get tenure.

This leaves me with a dilemma. I have argued that *fewer than* is not a focus-sensitive scope splitting expression because split readings are far more restricted with *fewer than* than with its scope-splitting counterpart *at most*. On the other hand, (22) illustrates that split scope readings are not entirely impossible with *fewer than*.

Here I will argue that the way out of this dilemma is to posit that split scope readings are possible with *fewer than*, but they are more difficult to obtain than with expressions such as *at most*. This is because an extra step is needed to yield spilt readings with *fewer than* that is not needed with *at most*: obtaining split readings with *fewer than* necessitates the insertion of an extra syntactic operator, namely the $\textsc{max}_S$ operator I proposed above. I propose that this additional operation makes the reading more difficult to get and therefore disfavoured. In the remainder of this section I will sketch a way in which this idea can be implemented.

Let us first consider an example with a universal modal and *fewer than*. I propose that the phrase *you have to publish fewer than three books* from (22) has the basic semantics in (148). It simply says that in all deontically accessible worlds, the number of books you publish is lower than three.

(148) $\Box$ [$|\{x \mid \text{books}(x) \wedge \text{publish}(\text{you},x)\}| < 3$]

The idea is that we can now optionally insert the MAX_S operator I defined in (86), repeated below.

(86) $\text{MAX}_S(p) = \lambda w \ . \ \forall p' \in CQ_S[p'(w) \rightarrow p \geq_S p']$

I take the syntactic structure of the sentence to be as in (149). There is no focused expression in the sentence. Therefore, the focus projects and MAX associates with the constituent *you publish fewer than three books* as a whole.

(149) [MAX_S [$\Box$ [you publish fewer than three books]$_F$]]

As explained earlier, the maximality operator takes a proposition p and returns the set of worlds that are either in p or in propositions that are weaker than p. Worlds in propositions stronger than p are discarded.

Given that there is no focused constituent within *you publish fewer than three books*, the two relevant alternatives are simply the alternative that you publish fewer than three books and its negation: you do not publish fewer than three books, or, in other words, you publish three or more books. This yields the CQ in (150).

(150) CQ = { you publish fewer than three books, you publish three or more books }

There is no entailment relation between these two propositions. But, as we saw earlier, MAX_S can use pragmatic scales too. In this case, the obvious ordering is the one given in S below: intuitively, *three or more* is ordered higher than *fewer than three*. In general, we can say that n *or more* is a higher alternative than *fewer than* n.

(151) S = { ⟨you publish three or more books, you publish fewer than three books⟩ }

Applying MAX_S to (148) results in the truth conditions in (152).

(152) MAX_S [$\Box$ [$\{n \mid \#x = n \wedge \text{books}(x) \wedge \text{publish}(\text{you},x)\} < 3$]]

Given the fact that MAX_S associates with *you publish fewer than three books* and given the ordered alternatives S in (151), the reading we get is the one in (153).

(153) $\neg$ [$\Box$ [$\{n \mid \#x = n \wedge \text{books}(x) \wedge \text{publish}(\text{you},x)\} \geq 3$]]

This is simply the negation of the higher, *more than three*, alternative. The reading of (22) with the maximality operator, then, is the reading that it is not the case that you must publish three or more books. In other words, you do not need to publish more than two books to get tenure. This is the split reading Hackl describes.

Crucially, obtaining this split reading necessitates the insertion of a covert syntactic operator. This makes the reading harder to obtain, which explains why this split reading is not as obvious as split readings with expressions like *at most*.

Now let us consider a case with an existential modal. The existential equivalent of (22) is given in (154).

(154) You're allowed to publish fewer than three books.

Without the addition of MAX, the meaning is as in (155).

(155) $\Diamond$ [$|\{x \mid \text{books}(x) \wedge \text{publish}(\text{you},x)\}| < 3$]

This represents the relatively weak meaning that there is a world in which the number of books you publish is lower than three, without excluding the possibility that there are also worlds in which you publish three or more books.

Adding MAX_S results in (156).

(156) MAX_S [$\Diamond$ $|\{x \mid \text{books}(x) \wedge \text{publish}(\text{you},x)\}| < 3$]

MAX_S associates with *you publish fewer than three books*, as above, so S remains the same as well. The meaning we obtain is (157).

(157) $\neg$ [$\Diamond$ [$\{n \mid \#x = n \wedge \text{books}(x) \wedge \text{publish}(\text{you},x)\} \geq 3$]]

Instead of the meaning that you are allowed to publish fewer than three books, we now get the meaning that you are not allowed to publish more than three books. This is the split reading of (154).

Of course it is also possible for MAX_S to associate with its entire prejacent including the modal, *you may/must publish fewer than three books*, rather than just the lower constituent *you publish fewer than three books*. In this case, the stronger alternative that is negated is *you may/must publish three or more books*, which results in the reading in (158).

(158) $\Diamond/\Box$ [$\neg$ [$\{n \mid \#x = n \wedge \text{books}(x) \wedge \text{publish}(\text{you},x)\} \geq 3$]]

(158) says that you may or must not publish more than three books. In other words: you may or must publish fewer than three books. This reading is thus exactly the same as the readings of these sentences without the insertion of MAX_S ((155) and (148) respectively).

The central notion is that to obtain split scope readings with class A modifiers such as *fewer than*, it is necessary to perform an extra operation: an additional syntactic operator must be inserted in the structure. This is not the case for *at most*, where the operator is already present in the lexical entry. This is what explains the contrast between *fewer than* and *at most*: split scope readings are more prevalent in the *at most* cases because *at most* is itself a scope splitting expression that contains a maximality operator. Split scope readings with *fewer than* are less widespread and not as natural as they are with at most because they only arise when we perform the operation of inserting an extra syntactic operator. Inserting MAX_S is costlier than not inserting it. Therefore, non-split readings with *fewer than* are generally preferred. However, when the context clearly favours a split reading, as it does in sentences like (22), a split reading can be forced into existence using MAX_S.

In sum, the present theory offers two ways of deriving split readings: by using a scope splitting expression or an exhaustifier. This accounts for the fact that there are graded judgments, and more specifically for the fact *at most* gives rise to split scope readings much more easily than *fewer than*.

5.4.4 Back to the data

Now I will consider how this analysis accounts for the data. First, my account of split scope does not depend on any non-existent scope configurations. Unlike in De Swart's (2000) or Abels and Martí's (2010) analyses, split scope is not a special kind of inverse scope reading in my account. For both De Swart and Abels and Martí, the split scope reading comes about by creating an inverse scope configuration and adding some extra ingredient (quantification over properties or selective deletion and world binding). This means that as soon as you predict that there is a split scope reading, you also predict the existence of an inverse scope reading. This is undesirable given that only the split readings are attested readings. In my account, split readings come about by moving scope splitting expressions by themselves. No inverse scope configuration needs to be created to derive the split reading. Put differently, there is some unknown constraint on inverse scope. My account can derive split readings in spite of this constraint.

Second, there is another way in which my account does not overgenerate: it only creates split readings for those expressions that actually give rise to them. We have seen that split readings are very easy to get for *at least* and *at most* but difficult for *more than* and *fewer than*. This account captures these facts by positing that only the former expressions are scope splitting expressions. Ostensible split scope readings with *fewer than* are actually the result of a covert exhaustification operator. This captures the observed contrast while still allowing some split readings for *fewer than*, accounting for the graded judgments.

Crosslinguistically, too, the account only generates those readings that are actually there. The negative indefinites that yield split readings are of type $\langle p, p\rangle$. This means that they are of the right type to attach to a proposition, and it gives them the ability to take scope over modals without the rest of the DP they occur in. It is this mechanism that creates split scope readings. In languages where negative indefinites do not generally create split readings, negative indefinites are regular quantifiers of type $\langle\langle e,t\rangle, \langle\langle e,t\rangle, t\rangle\rangle$. This means that the only hope they have of taking wide scope is to undergo a type shifting operation such as QR with their DP complement, which would yield inverse scope readings (although we have seen that even this route is blocked for them), but they cannot move by themselves. As a result, they fail to give rise to split scope readings.

Third, grouping together the expressions *at least*, *at most*, *geen*, and *only* is consistent with the fact that these four expressions behave alike in how they take scope. They are subject to the Heim-Kennedy Generalisation and have to take scope over existential modals.

Finally, and perhaps rather obviously, the analysis captures the correlation between focus-sensitivity and split scope. The focus-sensitivity generalisation this account is based on also subsumes the numeral modifier generalisation from Blok et al.: the reason why there is a correlation between split scope and numeral modification is because focus-sensitive operators have both the property of being scope-splitting operators and the ability to associate with a wide variety of different types of expressions, numerals being among them.

This concludes the main part of this chapter. In the next section I will discuss some questions with respect to degree quantifier movement that arise at this point. Afterwards I will explore two possible extensions of the account.

5.5 The status of degree quantifier movement

One of the claims I have made in this chapter is that *fewer than* is not a true scope splitting expression. I have argued that the reason why split scope readings are more difficult to get with *fewer than* than with, say, *at most*, is that they can only arise when we insert a covert EXH operator in the structure, which is costly. It is a common assumption that *fewer than* is a degree quantifier; an expression of type $\langle\langle d,t\rangle,t\rangle$ (Hackl, 2000). If this is true, then *fewer than* should be able to undergo degree QR and take scope over a modal this way, just like *at least* and *at most* in a degree quantifier account (cf. chapter 2 and 4). On this assumption, *fewer than* is expected to give rise to split readings. For example, (159) could have the LF in (160), where *fewer than 5* has quantifier raised to a position above *allowed*, yielding the truth conditions given in (161).

(159) Marin is allowed to read fewer than five books.

(160) [Fewer than 5 [λd [$\Diamond$ [Marin [[reads] [[*d many*] [books]]]]]]]

(161) $max\ \{n \mid \Diamond[\exists x[\#x = n \wedge \text{book}(x) \wedge \text{read}(\text{Marin}, x)]]\} < 5$

(161) is a split reading: the maximum number of books Marin is allowed to read is lower than five. If *fewer than* is indeed a degree quantifier, then there is a loophole: split readings can be obtained by quantifier raising it. There is no need to insert a silent exhaustifier, and therefore no reason why split readings with *fewer than* are less available than with, say, *at most.* This results in the incorrect prediction that the reading in (161) for (159) is as natural as the split scope reading of (162).

(162) Marin is allowed to read at most five books.

Before addressing this issue, I should point out that there are other cases where we seem to observe degree quantifier movement with comparatives. For instance, consider (163), repeated from chapter 2 (Heim, 2000).

(163) [This draft is 10 pages.]
The paper is required to be less long than that.

Heim assumes that (163) can have the two LFs in (164), yielding the two possible denotations given in (165).

(164) a. required [[less than that] [λd [the paper be d long]]]
b. [less than that] [λd [[required [the paper be d long]]]]

(165) a. $\Box[max\{d : \text{long}(p, d)\} < 10p]$
b. $max\ \{d : \Box\text{long}(p, d)\} < 10p$

The assumption is that *less than that* quantifier raises by itself, and it can end up either below or above the modal *required*. When it ends up below the modal, the denotation is that what is required is this: the maximum degree to which the paper is long is less than 10 pages. This means that the maximum permitted paper length is nine pages (assuming a discrete scale). When it ends up above the modal, the reading is that the maximum degree for which it is required that the paper is long to that degree is less than 10 pages. This means that the minimum requirement on the paper's length is not longer than 10 pages.

If this ambiguity of (163), with *less than* as a comparative, results from degree quantifier movement, the question is how we can square this with the data on *fewer than* as a numeral modifier, for which I have claimed that split scope readings do not exist. In other words, why do we see readings where *fewer than* takes wide scope by itself in (163) but not when *fewer than* is used as a numeral modifier? There is a rather easy way out. We can assume that the modified numeral *fewer than* n is not a degree quantifier but rather an expression of type $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$. Evidence that expressions like *fewer/less than* and *more than* may not be degree quantifiers comes from data like (166). These examples show that these comparative modifiers can modify other things besides numerals. This means that in any case, saying that they are degree quantifiers cannot be the whole story.

(166) a. He's more than a man. (...He's a star.)
b. This is less than a house. (...It's more like a shed.) The easy way out can be summarised as follows: we assume that the comparatives *more than* and *less/fewer than* in adjectival comparatives are syntactically mobile degree quantifiers, whereas *more than* and *fewer than* as numeral modifiers are of a different type that does not enable them to move, such as the type of an adjective. Then, to get split readings in the *fewer than* cases such as (159),

> it is necessary to do some extra work by inserting a covert exhaustifier and/or calculating an implicature, which explains why split scope is more difficult to get here than if we had used a scope splitting expression like *at most*.

But the easy way out is ad hoc and counterintuitive. Why would *less than* in *less long than that* be a completely different kind of expression than *less than* in *less than 10 pages*? Given that both the form and the meaning are the same, it seems implausible that we are dealing with two separate expressions that behave very differently from a syntactic point of view. Perhaps it is necessary to explore a less easy way out.

Another option would be to say that the expressions *more than* and *less/fewer than* are degree quantifiers in all cases discussed here, both when they are used as comparatives and when they are used as numeral modifiers. In this case, we would have to say that there is no such thing as degree quantifier movement over modals. That is, degree quantifier movement is more restricted than previously thought. If this is the case, then the fact that *less/fewer than* fails to be able to take scope over modals is another instance of there being fewer scope configurations than expected.

A consequence of this idea is that whenever it looks like we observe a split reading with *less/fewer than*, or, in other words, it looks like *less/fewer than* has undergone degree QR to a position above a modal, the reading we have observed is caused by another mechanism. After all, if degree quantifiers cannot move over modals, they cannot yield split readings this way. A natural candidate for such an alternative mechanism is the insertion of an exhaustification mechanism. This would mean that ostensible split scope readings with *less/fewer than* are not only caused by an exhaustification operator when *less/fewer than* is used as a numeral modifier, but also when it is used as a comparative, like in Heim's examples. All cases of apparent split scope with *less/fewer than* discussed in this section would be the result of the insertion of EXH. In the rest of this section I will present three arguments for this claim.

First, the available evidence for the existence of degree quantifier movement is limited (as also pointed out by Beck, 2012). Heim mentions that wide scope readings can only be detected when downward entailing or non-monotone quantifiers are used. In Heim's account, using *longer than that* instead of *less long than that*, as in (167) yields the two LFs in (168) and the corresponding truth conditions in (169).

(167) [This draft is 10 pages.]
The paper is required to be longer than that.

(168) a. required [[-er than that] [λd [the paper be d long]]]
b. [-er than that] [λd [[required [the paper be d long]]]]

(169) a. $\Box[max\{d : \text{long}(p, d)\} > 10p]$
b. $max\ \{d : \Box\text{long}(p, d)\} > 10p$

Heim points out that it the commutativity of *-er than that* and *required* makes it impossible to tell whether there is a reading where the degree quantifier takes wide scope. Let us dive deeper into the readings to consider this idea. The surface scope reading is that in all worlds, the maximum number of pages the paper has is lower than ten. The split scope reading is that the maximum number the paper has in all worlds is lower than ten. If the maximum number of pages across all worlds is lower than ten, that means that in all worlds, the paper has less than ten pages. And if in all worlds the paper has less than ten pages, then the maximum number such that the paper has that many pages in all possible worlds is necessarily lower than ten. In other words, when we look purely at the models that make them true or false (169-a) and (169-b) are equivalent. However, the reality is slightly more complicated than that: (169-b) but not (169-a) presupposes that there is an upper bound to the number of pages the paper is required to have. In this case, that simply means that the paper is not required to be infinitely long, which is such a weak presupposition that it is probably impossible to tell whether it is there. But let us switch from universal modals to existential modals and consider (170), with its pairs or LFs and truth conditions in (171) and (172).

(170) [This draft is 10 pages.]
The paper is allowed to be longer than that.

(171) a. allowed [[-er than that] [λd [the paper be d long]]]
b. [-er than that] [λd [[allowed [the paper be d long]]]]

(172) a. $\Diamond[max\{d : \text{long}(p, d)\} > 10p]$
b. $max\ \{d : \Diamond\text{long}(p, d)\} > 10p$

These are very similar to the types of cases we saw in chapter 4, when I argued that *at least* but not *more than* must outscope existential modals. (172-a) means that it is allowed for the paper length to exceed ten pages. (172-b) says that there is a page limit, and this page limit is higher than ten. (170) intuitively does not have a reading where this presupposition is present. When we use *at least*, as in (173), we do seem to get the presupposition.[17]

(173) [This draft is 10 pages.]
The paper is allowed to be at least that long.

This may be a sign that wide scope for *longer than that*, or *-er than that* in Heim's syntax, is in fact not possible. So as Heim pointed out, we do not know for sure if degree quantifier movement is possible with upward monotone degree quantifiers, and this is one thing. But the data above show that we may actually have reasons to believe that it is not. The fact that scope readings are restricted in this way limits the evidence for the existence of degree quantifier movement.

Second, when we consider examples with existential modals, split scope

[17] See section 4 of chapter 4 to see this argument worked out in detail for *more than* and *at least* as numeral modifiers.

readings with *fewer/less than* are actually not that easy to get, especially when compared to parallel cases with *at most*. Consider (174) and its two possible LFs and denotations.

(174) [This draft is 10 pages.]
The paper is allowed to be less long than that.

(175) a. allowed [[less than that] [λd [the paper be d long]]]
b. [less than that] [λd [[allowed [the paper be d long]]]]

(176) a. $\Diamond[max\{d : \text{long}(p, d)\} < 10p]$
b. $max\ \{d : \Diamond\text{long}(p, d)\} < 10p$

The most obvious reading here is the surface scope reading: the listener needn't worry if her paper is less long than 10 pages, because this is perfectly acceptable. On the split scope reading, the listener with the eight page paper might have reasons to worry: there is a page limit, and this limit is between zero and nine. The page limit may very well be six, which means that our imaginary listener has exceeded it. This reading is not very prevalent. Now consider (177) and its possible LFs and truth conditions in a degree quantifier account.

(177) [This draft is 10 pages.]
The paper is allowed to be at most that long.

(178) a. allowed [[at most that] [λd [the paper be d long]]]
b. [at most that] [λd [[allowed [the paper be d long]]]]

(179) a. $\Diamond[max\{d : \text{long}(p, d)\} \leq 10p]$
b. $max\ \{d : \Diamond\text{long}(p, d)\} \leq 10p$

The readings are the same as those in (176) except for the non-strict comparison. In this case, the worry-inducing split scope reading is far more prevalent: writing more than ten pages is definitely not allowed. This is exactly the same contrast between *at most* and *fewer than* as numeral modifiers that I observed earlier in this dissertation. The conclusion is that in Heim's cases, too, split scope is actually not always that easy. This is an argument for an account where split scope takes some more work than merely movement. If we assume that an exhaustifier is needed to get a split scope reading in (174) but not in (177), we explain why split scope is easier in the latter case, exactly as we did above in the domain of modified numerals.

Another piece of data that makes the same point is the contrast in (180).

(180) [The draft is 10 pages.]

a. Het paper kan minder lang geweest zijn dan dat.
The paper can less long been is than that.
'The paper might have been less long than that.'

b. Het paper kan hoogstens zo lang geweest zijn.
The paper can *at most* as long been is.
'At most, the paper might have been as long as that.'

While the English epistemic existential modal *might* seems to resist embedding, the Dutch modal *kunnen*, 'can', when used epistemically, shows the same contrast between downward entailing comparatives and scope splitting expressions. (180-a), with *minder dan*; 'less than', only has a surface scope reading: there is a possibility that the paper was less long than ten pages. (180-b) with *hoogstens*; 'at most', only has a split reading: it is not possible that the paper was longer than that.

A third argument that degree quantifier movement over modals is not possible has to do with the Heim-Kennedy Generalisation (Kennedy, 1997; Heim, 2000). As I mentioned earlier, the Heim-Kennedy Generalisation holds not only for expressions that have traditionally been analysed as degree quantifiers, such as *fewer than* and *at least*, but also for *geen* and *only*. I will discuss this fact in a bit more detail here. None of the sentences in (181) have split scope readings, which indicates that none of the operators can take scope over the nominal quantifier *most children*.

(181)
a. Most children found fewer than six Easter eggs.
b. Most children found at most five Easter eggs.
c. De meeste kinderen vonden geen paaseieren.
   The most children found no Easter eggs.
   'Most children did not find any Easter eggs.'
d. Most children found only five Easter eggs.

If one does treat the expressions in (181-a) and (181-b) as cases of degree quantifiers (as is commonly done, see e.g. Kennedy, 2015), then the Heim-Kennedy Generalisation indeed correctly captures that split scope readings are impossible for these sentences.[18] The split scope reading of (181-a) and (181-b) would be the reading that the maximum number such that most children found that many Easter eggs is five or lower, as shown in (182).

(182) $max\ \{\ d : \text{most children found}\ d\ \text{Easter eggs}\ \} \leq 5$

Let us say that *most* means 'more than half'. Then the split scope reading is true in a scenario where there are ten children, of which five found four Easter eggs, and the other five found six. As the children who found six eggs also found four eggs, the highest number such that more than half the children found that many eggs is four. Intuitively, the sentence is false in this scenario. It only has the surface scope reading that for most children, it is the case that they found five Easter eggs or fewer.

But, as I have said earlier, the Heim-Kennedy Generalisation actually appears to hold for a broader class of expressions than expressions that have been assumed to be degree quantifiers. It also holds for (181-c) and (181-d). We have seen that *geen* and *slechts*/*only* can move over modals; this is how they give

[18] The same prediction would hold for parallel sentences with *at least* and *more than* but this is a probably untestable prediction due to the commutativity of *most* and *at least*/*more than*.

rise to split scope readings. But they cannot move over nominal quantifiers. The split scope reading of (181-c) would be that it is not the case that most children found Easter eggs. (181-c) only has the stronger surface scope reading that most children did not find any Easter eggs. Similarly, (183) lacks the split scope reading that it is not the case that exactly one child found Easter eggs.

(183) Precies één kind vond geen paaseieren.
Exactly one child found GEEN Easter eggs.
'Exactly one child didn't find any Easter eggs.'

Turning to *only*, (181-d) cannot mean that not all children found five Easter eggs. Instead, it only has the surface scope reading that for most children, it was the case that they found five Easter eggs or fewer. Similarly, (184) lacks a split scope reading.

(184) Some child found only (five) Easter eggs.

The surface scope reading is that for some child it is the case that she found only Easter eggs and nothing else, or that she did not find more than five Easter eggs (if we include the numeral *five* in the sentence). Now let us consider the split readings. The split reading of the sentence with the numeral would be that the strongest statement we can truthfully make is *a child found five Easter eggs*; any other statement that does not entail *some child found five Easter eggs* is false. This means that *a child found* n *Easter eggs* for any number *n* above five is predicted to be false. Thus, the sentence ends up meaning that no child found more than five Easter eggs. This is not a possible reading of (184) with a numeral. Without a numeral, the split reading would be that all alternatives of the form *some child found* x are false, again unless they entail the prejacent of *only*. So: a child found Easter eggs, and no child found anything else. This reading is way too strong. So: *only* must also take scope under the nominal quantifier *some*.

So: all scope splitting expressions seem to abide by the Heim-Kennedy Generalisation, including those that have not generally been analysed as degree quantifiers: *geen* and *only*. This means that we have to reconsider the status of the Heim-Kennedy Generalisation: it may not be a constraint on degree quantifier movement but rather a constraint on scope for a broader class of expressions, namely the class of scope splitting expressions. I have defined this new Heim-Kennedy Generalisation in (185).[19]

(185) **Heim-Kennedy Generalisation 2.0, option 1**
A nominal quantifier cannot intervene between a scope-splitting focus-

[19] This is similar to the proposal in Beck (2012): nominal quantifiers are interveners between her covert operator AT MOST and the alternatives, which are generated lower. Unlike in Beck's account, the operators that occur above the modal in my analysis are the ones that are overtly present in the structure rather than covert AT MOST operators. In addition, I assume that the observations made here also hold for the upward entailing *at least* rather than merely for downward entailing or non-monotone expressions, as Beck does.

sensitive operator and the expression it associates with

This covers the cases with *at least*, *at most*, *only*, and *geen*. For the new Heim-Kennedy Generalisation to work, we have to assume that EXH is also focus-sensitive. This is what I have done above, and as the meaning of EXH is similar or, under some analyses, equivalent to the meaning of *only*, this seems plausible. The new Heim-Kennedy Generalisation then covers all Heim's original cases, all the split scope cases with *at least*, *at most*, *only*, and *geen*, and the seemingly split readings with *fewer than*. Therefore, we cover more data this way than with the original Heim-Kennedy Generalisation. Given that this potentially better way of stating the constraint does not make reference to degree quantifiers, we no longer need to assume the existence of degree quantifier movement over modals. This is a third argument why degree quantifier movement over modals may not be real.

As a small detour, another option for a new Heim-Kennedy Generalisation is given in (186).

(186) **Heim-Kennedy Generalisation 2.0, option 2**
Downward entailing operators cannot take scope over nominal quantifiers unless they overtly occupy a position above the nominal quantifier

This covers the lack of split readings across nominal quantifiers with *at most*, *geen*, and *only*, because these operators are all downward entailing. Unlike (185), it also explains that DPs containing the non-scope-splitting expression *no* in English fail to be able to undergo QR over nominal quantifiers, as in example (187).

(187) Every student attended no parties.

But there is a reason to prefer (185) over (186): (188) also lacks a split scope reading.

(188) Exactly two children found at least five Easter eggs.

The split reading is schematised in a degree quantifier framework in (189).

(189) max { d : exactly two children found d Easter eggs } ≥ 5

Say that there are four children. Child 1 found four Easter eggs, children 2 and 3 each found six Easter eggs, and child 4 found seven Easter eggs. The sentence is intuitively false in this scenario: there are three children who found at least five Easter eggs, not two. But under the reading where *at least* takes wide scope, schematised in (189), the sentence is predicted to be true. There is only one number in the set of numbers such that exactly two children found that number of eggs: the number six. The maximum number in the set is therefore six. Six is greater than five, so the sentence is true. (189) is not a possible reading for (188), so *at least* cannot take wide scope.

In my account, the prediction is the same. The meaning is represented in (190), where $\exists!$ stands for 'there is exactly one'. So: the highest ordered proposition is the proposition that there is exactly one group of two children who found five Easter eggs or some higher ordered proposition. With the S in (191), (187) is again predicted to be true. This is because the alternative *exactly two children found six Easter eggs* is true, and this alternative is ordered higher than p.

(190) $\textsc{max}_S(p') \geq_S [\exists! x[\#x = 2 \wedge \text{children}(x) \wedge x \text{ found 5 Easter eggs}]]$

(191) $S = \{$ ..., ⟨exactly 2 children found 6 Easter eggs, exactly 2 children found 5 Easter eggs⟩ , ⟨exactly 2 children found 5 Easter eggs, exactly 2 children found 4 Easter eggs⟩ , ... $\}$

Exactly two children is a nominal quantifier and *at least* is a scope-splitting operator, so (185) correctly predicts that (187) does not have a split scope reading. Since *at least* is not downward entailing, (186) does not. If we go down the route of (185), we have to say that the lack of split scope readings with (187) is caused by some other phenomenon. This is not that far-fetched given that I have argued that *no* is a profoundly different animal from scope splitting negative indefinites, and is not of the right semantic type to move by itself.

A small summary is in order. I began this section by pointing out an issue that was probably already on the minds of all degree semantics-savvy readers: it is impossible to maintain both my account of split scope and a degree quantifier analysis of comparative numeral modifiers like *fewer than*. If we do this, we can no longer explain why split scope is harder with *fewer than* than with *at most*. The solution I tentatively suggest is to assume that there is no such thing as degree quantifier movement over modals. I have presented three arguments for this claim. Two of these arguments were based on the limitations of the empirical evidence for degree quantifier movement: degree quantifier movement is not attested for upward entailing degree quantifiers (and there may even be some evidence that this does not exist) and even with downward entailing degree quantifiers it is relatively difficult to get inverse scope readings with existential modals. My third argument was that if we do away with degree quantifier movement over modals, assume only movement of focus-sensitive elements, and adjust our definition of the Heim-Kennedy Generalisation accordingly, we can cover a wider range of data. This seems to me to be a promising route to take, although the full range of consequences of such a proposal still needs to be explored.

5.6 Extensions

In this section I will describe two possible extensions of my account. The first has to do with split scope readings with the so-called 'hat contour' intonation. The second concerns split scope readings with *exactly*.

5.6.1 Split readings with universal nominal quantifiers?

As discussed in the previous section and earlier in this dissertation, split scope across nominal quantifiers is generally impossible. However, there is one specific case in Dutch and German where we do seem to get something that resembles split readings across nominal quantifiers (I believe that Jacobs, 1980, was the first to observe this). These readings are very restricted: they only occur when a universal quantifier co-occurs with a negative indefinite and when the specific 'hat contour' or 'rise-fall contour' intonation is used (Büring, 1997; Krifka, 1998). Therefore, some authors have, perhaps rightly, dismissed these cases as a separate phenomenon that does not need to be covered by an account of split scope (Abels & Martí, 2010; Blok et al., 2017). Nevertheless, I will now spend some time discussing to what extent my account can handle these cases. (192) exemplifies the phenomenon.

(192) [Iedereen]$_F$ is geen genie.
[Everyone]$_F$ is GEEN genius.
'Not everyone is a genius.'
#'Everyone is not a genius.'

With the hat contour intonational pattern, (192) has the reading 'not everyone is a genius', a reading that ostensibly arises from negation scoping over *iedereen*; 'everyone', and the rest of the DP *geen genie*; 'no genius', scoping under it. When the hat contour intonation is used, this is the only possible reading of (192); the surface scope reading is not there. Without the hat contour, the pattern is reversed: (193) only allows a surface scope reading.

(193) Iedereen is geen genie.
Everyone is GEEN genius.
#'Not everyone is a genius.'
'Everyone is not a genius.'

Thus, split scope in these cases is only possible with a special intonational pattern. In addition, it seems only to be possible with *geen* and not with any other scope splitting expressions. (194) shows that using *hoogstens*; 'at most', instead leads to infelicity with the hat contour intonation.

(194) #[Iedereen]$_F$ zag hoogstens vijf vogels.
[Everyone]$_F$ saw at most five birds.
'Everyone saw at most five birds.'

My account of split scope may shed some light on these facts. First, consider how the split reading of (192) would be derived in this analysis. As schematised in (195), we can say that *everyone* is in focus, so *geen* associates with it. The reading we obtain is that it is not the case that everyone is a genius, but one of the alternatives of the form *x is a genius* is true. In other words, not everyone is a genius, but someone is. This is a perfectly interpretable reading, and it is the reading that corresponds to the meaning of the sentence.

(195) *geen* [everyone]$_F$ is ∃ genius

Now consider (194), whose meaning is schematised in (196).

(196) *at most* [everyone]$_F$ saw five birds

Given the focus on *everyone*, the predicted reading is that (196) is the highest ordered alternative that is true out of the set of alternatives of the form *x is a genius*. But this is a tautology: *at most everyone is a genius* is compatible with no-one being a genius, with everyone being a genius, and with every possibility in between. Therefore, it is ruled out.

Thus, my account can explain the contrast between (192) and (194). It can also explain why (197) is infelicitous with the hat contour intonation: *no* is not focus-sensitive and not a scope-splitting expression. Therefore, it does not have the flexible semantics required for it to be able to move up by itself and to attach to *everyone*.

(197) #[Everyone]$_F$ is no genius.

By contrast, (198), with the focus-sensitive *not*, can be used with the hat contour and does have the split reading that not everyone went.

(198) [Everyone]$_F$ didn't go.

Unfortunately, though, not all problems are solved. If we go with this line of explanation, then we also predict that split scope is possible in (199).

(199) #De [meeste]$_F$ mensen zagen hoogstens vijf vogels.
The most people saw at most five birds.
'Most people saw at most five birds.'

After all, (200) makes perfect sense. It means that (199) is the most highly ordered true alternative of the form *x saw at most five birds*, which is not a tautology. It excludes the possibility that everyone saw five birds. (199) is infelicitous and certainly cannot have this reading.

(200) at most [most people]$_F$ saw five birds

Though I will leave this as an open issue, I should remark that I believe that no other account of split scope or in fact of hat contour sentences (Büring, 1997; Krifka, 1998) can explain (199). Therefore, the fact that my analysis *can* account for the split scope cases with *every* should be seen as a bonus, and the fact that some issues remain is not an argument against my theory of split scope.

Thus, viewing scope splitting expressions as focus-sensitive operators can shed some light on split readings with nominal quantifiers but does not eliminate all problems. Finally, current unified accounts of split scope (the present account, Abels & Martí, 2010, and Blok et al., 2017) are based on the premise that split scope is restricted by the Heim-Kennedy Generalisation. In order to understand why these cases, if they are indeed cases of split scope, would be an exception to the Heim-Kennedy Generalisation, we first need to understand why the Heim-Kennedy Generalisation exists. If prosody affects the Heim-Kennedy Generalisation facts, then this may indicate that focus plays a role. This may indicate that restating the Heim-Kennedy Generalisation as a constraint on focus-sensitive operators may be on the right track. In addition, the considerations discussed in this section may be a first step towards understanding why the Heim-Kennedy Generalisation is as it is.

5.6.2 *Exactly*

Exactly is an expression that has been claimed to take wide scope without the rest of the DP it occurs in, either via degree quantifier movement (Heim, 2000; Hackl, 2000) or a split scope mechanism (Abels & Martí, 2010). Given that I claim that split scope is a focus phenomenon, I predict that *exactly* is focus-sensitive. I will discuss this prediction in this section.

First let us see what split scope readings with *exactly* look like. I will assume a degree quantifier analysis for ease of exposition, and give *exactly* the semantics in (201). That is, it takes a degree m and a degree predicate P and conveys that out of all degrees n for which P holds, the highest one is equal to m.

(201) $[\![\text{exactly}]\!] = \lambda m_d \lambda P_{\langle d,t\rangle}.\ \mathit{max}\ \{n \mid P(n)\} = m$

Now let us consider the semantics of (202). The two possible structures of this sentence are given in (203) and the truth conditions are in (204).

(202) Nigella is allowed to bake exactly five cakes.

(203) a. [$\Diamond$ [Exactly 5 [λd [Nigella [[bakes] [[d many] [cakes]]]]]]]
b. [Exactly 5 [λd [$\Diamond$ [Nigella [[bakes] [[d many] [cakes]]]]]]]

(204) a. $\Diamond$ [$\mathit{max}\ \{n \mid \exists x \wedge \#x = n \wedge \text{cake}(x) \wedge \text{bake(Nigella}, x)\} = 5]$
b. $\mathit{max}\ \{n \mid \Diamond[\exists x \wedge \#x = n \wedge \text{cake}(x) \wedge \text{bake(Nigella}, x)]\} = 5$

(204-a) corresponds to the surface scope reading of (202). It says that it is permissible for the maximum number of cakes Nigella bakes to be exactly five. This means she can choose to bake exactly five cakes but she can also choose to bake fewer or more cakes. (204-b) says that the maximum number for which it is true that Nigella is allowed to bake that number of cakes is exactly five. This means that she cannot bake more than five cakes. This is the split scope reading of the sentence.

So is *exactly* focus-sensitive? Heim (2000, p.225) talks in passing about 'focus-sensitive adverbs like [...] *exactly*' and Beck (2012) assumes that *exactly* is focus-sensitive, but it is difficult to find evidence for this claim. Earlier in this chapter I used (28) to argue that *at most* is focus-sensitive: it can associate with different focused elements in its c-command domain and exclude different higher alternatives depending on which element is focused.

(28) a. Maggie drank at most [three]$_F$ vodkas.
⇝ Maggie drank no more than three vodkas (she possibly drank wine too)
b. Maggie drank at most [three VODKAS]$_F$.
⇝ All Maggie drank is three vodkas (she didn't drink anything else)

This does not work for *exactly*. As can be seen in (205), *exactly* cannot associate with the entire DP *three vodkas*.

(205) a. Maggie drank exactly [three]$_F$ vodkas.
b. #Maggie drank exactly [three VODKAS]$_F$.

I posit that this is not due to the fact that *exactly* is not focus-sensitive but rather to the nature of its lexical semantics. *Exactly* adds very little to the meaning of a proposition; it merely removes any ambiguity about some other lexical item. In the examples below, the meaning *exactly* contributes is that it takes away the option to interpret *forty*, *right*, and *what* respectively in a non-precise manner.

(206) a. Maggie worked exactly forty hours.
b. Maggie was exactly right.
c. What exactly do you mean?

Because the contribution of *exactly* is rather limited, it is often redundant. In (207), for instance, *exactly* cannot be used.

(207) #Maggie drank exactly vodka.

Intuitively, the reason for the infelicity of (207) is that (208) means exactly the same thing. *Vodka* is not a concept that allows any imprecision or ambiguity, so the use of *exactly* in (207) is redundant.

(208) Maggie drank vodka.

It seems to me that this is the reason why (205-b) is out. In (205-a) *exactly* can modify the numeral, and as numerals allow both a precise and a lower bound reading as well as an approximate reading, *exactly* can do some work here. But in (205-b), *exactly* modifies either *vodkas* or the whole DP *three vodkas*. Like *vodka* in (207), these are not concepts that allow for an imprecise meaning and for that reason, *exactly* cannot associate with them.

Note that the problem is not a syntactic one. The examples in (209) both have the same syntactic structure, but only (209-a) is felicitous because it makes sense to talk about precision when it comes to geometric shapes but not when it comes to Frenchmen.

(209) a. France is exactly a hexagon.
b. #Nicolas is exactly a Frenchman.

(210) makes the same point as (207).

(210) a. Maggie is { at least / at most } an associate professor.
b. #Maggie is exactly an associate professor.

At least and *at most* clearly change the meaning of the sentence here: they allow for the possibility that Maggie's position is either higher or lower than the position of an associate professor. Using *exactly* here, on the other hand, makes no sense. Being 'exactly an associate professor' is the same thing as simply being an associate professor, and so the redundancy of *exactly* leads to infelicity.

The fact that *exactly* is less flexible in what it can associate with than the other scope splitting expressions is thus due to its lexical semantics, which is unrelated to the matter of whether *exactly* can in principle associate with arguments of different types depending on whether they are in focus. For now, I can only conclude that I do not know whether *exactly* is focus-sensitive. If it is, I could incorporate *exactly* in my account. If it is not, perhaps the upper-bound reading of examples like (202) could be analysed as an exhaustified reading, but more work is needed to find out whether that would be the right move to make.

5.7 Conclusion

In this chapter I have presented a unified account of split scope. The account I proposed is not reliant on non-existent inverse scope configurations because it lets the focus-sensitive operator take scope by itself. In addition, the account avoids overgeneration of another kind: it only predicts true split scope readings for expressions that are scope splitters. This means that the account singles out the correct scope splitting expressions both within languages and across languages.

The key insight came from the focus sensitivity generalisation: only focus-sensitive operators give rise to split scope readings. After having discussed this idea, I presented an analysis that was based on this generalisation by giving scope splitting expressions a focus-sensitive semantics. I derived split readings by letting these expressions take scope over modals by themselves.

An important aspect of the account is that there are two ways to derive split scope readings, only one of which involves scope splitting expressions. Sentences with modals and the non-scope splitting expression *fewer than* can have a reading that resembles a split reading but is actually an exhaustified reading. This accounts for the fact that these readings are sometimes present but much harder to get than split scope readings with *at most*.

A consequence of thinking of split scope this way is that the option of degree quantifier raising *fewer than* must be ruled out. If it were not, *fewer than* could give rise to split scope readings that way. I argued that this may not be such a strange thought and in doing so suggested that the Heim-Kennedy Generalisation may need to be rephrased to apply to scope-splitting expressions rather than degree quantifiers.

Finally, I discussed two different possible extensions of the account: the rare cases where we seem to observe split scope readings with universal nominal quantifiers and incorporating *exactly* as a potential scope-splitting expression.

The problem I discussed in chapter 3 has been solved: we now have an account of split scope that is independent of unattested inverse scope configurations. However, the problem from chapter 4 still stands: how do we create an account for the pragmatics of class B modified numerals without relying on the non-existent scope configurations where existential modals take scope over the modified numerals? I will give a solution to this problem in the next chapter. The account i discuss there builds on the present account but has the added dimension of inquisitive semantics to calculate pragmatic implicatures.

CHAPTER 6

The pragmatics of modified numerals

6.1 Introduction

In the previous chapter I proposed a theory that encompasses split scope readings with negative indefinites in certain Germanic languages and split scope readings with modified numerals as well as split scope with *only*. The central idea was that certain focus-sensitive expressions give rise to split scope readings, and the set of focus-sensitive operators includes some but not all modified numerals and negative indefinites in some but not all Germanic languages.

Here I will build on this account and zoom in on *at least* and *at most*. Specifically, I will present an analysis that derives the epistemic and variation readings these two expressions give rise to discussed in chapter 4. To do this, I will enrich the semantics I proposed for these expressions in the previous chapter by using inquisitive semantics. The aim is to derive the right readings for each combination of a numeral modifier and a modal without relying on any non-existent scope configurations, namely those where *at least* and *at most* take scope under an existential modal (cf. chapter 4).[1] In addition, the account captures the fact that the combinations of *at least* with a universal modal and *at most* with an existential modal are more natural than the other two possible combinations.

This chapter is organised as follows. In the next section I will summarise the data I presented in chapter 4. In section 6.3 I will briefly introduce the framework of inquisitive semantics. Section 6.4 contains the main analysis. In section 6.5 I discuss how the account can be extended to examples with universal nominal quantifiers, and section 6.6 concludes.

6.2 The data revisited

Here I will briefly review the observations on the interactions between modified numerals and modals I discussed in chapter 4. Let us begin with (1).

(1) Nemo is allowed to eat at most forty grams of food.

The combination of *allowed* and *at most* sounds very natural, and the most obvious reading is an authoritative reading. Semantically, the sentence means that Nemo (a cat, for those who have not read chapter 4) is not allowed to eat more than forty grams of food. There is an additional pragmatic inference, the variation (often called 'free choice') inference, which is that Nemo is allowed to choose between multiple different amounts of food. For instance, it is not the case that she can only eat 35 grams of food. As long as she stays under forty, there is no set amount of food she has to eat. The other possible reading is the *epistemic* reading: there is an upper bound to how many grams of food Nemo

[1] For ease of reference I will continue to use the term *numeral modifier* to refer to expressions like *at least* and *at most*, even though in my theory they would be called 'focus-sensitive operators that can associate with numerals'.

is allowed to eat. The speaker does not know exactly what this upper bound is, but she knows that is 40 or lower. This reading is more difficult to get than the authoritative reading.

The combination of *at least* with a universal modal in (2) is also a natural-sounding one, and again, the most prevalent reading is an authoritative reading.

(2) Nemo is required to eat at least forty grams of food.

This sentence means that in all possible worlds, Nemo eats forty grams of food or more. The pragmatic inference is that there is no specific number of grams of food that Nemo is required to eat. It has to be forty or higher, but within that range Nemo has options. There is also an, again less obvious, epistemic reading: there is a certain minimum amount of food Nemo has to eat. The speaker is ignorant about this exact minimum, but he knows that it is 40 or higher.

At most and *required* seem a bit less happy together than either one would have been with the other possible partner. Nevertheless, (3) is still relatively natural and also has an authoritative reading.

(3) Nemo is required to eat at most forty grams of food.

The reading is that Nemo is not allowed to eat more than forty grams of food with the inference that multiple number of grams of food under forty are options. The epistemic reading is starting to become a bit more prominent: there is a minimum amount of food Nemo has to eat, and this minimum is in the [0-40] range.

As shown in (4), *allowed* and *at least* are deeply unhappy with one another.

(4) Nemo is allowed to eat at least forty grams of food.

The sentence sounds rather unnatural and there does not seem to be an authoritative reading. The epistemic reading is the only possible reading: there is an upper limit to how much Nemo is allowed to eat, and the speaker only knows that this upper limit is forty or higher.

Thus, the facts to be accounted for are that the first two combinations are more natural than the last two, with (3) being more natural than (4). Naturalness correlates with the ability to yield authoritative readings. A final fact that needs to be incorporated in the account is that *at least* and *at most* have to take scope over existential modals. This can be seen by considering the contrasts in (5) and (6).

(5) a. Marin is allowed to read at most five books (#and more is fine too).
b. Marin is allowed to read fewer than than six books (and more is fine too).

(6) a. Marin is allowed to read at least five books.
b. Marin is allowed to read more than four books.

As explained in detail in chapter 4 (section 4) and summarised in chapter 5 (section 2.2), the a-sentences with class B numeral modifiers only have readings where the numeral modifier outscopes the modal: (5-a) cannot merely mean that Marin has permission to read between zero and five books but must have the stronger meaning that she cannot read more than five books, and (6-a) has to have the meaning component that there is an upper bound to the number of books Marin is allowed to read. The b-sentences with class A modifiers do have surface scope readings: the reading that only gives permission to read between zero and five books and the reading without an upper bound meaning component respectively.

Thus, we must account for the readings in (1)-(4) without using the scope configuration where an existential modal takes scope over a numeral modifier. I will use inquisitive semantics to take on this challenge. Inquisitive semantics provides a way to enrich the meaning of propositions from simple sets of worlds to sets of sets of worlds. As I will show, making this enrichment optional in certain cases with modals gives rise to a theory where both authoritative and epistemic readings can be derived without relying on scope. In the next section I will briefly introduce the framework of inquisitive semantics that I will use in my analysis.

6.3 Inquisitive semantics and epistemic inferences

As I explained in chapter 4, certain authors (Schwarz, 2013; Kennedy, 2015) use the so-called 'standard recipe' (Sauerland, 2004b; Geurts, 2010) to calculate epistemic inferences: primary quantity implicatures are calculated and when these cannot be strengthened to secondary quantity implicatures, an epistemic reading arises. We have seen that this leads to a number of problems: accounts of this type both undergenerate and overgenerate and force us to rely on non-existent scope configurations. Another way to calculate epistemic inferences is to use inquisitive semantics and quality implicatures. Later in this chapter I will propose a particular implementation of this mechanism that circumvents the issues faced by the standard recipe approach. Here I will show how this mechanism works.

In inquisitive semantics, propositions are sets of possibilities. A possibility is what is usually called a proposition: an expression of type p $(=\langle s,t\rangle)$. When a proposition contains more than one possibility, it is called an *inquisitive* proposition. By using an inquisitive proposition, a speaker is said to raise an issue. An issue is a request for the hearer to resolve the issue: to pick out the possibility in the proposition that is true. For example, the disjunction in (7) raises two possibilities: the possibility that Anne speaks French and the possibility that she speaks German.

(7) Anne speaks French or German.

This is represented in (8), where p_f stands for the set of worlds where she speaks only French and p_g stands for the set of worlds where she speaks only German.

(8) $\{p_f, p_g\}$

Inquisitive semantics has been used in the literature on modified numerals to calculate epistemic inferences (Coppock & Brochhagen, 2013; Blok, 2015b, 2016; Ciardelli, Coppock, & Roelofsen, 2016; Blok, 2017; Cremers, Coppock, Dotlacil, & Roelofsen, 2017). In this literature, the epistemic inferences class B numeral modifiers give rise to are said to be quality implicatures. I will follow Ciardelli et al. (2016)'s way of calculating these implicatures, which is slightly different from the way it is done in the other literature I have cited.[2] The idea is that the Gricean Maxim of Quality (Grice, 1975) consists of two parts, given below.

(9) The Maxim of Quantity in Inquisitive Semantics (Ciardelli et al., 2016)
  a. $s \subseteq \text{info}(\phi)$
  b. if ϕ is inquisitive, then $s \notin [\![\phi]\!]$

The Maxim of Quality is only satisfied if both conditions are met. info(ϕ) is the information contained in a proposition ϕ: the union of all its possibilities. s is the speaker's information state: a set of worlds. (9-a) says that the speaker's information state must be a subset of the informative content of the proposition she utters. This is the original Quality Maxim: say only what you believe to be true. The second part only comes into play when an inquisitive proposition is used. In this case, the speaker's information state cannot be an element of the proposition she utters. That is, none of the possibilities in the proposition can be the speaker's information state. For instance, say that the speaker knows that Anne speaks French: the possibility p_f is her information state. Then if she utters (7), she violates the Maxim of Quality, because she raises a proposition that contains a possibility that is her information state. In less technical terms, she suggests multiple options, inviting the hearer to select the true option, even though she herself knows which option is true.[3]

As discussed in chapter 4, when class B modified numerals are used without a modal, they give rise to epistemic inferences. To derive these inferences, Ciardelli et al. (2016) propose that class B numeral modifiers such at *at least* and *at most* give rise to inquisitive propositions containing two possibilities. For instance, (10) contains the two possibilities illustrated in (11): the possibility that Anne speaks exactly two languages, represented by p_2, and the possibility

[2]Specifically, Ciardelli et al. (2016)'s theory is formulated in the framework Inq_B, which is the downward closed version of inquisitive semantics: whenever a possibility occurs in a proposition, all of its subsets are also in the proposition. The other papers cited here are formulated in $\text{Inq}_\cup$, which is not downward closed and therefore allows nested possibilities: one possibility can be contained in another possibility in the same proposition in a non-trivial way.

[3]Of course this is a simplified model: any speaker's information state will contain more information than just the information that Anne speaks French.

that she speaks three or more languages, represented by $p_{[3-\infty)}$.

(10) Anne speaks at least two languages.

(11) $\{p_2, p_{[3-\infty)}\}$

Assuming that the speaker is being cooperative and following the Quality Maxim, we can conclude from the fact that she used an inquisitive proposition that she does not know which of the possibilities in the proposition are true. Thus, she does not know if Anne speaks at least two languages and she does not know if Anne speaks three or more languages. This is how the epistemic implicature comes about. In the next section I will use this method in my account of the class B numeral modifiers *at least* and *at most*.

6.4 Analysis

6.4.1 The basics

I propose the inquisitive lexical entries for *at least* and *at most* given below, with $\textsc{max}_{AL}$ as defined in (14).[4]

(12) $[\![\text{at least}]\!]^{S,AL} = \{\lambda p.\textsc{max}_{AL}\ p\ ,\ \lambda p. \cup \{\textsc{max}_{AL}\ p' \mid p'\ >_S p\}\}$

(13) $[\![\text{at most}]\!]^{S,AL} = \{\lambda p.\textsc{max}_{AL}\ p\ ,\ \lambda p. \cup \{\textsc{max}_{AL}\ p' \mid p'\ <_S p\}\}$

(14) $\textsc{max}_{AL} = \lambda p.\{w | w \in p \wedge \neg\exists p'[p' >_{AL} p \wedge w \in p']\}$

A quick look at these lexical entries reveals that they are disjunctive, taking the union of two possibilities. In fact, they can be regarded as disjunctive versions of the lexical entries of *at least* and *at most* that we saw in chapter 5. It is this disjunctive nature that will give us the epistemic readings that we need.

To understand these lexical entries, we must first understand what $\textsc{max}_{AL}$ does. $\textsc{max}_{AL}$ takes a possibility and returns a subset of this possibility. None of the worlds in this subset are in a possibility p' that is ranked higher than p. This ranking is dependent on an ordered set of alternatives AL. As in the previous chapter, we assume a ranked Question under Discussion S, where the way the possibilities are ranked in S can be either an entailment ordering or a pragmatic ordering. (I will only use examples with numerals in this chapter, so the reader who only reads this chapter can simply assume that $\geq_S$ is an entailment ordering.) AL is equivalent to S but comes about in a different way. I will have more to say about this distinction in the next section. For now, I will simply say $AL = S$. Note that this $\textsc{max}_{AL}$ is different from the $\textsc{max}$ used in the previous chapter, but I only use the $\textsc{max}_{AL}$ defined in (14) in this chapter and only the $\textsc{max}$ defined in chapter 5 in chapter 5, so no confusion should arise.

[4]When not specified, all denotations represent the ordinary semantic value rather than the set of alternatives. I will only use the superscripts O and A when the distinction is relevant.

At least takes a possibility or set of worlds as an argument. It returns a proposition containing two possibilities. The first is the possibility that results from applying MAX_{AL} to the possibility it takes as an argument: $\text{MAX}_{AL}\ p$. The second is the union of the set of possibilities $\text{MAX}_{AL}\ p'$ for all possibilities p' that are ranked higher on S than p. *At most* also returns $\text{MAX}_{AL}\ p$ and it returns the set of possibilities $\text{MAX}_{AL}\ p'$ for all possibilities p' that are ranked lower on S than p.

Let us consider the example in (15) to make this more concrete. The prejacent of *at least* is the singleton proposition in (16).

(15) Abdullah ate at least two sandwiches.

(16) $[\![\text{Abdullah ate two sandwiches}]\!]^O = p_2 = \{\exists x[\#x = 2 \wedge \text{sandwiches}(x) \wedge \text{ate}(\text{Abdullah}, x)]\}$

If the relevant scale is provided by the numeral, then the set S is ordered as in (17), where p_n stands for $[\![\text{Abdullah ate } n \text{ sandwiches}]\!]^O$. The set AL used by MAX_{AL} is equivalent to S. I assume a one-sided meaning of bare numerals. This means that p_n contains the world $w_{[n]}$ and also the worlds $w_{[n]+[1]}$, $w_{[n]+[2]}$, etc., where $[n]$ means 'exactly n'.

(17) $S = AL = p_0 < p_1 < p_2 < p_3 < p_4$ ...

At least takes this possibility as an argument through pointwise functional application (or Hamblin functional application, Hamblin, 1973) and returns (18).

(18) $\{p_2 \wedge \neg p_3, p_3\}$

(18) contains two possibilities. The first possibility, $p_2 \wedge \neg p_3$, is the result of applying MAX_{AL} to the prejacent p_2. MAX_{AL} takes the possibility p_2 and takes out all the worlds that are in some alternative ordered higher than p_2. Thus, it takes out all the worlds that are in p_3. Assuming a discrete scale, these are the worlds $w_{[2]}$, $w_{[3]}$, $w_{[4]}$... ∞. Thus, it takes out all the worlds in p_3. It also takes out all the worlds that are in p_4 but not in p_2, but this is vacuous, as these worlds are also present in p_3. Thus, the result is $p_2 \wedge \neg p_3$.

The second possibility is the result of applying MAX_{AL} to all possibilities p' in S that are ordered higher than p. This process is shown in (19).

(19) $\text{MAX}_{AL}\ p_3 = p_3 \wedge \neg p_4$,
$\text{MAX}_{AL}\ p_4 = p_4 \wedge \neg p_5$,
$\text{MAX}_{AL}\ p_5 = p_5 \wedge \neg p_6$,
etc.

In this process, two scales are used: the possibilities p_3, p_4, p_5... that are ranked higher than p_2 are obtained from the scale S, as $>_S$ in the denotation of *at least* uses this scale. Upon receiving these possibilities, the maximality operator uses the scale AL (equivalent to S) to return $p_3 \wedge \neg p_4$, $p_4 \wedge \neg p_5$, etc. As I have mentioned, it will become clear later why it is necessary to have two scales and what the nature of AL is.

As the denotation of *at least* shows, after the application of $\textsc{max}_{AL}$ we take the union of the set of all the possibilities in (19). This union is simply p_3. Therefore, p_3 is the second possibility in (18).

Thus, the sentence in (15) conveys two possibilities: the possibility that Abdullah ate exactly two sandwiches and the possibility that he ate three or more sandwiches. The Inquisitive Maxim of Quality says that one should not utter an inquisitive proposition unless all the possibilities in the proposition are live possibilities in your information state s. Thus, neither the possibility $p_2 \wedge \neg p_3$ nor the possibility p_3 are in the information state of the speaker of (15). Therefore, the speaker is ignorant about which of the possibilities are true. This is how the epistemic inference is derived.

The derivation of a sentence with *at most*, like (20), is very similar. The prejacent of *at most*, like the prejacent of the *at least* sentence, is p_2, spelled out in (16).

(20) Abdullah ate at most two sandwiches.

Applying *at most* to the prejacent derives the proposition in (21).

(21) $\{p_2 \wedge \neg p_3, \{w_{[0]}, w_{[1]}\}\}$

First we get $p_2 \wedge \neg p_3$ from $\textsc{max}_{AL}\ p_2$, as above. Then we apply $\textsc{max}_{AL}$ to all propositions that are ordered lower than p_2 on S, as in (22).

(22) $\textsc{max}_{AL}\ p_0 = p_0 \wedge \neg p_1,$
$\textsc{max}_{AL}\ p_1 = p_1 \wedge \neg p_2$

The union of these two possibilities is $\{w_{[0]}, w_{[1]}\}$.[5] (20) then conveys that either Abdullah ate exactly two sandwiches or he ate fewer than two. As the proposition is inquisitive, an epistemic implicature is derived through the Maxim of Quality.

I have assumed here that *at least* and *at most* take possibilities as arguments. In reality, I believe that their type is flexible. One way to implement this is to follow Coppock and Brochhagen (2013) and assume flexible lexical entries, as in (23)-(24), where α stands for any type ending in p and β is whatever type α takes as an argument.

(23) $[\![\text{at least}]\!]^{S,AL} = \{\lambda\alpha\lambda\beta.\textsc{max}_{AL}\ (\alpha(\beta))\ ,\ \lambda\alpha\lambda\beta.\cup\{\textsc{max}_{AL}\ p' \mid p' >_S \alpha(\beta)\}\}$

(24) $[\![\text{at most}]\!]^{S,AL} = \{\lambda\alpha\lambda\beta.\textsc{max}_{AL}\ (\alpha(\beta))\ ,\ \lambda\alpha\lambda\beta.\cup\{\textsc{max}_{AL}\ p' \mid p' <_S \alpha(\beta)\}\}$

This way, *at least* and *at most* can be interpreted *in situ*. For instance, in (25) *at least* takes *five beers* as an argument, which is turned into a regular quantifier

[5] This is equivalent to $\neg p_2$.

over individuals through Hackl's (2000) *many* quantifier, as in earlier chapters. The definition of *five* many *beers* is given in (26).

(25) Indira drank at least five beers.

(26) $[\![\text{five } \textit{many} \text{ beers}]\!] = \{\ \lambda P_{\langle e,p\rangle}.\exists x_e[\#x = 5 \wedge \text{beers}(x) \wedge P(x)]\ \}$

The relevant denotation of *at least* is the one in (27). Applying *at least* to *five beers* yields (28), which can then be combined with *drank* using QR or type shifting.[6]

(27) $[\![\text{at least}]\!]^{S,AL} = \{\lambda\mathcal{P}_{\langle\langle e,p\rangle,p\rangle}\lambda Q_{\langle e,p\rangle}.\text{MAX}_{AL}\ (\mathcal{P}(Q))\ , \lambda\mathcal{P}_{\langle\langle e,p\rangle,p\rangle}\lambda Q_{\langle e,p\rangle}.\cup \{\text{MAX}_{AL}\ p' \mid p'\ >_S \mathcal{P}(Q)\}\}$

(28) $[\![\text{at least five } \textit{many} \text{ beers}]\!] = \{\lambda Q_{\langle e,p\rangle}.\text{MAX}_{AL}\ (\exists x_e[\#x = 5 \wedge \text{beers}(x) \wedge Q(x)]), \lambda Q_{\langle e,p\rangle}. \cup \{\text{MAX}_{AL}\ p' \mid p'\ >_S \exists x_e[\#x = 5 \wedge \text{beers}(x) \wedge Q(x)]\}\}$

Throughout the rest of this chapter I will continue to use the denotations in (12)-(13) because this makes for less complex derivations. Provided that the order of interpretation stays the same when there are different operators in the sentence, it makes no difference for the end result. Recall that my aim is not to devise an analysis that excludes certain scope configurations but rather to account for the readings we observe without relying on any non-existent scope configurations. Therefore, the fact that surface scope readings with existential modals can in principle be generated is not an issue I am concerned with here.

So far the readings I have derived are the same as those in Ciardelli et al. (2016), although the compositional implementation of the idea is my own. In the next section I will show how variation and epistemic readings with class B modifiers and modals can be derived using the lexical entries I proposed above in combination with an additional mechanism of optional flattening that has not been used in the literature.

6.4.2 Deriving epistemic and variation readings

The mechanism

My account rests on two assumptions. The first is that sentences with modals and class B modified numerals such as (29) have the structure in (30), where the numeral modifier c-commands *two* many *cats* and has the ability to move up by itself.

(29) Malika is { allowed / required } to adopt { at least / at most } two cats.

(30) [{ at least / at most } [{□/◇} [Malika adopts [[~~{ at least / at most }~~ [[two *many*] cats]]]]]]

[6]See chapter 7 for arguments why this type clash should be resolved using type shifts rather than QR.

I motivated this structure in chapter 2 and in the previous chapter. I will take the structure where the numeral modifier takes wide scope to be the basic structure from which I derive most readings. In the case of existential modals, this structure coincides with the only possible scope configuration. The case with universal modals is slightly different. I will return to this point in section 6.4.4.

The second assumption I make has to do with the role of the modal. Coppock and Brochhagen (2013), inspired by Kratzer and Shimoyama (2002), assume that a modal flattens the set of possibilities in its scope. That is, when the prejacent of a modal contains multiple possibilities, the modal returns the union of these possibilities. For them, this mechanism is linked to scope. They assume that all possible scope configurations between modified numerals and modals are possible, and the modal can flatten only when it takes wide scope.

To see how this mechanism works, consider a sentence where a universal modal occurs with *at least*. When *at least* takes wide scope, the denotation Coppock and Brochhagen derive is as in (31).[7]

(31) $\textit{at least 2} > \Box \rightarrow \{\Box p_2,\ \Box p_3,\ \Box p_4,\ ...\ \}$

This denotation is inquisitive, and therefore an epistemic inference is derived: the speaker is unsure about whether two is required, whether three is required, etc.

When the modal takes wide scope, however, it flattens the possibilities created by *at least*, returning a single possibility, as in (32). This denotation is no longer inquisitive, and as a result, no epistemic inference is derived.

(32) $\Box > \textit{at least 2} \rightarrow \{\Box \cup \{p_2, p_3, p_4,\ ...\ \}\} = \{\Box p_2\}$

The way I use the flattening mechanism is different. As I mentioned in the previous chapter, *at least* and *at most* are focus-sensitive. They therefore interact with both the ordinary semantic value of their prejacent $[\![\alpha]\!]^O$ and the alternative semantic value of their prejacent $[\![\alpha]\!]^A$. My proposal is that a modal flattens everything it sees: it turns both $[\![\alpha]\!]^O$ and $[\![\alpha]\!]^A$ into singleton sets. Furthermore, I propose that this flattening mechanism is optional. This optionality is the key to deriving both the variation and the epistemic reading with only one scope configuration, which is necessary given that only one scope configuration is available with existential modals.[8]

When the modal takes scope under the modified numeral, as it usually does, its prejacent will not be inquisitive, because it is the numeral modifier that makes the proposition inquisitive. Therefore, flattening $[\![\alpha]\!]^O$ is vacuous in

[7] Coppock and Brochhagen's semantics of *at least* and *at most* is very different from mine. I use their analysis here purely to illustrate how flattening works.

[8] Although I say here that it is the modal that optionally does the flattening, I believe that this cannot be true. The reason is that we would need two lexical entries for each modal in order for it to work: one that flattens and one that does not. A better way to think about it is that there is a flattening operator that is optionally present in the structure. When it is present, it needs to be licensed by a modal.

this case. Flattening $[\![\alpha]\!]^A$, on the other hand, will have an effect: it modifies the alternatives the modified numeral can use when it is merged. As we will see in the next section, there are some cases where universal modals take scope over modified numerals. In these cases, flattening $[\![\alpha]\!]^O$ will have an effect: the numeral modifier will have made the prejacent of the modal inquisitive, and flattening undoes this action. In this case, flattening $[\![\alpha]\!]^A$ will be vacuous. When the modal is merged, the numeral modifier has already used the alternatives in its computation, and therefore it no longer matters what the set of alternatives looks like. This is summarised in (33).

(33) **Proposal**
Modals optionally flatten both $[\![\alpha]\!]^O$ and $[\![\alpha]\!]^A$

a. When a modal takes scope under the modified numeral, flattening $[\![\alpha]\!]^O$ is vacuous (because its prejacent will already be flat) but flattening $[\![\alpha]\!]^A$ has an effect
b. When a universal modal takes scope over the modified numeral, flattening $[\![\alpha]\!]^A$ is vacuous (because the numeral modifier has already used the alternatives at this point) but flattening $[\![\alpha]\!]^O$ has an effect

I realise that this discussion is rather dry and perhaps difficult to follow without any examples. I hope the reader will permit me to make two more remarks on the technical mechanism before moving on to the examples. First, as in the previous chapter, I use Beaver & Clark's (2008) theory of focus. Beaver and Clark assume that an alternative semantic value $[\![\alpha]\!]^A$ is calculated à la Rooth (1985, 1992) but that a focus-sensitive operator does not interact directly with this set of alternatives. Instead, it interacts with it through the Current Question under discussion CQ. Although the reality is slightly more complex then this, for our purposes here it suffices to say that the CQ must be a subset of $[\![\alpha]\!]^A$. The ordered set of alternatives S that we have already come across in this chapter is an ordered version of the CQ.

Second, the set S is thus derived from the set of Rooth-Hamblin alternatives. It is this set that *at least* and *at most* use to set a lower bound and an upper bound respectively. MAX_{AL}, on the other hand, uses another ordered set of alternatives AL. This set is not generated via the Rooth-Hamblin alternatives but is a separate set. As the Rooth-Hamblin alternatives can be flattened by modals, so can the CQ and S, which are derived from the Rooth-Hamblin alternatives. AL, on the other hand, exists as a separate entity that is unaffected by such flattening operations. The intuition behind this idea is that although a set consisting of multiple possibilities is sometimes flattened into a single set, this does not mean that there are no alternatives left to the proposition that is being uttered. Regardless of what happens during a particular computation, there can always be alternatives to any proposition. For instance, when we use Kratzer and Shimoyama's (2002) operation of Existential Closure, which puts all the disjuncts of a disjunction into one possibility (i.e. it flattens the disjuncts), we do not want to say that the disjuncts no longer give rise to two (or more) alternative possibilities in the minds of the speakers.

Similarly, if we flatten the possibilities in a sentence with the German free choice indefinite *irgendein* in (34), also from Kratzer and Shimoyama (2002), the modal may flatten the alternatives (of the form *Marry marries doctor x, Mary marries doctor y, ...*) but we still need alternatives to (34), for instance to calculate the run-of-the-mill quantity implicature *Mary does not have to marry all doctors*. Under the present assumptions, S could be flattened by the modal while AL would remain intact for the computation of quantity implicatures.

(34) Mary muss irgendeinen Arzt heiraten.
Mary must IRGENDEIN doctor marry.
'Mary has to marry a doctor, any doctor is a permitted option.'

Finally, if we have a sentence like (35) and the modal flattens the alternatives, which, as we will see, are of the form *Robin and Cormoran solved* n *crimes*), this does not mean that potential alternative numbers of crimes are suddenly not relevant any more for the speaker.

(35) Robin and Cormoran were required to solve at least three crimes.

Using a sentence with a numeral always involves reasoning about numbers and possible alternative numbers and a scale is needed for this. To this end, the scale AL is independent of the set $[\![\alpha]\!]^A$ and is therefore immune to any operations in the computation that might affect the alternatives. This distinguishes it from S, which has no such immunity. Below it will become clear why MAX_{AL} uses AL rather than S.

Natural combinations

Now that we are equipped with all this technical paraphernalia, I think we are ready to jump in the deep, which is where all the fun happens. We will first go through the two combinations that are intuitively the most felicitous ones: *at least* with a universal modal and *at most* with an existential modal. We begin with *at least*, as Malika's cat saga continues in (36).

(36) Malika is required to adopt at least two cats.

Let us first see what reading we derive when the modal does not do any flattening. As mentioned before, I assume wide scope readings for the numeral modifier throughout this section. The prejacent of *at least* is then as in (37).

(37) $[\![\text{Malika is required to adopt two cats}]\!]^O = \{\Box p_2\}$

The relevant alternatives are is given in (38).

(38) $[\![\text{Malika is required to adopt two cats}]\!]^A = \{\Box p_0, \Box p_1, \Box p_2, \Box p_3, ...\}$

As explained in chapter 5, for my purposes it suffices that the CQ be a subset of the set of Rooth-Hamblin alternatives. In this case and all other cases in this chapter (and this dissertation), the CQ is equivalent to the set of alternatives $[\![\alpha]\!]^A$.

(39) $CQ = [\![\text{Malika is required to adopt two cats}]\!]^A = \{\Box p_0, \Box p_1, \Box p_2, \Box p_3, ...\}$

The alternatives are ordered as in (40), which is an entailment ordering: if you adopt two or more cats in every world, you also adopt one or more cats in every world. As before, AL is equivalent to S.

(40) $S = AL = \Box p_0 < \Box p_1 < \Box p_2 < \Box p_3 < \Box p_4$ ...

Applying *at least* to (37) yields (41).

(41) $\{\Box p_2 \wedge \neg\Box p_3,$
$\cup\, \{\Box p_3 \wedge \neg\Box p_4, \Box p_4 \wedge \neg\Box p_5, ...\}\}$

There are two possibilities in this proposition. The first possibility, $\Box p_2 \wedge \neg\Box p_3$, is obtained simply by applying $\textsc{max}_{AL}$ to $\Box p_2$. The set $\{\Box p_3 \wedge \neg\Box p_4, \Box p_4 \wedge \neg\Box p_5, ...\}$ is obtained by applying $\textsc{max}_{AL}$ to all higher alternatives, and this set of possibilities is turned into a set of worlds by applying the union operation. $\Box p_2 \wedge \neg\Box p_3$ says that Malika adopts two or more cats in every world, but she does not adopt three or more cats in every world. In other words: two cats is sufficient; three cats is not required. The other alternatives have the same meaning except with higher numbers. There are two possibilities, so the proposition is inquisitive. This means that epistemic inferences are derived: the speaker is not sure if Malika has to adopt two cats and for all numbers above two, the speaker is also not sure is Malika has to adopt that many cats. This corresponds to the epistemic reading of (41).

Note that $\cup\{\Box p_3 \wedge \neg\Box p_4, \Box p_4 \wedge \neg\Box p_5, ...\}$ is not equivalent to $\Box p_3$. This is because there must be some number n, somewhere down the line, for which, $\neg\Box p_n$ holds. This is incompatible with $\Box p_3$, which includes all numbers from three to infinity. The fact that there is some number n such that $\neg\Box p_n$ means that there is a limit to what is required; it is not the case that Malika has to adopt an infinite number of cats. There is some number n such that n is a sufficient number of cats for Malika to adopt.

Now let us see what happens when the modal flattens everything it sees. The prejacent of the modal is p_2; the proposition that Malika adopts two cats. The prejacent of the modal is given in (42).

(42) $[\![\text{Malika adopts two cats}]\!]^O = \{p_2\}$

This is not an inquisitive proposition, so $[\![\alpha]\!]^O$ is already a singleton set: there is nothing there for the modal to flatten. But assuming that the numeral is the focused element in the sentence, $[\![\alpha]\!]^A$ contains multiple possibilities, as shown in (43).

(43) $[\![\text{Malika adopts two cats}]\!]^A = \{p_0, p_1, p_2, ...\}$

The modal flattens this set, as in (44).

(44) $[\![\text{Malika adopts two cats}]\!]^A = \{\{w_{[0]}, w_{[1]}, w_{[2]}, ...\}\} = \{p_0\}$

Adding the lexical meaning of the modal yields the ordinary meaning in (45) and the alternatives in (46).

(45) $[\![\text{Malika is required to adopt two cats}]\!]^O = \{\Box p_2\}$

(46) $[\![\text{Malika is required to adopt two cats}]\!]^A = \{\Box p_0\}$

The CQ is a subset of $[\![\alpha]\!]^A$. Given that $[\![\alpha]\!]^A$ only contains one element, the CQ is now equivalent to it, as shown below.

(47) $\text{CQ} \subseteq [\![\alpha]\!]^A = \{\Box p_0\}$

The set AL, on the other hand, is independent from $[\![\alpha]\!]^A$ and therefore stays as it is. Thus, we have:

(48) $S = \Box p_0$

(49) $AL = \Box p_0 < \Box p_1 < \Box p_2 < \Box p_3 < \Box p_4$

Now we are ready to add *at least*. The meaning of (36) with a flattened set of alternatives is given in (50).

(50) $\{\Box p_2 \wedge \neg \Box p_3\}$

This meaning comes about as follows. First, we apply $\textsc{max}_{AL}$ to the prejacent $\Box p_2$. This yields $\Box p_2 \wedge \neg \Box p_3$. Then we take all higher alternatives in S and apply $\textsc{max}_{AL}$ to them. But the modal has thrown all higher alternatives of S in the bin. We only have $\Box p_0$ left, which is ranked lower than $\Box p_3$. Furthermore, even if we had higher alternatives, $\Box p_2$ is no longer in the set of alternatives, so the part $p' >_S p$ in the definition of *at least* is vacuous; there is no longer a p to compare p' to. Thus, we only derive the possibility $\Box p_2 \wedge \neg \Box p_3$. This is where we need a separate scale for $\textsc{max}_{AL}$. If $\textsc{max}_{AL}$ used S, it would be unable to apply to the prejacent because there is no prejacent left in S. The fact that $\textsc{max}_{AL}$ uses AL enables it to yield (50) even when S has been flattened to contain only $\Box p_0$.

The proposition in (50) is not inquisitive, so we do not derive epistemic implicatures. The meaning is that Malika is required to adopt two or more cats but she is not required to adopt three or more cats. This is the authoritative reading with a variation inference. She has to adopt at least two cats, and she is free to choose a number of cats to adopt in the [3-∞) range. In other words, it is not the case that there is some number higher than the number two such that she has to adopt that number of cats. So, when the modal does not do any flattering, we derive the epistemic reading. When the modal does flatten, we get the authoritative reading.

Now let us move on to the other natural combination: *at most* with *allowed*, exemplified in (51).

(51) Malika is allowed to adopt at most two cats.

S is now as in (52), which is again an entailment ordering.

(52) $S = AL = \Diamond p_0 < \Diamond p_1 < \Diamond p_2 < \Diamond p_3 < \Diamond p_4 ...$

Let us first assume that the modal does not do anything except add its regular meaning to the mix, as in (53).

(53) $[\![\text{Malika is allowed to adopt two cats}]\!]^O = \{\Diamond p_2\}$

Merging *at most* results in the meaning in (54).

(54) $\{\Diamond p_2 \wedge \neg\Diamond p_3,$
$\cup \{\Diamond p_0 \wedge \neg\Diamond p_1, \Diamond p_1 \wedge \neg\Diamond p_2\}\}$

$\textsc{max}_{AL}$ $\Diamond p_2$ yields the first possibility. The second possibility is the union of the possibilities $\textsc{max}_{AL}$ $\Diamond p_n$ for all numbers lower than 2: $\Diamond p_0$ and $\Diamond p_1$. The speaker conveys two possibilities: Malika is allowed to adopt two cats but no more or she is allowed to adopt fewer than two cats but no more. In other words: the upper bound is two or it is lower than two. The fact that the proposition is inquisitive means that an epistemic implicature can be calculated: the speaker does not know whether the upper bound is two or some number under two. This corresponds to the epistemic reading.

Now we will consider the other reading of the sentence, where the modal puts all possibilities in the alternatives into a single possibility. We start off with the sister of the modal, given in (55).

(55) $[\![\text{Malika adopts two cats}]\!]^O = \{p_2\}$

The alternatives the modal gets are the ones in (56), and flattening this set yields (57).

(56) $[\![\text{Malika adopts two cats}]\!]^A = \{p_0, p_1, p_2, ...\}$

(57) $[\![\text{Malika adopts two cats}]\!]^A = \cup\{p_0, p_1, p_2, ...\} = \{p_0\}$

Adding the modal gives us (58) and (59).

(58) $[\![\text{Malika is allowed to adopt two cats}]\!]^O = \{\Diamond p_2\}$

(59) $[\![\text{Malika is allowed to adopt two cats}]\!]^A = \{\Diamond p_0\}$

Given that S in an ordered version of the CQ and CQ $\in [\![\alpha]\!]^A$, we get (60). AL, being independent of $[\![\alpha]\!]^A$, remains unaffected by this change, as shown in (61).

(60) $S = \Diamond p_0$

(61) $AL = \Diamond p_0 < \Diamond p_1 < \Diamond p_2 < \Diamond p_3 < \Diamond p_4$

After adding *at most*, we get the final meaning in (62).

(62) $\{\Diamond p_2 \wedge \neg\Diamond p_3\}$

As in the *at least* case, this is simply MAX_{AL} applied to the prejacent. This is possible because while S has been flattened, AL is still as in (52). As for the other alternatives, there is one alternative that is lower than $\Diamond p_2$, namely $\Diamond p_0$, the only alternative we have left. But according to the definition of *at most*, we have to find all $p' <_S p$. p is the prejacent $\Diamond p_2$, but $\Diamond p_2$ has been taken out of CQ and is therefore no longer ordered by S. As a result, we still cannot pick out any alternative, and are left with just the first possibility.

(62) says that Malika is allowed to adopt two cats but she is not allowed to adopt three cats. Thus, it places an upper bound of two on the number of cats Malika is allowed to adopt. There is no epistemic implicature because there is only one possibility. This is the authoritative reading we wanted to derive.

In sum, we derive both an authoritative reading and an epistemic reading for the two natural combinations, as desired.

Less natural combinations

I will discuss the less natural readings in a slightly different order, mostly because it makes more sense that way but also just to shake things up. First I will show how an epistemic reading can be derived for both combinations, and then I will turn to the variation readings.

(63) is the least natural combination, and it only has an epistemic reading.

(63) Malika is allowed to adopt at least two cats.

The ordered alternatives are as in (52) and the denotation is given in (64).

(52) $S = AL = \Diamond p_0 < \Diamond p_1 < \Diamond p_2 < \Diamond p_3 < \Diamond p_4 \ ...$

(64) $\{\Diamond p_2 \wedge \neg\Diamond p_3,$
$\cup \{\Diamond p_3 \wedge \neg\Diamond p_4, \Diamond p_4 \wedge \neg\Diamond p_5, ...\}\}$

As before, the first possibility is simply $\text{MAX}_{AL}\ \Diamond p_2$. The second possibility is the result of applying MAX_{AL} to the higher alternatives and taking the union of the resulting set of possibilities. The first possibility says that Malika is allowed to adopt two but not three cats. The second says that she is allowed to adopt three cats but there is some number for which she is not allowed to adopt that many cats. The second possibility is equivalent to (65).

(65) $\Diamond p_3 \wedge \exists p'[p' >_S p_3 \wedge \neg\Diamond p']$

Together, these possibilities say that either Malika is allowed to adopt two cats but no more, or she is allowed to adopt some other number of cats above two, but there is an upper bound to how many cats she is allowed to adopt. The proposition is inquisitive so the reading is epistemic. Recall from chapter 4 that sentences with *at least* and an existential modal only have the stronger epistemic reading that conveys ignorance about where the upper bound to what is allowed is and not the weaker epistemic reading that merely conveys ignorance about which numbers are allowed. The reading I have derived here is thus precisely the kind of epistemic reading we want: it is not merely an ignorance reading but more specifically ignorance about where the upper bound is.

We now turn to our final combination in (66), with the ordered alternatives in (40).

(66) Malika is required to adopt at most two cats.

(40) $S = AL = \Box p_0 < \Box p_1 < \Box p_2 < \Box p_3 < \Box p_4$ ...

The reading we derive is shown in (67). The possibilities are derived as usual: by first applying MAX_{AL} to the prejacent of *at most* and then to the alternatives that are ordered lower, after which we take the union of the lower alternatives.

(67) $\{\Box p_2 \wedge \neg \Box p_3,$
$\cup \{\Box p_0 \wedge \neg \Box p_1, \Box p_1 \wedge \neg \Box p_2\}\}$

The first possibility is that Malika has to adopt two cats but she need not adopt more than two cats. The second possibility is that there is some number below the number 2 such that she has to adopt that many cats (this number can also be zero). This possibility is equivalent to (68) (which is equivalent to its second conjunct, given that $\Box p_0$ is a tautology). There are two possibilities, so the reading is an epistemic one. The speaker conveys that either Malika has to adopt at least two cats or she has to adopt some minimum number of cats below two. There is ignorance about the lower bound. This is the epistemic reading we wanted to derive.

(68) $\Box p_0 \wedge \neg \exists p'[p' <_S p_2 \wedge \Box p']$

Now let us try to derive variation readings for (63) and (66), starting with (63). Flattening gives us a CQ that only contains $\Diamond p_0$, as before. And like before, using AL we only derive $\text{MAX}_{AL}\ \Diamond p_2$, because there are no alternatives p' left in S such that $p' >_S \Diamond p_2$. We derive (69).

(69) $\{\Diamond p_2 \wedge \neg \Diamond p_3\}$

This is clearly not a possible reading of (63); it says that Malika is allowed to adopt *at most* two cats. In fact, it is equivalent to the authoritative reading of (51), in (62). Before I say more about this, let us have a look at the flattened reading of (66).

When the alternatives are flattened, we are left with a CQ containing only $\Box p_0$ again. Given that the prejacent $\Box p_2$ is no longer in the set of alternatives, the part $p' <_S p$ of the denotation of *at most* cannot pick out any possibilities. We only derive $\text{MAX}_{AL}\ \Box p_2$, which is equivalent to (70).

(70) $\{\Box p_2 \wedge \neg\Box p_3\}$

This is not an attested reading of (66). It is a reading that sets a lower bound: Malika must adopt at least two cats but she need not adopt more. This reading is equivalent to the variation reading of (36) in (50).

So, (69) is equivalent to (62) and (70) is equivalent to (50). This can also be seen in the table below, where the readings with a # refer to derived but unattested readings. In the two 'authoritative' rows, *at least* and *at most* yield the same denotation.

		at least	***at most***
$\Diamond$	aut.	(69) $\#\{\Diamond p_2 \wedge \neg\Diamond p_3\}$	(62) $\{\Diamond p_2 \wedge \neg\Diamond p_3\}$
	ep.	(64) $\{\Diamond p_2 \wedge \neg\Diamond p_3,$ $\cup\{\Diamond p_3 \wedge \neg\Diamond p_4, \Diamond p_3 \wedge \neg\Diamond p_4, ...\}\}$	(54) $\{\Diamond p_2 \wedge \neg\Diamond p_3,$ $\cup\{\Diamond p_0 \wedge \neg\Diamond p_1, \Diamond p_1 \wedge \neg\Diamond p_2\}\}$
$\Box$	aut.	(50) $\{\Box p_2 \wedge \neg\Box p_3\}$	(70) $\#\{\Box p_2 \wedge \neg\Box p_3\}$
	ep.	(41) $\{\Box p_2 \wedge \neg\Box p_3,$ $\cup\{\Box p_3 \wedge \neg\Box p_4, \Box p_4 \wedge \neg\Box p_5, ...\}\}$	(67) $\{\Box p_2 \wedge \neg\Box p_3,$ $\cup\{\Box p_0 \wedge \neg\Box p_1, \Box p_1 \wedge \neg\Box p_2\}\}$

Table 6.1: Summary of denotations

In table 6.2 I have summarised the types of readings this analysis derives for each combination, again with # signifying unattested readings.

		at least	***at most***
$\Diamond$	authoritative epistemic	#UB LB, UB ignorance	UB UB, UB ignorance
$\Box$	authoritative epistemic	LB LB, LB ignorance	#LB UB, LB ignorance

Table 6.2: Summary of readings

As this table shows, the epistemic readings have two kinds of bounds: the bound set by the lexical item (a lower bound for *at least* and an upper bound for *at most*) and the bound that the epistemic inference is about, set by the modal (a lower bound for a universal modal and an upper bound for an existential modal). Below I will go through each combination.

For the natural combination $\Box$ + *at least*, the account derives an authoritative reading that sets a lower bound. It also derives an epistemic reading that sets a lower bound, and the ignorance on the part of the speaker is also about where lower bound is. That is, for (36), repeated below, the epistemic reading is that there is some lower bound of cats Malika needs to adopt, and the speaker does now know whether this lower bound is two or higher.

(36) Malika is required to adopt at least two cats.

Similarly, for our other natural combination $\Diamond$ + *at most*, the authoritative reading sets an upper bound, and the epistemic reading conveys ignorance about the upper bound. For (51), there is some upper limit to the number of cats Malika can adopt, and this upper limit is two or lower.

(51) Malika is allowed to adopt at most two cats.

For these two natural combinations, then, the bound set by the modal corresponds to the bound set by the numeral modifier.

For (63), which exemplifies the less natural $\Diamond$ + *at least* combination, the epistemic reading is that there is some upper bound to the number of cats Malika is allowed to adopt, and this upper bound is at least two. Thus, the ignorance is about where the upper bound is, but the sentence still conveys a lower bound: the upper bound is two or *higher* than two.

(63) Malika is allowed to adopt at least two cats.

The other less natural combination (66) works the same way, except that the bounds are now flipped. In the epistemic reading, the ignorance is about the lower bound to what is required, but there is an upper bound to this lower bound: the lower bound is *no higher* than two.

(66) Malika is required to adopt at most two cats.

As mentioned above, the modal determines the kind of bound the speaker is ignorant about, with $\Diamond$ yielding a lower bound and $\Box$ yielding an upper bound. The numeral modifier determines the bound of the variation reading and the 'bound of the bound' of the ignorance reading. For instance, using a universal modal as in (66) means that the ignorance is about the lower bound, but adding *at most* to the mix sets an upper bound to where this lower bound can be.

In all the cases I have discussed so far, the bound set by the numeral modifier is maintained. So, even though the 'ignorance bound' contributed by the modal may not be the same as the bound set by the numeral modifier, the numeral modifier still contributes a limit to this 'ignorance bound'. In all of these cases, *at least* contributes a lower bound and *at most* contributes an upper bound.

Now let us consider the non-attested variation readings we have derived for the $\Diamond$ + *at least* combination and the $\Box$ + *at most* combination. Here we see that the bound of the modal has prevailed, and there is nothing left of the bound of the modified numeral. The *at least* example sets an upper bound and the *at most* example sets a lower bound. I propose that this is why these readings are not attested. The primary meaning contribution of *at least* and *at most* is to set a bound, and in (69) and (70) this bound has completely disappeared.

One way to explain this by saying that there is a principle in language that states that when a lexical item contributes a meaning, this meaning must be maintained throughout the rest of the derivation. This is reminiscent of Buccola and Spector's (2016:165) 'Pragmatic economy constraint' on numerals. This constraint says that a sentence with a numeral n is infelicitous if replacing this numeral by a different numeral m would result in the same meaning. Minimally rephrasing their constraint for our current purposes as in (71) would not work, however:

(71) **Pragmatic economy constraint** (non-final)
An LF ϕ containing a numeral modifier M is infelicitous if, for some N distinct from M, ϕ is truth-conditionally equivalent to $\phi[M \mapsto N]$

The reason this does not work is because it would rule out both denotations on the second and the fourth row of table 6.1 instead of only the denotations carrying a #. In other words, if the constraint in (71) held, we would expect *all* authoritative readings ((69), (62), (50), (70)) to be bad. This indicates that we must be more specific about which numeral modifier survives and which is ruled out. This is done by (72).

(72) **Pragmatic economy constraint**
For lower-bounded and upper-bounded numeral modifiers M, an LF ϕ containing M is only felicitous if ϕ sets the same bound as M.

This constraint correctly rules out (69) and (70) but not (62) and (50). (72) can be viewed as an economy principle: it is not efficient to use an expression with a certain meaning (in particular: a lower bound or upper bound) only to subsequently remove this meaning in the computation.

Another way to think about the reason why (69) and (70) are not attested is to invoke a blocking mechanism. Nouwen (2010) also uses such a mechanism to block certain readings with class B modifiers. His way of implementing the notion of blocking is that whenever a marked form and an unmarked form convey the same meaning, the unmarked form is given precedence, and the marked form is blocked from having this meaning. For him, the competition is between class B modifiers and bare numerals, with the bare numeral denotations being less marked. In this case, we also have two cases where the meanings are identical: (69) is identical to (62) and (70) is identical to (50). But (62) and (50) get their meaning in a less convoluted way. In these cases, the bound set by the numeral modifier corresponds to the bound set by the modal. In the case of (69) and (70), the derivation involves a reversal of the bound. This is not quite the same as the notion of marked versus unmarked meanings. Instead, the difference is that in one case, the derivation involves the rather complex and counterintuitive step of turning a lower bound into an upper bound or vice versa, while the other derivation does not. The simpler derivation is preferred. This could be a constraint on language proper in the sense that it is not only forms but also derivations that compete with one another. This would need to be made more precise, because in the mechanism as I have proposed it there is not a single step we can point at that is more complex than some step in the derivation that is not blocked. It could also be a cognitive constraint: it is cognitively costly to use an expression that sets a lower bound in a proposition that sets an upper bound or vice versa. This could be because it requires changing the meaning from one bound to the other mid-computation.

It is clear that the exact implementation of this idea needs to be refined. For now, the proposal is that it is not economical to use an expression with a certain meaning component and to then delete this meaning component in the derivation, meaning that there is nothing left of it in the proposition we derive.

6.4.3 Authoritative readings with *at most* and universal modals

In this section I will return to example (66). I have called this one of the less natural combinations and said that we can only derive an epistemic reading for it.

(66) Malika is required to adopt at most two cats.

It is clear that (51) is a better candidate for expressing that Malika is not allowed to adopt more than two cats.

(51) Malika is allowed to adopt at most two cats.

However, (66) still does have an authoritative reading. So far I have not derived this reading. It turns out that this is actually the surface scope reading of (66), with the structure in (73).

(73) [$\Box$ [Malika adopts [at most [[2 *many*] cats]]]]

Recall that this sentence can have a surface scope structure because nothing stops modified numerals from taking scope under universal modals.

The prejacent of *at most*, with focus on the numeral, gives rise to the Rooth-Hamblin alternatives in (74).

(74) $[\![\text{Malika adopts [two]}_F \text{ cats}]\!]^A = \{p_0, p_1, p_2, p_3...\}$

As usual, the CQ is derived from this set and is ordered as S in (75), and we have an equivalent AL.

(75) $S = AL = p_0 < p_1 < p_2 < p_3 < p_4$ ...

Adding *at most*, we derive (76) as the meaning of the prejacent of the modal.

(76) $[\![\text{Malika adopts at most two cats}]\!]^O = \{p_2 \wedge \neg p_3, \{w_{[0]}, w_{[1]}\}\}$

This is an inquisitive proposition containing two possibilities: the possibility that Malika adopts exactly two cats and the possibility that she adopts fewer than two cats.

We saw above that a modal optionally flattens both the ordinary semantic value and the alternative semantic value of its prejacent. In this case, flattening $[\![\alpha]\!]^A$ will not do much, because there is no operator above the modal that needs to use the alternatives. *At most* has already done this below the modal.

Flattening $[\![\alpha]\!]^O$, on the other hand, does have an effect. As shown in (77), the modal now turns the inquisitive proposition in (76) into a non-inquisitive proposition containing only one possibility.

(77) $\{\Box \cup \{p_2 \wedge \neg p_3, \{w_{[0]}, w_{[1]}\}\}\} = \{\Box\{w_{[0]}, w_{[1]}, w_{[2]}\}\}$

(77) says that in all accessible worlds, Malika adopts between zero and two kittens and no more. This is the authoritative reading of (66).

Note that it is also possible, though not necessary, to derive an additional authoritative reading with a universal modal and *at least* this way. For (36), the prejacent of the modal is as in (78).

(36) Malika is required to adopt at least two cats.

(78) $\{p_2 \wedge \neg p_3, p_3\}$

When the modal flattens (78), we get (79). This says that in all worlds, Malika adopts two or more cats.

(79) $\{\Box \cup \{p_2 \wedge \neg p_3, p_3\}\} = \{\Box p_2\}$

Thus, the surface scope configuration that is available when modified numerals occur with universal modals allows for the generation of an authoritative reading with *at most*, which we indeed observe. It also enables the calculation of a harmless extra authoritative reading with *at least*.

6.4.4 A note on the nature of epistemic inferences

Before moving on to two other uses of this account, I will make some observations about the exact nature of the epistemic inferences we have derived. Coppock and Brochhagen (2013), who were the first to use inquisitive semantics in an account of modified numerals, derived meanings of the form in (81) for sentences like (80).

(80) Malika adopted at least two cats.

(81) $\{p_2, p_3, p_4, p_5, ...\}$

Thus, for each number from two upwards, the proposition contains the possibility that Malika adopted that number of cats.

Ignorance was derived as a Quality implicature, but in a slightly different way than I have done here. Coppock & Brochhagen posited the so-called *Maxim of Interactive Sincerity.* This Maxim said that when a proposition is interactive, it must also be interactive in the speaker's information state. Here interactivity means 'containing multiple possibilities'.[9] Informally, when you utter a propo-

[9] The reason why the terminology is different is because Coppock & Brochhagen use $\text{Inq}_\cup$ instead of Inq_B, which allows nested possibilities. In this framework, an interactive proposition is a proposition that contains multiple possibilities. Interactivity does not necessarily imply inquisitivity, because for a proposition to be inquisitive it has to contain at least two

sition with different possibilities, those possibilities must be possibilities in your mind.

Schwarz (2016) pointed out that there is a problem with this way of deriving epistemic inferences: you cannot utter (80) unless you consider it a possibility that Malika adopted exactly two cats. In general, the numeral modified by *at least* or *at most* must always correspond to one of the possibilities the speaker considers. Coppock and Brochhagen do not derive this. Say that you think that Malika adopted either nine or ten cats, and you utter (80). Coppock & Brochhagen predict that this is felicitous. After all, the number is two or higher and the proposition is interactive in your information state.

This shows that the epistemic inference Coppock & Brochhagen derive is too weak in general. For instance, according to their account, you can say *at least one* when you know that the actual number is either one million or two million, and you can say *at most a thousand* when you are unsure whether the number is one or two.

They could remedy this by saying that the possibilities in the speaker's information state must be equivalent to the possibilities in the proposition. A speaker who utters (80) must then consider all the possibilities in (81) to be potentially true. But now the epistemic reading is too strong. Say that there is a particular shelter where you can only adopt pairs of two cats. Then a speaker who knows this and who also knows that Malika adopted a certain number of cats from this shelter can felicitously utter (80) even though all possibilities p_n where n is an odd number are not in the speaker's information state.

Ciardelli et al. (2016), inspired by Quantity implicature-based accounts such as Büring (2008), Schwarz (2013), and Kennedy (2015), solve this problem by saying that (80) denotes the possibilities in (82): either Malika adopted exactly two cats or she adopted some number of cats above two.

(82) $\{p_2 \wedge \neg p_3, p_3\}$

Now we can say that the possibilities in the speaker's information state must correspond to the possibilities in the proposition and generate the right implicatures that way. Either the number in the prejacent of the modified numeral is the right number or it is some number higher than that number, but not all higher numbers have to be live possibilities for the speaker. I have followed Ciardelli et al. (2016) in adopting this method, and therefore my analysis, too, generates the right kinds of implicatures.

As a final remark, quality implicatures are more difficult to cancel than quantity implicatures, as mentioned by Ciardelli et al. (2016). As can be observed in (83), this is a correct prediction.[10]

(83) a. Malika adopted at least two cats. #In fact, she adopted four.
b. Malika adopted more than two cats. In fact, she adopted four.

independent possibilities.

[10] But see Alexandropoulou (2018), chapter 5, for a more careful discussion of these data that suggests that these facts might be slightly different.

Adding the information that Malika adopted four cats implies exact knowledge of the number of cats she adopted, and this is incompatible with the epistemic inference of *at least*, making (83-a) infelicitous. On the other hand, it is fine to add this information to a *more than* sentence like in (83-b), which suggests that *more than* either does not give rise to epistemic inferences or gives rise to weaker, perhaps quantity, implicatures.

This concludes the discussion of the main analysis. In the following section, I will extend the account to epistemic and non-epistemic readings with universal nominal quantifiers.

6.5 Variation and epistemic readings with universal quantifiers

In chapter 4 I mentioned that sentences with universal modals and class B numeral modifiers, such as (84), also have two readings.

(84) Everyone adopted at least two cats.

The most obvious reading is a non-epistemic reading: everyone adopted two cats or more. In parallel to the authoritative readings we have seen, this reading comes with a variation inference: not everyone adopted the same number of cats. That is, (84) is infelicitous when the speaker knows that everyone adopted, say, exactly ten cats. There is also an epistemic reading, which is a bit more difficult to get: everyone adopted the same number of cats, and this number is two or higher. As shown in chapter 4, neither reading corresponds to a reading where the entire DP *at least two cats* takes wide scope. Furthermore, we know that *at least* cannot move over *everyone* by itself since this instantiates a violation of the Heim-Kennedy Generalisation (as discussed elaborately in chapter 5). Therefore I have argued that (84) represents another case where we only get one scope configuration but we do observe two readings, just like the cases where numeral modifiers must take scope over existential modals.

Using the analysis laid out above, we can actually derive both readings from the surface scope configuration. The only assumption we need, which may or may not be a slightly controversial one, is that universal quantifiers also have the ability to optionally flatten their prejacent. Let us go through the derivation of (84) to see how this works. The denotation of the prejacent of *everyone* is given in (85).

(85) $\{\lambda x\ .\ \textsc{max}_{AL}[\exists y[\#y = 2 \wedge \text{cats}(y) \wedge \text{adopts}(x,y)]]\ ,\ \lambda x\ .\ \cup\ \{\ \textsc{max}_{AL}\ p' \mid p' >_S [\exists y[\#y = 2 \wedge \text{cats}(y) \wedge \text{adopts}(x,y)]]\}\}$

This meaning comes about through the use of the denotation of *at least* in (23) where α is $\langle\langle e,p\rangle,p\rangle$ and β is $\langle e,p\rangle$, as in (27).

(23) $[\![\text{at least}]\!]^S = \{\lambda\alpha\lambda\beta.\textsc{max}_{AL}\ (\alpha(\beta))\ ,\ \lambda\alpha\lambda\beta.\cup\{\textsc{max}_{AL}\ p' \mid p' \ >_S$

$\alpha(\beta)\}\}$

(27) $[\![\text{at least}]\!]^S = \{\lambda \mathcal{P}_{\langle\langle e,p\rangle,p\rangle}\lambda Q_{\langle e,p\rangle}.\text{MAX}_{AL}\ (\mathcal{P}(Q))\ ,\ \lambda \mathcal{P}_{\langle\langle e,p\rangle,p\rangle}\lambda Q_{\langle e,p\rangle}. \cup \{\text{MAX}_{AL}\ p' \mid p'\ >_S \mathcal{P}(Q)\}\}$

(85) gives us two possibilities: the *exactly 2* possibility and the *3 or more* possibility. Adding the universal quantifier yields (86).

(86) $\{\forall x\ [\ \text{MAX}_{AL}[\exists y[\#y = 2 \wedge \text{cats}(y) \wedge \text{adopts}(x,y)]]]\ ,\ \forall x\ [\ \cup\ \{\ \text{MAX}_{AL}\ p' \mid p' >_S [\exists y[\#y = 2 \wedge \text{cats}(y) \wedge \text{adopts}(x,y)]]]\}\}$

If P_n stands for 'the set of people who adopted n cats', the meaning in (86) can be represented as in (87).

(87) $\{\forall x P_2 \wedge \forall x \neg P_3\ ,\ \cup\{\forall x P_3 \wedge \forall x \neg P_4\ ,\ \forall x P_4 \wedge \forall x \neg P_5, ...\}\}$

The first possibility is the possibility that everyone adopted two cats and no more. The second possibility is the union of all possibilities such that everyone adopted a higher number than two cats n and no-one adopted more than n cats. Thus, either everybody adopted exactly two cats or everybody adopted some higher number of cats. Either way, everyone adopted the same number of cats. This proposition is inquisitive, so we derive the inference that the speaker does not know which possibility is true. This is the epistemic reading of (84).

To derive the non-epistemic reading, the universal quantifier must flatten (85). Note that this is a case of the relevant operator flattening $[\![\alpha]\!]^O$ rather than $[\![\alpha]\!]^A$, as in section 6.4.4 (i.e. this corresponds to the mechanism described in (33-b) except that a universal quantifier is used instead of a universal modal).

The union of the two sets in (85) is given in (88): *exactly 2* or *3 or more* comes down to *at least 2*.

(88) $\{\lambda x.\exists y[\#y = 2 \wedge \text{cats}(y) \wedge \text{adopts}(x,y)]\}$

Adding in the universal quantifier, the proposition we end up with is the one in (89).

(89) $\{\forall x.\exists y[\#y = 2 \wedge \text{cats}(y) \wedge \text{adopts}(x,y)]\}$

This is a singleton set, so it is not inquisitive. It says that for everyone x there is a certain number of cats y that x adopts, and the cardinality of y is 2. Given the one-sided meaning of the bare numeral 2, (89) has a lower-bounded reading: everyone adopted two or more cats. This is the most prominent reading of (84) without an epistemic implicature.

Thus, the optional flattening mechanism can also derive the two readings we observe with universal quantifiers, without relying on any non-existent scope configurations. As degree-based accounts of modified numerals do use two scope configurations to get two readings, the Heim-Kennedy Generalisation prevents them from predicting the attested ambiguity in cases with nominal quantifiers. My account solves this issue.

6.6 Conclusion

In this chapter I built on the insights from the previous chapter to account for the readings we observe when class B numeral modifiers co-occur with a modal. Specifically, I borrowed from the previous chapter the idea that *at least* and *at most* are part of a class of focus-sensitive expressions that have the capacity to take wide scope without their DP complement and give rise to split scope readings this way. This allowed me to derive readings where *at least* and *at most* take scope over modals. The insight that these modifiers not only can but must take scope over existential modals prevents the prediction of any non-existent semantic readings.

Adding the inquisitive layer and the notion that modals optionally flatten both the ordinary semantic value and the alternative semantic value in their scope allowed me to derive the right types of epistemic and variation readings for all combinations of a class B modifier and a modal. The analysis derives the right kinds of epistemic readings, building on insights from Ciardelli et al. (2016), and can be extended to account for variation and epistemic readings with numeral modifiers and universal quantifiers.

The account from chapter 5 and the present analysis can be seen as one single theory. One crucial insight that led to this theory is that not all scope configurations are attested. For instance, we observe split scope readings but not inverse scope readings, and we observe an ambiguity between variation and epistemic readings but it turns out that this is not a scope ambiguity. Playing close attention to the scope facts can prevent us from deriving non-existent readings and also help us class certain expressions together. For instance, the fact that *at least*, *at most*, *only*, and negative indefinites like *geen* must all outscope existential modals is a sign that they should be grouped together as a natural class. The other crucial insight is the Focus Sensitivity Generalisation from the previous chapter, which was the key to creating unified theory of split scope and class B modified numerals and thereby explaining the similar behaviour we observe from operators in these two areas.

This chapter added two more important ingredient to the mix: inquisitive semantics and optionality. Using inquisitive semantics allows for denotations that contain multiple alternatives, not just in the alternative semantic value but also in the ordinary semantic value. Allowing the modal to optionally flatten these alternatives provides an analysis for the ambiguity between authoritative and epistemic readings we observe for modified numerals. Combined with the insight that not all scope configurations are possible and a pragmatic economy constraint or blocking mechanism, this method gives us exactly the readings we observe and excludes the readings we do not observe.

CHAPTER 7

A plea for optional QR

7.1 Introduction

In this chapter I will discuss the third and final case where scope shifts need to be further constrained. This chapter contains the most general version of this idea: given that scope ambiguities in doubly quantified sentences do not always arise, we must be able to constrain scope shifts. As will become clear below, our current model does not allow us to do this. The discussion in this chapter is about the mechanism of Quantifier Raising, though I believe that my arguments also hold for other scope shifting mechanisms such as type shifts.

I have argued throughout this dissertation that given that not all theoretically possible scope configurations are actually attested, we must consider carefully which scope configurations are and which scope configurations are not available before we account for phenomena such as split scope and the interactions between modified numerals and modals. If scope is often constrained, we must have a way to constrain it. As I will show below, given our current assumptions, we actually do not.

In modern generative syntax and semantics, the following two assumptions are commonly made:

1. When an element moves to a different position, it leaves behind a full copy of itself rather than a trace — the Copy Theory of Movement (Chomsky, 1993)
2. When a quantifier occurs in object position, the type clash between it and the lexical item it combines with is resolved by using QR (Heim & Kratzer, 1998)

I will argue that these two assumptions cannot both be true. To see why, let us begin by considering a run-of-the-mill doubly quantified sentence like (1).

(1) Some cat ruined every piece of furniture.

Let us go through the derivation of this sentence given the assumptions listed above. First the object quantifier *every piece of furniture* is merged in its theta-position as a sister of the verb *ruined*. Then the subject quantifier *some cat* is merged in the vP (the vP-Internal Subject Hypothesis, e.g. Koopman & Sportiche, 1991). *Every piece of furniture* is not interpretable *in situ* and needs to attach to a node of type t to be interpreted. The closest node of type t is the vP-node in (2-b), so given Shortest Move (see below), we can assume that this is what it attaches to, as in (2-c). Finally, *some cat* overtly moves to its final landing site in TP.

(2) a. $[_{\text{VP}}$ ruined every piece of furniture]
b. $[_{\text{vP}}$ some cat $[_{\text{VP}}$ ruined every piece of furniture]]
c. $[_{\text{TP}}$ every piece of furniture $[_{\text{vP}}$ some cat $[_{\text{VP}}$ ruined every piece of furniture]]]

d. [$_{TP}$ some cat [$_{TP}$ every piece of furniture [$_{vP}$ some cat [$_{VP}$ ruined every piece of furniture]]]]

The sentence in (1) is scopally ambiguous. The surface scope interpretation is true iff there is a cat who single-pawedly destroyed all furniture. The inverse scope interpretation is true iff for every piece of furniture, there is a cat that destroyed it. Under this interpretation, it is possible that one cat was responsible for all the destruction, but it is also possible that different cats took care of different pieces of furniture. For instance, Chloe destroyed the sofa, Mrs. Purrington destroyed the chair, and Harold destroyed the pouffe.

The surface scope interpretation can now come about by interpreting the higher copy of both quantifiers and deleting the lower copies, as in (3).

(3) [$_{TP}$ some cat [$_{TP}$ every piece of furniture [$_{vP}$ ~~some cat~~ [$_{VP}$ ruined ~~every piece of furniture~~]]]]

To get the inverse scope interpretation, the higher copy of the object quantifier and the lower copy of the subject quantifier can be interpreted, as illustrated in (4).

(4) [$_{TP}$ ~~some cat~~ [$_{TP}$ every piece of furniture [$_{vP}$ some cat [$_{VP}$ ruined ~~every piece of furniture~~]]]]

Thus, the inverse scope interpretation is obtained by reconstructing the subject to its vP-internal position, which in the Copy Theory of Movement is done by simply interpreting the lower copy and deleting the higher one (Chomsky, 1993, 1995). This makes it end up under the higher copy of the object, which results in the desired reading.

Hornstein (1995) and Johnson and Tomioka (1997) have argued for a configuration like the one in (4), where QR involves both movement of the object and Reconstruction of the subject. What I aim to show here is that there is no need to do any special work to obtain (4); it is an inevitable consequence of the two assumptions given above. If the object quantifier moves for type reasons, by assumption 2, it will end up above the lower copy of the subject. If movement leaves a full copy rather than a trace, by assumption 1, it will be possible to interpret the lower copy of the subject rather than the higher one. Therefore, (4) must be a possible structure that leads to an inverse scope reading.

The only difference between surface scope and inverse scope in this system is the deletion and interpretation of a different copy of the subject. Crucially, no additional movement operation is needed to get an inverse scope reading. The surface scope structure in (3) is the same as the inverse scope structure in (4) but for the location of the interpretation of the subject. In this chapter I will argue that this is an undesirable aspect of our system. I will show that the combination of the two assumptions I have discussed and the result in (4) make incorrect empirical predictions as well as problematic predictions with respect to processing. I will argue that these problems show that we need to assume that some additional step is needed to obtain an inverse scope configuration: having a system where solving the type clash also yields a structure that allows an inverse scope configuration is undesirable. The specific solution I propose to implement this idea is to assume that object quantifiers can be interpreted *in situ* through a type shifting mechanism while maintaining a movement account of scope ambiguities.

Before I move on to these points, however, I would like to briefly address two other assumptions that I made in discussing the derivation in (2): the vP-Internal Subject Hypothesis and Shortest Move. The reader may wonder whether the issue I bring up here is really only the result of the two assumptions listed at the beginning of this section or whether these two auxiliary assumptions play a role too. The fact is that if we omit either one of those assumptions we not only get inverse scope without an extra movement step, as before, but we also lose our surface scope configuration. To see this, let us start with the vP-Internal Subject Hypothesis. If we do not make this assumption, the subject *some cat* is merged directly in TP. The only node of type *t* that the object *every piece of furniture* can attach to here is this TP, so that is where it moves. The result is given in (5).

(5) [$_{\text{TP}}$ every piece of furniture [$_{\text{TP}}$ some cat [$_{\text{VP}}$ ruined every piece of furniture]]]

As the VP copy of *every piece of furniture* is not interpretable, we have to interpret the higher copy of the object, and we automatically get inverse scope again. In fact, there is now no copy of *some cat* above an interpretable copy of *every piece of furniture*, so we have to do extra work to get the surface scope configuration, plausibly by moving *some cat* to a position above the higher copy of the object.

Now let us turn to Shortest Move. If we do not assume Shortest Move, it is possible that the object moves over both copies of the subject in one step, as it has done in (6).

(6) [$_{\text{TP}}$ every piece of furniture [$_{\text{TP}}$ some cat [$_{\text{vP}}$ some cat [$_{\text{VP}}$ ruined every piece of furniture]]]]]

The same thing happens here: we get an inverse scope configuration, and in fact we would need to move *some cat* again to obtain the surface scope configuration. Thus, if we do not assume the vP-Internal Subject Hypothesis or Shortest Move, obtaining an inverse scope configuration still does not require an extra movement step. Quite the contrary: it is the surface scope reading that would involve an additional movement operation in these cases. Therefore, it is the combination of the two assumptions listed at the beginning of this section and not these two other assumptions that create a situation where we have a structure that allows both a surface scope interpretation and an inverse scope interpretation.

Now that we have this out of the way, it is time to look forward. In the following three sections, I will present three problems that arise in a system where inverse scope does not require an extra movement step. The first problem has to do with Scope Economy, the second is related to absent inverse scope readings, and the third has to do with processing. Then I will lay out my proposal of a hybrid flexible types/movement account in section 7.5. In section 7.6 I discuss three alternative solutions to the problems I will describe. Section 7.7 concludes.

7.2 Problem 1: Scope Economy

7.2.1 Scope Economy

Scope Economy is a constraint on covert movement that has been proposed by Fox (2000). The Scope Economy condition can be defined as in (7).

(7) *Scope Economy*
Scope Shifting Operations that are not forced for type considerations must have a semantic effect (Fox, 2000:23)

A Scope Shifting Operation is a movement operation that changes the scope relations between operators in a sentence. Although Fox does not explicitly state this, his choice of examples indicates that he considers Scope Shifting Operations to be the covert movement operations of QR and Reconstruction, and not overt movement operations like *wh*-movement, topicalisation, or movement for EPP reasons. These types of movement can also affect scope relations but even when they do not, they affect the phonology interface. It seems that the intuition behind Fox's proposal is that if you move, this should affect one of the interfaces. If it has no impact on the phonology, it should affect interpretation.

At first glance, Scope Economy seems like an impossible condition to test. It predicts that QR is possible in (8-a) but not in (8-b). This is because moving *every piece of furniture* over *a cat* leads to an inverse scope configuration with an interpretation that is different from the surface scope configuration, as we have seen. Conversely, *every piece of furniture* and *Mrs. Purrington* are scopally commutative, *Mrs. Purrington* being a proper name, so QR of the object should be prohibited here. However, since QR would have no semantic effect in (8-b), it is impossible to see if the prediction made by Scope Economy is borne out.

(8) a. A cat destroyed every piece of furniture.
b. Mrs. Purrington destroyed every piece of furniture.

For this reason, Fox does not use simple sentences like the ones in (8) but rather sequences of two sentences where one sentence is partly elided. To see how this works, we first need to consider the concept of Parallelism. Parallelism is a requirement on ellipsis: whenever a phrase is elided, there must be a phrase that is similar to the elided phrase in an earlier sentence (see van Craenenbroeck, to appear, for an overview of different versions of this requirement). For his purposes, Fox formulates Parallelism as in (9).

(9) *Parallelism*
The scope-bearing elements in the antecedent sentence must receive scope parallel to that of the corresponding elements in the ellipsis sentence (Fox, 2000:31)

To see Parallelism in action, consider (10), where the VP *ruined every piece of furniture* has been elided in the second sentence.

(10) A cat ruined every piece of furniture. A pig did, too.

As illustrated in (11), (10) can have two readings: a reading where *a cat* and *a pig* both take scope over *every piece of furniture* and a reading where they both take scope under *every piece of furniture*. Mixed readings are not allowed: there is no reading where *a cat* scopes over the object but *a pig* scopes under it or vice versa.

(11) a. a cat > every piece of furniture ; a pig > every piece of furniture
b. every piece of furniture > a cat ; every piece of furniture > a pig
c. *a cat > every piece of furniture ; every piece of furniture > a pig
d. *every piece of furniture > a cat ; a pig > every piece of furniture

Now let us take another look at the contrast in (8), this time with ellipsis cases. The relevant example is given in (12).

(12) A cat ruined every piece of furniture. Walter did, too.

Now that we have replaced the quantifier *a pig* by the proper name *Walter*, the first sentence only has a surface scope reading.[1] That is, once the ellipsis sentence has been added to it, the first sentence in (12) can only mean that there is one cat who ruined all the furniture and not that different cats ruined different pieces of furniture.

Fox claims that the reason for this is Scope Economy. Scope Economy prevents *every piece of furniture* from moving over *Walter* in the ellipsis sentence because this movement would be semantically vacuous. The Parallelism condition requires that the antecedent sentence and the ellipsis sentence have identical scope configurations. For this reason, Parallelism subsequently prevents QR in the antecedent sentence. As a result, surface scope is the only option for both sentences.

Thus, the lack of inverse scope in the antecedent sentence in (12) is part of the pattern in (13). The mixed readings in (13-c) and (13-d) are out because they do not obey Parallelism, exactly as in (11). However, the case where both

[1] As Walter is clearly a pig name and not a cat name, there is no entailment relation between these two sentences.

sentences have an inverse scope configuration in (13-b) is now also disallowed, unlike in (11). Therefore, the only option left is the surface scope option in (13-a), so this is the reading we get for (12).

(13) a. a cat > every piece of furniture; Walter > every piece of furniture
b. *every piece of furniture > a cat; every piece of furniture >Walter
c. *a cat > every piece of furniture; every piece of furniture > Walter
d. *every piece of furniture > a cat; Walter > every piece of furniture

To sum up, the argument goes as follows:

- We see both surface scope and inverse scope in the antecedent and ellipsis sentence of (10) but we only see surface scope in the antecedent sentence of (12) (we cannot see what is going on in the ellipsis sentence, because the two readings are equivalent).
- The difference between (10) and (12) is that in the ellipsis sentence of the former, QR would have a semantic effect, whereas in the ellipsis sentence of the latter, it would not.
- Because of this fact, Scope Economy allows QR in the ellipsis sentence of (10) but not in the ellipsis sentence of (12).
- For that reason, Parallelism allows inverse scope in the antecedent sentence of (10) but not in the antecedent sentence of (12).
- The result is that we only get surface scope in the antecedent sentence of (12), while we get both surface scope and inverse scope in the sentence in (10).

7.2.2 The problem

Fox (2000) does not assume the Copy Theory of Movement. Instead, he assumes that movement leaves behind a trace that is co-indexed with the moved element. The derivation of the ellipsis sentence of (12) then proceeds as follows. The object is first merged in the VP and then covertly moves up to TP for type reasons. The subject starts off in vP and overtly moves to TP. This is shown in (14). Both movement operations leave behind traces rather than full copies.

(14) $[_{\text{TP}}$ Walter$_2$ $[_{\text{TP}}$ ever piece of furniture$_1$ $[_{\text{vP}}$ t_2 $[_{\text{VP}}$ ruined t_1]]]]

The structure given in (14) is the surface scope structure of (12). To get an inverse scope reading, *every piece of furniture* has to QR over Walter to take scope over it, as it has done in (15).

(15) $[_{\text{TP}}$ every piece of furniture$_1$ $[_{\text{TP}}$ Walter$_2$ $[_{\text{TP}}$ t_1 $[_{\text{vP}}$ t_2 $[_{\text{VP}}$ ruined t_1]]]]]

This last movement step is the one that is blocked by Scope Economy. As *Walter* and *every piece of furniture* are scopally commutative, moving one over the other has no semantic effect and is therefore prohibited.

Now let us consider how the derivation would proceed if you assume the Copy Theory of Movement. The steps displayed in (14) would be exactly the same, except that the movement now leaves full copies instead of traces. The resulting structure is the one in (16).

(16) [$_{\text{TP}}$ Walter [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ Walter [$_{\text{VP}}$ ruined every piece of furniture]]]]

As we have seen, the movement operation illustrated in (15) is no longer necessary to get inverse scope now. Instead, the semantic component can simply interpret the higher copy of the object and the lower copy of the subject and delete the other two copies, as in (17).

(17) [$_{\text{TP}}$ ~~Walter~~ [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ Walter [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

How can Scope Economy block semantically vacuous QR in this system? Let us consider each movement step involved in the derivation and see if Scope Economy can block them.

Option 1: the first movement step of the object Can Scope Economy block the movement of the object out of the VP? The way Fox stated Scope Economy, the answer to that question is no. Recall from (7) that Scope Economy restricts movement that is not forced by type reasons. The first movement step of the object *is* forced by type reasons and is therefore not semantically vacuous; without it, the structure would be uninterpretable. Because the movement is semantically motivated, Scope Economy allows it. Therefore, this movement is not blocked.

Option 2: overt movement of the subject Now let us consider the movement step of the subject from vP to TP. Could Scope Economy block this movement step? The answer is no: Scope Economy restricts covert movement, not overt movement.[2] And even if Scope Economy could somehow prevent the subject from moving to TP, this would not help. In fact, it would only make matters worse: the object would still end up above the subject (above the vP copy, which is now the only copy), resulting in an inverse scope reading. The surface scope reading would then be predicted to be unavailable instead of the inverse scope reading.[3]

[2]If Scope Economy also restricted overt movement, this would have dramatic consequences: every single movement operation in the grammar would have to result in some semantic change.

[3]This problem also arises if we assume the PF movement theory of Reconstruction; see section 7.6.3.

Option 3: interpretation and deletion A third option is that the deletion/interpretation procedure that results in (17) is somehow costly. This may be so, but compare (17) to the surface scope configuration of (12), given in (18).

(18) [$_{\text{TP}}$ Walter [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ ~~Walter~~ [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

The only difference between surface scope and inverse scope is the interpretation and deletion of a different copy of *Walter*. There is no reason why one of these options should be more economical than the other. In other words, if Scope Economy restricts deletion, you would need to stipulate that deleting the higher copy of the subject is costlier than deleting the lower copy. I see no rationale for making such a claim.[4]

We have tried to put Scope Economy to work at every step of the derivation, but each time the derivation gets away with all of its cunning movement and deletion operations. In other words, Scope Economy has no way to prevent (17) from coming into existence. Inverse scope is therefore predicted to be available for the ellipsis sentence in (12). Consequently, Parallelism has no choice but to allow inverse scope in the antecedent sentence of (12). Therefore, we now predict that both surface scope and inverse scope should be available for the antecedent sentence in (12). This is an incorrect prediction.

I have already shown that this problem does not arise if we do not assume the Copy Theory of Movement. Fox did not assume it, and everything went quite well for him. (19) demonstrates that the problem also does not arise if we do not assume that objects move for type reasons. If *every piece of furniture* were interpretable *in situ*, the surface scope structure would be the one in (19-a) (I randomly deleted the lower copy of the subject here, but this choice is irrelevant.) Inverse scope would look as in (19-b), which is the same structure we saw earlier, in (17). The difference, however, is that the movement of the object is now not forced for type reasons. Instead, it happens purely so that the object can take scope over the subject. Therefore, it is not exempt from Scope Economy as it was before, and so it can be blocked by it. We correctly predict that inverse scope is impossible, and the problem disappears.

(19) a. Surface scope: [$_{\text{TP}}$ Walter [$_{\text{vP}}$ ~~Walter~~ [$_{\text{VP}}$ ruined every piece of furniture]]]
b. Inverse scope: [$_{\text{TP}}$ ~~Walter~~ [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ Walter [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

In sum, if we make the two assumptions that movement leaves behind full copies and that objects must move for type reasons, Scope Economy no longer blocks semantically vacuous movement. As soon as we give up one of these assump-

[4] Although one could claim that deleting a different copy at PF than at LF, as is done in (17), is less economical than deleting the same copy at PF as at LF, as in (18). See section 7.6.2 for an elaborate discussion of this option.

tions, Scope Economy works again. This is the first problem the assumptions give rise to.

7.3 Problem 2: Missing Readings

The second problem I would like to address is much more straightforward than the first: QR is simply not always available. Consider the examples in (20).

(20) a. Some students read exactly two books.
b. No music critic listened to exactly two albums.
c. Every child visited exactly two amusement parks.
d. Every student attended no parties.
e. No child found an Easter egg.
f. No boy read every book.
g. Two people carried three pianos.

None of these sentences have inverse scope readings. For instance, (20-a) means that there were students for whom it was the case that they read exactly two books. It cannot mean that there were exactly two books that were read by some students, which would entail that no student read fewer than two books and no student read more than two books. Similarly, (20-f) can have the surface scope interpretation that there was no boy for whom it was true that he read every book. It cannot have the inverse scope interpretation that for every book, it was the case that no boy read it, which would mean that no boy read any book.

Many authors have proposed restrictions on QR that aim to explain why the operation is not always available (e.g. Beghelli & Stowell, 1997; Mayr & Spector, 2012). I will not discuss such proposals here, nor is it my aim to account for the lack of inverse scope readings in (20). Instead, the simple point I want to make is that we need restrictions on QR.

The problem is that such restrictions are unstatable in the current system. We again get a derivation like the one in (21) for (20-a), and again, the semantics is free to interpret the lower copy of *some students* and the higher copy of *exactly two books* and delete the other two copies.

(21) [$_{\text{TP}}$ Some students [$_{\text{TP}}$ exactly two books [$_{\text{vP}}$ some students [$_{\text{VP}}$ read exactly two books]]]]

Above I described Scope Economy's struggle to block any movement operation in a structure like this. This is a shared struggle: any restriction on movement will be unable to prohibit inverse scope for (21). A restriction on movement cannot prevent *exactly two books* from quantifier raising out of the VP, because leaving it in there leads to uninterpretability. Preventing movement of the subject does not help for the reasons mentioned in the previous section. And again, a restriction on deletion that prevents deletion of the higher copy of the subject but allows deletion of the lower copy will be ad hoc and merely descriptive (though see section 7.6.2 for a discussion of an idea like this).

One could argue that we actually do not need restrictions on movement to account for the lack of inverse scope readings in (20). Maybe movement is in principle freely available but some pairs of quantifiers lead to interpretable structures when they occur in a particular scope configuration. In other words: maybe (20) shows us that there are constraints on interpretability, not that there are constraints on movement. This may be the case for some pairs of quantifiers in (20), but it cannot be the whole story. To see this, consider (22).

(22) a. Exactly two students read some books.
b. No student attended every party.

The sentence in (22-a) is the same as the one in (20-a) and (22-b) is the same as (20-d), except for the fact that the quantifiers have been switched. (22-a) and (22-b) have perfectly fine surface scope interpretations: the interpretation that the number of students who read any books is exactly two and the interpretation that every professor met with a possibly different girl respectively. This indicates that there is nothing wrong with *exactly two* scoping over *some* or with *all* scoping over *a*. An even stronger argument comes from the passivised versions of (20) given in (23).

(23) a. Exactly two books were read by some students.
b. Exactly two albums were listened to by no music critic.
c. Exactly two amusement parks were visited by every child.
d. No parties were attended by every student.
e. An Easter egg was found by no child.
f. Every book was read by no boy.
g. Three pianos were carried by two people.

These sentences have the surface scope readings that correspond to the missing inverse scope readings in (20). Putting the quantifiers in this order thus leads to perfectly interpretable sentences. This demonstrates that inverse scope is prohibited in (20-a) and (20-d) not because of some constraint on interpretability but rather because of a constraint on movement.

So: we must be able to formulate constraints on QR, but we are unable to do so. This is another problem that arises from the interplay between the two assumptions given in the introduction of this chapter. If we did not assume that object quantifiers have to move for type reasons, they would not automatically end up above the lower copy of the subject, and we could constrain their upward movement. If we did not assume the Copy Theory of Movement, the lower copy of the subject would not be there, and the object would have to take a second movement step to take scope over the subject. This movement operation could then be constrained.

7.4 Problem 3: Processing

In addition to the purely linguistic problems I described above, the two assumptions give rise to a problem with regards to language processing. Many authors have shown that inverse scope configurations require more processing resources than surface scope configuration (Catlin & Micham, 1975; Micham, Catlin, VanDerveer, & Loveland, 1980; Gillen, 1991; Kurtzman & MacDonald, 1993; Tunstall, 1998; Anderson, 2004). Anderson's (2004) dissertation contains a particularly elaborate study on this topic. In a series of offline and online experiments, Anderson shows that participants have more trouble processing inverse scope configurations than surface scope ones.

In Anderson's offline experiments, she presented experiments with doubly quantified sentences and asked them a question that was designed to reveal whether they got the surface scope reading or the inverse scope reading. This experiment showed that participants overwhelmingly favoured the surface scope reading. Even when Anderson conducted another experiment where the doubly quantified sentences were accompanied by a context designed to favour the inverse scope reading, participants still found the inverse scope reading more difficult to get than the surface scope reading.

Anderson's online experiments have the same outcome. Here Anderson presented people with a doubly quantified sentence followed by a sentence that disambiguated the doubly quantified sentence in a self-paced reading task. The sentences that disambiguated towards inverse scope were read more slowly than those that disambiguated towards surface scope. In another experiment, Anderson used non-disambiguating follow-up sentences and instead asked participants a question designed to reveal which reading they got for the doubly quantified sentence. The participants that got the inverse scope reading read the follow-up sentence more slowly than the participants who got the surface scope reading.

This indicates that something about inverse scope configurations makes them harder for people to process than surface scope configurations. The most obvious reason for this, and indeed the reason Anderson gives for her findings, is that inverse scope configurations have a higher degree of complexity than surface scope configurations.

Recall that in the present system, the surface scope and inverse scope configurations of a doubly quantified sentence look as in (3) and (4), repeated here as (24) and (25), respectively.

(24) [$_{\text{TP}}$ some cat [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ ~~some cat~~ [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

(25) [$_{\text{TP}}$ ~~some cat~~ [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ some cat [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

This shows that the surface scope and inverse scope configuration are syntactically equivalent, the only difference residing in the deletion and interpretation procedure of the semantic component. Even if we take the semantic component into account, there is no obvious reason why deleting one copy should require more processing resources than deleting another. For this reason, we fail to predict that inverse scope is harder to process than surface scope.

If we did not assume the Copy Theory of Movement, an extra movement step would be required to get inverse scope, and this would lead to a more complex structure, as illustrated in (26).

(26) a. Surface scope:
$[_{\text{TP}}$ some cat $_2$ $[_{\text{TP}}$ ever piece of furniture$_1$ $[_{\text{vP}}$ t_2 $[_{\text{VP}}$ ruined t_1]]]]

b. Inverse scope:
$[_{\text{TP}}$ every piece of furniture$_1$ $[_{\text{TP}}$ some cat $_2$ $[_{\text{TP}}$ t_1 $[_{\text{vP}}$ t_2 $[_{\text{VP}}$ ruined t_1]]]]]

Similarly, if we did not assume that object quantifiers need to move for type reasons, we would correctly predict that surface scope is less complex and therefore easier to process than inverse scope, as shown in (27).

(27) a. Surface scope:
$[_{\text{TP}}$ some cat $[_{\text{vP}}$ ~~some cat~~ $[_{\text{VP}}$ ruined every piece of furniture]]]

b. Inverse scope:
$[_{\text{TP}}$ ~~some cat~~ $[_{\text{TP}}$ every piece of furniture $[_{\text{vP}}$ some cat $[_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

Therefore, this is a third problem that arises from the combination of the Copy Theory of Movement and movement for type reasons.

7.5 A hybrid account

We have seen that it is the combination of the two assumptions listed in the introduction of this section that causes problems; neither assumption is problematic on its own. Therefore, if we were to give up one of these assumptions, all of our troubles would disappear.

As is well known, there are good theoretical and empirical reasons to assume the Copy Theory of Movement. On the theoretical side, the theory simplifies syntax: as it does away with traces, it is no longer necessary to assume the existence of any syntactic objects besides the elements in the lexicon. In addition, it collapses the two operations of inserting a lexical item in the structure and moving a lexical item: both are now instances of the *merge* operation, the only difference being in whether the merged element is taken from the lexicon or from a different part of the derivation (Chomsky, 1995).

On the empirical side, the Copy Theory of Movement correctly predicts that certain types of movement do not feed Condition C (Fox, 2002). Consider (28) and (29).[5]

[5]These examples and judgments are from Fox 2002.

(28) ??Guess [which friend of John's$_1$]$_2$ he$_1$ visited t_2?

(29) ??/*[Every friend of John's$_1$]$_2$, someone introduced him$_1$ to t_2.

Here the phrases *which friend of John's* and *every friend of John's* have been moved out of the scope of the pronoun *he*. Condition C states that referential expressions must be free in their c-command domain. That is, it cannot be coreferential with a pronoun that c-commands it. As the referential expression *John* has been moved out of the c-command domain of *he*, the prediction would seem to be that coreference between *John* and *he* is possible. However, if you assume the Copy Theory of Movement, there is a copy of *John* below *he* as well as above *he*. The lower copy of *John* is c-commanded by *he*, which is a Condition C violation. The Copy Theory of Movement therefore correctly predicts the inability of *John* to corefer with *he* in (28) and (29).

Similarly, there are good reasons to assume the existence of Quantifier Raising. For instance, QR can explain why (30) has a reading where *her* is bound by *every colleague* (see Cable, 2014, for an overview of arguments for and against QR). This is the reading where all of Lucy's colleagues potentially have different favourite books, and whatever the favourite book of a particular colleague is, that is the book that she was given by Lucy.

(30) Lucy gave [every colleague]$_1$ her$_1$ favourite book.

If c-command is a prerequisite for binding, QR can ensure that we get the correct reading. As (31) shows, *every colleague* can move to a position where it c-commands the pronoun *her* and bind it in this position.

(31) [$_{\text{TP}}$ Lucy [$_{\text{TP}}$ every colleague [$_{\text{vP}}$ Lucy [$_{\text{VP}}$ [$_{\text{VP}}$ gave [$_{\text{DP}}$ every colleague]] [$_{\text{DP}}$ her favourite book]]]]]

The most well-known argument for QR is Antecedent Contained Deletion. We saw in section 7.2.1 that ellipsis is subject to a Parallelism condition: the structure of the antecedent sentence must match the structure of the ellipsis sentence. The relevant identical structure in (32) is the VP *ruin every piece of furniture*.

(32) A cat ruined every piece of furniture. A pig did, too <ruin every piece of furniture>.

In (33), there is no structure in the antecedent sentence that can be identical to the elided part of the ellipsis sentence. This is because the antecedent VP is contained in the elided VP.

(33) Mrs Purrington ruined every piece of furniture Walter did <ruin every piece of furniture Walter did <ruin every piece of furniture Walter did ... etc. >>

QR solves this problem: if we move the object quantifier over the subject, we have two identical VPs, namely *ruin t*.[6] This is demonstrated in (34).

(34) [Every piece of furniture]$_1$ Mrs. Purrington ruined t_1 Walter did <ruin t_1>.

QR is thus a well motivated operation. However, QR for type reasons is a different story. As far as I know, there is no reason why the operation that gives us inverse scope readings should be the same as the mechanism that resolves the type clash object quantifiers give rise to. Therefore, I propose to do away with the assumption that these two different phenomena should be accounted for using the same mechanism.

Instead, I propose that even in an account that assumes the existence of QR, object quantifiers should be interpretable *in situ*. One way to implement this is to say that object quantifiers are ambiguous à la Montague (1973) and Partee and Rooth (1983) and can be interpreted in the position where they are base generated.[7] In these accounts, a quantifier like *every* is ambiguous between a type $\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle$ and a type $\langle\langle e,t\rangle,\langle\langle e,\langle e,t\rangle\rangle,\langle e,t\rangle\rangle\rangle$ interpretation, as in (35).

(35) a. $[\![every]\!] = \lambda P_{\langle e,t\rangle}\lambda Q_{\langle e,t\rangle}.\forall x : P(x) \rightarrow Q(x)$
b. $[\![every]\!] = \lambda P_{\langle e,t\rangle}\lambda R_{\langle e,\langle e,t\rangle\rangle}\lambda y.\forall x : P(x) \rightarrow Q(x)(y)$

Of course this is just one way to allow object quantifiers to be interpretable *in situ*. Another option is to let transitive verbs take quantifiers as arguments. I am not tied to any particular implementation of this idea. All that matters is that the object can stay where it is. What I aim to do here is not to argue for any of the flexible types accounts on the market. Instead, I argue for a hybrid account: QR can be used for scope and ACD resolution but should not be needed to resolve type clashes. Instead, a type shifting mechanism should be available to take care of that.

Now that we have this idea in place, the two possible structures of the doubly quantified sentence in (36) are as in (37) (repeated from (27)).

(36) A cat ruined every piece of furniture.

(37) a. Surface scope:
[$_{\text{TP}}$ some cat [$_{\text{vP}}$ ~~some cat~~ [$_{\text{VP}}$ ruined every piece of furniture]]]
b. Inverse scope:
[$_{\text{TP}}$ ~~some cat~~ [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ some cat [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

(37-b) is now more complex than (37-a) in the sense that there are two movement operations in (37-b) and only one in (37-a). This solves all three problems

[6] There are some complications for this account in the Copy Theory of Movement. See Fox, 2002 for a possible solution.

[7] As mentioned in chapter 2 of this dissertation, a type shift can also be applied to the predicate *ruined* to obtain the same effect (Hendriks, 1993). I am agnostic about which option is best and it makes no difference for the present purposes.

I discussed in the previous sections.

Scope Economy can now restrict QR because it is an optional operation that is not required for type reasons. Without this adjustment to the theory, an object quantifier always moves because it is uninterpretable *in situ.* This kind of movement for type reasons is semantically motivated and therefore exempt from Scope Economy. Now this movement for type reasons is no longer required. Therefore, moving *every piece of furniture* over *Walter* for sentence (38) is no longer allowed by Scope Economy. It is not needed for type reasons and it is not needed for scope, so Scope Economy blocks it. In other words, Scope Economy works again.

(38) Walter ruined every piece of furniture.

Similarly, other constraints on QR can be formulated. We have seen that certain doubly quantified sentences simply do not have inverse scope readings. (39) is an example of such a sentence; it does not have the reading that there are exactly two amusement parks that every child visited. Instead, (39) only has the surface scope reading that for every child it is the case that they visited no more and no fewer than two amusement parks.

(39) Every child visited exactly two amusement parks.

When the object quantifier ends up above the subject quantifier for type reasons, it is difficult to prevent unattested inverse scope readings from being generated. Letting the object quantifier be interpreted in its original position solves this problem. We can now formulate constraints on QR in our system, which prevents us from deriving inverse scope readings for sentences like (39).

Finally, the inverse scope structure in (37-b) has a higher level of complexity than the surface scope structure in (37-a). There are two ways to think about this. The first is that (37-b) involves two movement steps rather than just one, as in (37-a), so the derivation is more complicated. The second is that the final structure we derive in (37-b) is more complex than the structure in (37-a): it contains an additional TP and an extra copy. Either way, the higher complexity in (37-b) is in line with processing data, which show that inverse scope configurations are more difficult to process than surface scope configurations.

A question that might arise at this point is why we still need to assume the existence of QR. We are now using a type shift to resolve a type clash, so why not just use type shifts for everything, as in Hendriks (1993)? My answer to this question is that we may not need it. The main contribution I wish to make here is not to claim that we should specifically use the operation of QR for scope and we should specifically use type shifting to resolve type clashes. Instead, my main point is that we need to differentiate between resolving type clashes and changing scope configurations. It is undesirable to have a system where resolving a type clash results in a configuration where both surface scope and inverse scope are available. Given that this chapter is written from a 'QR perspective', using a type shift for type clashes and QR for scope is a way to differentiate. It is a way to ensure that resolving the type clash only resolves the type clash and does not have consequences for scope. But for linguists who use type shifts both for resolving type clashes and for scope, QR can be seen as a proxy for an extra type shift.

This concludes the main part of this chapter. In the next section I will explore three potential alternatives one might have to the solution I have proposed.

7.6 Three potential alternative solutions

Here I will discuss three alternative solutions to the problem of 'free inverse scope' discussed above. The first is that if we adopt Kratzer's (1996) event semantics account, which assumes a different argument structure, there is no longer an object type clash. The second is the idea that interpreting different copies at LF than at PF is costly, which could explain many of the data I have discussed above. The third is that, given that QR also involves Reconstruction of the subject in the Copy Theory of Movement, perhaps the problems I have addressed are not due to QR being too freely available but to Reconstruction being too freely available. I will discuss each of these ideas in turn. My conclusion will be that none of these alternative proposals can truly solve the issue of 'free inverse scope'.

7.6.1 Adopting a different argument structure

It has been proposed to me by an anonymous reviewer that an alternative way to solve the problems described above would be to assume Kratzer's (1996) event semantics account. Even though Kratzer's reasons for making her proposal have nothing to do with the present issues, her account does appear to lend itself to solving them. Kratzer argues that transitive verbs are one-place predicates; subjects are not arguments of the verb but rather of a separate inflectional head called VOICE. One-place predicates can be taken as arguments by quantifiers, which means that transitive verbs and object quantifiers no longer give rise to a type clash. As a result, the object quantifier can be interpreted *in situ*, and there is no reason to move it.

To see how this could work, let us consider a sample derivation in Kratzer's system. Let us take (40) as our example sentence.

(40) Mrs. Purrington destroyed every piece of furniture.

The structure of (40) in Kratzer's system is given in (41) (I have slightly simplified the structure for illustrative purposes).

(41) $[_{\text{VoiceP}}$ $[_{\text{DP}}$ Mrs. Purrington] $[_{\text{Voice'}}$ $[_{\text{Voice}}$ Agent] $[_{\text{VP}}$ $[_{\text{V}}$ destroyed] $[_{\text{DP}}$ every piece of furniture]]]]

Mrs. Purrington is thus a sister of the *Voice'* node, and it is an argument of this node rather than of the verb, as I will show in detail below.

Kratzer assumes that in addition to the type e of individuals and the type t of truth values, there is a third basic type: type s; the event type. A transitive verb like *destroy* is of type $\langle e, \langle s, t\rangle\rangle$: it takes an individual and returns a function from events to truth values. As can be seen in (42), *destroy* conveys that its argument is destroyed at some event e.

(42) $[\![\text{destroy}]\!] = \lambda x_e \lambda e_s[\text{destroy}(x)(e)]$

Kratzer does not say anything about the type of quantifiers, but it seems reasonable to assume that a quantified DP like *every piece of furniture* would have the denotation given in (43) in Kratzer's account. The only difference between the denotation in (43) and the classic denotation of a universally quantified DP is the addition of the event argument. *Every* is thus of type $\langle\langle e, \langle s, t\rangle\rangle, \langle\langle e, \langle s, t\rangle\rangle, \langle s, t\rangle\rangle\rangle$ and *every piece of furniture* is of type $\langle\langle e, \langle s, t\rangle\rangle, \langle s, t\rangle\rangle$.

(43) $[\![\text{every piece of furniture}]\!] = \lambda P_{\langle e,\langle s,t\rangle\rangle} \lambda e_s[\forall x[\text{ piece of furniture}(x)(e) \rightarrow P(x)(e)]]$

The transitive verb is now of the right type to be taken as an argument by the quantified DP. The VP *destroyed every piece of furniture* then has the denotation of type $\langle s, t\rangle$ given in (44).

(44) $[\![\text{destroyed every piece of furniture}]\!] = \lambda e_s[\forall x[\text{ piece of furniture}(x)(e) \rightarrow \text{destroy}(x)(e)]]$

As shown above, the VP is the sister of the *Agent* head. This head is of type $\langle e, \langle s, t\rangle\rangle$ and has the denotation given in (45).

(45) $[\![\textit{Agent}]\!] = \lambda x_e \lambda e_s[\text{Agent}(x)(e)]$

There is thus a type clash between the type of *agent* and the type of *destroyed every piece of furniture* at the *Voice'* node. Kratzer remedies this by proposing a separate rule she calls Event Identification. This rule is given in (46).

(46) Event Identification
$f_{\langle e,\langle s,t\rangle\rangle}\ g_{\langle s,t\rangle} \rightarrow h_{\langle e,\langle s,t\rangle\rangle} = \lambda x_e \lambda e_s[f(x)(e) \wedge g(e)]$

Event Identification thus simply conjoins the two functions and lets their event variable be bound by the same lambda operator. For our sample derivation, this results in (47).

(47) $[\![\text{Agent destroyed every piece of furniture}]\!] = \lambda y_e \lambda e_s[\text{agent}(y)(e) \wedge \forall x[\text{piece of furniture}(x)(e) \rightarrow \text{destroyed}(x)(e)]]$

Combined with the subject, this yields the denotation in (48) for the entire sentence.

(48) $[\![$Agent(Mrs. Purrington) destroyed every piece of furniture$]\!]$ =
λe_s [agent(Mrs. Purrington)$(e) \wedge \forall x$[piece of furniture$(x)(e) \rightarrow$ destroyed$(x)(e)$]]

Sentences thus denote functions from events to truth values. In this case, the relevant events are the ones where there is an agent identified as Mrs. Purrington and where every piece of furniture is destroyed.

Hence, some extra machinery in the form of Event Identification is needed to make everything fit, but the object can be interpreted inside the VP and therefore it does not need to move for type reasons.

This solves problem 2 described above. As the object can be interpreted *in situ*, a configuration where an inverse scope interpretation is possible does not come about automatically. It requires an extra movement step, and this movement step can be constrained. It also solves problem 3: inverse scope would lead to a structure like the one in (49), which is more complex and therefore presumably more difficult to process than the surface scope structure in (41).[8]

(49) $[_{\text{VoiceP}}$ every piece of furniture$_1$[VoiceP $[_{\text{DP}}$ some cat] $[_{\text{Voice'}}$ $[_{\text{Voice}}$ Agent] $[_{\text{VP}}$ $[_{\text{V}}$ destroyed] $[_{\text{DP}}$ ~~every piece of furniture~~]]]]]

Problem 1 has also been resolved. After all, inverse scope now requires an extra movement operation, which can be blocked by Scope Economy if it is semantically vacuous. However, adopting this account results in a new problem relating to Scope Economy. Let us consider what would happen in a case where the object quantifier raises in order to take scope over the subject. As discussed in the introduction of this section, we assume Shortest Move. This means that when the object moves up, it attaches to the first propositional node it can find. Propositional nodes are of type $\langle s, t\rangle$ rather than of type t in this system. The closest node of this type is the VP node, as can be seen in (44). This means that the object attaches to the VP, as in (50).

(50) $[_{\text{VoiceP}}$ $[_{\text{DP}}$ some cat] $[_{\text{Voice'}}$ $[_{\text{Voice}}$ Agent] $[_{\text{VP}}$ $[_{\text{DP}}$ every piece of furniture] $[_{\text{VP}}$ $[_{\text{V}}$ destroyed] $[_{\text{DP}}$ every piece of furniture]]]]]

The object is still below the subject. Note that Kratzer does not assume the vP-Internal Subject Hypothesis here, but if she did, the lowest copy of the subject would be in the vP and not the VP, so it would still be higher than the object in (50).[9] So, in order to take scope over the subject, the object needs

[8] I have changed the proper name *Mrs. Purrington* to *some cat* here so that there is an actual inverse scope reading and not just an inverse scope structure (which would be blocked by Scope Economy).

[9] It is not immediately obvious how Kratzer could incorporate the vP Internal Subject Hypothesis in this system. The subject is the argument of the *Agent* head, so it cannot be interpreted by itself. Presumably, two copies of both the subject and the agent head would be needed, as in (i).

(i) $[_{\text{VoiceP}}$ $[_{\text{DP}}$ Mrs. Purrington] $[_{\text{Voice'}}$ $[_{\text{Voice}}$ Agent] $[_{\text{Voice'}}$ $[_{\text{Mod}}$ must] $[_{\text{VoiceP}}$ $[_{\text{DP}}$ Mrs. Purrington] $[_{\text{Voice'}}$ $[_{\text{Voice}}$ Agent] $[_{\text{VP}}$ $[_{\text{V}}$ destroy] $[_{\text{DP}}$ every piece of furniture to move again, and then its highest copy would need to be interpreted by the semantics, as in (51).

(51) $[_{\text{VoiceP}}$ $[_{\text{VoiceP}}$ $[_{\text{DP}}$ every piece of furniture] $[_{\text{DP}}$ some cat] $[_{\text{Voice'}}$ $[_{\text{Voice}}$ Agent] $[_{\text{VP}}$ $[_{\text{DP}}$ ~~every piece of furniture~~] $[_{\text{VP}}$ $[_{\text{V}}$ destroyed] $[_{\text{DP}}$ ~~every piece of furniture~~]]]]]]

So: obtaining an inverse scope configuration is now a process that requires two steps. The second step is needed because the first step does not lead to a structure where the object outscopes the subject. This means that the first step is semantically vacuous. Therefore, Scope Economy should block the first movement step. As a result, inverse scope is predicted to be impossible. If we adopt Kratzer's system, the consequence is not only that QR for type reasons is not necessary, but also that QR for scope reasons is not allowed. This is an unwanted prediction.

In sum, Kratzer's account solves the three problems described above by letting the object stay in place, but it creates a new problem relating to Scope Economy, and it is the opposite of the problem we saw earlier. While before, Scope Economy was not able to do its job and could not prevent inverse scope, now it blocks all instances of QR in a doubly quantified sentence. The only way around this, as far as I can see, is to give up Shortest Move. As my solution does not have these issues, I think it is to be preferred over this one.

7.6.2 It is costly to pick a different copy at PF than at LF

The second alternative solution that one might propose is that deleting a different copy at PF than at LF is costlier than deleting the same copy at both interfaces. As can be seen in (52), the object that has undergone QR is deleted in its original position at LF and deleted in its moved position at LF. The subject is deleted high at LF and low at PF.

(52) a. LF: $[_{\text{TP}}$ ~~some cat~~ $[_{\text{TP}}$ every piece of furniture $[_{\text{vP}}$ some cat $[_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]
b. PF: $[_{\text{TP}}$ some cat $[_{\text{TP}}$ ~~every piece of furniture~~ $[_{\text{vP}}$ ~~some cat~~ $[_{\text{VP}}$ ruined every piece of furniture]]]]

I have argued that it is necessary for QR to require an extra movement step, and one argument I had for this is that inverse scope readings are more difficult to process than surface scope readings. But maybe the complexity that causes a processing delay should lie not in an extra movement or a more complex

]]]]]]]

The two copies of both the subject and the Agent head would then have to be either deleted or interpreted at the interfaces.

structure, but rather in a PF/LF discrepancy. In (52-a), the inverse scope structure requires the same number of movement steps and is equally complex as the surface scope configuration in (53-a). But when we take the pair in (52) and compare it to the pair in (53), the PF/LF discrepancy is larger in the former pair. While the object in (53-a) still has to be interpreted high for type reasons, the subject is interpreted in the same place as where it is pronounced at PF.

(53) a. LF: [$_{\text{TP}}$ some cat [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ ~~some cat~~ [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]
b. PF: [$_{\text{TP}}$ some cat [$_{\text{TP}}$ ~~every piece of furniture~~ [$_{\text{vP}}$ ~~some cat~~ [$_{\text{VP}}$ ruined every piece of furniture]]]]

In this section I will explore this alternative possibility. The first question that arises is at what level this PF/LF comparison takes place. The generally accepted model of language in generative linguistics is the Y-model or T-model (e.g. Chomsky, 1993) shown in figure 7.1. The idea is that the syntax creates a structure, which is then sent to LF to be interpreted and to PF to be pronounced. PF and LF do not directly meet, so in this model, there is no place where a PF/LF comparison could take place.

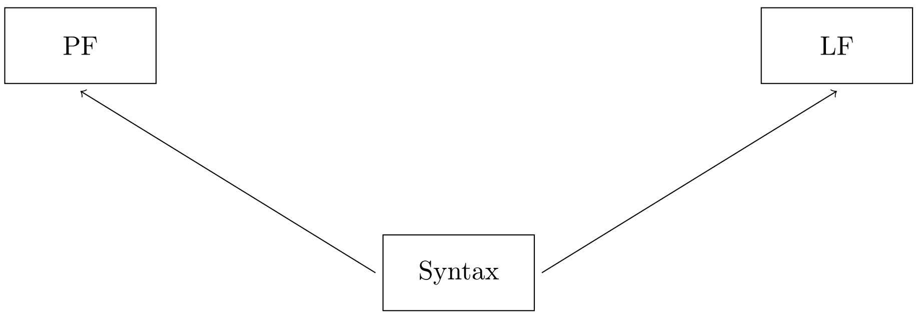


Figure 7.1: Y-model

In the following two sections I will discuss two ways for PF and LF to meet. The first is to adopt Reinhart's reference set computation model. The second is to deviate from the Y-model and assume that there is a direct link between PF and LF. I will show that neither method provides a satisfactory solution to the three problems I have discussed in this chapter.

Implementation 1: Reference set computation

The reference set computation approach goes back to Reinhart (1995, 2006a). Reinhart starts from the observation that inverse scope is marked: as I have also discussed here, linguists' intuitions and experimental data alike indicate that inverse scope readings are difficult to obtain for doubly quantified sentences.

She claims that in principle, QR does not take place, and only the surface scope interpretation is available. When this interpretation is incompatible with the context of the utterance, QR becomes an option. To determine the correct interpretation, reference set computation takes place. Reference set computation compares pairs of forms and meanings. In the case of QR of a doubly quantified sentence like (1), repeated here as (54), there is one form; one surface string. Let us call this form f_1. There are two possible meanings: the meaning that results from surface scope, which I will call m_1, and the inverse scope meaning, which I will call m_2. The pair $< f_1, m_1 >$ is now compared to the pair $< f_1, m_2 >$. In the case where the context favours m_2, $< f_1, m_2 >$ can be selected.

(54) Some cat ruined every piece of furniture.

Thus, there is an additional level of representation built on top of the Y-model where LFs and PFs are compared, as in figure 7.2.

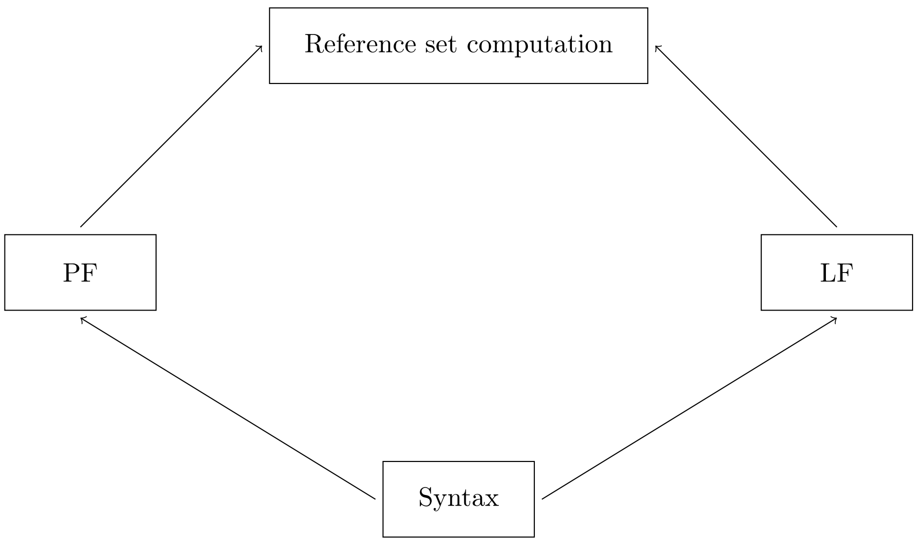


Figure 7.2: Y-model plus reference set computation

The reason why inverse scope readings are more marked than surface scope readings, according to Reinhart, is that they involve reference set computation. The process of comparing two LFs and deciding which one is best for the context is costly, and it is this cost that causes inverse scope configurations to be more marked and harder to process than surface scope configurations. So, Reinhart's proposal is that when the context is compatible with the surface scope reading of a doubly quantified sentence, nothing happens. The object quantifier does not raise, the sentence is interpreted as it is, and no reference set needs to be computed. When there is an incompatibility between the context and the surface scope reading, the object quantifier raises, and the resulting

LF is compared to the surface scope LF. When certain conditions are met, the inverse scope configuration can be chosen. This process of comparing multiple LFs is difficult for the human brain and incurs a processing cost.

Reinhart explicitly says that QR must be optional. But we are interested in seeing how we can use her account to compare LFs and PFs under the assumption that QR is obligatory. Let us consider how such an approach would work. Since we are assuming that object quantifiers move for type reasons, the structure in (55) is generated for (54).

(55) [TP some cat [TP every piece of furniture [vP some cat [VP ruined every piece of furniture]]]]

PF deletes the higher copy of the object and the lower copy of the subject. LF can choose to delete either copy of the subject and the object, so it can interpret (54) with both possible scope configurations, as in (56).

(56) a. [$_{\mathrm{TP}}$ some cat [$_{\mathrm{TP}}$ every piece of furniture [$_{\mathrm{vP}}$ ~~some cat~~ [$_{\mathrm{VP}}$ ruined ~~every piece of furniture~~]]]]
b. [$_{\mathrm{TP}}$ ~~some cat~~ [$_{\mathrm{TP}}$ every piece of furniture [$_{\mathrm{vP}}$ some cat [$_{\mathrm{VP}}$ ruined ~~every piece of furniture~~]]]]

Now we need to start comparing LFs and PFs. As in Reinhart's approach, we have one form and two meanings. Using the same notation as above, we again have the pair $< f_1, m_1 >$ and $< f_1, m_2 >$. We now need to say that among these pairs, the most economical one is the one with the least amount of cases where a copy is deleted at one interface but not at the other.

In this case, m_1 is a meaning that results from the LF in (56-a). f_1 is the PF given in (57). There is one PF/LF discrepancy here: the higher copy of the object is interpreted but the lower copy of the object is pronounced. The pair $< f_1, m_2 >$, where m_2 is the LF in (56-b), has two PF/LF discrepancies: the object is again interpreted high and pronounced low, and in addition the subject is now interpreted low and pronounced high.[10] $< f_1, m_1 >$ should be preferred to $< f_1, m_2 >$ because it has only one PF/LF discrepancy.

(57) PF: [some cat ~~every piece of furniture~~ ~~some cat~~ ruined every piece of furniture]

The first problem with this approach is that economy is a stipulation. There is no reason why choosing (56-a) over (56-b) should be less costly than choosing (56-b) over (56-a). In Reinhart's original theory, the fact that inverse scope requires the comparison of several different propositions is what makes it less economical. Recall that in Reinhart's account, QR only takes place optionally, so surface scope is the default option. Reference set computation only takes place in the inverse scope case. Thus, there is an extra operation that takes

[10]The subject is only pronounced high if we assume the EPP condition. Without that, we could also say that it is pronounced low, because it makes no difference to the surface order.

place in the inverse scope case but not in the surface scope case. This is not so in the PF/LF discrepancy approach. Here, we are assuming that QR always takes place for type reasons. The resulting configuration allows both a surface scope interpretation and an inverse scope interpretation, so there can be no default option. As a result, reference set computation must always take place. If we assume that PF/LF correspondence is less costly than PF/LF discrepancy, we need to compute the reference set to check to what extent the given PF corresponds to the LFs under consideration. But now we lose the intuition behind Reinhart's account. For her, resorting to reference set computation is not economical, and the fact that inverse scope necessitates this move is what makes inverse scope less economical. In the PF/LF discrepancy approach reference set computation always has to take place, because we no longer have a default interpretation. Therefore, surface scope and inverse scope are still predicted to be equally costly.

A second, more general, problem is that there is nothing that constrains reference set computation in this approach. Simply claiming that PFs and LFs must be as similar as possible without formulating any constraints on when this comparison should come into play results in a situation where reference set computation must always take place. It is the only way to compare LFs to PFs. Even for sentences where no movement at all has taken place, we need reference set computation, because there is no way to tell what has happened at the other interface until you make this comparison. Perhaps it is possible to find a way to formulate constraints on when reference set computation takes place within this approach, but note that this is not possible for the case at hand. As the structure in (56) is generated in both the surface and the inverse scope case, there is no default structure. In this approach it makes no sense to say, as Reinhart does, that reference set computation only happens if the meaning associated with the surface scope structure does not match the context, because could just as easily say that reference set computation only happens if the meaning associated with the inverse scope structure does not match the context.

Finally, it makes a range of other predictions. Covert movement is predicted to always be costlier than overt movement. For example, given obligatory QR, any structure with an object quantifier is predicted to be costlier than the same structure with a referential object, even if it has a quantifier in subject position. (58-a) is predicted to be harder to process than (58-b).

(58) a. Keira liked every play.
b. Every girl liked *Hamlet*.

Under a covert movement account of *wh-in-situ*, a sentence with *wh-in-situ* is predicted to be costlier than a sentence with a moved *wh*-element. For instance, the French sentence in (59-a), where *qui* stays *in situ*, should be harder to process than (59-b), where the *wh*-element has been moved.[11]

[11]Both phrasings appear to be very common. A Google search on 11 May 2017 yielded 16.700 hits for (59-a) and 18.900 hits for (59-b). This difference does not seem very large. Of

(59) a. Tu as vu qui?
You have seen who?
'Who did you see?'
b. Qui as-tu vu?
Who have-you seen?
'Who did you see?'

It is not clear if these predictions are borne out.

For these three reasons, this does not seem to be a promising approach when it comes to accounting for processing cost incurred by inverse scope configurations. Now let us turn to the missing readings problem and see how the account fares.

The missing readings problem is the problem that inverse scope readings are not always attested. Therefore, we must be able to formulate constraints on QR to avoid overgeneration. One such constraint that has been proposed in the literature is Mayr & Spector's (2012) Generalised Scope Economy constraint, which roughly states that covert move- ment operations are not allowed to strengthen the meaning of a proposition. For instance, (60) (Mayr & Spector, 2012, p.3) does not have the inverse scope reading that John met no student of mine in time. According to the authors, this is because this reading asymmetrically entails the surface scope reading that it is not the case that John met every student of mine on time.

(60) John didn't meet every student of mine on time

The way this constraint was originally formulated was as a constraint on movement. In the PF/LF discrepancy approach, it would have to be formulated as in (61).

(61) *Generalised Scope Economy in the PF/LF discrepancy approach*
When two copies of the same element are generated, LF and PF can each delete a different copy iff this procedure does not lead to stronger reading than when PF and LF delete the same copy

It is not obvious why a rule like (61) should exist, but the same could be said for Generalised Scope Economy as a constraint on movement. What is clear is that it is possible to formulate a constraint on inverse scope in this framework. However, it is good to keep in mind that the PF/LF discrepancy approach does not allow us to formulate constraints on QR in the syntax. We have to assume that this is always allowed, and that the only possible constraints on inverse scope are transderivational constraints like (61). This kind of theory could be on the right track, but it would involve a completely different view of grammaticality. We now no longer define constraints at the level of narrow

course, Google is not a corpus and frequency cannot be equated with processing difficulty, so a far more rigorous study is needed to check whether the prediction that (59-a) is harder to process than (59-b) is borne out.

syntax but rather constraints on the linguistic system as a whole.

Finally, let us turn to Scope Economy. Reinhart formulates a version of Scope Economy that uses the notion of reference sets, but this way of stating Scope Economy, too, is dependent on QR being optional. If QR is not optional, we need to formulate a Scope Economy constraint like (62).

(62) *Scope Economy in the PF/LF discrepancy approach*
When two copies of the same element are generated, LF and PF can each delete a different copy iff this procedure leads to different truth conditions than when LF and PF delete the same copy

We could state Scope Economy this way, but the arguments I gave against the PF/LF discrepancy approach earlier also apply here. We are at a stage where we have already raised the object quantifier and we have already computed the reference set. It is not clear why choosing an LF-PF pair where the same copies are chosen at both interfaces would then be more economical than choosing any other LF-PF pair from the set, as there is no obvious reason why this should incur an extra processing cost in this model. Therefore, the condition in (62) has lost the connection to the intuition behind the original Scope Economy condition.

As a final remark, another consequence of taking the PF/LF discrepancy approach for Scope Economy is that we need to think carefully about when to apply ellipsis. Recall that the relevant contrast is between (63) and (64), repeated from (10) and (12).

(63) A cat ruined every piece of furniture. A pig did, too.

(64) A cat ruined every piece of furniture. Walter did, too.

Scope Economy allows QR in the ellipsis sentence of (63) but not (64) because it would be semantically vacuous in (64). The cases that illustrate Scope Economy are cases where the VP has been elided. Fox assumes a PF deletion account of ellipsis: ellipsis structures have fully fledged syntactic structures, and the elided part is only deleted at the PF interface, leaving the syntax and semantics unaffected (Fox, 2000, p. 179). Therefore, Fox assumes that whatever holds for (65-a) also holds for (65-b).

(65) a. Walter did, too.
b. Walter ruined every piece of furniture, too.

Given this approach to ellipsis, the fact that the relevant examples contain ellipsis is unproblematic under the assumption that Scope Economy applies at syntax or at LF. It also does not affect Reinhart's approach to Scope Economy. In her system, when different pairs of a form and a meaning are compared, the factor that determines whether inverse scope is allowed is whether the meanings are different. What the PF looks like makes no difference.

If we adopt the PF/LF discrepancy approach, on the other hand, we need to compare what the relevant PF looks like to what the LF looks like. If we delete the VP *ruined every piece of furniture* before taking this step, the comparison cannot be made. Thus, we need to postulate that the following three things need to happen at PF, in this order:

1. Selective deletion
2. PF/LF compatibility check
3. VP deletion

Of course, this could be what actually happens. It may be impossible to test whether it is, but it is good to keep in mind that if we take the PF/LF approach, the role of ellipsis in the Scope Economy account is not a trivial one.

The main message here is that using reference set computation to compare PFs and LFs requires the extra step of comparing PFs and LFs regardless of whether we are dealing with a surface scope configuration or an inverse scope configuration. Therefore, ruling out the inverse scope structure is arbitrary. Thus, this is not a promising way to implement the PF/LF discrepancy account. Let us try another method.

Implementation 2: Direct PF-LF link

Another way to compare LFs and PFs is to assume that they already have a direct link. That is, no extra set of reference set computation is needed for LF and PF to 'see' each other, as in figure 7.3.

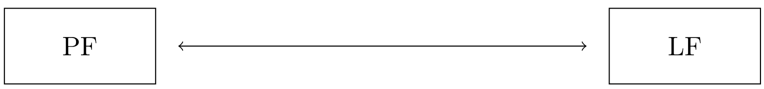


Figure 7.3: Direct PF-LF link

I will first discuss an account that makes this assumption, namely Bobaljik and Wurmbrand (2012). The discussion will be brief, as it will quickly become clear that their account is not suitable for the types of data I explore in this chapter. Then I will consider an alternative way to think about the direct PF-LF link, namely as a processing model rather than a model of language. The conclusion will be that this is probably the best way to implement the PF/LF story, but it is still far from perfect.

So let us start with Bobaljik and Wurmbrand (2012). Bobaljik and Wurmbrand argue that PF and LF are not two disjoint interfaces that only connect through narrow syntax. Instead, they propose that LF and PF have a direct link, and that LF is the input to PF. That is, in their model of language, one LF is generated, and then several PFs compete in an LF representation beauty contest. In addition, they propose the general condition given in (66), where > means 'scopes over' at LF and 'linearly precedes' at PF.

(66) *Scope Transparency*
If the order of two elements at LF is A>B, the order at PF is A>B

This condition then interacts with other conditions to account for a range of phenomena. One of these is the contrast in (67).

(67) a. (Exactly) one student is likely to be absent. $\exists$ >*likely* ; *likely*> $\exists$
b. There's likely to be (exactly) one student absent. *$\exists$ >*likely* ; *likely*> $\exists$

Only (67-a) can have an inverse scope configuration. The authors propose that this is because of an interaction between (66) and the condition in (68).

(68) *DEP*
Don't insert expletive pronoun

The explanation then goes as follows. To represent the LF where *likely* scopes over *one*, the PF in (67-a) fails to meet Scope Transparency; *one* linearly precedes *likely*. As it does not contain an expletive pronoun, it does not violate (68). The opposite is true for (67-b): this PF contains the expletive pronoun *there* so it violates DEP, but *likely* precedes *one*, so Scope Transparency is satisfied. As both PFs violate one condition, there is no winner, and both are allowed.

To represent the LF where *one* takes scope over *likely*, (67-a) gives a stellar performance: it satisfies both Scope Transparency and DEP, so it gets top marks. (67-b) unfortunately loses this beauty contest: both its expletive pronoun and its *likely*>*one* order are considered to be flaws by the judges, so it does not get to represent this LF.

All of Bobaljik and Wurmbrand's examples have this format: one LF, two competing PFs, and two conditions. The score is always 1-1 for one LF and 2-0 for the other, leading to what they call the $^3/_4$ signature: three out of four possible readings are attested. Extending this model to the cases at hand is not straightforward. For instance, it is not clear what PF (69); one of Reinhart's examples of a sentence that lacks an inverse scope reading, would be competing with. Inserting an expletive pronoun as in (70) would not change the order of the two quantifiers. We could try the PF in (71), but it is not clear what other condition besides Scope Transparency would be at play here and whether the PF in (71) is similar enough to (69) to compete for the same LF.

(69) Two flags are hanging in front of three buildings.

(70) There are two flags hanging in front of three buildings.

(71) Three buildings have two flags hanging in front of them.

In addition, it is not possible to predict that a PF is capable of representing a certain LF, but it is a marked reading that is difficult to process, as is the case for inverse scope readings in cases like (72-a). In Bobaljik and Wurmbrand's system, the PF with the highest score wins and the other one loses, and there is nothing in between. To enrich the system to allow for this, perhaps we could imagine more complex situations where three or more conditions are at play. In this case, we could construe the conditions in such a way that the outcome for the *every* > *some* configuration in (72) would be, say, 3-2 for (72-b), and we could stipulate that scores at a certain threshold (here: 2) lead to existent but marked readings.

(72) a. Some cat destroyed every piece of furniture.
b. Every piece of furniture was destroyed by some cat.

However, I do not think that it is possible to explain all the data this way. To do this, we would have to find a suitable competing PF for every PF, and we would have to formulate many conditions in such a way that they would predict exactly which PFs rule out other PFs and which PFs are merely more marked than other PFs. More importantly, the data at hand simply do not lend themselves to being explained by a PF comparison mechanism. For instance, the PFs in (73) ((73-a) repeated from (20)) have exactly the same structure as the PFs in (72). It seems to be impossible in this framework to explain why (73-b) rules out (73-a) while (72-b) only makes (72-a) more marked.

(73) a. No child found an easter egg.
b. An easter egg was found by no child.

So let us not try to extend Bobaljik and Wurmbrand's account to our cases Instead, we can conceive of a system where PF and LF have a direct connection without the other aspects of Bobaljik and Wurmbrand's account. This is the second possibility I will review in this section. Let us say that the PF/LF discrepancy approach should be completely disjoint from the Y-model. Instead, it should be part of our processing model of language. Thus, we do not claim that an LF and a PF are both formed and then different PF-LF pairs are compared, as in my description of the PF/LF discrepancy approach in the previous section. Nor do we say that LF has to be the input to PF and not vice versa, or that there are always multiple conditions that determine which PF is selected, as in Bobaljik and Wurmbrand's account. Instead, we say that when language is used, a speaker has a certain LF in mind and needs to convert this to a PF. The more different from the LF the PF is, the harder the conversion is. Similarly, when a hearer hears a PF that is very different from the intended LF, she has to do more work to get the right meaning. This could simply be how processing works, independently of how the linguistic system in the narrow sense functions.

This could work, though this way of implementing the PF/LF approach also predicts the contrasts between (58-a) and (58-b) and the contrast between (59-a) and (59-b) discussed above. The question is whether this account could solve the other two problems at hand: Scope Economy and missing readings. For Scope Economy, the answer seems to be yes. Scope Economy could be a constraint on processing: as it is not economical to pronounce a different copy than you interpret, or to interpret a different copy than you have heard, there could be a rule stating that this can only happen when it results in a truth conditional change. Note, though, that parallelism would also have to be a processing constraint in this story. Parallelism looks at the antecedent sentence and the ellipsis sentence of an ellipsis construction after all movement operations have taken place and then determines whether the two structures resemble each other closely enough for ellipsis to be licensed. Given that Scope Economy prohibits certain inverse scope configurations, Parallelism must check the construction after Scope Economy has done its work. Hence, if Scope Economy is not a constraint on syntax but rather a higher-level processing constraint, Parallelism must be, too.

What about the missing readings problem? This seems to be much harder to explain in terms of processing than the other two issues. Inverse scope is possible in (74-a) but not in (74-b). (74-b) cannot mean that no piece of furniture was destroyed by a cat.

(74) a. Some cat destroyed every piece of furniture.
b. No cat destroyed every piece of furniture.

The only difference here is the nature of the subject quantifier. This indicates that we need an explanation for the contrast in (74) that appeals either to the semantics or perhaps to the syntactic properties of these quantifiers. (75) makes the same point. (75-a) has an inverse scope reading: for every piece of furniture, there was exactly one cat who destroyed it. The (perhaps marginal) example in (75-b) does not; it cannot mean that there is no piece of furniture that was destroyed by exactly one cat. Instead, it means that there was one cat, no fewer and no more, who did not destroy any furniture.

(75) a. Exactly one cat destroyed every piece of furniture.
b. Exactly one cat destroyed no piece of furniture.

What the contrasts in (74) and (75) illustrate is that, as is well known, the nature of the operators in a sentence determines whether QR is possible (e.g. Szabolcsi, 1997). It matters whether you insert a universal quantifier or a negative quantifier, and it matters whether you insert a nominal quantifier or a modal. This indicates that we need access to the linguistic properties of these expressions in order to formulate our constraints on QR, and it is not obvious how this should be done in a model that only considers processing.

Finally, there are some cases where only an inverse scope reading is attested. Two examples are given in (76).

(76) a. I can wait no more.
b. Enrique is allowed to sing at most one song.

(76-a) is a line from the song ‘Bailando’ by Enrique Iglesias. Here the surface scope reading would be that it is possible for Enrique to wait no more. This does not rule out the option that it is also possible for Enrique to wait more. The inverse scope reading is that it is not possible for Enrique to wait any longer. Given the rest of the lyrics and the nature of Enrique Iglesias, it is quite clear that the intended reading is the inverse scope reading, and in fact the surface scope reading is not a possible reading for this sentence (see also Iatridou & Zeijlstra, 2013, for the observation that negation must outscope existential modals).

Listening to 'Bailando' might lead someone to make a statement like (76-b). Here the surface scope reading is that Enrique is allowed to sing zero songs or one song. This allows for the possibility that Enrique sings more than one song. The inverse scope configuration puts an upper bound on how many songs Enrique can sing: he can sing one song, but no more than that. This is the only available reading for (76-b) (Blok, 2015a).

Thus, there are cases where QR is blocked, but also cases where only an inverse scope reading is available, as attested by the lack of surface scope readings for the sentences in (76). It may somehow be possible to account for the lack of inverse scope readings with certain quantifiers or modals if we take the PF/LF discrepancy approach, but this account has no hope of explaining obligatory inverse scope readings. After all, if the only principle we have is that surface scope configurations are more economical than inverse scope configurations, we cannot explain cases where only the latter are attested. Of course this does not mean that certain cases where there are no inverse scope readings cannot be due to processing constraints, but it does mean that the PF/LF discrepancy account can never provide us with a full account of which readings are available and which ones are not. We need constraints in the linguistic system to do that. And for us to be able to formulate constraints in the linguistic system, we need QR to be optional.

7.6.3 The problem is not a QR problem but a Reconstruction problem

We have seen that if we adopt the Copy Theory of Movement and obligatory QR, then the process of obtaining an inverse scope reading involves Reconstruction: interpreting the lower copy of the subject rather than the higher copy. The solution I have proposed above involves constraining QR. But given that Reconstruction is part of the operation of QR, one might wonder whether it is Reconstruction rather than QR that should be constrained. If we have a structure like (77), where *every piece of furniture* has undergone obligatory QR, we only get an inverse scope reading if *a cat* is interpreted low. But if we can somehow prevent this, then we no longer need to constrain QR because we no longer get inverse scope 'for free'. In this section, I will explore whether this is a viable alternative.

(77) $[_{\text{TP}}$ A cat $[_{\text{TP}}$ ever piece of furniture $[_{\text{vP}}$ a cat $[_{\text{VP}}$ ruined ~~every piece of furniture~~]]]]

This section is organised as follows. First, I will address the question of whether or not Reconstruction is indeed constrained in the same way that QR is. I will discuss whether it is constrained by Scope Economy and whether reconstructed readings are sometimes blocked. The conclusion will be that there are indeed cases where Reconstruction is impossible, which indicates that we need to be able to constrain it, like QR. Thus, the problem for QR that I have sketched in this chapter also seems to hold for Reconstruction. At this point, given that Reconstruction needs to be constrained on independent grounds, it seems like the solution for QR I proposed earlier is perhaps unnecessary. But, as I will discuss below, this is not the end of the story. First I will show that it is not at all straightforward to find a way to constrain Reconstruction. I will discuss two alternative accounts of Reconstruction and show that neither account can provide us with a solution. Then I will show that there are cases where Reconstruction is clearly allowed but where QR is still blocked. This shows that regardless of how we treat Reconstruction, constraining QR is still necessary.

Is reconstruction constrained?

In this section, I will explore whether Reconstruction is freely available or whether it is restricted by Scope Economy and other constraints on scope. I will begin with Scope Economy.

If we assume the Copy Theory of Movement account of Reconstruction, where obtaining a reconstructed reading simply involves interpreting the lower copy of the subject, the prediction is that Scope Economy does not work for Reconstruction. Consider (78). If Reconstruction were a downward movement operation, as Fox (2000) assumes (Quantifier Lowering, May, 1977), the prediction is that *Mrs. Purrington* is not allowed to lower to a position below the elided *seem*. The reason is that *Mrs. Purrington* and *seem* are commutative, so moving one over the other does not change the truth conditions of the proposition. Because of Parallelism, *a monster* is then not allowed to lower below *seem*. Scope Economy thus predicts that we only get a surface scope reading for the antecedent sentence in (78).

(78) A monster seems to be under the bed. Mrs. Purrington does, too.

If we assume the Copy Theory of Movement, however, Reconstruction does not involve a movement operation but rather the interpretation of the lower copy of the subject, as in (79). There is no movement operation for Scope Economy to block, so the prediction is that inverse scope is allowed in the ellipsis sentence, and, by Parallelism, also in the antecedent sentence.

(79) [$_{\mathrm{TP}}$ ~~Mrs. Purrington~~ [$_{\mathrm{TP}}$ seems [$_{\mathrm{vP}}$ Mrs. Purrington [$_{\mathrm{TP}}$ to be under the bed]]]]

Similarly, the ellipsis cases with modals in (80) are now all predicted not to be constrained by Scope Economy.

(80) a. A student is required to attend the meeting. Thomas is, too.
b. A kid may have set off the fire alarm. Annette may have, too.
c. Someone from our class is likely to get a job in Paris. Lydia is, too.

Fox provides similar Reconstruction data with *seem* and *likely*, such as (81). He claims that Scope Economy does hold for Reconstruction in the same way that it holds for QR.

(81) Someone from New York is likely to win the lottery. John is, too.

I have collected a lot of data on this and although my informants seemed to get inverse scope readings for the antecedent sentence of pairs of sentences such as the ones in (78), (80), and (81), they also did not straightforwardly agree with Fox's QR data or even relatively simple Parallelism data like (82), repeated from (10): not all of my informants seemed to agree that the antecedent sentence must have the same scope configuraton as the ellipsis sentence in such cases.

(82) A cat ruined every piece of furniture. A pig did, too.

Therefore, I will leave this as an open issue here, and merely note that the prediction made by the Copy Theory of Movement is that Scope Economy does not work for Reconstruction.

Fox also uses coordination data to argue that Scope Economy holds for Reconstruction. To do this, he first introduces the Coordinate Structure Constraint, which states that movement into or out of a coordinate structure is possibly only if it's across the board movement: the same operation must apply to both conjuncts. Thus, this constraint is basically Parallelism for coordinate structures. A relevant example is given in (83). According to Fox, the structure of this sentence is as in (84). To satisfy the Coordinate Structure Constraint, *a guard* can either stay above both conjuncts or it can lower into both conjuncts, as in the slightly simplified strucutre in (85). As Fox assumes obligatory QR for type reasons, lowering leads to the plausible inverse scope reading: there are multiple guards, each standing in front of a church or sitting at the side of a mosque.

(83) A guard is standing in front of every church and sitting at the side of every mosque.

(84) A guard$_2$ is [every church$_1$ [t$_2$ [standing in front of t$_1$]]]
and [every mosque$_1$ [t$_2$ [sitting at the side of t$_1$]]]

(85) t$_2$ is [every church$_1$ [a guard$_2$ [standing in front of t$_1$]]]
and [every mosque$_1$ [a guard$_2$ [sitting at the side of t$_1$]]]

The crucial data for Scope Economy, then, are given in (86). According to Fox, the only available reading here is the reading that involves no lowering. This is because moving *a guard* to a position below *this mosque* would not change the truth conditions in the second conjunct, so it is prohibited by Scope Economy. Because of the Coordinate Structure Constraint, no lowering at all can tan take place. Thus, the sentence only has the implausible meaning that there is one guard, and this guard is standing in front of every church and sitting at the side of a mosque.

(86) A guard is standing in front of every church and sitting at the side of this mosque.

This is a case where the data are perhaps more clear, and where Scope Economy seems to constrain Reconstruction. That would be a problem for the Copy Theory of Movement: if we assume that the traces in the structures above are all full copies, we again predict no economy constraints. However, Fox's explanation of these data relies on obligatory QR. If we assume that QR is optional, the data are actually no longer an issue for the Copy Theory of Movement. In this case, the surface scope structure is as in (87) and the inverse scope structure is as shown in (88).

(87) A guard is [a guard [standing in front of every church]]
and [a guard [sitting at the side of this mosque]]

(88) ~~A guard~~ is [every church [a guard [standing in front of ~~every church~~]]]
and [this mosque [a guard [sitting at the side of ~~every mosque~~]]]

There is no possibility to get an inverse scope reading from (87) regardless of which copy of *a guard* is interpreted. To do this, the objects in both conjuncts have to QR, as they have done in (88). In this case, QR is the second conjunct is semantically vacuous and therefore not licensed by Scope Economy. It is not possible for only one of the objects to move up, as this would violate the Coordinate Structure Constraint. Therefore, QR is also blocked in the first conjunct, and the only available reading is the surface scope reading. Reanalysing the data as cases where Scope Economy blocks QR, not Reconstruction, solves the problem here. Crucially, we again need the assumption that QR is optional. Therefore, these data are another argument to let object quantifiers be interpreted *in situ*.

In sum, there is no clear evidence that Scope Economy holds for Reconstruction. What about other constraints on scope?

In section 7.3, I discussed the missing readings problem for QR. I argued that we need to be able to restrict QR, because often we simply don't find the readings that we would expect if QR had taken place. I showed that the absence of these readings must be due to a constraint on movement rather than a constraint on interpretability by overtly switching the order of the quantifiers. This led to perfectly interpretable sentences. For instance, (89-a) does not have an inverse scope reading. It cannot mean that there were exactly two books that were read by some student, which could be true in a situation in which not a single student read exactly two books. But if you swap the quantifiers by passivising the sentence, as in (89-b), the sentence does have this reading. Therefore, *exactly two* is perfectly happy scoping over *some*; it just cannot QR over it in (89-a).

(89) a. Some student read exactly two books.
b. Exactly two books were read by some student.

By making QR optional, formulating constraints on it is possible again. But what about Reconstruction? Reconstruction in the Copy Theory of Movement involves simply interpreting the lower copy of the subject. There is no movement involved, so the prediction here, too, is that it should be freely available. Whenever there is no reconstructed reading, we predict that this must be because of a constraint on interpretability. It cannot be a constraint on movement, because there is no movement. In this section, I will discuss this prediction and the possible consequences it may have for my account.

Let us consider the data in (90), where an existential modal interacts with a DP containing a modified numeral. These are both cases where Reconstruction is impossible. For instance, imagine that there is a rule that students need to have a GPA of at least 3.5 to attend the seminar. If more than half of the students have a GPA of 3.5 or higher, it follows that more than half of the students can attend. But in the actual world, it happens to be the case that only 30% of the students have a GPA of at least 3.5. In this scenario, the surface scope reading is false but the inverse scope reading is true: it is in principle allowed for more than half of the students to attend; it just so happens that in the actual world, less than half of the students can attend. Intuitively, (90-a) is false in this scenario. This shows that there is no reconstructed reading. The judgment for (90-b) is easier to get: the reconstructed reading is the reading that it is possible for zero, one, two, three, four, or five people to fit in the car, without excluding the possibility that six or more people could fit in. The surface scope reading sets an upper bound on what is possible: the maximum number of people that can fit in the car is five. This is the only available reading.

(90) a. More than half of the students are allowed to attend the seminar.
b. At most five people can fit in this car.

Now let us see what happens when we switch the order of the quantifiers, as in (91). Now, the inverse scope readings are the only available readings. In a situation where John is the one who has to invite the students with a GPA of 3.5 or higher to the seminar and the rest of the scenario is the same as the one described above, (91-a) is false, just like (90-a). Similarly, (91-b) is not compatible with the possibility of Mary being able to fit ten suitcases in her car.

(91) a. John is allowed to invite more than half of the students.
b. Mary can fit at most five suitcases in her car.

The same observation can be made for cases where a negative DP interacts with a modal. cannot mean that the scenario of nobody leaving is merely one of the available options, so Reconstruction is not possible. When we swap the surface order of the quantifiers, inverse scope is the only available option: (92-b) can only mean that there is nobody such that the hearer can tell that person. It cannot have the weak reading that the speaker can choose not to tell anybody if she so desires.

(92) a. No one can leave.
b. You can tell no one.

Reconstructed readings with negative DPs and universal modals seem easier to get. For instance, the most prominent reading of (93-a) is not that no one has the requirement to leave but the reconstructed reading that it is necessary that everybody leaves. Similarly, (93-b) seems to have the reconstructed reading that it is necessary that no more than five people be there — the surface scope reading is that between zero and five people have the requirement to be present, leaving open the possibility that more than five people can be there.

(93) a. No one must leave.
b. At most five people must be there.

Reconstruction appears to be harder under *required.* Unlike the ones in (93), the most prominent readings for the sentences in (94) are the surface scope readings that nobody carries the requirement to leave and that at most five people carry the requirement to be there. The reconstructed readings are more difficult to get.

(94) a. Nobody is required to leave.
b. At most five people are required to be there.

When you swap the quantifiers in the *must* and *required* cases, a similar pattern emerges. (95) only seem to have surface scope readings, whereas in (96), inverse scope is more prominent.

(95) a. Cathy must tell nobody.
b. Anthony must invite at most five people.

(96) a. Cathy is required to tell nobody.
b. Anthony is required to invite at most five people.

Although the data with existential modals are clearer than the data with universal modals, the generalisation that emerges seems to be that whenever a DP A cannot reconstruct below a modal B, this is because the scope configuration $B > A$ is not licit. This is attested by the fact that when A is base-generated below B, we still get the $A > B$ reading rather than the $B > A$ reading. The data above corroborate the prediction of the Copy Theory of Movement that Reconstruction is a freely available operation.

Now let us move on to cases with negation. Reconstructed readings are available for the sentences in (97), although they require a special intonational pattern; the so-called hat-contour pattern (Büring, 1997).

(97) a. Everybody didn't leave.
b. A girl didn't leave.

However, it has been claimed that Reconstruction of A-movement is severely limited (Lasnik & Saito, 1991; Chomsky, 1993, 1995; Lasnik, 1999). For instance, (98-a) does not have a reading where the universal quantifier takes scope under negation. It cannot mean that it seems to be the case that not everyone is there yet. Similarly, the ECM case in (98-b) does not have the reading that Rose proved that not every defendant was guilty.

(98) a. Everyone seems not to be there yet.
b. Rose proved every defendant not to be guilty.

As the paraphrases above and the sentences in (99) show, the scope orders *seems* > *not* > *everyone* and *not* > *every* are not ruled out independently. This means that the data in (98) exemplify true restrictions on Reconstruction.

(99) a. It seems that not everyone is there yet.
b. Rose proved that not every defendant was guilty.

The first thing to note here is that the examples where Reconstruction appears to be blocked are examples with negation, whereas the ones where it is more freely available are sentences with modals. Thus, we may have stumbled upon an interesting contrast in the availability of Reconstruction.

Second, the data in (98) are rather more complicated than the data with modals. They do not involve simple structures of the form [Subject [operator [subject]]]. (98-a) contains two operators instead of one; *seem* and negation, and (98-b) is an ECM structure. Nevertheless, all the cases I have discussed in this section are cases of A-movement Reconstruction, and the examples in (98) do seem to show that this kind of Reconstruction is not freely available, at least not for the entire range of data. This is another problem for the Copy Theory of Movement, and it may also be a problem for this account. Given that Reconstruction is constrained, perhaps it is not necessary to constrain QR at all. In the next section, I will show that things are not quite that easy.

Imposing restrictions on Reconstruction does not solve everything

Here I will discuss whether changing our theory of Reconstruction so that it is no longer predicted to be freely available will also solve the problem of QR being too freely available. First I will discuss two theories of Reconstruction that offer alternative ways of obtaining Reconstructed readings than merely interpreting the lower copy instead of the higher one. I will conclude that current theories of Reconstruction and current ideas of syntax in general make it difficult to constrain Reconstruction. Then I will argue that even if we do manage to constrain Reconstruction, we still need to constrain QR as well.

Let us first consider the semantic theory of Reconstruction. A number of authors have argued that reconstructed readings can be obtained through a semantic rather than a syntactic mechanism (Chierchia, 1995; Cresti, 1995; Rullmann, 1995b; Ruys, 2015). I will focus on the most modern interpretation of this idea here: the one in Ruys, 2015. Ruys' analysis is based on the notion that the lower copy of a movement chain can be interpreted as a variable by the semantics. I will not go into the details of how this can be done, but Fox (2002) proposed an operation he named *Trace Conversion* that does this. This variable can then be interpreted as a variable of type e, as in the representation of (100) given in (101).

(100) A cat is likely to purr.

(101) $[_{\text{TP}}$ A cat $[_{\text{TP}}\ \lambda x_e\ [_{\text{TP}}$ likely $[_{\text{vP}}\ x_e\ [_{\text{VP}}$ purr $]\ ]\ ]\ ]\ ]$

This way, the quantifier *a cat* takes its sister; λx . *x is likely to attend the meeting*, as an argument. This results in the surface scope reading of (100).

However, Ruys posits that the variable can also be interpreted as a variable of type $\langle\langle e,t\rangle,t\rangle$, as shown in (102).

(102) $[_{\text{TP}}$ A cat $[_{\text{TP}}\ \lambda X_{\langle\langle e,t\rangle,t\rangle}\ [_{\text{TP}}$ likely $[_{\text{vP}}\ X_{\langle\langle e,t\rangle,t\rangle}\ [_{\text{VP}}$ purr $]\ ]\ ]\ ]\ ]$

In this case, *a cat* is taken as an argument by its sister. This results in *a cat* being in the scope of the modal *likely*, yielding the inverse scope reading.

This approach suffers from the same problems as the simple Copy Theory of Movement account of Reconstruction. Recall that the two elements that lead to 'free inverse scope' are QR for type reasons and the option to interpret the lower copy of the subject. The problem is that neither is a movement operation that can be constrained: the formed cannot be constrained because it is obligatory, and the latter cannot be constrained because it does not involve movement. An different account of Reconstruction has the potential to change the nature of the second element. The semantic theory of Reconstruction, however, does not. An inverse scope interpretation can be obtained by interpreting the variable in the vP as a higher typed variable, so Reconstruction is not an operation that requires an additional movement step.

One might counter that it could be the type shift involved in (102) that makes it costly. However it is not clear why the object taking its sister as an argument would be less costly than the reverse. Why would the e type be the default type? Furthermore, even if the lower type is the default type, it is not obvious that type shifting is costly. Movement involves the insertion of an extra lexical element in the structure, but this is not so for type shifting. Therefore, this approach to Reconstruction does not solve the three issues mentioned earlier in this chapter.

Let us move on to another account of Reconstruction. Certain authors have argued that EPP is a requirement that holds at the level of PF rather than at the level of syntax (Merchant, 2001; Sauerland & Elbourne, 2002; van Craenenbroeck & den Dikken, 2006). Sauerland and Elbourne (2002) claim that Reconstruction is dependent on the level at which EPP is satisfied. EPP is a PF condition, and this means that it has to be satisfied by the time the derivation reaches PF, but it can also be satisfied at narrow syntax, as this level of representation precedes PF. In this case, one copy of the subject ends up in the TP at syntax, and we have the possibility to obtain the surface scope reading. If EPP is satisfied only at PF, the syntax of (100) is as in (103-a), with *a cat* only moving over *likely* at PF, as in (103-b). As there is no copy of the subject above the modal at the level of syntax, the LF has no choice but to interpret the copy that is under the modal. This leads to a reconstructed reading.

(103) a. Syntax: [$_{\text{TP}}$ likely [$_{\text{vP}}$ a cat [$_{\text{VP}}$ purr]]]
b. PF: [A cat likely ~~a cat~~ purr]

In the scenario where EPP is satisfied at syntax, the situation is exactly the same as before: the LF gets two copies and is free to interpret the lower one. Reconstruction is still a movement free operation, and therefore, so is QR, if we assume object movement for type reasons. In the case where EPP is satisfied only at PF, the only available reading is the reconstructed reading. For the QR cases, this means LF receives the structure in (104).

(104) [$_{\text{TP}}$ every piece of furniture [$_{\text{vP}}$ a cat [$_{\text{VP}}$ ruined ~~every piece of furniture~~]]]

Thus, LF receives a structure that gives rise to the inverse scope reading. If there is such a thing as movement at LF, perhaps there is a possibility that *a cat* moves up at LF to scope over the object. However, Sauerland and Elbourne claim that parallel movement at PF and at LF is ruled out for economy reasons. More importantly, even if it were allowed, it would actually make the problem worse. We would then have a situation where inverse scope is the default, and obtaining the surface scope structure would require an extra movement step. This is the opposite of what we want.

In conclusion, neither the semantic theory of Reconstruction nor the PF movement theory of Reconstruction allows us to formulate constraints on Reconstruction. May's (1977) Quantifier Lowering account would solve the problem. If we adopted Quantifier Lowering, we would assume that the subject moves to TP at the level of narrow syntax, leaving a trace as it does so. At LF it moves back down to a position below the operator it interacts with (such as a modal or negation). In the QR cases, it would move down over the QR'ed object, as in (105).

(105) [$_{\text{TP}}$ A cat$_2$ [$_{\text{TP}}$ ever piece of furniture$_1$ [$_{\text{vP}}$ t_2 [$_{\text{VP}}$ ruined t_1]]]]

As Reconstruction involves movement in this account, it can be constrained just like QR. However, this account goes against the spirit of Minimalism. For starters, it requires the existence of traces, which is undesirable because it involves adding elements other than the lexical items to the syntax and thereby making *move* a more complex operation that differs fundamentally from merging a lexical item that has not previously occurred in the structure. In addition, downward movement involves building up a structure and then taking it apart again to insert an element. This is not considered Minimalist and it violates the No Tampering Condition, which prohibits tampering with an already constructed derivation (Chomsky, 2008).

Given our current assumptions on syntax, constraining Reconstruction is no easy feat. But the data in (106) indicate that restricting Reconstruction cannot be a complete solution to the QR problem anyway. Consider (106-a). The most prominent reading of this sentence is arguably the reconstructed reading: it is likely that some shop attendant or other will bother every customer. For the sentence to be felicitous, there does not need to be a specific shop assistant that the speaker thinks will bother every customer, which would be the non-reconstructed reading. The point is that under this reconstructed reading, the object *every customer* is still interpreted most naturally as having narrow scope with respect to *some*. The most prominent reading is that it is likely that some shop attendant or other will, by himself, bother all of the customers. The inverse scope reading that for every customer, it is likely that some shop attendant will bother appears to be more marked. The same observation can be made for the other sentences in (106).

(106) a. Some shop attendant is likely to bother every customer.
likely > some > every
b. Exactly two shop attendants are likely to bother every customer.
likely > exactly 2 > every
c. Every CEO didn't fire exactly two people.[12]
not > every > exactly 2

What this shows is that even when we know that the subject is interpreted in its vP-internal posiiton, the reading that would result from quantifier raising the object to a position above the subject does not become any more prominent. Hence, it may be so that we also need to restrict Reconstruction, but even if this is so, we also need to restrict QR.

Let me sum up what I have done in this section. The question I addressed was whether constraining QR would obliterate the need to constrain QR. First I explored whether Reconstruction data do indeed show that Reconstruction needs to be constrained. The answer was a tentative yes. Then I made the point that even if this is so, it is not easy to do this, and furthermore, the data in (106) show that it cannot solve our QR problem. Therefore, optional QR is needed regardless.

[12] This sentence should be read with the *hat contour* intonation (Büring, 1997).

7.7 Conclusion

The purpose of this chapter was to expose a problem that arises if we adopt both the Copy Theory of Movement and QR for type reasons: inverse scope readings no longer require an extra movement step. This wrongly predicts that they should be just as easy to get as surface scope readings and makes it impossible to constrain inverse scope readings. This last problem is especially pertinent in this work given that in all preceding chapters I showed that scope is very often constrained.

To resolve this problem I argued that we need inverse scope to require an extra step in the derivation. I implemented this idea by letting object quantifiers be interpreted *in situ* through a type shifting mechanism.

In the second part of this chapter, I discussed three other ways that might solve the problem: Kratzer's event semantics account, a PF/LF discrepancy account, and restricting Reconstruction. The general conclusion is that none of these accounts solve the problems associated with obligatory QR in the Copy Theory of Movement. If we adopt the event semantics account, Scope Economy is predicted to block all instances of QR. The most promising version of the PF/LF account makes a host of dubious predictions about the processing cost associated with covert movement. For instance, subject quantifiers are predicted to be easier to process than object quantifiers. In addition, it has no hope of explaining why surface scope readings are not available in some cases. Finally, it is possible that Reconstruction, like QR, needs to be constrained in some way, but this is difficult to do and does not account for all the data, as exemplified by (106) above. In conclusion, we still need QR to be optional.

CHAPTER 8

Conclusion

In this dissertation I have discussed three cases where we see fewer scope interactions than thus far assumed in the literature or predicted by the literature: the case of split scope, the case of modified numerals and their interactions with modals, and the more general case of doubly quantified sentences. In addition, I have argued for a focus-based theory that unifies class B numeral modifiers, negative indefinites in split scope languages, and expressions like *only*. For the numeral modifiers I further refined this theory to account for the pragmatic inferences they give rise to. Below I will give a summary of each content chapter of this dissertation. In section 8.2 I will discuss the main contributions of this dissertation.

8.1 Chapter summaries

Chapter 3: Restrictions on split scope

Here I discussed the first case in the literature where too many scope configurations are taken to exist: the case of split scope. I showed that sentences that have split scope readings, where an operator from the object DP takes wide scope, but lack inverse scope readings where the entire object DP takes wide scope. Compositional accounts of split scope (De Swart, 2000; Abels & Martí, 2010) obtain split scope readings by first generating a wide scope configuration and then applying an extra operation to turn the wide scope reading into a split scope reading (type lifting for De Swart, selective deletion and binding of world variables for Abels and Martí). Thus, a wide scope configuration is needed to get split scope readings. This is problematic given that these wide scope configurations are not attested, which disables these accounts from deriving split readings. An account of split scope, then, must let the determiner of the object DP take scope by itself, without generating a structure where the whole object DP takes wide scope.

An account that does this is Blok et al. (2017). Blok et al. proposed that negative indefinites in split scope languages, such as *kein* in German and *geen* in Dutch, are degree quantifiers. They can take wide scope without the rest of the DP they occur in through the mechanism of degree quantifier movement, just like other degree expressions such as *fewer than* or *at least*. I discussed this account and the two main arguments for it: the Numeral Modifier Generalisation and the Heim-Kennedy Generalisation. The former is a new generalisation made by Blok et al. and states that negative indefinites in scope splitting languages can all modify numbers, just like other degree quantifiers. The latter states that degree quantifiers cannot move over modals but not over nominal quantifiers. Blok et al. show that this generalisation also holds for scope splitting negative indefinites, which again likens them to (other) degree quantifiers.

Thus: Blok et al.'s account allows scope-splitting negative indefinites to take wide scope by themselves and thereby derive split scope readings while avoiding the incorrect generation of wide scope readings. At the end of this chapter, however, I showed that Blok et al.'s story cannot be the complete solution. By putting scope-splitting negative indefinites in the category of degree quantifiers, the prediction is that all degree quantifiers including these negative indefinites display the same scopal behaviour. After all, they all have the same semantic type. It turns out that this prediction is incorrect: not all ostensible degree quantifiers are alike. A more detailed look at the data is called for.

Chapter 4: Restrictions on the scope of modified numerals

In this chapter I showed that even if we go down a level and use degree quantifier movement instead of full DP movement to get split readings, we still overgenerate. In looked at a specific type of degree quantifiers, namely modified numerals. I showed that in this domain, so-called class B numeral modifiers, such as *at least* and *at most*, are unable to take scope under existential modals. Class A numeral modifiers such as *fewer/less than* and *more than* do have this ability (terminology from Nouwen, 2010). This constitutes the second case I discussed in this book where too many scope configurations are thought to exist.

Sentences where class B modified numerals co-occur with modals can have two readings: an epistemic reading and an authoritative reading. There are two natural combinations of class B numeral modifiers and modals: combining *at least* with a universal modal or *at most* with an existential modal leads to sentences that are judged to be felicitous. The other two combinations result in less natural sounding sentences. Naturalness correlates with the ability to have an authoritative reading: the two natural combinations have strong authoritative readings, whereas for the less natural combinations the epistemic reading is more obvious.

In a much of the existing literature on modified numerals (Schwarz, 2013; Kennedy, 2015), all numeral modifiers are thought to be degree quantifiers. In their capacity as quantifiers, they are thought to be able to take wide and narrow scope with respect to any modal. The two scope configurations that are available if you let a modified numeral take scope either over or under a modal are then used to generate the two readings described above: wide scope for the modified numeral leads to epistemic readings whilst narrow scope for the modified numeral generates authoritative readings.

The problem is that while we do see two readings for sentences with modals and class B modified numerals, when the modal is existential, only one out of the two possible scope configurations is attested: the one where the numeral modifier takes wide scope. Thus, using scope to account for the ambiguity we observe cannot work. Just like in chapter 3, the literature overgenerates by assuming that all possible scope configurations exist, contrary to fact. As I showed in detail in this chapter, the theories under discussion also run into a number of other problems.

Thus, we need a theory of split scope that does not make use of non-existent wide scope configurations and we need a theory of class B modified numerals that does not make use of non-existent configurations where an existential modal takes scope over the modified numeral.

Chapter 5: Focussing on split scope

The goal of this chapter was to provide a unified account of split scope and numeral modifiers that does not rely on any non-existing scope configurations. In addition, the account must avoid overgeneration in a second way: it must only generate split scope for expressions that actually give rise to split scope readings.

To elaborate on the second point, it turns out that both across and within languages, the number of expressions that yield split readings is quite restricted. Across Germanic languages, only negative indefinites in Dutch, Frisian, German, and Icelandic consistently give rise to split scope readings (as already observed by Blok et al. (2017)). Within languages, only class B numeral modifiers consistently generate split scope readings. In addition, the expression *only* yields split readings as well.

The key to unlocking a theory that encompasses all these facts is the Focus-Sensitivity Generalisation: only focus-sensitive operators are scope-splitting expressions. I show that negative indefinites in scope splitting languages and class B numeral modifiers such as *at least* and *at most* are focus-sensitive. Uncontroversially, *only* is too. Negative indefinites in non scope-splitting languages (Danish, English, Norwegian, and Swedish) are not, and neither are class A modifiers such as *more than* and *fewer than.* To provide more evidence for the dichotomy supplied by the Focus-Sensitivity Generalisation, I show that not only class B numeral modifiers but all focus-sensitive expressions share the property of having to outscope existential modals. The Focus-Sensitivity Generalisation encompasses the Numeral Modifier Generalisation proposed by Blok et al.: the focus-sensitive operators under discussion can associate with a wide variety of types of expressions, including numerals.

The Focus-Sensitivity Generalisation thus singles out the correct set of expressions that consistently yield split scope readings. After establishing this, I built a theory of split scope by positing that focus-sensitive expressions are able to take wide scope by themselves. The intuition behind this theory is that focus-sensitive operators are known to be able to associate with a wide variety of types of expressions. The step I take is to posit that they can also do this covertly, and that this covert movement can yield split scope readings. As an aside, the flexibility of focus-sensitive expressions also means that the Focus-Sensitivity Generalisation encompasses the Numeral Modifier Generalisation proposed by Blok et al.: numerals are simply one of the many kinds of expressions focus-sensitive operators can associate with.

The fact that these focus-sensitive expressions can move by themselves means that in order to compute split readings, we do not need to generate any unattested readings where the DP as a whole takes wide scope. Thus, my theory is consistent with restrictions on inverse scope. In addition, it only generates split readings for those expressions that robustly give rise to such readings, unlike Blok et al., for whom there is no distinction between negative indefinites in split scope languages, class A numeral modifiers, and class B numeral modifiers.

There are some rare cases where we do see split scope with class A numeral modifiers (Hackl, 2000). To account for these cases, I proposed the optional availability of a covert focus-sensitive operator MAX in these structures. The idea is that it is costly to insert such an extra operator, which means that split scope readings in these cases are possible but more difficult to get, in line with the data.

I ended this chapter with a discussion of the status of degree quantifier movement. If degree quantifier movement is available for class A modifiers like *fewer than*, I reasoned, then we predict split scope readings to be widely available for these expressions. I tentatively argued that this type of movement is indeed not possible.

Chapter 6: The pragmatics of modified numerals

In the sixth chapter I zoomed in on *at least* and *at most* and enriched the focus-sensitive analysis of these expressions from chapter 5 with inquisitive semantics. The goal of this chapter was to account for the ambiguity between authoritative and epistemic readings we see in the domain of modified numerals, discussed in chapter 4, without relying on the non-existent scope configuration where an existential modal takes scope over a class B modified numeral.

The workings of this account are as follows. Inquisitive semantics allows for denotations that consist of multiple sets of worlds (possibilities) rather than just one set of worlds. Following Ciardelli et al. (2016), I used this fact in conjunction with a new clause in the Gricean Maxim of Quality (Grice, 1975) to generate epistemic readings. To account for authoritative readings, I proposed that modals optionally turn a complex denotation consisting of multiple possibilities into a singleton set denotation. When this happens, an authoritative reading is derived. This optionality enabled me to compute two readings without needing two scope configurations.

In addition, I showed that my account correctly predicts that for the more natural combinations of modals and modified numerals (*at least* with a universal modal and *at most* with an existential modal), an authoritative reading as well as an epistemic reading can be derived. For the less natural combinations, epistemic readings are also generated but the authoritative readings are ruled out by a pragmatic blocking or economy mechanism. In addition, the fact that authoritative readings are still available for cases with *at most* and a universal modal (though the combination of *at most* with an existential modal provides a far more natural way to express this) is accounted for by using the surface scope configuration. As this configuration is not available for cases with existential modals, this authoritative reading is correctly ruled out for the cases with *at least* and an existential modal. Finally, I showed that the account can also be used for cases where modified numerals occur with universal quantifiers, which show a similar ambiguity to the cases with modals.

Thus, this refinement of the analysis of chapter 5 generates the correct readings for all four combinations of *at least* and *at most* with modals and universal quantifiers without relying on the unattested scope configuration where an existential modal takes scope over the numeral modifier.

Chapter 7: A plea for optional QR

After a detailed consideration of the readings we obtain with specific kinds of modified numerals, in the final chapter I zoomed back out and looked at simpler doubly quantified sentences. Throughout this dissertation I have argued that not all scope configurations are available and that we need to take this into account when we analyse different kinds of linguistic phenomena. Here I showed that constraining scope shifts is actually not possible given modern assumptions in generative syntax and semantics.

In particular, the combination of the assumption of QR for type reasons and the Copy Theory of Movement make it impossible to constrain QR. This is because we automatically get a configuration where the object occupies a position below the subject as well as above the subject, and whether we get a surface scope reading or an inverse scope reading depends on which of these two copies we choose to interpret.

This gives rise to two kinds of problems. First, as both copies are equal in status, there is no reason why the surface scope reading should be more readily available or easier to process than the inverse scope reading. However, psycholinguistic work such as Anderson's (2004) has shown that inverse scope readings are more difficult to process than surface scope readings.

Second, as we always generate a structure that allows for both an inverse scope reading and a surface scope reading, there is no way to constrain scope shifts. Thus, we cannot formulate constraints on inverse scope in the current framework. This breaks the well-known Scope Economy constraint (Fox, 2000) as well as any other constraints one might wish to posit, such as the ones I have discussed in this dissertation.

To solve this issue, I argued that we need two separate mechanisms for resolving the type clash between a predicate and an object quantifier and scope. If we take QR to be responsible for scope, then a different mechanism should regulate the type clash. I implemented this notion by arguing for a model where type shifts resolve the type clash while QR is reserved for scope. This way, object quantifiers can be interpreted *in situ* and must move specifically for scope reasons if they are to take wide scope. This makes inverse scope readings more complex than surface scope readings in line with Anderson's experimental data and enables us to formulate constraints on inverse scope.

In the final part of this chapter I discussed three possible alternative solutions to the problem I presented, such as the idea that it is less costly for LF to interpret the same copy that is pronounced at PF than to interpret a different copy. I concluded that even though some of the alternative solutions may work, regardless of which solution we choose, we still need QR to be optional for any of them to work.

8.2 Main contributions

I believe that this dissertation makes two main contributions. The first one is the notion that it is important to take into account restrictions on scope when we build our theories. In chapter 7 I showed that placing restrictions on scope is not possible at all given our modern assumptions in generative syntax and semantics and I provided a solution for this problem. But most of this dissertation has been about issues that are not directly related to the nature of scope taking. I showed that in these areas, too, it is important to carefully consider which scope configurations correspond to attested readings and which ones do not. Only then can we successfully analyse phenomena like split scope and modified numerals.

In the area of split scope, this has allowed for the creation of an account that is in line with the readings we actually observe: split readings but no inverse scope readings. But I believe that this approach has borne even more fruit in the domain of modified numerals. Here I have taken it as a given that class B numeral modifiers must outscope existential modals and used an optional flattening mechanism instead of scope to generate the observed ambiguity we see when numeral modifiers occur in a sentence with a modal. The interplay between this optional flattening mechanism and the framework of inquisitive semantics has generated exactly those readings we observe and not generated any unattested readings. In addition to computing authoritative readings only in places where authoritative readings are observed, it generates the right kind of epistemic readings. The observed readings do not merely convey ignorance about numbers but rather ignorance about bounds. Existential modals create ignorance about upper bounds whereas universal modals yield ignorance about lower bounds. Finally, the account of modified numerals I have presented not only captures the correct readings with modals but also with universal nominal quantifiers. As far as I know, all other accounts of the pragmatics of modified numerals on the market run into serious problems when modals enter into the computation, and these problems are caused by the assumption built into these accounts that for any sentence with a modal and a modified numeral, there are two possible scope configurations. Getting rid of this assumption has allowed for the creation of an account that successfully predicts all attested readings while not predicting any unattested ones.

In the domain of split scope, this careful consideration of which readings are and which readings are not observable in the data has not only led to an account of split scope that does not rely on unattested inverse scope readings, it has also correctly singled out the expressions that give rise to split scope readings. It turns out that all expressions that consistently create split readings are focus-sensitive operators: the Focus-Sensitivity Generalisation. This observation has led to the idea that focus-sensitive operators can covertly move to a higher position while associating with a lexical element lower in the derivation, and that it is this movement that yields split scope configurations. The intuition behind this idea was that focus-sensitive operators are able to associate with a wide variety of different types of expression and can also occupy a multitude of different positions in the structure. The only extra assumption that was needed for my account is that they can also do this covertly.

I believe that this focus-sensitive account of both split scope and modified numerals is the second main contribution of this dissertation. In the literature on modified numerals, it has become customary to treat numeral modifiers as degree quantifiers. The move to a focus-based account for certain kinds of numeral modifiers (which was inspired by the focus-based accounts of Krifka, 1999 and Geurts & Nouwen, 2007) has led to a deepening of an existing dichotomy in the domain of modified numerals: the distinction between class A and class B numeral modifiers (Nouwen, 2010) is not merely a distinction between numeral modifiers that give rise to epistemic inferences and those that do not. Instead, in my theory they are two completely different kinds of expressions: class B numeral modifiers are not actually numeral modifiers but focus-sensitive operators that form a natural class with *only* and negative indefinites in languages in which negative indefinites are scope splitters. Class A numeral modifiers, on the other hand, are not focus-sensitive and in fact not mobile. In am agnostic about what they are exactly, but one option is that they are simply adjectival modifiers.

There is a second dichotomy that ensues from my account, though this idea was already present in Blok et al. (2017): the crosslinguistic distinction between negative indefinites that do and those that do not give rise to split scope readings across the board. The data show that, as by the Focus-Sensitivity Generalisation, only focus-sensitive negative indefinites consistently generate split scope readings. Given that English *no* is not such an expression, the question that naturally arises from these observations is why there have been a few cases of split scope with *no* in the literature (e.g. Potts, 2000; Alrenga & Kennedy, 2013).

This is an issue I have not completely resolved; I have merely said that given the lack of consistency of split readings with *no* when compared to, for instance, *geen* in Dutch, must mean that these readings constitute a different phenomenon. But note that my analysis does allow for some gradability. We have seen that the case of *fewer than* is similar to the case of *no*: split scope readings with *fewer than* are much less predominant than those with, for example, *at most*, but they exist in a few cases nonetheless (Hackl, 2000). I argued that these seemingly split readings are due to the optional insertion of a focus-sensitive operator MAX. This insertion of an extra operator, I have claimed, makes for a more complex derivation, which is why these readings are not as easy to get as split readings with actual scope-splitting expressions such as *at most*. A similar mechanism might be responsible for 'split' readings with *no*.

A consequence of my theory is that class A modifiers such as *fewer than* or *more than* cannot undergo degree quantifier movement. If they could, split readings would be as easy to obtain for them as for class B modifiers and other scope-splitting expressions. To meet this challenge, I have argued that the data supporting the existence of degree quantifier movement is actually quite limited. In addition, if we say that the Heim-Kennedy Generalisation is a constraint on movement of focus-sensitive operators rather than a constraint on degree quantifier movement, we cover more data. For instance, we account for the fact that scope-splitting negative indefinites and *only* also abide by the Heim-Kennedy Generalisation. These observations indicate that degree quantifier movement may not exist after all.

To conclude, I have shown that taking restrictions on scope seriously leads to new insights into the workings of split scope and modified numerals. These insights have led to a unified, focus-based account of these phenomena that only uses attested scope configurations and still gives us all the readings we observe.

Bibliography

Abels, K., & Martí, L. (2010). A unified approach to split scope. *Natural Language Semantics*, *18*, 435-470.

Alexandropoulou, S. (2018). *On the pragmatics of numeral modifiers: The availability and time course of variation, ignorance and indifference inferences.* Doctoral dissertation, Utrecht University.

Alrenga, P., & Kennedy, C. (2013). *No more* shall we part: Quantifiers in English comparatives. *Natural Language Semantics*, *22*(1), 1-53.

Anderson, C. (2004). *The structure and real-time comprehension of quantifier scope ambiguity.* PhD Thesis, Northwestern University.

Beaver, D., & Clark, B. (2008). *Sense and sensitivity: How focus determines meaning.* Chichester: Wiley-Blackwell.

Beck, S. (2012). DegP scope revisited. *Natural Language Semantics*, *20*, 227-272.

Beghelli, F. (1993). A minimalist approach to quantifier scope. In *Proceedings of NELS 23* (Vol. 1, p. 65-80).

Beghelli, F. (1995). *The phrase structure of quantifier scope.* PhD Thesis, UCLA.

Beghelli, F., & Stowell, T. (1997). Distributivity and negation: The syntax of *each* and *every*. In A. Szabolcsi (Ed.), *Ways of scope taking* (p. 71-107). Dordrecht: Kluwer.

Blok, D. (2015a). Scope interactions between modals and modified numerals. In T. Brochhagen, F. Roelofsen, & N. Theiler (Eds.), *Proceedings of the 20th Amsterdam Colloquium* (p. 70-79).

Blok, D. (2015b). The semantics and pragmatics of directional numeral modifiers. In S. D'Antonio, M. Moroney, & C.-R. Little (Eds.), *Proceedings of SALT 25* (p. 471-490).

Blok, D. (2016). Directional numeral modifiers: an implicature-based account. In C. Hammerly & B. Prickett (Eds.), *Proceedings of NELS 46* (Vol. 1, p. 123-136).

Blok, D. (2017). *The semantics and pragmatics of directional numeral modi-*

fiers. Unpublished manuscript, available at: `http://www.dominiqueblok.org/work`.

Blok, D., Bylinina, L., & Nouwen, R. (2017). Splitting Germanic negative indefinites. In *Proceedings of the 21st Amsterdam Colloquium.*

Bobaljik, J., & Wurmbrand, S. (2012). Word order and scope: Transparent interfaces and the 3/4 signature. *Linguistic Inquiry*, *43*(3), 371-421.

Buccola, B., & Spector, B. (2016). Modified numerals and maximality. *Linguistics & Philosophy*, *39*(3), 151-199.

Büring, D. (1997). The great scope inversion conspiracy. *Linguistics & Philosophy*, *20*, 175-194.

Büring, D. (2008). The least *at least* can do. In *Proceedings of the West Coast Conference on Formal Linguistics* (Vol. 26, p. 114-120).

Büring, D., & Hartmann, K. (2001). The syntax and semantics of focus-sensitive particles in German. *Natural Language and Linguistic Theory*, *19*, 229-281.

Bylinina, L., & Nouwen, R. (2017). On 'zero'. In D. Burgdorf, J. Collard, S. Maspong, & B. Stefánsdóttir (Eds.), *Proceedings of SALT 27.*

Cable, S. (2014). *Quantificational DPs, part 3: Covert movement vs. type shifting.* Class handout *Semantics and Generative Grammar*, UMass Amherst.

Carlson, G. (1977). *Reference to kinds in English.* PhD Thesis, UMass Amherst.

Catlin, J., & Micham, D. (1975). Semantic representations as procedures for verification. *Journal of Psycholinguistic Research*, *4*(3), 209-225.

Chemla, E. (2017). *Connecting content and logical words.* `http://semanticsarchive.net/Archive/WVhYzUwM/Chemla-ConnectWords.pdf`.

Chierchia, G. (1995). Individual-level predicates as inherent generics. In G. Carlson & F. Pelletier (Eds.), *The generic book* (p. 176-223). Chicago: University of Chicago Press.

Chomsky, N. (1976). Conditions on rules of grammar. *Linguistic Analysis*, *2*, 303–351.

Chomsky, N. (1993). A minimalist program for linguistic theory. In K. Hale & S. Keyser (Eds.), *The view from building 20* (p. 1-52). Cambridge, MA: MIT Press.

Chomsky, N. (1995). Categories and transformations. In *The minimalist program* (pp. 219–394). Cambridge, MA: MIT Press.

Chomsky, N. (2008). On phases. In *Foundational issues in linguistic theory: Essays in honor of Jean-Roger Vergnaud.* Cambridge, MA: MIT Press.

Ciardelli, I., Coppock, E., & Roelofsen, F. (2016). Implicatures of modified numerals: Quality or quantity? In *Proceedings of Sinn & Bedeutung 21.*

Cooper, R. (1975). *Montague's semantic theory and transformational syntax.* PhD Thesis, UMass Amherst.

Cooper, R. (1979). Variable binding and relative clauses. In D. Guenthner & S. Schmidt (Eds.), *Formal semantics and pragmatics for natural lan-*

guages (p. 131-169). Dordrecht: Reidel.

Cooper, R. (1983). *Quantification and syntactic theory.* Dordrecht: Reidel.

Coppock, E., & Beaver, D. (2013). Principles of the exclusive muddle. *Journal of Semantics*, *31*(3), 371-432.

Coppock, E., & Brochhagen, T. (2013). Raising and resolving issues with scalar modifiers. *Semantics & Pragmatics*, *6*(3), 1-57.

van Craenenbroeck, J. (to appear). VP-ellipsis. In M. Everaert & H. van Riemsdijk (Eds.), *The Blackwell companion to syntax. 2nd edition.* Hoboken: Wiley-Blackwell.

van Craenenbroeck, J., & den Dikken, M. (2006). Ellipsis and EPP repair. *Linguistic Inquiry*, *37*, 653–664.

Cremers, A., Coppock, E., Dotlacil, J., & Roelofsen, F. (2017). *Modified numerals: Two routes to ignorance.* Submitted.

Cresti, D. (1995). Extraction and reconstruction. *Natural Language Semantics*, *3*, 79-122.

Fox, D. (2000). *Economy and semantic interpretation.* Cambridge, MA: MIT Press.

Fox, D. (2002). Antecedent-contained deletion and the copy theory of movement. *Linguistic Inquiry*, *33*(1), 63-96.

Geurts, B. (1996). On *no*. *Journal of Semantics*, *13*, 67-86.

Geurts, B. (2010). *Quantity implicatures.* Cambridge: Cambridge University Press.

Geurts, B., & Nouwen, R. (2007). At least *et al.*: the semantics of scalar modifiers. *Language*, *83*(3), 533-559.

Gillen, K. (1991). *The comprehension of doubly quantified sentences.* PhD Thesis, Durham University.

Grice, P. (1975). Logic and conversation. In P. Cole & J. Morgan (Eds.), *Syntax and semantics 3: Speech acts* (p. 41-58). New York: Academic Press.

Hackl, M. (2000). *Comparative quantifiers.* PhD Thesis, Department of Linguistics and Philosophy, Massachusetts Institute of Technology.

Hale, K. (1978). *The structure of English sentences.* Handout, Massachusetts Institute of Technology.

Hamblin, C. (1971). Mathematical models of dialogue. *Theoria*, *37*, 130–155.

Hamblin, C. (1973). Questions in Montague English. *Foundations of Language*, *10*, 41–53.

Heim, I. (2000). Degree operators and scope. In *Proceedings of SALT 10* (p. 40-64). Ithaca, NY: Cornell Linguistics Club.

Heim, I., & Kratzer, A. (1998). *Semantics in generative grammar.* Oxford: Blackwell.

Hendriks, H. (1993). *Studied flexibility: categories and types in syntax and semantics.* PhD Thesis, University of Amsterdam.

Hornstein, N. (1995). *The grammar of logical form: From GB to minimalism.* Cambridge, MA: Blackwell.

Iatridou, S., & Sichel, I. (2011). Negative DPs, A-movement, and scope diminishment. *Linguistic Inquiry*, *42*(4), 595 – 629.

Iatridou, S., & Zeijlstra, H. (2013). Negation, polarity, and deontic modals. *Linguistic Inquiry*, *44*(4), 529-568.

Jacobs, J. (1980). Lexical decomposition in Montague Grammar. *Theoretical Linguistics*, *7*, 121-136.

Jacobs, J. (1991). Negation. In A. von Stechow & D. Wunderlich (Eds.), *Semantics: An international handbook* (p. 560-596). Berlin: De Gruyter.

Johnson, K., & Tomioka, S. (1997). Lowering and mid-size clauses. In G. Katz, S. Kim, & H. Winhart (Eds.), *Reconstruction: Proceedings of the 1997 Tübingen workshop* (p. 185-206). Universität Stuttgart and Universität Tübingen.

Kennedy, C. (1997). *Projecting the adjective.* PhD dissertation, University of California, Santa Cruz.

Kennedy, C. (2007). Vagueness and grammar: the semantics of relative and absolute gradable adjectives. *Linguistics & Philosophy*, *30*(1), 1-45.

Kennedy, C. (2015). A 'de-Fregean' semantics (and neo-Gricean pragmatics) for modified and unmodified numerals. *Semantics and Pragmatics*, *8*(10), 1–44.

Kennedy, C., & McNally, L. (2005). Scale structure, degree modification, and the semantics of gradable predicates. *Language*, *81*(2), 345-381.

Kobele, G., & Zimmermann, M. (2012). Quantification in german. In E. L. Keenan & D. Paperno (Eds.), *Handbook of quantifiers in natural language.* Studies in Linguistics and Philosophy 90.

Koopman, H., & Sportiche, D. (1991). The position of subjects. *Lingua*, *85*, 221-258.

Kratzer, A. (1995). Stage-level and individual-level predicates. In G. Carlson & F. Pelletier (Eds.), *The generic book* (p. 125-175). Chicago: University of Chicago Press.

Kratzer, A. (1996). Severing the external argument from its verb. In J. Rooryck & L. Zaring (Eds.), *Phrase structure and the lexicon* (Vol. 33, p. 109-137). Dordrecht: Kluwer.

Kratzer, A. (1998). Scope or pseudoscope? Are there wide scope indefinites? In S. Rothstein (Ed.), *Events in grammar* (p. 163-197). Dordrecht: Kluwer.

Kratzer, A., & Shimoyama, J. (2002). Indeterminate pronouns: The view from Japanese. In Y. Otsu (Ed.), *Proceedings of the third Tokyo conference on psycholinguistics* (p. 1-25). Tokyo: Hituzi Syobo.

Krifka, M. (1998). Scope inversion under the rise-fall contour in German. *Linguistic Inquiry*, *29*(1), 75-112.

Krifka, M. (1999). At least some determiners aren't determiners. In K. Turner (Ed.), *The semantics/pragmatics interface from different points of view (= Current research in the semantics/pragmatics interface vol. 1)* (p. 257-291). Elsevier Science.

Kurtzman, H., & MacDonald, M. (1993). Resolution of quantifier scope ambiguities. *Cognition*, *48*, 243-279.

Landman, F. (2011). *Boolean pragmatics.* Ms.

Lasnik, H. (1999). Chains of arguments. In S. Epstein & N. Hornstein (Eds.), *Working minimalism.* Cambridge, MA: MIT Press.

Lasnik, H., & Saito, M. (1991). On the subject of infinitives. In *Papers from the 27th regional meeting of cls* (p. 324-343).

Link, G. (1983). The logical analysis of plural and mass terms: a lattice theoretical approach. In R. Bäuerle, C. Schwarze, & A. von Stechow (Eds.), *Meaning, use and interpretation of language* (p. 302-323). Berlin: Mouton de Gruyter.

May, R. (1977). *The grammar of quantification.* PhD Thesis, Massachusetts Institute of Technology.

Mayr, C., & Spector, B. (2012). *Generalized scope economy – Not too strong!* Unpublished manuscript.

McCloskey, J. (1997). Subjecthood and subject positions. In L. Haegeman (Ed.), *Elements of grammar* (p. 197-235). Dordrecht: Kluwer.

Merchant, J. (2001). *The syntax of silence: Sluicing, islands, and the theory of ellipsis.* Oxford: Oxford University Press.

Micham, D., Catlin, J., VanDerveer, N., & Loveland, K. (1980). Lexical and structural cues to quantifier scope relations. *Journal of Psycholinguistic Research*, *9*(4), 367-377.

Montague, R. (1973). The proper treatment of quantification in ordinary English. In J. Hintikka, J. Moravcsik, & P. Suppes (Eds.), *Approaches to natural language.* Dordrecht: Reidel.

Nouwen, R. (2010). Two kinds of modified numerals. *Semantics & Pragmatics*, *3*(3), 1-41.

Nouwen, R. (2015). Modified numerals: the epistemic effect. In L. Alonso-Ovalle & P. Menéndez-Benito (Eds.), *Epistemic indefinites.* Oxford: Oxford University Press.

Partee, B. (1984). Compositionality. In F. Landman & F. Veltman (Eds.), *Varieties of formal semantics,* (pp. 281–312). Dordrecht: Foris.

Partee, B. (1987). Noun phrase interpretation and type shifting principles. In J. Groenendijk, D. de Jongh, & M. Stokhof (Eds.), *Studies in discourse representation and the theory of generalized quantifiers* (p. 115-143). Dordrecht: Foris.

Partee, B., & Rooth, M. (1983). Generalized conjunction and type ambiguity. In R. Bauerle, C. Schwarze, & A. von Stechow (Eds.), *Meaning, use and interpretation of language.* Berlin: De Gruyter.

Penka, D. (2011). *Negative indefinites.* Oxford: Oxford University Press.

Penka, D., & Zeijlstra, H. (2005). *Negative indefinites in Dutch and German.* Paper presented at the 20th Comparative Germanic Syntax Workshop.

Potts, C. (2000). When even *no*'s neg is splitsville. In S. Chung, J. McCloskey, & N. Sanders (Eds.), *Jorge hankamer's webfest.* Santa Cruz, CA: Linguistics Research Center.

Reinhart, T. (1995). *Interface strategies.* OTS Working Papers in Linguistics.

Reinhart, T. (2006a). *Interface strategies.* Cambridge, MA: MIT Press.

Reinhart, T. (2006b). Scope shift with numeral indefinites – syntax or processing? In L. Tasmowski & S. Vogeleer (Eds.), *Non-definiteness and plurality* (p. 291-311). Amsterdam: John Benjamins Publishing Company.

Rooth, M. (1985). *Association with focus.* PhD Thesis, UMass Amherst.

Rooth, M. (1992). A theory of focus interpretation. *Natural Language Semantics*, *1*, 75-116.

Rullmann, H. (1995a). Geen eenheid. In *TABU: Bulletin voor taalwetenschap* (Vol. 25, p. 194-197).

Rullmann, H. (1995b). *Maximality in the semantics of wh-constructions.* Doctoral dissertation, University of Massachusetts, Amherst.

Ruys, E. (2015). A minimalist condition on semantic reconstruction. *Linguistic Inquiry*, *46*(3), 453 – 488.

Ruys, E., & Winter, Y. (2010). Scope ambiguities in formal syntax and semantics. In D. Gabbay & F. Guenthner (Eds.), *Handbook of philosophical logic* (pp. 159–225). Amsterdam: John Benjamins Publishing Company.

Sauerland, U. (1998). *The meaning of chains.* MIT dissertation.

Sauerland, U. (2004a). The interpretation of traces. *Natural Language Semantics*, *12*, 63-127.

Sauerland, U. (2004b). Scalar implicatures in complex sentences. *Linguistics & Philosophy*, *27*(3).

Sauerland, U., & Elbourne, P. (2002). Total reconstruction, PF movement, and derivational order. *Linguistic Inquiry*, *33*(2), 283-319.

Schwarz, B. (2013). *At least* and quantity implicature: Choices and consequences. In M. Aloni, M. Franke, & F. Roelofsen (Eds.), *Proceedings of the 19th Amsterdam Colloquium.*

Schwarz, B. (2016). *At least* and ignorance: A reply to Coppock & Brochhagen (2013). *Semantics & Pragmatics*, *9*(10).

von Stechow, A. (1991). Focusing and background operators. In *Discourse particles* (p. 37-83). Amsterdam: John Benjamins Publishing Company.

De Swart, H. (2000). Scope ambiguities with negative quantifiers. In K. von Heusinger & U. Egli (Eds.), *Reference and anaphoric relations* (p. 109-132). Dordrecht: Kluwer.

De Swart, H. (2010). *Expression and interpretation of negation: An OT typology.* Dordrecht: Springer.

Szabó, G. (2017). Compositionality. In E. Zalta (Ed.), *The Stanford encyclopedia of philosophy (summer 2017 edition).*

Szabolcsi, A. (1997). Strategies for scope taking. In A. Szabolcsi (Ed.), *Ways of scope taking* (p. 109-154). Dordrecht: Kluwer.

Tunstall, S. (1998). *The interpretation of quantifiers: semantics & processing.* PhD Thesis, UMass Amherst.

Zeijlstra, H. (2004). *Sentential negation and negative concord.* PhD Thesis, University of Amsterdam.

Zimmermann, T. E. (1993). On the proper treatment of opacity in certain verbs. *Natural Language Semantics*, *1*, 149-179.

Samenvatting in het Nederlands

Wat is bereik?

Stel, je bent op het verjaardagsfeest van een vriendin, Imme. Je raakt in gesprek met Imme en een vriend, Bart. Imme vertelt dat ze haar ouders graag vaker zou willen zien maar ze heeft geen auto en haar ouders zijn lastig te bereiken met het openbaar vervoer. Bart vertelt dat hij wekelijks naar het dorp waar Immes ouders wonen rijdt voor zijn werk, maar financieel krap zit door de kosten van de benzine. Jij deelt op jouw beurt dat je nog niet zo lang je rijbewijs hebt maar, net als Imme, geen auto hebt en daardoor weinig oefent. Je zou dan de zin in (1) kunnen uiten.

(1) Er is een oplossing voor elk probleem.

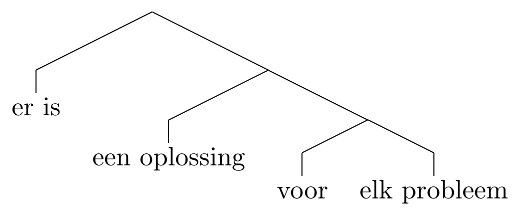
De oplossing ligt voor de hand: als jullie wekelijks met zijn drieën naar het dorp van Immes ouders rijden met jou aan het stuur heb jij je rijervaring, kan Imme haar ouders opzoeken en kan Bart de benzinekosten met jou en Imme delen. Er is dus één oplossing voor alledrie de problemen, en dat is wat de zin in (1) uitdrukt.

De meeste gevallen waarin je (1) zou gebruiken zouden echter van een andere soort zijn, namelijk situaties waarin er weliswaar een oplossing is voor alle problemen, maar niet noodzakelijkerwijs dezelfde oplossing voor elk probleem. Bijvoorbeeld: Imme wil haar ouders vaker zien en de oplossing is om een auto te kopen, Bart heeft geldproblemen en de oplossing is om meer uren te gaan werken, en jij hebt weinig rij-ervaring en de oplossing is om af en toe de auto van iemand te lenen en daarin wat kilometers te maken. In dit geval is zin (1) ook waar: niet elk probleem heeft dezelfde oplossing, maar er is nog steeds een oplossing voor elk probleem.

Deze twee situaties laten de twee betekenissen zien die zin (1) kan hebben. Deze twee betekenissen hebben te maken met bereik. De eerste lezing, de *oppervlaktebereikslezing*, is kort geschetst in (2). De bijbehorende structuur van de zin staat in (3).[1]

(2) Er is een oplossing waarvoor geldt: de oplossing is voor elk probleem

(3)



Hier staat *een oplossing* hoger in de structuur dan *elk probleem*, wat betekent dat *een oplossing* iets zegt over elk probleem: er is een oplossing, en die oplossing is er voor elk probleem. We hebben het dus over één oplossing, en die ene

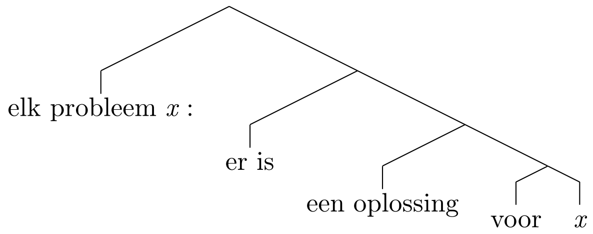
[1] De werkelijke structuur is ingewikkelder, maar de details daarvan zijn niet relevant voor deze uitleg. Dit geldt voor alle boomstructuren in deze samenvatting.

oplossing lost meerdere problemen op.

De andere lezing is de *omgekeerde bereikslezing*. Dit is de lezing waarbij *elk probleem* bereik neemt over *een oplossing*. De lezing die je dan krijgt is die in (4), en de grammaticale structuur is die in (5).

(4) Voor elk probleem geldt: er is een oplossing voor het probleem

(5)



Hier zegt *elk probleem* dus iets over *een oplossing* in plaats van omgekeerd: voor elk probleem geldt iets, namelijk dat er een oplossing voor iets. Dit hoeft niet per se dezelfde oplossing te zijn: er kunnen verschillende oplossingen zijn voor de verschillende problemen.

Uitdrukkingen als *een* en *elk* worden *kwantoren* genoemd omdat ze iets zeggen over kwantiteit: *een* zegt iets over de hoeveelheid oplossingen en *elk* zegt iets over de hoeveelheid problemen. In een zin met meerdere kwantoren zijn er meerdere grammaticale structuren denkbaar: de ene kwantoor kan bereik hebben over de andere, of omgekeerd. Dit kan leiden tot verschillende betekenissen.

Deze dissertatie gaat over gevallen waarin bereik beperkter is dan je zou denken. Dat zijn gevallen waarbij er een zin is met twee uitdrukkingen die voor bereiksambiguïteit zouden kunnen zorgen, maar die toch niet de twee betekenissen heeft die je op basis van de twee bereiksmogelijkheden zou verwachten. Hieronder beschrijf ik twee van die gevallen en leg ik uit waarom dit tot problemen leidt voor onze theorieën. In beide gevallen is het probleem dat er in de literatuur vanuit wordt gegaan dat de twee bereiksopties wèl bestaan en op basis van die aanname analyses van bepaalde fenomenen zijn gemaakt. Ik laat zien dat die aanname niet klopt en dat we dus analyses nodig hebben. Die alternatieve analyses bied ik vervolgens ook. De twee gevallen van beperkt bereik die ik hieronder beschrijf zijn beperkt bereik met zogenaamde *nummermodificeerders* en beperkt bereik met *gespleten bereikszinnen*. Na die twee problemen besproken te hebben schets ik kort mijn theorie die deze problemen oplost.

Beperkt bereik met nummermodificeerders

Beperkt bereik

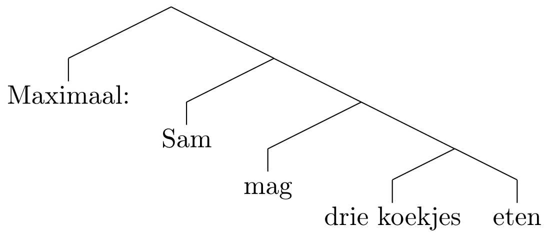
Er zijn ook andere soorten woorden die in principe voor bereiksambiguïteit kunnen zorgen. Eén voorbeeld daarvan zijn *modalen*: woorden die iets zeggen over welke scenario's er bijvoorbeeld mogelijk, noodzakelijk of wenselijk zijn zoals *mogen*, *moeten*, *willen* en *kunnen*. In (6) staat de modaal *mag* in een zin met *maximaal*. We noemen uitdrukkingen als *maximaal*, *minstens*, *meer dan* en *hoogstens* *nummermodifieerders* omdat ze iets zeggen over een nummer. In dit geval zegt *maximaal* dat het nummer *drie* de bovengrens is van de hoeveelheid koekjes die Sam mag eten. We hebben dus een zin met een modaal en een nummermodificeerder.

(6) Sam mag maximaal drie koekjes eten.

Omdat je twee *bereiksoperatoren* in de zin hebt (*mag* en *maximaal*) zou je hier verwachten dat je, net als bij zin (1) hierboven, twee lezingen krijgt. Ik laat in deze dissertatie zien dat dat niet het geval is. Laten we kijken naar de twee theoretisch mogelijke lezingen. We beginnen eerst met de omgekeerde bereikslezing, omdat dat de lezing is die wel bestaat. De lezing is samengevat in (7) en heeft de structuur in (8).

(7) Het maximale aantal koekjes dat Sam mag eten is drie

(8)

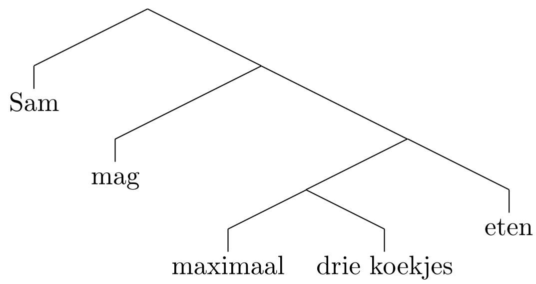


Maximaal begrenst hier wat *mag*: Sam mag drie koekjes eten, maar niet meer dan dat. Dit is ook wat de intuïtieve betekenis van de zin in (6) is.

Laten we nu eens kijken naar de oppervlaktebereikslezing, die is weergegeven in (9) met de structuur in (10).

(9) Iets wat mag is dit: Sam eet maximaal drie koekjes

(10)



De betekenis die hieruit komt is de betekenis die Sam toestemming geeft om drie of minder koekjes te eten. Hij mag dus nul, één, twee of drie koekjes eten, en er wordt hem verder niks verboden. Hij mag dus ook meer koekjes eten. Die betekenis bestaat niet. Dit wordt kan worden aangetoond met zinnen als (11), die contradictoir zijn. Als (6) de betekenis in (9) zou kunnen hebben, zou het prima zijn om te zeggen dat hij ook meer koekjes mag eten, maar de zin heeft alleen de betekenis in (7): Sam mag niet meer dan drie koekjes eten. Dit wordt tegengesproken door *en hij mag er ook meer eten*, en dat is de reden dat (11) raar klinkt.[2]

(11) ??Sam mag maximaal drie koekjes eten en hij mag er ook meer eten.

(6) is dus een voorbeeld van een zin met twee bereiksoperatoren die toch maar één betekenis heeft, namelijk de betekenis die overeenkomt met de omgekeerde bereiksconfiguratie; de structuur waarin *maximaal* wijd bereik neemt.

De pragmatiek van nummermodificeerders

Er is nog iets raars aan de hand met zinnen met nummermodificeerders zoals *maximaal*: ze hebben zogenaamde *onwetendheidseffecten*. De zin in (12) klinkt raar omdat het lijkt alsof de spreker niet weet hoeveel kinderen hij precies heeft.[3]

(12) ?Ik heb maximaal tien kinderen.

Dit is bij uitdrukkingen als *maximaal* anders dan bij bijvoorbeeld *minder dan*:

(13) Ik heb minder dan tien kinderen.

(13) heeft geen onwetendheidseffect: iemand die weet dat hij precies vier kinderen heeft kan deze zin prima gebruiken.

Als je een modaal zoals *mag* in de zin zet, verandert de zaak. Bij (63) is de meest voor de hand liggende betekenis er één zonder onwetendheidseffect. De spreker weet perfect wat Sam wel en niet mag: hij mag namelijk wel nul, één, twee of drie koekjes eten, maar niet vier of meer.

(6) Sam mag maximaal drie koekjes eten.

Een andere lezing van deze zin is de zin mèt onwetendheidseffect, maar deze lezing is moeilijker te zien. Het tekstje in (14) haalt deze tweede lezing naar boven.

(14) Sam at altijd de hele koektrommel leeg, dus nu heeft Sams vader Sams koekjesinname aan banden gelegd. Hij mag nu maar een beperkte hoeveelheid koekjes per dag eten. Ik weet niet meer precies wat de grens is, maar ik weet dat Sam maximaal drie koekjes mag eten.

Hier heeft de zin wel een onwetendheidseffect: de spreker weet niet meer zeker of de bovengrens van de hoeveelheid koekjes die Sam op een dag mag eten drie

[2]Het is een conventie binnen de semantiek om één of meerdere vraagtekens voor een zin te zetten om aan te geven hoe ver de wenkbrauwen omhoog gaan bij het lezen van de zin. Bij één vraagteken ontstaat er al een verontrustende frons; twee vraagtekens betekent: foute boel.

[3]Of 'zij', maar dan is het wel een erg onoplettende vrouw.

of lager is. De mogelijkheden die de spreker opwerpt zijn de mogelijkheid dat Sam maximaal drie koekjes per dag mag eten, dat hij er maximaal twee per dag mag eten, maximaal één, of wellicht helemaal geen.[4]

Zinnen met een modaal en een nummermodificeerder als *maximaal* hebben dus twee lezingen: een lezing mèt en een (prominentere) lezing zonder onwetendheidseffect.

We hebben twee theoretisch mogelijke bereiksconfiguraties voor zin (6) en we hebben twee lezingen. In de literatuur over nummermodificeerders en onwetendheidseffecten worden die twee dingen aan elkaar gekoppeld. We kunnen pragmatische effecten zoals onwetendheidseffecten berekenen door bepaalde operaties uit te voeren op basis van een semantische betekenis van een zin. In de literatuur wordt de betekenis die hoort bij de structuur waarbij de nummermodificeerder wijd bereik heeft (die in (8)) als basis gebruikt om de onwetendheidslezing te berekenen. De betekenis die hoort bij de structuur waarbij de modaal wijd bereik heeft (die in (10)) wordt gebruikt om de lezing zonder onwetendheidseffect af te leiden.

Zoals we in de sectie hiervoor hebben gezien heeft zin (6) maar één bereiksconfiguratie, namelijk die in (8). Die in (10) hoort bij een betekenis die er simpelweg niet is. Dit is één van de centrale problemen die ik aanstip in dit proefschrift: er worden twee lezingen afgeleid (die mèt en die zonder onwetendheidseffect) van twee structuren, maar één van die structuren is helemaal geen mogelijke structuur voor de zin. Deze theorieën van onwetendheidseffecten kunnen dus niet kloppen.

Beperkt bereik met gespleten bereikszinnen

Ik zal nu een tweede geval bespreken waarbij je in bepaalde soorten zinnen twee bereiksmogelijkheden verwacht en er maar één ziet. Dit is ook een geval waarbij er analyses bedacht zijn die rusten op de aanname dat de twee bereiksstructuren wèl bestaan, wat problematisch is.

Zin (15) bevat ook de modaal *mag* en het woord *geen*, een woord dat we een *negatieve indefiniet* noemen.

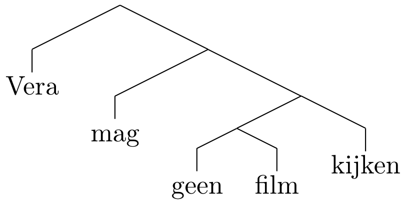
(15) Vera mag geen film kijken.

In dit soort gevallen zijn er volgens de literatuur niet twee maar drie mogelijke lezingen. We beginnen met de oppervlaktebereikslezing: de lezing waarin de modaal *mag* bereik heeft over *geen*. Die lezing is samengevat in (16) en hoort bij de structuur in (17).

(16) Iets wat mag is dit: Vera kijkt geen film

[4] Al zou 'helemaal geen' vreemd zijn in deze context, want dat kun je niet echt een maximum meer noemen.

(17)



Deze lezing lijkt een beetje op de oppervlaktelezing in (9). De betekenis is dat Vera toestemming krijgt om geen film te kijken. Ze wordt dus niet gedwongen tot het kijken van een film. Dit sluit niet uit dat ze wel een film màg kijken. Dit is geen mogelijke betekenis van de zin in (15). Dit wordt geïllustreerd in (18)

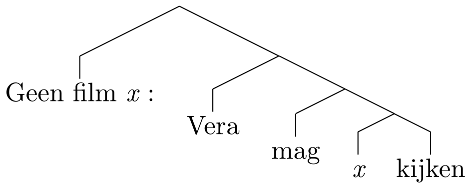
(18) ??Vera mag geen film kijken, en ze mag ook wel film kijken.

Zin (18) klinkt contradictoir, en dat komt doordat *Vera mag geen film kijken* Vera geen toestemming geeft om geen film te kijken maar haar verbiedt om film te kijken. Die betekenis is niet te rijmen met het tweede deel van de zin *en ze mag ook wel film kijken.*

De oppervlaktebereikslezing bestaat dus niet, wat aangeeft dat de structuur die tot deze lezing leidt — die in (17) — geen mogelijke structuur is van de zin. Laten we kijken of de omgekeerde bereikslezing wel bestaat. Deze lezing is geschetst in (19) en hoort bij de structuur in (20).

(19) Voor geen film geldt: Vera mag die film kijken

(20)

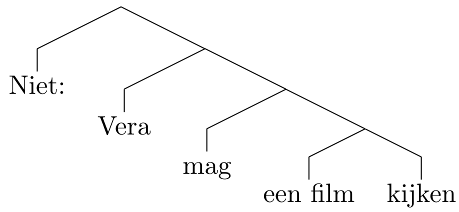


De betekenis is dus dat er geen specifieke film te bedenken is die Vera mag kijken. Dus: welke film je ook noemt, of het nou *Amélie* is of *The Shawshank Redemption*, Vera heeft geen toestemming gekregen om die film te kijken. Dit komt al dichter in de buurt van de werkelijke betekenis van (15) en in de literatuur wordt ook aangenomen dat deze lezing bestaat. Maar laten we even verder kijken naar de derde mogelijke lezing voordat we definitieve conclusies trekken.

De derde lezing is de lezing die dit soort zinnen bijzonder maakt, namelijk de *gespleten bereikslezing*. Die lezing en de structuur staan respectievelijk in (21) en (22).

(21) Het volgende is **niet** het geval: Vera mag **een** film kijken

(22)



Deze lezingen heten zo omdat het lijkt alsof *geen* is opgesplitst in de twee delen: *niet* en *een*, zoals vetgedrukt is aangegeven in de parafrase in (21). De modaal *mag* neemt bereik tussen *niet* en *een* in. Deze lezing kun je zien als een directe ontkenning van zin (23).

(23) Vera mag een film kijken.

Je zou dit ook met het woord *niet* kunnen bewerkstelligen, zoals in (24), maar in het Nederlands klinkt dat niet helemaal goed, en geven we de voorkeur aan (15) om deze betekenis weer te geven.

(24) ?Vera mag niet een film kijken.

In het Engels wordt wel *not* gebruikt in dit soort gevallen, zoals je in (25) ziet.

(25) Vera is **not** allowed to watch **a** film.

In het Engels komen de woorden *not*, *allowed* en *a* in de volgorde voor waarop ze ook geïnterpreteerd worden, overeenkomend met de structuur in (22). In het Nederlands moeten we dus iets doen als het woord *geen* opsplitsen om deze betekenis te krijgen.

Laten we, om een gevoel te krijgen voor het verschil tussen de gespleten lezing en de omgekeerde bereikslezing, over het volgende scenario nadenken. Stel dat Vera altijd toestemming moet vragen aan haar ouders als ze een film wil kijken, zodat haar ouders kunnen checken of de film niet te eng of grof is voor Vera. Vera wil graag een film kijken maar heeft nog geen film gekozen en ze heeft dus ook nog geen toestemming voor een specifieke film gevraagd aan haar ouders. Haar ouders hebben wel gezegd dat Vera vanavond film mag kijken. In dat geval is de interpretatie in (19) waar: er valt geen film op te noemen waarvan je kunt zeggen dat Vera die film mag kijken. De interpretatie in (21), daarentegen, is niet waar: Vera mag in principe een film kijken. Laten we nu nog eens kijken naar de zin waar we het over hebben, namelijk zin (15). Kun je deze zin gebruiken in het scenario dat hierboven beschreven staat? Nee, als je zegt dat Vera geen film mag kijken, bedoel je niet alleen dat er geen specifieke film is die ze mag zien, je bedoelt dat ze geen enkele film mag kijken. Als de lezing in (19) een mogelijke lezing zou zijn van zin (15), zouden we (27) moeten kunnen zeggen. Hiermee zouden we dan bedoelen: Vera heeft geen toestemming om een specifieke film te kijken, maar ze mag wel film kijken. (27) klinkt echter tegenstrijdig, en dit toont aan dat de enige mogelijke lezing van de zin die in (21) is.

(26) ??Vera mag geen film kijken, maar haar ouders hebben wel gezegd dat ze film mag kijken.

Kortom, gespleten bereikszinnen hebben alleen een gespleten lezing. Ze hebben geen oppervlaktebereikslezing en ook geen omgekeerde bereikslezing. Dit is één van de belangrijke dingen die ik aantoon in dit proefschrift.

Veel analyses van gespleten bereik gaan er vanuit dat je eerst de omgekeerde bereiksconfiguratie vormt en je daarna nog één of meerdere extra semantische of syntactische operaties uitvoert om de gespleten lezing te krijgen. Maar die eerste stap, het vormen va de omgekeerde bereiksconfiguratie, is niet mogelijk. Als die stap mogelijk zou zijn zouden we een omgekeerde bereikslezing krijgen, maar zoals zojuist uitgelegd zien we die niet. Op basis daarvan beargumenteer ik in deze dissertatie dat theorieën die deze aanname doen niet kunnen werken.

Dit probleem is qua structuur gelijk aan het probleem met de nummermodificeerders uit de vorige sectie: er wordt in de literatuur vanuit gegaan dat er twee bereiksconfiguraties zijn en op basis daarvan worden analyses gebouwd van bepaalde fenomenen (onwetendheidseffecten in de vorige sectie, gespleten bereik in deze sectie). In beide gevallen toon ik aan dat er in werkelijkheid maar één mogelijke bereikslezing is, en dat je er in je theorieën van deze fenomemen dus niet vanuit kunt gaan dat beide mogelijke structuren ook daadwerkelijk bestaan. Integendeel: als de structuren zouden bestaan, zouden we de bijbehorende lezingen moeten kunnen observeren.

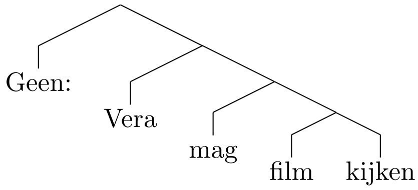
Nieuwe analyse

Wie zegt dat bepaalde soorten theorieën niet kunnen werken kan maar beter met een alternatief plan komen. Dat is wat ik doe in de tweede helft van dit proefschrift. Het doel van mijn analyse is om de pragmatiek van zinnen met nummermodificeerders en modalen uit te leggen (namelijk: het feit dat je optionele onwetendheidseffecten hebt) en ook gespleten bereikslezingen te krijgen.

Het centrale idee van mijn theorie is dat er een bepaalde groep uitdrukkingen is, een specifiek soort zogenaamde *focussensitieve uitdrukkingen*, die een natuurlijke klasse vormen: ze gedragen zich allemaal op dezelfde manier. Woorden die tot deze klasse behoren zijn de hierboven besproken *geen* en *maximaal* maar ook *minimaal*, *hoogstens*, *minstens*, *slechts* en *maar*.

Mijn claim is dat één van de eigenschappen van deze woorden is dat ze in hun eentje wijd bereik kunnen nemen. In (5) en (20) zie je dat een object dat wijd bereik neemt volgens standaardanalyses in zijn geheel bovenaan de structuur terecht komt: *Elk probleem* staat in zijn geheel bovenaan en *geen film* ook. Volgens mijn analyse kunnen de woorden in de groep focussensitieve uitdrukkingen die ik benoem alleen wijd bereik nemen en dus bovenaan staan. In plaats van (20) krijg je dan ongeveer (27).

(27)



Met nog een kleine semantische operatie erbij die vaker wordt gebruikt in de taalkundige literatuur, krijg je met deze structuur de betekenis in (21).

(21) Het volgende is **niet** het geval: Vera mag **een** film kijken

Dit is de betekenis van de gespleten bereikslezing. Door aan te nemen dat *geen* in haar eentje wijd bereik kan nemen, zonder *film* erbij, kun je dus de gespleten bereikslezing afleiden. Het cruciale voordeel van deze theorie is dat je deze lezing kunt krijgen zonder dat je de omgekeerde bereiksstructuur in (20) hoeft te gebruiken. Je krijgt zo alleen de lezing dat het niet zo is dat Vera film mag kijken en niet de niet-bestaande lezing dat er geen specifieke film is waarvoor Vera toestemming heeft gekregen om die te kijken. Daarmee is het probleem met gespleten bereikszinnen dat ik hierboven aanstip opgelost.

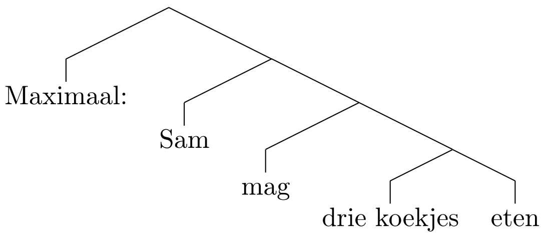
Op precies diezelfde manier neem ik aan dat *maximaal* in (6) alleen bereik kan nemen, zonder *drie koekjes* mee te nemen.

(6) Sam mag maximaal drie koekjes eten.

Dit heb ik in (7) en (8) hierboven al volgens mijn eigen theorie gedaan om het simpel te houden (bij veel andere theorieën komt er wat meer bij deze structuren kijken).

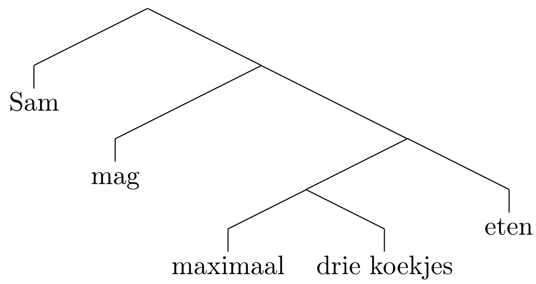
(7) Het maximale aantal koekjes dat Sam mag eten is drie

(8)



De cruciale stap voor nummermodificeerders is dat ik, naast deze structuur, op een specifieke manier de zogenaamde *inquisitieve semantiek* gebruik. De details passen niet in deze samenvatting, maar het komt erop neer dat je, door de inquisitieve semantiek op een bepaalde manier wel of juist niet in te zetten, twee lezingen krijgt: een onwetendheidslezing en een niet-onwetendheidslezing. Je hebt alleen de structuur in (8) nodig om die twee betekenissen af te leiden: de parameter waar je mee werkt is niet bereik maar het wel of niet gebruiken van bepaalde inquisitieve methodes. Gebruik je die wel, dan krijg je een onwetendheidseffect. Gebruik je die niet, dan krijg je dat effect niet. Het belangrijkste punt hier is dat je met deze methode de twee lezingen af kunt leiden zonder dat je twee bereiksstructuren nodig hebt. Je kunt beide betekenissen afleiden van (8) en hebt dus niet de niet-bestaande structuur in (10) nodig.

(10)



Zoals hierboven beschreven hoort deze structuur bij de betekenis in (9), die Sam alleen toestemming geeft om drie of minder koekjes te eten maar hem niks verbiedt.

(9) Iets wat mag is dit: Sam eet maximaal drie koekjes

Mijn theorie brengt dus verschillende fenonomenen samen — zinnen met nummermodificeerders en modalen en gespleten bereikszinnen — en biedt daar een analyse voor die de twee fenomenen samenvoegt tot één verschijnsel. Daarnaast geeft de theorie ons een manier om deze twee fenomenen te verklaren zonder het bestaan van niet-bestaande bereiksstructuren te hoeven gebruiken. Kortom:

(1) Er is een oplossing voor elk probleem.

Curriculum Vitae

Dominique Blok was born on 1 July, 1989, in Amsterdam, the Netherlands. After graduating from secondary school in 2007 and subsequently spending a year trying to figure out the meaning of life in London she studied French Language and Culture with a specialisation in linguistics at Utrecht University, obtaining her Bachelor's Degree in 2011 (*cum laude*). The linguistic spark having been ignited in her mind, she then went on to do a Research Master in linguistics at the same university. During this time she also spent some time at the Massachusetts Institute of Technology for a research internship. She graduated in 2013 (*cum laude*). In that same year she started her PhD in Rick Nouwen's ERC-funded project *Restriction and Obviation in Scalar Expressions*. In January of 2018 she started working at Google as the project manager of the team of linguists in the Google Amsterdam office whilst at the same time finishing her PhD. This book is the result of that rather exhausting but very rewarding effort.