Modality in Typological Perspective

INSTITUTE FOR LOGIC, LANGUAGE AND COMPUTATION

Modality in Typological Perspective

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
prof. dr. D.C. van den Boom
ten overstaan van een door het college voor promoties ingestelde
commissie, in het openbaar te verdedigen in de Agnietenkapel
op donderdag 4 september 2008, te 10.00 uur

door

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geboren te Mont-de-Marsan,
Frankrijk

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Contents

Acknowledgments

One piece of advice I can give to any new PhD student is to start right away with the writing of their acknowledgements. As you might expect, it is too late for me to follow this advice; for all those I forget to mention, my sincere apologies. However as the process of writing this dissertation finally comes to an end, a certain number of names come to mind as having been of importance in this long journey.

First and foremost, I would like to thank my promotors Frank Veltman and Kees Hengeveld. Frank Veltman gave me the opportunity to be a PhD student under his guidance: for that I cannot thank him enough. I have truly enjoyed and benefited from each of our numerous discussions and his patience and sense of humor have always been a great support. Through our contact I've learned that one of the greatest joys of academics is to have the freedom to build your own *luchtkastelen*. The first two chapters would never have been possible without the help of Kees Hengeveld. With him I discovered the gentle art of reading descriptive grammars and the pleasures of discussing exotic languages.

Quite a lot of people helped me with the second chapter of this dissertation. Some are teachers, others scholars; some are native speakers, others second-language speakers; some corresponded with me by email, others spent hours responding to my questions in person; I am very much indebted to all of them: Enoch Aboh (Fon), Young-Mee Choi and Sana Song of the Korean School Amsterdam and Robert Cloutier (Korean), Jan van Eijk and Henry Davis (Lillooet), Margreet Dorleijn (Turkish) and Niko Besnier (Tuvaluan).

Writing a dissertation and studying semantics is really gratifying but can sometimes be a lonely business. I have been lucky to be surrounded by many great colleagues always ready for discussion (the second floor of the Philosophy Department is hereby thanked). For the present work, I have greatly benefited from the insights of Rosja Mastop, Katrin Schulz, Paul Dekker, Robert van Rooij and Kai von Fintel.

I would like to thank everyone at the ILLC and at the Philosophy Department.

A particular mention should go to Ingrid van Loon and Dick de Jong for giving me the chance to follow the Master of Logic program at the ILLC, to Michiel van Lambalgen who, to my great pleasure, supervised my Masters thesis and to Tikitu de Jager who took it on himself to proofread this dissertation under great time pressure (of course, he cannot be held responsible for any remaining mistakes).

Finally, my sincere gratitude and best wishes go to all the people without whom this dissertation would have been finished a long time ago.

Amsterdam   Fabrice Nauze
July, 2008.

Introduction

The overall goal of this dissertation is to study natural language modalities from the perspective of both typology and formal semantics. The idea is to combine the methods and results of both in order to get a better grip on the systematic features of modality.

Two important parts of this dissertation thus consist in investigating the notional category of modality from a typological perspective, and in using the results of this investigation as input for formal semantics. The typological approach to modality becomes the first step of the research strategy for semantics. Another question that this dissertation will address is whether a formalized semantics of modality can provide an explanation for the results of the typological investigation (on top of being an adequate description of these results).

Modality is a broad category embracing many different interpretative types that can be expressed by many different constructions. There are surely a lot of directions for research within the typological approach that may deliver fruitful information about the category of modality.

One possibility is for instance to classify languages in terms of the type of system they use to express modality. This is illustrated in the famous (Palmer 2001) where such a distinction is drawn. Some languages express modality through modal systems, others through mood. Palmer (2001) further classifies the category of modality for both systems. This results in a typology of modality based on crosslinguistic analysis. This path has been successfully followed by among others Palmer (1986), van der Auwera and Plungian (1998), and Hengeveld (2004).

Another research program investigates the grammaticalization paths of modal elements as in (Bybee, Perkins and Pagliuca 1994) and (van der Auwera and Plungian 1998). These works are characterized by their diachronic perspective.

A last example of fruitful investigation within the typological approach is the cross-linguistic study of the interaction of modality with other categories such as tense and aspect, or with operations like negation (de Haan 1997).

This dissertation concentrates on modal systems and leans on existing typolo-

gies of modality. I therefore take for granted much of the work cited above and will leave the mood category for future work. In contrast to the second suggestion above, this study is synchronic in nature. Finally I will not investigate the interaction of modality with other categories but focus instead on the combinations of modal items within the category of modality.

It is not an uncommon practice in semantics to use typological data, or at least to use some examples from languages other than English in order to investigate some issue. Ad hoc examples are often used to argue for or against a hypothesis within a language. Typically, crosslinguistic data is not used in such situations to make universal claims about how semantics should look. This method is perfectly fine as long as one wants to find support for one's analysis (or arguments against a competing one). Nevertheless it falls short when the goal is to make general claims about the semantic architecture of modality. Such a goal needs a *systematic* crosslinguistic analysis of modality. This fact has been made clear for the study of modality in a series of publications by Kai von Fintel and Sabine Iatridou, (von Fintel and Iatridou 2004), (von Fintel and Iatridou 2006) and (von Fintel and Iatridou 2007).[1]

The aim of this dissertation is to make general claims about the architecture of the category of modality. The formal semantics of modality presented here will thus be based on the results of a systematic typological investigation.

This being said, what does a typological investigation into modality usually consists in? First, it begins with the study of the syntactic items expressing modality in a relevant sample of languages. The next step consists in classifying the data, i.e. constructing a typology. The kind of classification obtained is of course dependent on the specific question being asked. For instance, if the question is "what are, crosslinguistically, the different types of modality?", the result will be a categorization of the relevant types of modality found in the data. If the question is "how does modality interacts with negation?", quite a different typology will be obtained revealing the different strategies of combinations with negation (for instance the use of specialized modals). Based on the typology one can then make hypotheses on the nature of the modal system and for instance look at crosslinguistic regularities. If some property or pattern of the system occurs for each language, we can formulate it as a general principle that accounts for this regularity (called an unrestricted language universal); if some pattern occurs under some condition for each language, we can formulate a general principle that accounts for this variation (called an implicational universal). The natural step is then to adopt this universal as a constraint on your theory as long as no counter-example is found.

I will adopt this method and use it to build and constrain a formal framework for the semantics of modality. To make this point clear, it seems obvious that we want to have at least descriptively adequate semantic theories, therefore we

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[1](Iatridou 2000) is probably the precursor of this fruitful method.

should in the first place make our theory compatible with the general results obtained from the typological investigation.

The departure point of this investigation is thus the study of modal items in the languages of our sample. That is, the investigation begins at the syntax/semantics interface where I will have to identify and organize the semantic information about modality via some syntactic or lexical items (which can vary in nature). Of course, it would be difficult to take this step without a prior expectation or hypothesis about the structure and organization of the semantic system of modality. As already mentioned this dissertation leans on the available literature on the typological approach to modality, particularly (Palmer 1986), (Bybee et al. 1994), (van der Auwera and Plungian 1998), (Hengeveld 2004).

The method of investigation is thus circular in nature: we make assumptions about the nature of the system of modality, test these assumptions with the data obtained for some languages and finally, fine tune our theory and assumptions with respect to the results of the tests. This circularity is not different from the circularity involved in any other empirical investigation. In a way it would only come to an end if a complete analysis was given, and this dissertation will not reach this ideal end state. A first example of such an assumption is that modality is expressed crosslinguistically through either a modal system or mood (Palmer 2001). Another example would for instance be that any modal system divides into an epistemic and a non-epistemic part (with maybe further distinctions into the non-epistemic realm).

The thread running through this dissertation is the question of combinations of modal items. I will in particular show that a certain ordering between modal items is valid through all the sample and conjecture that it is an unrestricted universal: in a nutshell (based on the toy hypothesis made above about the nature of modal systems) epistemic modals outscope non-epistemic modals.

The task will then be to check whether existing semantic theories of modality account for this semantic universal and can explain it. I will argue that, as it stands, this is not the case and I will thus present a new formalism. Finally the last move of this circular process will be to go back to particular language data and see how it can help further research on modality for particular languages.

A hidden assumption of the proposed method is that I must assume a version of the "no variation" hypothesis which roughly says that "there is no crosslinguistic variation in the semantics" (Matthewson 2001, p156). This hypothesis is quite standard in the typological literature and amounts to assuming an underlying semantic or conceptual space ((van der Auwera and Plungian 1998, p86) or (Croft 2003, p134) respectively) that allows us to compare different languages in terms of their grammatical realization of this space.[2] Obviously there will be

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[2]Semantics with respect to this hypothesis refers to the realm of things that can be expressed (for instance, within a category like modality) independently of the particular grammatical form used.

a great deal of variation at the syntax/semantics interface, hence I will need to assume some kind of separation between the particular language-dependent realization of modality and its (formal) semantics. Therefore the view proposed in crosslinguistic semantic research can be contrasted with a more traditional approach in the following way. The usual way for semanticists to go is to formalize their intuitions about some phenomenon in their preferred language from their intuitions about the data at the syntax/semantics interface, and to then check whether it correctly predicts the observed patterns.

$$Data$$

$$test \qquad intuitions$$

$$Formal\ theory$$
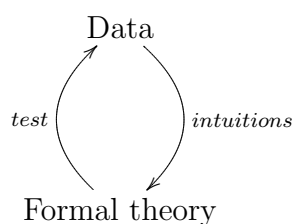
The method of investigation is here somehow less direct and involves some extra steps and a different starting point. We begin by studying a phenomenon, here the notional category of modality, in different languages.[3]

$$Crosslinguistic\ data \longrightarrow Typology$$

$$test \qquad \begin{array}{c} compatibility \\ constraint \end{array}$$

$$Formal\ framework \longleftarrow \begin{array}{c} hard \\ constraint \end{array} Language\ universals$$
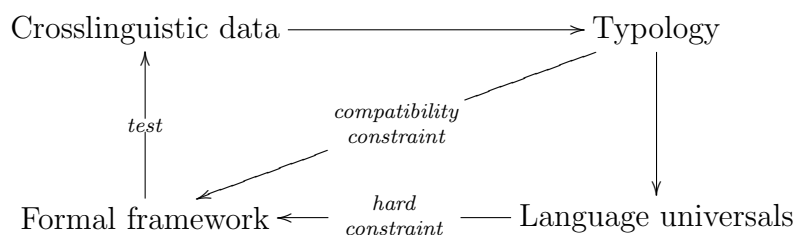
The dissertation is organized as follows. In the first chapter, I begin with a succinct general introduction of the concepts and key notions of typology. The body of this section is mainly based on the textbooks of (Greenberg 1974), (Comrie 1989) and (Croft 2003). The second part of this chapter is devoted to the core topic of this dissertation, modality. I will present some typologies of modality developed by (Palmer 2001), (Hengeveld 2004) and (van der Auwera and Plungian 1998). I will choose the last typology as a starting point for the investigation of modality in the second chapter.

The second chapter is devoted to the investigation of the modal systems of six languages: Dutch, Gbe (cluster), Korean, Lillooet, Turkish and Tuvaluan. The description of these modal systems will show that the chosen typology is quite accurate in the sense that the different types of this typology are indeed represented by specialized modal items. I will first for each language present an overview of the modal system and then investigate the issue of modal combinations. The findings are summarized in the last section and an unrestricted semantic universal concerning the combination of modal items is formulated.

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[3]The diagram will be discussed in section 1.1.3.

I then turn to the formal theory of modality. In the third chapter, I present and discuss the theory of modality developed by Angelika Kratzer in (Kratzer 1976) up to (Kratzer 1991). In this series of articles, a context-dependent analysis of modality is formulated that still forms the backbone of most semantic work on modality. I will also present some extensions of this standard framework proposed by (von Fintel and Iatridou 2004) and (Brennan 1993) to account for some interesting data about goal-oriented modality and dynamic modals respectively.

The fourth chapter is about some problems which I will argue the standard framework and its extensions cannot cope with. In particular the issue of modal combinations for which an unrestricted universal has been formulated in the previous chapter will be shown to be highly problematic.

In the fifth chapter, I construct an update semantics framework for modality. The gist of this framework is to implement the typology of modality discussed in the previous chapters as a constraint on the architecture of the framework. Therefore different types of modality operate at different places in the architecture (although in a very similar manner). This permits an elegant account of the unrestricted universal on combinations of modals and also explains most of the problems of the standard framework. Another key point is the intrinsic connection it makes between the two types of goal-oriented modality and ability.

Finally I conclude on what has been achieved in this dissertation and the future prospects.

Chapter 1

Typology and modality

In this chapter I will present some basic notions of the typological approach to linguistics and some relevant typologies of modality. I will first give some different but related perspectives on the way to look at typology as a linguistic field and the challenges one has to face in the typological approach. After this general introduction I will turn to the category under scrutiny in this dissertation: modality. I will furthermore present some classifications of the notional category of modality based on cross-linguistic comparison (typologies of modality).

1.1 Typology

1.1.1 Variation in the languages of the world

The world counts around 6000 languages (up to 7000 according to some sources). If there is something certain about this number, it is that it contains much variation. That is, variation is a basic fact about the world's languages. A straightforward part of the meaning of the word *typology* is that of classification into types. Therefore we have now defined the coarsest, and most trivial, way to typologize or classify languages: each language is its own type (identical with itself and different from the others). This truism, however, raises the question of the distinctiveness of languages. How can we decide in the first place that two languages are different? This is best illustrated by an example. English and Dutch differ structurally from each other in their phonology and morphology as well as in their syntax. For instance, the word order of the English relative clause is SVO (Subject-Verb-Object), whereas Dutch word order is SOV. Of course, a different word order in the relative clause is not enough to claim that English and Dutch are distinct languages, and this conclusion is drawn from a broad range of other structural differences between the two languages.

In order to situate typology within linguistics, we can use an analogy with psychology made by Greenberg (1974, p27): "every language is in certain re-

spects,"

1. like no other languages,

2. like some other languages,

3. like all other languages."

To begin with the first point: this is the traditional area of linguistics and concerns the study of particular languages. That is, the object of study is a unique language. Language descriptions and grammars are useful tools for the typologist but are not more than a prerequisite for typological work. In the typological tradition, the unique variations between languages are considered as a random phenomenon that will ultimately need to be explained. However, such variations do not reflect general properties of language. One of the goals of typology is to find those properties that are not random in language variation, and this enterprise is based on the assumption that it makes sense to look for such properties, that is as Greenberg (1974, p54) puts it:

> "The hypothesis that typology is of theoretical interest is essentially the hypothesis that the ways in which languages differ from each other are not entirely random. . . "

The second point is about classification, i.e., the finding of relevant types or strategies along which languages can be classified. This is an important part of the typological approach which involves cross-linguistic investigation. A typology is of course in some sense of the word a classification, for instance a classification of languages, but making this classification the endpoint of all typological work would be too reductive. Finally the third point is about finding generalization within the classification, that is, correlations between different types and classified languages. This step is the search for language universals.

1.1.2   Language comparison

First, in order to classify, we need to compare languages. In the case of English and Dutch word order in relative clauses we would thus need to identify the categories of subject, object, verb and of course relative clauses.

Traditionally, typology is based on the comparison of surface structures or properties among different languages. This makes the use of structural definitions of grammatical categories almost impossible in order to compare languages as the definition would already exclude other structures that might express this category. The structures have to be found based on structure-external criteria, for instance, semantic criteria. Croft (2003, p14) describes the strategy to follow:

"(i) Determine the particular semantic(-pragmatic) structure or situation type that one is interested in studying.

(ii) Examine the morphosyntactic construction(s) or strategies used to encode that situation type.

(iii) Search for dependencies between the construction(s) used for that situation and other linguistic factors: other structural features, other external functions expressed by the construction in question, or both."

Therefore, the typological classification will be based on grammatical categories that will be externally defined by semantic criteria. This ensures that we do not a priori exclude any construction used to express modality.

1.1.3 Three steps of typology

A different perspective on typology is to consider it more globally as a general approach to linguistics. That is, the typological approach consists first of steps 2 and 3 mentioned in (Greenberg 1974, p27). We compare languages, classify them and extract generalizations about the patterns observed. However, the typological approach also aims at explaining those patterns, usually in functionalist terms (the patterns observed relative to some structures will thus be explained in terms of the function of these structures). We can therefore characterize the typological approach as an empirical approach to language consisting of three layers as in (Croft 2003, p2):

1. typological classification based on surface structure   (descriptive part)

2. typological generalization   (language universals)

3. functional-typological approach   (external explanation of the universals)

Those three steps quite nicely fit in a slightly modified version of the schema provided in the introduction: The last step is presented a bit differently than in
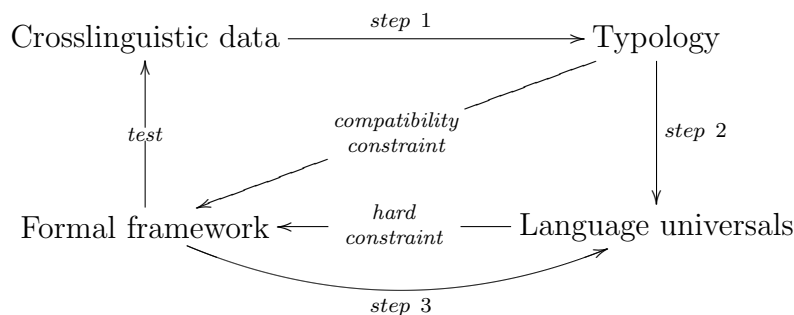
Figure 1.1: The three steps of the typological approach.

(Croft 2003, p2). This is because I will not provide a functional explanation of

language universals but try to provide a formal semantic framework that accounts for and explains them. The diagram reflects furthermore the fact that, although the minimum requirement on the formal theory is to be descriptively adequate with respect to the language universals, we also want it to be explanatory.

Of course the first step of the typological approach is only made possible through the availability of precise data (descriptive grammars, native speakers, informants, etc. . .) of a large sample of languages. This brings us to the question of the selection of the languages to be considered.

1.1.4   Language sample

As already stated, there are about 6000 languages in the world and we obviously need a way to select some of them in order to obtain a sample of workable size. There are two main strategies to construct a sample and the choice between these two is guided by the purpose of the investigation. The first strategy is to construct a probability sample. This is best suited to testing the statistical relevance of some pattern or more generally to making statistical generalizations. The second strategy is to construct a variety sample. This type of sample "is designed to maximize the amount of variation in the data" for the structure or phenomenon under scrutiny (Rijkhoff, Bakker, Hengeveld and Kahrel 1993). As the topic of this dissertation is the study of modality from a typological perspective it seems natural to choose for the strategy of a variety sample. A way to select such a variety sample is presented in (Rijkhoff et al. 1993). This method is designed to obtain a sample as diverse as possible by avoiding above all genetic bias in the sample (instead of, for instance, geographical bias). This means that, based on the classification of (Ruhlen 1987), we would at least have to pick a language for each of the 27 groups of genetically related languages also called phyla[1] in order to have a representative and diverse sample.[2]

The core problem when designing a sample is the availability of documentation on the chosen languages. It is needless to say that language x of phylum y is not a good candidate to represent phylum y if there is no (descriptive) grammar available nor any access to texts, native speakers or informants. Furthermore, even when a descriptive grammar is available for a particular language, it is often not sufficient to form a coherent picture of the modal system. These two problems are the reason why the sample in this dissertation will not reach the 27 languages but be limited to 6: Dutch (Indo-Hittite), the Gbe cluster (Niger-Kordofanian), Korean (Korean-Japanese / language isolate), Lillooet (Salishan), Turkish (Altaic) and Tuvaluan (Austric).

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[1]Notice that the definition/composition of those phyla is still a subject of discussion.

[2]The main point of (Rijkhoff et al. 1993) is to give a method to improve the diversity of the sample by allowing some genetic bias (some phyla are represented by more than one language).

1.1.5 Language universals

Once the language sample has been constructed and a classification into types
has been made, it is possible to look for language universals. Language universals
are a generalization of the typology as they tell us which types of languages are
possible as a function of one or more parameters. There are two basic types of
languages universals: unrestricted and implicational universals.

Unrestricted universals

The following quote from (Croft 2003, p52) explains perfectly what an unre-
stricted universal is:

> "An unrestricted universal is an assertion that all languages belong
> to a particular grammatical type on some parameter, and the other
> types on the same parameter are not attested (or extremely rare)."

Therefore an unrestricted universal says that on some parameter (almost) all
languages belong to the same type. Croft (2003, p52) also provides an example of
such a parameter in the realm of phonology: having oral vowels. The correspond-
ing unrestricted universal is that "all languages have oral vowels." This means
that, according to the situation pictured in figure 1.1, any theory of phonology
must at least be compatible with this fact. It is also desirable that this theory
provides support for an (functional) explanation of the phenomenon.

An important contribution of this dissertation will be to acknowledge the
status of unrestricted universal of a particular statement about combinations of
modal items and to provide an explanation based on a formal semantic framework.

Implicational universals

Implicational universals restrict the possible types of languages through an impli-
cational statement with two parameters. Therefore, if we consider two parameters
P and Q, an implicational universal is a true statement of the form *if a language
has P then it has Q* (write $P \rightarrow Q$). The truth table[3] for such an implication is:

P	Q	$P \rightarrow Q$
1	1	1
1	0	0
0	1	1
0	0	1

The implicational universal accounts thus for the following pattern. Languages
that obey parameter P but not Q are not attested (or only marginally) and all
the other combinations of parameters are possible and attested.

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[3]I follow the usual notation and write 1 for "true" and 0 for "false."

1.2   Typologies of modality

As explained in the previous section, the first problem of any typological investigation is to determine the semantic structure that is going to be investigated and to find the strategies used to express it. Modality, however, cannot be characterized as a unique semantic structure or type but is more a whole category of (related) semantic structures. Notice that we shift the use of the word *typology* in the sense that we will not so much try to classify languages (in terms of one or more parameters) but instead give a typology of a certain notional category based on the languages of the world where it is found. That is, we are looking for a cross-linguistically based typology of a certain notion or structure.

The main problem is that there is no agreement on the precise delimitation of the different modal semantic subtypes. Roughly, the only agreement seems to be that all scholars in the field make a distinction between an epistemic and a non-epistemic subtype. I will now present some of those typologies: Palmer (1986) (here as Palmer (2001)), Hengeveld (2004) and van der Auwera and Plungian (1998). The goal will be to determine which distinctions are the most relevant for this investigation. The view entertained here is that there is no perfect typology of modality but only good typologies suited to the purpose of a given study. Notice finally that an overlap of terminology will be unavoidable in the review of the different typologies but that, whenever possible, differences will be highlighted.

1.2.1   Palmer

According to Palmer (2001, p1), "modality is a valid cross-language grammatical category that can be the subject of a typological study." Palmer proposes a classification of the different types of modality where a basic distinction is made between mood (irrealis/realis included) and modal systems as the two grammatical ways to express the notion of modality. Languages may use both systems (although I will concentrate this inquiry on modal systems). The mood systems are characterized by a binary distinction between indicative and subjunctive or realis and irrealis (the imperative being left by Palmer outside of the core mood system), the distinction being made on the ground of syntactic distribution. Even though modality can thus be expressed by the mood/irrealis strategies, the mood systems are usually not specialized therein. I will therefore leave mood aside and concentrate instead.on what Palmer calls modals systems To be more precise, I will focus on those elements, grammatical and sometimes lexical, specialized in expressing modality (and therefore part of the modal system). Palmer's modal systems (see figure 1.2) are divided in two major categories: propositional modality and event modality. The former is concerned with the "speaker's attitude to the truth value or factual status of the proposition" whereas event modality refers to "events that are not actualized,...that have not taken place but are merely potential" (Palmer 2001, p24 and p70 respectively).

Propositional modality		Event modality	
Epistemic	Evidential	Deontic	Dynamic
Speculative	Reported	Permissive	Abilitive
Deductive	Sensory	Obligative	Volitive
Assumptive		Commissive	

Figure 1.2: Palmer's modal system

Propositional modality is crucially characterized as a speaker's attitude. I will later argue that the speaker's role should, in this definition, be replaced by a more neutral notion, because it is not necessarily the speaker that expresses his attitude, as can be seen in quotation contexts, under verbs of saying or under hearsay evidentials. I will adopt Palmer's division of propositional modality into epistemic and evidential even though I won't keep the overarching category as such. It seems to be at a level of description too coarse to be useful and it is actually not a settled issue among scholars whether evidentiality and epistemic modality should be considered as part of the same system. Therefore I will focus on epistemic and evidential modality. Further classification is at this point not really needed in the epistemic realm (divided by Palmer into speculative, deductive and assumptive), however I will now comment on Palmer's subcategories of evidentiality. Palmer distinguishes between two major types of evidentiality in modal systems, reported and sensory evidentials, but nonetheless agrees in (Palmer 2001, p9) that one could consider these two types as direct subcategories of propositional modality (see figure 1.3). The Turkish *-mIş* past is actually

Propositional modality
Epistemic
Reported
Sensory

Figure 1.3: Palmer's alternative typology of propositional modality

a good example of a modal item involving all three categories of propositional modality (besides being a past participle). It can be used to express reported modality (hearsay) or "inference from observed facts."[4] This last interpretation is a subtle combination of what Palmer calls a deductive (usually called inferential) based on direct sensory evidence, though not of the state of affairs itself. In the following I will neglect sensory evidentials, and for instance, treat Turkish *-mIş* as either reported or inferential (not mentioning the sensory nuances). This

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[4](Lewis 1975, p122)

choice is partly driven by a problem of scarcity of data on sensory evidentials and by the fact that reported evidentials seem to be richer in their ability to combine meaningfully with epistemic expressions. Furthermore we will see that some authors consider the deductive/inferential category as inherently evidential (the reason for that is somewhat illustrated by the Turkish *-mIş*: inference based on evidence). Therefore I will use in the following the term evidential with the restricted meaning of quotative and reported evidentials.

Event modality has two sub-types: deontic and dynamic modality. Deontic modality has to do with obligations and permissions imposed on an agent, or a group of agents, by himself or others. Palmer distinguishes thus between permissive, obligative and commissive. The distinctions made in dynamic modality between ability and volition are quite straightforward. In particular, volitive modality is about the agent's desires and wishes whereas abilitive modality is about the agent's capacities to perform certain events. It should be noticed that modal items for volitive modality seem to be able to express assumptive and commissive modality as well (at least in English, see (Palmer 2001, p78)) and we will see that they seem to have some properties that set them apart from the other modals. I will therefore leave them out of this study, considering that they need a work of their own.

Finally, Palmer identifies three main types of grammatical markers involved in modality, Palmer (2001, p19):

1. individual suffixes, clitics and particles,

2. inflection,

3. modal verbs.

As I already mentioned I will also use lexical items and idiomatic constructions. This will mainly happen in situations where the scarcity of grammaticalized modal items makes it a relevant way to obtain more data in order to illustrate the main thesis of this dissertation about the scope of modal elements.

1.2.2   Hengeveld

Hengeveld (2004) proposes a typology of modality that reflects the different layers of the clause structure in the functional grammar tradition. That is, modal elements can be seen as modifiers (also called operators) at different layers of the clause (predication, event or proposition). Hengeveld (2004) uses two classifying parameters: the target of evaluation and the domain of evaluation. The target of evaluation is crucially the part that represents these different layers of modification in the clause. It is thus constituted of three different parts:

1. Participant-oriented modality.

2. Event-oriented modality.

3. Proposition-oriented modality.

The first type characterizes those modal items that somehow modify the relation between a participant and an event. A typical example would be the modal *can* in the following example:

(1)   John can break this code.

The event-oriented type concerns the assessment of the descriptive content of a sentence and most importantly, doesn't involve the speaker's judgement. In the following sentence, the modal verb *must* describes a general obligation or regulation but doesn't modify the relation between a participant and an event.

(2)   Thesis paper must be acid-free.

The last type, propositional modality, specifies the speaker's judgement, or attitude, towards the proposition (notice the similarity with Palmer's notion of propositional modality) as illustrated in example (3).

(3)   Maybe John went to the conference.

The second parameter is the domain of evaluation. This is the place of the traditional modal distinctions.

1. Facultative (abilities).

2. Deontic.

3. Volitive.

4. Epistemic.

5. Evidential.

As Hengeveld (2004, p1193) notes these two parameters should lead to 15 different combinations, however, only 10 out of the 15 possible are actually realized as can be see in figure 1.4. Hengeveld (2004) argues that this is due to incompatibilities between some values of the target of evaluation and of the domain of evaluation. For instance, it doesn't seem to make sense to evaluate the propositional content of an utterance (i.e. target of evaluation = propositional modality) on the basis of their 'ability' (domain of evaluation = facultative). Ability is a notion that typically applies to agents not to propositions. As I already mentioned I will not consider volitive modality. It can be noticed that this is the only domain that is represented at all levels of evaluation which makes it quite unfit for investigation concerning its combinations with other modals (namely, within this typology, it should be able to combine at almost all levels). It is quite instructive to compare

Domain	Target		
	Participant	Event	Proposition
Facultative	+	+	-
Deontic	+	+	-
Volitive	+	+	+
Epistemic	-	+	+
Evidential	-	-	+

Figure 1.4: Hengeveld's typology of modality

Hengeveld's typology with Palmer's. The most flagrant difference is the addition of Hengeveld's event-oriented modality. This new type seems to be situated somewhere in between Palmer's propositional and event modality. Actually it is probably more appropriate to see it not as creating a new type but as a reshaping of the typology. The fact is that the distinction between propositional and event modality is fairly uncontroversial for the core meaning of those categories. The problem occurs at the 'border' of the categories, for instance, when a dynamic or deontic modal is used with a non-animate subject. The question is then whether the difference in meaning necessitates the introduction of a new type. I will side with (Hengeveld 2004) on this issue and assume that there is a relevant modal meaning that is not directly connected to participants in events and yet not epistemic or necessarily deontic.

For my purpose there is however a major problem with this typology. Although the defined types correspond to sensible choices, the design of the typology is somehow unfortunate. Namely, the target of evaluation presupposes a particular vision of the operators and of their combinations within a clause that already constrains their a-priori combinations. Therefore I propose to keep in mind the relevant distinctions but to reorganize the types in a neutral configuration with respect to our problem of modal combinations.

1.2.3   Van der Auwera and Plungian

I will now present the typology of modality of van der Auwera and Plungian (1998) as illustrated in figure 1.5. Their system builds on Bybee et al. (1994) to construct a semantic map of modality. That is, their goal is to provide a map of the grammaticalization paths of modal items. They define modality as the "semantic domains that involve possibility and necessity as paradigmatic variants"[5] and distinguish four main types:

1. Participant-internal modality,

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[5]van der Auwera and Plungian (1998, p80)

2. Participant-external modality,

3. Deontic modality ($\subseteq$ participant-external modality),

4. Epistemic modality.

The focus on possibility and necessity partly justifies their decision to leave volition and evidentials outside the scope of their study. Evidentials of the inferential type are actually incorporated within epistemic modality: "Inferential evidentiality is thus regarded as an overlap category between modality and evidentiality" (van der Auwera and Plungian 1998, p86). I will however stay neutral on whether inferential evidentiality overlaps only with epistemic necessity, and just distinguish between evidential and epistemic: the first one representing hearsay and quotative meanings, the second standing for the speaker's assessment or inference based on knowledge of a proposition.

One important similarity with Hengeveld's typology is the space created for a modality that is neither a judgement on the part of the speaker (propositional-oriented and epistemic respectively) nor the qualification of the performance of an event by an agent (participant-oriented and participant-internal respectively). I will however side with (van der Auwera and Plungian 1998) and consider that deontic modality is a sub-type of participant-external modality. Anticipating on the data, I want to claim that this choice will be warranted because first, participant-external items outscope participant-internal items and second, because the distinction between the participant and event oriented domains blurs this result in the sense that, for instance, deontic modality can be both seen as participant and event oriented modality.

Possibility/Necessity		
Non-epistemic possibility		Epistemic possibility
Participant-internal	Participant-external	
	Non-deontic Deontic possibility	

Figure 1.5: Van der Auwera and Plungian's typology of modality

Finally, van der Auwera and Plungian (1998) only consider grammaticalized items, or items on their way to be grammaticalized. Therefore, the same remark as for Palmer (2001) and Hengeveld (2004) applies here. I will make use of a wider range of modal items or constructions when needed.

1.2.4   Typology of modality

To summarize, I will begin the investigation with the following typology (which can be seen as a simplified and slightly modified (i.e. less detailed) version of van der Auwera and Plungian (1998)'s typology):

Participant-internal	Participant-external		Epistemic
	Deontic	Goal-oriented	
Ability	Permission	Possibility	Possibility
Needs	Obligation	Necessity	Necessity

The modal items under investigation will not be restricted to grammatical items, but I will also be looking at lexical items when the analysis will benefit from additional data. The constructions under scrutiny will thus be the following: particles, inflection, auxiliaries, periphrasis (complex constructions), derivation and such lexical means as plain verbs and adverbs.

Chapter 2
Typological investigation of six modal systems

The major difficulty that arises when one wants to pursue a typological work on modality is the scarcity of descriptions of modal systems from a semantic perspective. Most descriptive grammars do address the issue of modality but not always in enough depths to make it useful from a semantic point of view. By this remark I do not intend to depreciate the incredible amount of work that is needed to complete a descriptive grammar. The genesis of this chapter has taught me that it is by no means an easy task. However it has also reinforced my belief that there is a great need for semantically motivated descriptions of modal systems. Part of the goal of this chapter is to provide such a description for six different languages. The descriptions of the modal systems will however not be exhaustive and reflect my interest for the combinations of modal elements. Although exhaustiveness was not the goal of those descriptions, I hope to have highlighted the most important properties of the modal systems and provided the reader with enough references to the literature as to where to find more detailed discussions.

I will now present the modal systems of six languages: Dutch, Fon cluster, Korean, Lillooet, Turkish and Tuvaluan. The goal of this chapter is to describe some of the diversity in how the world's languages express modality. Therefore, the six languages have been chosen from different phyla and are geographically widely spread.

The choice of those languages is also based on the availability of written sources (grammar, articles, written texts) and informants (native speakers and/or language specialists). Finally, the languages have been selected for their relatively rich modal systems.

The chapter will be organized as follows: I will for each of these languages give a succinct grammatical overview and then present the modal system.[1] I

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[1]I do not claim to give a complete account of all nuances of modality within those languages nor of all possible ways to express modality.
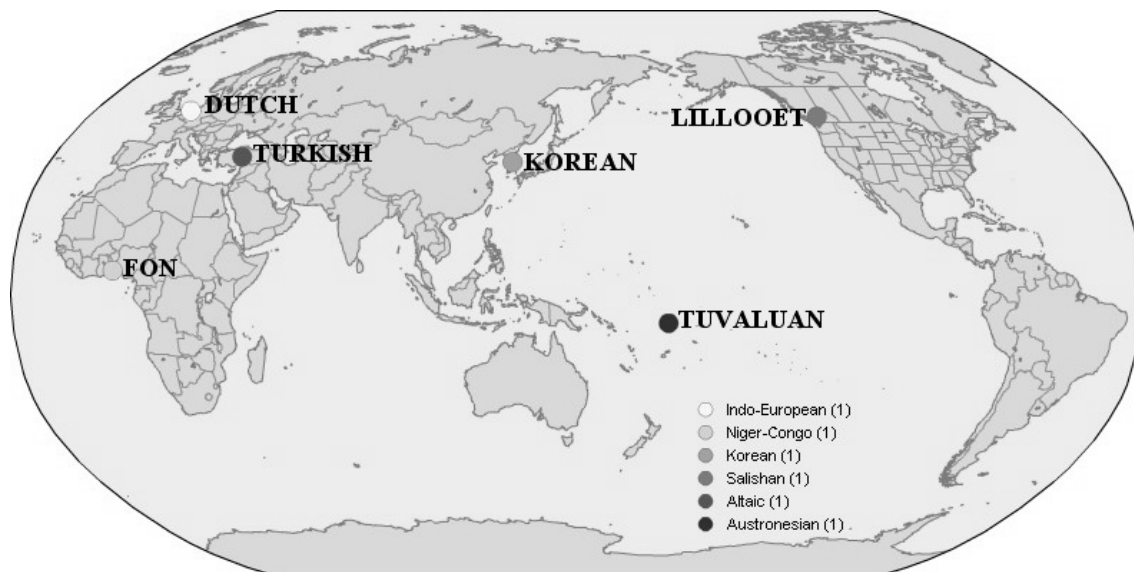
Figure 2.1: Language sample

will use the typology presented in the previous chapter as a guideline. I will furthermore look at combinations of modal items for each language in order to test the following hypothesis about the semantics of modal items:

Hypothesis 2.0.1 (Modal scope hypothesis)**.** If two modal items from different types are combined within the same clause in a grammatical sentence, their relative semantic scope will fall within the following pattern:

$$\text{Epistemic} > \text{Participant-external} > \text{Participant-internal}$$

I will finally present some general conclusions on the base of those languages and for instance argue that the scope hypothesis is verified.[2]

2.1   Dutch

The Dutch language is an Indo-European language of the Germanic family. It is spoken by around 23 million people mainly in the Netherlands, Belgium, the Netherlands Antilles, Aruba and Suriname. Dutch word order is quite flexible but is usually characterized as SVO/SOV. The only 'hard' rule is that in main clauses, the finite part of the verbal group comes in second position whereas the infinite part (infinitive, participles) is placed in final position.[3] The following table is adapted from (Fehringer 1999, table 44 p113):

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[2]In this chapter, the source of some examples is not mentioned. Those examples were made up and checked with my informants.

[3]See (Shetter and Van der Gruysse-Van Antwerpen 2002, p179), (Fehringer 1999, p112).

Basic		hij 3M.SG	gaat go.3SG		morgen tomorrow	naar huis to home	
Complex		hij 3M.SG	zal FUT.SG		morgen tomorrow	naar huis to home	gaan go
Subordinate	omdat because	hij 3M.SG		morgen tomorrow	naar huis to home	gaat go.3SG	
Inverted	morgen tomorrow		gaat go.3SG	hij 3M.SG		naar huis to home	
After subordinate	als hij kan, if 3M.SG can.SG		gaat go.3SG	hij 3M.SG	morgen tomorrow	naar huis to home	
Question			gaat go.3SG	hij 3M.SG	morgen tomorrow	naar huis? to home?	

The case system has almost completely disappeared and only subsists in some archaic forms (in particular for the genitive). Dutch expresses three genders, masculine, feminine and neuter, on its pronouns. The next table is taken from (Fontein and Pescher-ter Meer 2000, p122):

		Singular		Plural	
Person		Subject	Object	Subject	Object
1		ik	mij/me	wij/we	ons
2		jij/je	jou/je	jullie	jullie/je
	formal	u	u	u	u
3	masculine	hij	hem	zij/ze	ze
	feminine	zij/ze	haar		hun/hen
	neuter	het	het		

Some verbs have a separable prefix that is usually placed at the end of the clause when the verb is finite. Most prefixes are prepositions (*uit-geven*: out-give, 'to publish') or adverbs but can also be adjectives (*schoon-maken*: clean-make, 'to clean') or nouns (*plaats-vinden*: place-find, 'to take place'). In infinite forms, the infinitival marker *te* occurs between the separable prefix and the verb. Notice that some of the separable prefixes can also occur as non-separable even on the same verb form. In this case, accent placement is used to disambiguate between the two infinitival: *vóór-spellen* (separable, 'to show how to spell a word') and *voorspéllen* (non-separable, 'predict, foretell') (*E-ANS* 2004, 12.2.2.1).

2.1.1 Dutch modal system

I will first give a rough sketch of the Dutch modal system and then turn to the issue of combinations. Following (van der Auwera and Plungian 1998), there are

three main types of modality: participant-internal, participant-external and epistemic modality. I will follow the insight according to which those types of modality are tightly connected with the notions of possibility and necessity. Therefore items expressing moral judgments such as 'good', 'better', etc. will not be treated. Some examples in this section are taken from the online edition of the Dutch newspapers NRC Handelsblad and De Volkskrant but also from (Nuyts 2004) and (Nuyts, Byloo and Diepeveen 2005) (although Nuyts adopts a much broader notion of modality than I will).

Participant-internal modality

Participant-internal modality has to do with ability/capacity and the internal needs of the agent or, as van der Auwera and Plungian (1998, p80) formulates it, as "a kind of possibility or necessity internal to a participant engaged in the state of affairs."[4] This type of modality can be subdivided in three main parts: physical ability, learned ability and circumstantial ability/possibility (ability with respect to external conditions). This can be expressed in Dutch through two different kinds of constructions:

| | Participant-internal | |
Modal verbs	Lexical constructions	
kunnen	*in staat zijn om*
moeten	*in de gelegenheid zijn om*
hoeven	

The modal verb[5] *kunnen* is quite versatile and is used for (all) other types of modality (i.e. participant-external and epistemic). It is also versatile within the participant-internal type.

(1)   a.   Hij   kan   heel goed zwemmen.
             3M.SG can.SG very good swim
             'He can swim very well / He's very good at swimming.'
             (Haeseryn, Romijn, Geerts, de Rooij and van den Toorn 1997, p996)

---

[4]Notice that the agent need not be animate.

[5]Nuyts et al. (2005) refer to what I call modal verbs as "modal *auxiliary* verbs." However Dutch modal verbs do not seem to be as grammaticalized as their English counterparts. For instance, Dutch modal verbs do not always need a VP complement as shown in the following idiomatic construction:

(i)   Alleen betrokkenen   mogen   naar   binnen. . .
       only   concerned.people.PL may.PL PREP inside
       'Only concerned people may [go] inside [wearing a helmet].'

I will therefore use the more neutral denomination "modal verb" most of the time.

    b. Jan kan   weer trainen.
         John can.SG again train
         'John can train again.'

    c. Op zaterdagmiddag   kan   hij   nooit zwemmen...
         on Saturday.afternoon can.SG 3M.SG never swim
         'He can never swim on Saturday afternoon.'

<div align="right">(Haeseryn et al. 1997, p996)</div>

The sentences of (1) exemplify the use of the modal verb *kunnen*. In sentence (1-a), the modal is interpreted as attributing a physical ability to the agent. The same sentence without the modifier *heel goed* could express learned ability as well. Sentence (1-b) can express both physical ability (John was injured but he is fit again) and circumstantial possibility (John was temporarily excluded by the trainer). Finally, sentence (1-c) is only circumstantial (this due to the recurring time interval) and shows that the modal verb takes scope under negation.

(2)   Jan is   in   staat 100 kilo te   tillen.
        John COP.3SG PREP state 100 kilo INF lift up
        'John can lift 100 kilos.'

The lexical construction *in staat zijn* (see sentence (2)) is mainly used for circumstantial and physical ability.[6] Finally, these two expressions of participant-internal modality combine with negation in a straightforward way (this is true independently of the precise interpretation, i.e. physical, learned or circumstantial):

(3)   a. Ik kan   niet slapen
         1SG can.SG NEG sleep
         'I cannot sleep.'   (N09.02.07)

    b. Erdems   vader [...] is   niet in   staat om   te
         Erdem.GEN father   COP.3SG NEG PREP state PREP INF

---

[6]The construction *in de gelegenheid zijn om* has a similar meaning but seems to be less frequent and more oriented toward circumstantial ability.

(i)   Nederland was   niet in   de   gelegenheid om   Amerika na
        Netherlands COP.3SG.PAST NEG PREP DET occasion   PREP Amerika behind
        te   volgen in   verspilling.
        INF follow PREP wasting
        'The Netherlands were not able to follow the US in wasting habits.'   (N24.05.97)

It is interesting to notice that, although that construction is also specialized for participant-internal modality, if the copula *zijn* in *in de gelegenheid zijn om* is replaced by the verb *stellen* ('to place') the construction then means 'to enable' (*in staat stellen* is also possible) and that participant-external *kunnen* can also be expressed *de gelegenheid hebben* (*E-ANS* 2004, 18.5.4.4.iii.a).

werken.
work
'Erdem's father is not able to work.'   (N19.02.00)

Examples (4-a) and (4-b) are representatives of participant-internal necessity. Nuyts et al. (2005, 24-25) do not have any examples in their corpora available but acknowledge that such examples make sense in Dutch.

(4)   a.   "Maar zou   je de dia's   volgende keer weer met bloemetjes
              but   would 2SG DET slide'PL next   time again with flower.PL
             versieren?" Suzanne moet   lachen. "Waarom niet?"
             decorate   Suzanne must.SG laugh   why   NEG
             "But will you use slides with flowers again next time?" Suzanne
             laughs. "Why not?"   (N13.01.06)
        b.   "Ik moet   plassen, kan   ik even gaan?" vroeg   ze
             1SG must.SG pee   can1SG 1SG ADV go   ask.3SG.PAST 3F.SG
             aan   een collega.
             PREP DET colleague
             "I need to pee, may I go?" she asked a colleague.   (N03.10.03)

In both examples, the participant-internal necessity expresses that the agent cannot prevent himself from performing the action in the scope of the modal. In sentence (4-a), a journalist reports a conversation. The modal sentence provides some background information and is meant to describe the reaction of the hearer (Suzanne) after the journalist's question. The modal has thus a present interpretation and does not need to be translated in the English gloss. On the other hand, in sentence (4-b), the participant-internal necessity has a future interpretation.

Participant-external modality

Participant-external modality contains deontic modality plus all those meanings that are neither epistemic nor about ability and capacity. I will follow (van der Auwera and Plungian 1998) and mainly concentrate on the deontic and goal-oriented meanings. In Dutch, these can be expressed via modal verbs and modal adjectives.[7]

---

[7]Deontic modality can also be expressed through a lexical construction with nouns expressing deontic notions as *toestemming* (permission) and *verplichting* (obligation).

	Participant-external	
	Deontic	Goal-oriented
Modal verbs	*moeten*	*moeten*
	hoeven	*hoeven*
	mogen	*kunnen*
Adjectives	*toegestaan*	*mogelijk*
	verplicht	*nodig*
	verboden	*noodzakelijk*

With respect to the modal verbs, there are separate possibility modals for permission (*mogen*) and for goal-oriented modality (*kunnen*).[8] The necessity modals are able to express both meanings. The adjectives also display such a distribution: *noodzakelijk* and *mogelijk* are mainly used for goal-oriented modality and the others are specialized for deontic modality.

Goal-oriented modality All the modals in the following sentences express participant-external modality, except *kunnen* in the first sentence of example (5-a) which expresses circumstantial ability.

(5) a. In China kan je een gezonde nier   bestellen. De donor
         LOC China can.SG 2SG DET healthy kidney order   DET donor
         moet   alleen nog even worden doodgeschoten.
         must.SG only   still ADV AUX   kill.PERF
         'In China, you can order a healthy kidney. The donor only has to be
         killed.'   (N28.01.06)
     b. Wil   je het   goed doen, dan moet   je minimaal twintig
         want.2SG 2SG 3N.SG well do   then must.SG 2SG at least   twenty
         minuten de   tijd hebben voor iemand.
         minutes DET time have   for   someone
         'If you want to do it well, then you have to give each client at least
         20 minutes of your time.'   (N04.02.99)

The modal verb *moeten* in example (5-a) expresses thus goal-oriented necessity where the goal ($\approx$"to get a kidney") is induced by the preceding clause. That the donor has to be killed is thus a necessary condition to "get your kidney." In example (5-b), *moeten* is featured in a typical instance of anankastic construction (which is a way to get a goal-oriented interpretation):[9] the (necessity) modal expresses a necessary condition for the fulfillment of the conditional antecedent.

---

[8]Although sentence (4-b) shows that it is not completely clear whether *kunnen* cannot be used for permission in spoken language.

[9]To my knowledge, (von Wright 1963, p10) was the first to describe those sentences as anankastic. See (Sæbø 2001) and (von Fintel and Iatridou 2004) for further discussion.

That is, to spend at least 20 minutes with each client is a necessary condition in order to do this work correctly.

(6)   Je hoeft   er   pas om   tien uur te zijn.
       2SG need.3SG LOC only PREP ten hour INF COP
       'You only need to be there at ten.'   (*E-ANS* 2004, (6) 29.2.2)

Sentence (6) shows the mandatory use of a (here implicit) negative element (*pas om tien uur* 'not earlier than 10.00') in combination with *hoeven*. The negation or negative element always has scope over the modal *hoeven* and the construction expresses that something is not necessary.

(7)   Als je meer wilt,   kan je 70 procent van je   huidige inkomen
       if 2SG more want.2SG can.SG 2SG 70 percent of your current income
       als maatstaf nemen voor een toekomstig pensioen. . .
       as standard take   for DET future   pension
       'If you want more, you can take 70 percent of your income as the standard
       for a pension.'   (N24.07.07)

The possibility modal *kunnen* is used in sentence (7) to express that "to take 70 percent of your income as the standard for a pension" is a way of achieving what you want.

(8)   Volgens hem is   het   nodig   dat rijkere ouderen gaan
       according 3M.SG COP.3SG 3N.SG necessary that richer elderly go
       meebetalen aan   de   AOW om   de   gevolgen   van de
       with.pay   PREP DET AOW PREP DET consequences of   DET
       vergrijzing op   te   vangen.
       aging   PREF INF catch
       'According to him, it is necessary that richer elders will also contribute to
       the AOW in order to attenuate the consequences of the aging problem.'
                                                                       (N22.05.07)

Finally, sentence (8) exemplifies the use of an adjective (*nodig*) in a goal-oriented interpretation with a purpose clause. Probably the most important thing to notice about all these examples is that they actually feature two different kinds of construction: in (5-b), (6) and (7) the purpose clause (or conditional) and the necessary condition are co-indexed whereas this is not the case in (5-a) and (8). The difference is that, in the first case, the necessary condition stands for an action the agent has to perform to reach *his* goal whereas, in the second case, a certain state has to hold in order to reach the goal.

Deontic modality Sentences (9-a) and (9-b) express respectively prohibition and deontic permission. The interdiction in (9-a) can be interpreted as being

(metaphorically) imposed on the agents (and subjects) Tom and Jerry. However, the permission in (9-b) is not really directed to the subject of the sentence (doves and homing pigeons) but rather to people who own them.

(9) a. Tom en Jerry mogen niet meer roken.
         Tom and Jerry may.PL NEG more smoke
         'Tom and Jerry are not allowed to smoke anymore.'   (N21.08.06)
     b. Sier- en postduiven   [. . .] mogen vanaf volgende week
         dove and homing.pigeon.PL   may.PL from next   week
         woensdag   weer naar buiten.
         Wednesday again PREP outside
         'Doves and homing pigeons are allowed outside from next Wednesday
         on.'   (N08.03.06)

This shows, as Wurmbrand (1999, p611) puts it, that the roles of *obligee* or *permissee* "do not have to coincide with a specific syntactic argument in the sentence." In fact, sentence (9-a) can also be understood as forbidding television companies to broadcast cartoons where Tom and Jerry smoke.

(10)   Landis hoeft   zijn gele   trui   nog niet in   te leveren.
        Landis need.3SG his yellow jersey yet NEG PREF INF give
        'Landis doesn't have to give back his yellow jersey yet.'   (N07.08.06)

As in the case of goal-oriented modality, *hoeven* needs a negative element to form a grammatical deontic sentence and it is also interpreted with the negation having scope over the necessity modal, i.e. as 'not obliged to.' On the other hand, the modal verb *moeten* in its deontic interpretation takes scope over the negation and is interpreted as 'obliged not to.' The following examples are typical adjectival constructions of deontic sentences. Those constructions share a common denominator. Quite often, the *obligee* or *permissee* are not the grammatical subject but can be referred to through a for-clause as in (11-b) and (12-b). When this is not the case, the interpretation is usually generic as in (11-a) and (12-a).

(11)   a. Dat is   niet wettelijk verplicht.
            DEM COP.3SG NEG legally   mandatory
            'That is not mandatory by law.'   (N30.08.06)
        b. In   Iran zijn   hoofddoek en lange mantel verplicht   voor
            LOC Iran COP.PL headscarve and long   coat   mandatory for
            vrouwen.
            women
            'In Iran headscarves and long coats are mandatory for women.'
                                                               (N22.05.06)

Sentence (11-a) says that something is not a legal duty, i.e. the negation has scope over the modal. Sentence (11-b) expresses a legal obligation for women (though

they are not the grammatical subject of the sentence).

(12)   a.   "Godslastering wordt   helaas toegestaan in   West-Europa."
                 blasphemy   AUX.3SG alas   allow.PERF LOC Western-Europe
                 "Alas, blasphemy is allowed/tolerated in Western Europe."
                                                                        (N31.01.06)
         b.   Met het voorstel is   selectie aan de   poort mogelijk
                with DET proposal COP.3SG selection PREP DET gate   possible
                voor het hoger beroepsonderwijs.
                PREP DET higher technical education
                'With this proposal, entrance selection is possible for the technical
                education branch.'   (N10.02.06)

Sentences (12-a) and (12-b) both express permission; in (12-a) that blasphemy
is allowed and in (12-b) that selection is allowed. In both cases, the subject of
the sentence is not the actual recipient of the permission. In order not to get the
impression that the subject in those adjectival constructions is never the actual
recipient of the permission or obligation, observe finally the following sentence:

(13)   We zijn   verplicht samen   te   werken met het Tribunaal. . .
         1PL COP.PL obliged   together INF work   with DET tribunal
         'We are obliged to cooperate with the Tribunal [ICTY].'   (N16.10.00)

Modal source of deontic modality   A peculiarity of the Dutch system lies
in the fact that the source of a deontic modal can be referred to in conjunction
with the modal verb with the help of the preposition *van* 'of.'

(14)   a.   de   speler mag   van zijn club geen   uitlatingen doen
                DET player may.SG PREP his club NEG.DET comments do
                over   het incident.
                about DET incident
                'The player is forbidden by his club to comment on the incident.'
                                                                        (N05.08.06)
         b.   Ook makers   van huismerken moeten van   de   supermarkten
                even producers of   store.brands must.PL PREP DET supermarkets
                nóg goedkoper leveren.
                still cheaper   deliver
                'Producers of store brands also have to [based on the supermarkets
                demand] deliver still cheaper products.'   (N25.02.06)

In sentence (14-a) and (14-b) the source of the prohibition and obligation are
respectively a football club and supermarkets. The source is the authority nec-
essary for any deontic statement. It can be a person or entity as well as the law,
as can be seen in the examples in (11).

Epistemic modality

Epistemic modality "refers to a judgment of the speaker: a proposition is judged to be uncertain or probable relative to some judgment(s)" (van der Auwera and Plungian 1998, p81). As we will see with combinations of modals, the judgment is not necessarily the speaker's own but can also be attributed to other agents. There are three main classes of elements that express epistemic modality in Dutch. The modal verbs and the adjective *mogelijk* can also be used in participant-external modality. The epistemic adverbs and the second adjective (*waarschijnlijk*) cannot be used for any other type of modality.

| | Epistemic | |
Modal verbs	Adverbs	Adjectives
moeten	*misschien*	*mogelijk*
kunnen	*wellicht*	*waarschijnlijk*
	mogelijk	
	waarschijnlijk	

The following examples show some typical uses of the Dutch epistemic modals. For instance, the modal verb *moeten* in sentence (15-a) takes an impersonal pronoun as subject. An impersonal construction can also be used as in (15-b).

(15)   a.   ja 't moet   liggen op Jersey of Guernsey.
            yes 3N must.SG lie   LOC Jersy or Guernsey
            'Yes it must be situated on Jersey or Guernsey.'

                                      (Nuyts et al. 2005, (6) p20)

    b.   Het kan   zijn dat minister Verdonk te kort   door   de
            3N   can.SG COP that minister Verdonk too shoort through DET
            bocht is   gegaan bij   het ontkennen van het
            turn   COP.3SG go.PERF PREP DET denial   of   DET
            Nederlanderschap van mevrouw Hirsi Ali.
            Dutch.citizenship of   Ms   Hirsi Ali
            'It might be that Minister Verdonk was too quick in denying Dutch citizenship to Ms Hirsi Ali.'   (N17.05.06)

In Dutch, the adverbs are probably the most pervasive way to express one's judgment (see example (16-a) and (16-b)). The use of a (predicatively used) adjective as in (16-c) is less frequent but is also attested.

(16)   a.   Misschien is   het wel   een verslavende bezigheid.
            maybe   COP.3SG 3N PART DET addictive   occupation
            'Maybe it is an addictive occupation.'   (N02.10.06)

    b.   Juli 2006 wordt   waarschijnlijk de   warmste maand ooit.
            july 2006 AUX.3SG probably   DET hottest   month ever
            'July 2006 will probably become the hottest month ever.' (N22.07.06)

    c. Het is   mogelijk dat het paleis door aardbevingen
        3N   COP.3SG possible that DET palace PREP earthquakes
        is   verwoest.
        COP.3SG destroy.PERF
        'It is possible that the palace was destroyed by earthquakes.'

                                                              (N19.02.06)

Sentence (17) shows an embedding of a modal under a verb of saying. That is, the
epistemic qualification is attributed to Senator Lieberman, not to the speaker.

(17)   Senator Lieberman heeft   erop gezinspeeld dat dit   wellicht
        senator Lieberman have.3SG PREP allude.PERF that DEM probably
        ook zal   gebeuren.
        also FUT.AUX.SG happen
        'Senator Lieberman alluded to the fact that this might happen.'

                                                              (N10.09.98)

Notice that some might object that examples (17) and (16-b) are actually not
epistemic but metaphysical in the sense of (Condoravdi 2001, p3), i.e. they have
to do with "how the world may turn out, or might have turned out, to be."
However I will consider that this type overlaps with epistemic modality. One
important observation to support this assumption is that very often, the same
modal expressions are used to express both types.

    Finally all modal verbs and adverbs take scope over negation and only the
adjectives can scope under it.

Conclusion

The following table gives an overview of the different elements of the Dutch modal
system.[10]

| | Participant-internal | Participant-external | | Epistemic |
		Deontic	Goal-oriented	
Modal verbs	*moeten*	*moeten*	*moeten*	*moeten*
	hoeven	*hoeven*	*hoeven*	*hoeven*
	kunnen	*mogen*	*kunnen*	*kunnen*
Adverbs			*misschien*	
			wellicht	
Adjectives		*verplicht*	*mogelijk*	*mogelijk*
		verboden	*nodig*	*waarschijnlijk*
		toegestaan	*noodzakelijk*	
Lexical	*in staat zijn*	*toestemming hebben*		

---

[10]Remember that the list of modal elements presented in this section (and in this table) is
not exhaustive but that I tried instead to give a representative view of the modal system.

2.1.2 Combinations of modal items

I will now turn to the problem of combinations of modal elements within one clause.

Epistemic and participant-external

The most frequent combinations in (Nuyts 2004) concern combinations of deontic modal verbs *moeten* and *mogen* with epistemic adverbs (and adjectives) *misschien* and *waarschijnlijk*. Furthermore, it is interesting to notice that Nuyts (2004) encounters some difficulties in interpreting the data. Nuyts is searching for combinations of deontic and epistemic items but rightfully acknowledges for quite a lot of examples that the distinction between a deontic or a 'dynamic' reading is not easily made.[11] This makes me more comfortable with using the (van der Auwera and Plungian 1998) classification of those 'dynamic' readings as deontic modality under the *participant-external* header.

(18)   a.   misschien moeten we   maar een paar   mentoren geblesseerd
            maybe   must.PL 1PL PART DET couple counselors injure.PERF
            schoppen.
            kick
            'Maybe we have to injure a couple of student assistents.'

                                              (Adapted from (Nuyts 2004, (23) p36))

       b.   misschien moet   ik   ook wel   structuurrecht tentamen doen.
            maybe   must.SG 1SG also PART law   exams   do
            'Maybe I must also take the law exams.'

                                              (Adapted from (Nuyts 2004, (27) p37))

Examples (18-a) and (18-b) show a combination of the epistemic adverb *misschien* with the participant-external verb *moeten*. In particular, (18-a) contains a goal-oriented modal verb (in a discussion about how to achieve an organized weekend) whereas the modal verb in (18-b) is deontic (about the possible obligations of a student).

(19)   Mogelijk kan   minister Brinkhorst voor een andere benadering van
       possibly can.SG minister Brinkhorst for   DET other   approach   of
       zijn voornemens eens te rade   gaan bij   zijn collega   Zalm.
       his plans   PART INF advice go   PREP his colleague Zalm
       'Minister Brinkhorst can maybe consult his colleague Zalm for a different
       approach to his plans.'   (N03.03.06)

As example (19) shows, *mogelijk* can also be used as an adverb. It combines with participant-external *kunnen* in a goal-oriented interpretation.

---

[11]See in (Nuyts 2004) the discussions of examples (9) p31, (15) p33, (16) and (17) p34, (22)–(26) p36–37, (31) p39, (45) and (46) p44–45 and (49) p45.

(20)   Dat kan   noodzakelijk zijn om   de   monografie in   2009 te
        DEM can.SG necessary   COP in order DET monograph LOC 2009 INF
        laten verschijnen.
        let   appear
        That might be necessary in order to publish the monograph in 2009.
                                                                    (N10.05.06)

Sentence (20) combines the modal verb *kunnen* (may/can) used epistemically
(which is quite typival when it is combined with an impersonal demonstrative sub-
ject *dat*) with the participant-external adjective *noodzakelijk* (necessary) which
gets a goal-oriented modal interpretation (as can be seen from the presence of the
'in order to' complement).

(21)   waarschijnlijk moeten de   drie voor de   jeugdrechter komen.
        probably   must.PL DET three before DET judge   come
        'The three [children] probably have to appear before the judge.'
                                                          (Nuyts 2004, (19) p34)

(21) combines epistemic *waarschijnlijk* and deontic *moeten*. The sentence ex-
presses the speaker's judgment about a possible obligation for the three children.
Nuyts considers that in this case, the source of the obligation is clearly not the
speaker himself but another source. The speaker is not the source of the obliga-
tion because if he was, he would then use the more informative sentence with-
out 'probably.' This is nicely illustrated by the oddness of sentence (22). The
participant-external modal, in this case deontic, expresses the speaker's involve-
ment in the permission by the use of the prepositional phrase *van mij* 'from me.'
The oddness of the sentence is due to the incongruity of an epistemic uncertainty
about one's own commitments.[12]

(22)   ??Misschien mag   je   van   mij gaan.
         maybe   may.SG 2SG PREP me go
         'Maybe, you may go!'

Note that even when the epistemic item is in the (surface) syntactic scope of the
participant-external modal, as in example (23), the interpretation still involves
the epistemic having scope over the participant-oriented and not the other way
around.

(23)   Ik   moet   misschien nog een taalcursusje   volgen.
        1SG must.SG maybe   still DET language.course follow

_____

[12]Example (22) would therefore be less bizarre in a context where the speaker suffers memory
loss. Another possible situation where sentence (22) would make sense is one where the question
under discussion is "Who allowed me [the hearer] to go?" and where the speaker is not respecting
Grice's maxims of quantity: "Maybe" is thus interpreted as "for all you [the hearer] knows, it
is possible..."

'Maybe I still have to follow a language course.' (N11.09.06)

Finally epistemic adverbs can scope over participant-external adjectives as the following example shows:

(24) Het is   plezierig, [...] en misschien zelfs noodzakelijk om
      3N COP.3SG pleasant   and maybe   even necessary   PREP
      over boeken te praten.
      about books INF talk
      'It is pleasant, [challenging, ...] and maybe even necessary to talk about
      books.'   (N07.04.05)

One of the conclusions that can be reached from both Nuyts and the newspaper's data is that combinations of epistemic and participant-external items follow the pattern of hypothesis 2.0.1 where the epistemic item is used to express the speaker's judgment about the participant-external one. As Nuyts suggests, combining those items in the other way doesn't seem to be possible:

(25) #Het moet   waarschijnlijk zijn dat je   naar die   veradering gaat.
       3N   must.SG probable   COP that 2SG PREP DEM meeting   go.3SG
       'It must be probable that you are going to this meeting.'
                                                        (Nuyts 2004, (62-c) p50)

Examples involving two modal verbs are quite difficult to find. A possible explanation for this is the existence of two constraints that work in opposite directions. On the one hand the modal verbs often get an epistemic interpretation when used with an impersonal pronoun as subject (see (15-a), or when used in an impersonal construction (15-b)). On the other hand the participant-external modal verbs (mainly the deontic ones: *mogen, hoeven*) usually need a "permissee/obligee" to relate to, i.e. in the terms of (Hengeveld 2004, p1194-95), the modal verbs are mostly participant-oriented whereas the use of an impersonal pronoun favours an event-oriented interpretation. It appears from the data that when a sentence combines two modal verbs and,

1. the subject of the sentence is not impersonal, and

2. one of the two modals is interpreted as participant-external,

then the modal with the wider scope (semantically) is participant-external. (See the following section about combinations of participant-external and internal modals.)

Epistemic and participant-internal

The most common combinations involve epistemic adverbs over the modal verb *kunnen*, as in (26-a), (26-b) and (27). It almost goes without saying that in

all the examples the interpretation gives the epistemic having scope over the participant-internal item.

(26) a. Hij kan   waarschijnlijk voorlopig niet spelen.
          3m can.SG probably   yet   NEG play
          'He will probably not be able to play soon.'   (N23.08.06)
      b. Bernard Hinault had   zoiets   misschien ook
          Bernard Hinault have.3SG.PAST such.thing maybe   also
          gekund.
          can.PERF
          'Bernard Hinault would maybe also have been capable of such a
          thing.'   (N21.07.06)
      c. Spaarbeleg moet   dat kunnen berekenen.
          Spaarbeleg must.SG DEM can   calculate
          'Spaarbeleg must be able to calculate that.'   (N25.09.01)

The following example shows an epistemic adverb with scope over the lexical construction *in staat zijn om*.

(27) Ono [...] is   wellicht in   staat   de   zoekende aanvallers
      Ono   COP.3SG perhaps PREP condition DET searching strikers
      de   weg te   wijzen.
      DET way INF show
      'Ono is perhaps able to show the way to the hesitating strikers.'
                                                                (V01.09.03)

Finally, I have not found any combination of two modal verbs with an epistemic and a participant-internal interpretation. I think that the same explanation as for participant-external modality holds in this case. Participant-internal modals need an agent as subject and epistemic readings favor an impersonal pronoun as subject: that is not compatible.

Participant-external and participant-internal

The most common combinations involve a goal-oriented necessity modal verb and a participant-internal element. The following example features for instance the verb *moeten* (in a goal-oriented interpretation with an implicit goal of the kind "to do their job well") which takes scope over the lexical construction *in staat zijn om*.

(28) Ze moeten in   staat   zijn om uit gekleurde informatie
      3PL must.PL PREP condition COP PREP from colored   information
      feiten te   halen.
      facts INF get

'They [journalists] must be able to extract facts from biased information.'
(N21.04.00)

Sentences (29-a) and (29-b) combine respectively a goal-oriented *moeten* and *hoeven* over a participant-internal *kunnen*.

(29)   a.   Om te   kunnen spreken over plagiaat   moet   je   kunnen
                in order to can   speak   PREP plagiarism must.SG 2SG can
                vergelijken en   moet   je   dus twee documenten hebben.
                compare   and must.SG 2SG thus two   documents   have
                'In order to be able to speak of plagiarism, you have to be able to compare and therefore you need two documents.'   (N16.03.01)

    b.   Een gedicht hoef   je   niet te   kunnen begrijpen   om
                DET poem   need.2SG 2SG NEG INF can   understand PREP
                het   mooi te   vinden
                3N.SG nice   INF find
                'You don't need to be able to understand a poem to find it beautiful.'
                (N27.01.01)

Notice that, although I have found no clear-cut example (see (30-a)), I think that it is possible to force a reading with a deontic necessity modal over a participant-internal element.[13] Combinations of participant-external possibility and participant-internal modality are also difficult to find but are more easy to detect as *mogen* is exclusively deontic (see (30-b)).

(30)   a.   de   andere groepjes mogen   niet kunnen afluisteren.
                DET other   groups   may.PL NEG can   listen
                'The other groups are not allowed to be able to listen.'[14]

    b.   Beginners mogen al   kunnen rijden, maar al   kun   je
                beginners may.PL already can   ride   but   even can.SG 2SG
                helemaal niet rijden, ben   je   op   het   beginnerskamp ook
                entirely   NEG ride   COP.2SG 2SG LOC DET beginer.camp   also
                welkom.
                welcome
                'Beginners may already be able to ride, but even if you can not ride at all, you are still welcome at the beginner's camp.'

---

[13]In particular, the combination seems fine when the ability is to be reached at or before some future time:

(i)   Je   moet   me   vóór   donderdag kunnen terugbetalen!
        2SG must.SG 1SG before Thursday   can   pay.back
        'You must be able to pay me back before Thursday!'

[14]The fragment is part of the explanation of a game.
`http://www.ilo.uva.nl/homepages/gee/docs/HomeostaseHints.doc`

In sentence (30-a), the recipient of the obligation is not the grammatical subject of the sentence but the addressee whereas in (30-b) the recipient of the permission is the grammatical subject.

All in all, the scope hypothesis of 2.0.1 is supported by the Dutch data.

2.2   Fon cluster

In this section, I will present data from two dialects of Fon, Fongbe and Gungbe, that are (mainly) spoken in Benin. According to Capo's (1991, p11-15) classification, Fon is a dialect group of the Gbe cluster. The Gbe cluster consists of five main dialect groups: Vhe, Gen, Ajá, Fon and Phla-Pherá. This cluster corresponds to a group of Kwa languages that are spoken from Ghana to Nigeria. Figure 2.2 is based on (Capo 1991, figure 1 p15) and illustrates the classification of the Fongbe and Gungbe.
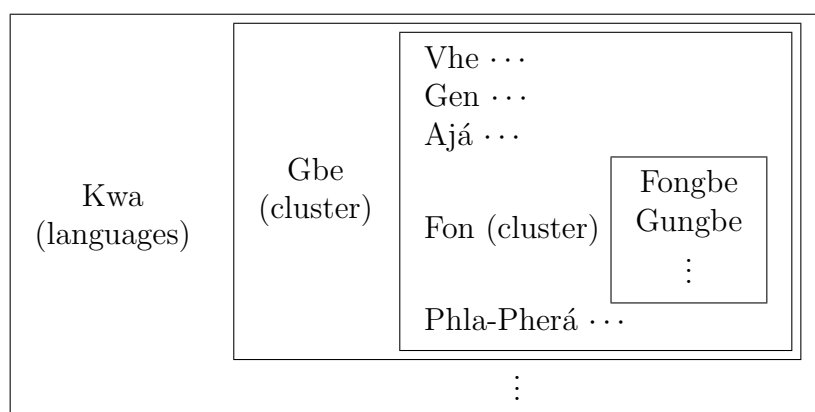
Figure 2.2: Fongbe and Gungbe in the Gbe cluster.

I will use the term 'Fon cluster' as a cover term for the invariant properties of all Fon dialects. I will therefore make an explicit distinction between Gungbe and Fongbe when the grammars of the two diverge on important issues. The discussion will mainly be based on Gungbe data from (Aboh 2004) and (Aboh 2006) and on Fongbe data from (Lefebvre and Brousseau 2002). When examples from other sources are used, I explicitly refer to the dialect used with [F] and [G] signs for Fongbe and Gungbe respectively.

The languages of the Fon cluster are tonal with (at least) two lexical tones, high ´ and low ` , that can be combined to form more complex tones.[15] Some

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[15]It is not settled in the literature (as (Lefebvre and Brousseau 2002, p25) mentions) whether the mid tone should be considered a basic tone like the high and low tones or as a complex tone (it is a phonetic variant of raising and falling for (Lefebvre and Brousseau 2002, p20). However it should be noted that all the Gbe languages have at least a three-way distinction between low, mid and high tone (Aboh 2004, p28).

lexical items can only be recognized by their tone as the following pair illustrates (Lefebvre and Brousseau 2002, p20): *gbà* 'to break' (low tone), *gbǎ* 'to build' (rising tone: low-high). The cluster has mainly an SVO word order but it allows for SOV word order, for instance, in nominalised clauses (see (Lefebvre and Brousseau 2002, p5)).

The Fon cluster can be considered an isolating language group in that it has a "poor inflectional morphology" (Aboh 2004, p32).[16] The following facts support this analysis. Firstly, it doesn't express number on the noun, as example (31) shows, and it doesn't express subject-verb agreement for either person, number or gender (Aboh 2004, p32).

(31) a. àmágà àtɔ̀n   /   àmágà ɔ́
          mango three   mango DEF
          'three mangos'   'the mango'

                                       (Lefebvre and Brousseau 2002, p28)

      b. àsɔ́n lέ   /   àsɔ́n ɔ́
          crab PL   crab DEF
          'the crabs'   'the crab'   (Lefebvre and Brousseau 2002, p39)

Secondly, case is not marked morphologically except for pronouns (Lefebvre and Brousseau 2002, p63).

	+ Nominative	− Nominative
1SG	*ùn*	*mì*
2SG	*à*	*wè*
3SG	*é*	*è*
1PL/2PL	*mí*	*mí*
3PL	*yé*	*yé*

In the Fon cluster, the verb is not inflected for tense, aspect or mood. Instead, the language has a rich set of TAM markers. When a TAM marker is used (their use is optional), it is mandatorily placed between the subject and the verb (if it is a complex TAM marker, its first component is placed between subject and verb). The following table shows some of those markers for Fongbe and Gungbe (based on (Lefebvre and Brousseau 2002, p89) and (Aboh 2004, p158)):[17]

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[16]Notice however that it has a quite productive derivational morphology (Lefebvre and Brousseau 2002, p6-7).

[17]It should be noticed that (Lefebvre and Brousseau 2002, p89) and (Lambert-Brétière 2005, p67) have also a marker called the 'indefinite future': *ná-wá*. This complex marker is actually the "combination of *ná*, the definite future marker, and *wá*, which, in isolation, means 'to come"' (Lefebvre and Brousseau 2002, p92). However, there is no broad consensus on its status as a separate TAM marker (for instance (Aboh 2004) doesn't treat it as a TAM marker) and I have trouble determining its meaning from the above-mentioned sources (it is sometimes translated as *eventually*, sometimes as *might*). Furthermore, most examples involving combinations with

		Fongbe	Gungbe
Tense	Anteriority	*kò*	*kó*
Aspect	Habitual	*nò*	*nò*
	Imperfective	*ɖò. . . wὲ*	*tò. . . [ˋ]*
	Prospective	*ɖò. . . ná. . . wὲ*	*nà. . . [ˋ]*
Mood	Definite future	*ná*	*ná*
	Subjunctive	*ní*	*ní*

Finally, Gungbe and Fongbe have a preverbal marker for sentential negation *má*.[18] However Fongbe allows also for a sentence-final negative marker *ă* that stresses the fact that the speaker "disagrees with the content of the proposition" (Lefebvre and Brousseau 2002, 6.5.3.1 p128). Finally Fon has specialized raising, control and modal verbs.

2.2.1   Fon modal system

Participant-internal modality

Participant-internal	
Modal verbs	Lexical verbs
ɖó-ná	*nyɔ́*
sìxú/sìgán	

The Fon cluster has two ways to express participant-internal modality. First, there are the modal verbs *sìxú/sìgán* and *ɖó-ná*. The first can be used to express ability as example (32) shows, but are also used for participant-external and epistemic modality. Both verbs express the same range of meanings but *sìxú*

TAM markers or modal items, as in (i), are not accepted by my informant (Aboh, pc). I will therefore not try to give an account of *ná-wá*. However, the reader should note that, in view of the analysis of *ná-wá* in (Lefebvre and Brousseau 2002), the combinatorial possibilities of this 'marker' support the overall thesis of this dissertation as the following example shows:

(i)   a.   Kòkú ná-wá   síxú wá
           Koku IND.FUT may come
           'Koku may/will have permission to come.'

                                            (Lefebvre and Brousseau 2002, (156) p291)

      b.   Kòkú síxú   ná-wá wá
           Koku IND.FUT may   come
           'Koku has permission to come in the (far) future.'

                                            (Lefebvre and Brousseau 2002, (157) p291)

When scoping over modal verbs, it can have a *might*-reading as in (i-a); when scoping under a modal verb, it only has an indefinite-future reading as in (i-b).

[18]Lefebvre and Brousseau (2002, 6.4 p120) represents the marker with low tone *mà* whereas Aboh (2004, 43–46) uses the high tone version, *má*.

is preferred by Fongbe speakers whereas *sìgán* is preferred by Gungbe speakers (Aboh, pc).[19]

(32)   a.   Kɔ̀kú sìgán yì
               Koku   can   leave
               'Koku can leave.'   (Lefebvre and Brousseau 2002, (162) p292)
    b.   Kɔ̀kú sìgán ɖú   wè
               Koku   can   dance dance
               'Koku can dance.'   [G] (Aboh, pc)

The modal verbs can be used to express ability in the past as in the following example:

(33)   Kɔ̀kú kò   sìgán yì
        Koku ANT can   leave
        'Koku could have left.'   (Lefebvre and Brousseau 2002, (163) p292)

The negation marker *mà* always precedes the modal verb to yield a 'not able to' scope.

(34)   a.   ní pɔ̀npì lɔ́   tò   kùnkùn lê,   mí má sìgǎn wà àzɔ́n
               if   tap   this IMPF run-run this.way.NLR 2PL NEG can   do job
               lɔ́
               this
               'If this tap keeps running this way, you cannot do the job.'
                                            (Aboh 2004, (41b) p176)
    b. #Kɔ̀kú sìgán mà   yì
         Koku   can   NEG leave
                      (Lefebvre and Brousseau 2002, (169-b) p293)

Notice that the incapacity for the subjects/agents of the main clause in (34-a) is not due to their intrinsic competence (i.e. internal) but to some external factor (the tap keeps running). That is, participant-internal ability might depend on participant-external circumstances. Finally the modal verb *ɖó-ná* can be used to express participant-internal necessity (involving a lack of control by the participant) as in (35).

(35)   ùn ɖó-ná xu   ado
        1SG must   reject/dry urine
        'I have to pee.'   [G] (Aboh, pc)

The second strategy in the Fon cluster for participant-internal modality uses the verb *nyɔ́* 'to know, to be good.' It expresses learned ability and combines in a transparent way with negation:

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[19]The Fongbe example (32-a) shows that this is only a preference.

(36)   a.   yé nyɔ́n   wè   ɖú
              3PL know.PERF dance dance
              'They can dance / they know how to dance.'

                                                        (Aboh 2004, (ii-e) p341)

        b.   yé mà nyɔ́n   wè   ɖú
              3PL NEG know.PERF dance dance
              'They can't dance / they don't know how to dance.' [G] (Aboh, pc)

Participant-external modality

A quite surprising fact about participant-external modality in the Fon cluster is
that there are no prominent lexical items (verbs, adjectives or noun-verb com-
binations). The following elements can be used instead: a mood marker, modal
verbs and an adverb.

	Participant-external	
	Deontic	Goal-oriented
Mood marker	*ní*	
Modal verbs	*ɖó-ná*	*ɖó-ná*
	sìxú/sìgán	*sìxú/sìgán*
Adverb	*dàndàn*	

Mood marker *ní*   The injunctive/subjunctive mood marker *ní* is used to ex-
press obligation (Lefebvre and Brousseau 2002, p93) (Aboh 2004, 5.3.3 p180) but
it can also be used in (exhortative) wishes and for orders in imperative construc-
tions (Lefebvre and Brousseau 2002, p93).[20]

(37)   a.   Bàyí ní ɖà   wɔ́
              Bayi ní prepare dough
              'Bayi must prepare dough.'
                                        (Lefebvre and Brousseau 2002, (21b) p93)

        b.   Kòfí ní jì   hàn
              Kofi ní sing song
              'Kofi should sing a song.'   (Aboh 2004, (47b) p181)

The mood marker *ní* is not allowed in goal-oriented sentences whether they are
formed with a want-conditional as (38-a) or with a purpose clause as (38-b).[21]

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[20]This marker is even more versatile as it can also work as conjunction (Aboh 2004, 5.3.1).
It is then quite similar to the English conditional marker *if* (Aboh 2004, p176) as can be seen
in example (47-a).

[21]This judgment was obtained with sentences where the choice of the modal element was
offered (either *ní* or the necessity modal *ɖó-ná*). The marker *ní* was explicitly refused in those
sentences for the goal-oriented interpretation.

(38)   [G] (Aboh, pc)

    a. #Nú   à   jló   ná   wà àzɔ́ ɔ́, à   ní   yì Kùtɔ́nû
       COMP 2SG want DEF.FUT do work DEF 2SG have.to go Cotonou
       'If you want to work, you have to go to Cotonou.'

    b. #À   ní   dó   àkwɛ́ bó (ɖó) ná yì tó   mὲ
       2SG have.to have money in.order.to go country in
       'You must have some money in order to travel.'

I will assume that the scope order of the mood marker *ní* with the negation *mà* is fixed and transparent for both Fongbe and Gungbe. The mood marker can precede the negation but the reverse order is not grammatical as examples (39-b) and (40-b) attest respectively:[22]

(39)   [F] (Avolonto 1992, p32)

    a. Kɔ̀kú ní má   dó   gbàdé ó
       Koku ní NEG sow corn   INS
       'Koku must not sow corn.'

    b. #Kɔ̀kú má   ní dó   gbàdé ó
       Koku NEG ní sow corn   INS

(40)   (Aboh 2004, (49b-c) p181-182)

    a. Àsíbá ní má   wá   blô
       Asiba ní NEG come anymore
       'Asiba should not come.'

    b. #Àsíbá má   ní wá   blô
       Asiba NEG ní come anymore

Notice that the examples (39-a) and (40-a) both feature a final particle: the insistence particle (Lefebvre and Brousseau 2002, p130-131) *ó* in (39-a) and the particle *blô* in (40-a). According to Aboh (pc), the combination *ní má* . . . PARTis the standard negative imperative form (for third person singular subjects) and the final particle is necessary. As the examples of (Avolonto 1992, p32) also contain a particle, I will assume that both Gungbe and Fongbe need such a particle,

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[22]The analysis of (Lefebvre and Brousseau 2002, p100) is different. Not all of their informants accept the combination of *ní* with *má*, but when they do, they consider both the following orders grammatical.

(i)   (Lefebvre and Brousseau 2002, (42a-b) p100)

    a. Bàyí ní mà   ɖà   wɔ́
       Bayi ní NEG prepare dough
       'Bayi should not prepare dough.'

    b. Bàyí mà   ní ɖà   wɔ́
       Bayi NEG ní prepare dough
       'Bayi does not have to prepare dough.'

The surface scope also determines the interpretation in the straightforward way.

contra example (i-a) of footnote 22. This does not mean that the mood marker
ní should be seen as an imperative marker (it can for instance be used in questions
and under verbs of saying and its predicate can be modified for aspect).

Finally *ní* can occur with the anteriority marker/adverbial *kò* in its scope.[23]

(41)   Sìká ní kò   ɖà   wɔ̀
       Sika ní already prepare dough
       'Sika must have prepared dough.'

                                        (Lefebvre and Brousseau 2002, (56a) p105)

Modal verbs   Three modal verbs can be used to express participant-external
modality: *ɖó-ná*, and *sìgán/sìxú*. The modal verb *ɖó-ná*[24] expresses all the
different notions of participant-external necessity: deontic in (42), goal-oriented
in (43).

(42)   a.   Ví   lɛ́ bí   ɖó-ná wá
            childPL all have.to come
            'All the children have to come.'
                                        (Lefebvre and Brousseau 2002, (143) p288)
       b.   A   ɖó ná   nyá àvɔ   élɔ…
            2SG have.to wash.cloth DEM
            'You have to wash this cloth…'
                                        [F] (Wekenon Tokponto 2002, 6 p90)

(43)   a.   À   ɖó-ná   dín   àkwɛ́ bó (ɖò) ná yì tó   mɛ̀
            2SG have.to search money in.order.to go country in
            'You have to find money in order to travel.'   [G] (Aboh, pc)[25]
       b.   Nú   à   jló   ná   yì tó   mɛ̀ ɔ́, à   ɖó-ná dó
            COMP 2SG want DEF.FUT go country in   DEF 2SG have.to have
            àkwɛ́
            money
            'If you want to travel, you must have enough money.'
                                        [F] (Aboh, pc)

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[23]According to (Lefebvre and Brousseau 2002, (68) p107), the reverse combination is accepted
by some speakers (with a minimal difference in meaning). However, Aboh (pc) doesn't accept
this order of TAM markers for Fongbe or Gungbe.

[24]According to Lefebvre and Brousseau (2002, p288), it is "the combination of *ɖó* 'to have'
and *ná*, the definite future marker." However, as Aboh (pc) pointed out to me, the *ná* part
of the modal could well have a different origin. In particular, it is not only used as a future
marker, but also in the prospective construction, as a preposition and as a verb *ná* 'to give.'

[25]Notice that the purposive construction is introduced either by *bó ná*, as in (Lefebvre and
Brousseau 2002, p174), or by *bó ɖò ná* (Aboh, pc). The first combinations is a contraction
of the second which combines the (same subject) clausal conjunction *bó* and the modal verb
ɖó-ná.

The meaning of *ɖó-ná* is best understood when contrasted with the meaning of *ní*. The modal verb is then stronger than the mood marker:

(44)   a.   Bàyí ɖó-ná   ɖà   wɔ́
              Bayi have.to prepare dough
              'Bayi must prepare dough.'   [F] (Aboh, pc)
   b.   Bàyí ní ɖà   wɔ́
              Bayi ní prepare dough
              'Bayi should prepare dough.'   [F] (sentence (37-a))

However, this does not mean that *ɖó-ná* has necessarily to be translated as 'must' as the following example makes clear.

(45)   Kofi talks on the phone with his mother who would like to visit him although she is very tired. He says:
   a.   À   má   ɖó-ná   wá...
              2SG NEG have.to come
              'You must/should not come.'   [G] (Aboh, pc)
   b.   àmɔ à   sìgán wá   ní   à   jló
              but 2SG can   come COMP 2SG want
              'but you can if you want to.'   [G] (Aboh, pc)

First notice that, if the modal in sentence (45-a) is interpreted as deontic 'must', the utterance of sentence (45-b) should be extremely odd. The second sentence is however possible in this context and this favors an interpretation as 'should.' The interpretation of (45-a) and (45-b) goes roughly as follows: with (45-a), the speaker expresses his opinion that it would be better that his mother doesn't come but (45-b) adds that this choice is hers. Figure 2.3 is an attempt to represent the contrast in meaning between *ní* and *ɖó-ná*. I will assume that the precise

$$[\text{weak}] \quad \frac{\text{MAY} \qquad \text{SHOULD} \quad \text{HAVE TO} \quad \text{MUST}}{} \quad [\text{strong}]$$
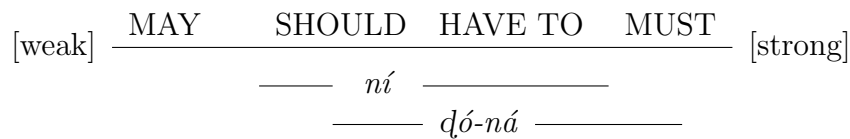
Figure 2.3: Fongbe participant-external necessity modals on a scale from weak to strong

interpretation of those two items is context dependent. For instance in the context of example (45), it seems that the mother/son relation has the effect of forcing a soft interpretation of *ɖó-ná*. If Kofi actually wants to order his mother not to come he would either have to use an imperative construction or to add the deontic modal adverb *dàndàn* to (45-a).

The modal combines with both types of negations *má* and *ǎ*. In both (46-a)[26] and (46-b), the negation is interpreted as having scope under the modal verb, i.e. as '*must not.*'[27] Sentence (46-c) shows that the negation is not allowed in the scope of the modal.

(46)   a.   Xwè ɖǎ é ɖó dìn, Àsíbá má ɖó-na ɖà làn
             age REL 3SG have now Asiba NEG have.to cook meat
             'Taking into account her age, Asiba must/should not cook meat.'
                                                    [G] (Aboh, pc)

        b.   A kà ɖó ná nyá àvɔ ɔ ɖò xwégbe á.
             2SG but have.to wash.clothes DEF at home   NEG
             'But you must not wash this cloth at home.'
                              [F] (Wekenon Tokponto 2002, 6 p90)

        c. #Kɔ̀kú ɖó-ná má wá
             Koku have.to NEG come
                      (Lefebvre and Brousseau 2002, (151b) p290)

The modal verbs *sìgán* and *sìxú* also have a participant-external modality interpretation. First, *sìgán* is interpreted deontically in sentence (47-a) and (47-c), whereas it has a goal-oriented interpretation in (47-b).

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[26]This example is adapted from (Aboh 2006, (33b) here as (i-a)) which shows that contrary to *ní*, *ɖó-ná* can be in the scope of the anteriority marker *kó*:

(i)   a.   Xwè ɖǎ é ɖó dìn, Àsíbá má kò ɖó-na nɔ̀ ɖà làn
           age REL 3SG have now Asiba NEG ANT have.to Hab cook meat
           'Taking into account her age, Asiba must not have been allowed to cook meat yet.'
           [G]
        b.   Kɔ̀kú kò ɖó-ná wá
           Koku ANT have.to come
           'Koku had to come.'   (Lefebvre and Brousseau 2002, (147) p289)

However, the precise effect of the anteriority marker on the modal verb is difficult to determine as becomes obvious from the contrast of translations between (i-a) and (i-b).

[27]The combinations of (Lefebvre and Brousseau 2002) don't fit with the analysis proposed here. Sentence (i-b) and (i-b) convey the meaning 'not have to.'

(i)   a.   Kɔ̀kú má ɖó-ná wá
           Koku NEG have.to come
           'Koku does not have to come.'   (Lefebvre and Brousseau 2002, (151a) p290)
        b.   Kɔ̀kú ɖó-ná wá ǎ
           Koku have.to come NEG
           'It is not the case that Koku must come.'
                         (Lefebvre and Brousseau 2002, (152) p290)

Obviously, both interpretations should not easily coexist within one language as one form, NEG MOD, could be interpreted as 'must not' and 'not have to' (I will assume that 'must not' is the standard and only interpretation possible).

(47)   a.   Ní é jló è,   Kɔ̀kú sìgán yì
             if 3SG want DEF.DET Koku can   leave
             Koku can leave if he wants to.   [G] (Aboh, pc)

       b.   Nú   à jló ná wà àzɔ́ ɔ́, à   sìgán yì Kùtɔ́nû
             COMP 2SG want DEF do work DEF 2SG can   go Cotonou
             'If you want to work, you can go to Cotonou.'   [F] (Aboh, pc)

       c.   (Ní   é jló,) Kɔ̀kú sìgán gɔ̀n   àzɔ́n wà
              COMP 3SG want Koku can   abstain work do
             'Koku may not work (if he wants to).'   [G] (Aboh, p.c.)

Lefebvre and Brousseau (2002, p292) say that it "may be assigned a deontic (capacity) [...] reading." This could seem to be at odds with the analysis of *sìgán* as an all-round participant-external and -internal modality. I think however that, in this case, the difference is merely a matter of definitions. First notice that capacity is not a deontic notion in the sense of permission and obligations. Therefore the term 'deontic' in (Lefebvre and Brousseau 2002) seems to cover the whole participant-internal and external range ('root' modality). In this dissertation, capacity can be participant-internal (see (32-a)) as well as participant-external in goal-oriented sentences. Sentence (47-b), for instance, is an example of a capacity use of the modal verb *sìgán* in a goal-oriented sentence.

    The negation marker must precede the modal verb, as in (34-a) for participant-internal modality. The interpretation follows straightforwardly from this word order and results in an English translation as 'cannot/not allowed.' It is possible to obtain an interpretation with the modal having scope above the 'negation' by using the verb *gɔ̀n* (meaning 'to abstain') as in sentence (47-c).

    Finally the modal verb *sìxú* behaves in the exact same way as *sìgán* with respect to negation and other TAM markers. It has a deontic possibility interpretation, as in sentences (48-a) and (48-b), but also goal-oriented possibility as in sentence (48-c).

(48)   a.   Kɔ̀kú sìxú wá
             Koku may come
             'Koku may come.'   (Lefebvre and Brousseau 2002, (153) p290)

       b.   Kɔ̀kú ná   sìxú wá
             Koku DEF.FUT may come
             'Koku will have permission to come.'
                          (Lefebvre and Brousseau 2002, (156) p291)

       c.   Nú   à jló ná   wà àzɔ́ ɔ́, à   sìxú yì Kùtɔ́nû
             COMP 2SG want DEF.FUT do work DEF 2SG can go Cotonou
             'If you want to work, you can go to Cotonou.'   [F] (Aboh, pc)

Adverbs The modal adverb *dàndàn* 'necessarily, obligatorily' supports a deontic interpretation when it is combined with the modal verb *ɖó-ná*, as in the

following example.

(49) Àsi   àtɔngɔ ɖèè a   dà   ɔ,   mì ɖó ná túùn fíɖèè é
      woman third   REL 2SG marry DEF 1PL have.to know side 3SG
      gósín   ɔ dándán   . . .
      come.from DEF necessarily
      'Concerning the third woman you married, we must (necessarily) be told
      where she comes from.'   [F] (Wekenon Tokponto 2002, 8 p108)

Although sentences with *dàndàn* do not necessitate the presence of the modal
verb, it seems to be a sure way to force a strong deontic necessity interpretation
as in (47-c).

    A characteristic of the adverb *dándán* is that it marks the authority of the
speaker (Aboh, pc). As sentence (50) shows, it doesn't embed under verbs of
saying. By using *dándán*, the speaker marks emphatically that, on his authority,
the embedded proposition is not open for discussion.

(50) Kɔkú ɖɔ̀ ɖɔ̀ Àsíbá wá   dándán
      Koku say that Asiba come necessarily
      'Koku DID say that Asiba came.'   [G] (Aboh, pc)

Modal recipient   The subject of a participant-external modal sentence is not
necessarily the recipient of the obligation or permission (in the deontic case). For
instance, the obligation in sentences (51-a) and (51-b) is not directed to Koku or
to the students. This is true with the mood marker and with modal verbs but
also with the adverb *dándán* as in (49).

(51)   The dean and a secretary prepare the list of participants for a conference.
          The dean says:
      a. Kɔkú ní mà wá   ó!
          Koku ní NEG come INS
          'Koku must not come!'   [G] (Aboh, pc)
      b. Wéxɔ̀mɛ̀ví lé bí   ɖó-ná wá
          student.PL all have.to come
          'All the students have to come.'   [G] (Aboh, pc)

What the dean means is that the secretary has to ensure that (51-a) and (51-b)
happen. The following sentences combine a modal verb and a resultative state
VP.

(52)   a. Hɔ̀n ɔ́ ɖó-ná ɖɔ̀ súsú.
              door DEF have.to be.at close.close
              'The door must be closed.'   [G] (Aboh, pc)

> b. Hɔ̀n ɔ́   sìgán   nɔ̀   súsú.
>   door DEF can/may remain close.close
>   'The door can/may be closed.'   [G] (Aboh, pc)

Obviously, doors are not the bearers of obligations or permissions. Therefore, the obligation and permission in sentences (52-a) and (52-b) are meant for agents external to the sentence.

Epistemic modality

Adverbs and modal verbs are the two main ways to express epistemic modality, although we will see that the mood marker *ná* can also get an epistemic interpretation in certain contexts (see example (57-b)).

Epistemic	
Modal verbs	Adverbs
ɖó-ná	*dódó*
sìxú/sìgán	*bɔ̀yà*

Modal verbs   All three modal verbs have an epistemic interpretation along with their participant-external one. As should be expected, the two modals *sìgán* and *sìxú* have an epistemic possibility interpretation whereas *ɖó-ná* gets a necessity reading. The following examples involve *sìgán*:

(53)   a.   Kɔ̀kú sìgán kò   yì
            Koku can   already leave
            'Koku may have left already.'
                              (Lefebvre and Brousseau 2002, (164) p292)

       b.   É   sìgán wá   fɔn   fɛ̀ɛ̀
            3SG can   come stand PART
            'He might finally stand up (at some point).'   [G] (Aboh, p.c.)

The modal verb *sìxú* has an epistemic interpretation in the following examples:

(54)   a.   Kɔ̀kú sìxú wá
            Koku may come
            'Koku has possibly arrived.'
                              (Lefebvre and Brousseau 2002, (153b) p290)

       b.   Kɔ̀kú kò   sìxú wá
            Koku ANT may come
            'Koku might have come.'
                              (Lefebvre and Brousseau 2002, (154a) p290)

Finally, although (Lefebvre and Brousseau 2002, p288) suggests that *ɖó-ná* is "essentially deontic," the following example and sentence (66-a) have an epistemic

interpretation.

(55) Tóóló kpoún ɔ yé lìn ɖɔ̀ mèɖé ɖó ná nɔ̀ nɔ̀ xwé ɔ́ gbè
right.away 3PL think COMP person have.to live house DEF in
'Immediately they thought that someone must be living in the house.'
[F] (Wekenon Tokponto 2002, 4 p111)

Notice that *ɖó-ná* needs not to be embedded under a belief attribution to express epistemic modality.

Adverbs The two adverbs, *bɔ́yà* and *dódó*, are "speaker oriented modal adverbs" (Lefebvre and Brousseau 2002, p383).[28] Firstly, the adverb *bɔ́yà* means 'perhaps, maybe' and has the special property of occurring clause-initially as sentence (56-a) shows (unlike the vast majority of adverbs that only occur clause-finally). The epistemic possibility adverb has a sentence final counterpart *vlàfò* (see sentence (59-b)). Secondly, the adverb *dódó* means 'certainly' and is only used in sentence final position as sentence (56-b) exemplifies.

(56) a. Bɔ́yà Kɔ̀kú yì Kùtɔ́nû
Koku go.PERF Cotonou maybe
'Maybe Koku has gone to Cotonou.' [G] (Aboh, pc)
b. Kɔ̀kú yì Kùtɔ́nû dódó
Koku go.PERF Cotonou certainly
'Koku has certainly gone to Cotonou.' [G] (Aboh, pc)

The necessity adverb is felt to be quite similar to *dándán* (Aboh, pc). However, whereas *dándán* marks the authority of the speaker, *dódó* involves his authority based on his knowledge.

Conclusion

	Participant-internal	Participant-external		Epistemic
		Deontic	Goal-oriented	
Mood marker		*ní*		(*ná*)
Adverb		*dàndàn*		*dódó*
				bɔ́yà
Modal verbs	*ɖó-ná*	*ɖó-ná*	*ɖó-ná*	*ɖó-ná*
	sìxú/sìgán	*sìxú/sìgán*	*sìxú/sìgán*	*sìxú/sìgán*
Lexical verbs	*nyɔ́*			

The modal system of the Fon cluster is based on a set of modal verbs, adverbs and mood markers. An important characteristic that can be brought forward is that

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[28]The participant-external adverb *dándán* is also a speaker oriented modal adverb (Lefebvre and Brousseau 2002, p383).

the verbs are polyfunctional in the sense of (van der Auwera, Ammann and Kindt 2005), that is, they can express different meanings: participant-external/internal and epistemic modality. On the other hand, the interpretation of the mood marker *ní* and of the modal adverbs seems to be circumscribed to one and only one category. For instance, the interpretation range of *ní* is a subset of participant-external modality (excluding goal-oriented uses).

The combination of the modal verbs and the mood marker *ní* with negation deserves further investigation. In particular, the important disagreement between the analysis proposed here and (Lefebvre and Brousseau 2002) needs to be settled by testing thoroughly a broad range of native speakers from different dialects (which is at this point unfortunately not feasible for me).[29]

2.2.2 Combinations of modal items

Epistemic and participant-internal

The first set of combinations involves the verb *nyɔ́* with the modal verbs in (57-a) and (66-a) and the mood marker for futurity *ná* in (57-b). The force of the epistemic judgment goes from possibility in (57-a), to good probability in (57-b) and to epistemic certainty in (57-c).

(57)　　a.　É　sìgán/sìxú nyɔ́n　　tɔ̀　lὲ
　　　　　　3SG can　　　know.PERF river clean
　　　　　　'He might be able to swim.'　　　　　　　[G/F] (Aboh, p.c.)

　　　　　b.　É　ná　nyɔ́n　　tɔ̀　lὲ　(fὲὲ)
　　　　　　3SG FUT know.PERF river clean PART
　　　　　　'He should be able to swim / he certainly knows how to swim'
　　　　　　　　　　　　　　　　　　　　　　　[G] (Aboh, p.c.)

---

[29]If we represent the relevant information in a clause structure as in (Aboh 2004), the comparison between the pros and cons of the two analysis becomes easier:

$$[_{\text{Fin}^\circ} \text{ní}_{\text{mood}} \; [_{\text{Neg}^\circ} \text{má} \; [_{\text{TP}} \; [_{\text{T}^\circ} \text{ná} \; [_{\text{MoodP}} \; \begin{matrix}\text{ɖó-ná} \\ \text{sìgán} \\ \text{sìxú}\end{matrix} \; [_{\text{Asp}^\circ 1} \text{nɔ̀}]]]]]]$$

This clause structure represents the relative surface position of grammatical items extrapolated from sentences in (Lefebvre and Brousseau 2002), (Aboh 2004) and (Aboh 2006). The scope information is transparent from left to right. This structure predicts, for instance, that the negation is interpreted over the modal verbs.

The analysis of (Lefebvre and Brousseau 2002) is formally appealing because its scope properties are transparent and uniform for the modal verbs, i.e. negation > modal. However, (Lefebvre and Brousseau 2002) provides many more combinations than this structure can account for. For instance, the negation *má* could also have scope over the mood marker *ní* or the definite future *ná* could scope under *sìxú* but not the other two modal verbs.

My analysis allows less combinations and fits this structure well but is still problematic when it come to the modal *ɖó-ná* which is interpreted above the negation like a mood marker.

c. É ɖó-ná nyɔ́n   tɔ̀ lὲ
   3SG have.to know.PERF river clean
   'He must be able to swim.'   [G] (Aboh, p.c.)

As can be expected, the modal verb *sìgán* in sentence (57-a) cannot be interpreted as participant-internal and gets here an epistemic interpretation. Furthermore *nyɔ̀* cannot take a modal verb as argument.

All epistemic adverbs can be combined with participant-internal *nyɔ̀* but only the epistemic possibility adverbs combine with *sìgán* (and therefore with *sìxú*), as is shown in (58) and (59) respectively.

(58)   a. Bóyà é nyɔ́n   tɔ̀ lὲ
          maybe 3SG know.PERF river clean
          'Maybe he is able to swim.'   [G] (Aboh, pc)
       b. É nyɔ́n   tɔ̀ lὲ   dódó
          3SG know.PERF river clean certainly
          'He certainly is able to swim.'   [G] (Aboh, pc)

(59)   a. Bóyà é sìgán ɖú   wè
          maybe 3SG can   dance dance
          'Maybe he can dance.'   [G] (Aboh, pc)
       b. Ní Kòfí jì   hàn, é   sìgán mo kwὲ   vlàfò
          if Kofi sing song 3SG can   find money maybe
          'If Kofi sings, he might be able to obtain some money.'
                                                            [G] (Aboh, p.c.)
       c. #É sìgán ɖú   wè   dódó
          3SG can   dance dance certainly
                                                            [G] (Aboh, pc)

Notice that in sentence (59-b), the interpretation of *sìgán* is participant-internal as in (34-a) and the epistemic possibility adverb occurs sentence-finally. However, the adverb *vlàfò* behaves more like a parenthetical and has actually the whole sentence in its scope (conditional antecedent included).[30] From the rejection of sentence (59-c), I will thus conclude that *sìgán* (and *sìxú*) cannot occur with sentence final modal adverbs.

Finally, the combination of sentence (60-a) is not ruled out by my informant (Aboh, pc), although it is somehow marked as not completely grammatical, whereas sentence (60-b) is clearly rejected.

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[30]Sentence (59-b) was obtained while trying to elicit a combination of the epistemic adverb with a goal-oriented modal as in the following sentence,

(i)   Maybe John should sing to get some money.

Although the sentences are not equivalent (despite their very similar meanings), it is obvious that the modal adverb was meant to have scope over the whole sentence.

(60) a. ?É ɖó-ná sìgán xɔ̀ wĕmà élɔ̀
           3SG must can   buy paper DEM
           'He must be able to buy this book.'   [G] (Aboh, pc)
      b. #É   sìgán ɖó-ná xɔ̀ wĕmà élɔ̀
           3SG can   must buy paper DEM

[G] (Aboh, pc)

Most examples (here and in the following sections) are from Gungbe. It is therefore necessary to be cautious with the conclusion: we can conclude that in Gungbe, epistemic modality always has scope over participant-internal modality, just as expected. Furthermore, I expect this conclusion to be valid for the whole Fon cluster.

Epistemic and participant-external

Lefebvre and Brousseau (2002, p382 & 394) mention that "more than one [non-modal] clause final adverb may occur at the end of the sentence." Their preliminary data on co-occurences suggests that the adverbs follow the mirror image order of adverbs in (Cinque 1999). This suggests that the scope order 'SVO bɔ́yà dándán' with a deontic adverb over an epistemic one should be impossible which is born out. More interestingly the scope order 'epistemic over deontic' is also impossible.

(61) #Bɔ́yà Kòfí yì Kùtɔ́nû dándán
       maybe Kofi go Cotonou necessarily

[G] (Aboh, pc)

I assume that the sentence initial adverb has scope over the whole sentence, that is, the sentence final version of (61) would be 'SVO dándán bɔ́yà.' The reason for this ungrammaticality is surely the speaker-orientedness of both adverbs. Both adverbs express an attitude of the speaker, *bɔ́yà* uncertainty and *dándán* speaker's authority, and these two attitudes cannot be combined within one sentence.

As can be seen in example (62), the epistemic possibility adverb *bɔ́yà* can combine with all modal verbs (in their participant-external interpretation). Sentences (62-a) and (62-b) have respectively the necessity modal verb *ɖó-ná* and the possibility verb *sìxú* in their deontic interpretation, whereas sentence (62-c) exemplifies a goal-oriented modal verb under the adverb.

(62) a. Bɔ́yà é   ɖó-ná yì Kùtɔ́nû
          maybe 3SG must go Cotonou
          'Maybe he has to go to Cotonou.'   [F] (Aboh, pc)
      b. Bɔ́yà é   sìxú yì Kùtɔ́nû
          maybe 3SG may go Cotonou
          'Maybe he is allowed to go to Cotonou.'   [F] (Aboh, pc)

　　　c.　Bɔ́yà　é　ɖó-ná　yì　Kútɔ́nû　bó-ná　　wà　àzɔ́
　　　　　maybe 3SG have.to go Cotonou in.order.to do　work
　　　　　'Maybe he has to go to Cotonou in order to work.'　[F] (Aboh, pc)

The data for the epistemic necessity adverb *dódó* in example (63) are less clear-cut, in particular because sentence final *dódó* doesn't combine with *sìgán* or *sìxú*. However, the participant-external necessity modal *ɖó-ná* does combine with *dódó* and the adverb has semantic scope over the modal verb.[31]

(63)　　a.　É　　ɖó-ná yì　Kùtɔ́nû　dódó
　　　　　　　3SG must　go Cotonou certainly
　　　　　　　'He must certainly go to Cotonou.'　　　　　　　[G] (Aboh, pc)
　　　　b. #É　　sìgán/sìxú yì　Kùtɔ́nû　dódó
　　　　　　　3SG can/may　　go Cotonou certainly

　　　　　　　　　　　　　　　　　　　　　　　　[G/F] (Aboh, pc)

Whatever the reason for the ungrammaticality of sentence (63-b) is, the main point remains that the participant-external modal verbs cannot scope over the epistemic modal adverb. Finally the modal adverbs cannot combine with the mood marker *ní*:

(64)　#Bɔ́yà　é　　ní jì　　hàn
　　　　maybe 3SG ní sing song

　　　　　　　　　　　　　　　　　　　　　　　　[G] (Aboh, pc)

Furthermore, the mood marker *ní* cannot precede any of the modal verbs and it also cannot occur in their scope.

　　　The modal verb *ɖó-ná* can combine with the possibility modals in their deontic interpretation but the same remark as for (60-a) holds, i.e. this is not judged entirely grammatical.

(65)　?É　　ɖó-ná sìxú xɔ̀　wěmà élɔ̀
　　　　3SG must　may buy paper DEM .
　　　　'He must be allowed to buy this book.'　　　　　　　[F] (Aboh, pc)

We can conclude from this data that all the sensible combinations of epistemic and participant-external modals yield the expected scope order, i.e. Epistemic > Participant-external. However, the mood marker doesn't exhibit any combinatorial possibilities. I think that the main reason for this fact is that *ní* always involves the speaker's judgment (order, advice from the speaker) and thus does not combine well with epistemic modality.

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　　[31]Unfortunately, I have no explanation for this behavior. From the scope properties of *ɖó-ná* with respect to negation, we would expect that it is higher than *sìgán* in the scope hierarchy. Therefore, as *dódó* cannot scope over *sìgán*, I would expect it not to be able to scope over *ɖó-ná*.

Participant-external and participant-internal

The participant-external modal verbs *ɖó-ná* and *sìxú* can be combined with the lexical verb *nyɔ́* as in (66-a).

(66) a. Yè ɖǒ nǎ nyǒ gbè mɛ̀ tɔ̀n wlǎn
          3SG have.to be.good language person GEN write
          'One must be able to write one's own language.'
                                        [F] (Lambert-Brétière 2005, (77a) p71)
      b. É sìxú nyɔ́n wè ɖú
          3SG may know.PERF dance dance
          'He is allowed to be able to dance!'[32]   [F] (Aboh, pc)

The combinations of modal verbs are constrained in the same way as in example (65), that is, a participant-internal interpretation of the possibility modal (instead of a participant-external one) does not change the judgment on this sentence.

(67) ?É ɖó-ná sìgán ɖú wè
      3SG must can   dance dance
      'He must be able to dance!'   [G] (Aboh, pc)

We have seen in examples (59-c) and (63-b) that *sìgán* and *sìxú* do not allow the sentence final epistemic adverb *dódó*. This is also the case with the deontic necessity adverb *dándán*.

(68) #Kòfí sìgán yì Kùtɔ́nû dándán
       Kofi can   go Cotonou necessarily
                                                           [G] (Aboh, pc)

Finally, we have already seen that the mood marker cannot combine with the modal verbs. This holds whatever their interpretation is and therefore, the *ní* equivalent of sentence (67) is not grammatical either. However it is fine with the lexical verb *nyɔ́*:

(69) É ní nyɔ́n wè ɖú hwɛ́có má gɔ̀
      3SG must know.PERF dance dance before 1SG.FUT come.back
      'He must be able to dance before I come back!'   [G] (Aboh, pc)

We can therefore conclude that the modal elements of Fon respect the scope order: Epistemic > Participant-external > Participant-internal.

---

[32]Notice however that it is difficult to find a context where sentence (66-b) actually makes sense.

2.3   Korean

The Korean language is spoken by approximatively by 75 million people including 5 million overseas Koreans. Its genetic relation to other languages is controversial. The older theory included Korean into the Altaic family but decisive arguments have been lacking, opening the way for the more recent opinion that Korean is an independent language, but in a zone of intensive language contact which would explain its close relationship to Japanese. I will adopt the second hypothesis as it also conveniently places Korean in a different phylum from the Altaic phylum including Turkish.

The phonology of the Korean language is obviously not the topic of this dissertation but its morphology is quite important. The main characteristic of Korean morphology is that it is agglutinative. For instance, nominals and verbal stems are assigned suffixes through derivational rules.

Furthermore, there is no agreement for person, number or gender but a rich system of honorific suffixes is used. Korean verbs have seven morphological slots, (Wymann 1996b, p31):

(28) $[[X]_V + \text{Honorific} + \text{Tense} + \text{Aspect}_1 + \text{Modal} + \text{Aspect}_2 + \text{Mood}]_V$

Syntactically, Korean is a strict verb-final language (leaning towards SOV but with an almost free word order) and the verb is the only mandatory element of finite clauses. Modifiers must precede their head noun. The language has a nominative-accusative case system but is better characterized as a topic-prominent language. Finally, I will organize the example glosses as follows:

(70)   Transcription.
         Gloss.
         English translation.
         Original Korean example.

For the transcriptions, I will follow Wymann (1996b) and use the Yale system for consonants and the McCune-Reischauer system for vowels. In this section, all the examples without explicit references to their origin have been checked with my informants.

2.3.1   Korean modal system

Participant-internal modality

Wymann (1996b) uses a notion of dynamic modality quite similar to the participant-oriented notion of (Hengeveld 2004). There are two subtypes of dynamic modality (Wymann 1996b, p20): ``a) possible internal capability which implies an environmental or contextual constraint, and b) possible internal knowledge or acquired

capability.'' I will call the first type circumstantial ability and the second one internal (or acquired).[33]

| | Participant-internal | |
	Internal/Acquired	Circumstantial
Auxiliary verbs	*mosha*	*mosha*
Lexical constructions	*cul + alta/molŭta*	*su + issta/ŏpsta*
(Noun + Verb)		*nŭnglyŏk + issta/ŏpsta*
Suffix constructions	*-ya hata*	*-ya hata*

Auxiliary verb The auxiliary verb 못하 *mosha* expresses ''inability or incapacity on the part of the subject if the subject is represented by an animate noun, especially a personal pronoun or nouns'' (Lee 1989, p137) (it can also express regret on the part of the speaker).

(71)   a.   kŭkcang-e   ka-ci   mosha-nta
        theater-LOC go-NLR not:able-VSFX
        '[She] cannot go to the theatre.'   (Lee 1989, 5.2.1.1.2.3.1.4.2 p137)
        극장에 가지 못한다.

    b.   kŭ-nŭn   uncŏn-ŭl   mosha-nta
        3SG-TOP drive-A:FUT not:able-VSFX
        'He is not able to drive.'
        그는 운전을 못한다

Sentence (71-a) is most likely circumstantial whereas (71-b) is internal (in this case acquired capability).

Lexical constructions To express internal and acquired capability, the Korean language has a construction combining the noun 줄 *cul* (expressing the notion of know-how) with one of the verbs 알다 *alta* (to know) and 모르다 *molŭta* (the lexicalized negated form of the verb to know).

(72)   a.   kŭ sŏnsaeng-nim-ŭn hankukmal-ŭl   ha-l
        that teacher-PRES-TOP Korean:language-ACC speak-A:FUT
        cul-ŭl   a-sipnita
        know:how-ACC know-VSFX
        'That teacher speaks Korean.'   (Wymann 1996b, (198) p178)
        그 선생님은 한국말을 할 줄을 아십니다.

    b.   heŏmchi-l   cul-ŭl   al-ko   iss-ŏyo
        swim-A:FUT know:how-ACC know-SFX exist-VSFX

---

[33]The following table does not exhaust the modal elements presented in this section (in particular for the Noun + Verb combinations).

'(I) can swim.'   (Wymann 1996b, (199) p179)
헤엄칠 줄을 알고 있어요.

Sentence (72-a) is ambiguous between an internal and acquired reading (Wymann 1996b, p178), the context usually resolving the ambiguity. In this example, we might for instance know more about the teacher: the teacher is Korean and therefore has the internal ability to speak the language or, the teacher teaches Korean but is not himself Korean, in which case he surely has acquired the ability to speak the language. Sentence (72-b), on the other hand, is unambiguously expressing an acquired ability.

The following combinations are all used for circumstantial ability and all combine a noun with the existential verb 있다 *issta* or its negated form 없다 *ǒpsta*. The first combination involves the noun 수 *su* 'means.' This is the most frequent marker for participant-internal modality (however it is also used marginally for deontic and epistemic modality).

(73)   ǒtuu-n   pam i-lato   pulkyǒtǔl-myǒn ka-l   su
       be:dark-A:PRES night COP-CSFX light-CSFX   go-A:FUT means
       iss-ǔpnita
       exist-VSFX
       'Even in the dark of night you can walk if you have a light.'   (Wymann 1996b, (191) p175)
       어두운 밤 이라도 불겨들면 갈 수 있읍니다.

The constructions in example (74) are listed in (Wymann 1996b) as circumstantial capability. Those modals convey the information that some action is possible because some enabling conditions are fulfilled.

(74)   a.   chungko-lǔl tǔt-ci   anh-nǔn   salam-ǔn   tou-l
            advice-ACC take-NLR NEG-A:PAST person-TOP help-A:FUT
            kil-i   ǒps-ǒyo
            way-NOM not:exist-VSFX
            'You cannot help a person who won't take advice (from you).' (Wymann 1996b, (193) p176)
            충고를 듣지 않는 사람은 도울 길이 없어요.
       b.   cǒnaek cipul   ha-l   nǔnglyǒk iss-ǔpnita
            full   payment do-A:FUT capability exist-VSFX
            '(I) can pay (you) back in full.'   (Wymann 1996b, (194) p176)
            전액 지불 할 능력 있읍니다.
       c.   kicha-lǔl tha-l   yǒyu iss-ǒyo
            train-ACC ride-A:FUT margin exist-VSFX
            '(One) can take the train.'   (Wymann 1996b, (195) p176)
            기차를 탈 여유 있어요.

    d.   kaelyang-ŭi   yŏci iss-ŏyo
        improvement-GEN scope exist-VSFX
        'It can be improved.'   (Wymann 1996b, (196) p177)
        개량의 여지 있어요.

Wymann (1996b, p176) proposes for instance the following context for sentence (74-c): there are ''landslides blocking the road from A to B'', the speaker has just called the station to know whether trains are operational, he utters (74-c).

Circumstantial vs internal/acquired   The difference between circumstantial and internal/acquired capability is minimal but I will try to illustrate it through a comparison of the Korean modals with English *can*. First, sentence (72-a) can be translated as 'That teacher can speak Korean.' The meaning of *cul alta* and *can* coincide for this example, i.e. both allow for internal (the teacher is Korean) and acquired (the teacher has learned Korean) capability interpretations, but not circumstantial capability.

Sentence (72-a)	Circumstantial	Internal	Acquired
Korean *cul alta*	never	yes	yes
English *can*	no	yes	yes

The reason for the unavailability of the circumstantial reading is different for the two languages. In Korean, this is due to the general restriction of *cul alta* to non-circumstantial ability whereas in English, it is due to the meaning of the predicate (which surely doesn't fit a circumstantial interpretation in any language). Sentence (72-b) makes the previous distinction come to light. The Korean sentence allows only an acquired ability reading because of i) the subject of the sentence (human) and the meaning of the predicate and ii) the restriction of *cul alta* to non-circumstantial ability. Naturally the restriction on internal modality holds for English too, but *can* also allows for a circumstantial reading: I missed last week's swimming training because of the flu, but I tell you: 'I feel better now, I can swim!'

Sentence (72-b)	Circumstantial	Internal	Acquired
Korean *cul alta*	never	no	yes
English *can*	yes	no	yes

Finally, circumstantial readings are obtained by using the *su issta* combination, as in the following example:

(75)   na-l   su   iss-ŏyo
        fly-A:FUT means exist-VSFX
        '(I) can fly!'   (Wymann 1996b, (200) p179)
        날 수 있어요.

On the one hand, the English translation allows the same acquired reading as (72-b), for instance, as an answer to the question 'Who has his pilot's certificate?'. On the other hand, the Korean sentence only allows for a circumstantial reading: I was sick and the doctor doubted whether I could take a flight to a conference, but I feel better now, i.e. (75).

Sentence (75)	Circumstantial	Internal	Acquired
Korean *su issta*	yes	never	never
English *can*	yes	no	yes

Finally, the use of negation doesn't modify this picture as the following example shows. Notice furthermore that negation always take scope over the modal element to yield a 'not able to' reading.

(76)   I can't cook Korean food.

    a.   na-nŭn   hankuk ŭmsik-ŭl mantŭ-l   cul   molŭ-nta
        1SG-TOP korean food-ACC confect-A:FUT know-how know-VSFX
        나는 한국 음식을 만들 줄 모른다.

    b.   na-nŭn   hankuk ŭmsik-ŭl mantŭ-l   su   ŏps-ŏyo
        1SG-TOP korean food-ACC confect-A:FUT means not:exist-VSFX
        나는 한국 음식을 만들 수 없어요.

    c.   na-nŭn   hankuk ŭmsik-ŭl mantŭ-l   yŏyu-ka
        1SG-TOP korean food-ACC confect-A:FUT margin-NOM
        ŏps-ŏyo
        not:exist-VSFX
        나는 한국 음식을 만들 여유가 없어요.

Sentence (76-a) can be used in a conversation about cooking abilities, for instance, I can prepare Dutch food but (76-a). Suppose we are in the kitchen thinking about what we are going to eat and I realize that we do not have crucial ingredients to make a Korean meal, I can't say (76-a) but have to say (76-b) instead. Finally, (76-c) could be used to make explicit that I don't have time to cook a Korean meal.

Participant-internal necessity   Finally, it is possible to express participant-internal necessity by using the participant-external suffix construction –야 하다 *-ya hata*.

(77)   kanŭn   swi hae-ya hae!
        1SG-TOP pee AUX-ya AUX-VSFX
        'I have to pee.'
        나는 쉬 해야 해!

Participant-external modality

The Korean language uses two kind of constructions to express participant-external modality. The first kind involves a suffix (and a main verb) whereas the second combines a noun and a verb.

	Participant-external	
	Deontic	Goal-oriented
Suffix constructions	*-ya hata*	*-ya hata*
	-to cohta/kwaenchanhta	
	-myǒn cohta/toeta	
	-ci anhǔmyǒn an toeta	
Lexical constructions	Noun + Verb	Noun + Verb

A peculiar feature of the participant-external subsystem is the abundance of deontic modals and the rarity of goal-oriented elements. I will first discuss deontic modality.

Deontic modality I will now review the different constructions used for permission. The most common encoding is a construction involving on the one hand a conditional or a concessive/emphatic suffix, **-면** *-myǒn* 'if' and **-도** *-to* 'even though' respectively, and on the other an evaluative verb, 좋다 *cohta* 'to be good' or 괜찮다 *kwaenchanhta* 'to be all right', or the auxiliary 되다 *toeta* 'become.'[34]

(78) a. nǒ-nǔn   ka-to   coh-ta
          2SG-TOP go-CSFX be:good-VSFX
          'You may go.'   (Wymann 1996b, (110) p99)
          너는 가도 좋다.
      b. cǒ kuk kyǒng citae-e   tǔlǒka-si-myǒn an   toe-pnita
          that state border zone-LOC enter-PRES-CSFX NEG become-VSFX
          '(One) may not enter the state border zone there.' (Wymann 1996b,
          (116) p101)
          저 국 경 지대에 들어가시면 안 됩니다.
      c. na-nǔn kǒki-e   ka-to   kwaenchanh-sǔpnita
          1SG-TOP there-LOC go-CSFX be:allright-VSFX
          'I am allowed to go there.'   (Wymann 1996b, (117) p101)
          나는 거기에 가도 괜찮습니다.

Sentences (78-a) and (78-c) mean literally 'even if I/you go, it is good' (Wymann 1996b, p99), that is, we have the following logical form:

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[34]Notice that, according to (Wymann 1996b, p101-102), the conditional suffix doesn't combine with *kwaenchanhta* and the concessive suffix doesn't combine with *toeta*. However, sentences (79-b) and (91) contradict this conclusion. As the two examples have been obtained from different sources (an internet dictionary and an informant's own example), I will take that as evidence against the hard constraint of (Wymann 1996a, (118)).

'x may do α' $\equiv$ '(even) if x does α, it is good.'

However, sentence (78-a) gives a permission to the addressee whereas (78-c) reports the existence of a permission. Sentence (78-b) shows an example of combination with the negation *an*. The negation operates on the matrix verb of the construction, here the auxiliary *toeta*. This results in the negation of the permission, literally, 'it is not good if you enter the border zone there', therefore:

'x is not allowed to do α' $\equiv$ 'if x does α, it is *not* good.'

If the negation is placed before the embedded verbal stem as in example (79-a) or if the verbal stem is the negative copula 않다 *anhta* (preceded by a nominalized clause) as in (79-b), the modal takes scope over the negation.

(79)   a.   ice-n   cip-ŭlo   an tolaka-to   coh-so
              now-TOP home-LOC NEG return-CSFX be:good-VSFX
              'You don't have to go home now.'
              이젠 집으로 안 돌아가도 좋소.
        b.   tangsin-ŭl tŏ isang kitali-ci   anha-to   toe-pnita
              2PL-TOP   anymore wait-NLR NEG-CSFX AUX-VSFX
              'You don't have to wait anymore.'
              당신은 더 이상 기다리지 않아도 됩니다.

'x is allowed not to do α' $\equiv$ '(even) if x does *not* α, it is good.'

Notice that the construction can also be used for deontic necessity. Sentence (80) shows the construction –지 않으면 안 되다 *-ci anhŭmyŏn an toeta* using a nominalizing suffix –지 *-ci* and the conditional construction –면 되다 *-myŏn toeta* with two negations.

(80)   na-nŭn il   ha-ci   anh-ŭmyŏn an   toe-nta
        1SG-TOP work do-NLR NEG-CSFX   NEG become-VSFX
        'I must work.'   (Wymann 1996b, (132) p109)
        나는 일 하지 않으면 안 된다.'

'x must do α' $\equiv$ '(even) if it is not the case that x does α, it is *not* good.'

Finally, example (81) shows that, although this construction is conditional in nature, it allows further modification by a conditional clause to yield a conditional permission.

(81)   ŭmsik-i   namŭ-myŏn naeil   cŏmsim-ŭlo ssa   ka-myŏn
        food-NOM remain-CSFX tomorrow lunch-LOC   pack go-CSFX
        t-waeyo
        AUX-VSFX
        'If you have food left over, you may take it for lunch tomorrow.'
        음식이 남으면 내일 점심으로 싸 가면 돼요.

The second construction used to express permission combines straightforwardly a noun meaning 'permission' as 허가 *hŏka*, 허락 *hŏlak*, 허용 *hŏyong* and 인가 *inka* and a verb, for instance the existential verb 있다 *issta*, or its negative form 없다 *ŏpsta*, or a verb meaning 'to receive' as 어다 *ŏta* and 받다 *patta* or the auxiliary 되다 *toeta* 'to get, become.'

(82) a. chwalyŏngha-l   hŏka-ka   iss-ŏyo
          take:photographs-A:FUT permission-NOM exist-VSFX
          '(You) may take photographs.'   (Wymann 1996b, (103) p96)
          촬영할 허가가 있어요.
      b. chwalyŏngha-l   hŏlak-i   ŏps-ŏyo
          take:photographs-A:FUT permission-NOM not:exist-VSFX
          '(you) may not take photographs.'   (Wymann 1996b, (104) p96)
          촬영할 허락이 없어요.
      c. Yŏngchŏlŭn   yŏnghwa kukyŏng-ŭl ka-l   inka-lŭl
          Yŏngchŏl-TOP movie   show-ACC   go-A:FUT permission-ACC
          pat-ta
          receive-VSFX
          'Yŏngchŏl may go to see a movie show.'   (Wymann 1996b, (106)
          p97)
          영철은 영화 구경을 갈 인가를 받다.
      d. i   kŏs-ŭn   kwanyong-ŭlo hŏyong-toe-ŏ   iss-ta
          this thing-TOP usage-INSTR   permission-become-SFX exist-VSFX
          'One may do this.'   (Wymann 1996b, (107) p97)
          이 것은 관용으로 허용되어 있다.

This construction is transparent enough not to need discuss it at great length. The important difference from the 'conditional' construction is in formal register. Basically, the noun-verb combinations are more formal and official than the 'conditional' construction. However, notice that it is a recurrent type of construction in Korean when it comes to express modal meanings.

I will now turn to deontic necessity. The same dichotomy as for possibility can be observed. There are on the one hand two suffix constructions and on the other noun-verb combinations. The most common encoding of deontic necessity (Wymann 1996b, p105) is a suffix construction combining the suffix –야 *-ya*[35] on a verbal stem with an auxiliary verb (mainly 하다 *hata* but also 되다 *toeta*).

(83) a. nŏ-nŭn   cikŭm ttŏn-aya ha-nta
          2SG-TOP now   leave-SFX AUX-VSFX
          'You must leave now.'   (Wymann 1996b, (129) p107)
          너는 지금 떠나야 한다.

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[35]The suffix is preceded by a connective suffix: either *ŏ* or *a*.

    b.   i   phyŏnci-lŭl ilk-ŏya   ha-nta
         this letter-ACC read-SFX AUX-VSFX
         '(He) must read this letter.'   (Wymann 1996b, (127) p106)
         이 편지를 읽어야 한다.
    c.   kŭ-nŭn untong-ŭl ha-ci   anh-aya ha-nta
         3SG-TOP move-ACC AUX-NLR NEG-SFX AUX-VSFX
         'He must not exercise too much.'
         그는 운동을 하지 않아야 한다.

This construction can be used to give orders as in (83-a) or to report about an existing order (83-b). The suffix can also be used in a reduced form *-ya-kess-ta* (*-kess* being the suffix expressing futurity). When combined with negation, for instance with the negative copula *anhta* as in (83-c), the modal has scope over the negation thus conveying a prohibition. Notice that the negation cannot occur between the suffix and the auxiliary but this 'don't have to' reading is expressed with the permission construction as in example (79).

    The last type of construction is used to express obligation. It simply combines a noun meaning 'obligation' or 'necessity' and a verb. Similarly to the noun-verb combinations expressing permission, the register is quite formal or official. The nouns 책무 *chaekmu* and 몬문 *ponpun* mean 'obligation, duty' and combine with the copula as in example (84).

(84)   a.   ŏlŭn-ŭl   sŏmki-nŭn kŏs-ŭn   ai-ŭi   chaekmu i-pnita
           elder-ACC serve-A:PRES thing-TOP child-GEN duty   COP-VSFX
           'Children must show respect for the elders.' (Wymann 1996b, (118)
           p102)
           어른을 섬기는 것은 아이의 책무 입니다.
    b.   kongpu-lŭl cal ha-nŭn   kŏs-ŭn   haksaeng-ŭi ponpun
         study-ACC well do-A:PRES thing-TOP student-GEN duty
         i-pnita
         COP-VSFX
         'Students must study well.'   (Wymann 1996b, (119) p103)
         공부를 잘 하는 것은 학생의 본분 입니다.

According to Wymann (1996b, p103), sentence (84-b) is only to be interpreted deontically (and not as a goal-oriented modality):

> "the modal expression in [(84-b)] is interpreted not as stating that students must study hard in order to pass difficult and tough exams, but rather that they have a responsibility to study well in a general sense of fulfilling social responsibilities."

This is also the case for the sentences containing the synonyms of *ponpun*, i.e. (84-a) with *chaekmu* and (85) with *ŭimu*. However 의무 *ŭimu* does not combine

with the copula but with the existential verb 있다 *issta* and with the verb 지다 *cita*, meaning 'to owe, bear.'

(85) napse-ǔi ǔimu-lǔl ci-pnita
taxes-GEN obligation-ACC owe-VSFX
'(One) must pay taxes.'   (Wymann 1996b, (121) p104)
납세의 의무를 집니다.

Goal-oriented modality   The means to express goal-oriented modality are not as varied as for deontic modality. The most frequent way to express goal-oriented necessity in Korean is to use the suffix construction *-ya hata* as in (86).

(86) yǒk-ǔlo ka-lyǒko ha-nta-myǒn, cǒngpantae pangyangǔlo
station-LOC go-SFX AUX-VSFX-CSFX contrary   direction-LOC
kǒlǒk-aya ha-nta
walk-SFX AUX-VSFX
'If you want to go to the station, you should walk in the opposite direction.'[36]
억으로 가려고 한다면, 정반대 방향으로 걸어가야 한다.

The sentence is also grammatical with an explicit 'want'-antecedent as the following example shows.

(87) yǒk-ǔlo ka-ko siphǔ-myǒn, cǒngpantae panghyangǔlo kǒlǒk-aya
station-LOC go-SFX want-CSFX   contrary   direction-LOC walk-SFX
ha-nta
AUX-VSFX
'If you want to go to the station, you have to walk in the opposite direction.'
억으로 가고 싶으면, 정반대 방향으로 걸어가야 한다.

The combinations of the noun 필요 *philyo* meaning 'necessity, requirement' with either the existential verb, its negated form or the auxiliary *hata* or the noun 요구 *yoku* meaning 'requirement, demand' with the auxiliary *toeta* express goal-oriented necessity. They express that something is necessary in order to meet 'the challenges of a given situation or action' (Wymann 1996b, p104).

(88) a. sǒtul-ǔl philyo-ka ǒps-ǒyo
hurry-A:FUT necessity-NOM not:exist-VSFX
'We don't have to hurry.'
서두를 필요가 없어요.
b. i il-e-nǔn taetanha-n cosim-i yoku
this work-LOC-TOP be:considerable-A:PRES care-NOM necessity

---

[36]-려고: 'in order to' (Lee 1989, 4.3.5.2.3(8) p109).

toe-nta
AUX-VSFX
'(One) must do this work with great care.'   (Wymann 1996b, (124)
p105)
이 일에는 대단한 조심이 요구 된다.

The following example shows this construction with a purpose clause.

(89)   uncŏn-esŏ sako-lŭl   phiha-ki wihae-sŏnŭn   cisokcŏkin
         drive-from accident-ACC avoid-NLR in.order.to-SFX constant

         cosim-i   philyo-hata
         vigilance-NOM necessity-AUX
         'Constant vigilance is necessary in order to avoid accidents in driving.'
         운전에서 사고를 피하기 위해서는 지속적인 조심이 필요하다.[37]

Finally, and most importantly, there is no modal element able to express goal-
oriented possibility. According to my informants, the standard strategy to render
goal-oriented possibility in Korean is to use an imperative in the (most) polite
form. This could be compared to the following English sentence keeping in mind
that the polite imperative form leaves the choice of executing the action to the
hearer.

(90)   If you want to go to Leiden, take the bus (for instance).[38]

However, the permission construction (as in sentence (91) with the concessive
suffix) can be used to convey a goal-oriented meaning when listing the possibilities
to achieve a goal.

(91)   leitŭn-ŭlo ka-ko siphŭ-myŏn, pŏsŭ-lŭl tha-to   toe-ko
         Leiden-LOC go-SFX want-CSFX   bus-ACC take-CSFX AUX-and

         kicha-lŭl tha-to   toe-pnita
         train-ACC take-CSFX AUX-VSFX
         'If you want to go to Leiden, you can take the bus or the train.'[39]
         레이든으로 가고 싶으면, 버스를 타도 되고 기차를 타도 됩니다.

---

[37]-기 위해서: 'for the purpose of.'

[38]Schwager (2005) presents the German counterpart of imperatives with a possibility inter-
pretation, as in (90), using *zum Beispiel* 'for example.'

[39]A more literal translation of the consequent of sentence (91) would be 'you may take the
bus and you may take the train.'

Epistemic modality

Suffix constructions	Epistemic Lexical constructions	Adverbs
-ci molŭta	Noun + Verb	*ama*
-kess-		*hoksi*
		ŏccŏmyŏn

Epistemic possibility   There are a number of ways to express epistemic possibility in Korean. It can be done with adverbs, and with noun-verb and suffix constructions. I will first present the adverbs and the suffix construction and finally the noun-verb combinations (with the parentheticals).

The adverbs for epistemic possibility are 아마 *ama*, 혹시 *hoksi* and 어쩌면 *ŏccŏmyŏn*. They are usually interpreted as English 'maybe, perhaps' and are very often used in combination with other strategies to express epistemic modality. Sentence (92-a) contains the adverb *ama* whereas in example (92-b) *hoksi* is used. Both sentences exemplify the possible combinations of epistemic elements. Sentence (92-a) combines three different epistemic elements: the adverb *ama* with the parenthetical *naŭi chuchŭkulo*[40] (literally 'according to my estimate') and the epistemic possibility modal *kŏs kathta*.

(92) a. ama   na-ŭi   chuchŭk-ŭlo   Cecu-e   sa-l   kŏs
          perhaps 1SG-GEN surmise-INSTR Cheju-LOC live-A:FUT thing
          kath-ayo
          seem-VSFX
          '(He) may live in Cheju City (I presume).'   (Wymann 1996b, (150) p131)
          아마 나의 추측으로 제주에 살 것 같아요.
      b. kŭ-nŭn   hoksi   onŭl   o-l-ci   molŭ-nta
          3SG-TOP perhaps today come-A:FUT-NLR not:know-VSFX

---

[40]This parenthetical belongs to a family of constructions involving a noun and a suffix (see also (i-a)). Those constructions can also be made with an auxiliary to express epistemic possibility as in (i-b). The following nouns can be used: *chuchŭk* 'surmise,' *chucŏng* 'presumption,' *cimcak* 'estimate,' *saengkak* 'thought,' *kacong* 'supposition,' *kasang* and *sangsang* 'assumption.'

(i) a. saengkak-khŏnte na-nŭn   sip li-lŭl   kŏl-ŭl   kŏs kath-ayo
         thought-SFX   1SG-TOP ten mile-ACC walk-A:FUT thing seem-VSFX
         '(I think) I may have walked ten miles.'   (Wymann 1996b, (149) p131)
         생각컨데 나는 십 리를 거를 것 같아요.
     b. kŭ-nŭn   yucoe-lo   chucŏng   ha-nta
         3SG-TOP guilt-INSTR presumption AUX-VSFX
         'He may be guilty (I presume).'   (Wymann 1996b, (148) p130)
         그는 요죄로 추정 한다.

'He may come today.'   (Wymann 1996b, p(163) 137)
그는 혹시 오늘 올지 모른다.

Notice that the adverb *hoksi* often occurs in interrogative sentences. In sentence
(92-b) it combines with the suffix construction -지 모르다 *-ci molŭta* in which
a verbal stem of the embedded proposition is nominalized and the matrix verb
meaning 'not know' takes an implicit first person subject. That is, a quite literal
paraphrase of sentence (92-b) (without the adverb) would be something like 'I do
not know whether he will come today.'

However, the most frequent form used to express epistemic possibility is the
noun-verb construction 것 같다 *kŏs kathta* (Wymann 1996b, p135) where *kŏs* can
be translated as 'thing' and *kathta* is the verb 'to seem' (the copula *ita* can also
be used although it is mostly used for epistemic necessity):

(93)   pŏsŭ-ka   nŭc-ŭl   kŏs   kath-ta
        bus-NOM be:late-A:FUT thing seem-VSFX
        'The bus may be late.'   (Wymann 1996b, (160) p136)
        버스가 늦을 것 같다.

Finally, one can express epistemic possibility by combining a noun meaning pos-
sibility and a verb. For instance, the nouns 가망 *kamang*, 가능성 *kanŭngsŏng*
and 수 *su* meaning 'possibility' can combine with the existential verb *issta* or its
negation *ŏps-ta* and the noun 줄 *cul* 'likelihood' can combine with the verb 미다
mit-ta 'believe.'

(94)   a.   nalssi-ka   kae-l   kamang-ŭn   iss-ta
              weather-NOM be:clear-A:FUT possibility-TOP exist-VSFX
              'The weather may clear up.'   (Wymann 1996b, (145) p129)
              날씨가 갤 가망은 있다.
        b.   Yŏngchŏl-ŭn   o-l   su   ŏps-ŏyo
              Yŏngchŏl-TOP come-A:FUT possibility not:exist-VSFX
              'It may be that Yŏngchŏl won't come.'   (Wymann 1996b, (158)
              p135)
              영철은 올 수 없어요.

Necessity   The canonical encoding for epistemic necessity (Wymann 1996b,
p139) is a noun-verb combination and features 것 *kŏs* 'thing' with the copula
이다 *ita*. This construction is illustrated by sentence (95-a). Notice that it can
also appear in grammaticalized forms as a suffix 걸 *kŏl* as in sentence (95-b).

(95)   a.   kŭ   salam phikonha-l kŏs   i-ŏyo
              that man   tire-A:FUT thing COP-VSFX
              'He must be tired.'   (Wymann 1996b, (166) p140)
              그 사람 피곤할 것 이어요.

> b. kŭ salam-i h-aessŭl-kŏl
> that man-NOM AUX-VSFX-kŏl
> 'He must have done it.'   (Wymann 1996b, (177) p146)
> 그 사람이 했을걸.

A large number of other noun-verb combinations are available to express epistemic necessity. Sentences (96-a), (96-b) and (96-c) exemplify respectively the combinations of 셈 *sem* 'conjecture' with the copula and 틀림 *thŭllim* 'error' with the negative existential verb and the conventionalized constructions involving 의심 *ŭisim* 'doubt' with the auxiliary and the negative copula 않다 *anhta*.[41]

(96) a. ilha-ko iss-nŭn sem-i-ta
      work-SFX exist-A:PRES conjecture-COP-VSFX
      '(He) must be working.'   (Wymann 1996b, (169) p141)
      일하고 있는 셈이다.
    b. kŭ-nŭn al-ko iss-ŭm-e thŭllim ŏps-ta
      3SG-TOP be:sick-SFX exist-NLR-LOC error not:exist-VSFX
      'He must be sick.'   (Wymann 1996b, (172) p143)
      그는 알고 있음에 틀림 없다.
    c. na-nŭn kŭ kŏs-ŭl cokŭmto ŭisim ha-ci anh-nŭnta
      1SG-TOP that thing-ACC not:at:all doubt AUX-NLR NEG-VSFX
      'That must (be so).'   (Wymann 1996b, (174) p144)
      나는 그 것을 조금도 의심하지 않는다.

Finally the future suffix –겠 *-kess* can be used to mark epistemic necessity and expresses a personal opinion of the speaker. This is somewhat comparable to the use of the English future to express epistemic necessity.

(97) a. ŏce sŏul-e pi-ka manhi w-ass-kess-ta
      yesterday Seoul-LOC rain-NOM much come-PAST-FUT-VSFX
      '(I presume that) it must have rained a lot in Seoul yesterday.'
                    (Wymann 1996b, (178) p147)
      '어제 서울에 비가 많이 왔겠다.'

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[41]Other combinations are possible with the following nouns: *malyŏn* 'arrangement,' *thŏ* 'expectation,' *phantan* 'judgement,' *li* 'good reason,' and *cul* 'likelihood' (Wymann 1996b, p139).

Conclusion

	Participant-internal	Participant-external		Epistemic
		Deontic	Goal-oriented	
Auxiliary verbs	*mosha*			
Suffix constructions	*-ya hanta*	*-ya hanta* *-to cohta* *-myŏn cohta*	*-ya hanta*	*-ci molŭta* *-kess-*
Adverbs				*ama* *hoksi*
Lexical constructions	Noun + Verb	Noun + Verb	Noun + Verb	Noun + Verb

Probably the most surprising feature of the Korean modal system is its use of a conditional-like construction to express deontic possibility (and necessity). I will not give a decompositional analysis of this construction but I assume that it has grammaticalized from a premodal reading (speaker's judgement about the value of an action) into a full deontic reading.[42]

The most common construction used to express modality in Korean consists of the combination of a noun and a verb. This type of encoding is used for all types of modalities (with some minor differences) and as Wymann (1996b, p136) says,

> "they generally encode the predicate of the modal proposition as verbal head of a relative clause through affigation of an adnominalizing suffix, which usually marks the predicate for future tense."

Wymann (1996b, p136-137) argues that, although the future tense suffix is a kind of default, other tense suffixes (present and past suffixes) can mark the embedded proposition. Figure 2.4 suggests that the scope of this claim should be revised somewhat. The table shows the number of Google-hits obtained for some very common verbs (the auxiliary, the existential and the verbs 'to come,' 'to fly' and 'to go'). These results suggest that participant-internal combinations with a verb marked for present or past are at best marginal whereas they are quite standard for epistemic modals.

It is a difficult matter to classify the Korean modal system with respect to polyfunctionality.[43] For instance, *su issta* can appear in constructions expressing deontic necessity as shown in (Wymann 1996b, p112). However, as Wymann (1996b) suggests, this might not be a case of polyfunctionality as some "additional syntactic input" is needed to get the deontic reading. On the other hand the construction *kŏs ita* also seems to allow some deontic interpretations in some

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[42]I would therefore add this path as a grammaticalization path to the semantic map of modality of (van der Auwera and Plungian 1998, Fig. 19 p111).

[43]A modal item is called polyfunctional if it can express meanings of different types, i.e. participant-internal, participant-external and epistemic.

1	2	3			
		Participant-internal		Epistemic	
		su issŭpnita 수 있습니다	*su issŏyo* 수 있어요	*kŏs kathta* 것 같다	*-ci molŭnta* -지 모른다
ha-(ta)	*-l* A:FUT	1540000	144000	220000	28000
AUX	*-nŭn* A:PRES	3	0	206000	1940
하다	*-n* A:PAST	2	0	61000	1270
iss-(ta)	*-ŭl*	105000	7090	229000	13100
'exist'	*-nŭn*	3	0	335000	5720
있다	*-ŭn*	0	0	20	0
o-(ta)	*-l*	51100	188	2220	1320
'come'	*-nŭn*	4	0	1970	48
오다	*-n*	0	0	8260	23
ka-(ta)	*-l*	87800	4040	1680	1170
'go'	*-nŭn*	1	3	6540	308
가다	*-n*	0	0	610	24

Figure 2.4: Number of hits of Google queries `"1:2 3"` restricted to domain `.co.kr`

isolated cases (Wymann 1996b, p113-117) but this reading seems to arise from pragmatic considerations.

Finally, it is also surprising that this rich system does not have a specialized modal for non-deontic participant-external possibility. The typical possibility modal *su issta*, which can express both participant-internal and epistemic modality, was not accepted by my informants in typical goal-oriented sentences.

2.3.2 Combinations of modal items

Epistemic and participant-internal

Sentence (98-a) of the following example combines the inability marker *mosha* with the noun-verb construction for epistemic modality *su issta* and (98-b) contains again *su issta* but this time as participant-internal with the epistemic *-ci molŭta*. Sentence (98-c) has an epistemic adverb over the learned ability *cul molŭta*.

(98)   a.   cŏ-nŭn   chuicik-ha-ci   mosha-l   su-to
                 1SG-TOP employement-AUX-NLR unable-A:FUT means-SFX
                 iss-ŭpnita
                 exist-VSFX
                 'I might not be able to get a job.'
                 저는 취직하지 못할 수도 있습니다.

         b.   ilŏn munce-nŭn   phul su   iss-ŭl-ci-to   mol-ŭnta
                 such problem-TOP solve means exist-A:FUT-NLR-SFX know-VSFX
                 'One may be able to solve those problems.'   (Shaw 1980, (99))
                 이런 문제 는 풀 수 있을지도 모른다.

         c.   ama   kŭ-nŭn hankuk ŭmsik-ŭl mantŭ-l   cul
                 perhaps 3SG-TOP korean food-ACC confect-A:FUT know-how
                 molŭl-ci   molŭ-nta
                 not:know-NLR not:know-VSFX
                 'Maybe he can't cook Korean.'
                 아마 그는 한국 음식을 만들 줄 모를지 모른다.

All sentences are unambiguously interpreted as an epistemic statement about some ability. I have furthermore not been able to elicit any other scope order than epistemic over participant-internal.

Epistemic and participant-external

All the combinations of epistemic elements with participant-external modals of example (99) contain an epistemic modal (an adverb in (99-a) and the noun-verb items *-ci molŭta* and *kŏs ita* in (99-b) and (99-c)) over the canonical participant-external necessity *-ya hata/toeta*.

(99)   a.   kŭ-nŭn   ŏccŏmyŏn isaka-ya toep-nita
                 that-TOP maybe   move-ya become-VSFX
                 'He may have to move.'
                 그는 어쩌면 이사가야 됩니다.

         b.   yŏlŏpun-ŭn myŏch sikan tongan kŭ   kos-e   anca kitali-ko
                 2PL-TOP   several hour during that place-LOC sit   wait-SFX
                 iss-ŏya ha-l-ci-to   mol-ŭnta.
                 exist-ya AUX-A:FUT-NLR-SFX not:know-VSFX
                 'You may have to sit there for hours waiting.'
                 여러분은 몇 시간 동안 그 곳에 앉아 기다리고 있어야 할지도 모른다.

         c.   yŏk-ŭlo   ka-ko siphŭ-myŏn, pŏsŭ-lŭl tha-ya toe-l
                 station-LOC go-SFX want-CSFX bus-ACC take-ya AUX-A:FUT
                 kŏs   ip-nita
                 thing COP-VSFX
                 'If you want to go to the station, you might have to take the bus.'

역으로 가고 싶으면, 버스를 타야 될 것 입니다.

The scope order is always epistemic over participant-external. Notice that one of my informants at first judged the 'epistemic under deontic' combination 것 같아야 한다 *kŏs kathaya hanta* grammatical (syntactically well-formed) but changed her opinion because she was not able to make sense of it. I think this exemplifies the problem at hand. The scope order is not hard-wired in the syntax but is a semantic issue.

Participant-external and internal

Finally, combinations of participant-external and internal modalities are shown in example (100). They also all confirm the scope hypothesis.

(100) a. kŏl-ŭl   su   iss-ŏya ha-nta
           walk-A:FUT means exist-ya AUX-VSFX
           'He must be able to walk.'
           걸을 수 있어야 한다.
       b. kŭ cangmyŏn esŏ nŭn toumŏpsi kŏ-l   ŭl-su issŏ-to
           the scene   in TOP unaided walk-A:FUT ability exist-SFX
           toe-nta
           become-VSFX
           'You may be able to walk unaided in that scene.'   (Shaw 1980,
           (34))
           그 장면 에서 는 도움없시 걸 을수 있어도 된다.

Notice that sentence (100-b) needs a particular context to be accepted by my informants. This was already mentioned in (Shaw 1980) where she provided something like the following context: a director discusses a play with an actor and explains to him what he may or may not do.

Finally we can conclude that, although I have not been able to find or elicit all combinations, the present Korean data is consistent with the scope hypothesis.

2.4 Lillooet

The Lillooet language, also called St'át'imcets in the literature, is a Salish language of British Columbia. In order to ease the description of the Lillooet modal system, I will first give a short overview of some basic notions of the Lillooet language as described in (van Eijk 1997).

Lillooet has two sentences types: mono-clausal and multi-clausal. Mono-clausal sentences come in two flavors: with or without auxiliary.[44] The word

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[44](van Eijk 1997, 22.4 p152): "Virtually every transitive stem that is temporal, aspectual, or modal in character may be used as an auxiliary."

order of mono-clausal sentences is the following,[35]

(101)   a.   Mono-clausal sentence without auxiliary:
                predicate − enclitic   − full-word adverb − complement(s)
                          (adverbial)
          b.   Mono-clausal sentence with auxiliary:
                predicate   − enclitic − full-word adverb − predicate
                (auxiliary)   (base)

Mono-clausal sentences and main clauses of multi-clausal ones may only contain an indicative or subjunctive predicate whereas subordinate clauses may only occur with a factual predicate (with some that-clause constructions) or a subjunctive predicate (with some wh-clause constructions).

   According to (van Eijk 1997, Section 8), the words of the Lillooet language can be classified into two classes: clitics and full words. The clitics (mainly second position enclitics) are invariable whereas most full words can be subjected to morphological operations such as personal affixation (possessives, object and subject), and various suffixations (aspectual, lexical, transitivising and intransitivising, reflexive, reciprocal).

   A word without personal affixation is called a stem. Stems are classified along two (overlapping) axes: there are (1) intransitive and transitive stems and (2) nominal and verbal stems. The following table adapted from (van Eijk 1997, figure 5 p44) shows this pattern. For instance, transitive stems in figure 2.5 take

	Marked			Unmarked		
Transitive verbal	ʔác'x̌-ən	k'áx-an'				
	'to see it'	'to dry it'				
Intransitive verbal	ʔác'x̌-əm	k'áx-xal	ʔíƛ'-əm	ʔác'x̌	k'ax	pála?
	'to see'	'to dry'	'to sing'	'seen'	'dry'	'one'
Intransitive nominal	s-qayx ͏ʷ	s-ɣap	s-ʔíƛ'-əm	qʷuʔ	tmixʷ	
	'man'	'tree'	'song'	'water'	'land'	

Figure 2.4: The Lillooet stems

the transitivizer suffixes *-ən* and *-an'*.[36] The intransitive stems are all the other stems that do not end with a transitivizer. Intransitive stems are either verbal stems overtly marked for intransitivity (with for instance the intransitivizers *-əm* or *-xal*) or nominalized stems (with the nominalizing prefix *s-*) or unmarked stems (nouns and 'naturally' intransitive verbs).

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[35]See (van Eijk 1997, 36 p226).
[36]Transitive stems are mandatorily marked.

2.4.1 Lillooet modal system

I will use the classification of modality due to van der Auwera and Plungian (1998) (participant-internal, participant-external and epistemic) with the addition of evidential modality.

Participant-internal modality

Participant-internal Circumfix
ka-...-a

To express participant-internal modality, Lillooet mainly uses the circumfix *ka-...-a* on the base predicate.[37]

> "The combination also expresses 'to manage, to be able to,' as in **ʔác'x̌-əm** 'to see, have a vision, intr.' that becomes **ka-ʔác'x̌-m-a** 'to be able to see, to manage to see' *[or **qʷal** 'to speak, talk', **ka-qʷál-a** 'to be able to speak']*. The underlying notion is that of a lack of control: something just happens suddenly or by accident without a person controlling the event, or a person finally manages to achieve something*[, usually after some trying]."*   (van Eijk 1997, 10.1.3)

I will concentrate on the ability interpretation of the circumfix which typically occurs with unergative verbs, as in example (102).

(102)   ka-álkst-kan-a
         ka-work-1SG-a
         'I am able to work.'   (Demirdache 1997, (8-a) p102)

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[37]There are also two other ways to express participant-internal possibility. First, there is an 'expert, ability, knowledge' suffix *-atməx* which, when combined with the root *zəw* 'to know' to form *zəwátməx* expresses know-how, i.e. 'knowing how to do something.' However, this suffix is not productive and is 'confined to a few lexicalized contexts' (Davis, pc). Second, there is the lexical suffix *-tən* mentioned by van Eijk (1997) but, according to Davis (pc), it is 'an old pattern which has fallen into disuse.' It can, in negative sentences and in combination with the transitivizer, *-s* have the meaning of 'able to.'

(i)   a.   *ʔáz'-* 'to buy': *ʔáz'-tən* 'to be able to buy, afford',
             mays- 'to fix': *máys-tən* 'to be able to fix',
             nik'- 'to cut': *ník'-tən* 'to be able to cut.'
       b.   xʷʔaz kʷ-a-stám'   kʷa-s-ník'-tən-s-an
             NEG   DET-IMPF-what DET-NLR-cut-tən-TR-(3SG-)1SG.SBJ
             'There isn't anything I can cut with, I don't have anything to cut with.': I can't
             cut.   (van Eijk 1997, 15.2.16 p80)

The ability reading also obtains with unaccusative and transitive[38] verbs in case they occur in a sentence with an auxiliary or with negation (examples in (103) and (104) respectively).[39]

(103)   a.   waʔ ka-ʕíp-a   ku   káwkəw   kəncʔá
                IMPF ka-grow-a DET sagebrush DEIC
                'Sagebrush can grow around here.'
                                    (Matthewson, Rullmann and Davis 2005, (16-a) p9)
         b.   waʔ ka-sə́k-s-ás-a   ti-sq'úm'c-a   ti-twə́w'w'ət-a
                IMPF ka-hit-CAUS-(3SG-)3SG-a DET-ball-DET DET-boy-DET
                'The boy is able to hit the ball.'   (Demirdache 1997, (21-b') p110)
         c.   huy'-ɬkan-hə́m'-ƛ'uʔ   ka-máys-c-a
                AUX-(3SG-)1SG-hə́m'-ƛ'uʔ ka-fix-CAUS-a
                'I will be able to fix it after all (-hə́m'-ƛ'uʔ).'   (van Eijk 1997, p17)

---

[38]According to (Demirdache 1997, p104), the directive transitivizer cannot combine with the circumfix *ka-. . .-a* (unlike to the causative one). However, sentence (235) of (Matthewson 2005, p281) would seem to contradict this statement:

(i)   ka-čəkʷ-ən-ɬkán-a   ʔayɬ ka-ʔúc'qʔ-a   ʔayɬ
          ka-pull-DIR-1SG-a then ka-go.outside-a then
          I pulled her, and she managed to get out.

According to Davis (pc), this is most likely a speech error and Demirdache (1997) is right about this combinatorial restriction.

[39]Otherwise, those verbs get a reading involving *suddenly* or *accidentally*. In mono-clausal sentences without negation or adverbial quantification, the interpretation depends on the properties of the verbal stem as follows (Demirdache 1997):

	Intransitive		Transitive	
	Unaccusative Bare root (BR)	Unergative BR-INTR	BR-causative	BR-directive
+ *ka-. . .-a*	accidental	able to	accidental	∅
NEG+ *ka-. . .-a*	able to	able to	able to	∅
AUX+ *ka-. . .-a*	able to	able to	able to	∅

Example (i)fn48 would thus be a counterexample to this table. More examples from (Matthewson 2005) seem to challenge this generalization. For instance, in sentence (411) (Matthewson 2005, p132) a stem marked by the causative is under the scope of both an auxiliary and adverbial quantification but doesn't seem to get an ability reading. The same thing happens in sentence (522) (Matthewson 2005, p153) with a bare root under an auxiliary, in sentence (39) (Matthewson 2005, p185-186) with a bare root under negation or in (52) (Matthewson 2005, p254) with both negation and auxiliaries. Notice finally that (Davis, Matthewson and Rullmann 2006, 4.4 p20) has recently argued against such a table claiming that the circumfix *ka-. . .-a* is 'insensitive to aspectual morphology.' In recent work, Davis, Matthewson and Rullmann (to appear) have argued that the incompatibility of the directive transitivizer with the circumfix *ka-. . .-a* is 'purely morphological in nature.'

Example (103-a) shows an unaccusative verb under the most common auxiliary *wa?* and, (103-b) and (103-c) show two verbs marked for transitivity by the causative under the auxiliaries *wa?* and *huz'*.

(104)   a.   xʷ?ạz kʷ-a-s   ka-qʷál-a
              NEG   DET-IMPF-3SG.POSS ka-speak-a
              'He couldn't say anything.'   (van Eijk 1997, 21.1n2)

         b.   xʷ?ạz kʷ-a-s   ka-kʷís-a ti-k'ə́ƛ'h'-a
              NEG   DET-NLR ka-fall-a DET-rock-DET
              'The rock can't fall.'   (Demirdache 1997, (22-c) p111)

         c.   xʷ?ạz kʷ-s   ka-sə́k-s-ás-a   ti-sq'úm'c-a
              NEG   DET-NLR ka-hit-CAUS-(3SG-)3SG-a DET-ball-DET
              ti-twə́w'w'ət-a
              DET-boy-DET
              'The boy is not able to hit the ball.'

                              (Demirdache 1997, (22-b) p111)

The negation in sentence (104-a) scopes over an unergative verb, whereas in (104-b) the verb is unaccusative and in (104-c) it is marked for transitivity.

Finally, notice that, contrary to what (Matthewson et al. 2005, p10) argued, Davis et al. (2006) managed to elicit sentences where the participant-internal circumfix is used to express participant-internal necessity. I will obviously follow (Davis et al. 2006) as it supersedes (Matthewson et al. 2005).

(105)   kan   ƛ'u? ka-q'sán'k-a ɬ-ən   qan'ím-əns k   Henry
         1SG.SBJ just ka-laugh-a   when-1SG.SBJ hear-TR   DET Henry
         kəns-?ucʷalmícʷ-ts
         try-Indian-mouth
         'I have to laugh when I hear Henry try to speak Indian.'

                              (Davis et al. 2006, (60))

However, the necessity reading doesn't arise in contexts about the (immediate) future in which an auxiliary must be used.

(106)   cuz'   nsnána? kw   s-Gertie
         going.to sneeze   DET NOM-Gertie
         'Gertie is gonna sneeze.'   (Matthewson et al. 2005, (19))

Participant-external modality

Participant-external modality can be expressed through lexical verbs (actually expressing deontic modality) or with the versatile enclitic *-ka*.

| | Participant-external | |
	Deontic	Goal-oriented
Enclitics	*-ka*	*-ka*
Lexical verbs	$x^w \partial c$'∂n	
	$nli \Upsilon^{\,w} c$	
	$nx^w \text{?} an$'	

Enclitic *-ka* This enclitic covers a broad swathe of the different subtypes of participant-external modality. It is used to express deontic modality (although some sentences could as well be interpreted as bouletic), both obligation and permission, and that will be the interpretation I will focus on. However, it also appears in *sentence-equivalent* constructions to express (the speaker's) wishes and hopes (van Eijk 1997, 29) and in counterfactual antecedents, consequents and wishes (Matthewson et al. 2005, p6).[40]

(107) a. cuk^{w}un'-ɬkán-ka-tiʔ
            finish-(3SG-)1SG-ka-DEM
            'I should finish that.'   (van Eijk 1997, 32.1.6(b))

        b. x^{w}ʔą́z-ka k^w-a-su-pápt   waʔ ʔúq^{w}aʔ
            NEG-ka   DET-IMPF-2SG.POSS-always IMPF drink
            'You shouldn't be drinking always.'   (van Eijk 1997, 32.1.6(d))

        c. plan-ɬkaɬ-ká-tuʔ   waʔ cix^w
            already-1PL-ka–tuʔ IMPF arrive.there
            'We should have arrived there already.' (van Eijk 1997, 32.3.7(c))

Notice that although *-ka* expresses by default (almost) universal quantification (equivalent to English *must/should*), it can express possibility as well (example (108)).

(108) a. lán-ɬkax^w -ka ác'x̌-ən ti   k^{w}támc-s^w-a
            already-2SG -ka see-TR DET husband-2SG.POSS-DET

---

[40]In this irrealis use, it is usually coupled to the subjunctive. Furthermore it is required that the embedded proposition be false (Matthewson et al. 2005, p7). The following sentences exemplify the contrast between the wish, irrealis wish and deontic uses, respectively:

(i)   a. swáts-ka k^w-s-ƛ'iq-s   ɬk^{w}únsa k^w-s-Bill
          I hope   DET-NLR-come-3SG.SBJ today   DET-NLR-Bill
          'I hope Bill will come today.'   (van Eijk 1997, 3(a) p187)
      b. q^{w}acác-as   -ka ti   sqáyx^w-a
          leave-3SG.SBJ -ka DET man-DET
          'I wish the man would leave.'   (Matthewson et al. 2005, (11-i) p7)
      c. q^{w}acác -ka ti   sqáyx^w-a
          leave   -ka DET man-DET
          'The man should leave.'   (Matthewson et al. 2005, suggestion from fn6 p7)

'You must/can/may see your husband now.'

(Matthewson et al. 2005, (10-e) p6)

b. lán-łkaxʷ -ka áč'x-ən ti kʷtámč-sʷ-a,   t'uʔ
    already-2SG -ka see-DIR DET husband-2SG.POSS-DET but

    áz-as   k-wá-su   xát'-min' k-wá-su
    NEG-3SG.SBJ DET-IMPF-2SG.POSS want-TR DET-IMPF-2SG.POSS

    nás-al'mən, t'uʔ áma
    go-want   just good

    'You may go see your husband, but you don't have to.' (literally:
    '...if you don't want to go, that's okay.')   (Davis et al. 2006,
    (30)p9)

Sentence (108-b) would be contradictory if -ka could only express deontic necessity (Davis et al. 2006, p8-9).

Finally, I have found only one sentence that could suggest a goal-oriented interpretation of the enclitic.

(109) ƛ'uʔ wáʔ-ka n-sxʷákʷəkʷ-a   c'áqʷ-an'-əm nił
       just IMPF-ka 1SG.POSS-heart-a eat-TR-1PL   FOC

       s-pápt-s-a   təxʷəxʷ-wít ł-as   kʷís-alt
       NOM-always-3SG.POSS-DET increase-3PL COND-3SG.SBJ fall-child

       i   sqʷəyíč-a
       DET.pl rabbit-DET

       'But I think we had to eat them because they were always having babies.'
       (Matthewson 2005, (248) p98)

A possible interpretation of this sentence is that they had to eat the rabbits in order to keep their number low which would indeed be a goal-oriented interpretation. However it is doubtful at this point that the enclitic has a goal-oriented use. Or better said, it is doubtful that goal-oriented constructions, in the way we have implicitly characterized them up to now (with a purpose clause or a *want*-conditional), are to be found in Lillooet (Davis, pc). Lillooet speakers (two informants of Davis, pc) seem to use different strategies to express goal-oriented modality. For instance, one speaker uses for the English sentence, "You have to drive to get to Lillooet," a translation meaning literally "Only someone who drives reaches Lillooet." However it is interesting to notice that the connection between goal-oriented and participant-internal modality is made explicit in goal-oriented possibility sentences as one possible translation involves the circumfix *ka-...-a*:

(110) To go to Vancouver, you can take the bus.   (Davis, pc)

    a. Wáʔ-łkacʷ ka-nás-a l-ti-bus-a   l-ku
        IMPF-2SG   ka-go-a in-DET-bus-DET at-DET-Vancouver-DET

panúph-a

'You can go to Vancouver on the bus.'

It is clear that if the goal-oriented sentence "To go to Vancouver, you can take the bus" is the case then sentence (110-a) is also the case.

Lexical verb $x^w\partial c'\partial n$ 'to force'   This verb can be used to express that someone (3rd person form) has some obligation (van Eijk, pc).

Lexical verbs 'to (be) allow(ed)'   Deontic possibility (permission) can also be expressed by lexical verbs, for example, by the verb *nliʕ'ʷc* 'open' (Davis, pc) as in the following sentence,

(111)   xʷʔạz kʷ-a-s-ənlíʕ'ʷc   l-wi-snuláp
         NEG   DET-IMPF-3SG.POSS-allowed PREP-DET-2PL
         'It is not allowed to you folks'   (van Eijk 1997, 24.1.1(s) p164)

The verb $nx^w\text{?}an'$ can express the (not-)giving of a permission as in (112-a), as well as having a permission (or not) as in (112-b) with a passive morphology.

(112)   a.   wáʔ-ɬkan-tuʔ n'ás-al'mən, ƛ'uʔ ʔáy-ƛ'uʔ kʷ-a-s
               IMPF-1SG-tuʔ go-want.to   just NEG-just DET-IMPF-3SG.POSS
               xʷʔán'-č-as   ta-n-kʷúkʷʔ-a
               allow(DIR)-1SG-3SG.SBJ DET-1SG.POSS-grandmother-DET
               kʷən-wá   n'as.
               DET-1SG.POSS-IMPF go
               'I wanted to go, but my grandmother didn't let me go.'
                                             (Matthewson 2005, (127) p200)
         b.   ʔáz-ƛ'uʔ kʷ-a-s   nxʷʔ-an'-tumúləm
               NEG-just DET-IMPF-3SG.POSS allowed-1PL.PASS
               kʷ-s-ʔac'x̌-ən-tánəmwit
               DET-NLR-see-DIR-3PL.PASS
               'We weren't allowed to see them.' (Matthewson 2005, (529) p433)

Epistemic modality

There are four different ways to express epistemic modality: two enclitics and two 'adverbs.'

	Epistemic	
	Adverbs	Enclitics
	sx̌ək	*-k'a*
	nsxʷák̓ʷək̓ʷ	*-kəɬ*

Adverbial *sx̌ək* The element *sx̌ək*[41] 'maybe, perhaps' is not properly an adverb, van Eijk (1997, 36.1) considers it could be more a "mono-clausal sentence itself, paratactically linked to the sentence it modifies." However, as sentence (113) shows, *sx̌ək* can be found in adverbial position; therefore I will from now on refer to it as an adverb.[42]

(113) wa^ʔ -k'a kənc^ʔá sx̌ək   ku   káwkəw
IMPF -k'a here   perhaps DET sagebrush
'Sagebrush might be growing around here.'

(Matthewson et al. 2005, fn7 p9)

(114) a. sx̌ək   ^ʔac'x̌ən-łkán-kł-tu^ʔ   k^wu-c'í^ʔ
perhaps see-(3SG-)1SG-kəł-tu^ʔ DET-deer
'Perhaps I might see a deer.'   (van Eijk 1997, 36.1(a))
b. sx̌ək   nas-wit-kə́ł-tu^ʔ
perhaps go-3PL-kəł-tu^ʔ
'They might go, you never know.'   (van Eijk 1997, 36.1(b))

The adverb often occurs in combination with an (epistemic) enclitic, as in examples (113), (114) and (118-c), although this is not a necessity as examples in (115) show. Furthermore the contribution of the enclitic *-kəł* in (114) is probably to force a future interpretation.

(115) a. níł-x̌'u^ʔ sx̌ək   k^w-s-wa^ʔ   čəkčák-wit...
FOC-just maybe DET-NLR-IMPF cool-3PL
'I think that helped them get cool...'   (Matthewson 2005, (243) p98)
b. pal^ʔ-usá^ʔ-x̌'u^ʔ   sx̌ək   k^w-ən-s-k^wáməm
one-berry.shape-just maybe DET-1SG.POSS-NLR-take
'I got maybe one dollar.'   (Matthewson 2005, (153) p269)

Enclitic *-k'a* This enclitic is characterized by (van Eijk 1997, 32.1.8) as expressing "possibility, surmise."

(116) (van Eijk 1997, 32.1.8 p202)
a. sáma^ʔ-k'a   k^wu-sq^wal'ən-táli
whiteman-k'a DET-tell-3SG.3SG
'It must have been a whiteman (sáma^ʔ) who told (sq^wál'ən) her.'

---

[41]Probably from the root *x̌ək* 'to count, figure out.'

[42]Henry Davis brought to my attention that another item is used in the lower dialect (Mount Currie). It is *kánas k'a* which is derived from the question marker *kan* ('is it the case?') followed by the third person subjunctive and the modal enclitic *k'a*. It can play the role of a sentence initial adverb as *sx̌ək* or can be used as a predicate governing a subordinate clause. I will not discuss this element much further as it, for as far as I understand, has the same characteristics as *sx̌ək* with respect to combinations with other modals.

b. xʷʔáz̲-k'a kʷ-a-s-xʷʔít
NEG-k'a   DET-IMPF-3SG.POSS-many
kʷu-waʔ-stəm'tə́təm'-s
DET-IMPF-belonging-3SG.POSS
'Apparently she did not have many belongings.'

The difference in meaning between this epistemic enclitic and the evidential enclitic is expressed in (van Eijk 1997) as follows:

-k'a refers only to a possibility, while **-an'** refers to an almost inevitable conclusion, compare [the following sentences]:

(117)   a. wáʔ-k'a   k'ʷzúsəm
IMPF-k'a work
'He must be at work (that's why he's not here).'
b. wáʔ-as-an'   k'ʷzúsəm
IMPF-3SG.SBJ-an' work
'It looks like he is working.'

Furthermore this enclitic can be used for both epistemic necessity and possibility (Matthewson et al. 2005, (4) p3):

(118)   a. waʔ-k'a   sə́naʔ qʷənúxʷ
IMPF-k'a ADV   sick
'He may be sick.' (Context: Maybe that's why he is not here.)[43]
b. plan-k'a   qʷacác
already-k'a leave
'Maybe he's already gone.' (Context: His car isn't here.)
c. qʷacác-k'a tuʔ   k   John, ƛuʔ waʔ-k'a   sx̌ek
leave-k'a   then DET John but IMPF-k'a perhaps
k-wa-s   xʷʔaz̲ ƛuʔ k-wa-s   qʷacác
DET-IMPF-3SG.POSS NEG   just DET-IMPF-3SG.POSS leave
'John may have left, but maybe he hasn't left yet.'

(Davis et al. 2006, (8)p4)

As Davis et al. (2006) notice, sentence (118-c) would be contradictory if the enclitic *-k'a* only expressed epistemic necessity.

Enclitic -kə́ɬ   This enclitic is not purely epistemic but expresses "remote future, possibility" (van Eijk 1997, 32.1.7).

(119)   a. qlil-min'-cih-as-kə́ɬ-tuʔ
angry-TR-2SG-3SG.SBJ-kə́ɬ-tuʔ

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[43]'sə́naʔ': "This adverb is used when the subject nurtures an unfulfilled wish or indicates he has changed his mind or that his plan have changed" (van Eijk 1997, 28.2.2 p182-183). Within this example, the 'changed plans' interpretation seems to be the only possible interpretation.

'He might get angry at you.'   (van Eijk 1997, 32.1.7(a))

b. λ'al̥an-c-ás-kɬ   ti-sqaẋaʔ-láp-a
    bite-1SG-3SG-kəɬ DET-dog-2PL.POSS-DET
    'The dog of you folks might bite me.'   (van Eijk 1997, 32.1.7(d))

c. ʔal̥səm-ɬkán-kɬ
    get.sick-1SG-kəɬ
    'I might get sick.'   (van Eijk 1997, p17)

(120) cʔas-kəɬ ku zús-xal
       come-kəɬ DET catch-INTR
       'A police man might come.'   (Matthewson et al. 2005, (7-b) p4)

In its epistemic interpretation, the enclitic -kəɬ is limited to possibility meanings
but even then only licenses a future interpretation (Matthewson et al. 2005, p4).
This property would support the conclusion of (Davis et al. 2006) to characterize
the enclitic as not epistemic. I do realize the use of -kəɬ is not a pure epistemic
one but I will still put it in this category and hope to make it clear why this is
legitimate with the formalization of the modal system.

Example (119-a) shows a combination of the enclitic with the enclitic -tuʔ.
It was analyzed by (van Eijk 1997, 32.1.2 p200) as a 'definite past' enclitic but
it is better seen as an adverb meaning roughly 'then' ((Matthewson et al. 2005)
and Davis, pc). The effect of this combination is a 'more remote possibility than
-kəɬ by itself' (van Eijk 1997, 32.3.12 p210). It seems that this combination only
allows an epistemic reading.[44] Notice that the possible event must lie in the
future.

Adverbial construction $nsx^w\acute{a}k^w\partial k^w$ 'my heart' The parenthetical[45] con-
struction n-$sx^w\acute{a}k^w\partial k^w$ 'my heart' works similarly to epistemic sx̌ək. It is not a
typical epistemic but is used to mark a speaker's judgment. As such it might as
well be considered as an evidential device, however I will treat it in what follows
as an epistemic item.[46]

(121) a. wáʔ-λ'uʔ n-sxʷákʷəkʷ   λ'íq-s-tum'x-as...
           IMPF-just 1SG.POSS-heart arrive-TR-1SG.3SG
           'I think he took me...'   (Matthewson 2005, (342) p118)

       b. ni   sqáyxʷ-a waʔ nah-ən-ítas   Rimsky-Korsakov
           DET man-DET IMPF name-TR-3PL.3SG Rimsky-Korsakov

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[44]A past in the future (English future perfect) interpretation doesn't seem available: all
examples involving this combination are translated as epistemic possibilities.

[45]Davis, pc.

[46]It can also be compared to the English 'according to' construction (restricted to the speaker)
which is somehow more evidential than epistemic. The parallel between the two constructions
should become clearer in the section on combinations of modal items.

n-sxʷákʷəkʷ
1SG.POSS-heart
'I think the man is called Rimsky-Korsakov.'

(Matthewson 2005, (410) p132)

c.   ʔaz   n-sxʷákʷəkʷ   kʷ-a-s   s-ɬik-s-twít-as
      NEG 1SG.POSS-heart DET-IMPF-3SG.POSS STAT-clear-TR-3PL.3SG
      kʷa   kʷukʷ ʔi-núkʷ-a
      DET.PROG cook   DET-other-DET
      'I think some of them didn't know how to cook.'

(Matthewson 2005, (816) p475)

Combinations of epistemic modals   We have already seen that the epistemic adverb *sx̌ək* often combines with both epistemic enclitics (see examples (113), (114) and (118-c)). However, the contribution of the adverb to the enclitic (or vice versa) is slightly different in the two cases. The enclitic *-k'a* is a modal with default universal force. When it is 'modified' by *sx̌ək*, it is interpreted as a possibility modal, i.e. the adverb modifies the interpretation of the enclitic. The epistemic use of *-kəɬ* is by default a possibility modal therefore it doesn't need to be modified by the adverb to enforce this reading. We are left with three options, either i) the adverb enforces the epistemic reading of the enclitic (against its pure future reading), or ii) the enclitic forces a 'future event' interpretation of the adverb, or iii) both at the same time.[47]

As mentioned in a previous section, the epistemic adverb *nsxʷákʷəkʷ* 'my heart' is used to mark the sentence where it occurs as being a speaker's judgment (much like *according to me* in English). Its combination with the epistemic enclitic *-k'a* in (122) restricts the epistemic judgment to the speaker only.

(122)   …n-sxʷákʷəkʷ-k'a   niʔ   kʷ-s-čún-it-as   Tchaikovsky.
          …1SG.POSS-heart-k'a DEM DET-NLR-say-3PL Tchaikovsky
          'I think maybe it was Tchaikovsky.'   (Matthewson 2005, (408) p131)

This is justified as the judgment can genuinely be switched to another source than the speaker.

Evidential modality

I will now present two enclitics of the evidential system. I have avoided so far to discuss evidentiality as a modal category but will make an exception in this case (as well as for Turkish) as those elements have recently been analyzed and formalized as (a variation of) epistemic modals (see (Matthewson, Rullmann and Davis 2006)). In particular, both enclitics share with epistemic modality the property that the speaker who uses one of them commits himself to the truth

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[47]I am unfortunately not yet sure which option is more likely.

of the utterance. This has the following consequence: sentences of the form *"p-an' but ¬p"* or *"p-kʷuʔ but ¬p"* are not felicitous. The Lillooet system has two evidential items, a quotative and a direct evidence enclitic.

Evidential enclitic
-an'
-kʷuʔ

Enclitic *-an'*   This enclitic is an *indirect inferring evidential* (Matthewson et al. 2006, p8). It is used by speakers to convey that the speaker makes an inference based on observed evidence. It is thus often translated as *must* or *apparently*.

(123)   a.   tayt-áxʷ-an'
            hungry-2SG.SBJ-an'
            'You must be hungry.'   (van Eijk 1997, 32.1.3(a))
        b.   xʷʔáz̲-as-an'   kʷ-a-s   huy' ƛ'iq
            NEG-3SG.SBJ-an' DET-IMPF-3SG.POSS AUX come
            'It looks like he won't come.'   (van Eijk 1997, 32.1.3(c))

It can be seen in sentence (123-b) that the enclitic has scope over negation.

Enclitic *-kʷuʔ*   The quotative enclitic is used to mark information as second-hand (i.e. not witnessed by the speaker), third-hand and also as folklore (it is often used when telling legends).[48]

(124)   a.   ƛ'ák-kʷuʔ káti?
            go-kʷuʔ   along
            'He was going along, as I was told.'   (van Eijk 1997, 32.1.9(a))
        b.   kʷan-xit-ə́m-kʷuʔ   ki-x̌ʷʔucin-álqʷ-a
            take-TR-3SG-PASS-kʷuʔ DET-four-stick-DET
            'Four sticks were taken from him, I hear.'

                                        (van Eijk 1997, 36.1.1(ah))

This enclitic also takes scope over negation.

Conclusion

There is a clear distinction between participant-internal and the rest of the system. Participant-internal modality is morphologically marked on the 'verb' whereas the other types use enclitics, adverbial constructions or plain verbs.

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[48]See (Matthewson et al. 2006).

	Participant-internal	Participant-external		Epistemic
		Deontic	Goal-oriented	
Enclitics	*ka-...-a*	*-ka*	*-ka*	*-k'a*
				-kəɬ
Adverbs				*sx̌ək*
Parentheticals				*nsx^{w}ák^{w}ək^w*
Verbs		*x^{w}əc'ən*		
		nliʕ$^{'w}$c		
		nx^{w}ʔan'		

There are two main features of Lillooet that are worthy of interest in that they do not fit with the traditional view of modality based on English modal auxiliaries.

1. Lillooet modals are not polyfunctional (van der Auwera et al. 2005).

2. Lillooet enclitics expressing epistemic and participant-external modality have a variable force (even though the default is universal force).

The first point is best seen in the previous table: there is no modal item appearing in two different columns (types of modality). Modal items are strictly assigned to one modal category.[49] The second point is about enclitics *-ka* and *-k'a*. As we have seen in examples (108) and (118), those enclitics are able to express necessity (default) and possibility.

2.4.2 Combinations of modal items

In the case of Lillooet, we also need to look at combinations involving the evidential enclitics.

On enclitics

As mentioned in (van Eijk 1997, 32.3.1 p207), the enclitics can only be combined in a fixed order.

(125)   Evidential   Epistemic/Deontic   Epistemic (future)
         -an' < *-k^{w}uʔ* < *-k'a/-ka*   < *-kəɬ*

Although it is not explicitly mentioned in (van Eijk 1997), the interpretation of the enclitics goes from left to right. The next example shows this for a predicate with three enclitics:

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[49]A more detailed analysis of the enclitic *-ka*, as in (Matthewson et al. 2005), shows however that the situation is more complex: this suffix expresses different meanings from deontic to counterfactual conditional or counterfactual wishes. However, the main point here is that it does not express epistemic modality.

(126)   Sentence: *predicate -e_1 -e_2 -e_3*
         Interpretation: *-e_1 > -e_2 > -e_3 > predicate*
         e_1 has (semantic) scope over e_2, which has scope over e_3, which has scope
         over the predicate.

However, combinations of modal enclitics are quite rare. Most of the relative
scopes are thus abstracted from the combinations with the other non-modal encl-
itics. The only problematic combinations that would contradict the scope order
in (127) are i) *-ka-k'a* and ii) *-ka-kəɬ*.

(127)   *Evidential > Epistemic > Participant-external > Participant-internal*

However both combinations are unattested and therefore don't contradict the
scope hypothesis.

Evidential and epistemic modality

The only combinations found involve the quotative enclitic *-$k^w u$ʔ*. This seems to
make sense if the evidential *-an'* is indeed an evidential item of direct (sensory)
evidence. In both examples the quotative has scope over the epistemic item.
In example (128), the epistemic modal is the enclitic *-k'a* (here translated as
apparently).[50]

(128)   qʷacac-kʷuʔ-k'a-tuʔ ʔi-waʔ-ʔəs-cmál't
         leave-kʷuʔ-k'a-tuʔ   DET-IMPF-have-offspring
         'The parents had left apparently, as I was told.'
                                                    (van Eijk 1997, 32.3.6(b) p209)

As remarked above, the order of enclitics fixes an interpretation where the quo-
tative has scope over the epistemic modal. The following sentence combines the
quotative enclitic with the epistemic *nsxʷákʷəkʷ* ('my heart') which gets trans-
lated as *I think*.

---

[50]The following example taken from (van Eijk 1997, p17) would seem to contradict the pre-
vious claim:

(i)   a.   qʷacac-kʷuʔ-k'á-tuʔ
             leave-kʷuʔ-k'a-tuʔ
             # 'He left allegedly, it seems.'

Here the translation literally follows the word order of the sentence, i.e. *-$k^w u$ʔ* as *allegedly*
and *-k'a* as *it seems*. However this gloss contradicts the interpretation rule in (126) which is
respected for the other examples. I will thus consider that sentence (i-a) should actually be
translated along the lines of 'He apparently left, as I was told'.

(129)   wáʔ-kʷuʔ ƛ'it nʔán'was n-sxʷákʷəkʷ   kʷ-sčmal't-s
         IMPF-kʷuʔ also two   1SG.POSS-heart DET-offspring-3SG.POSS
         tiʔ
         DEM
         'I think he also had two children.'   (Matthewson 2005, (286) p397)

Notice that the quotative doesn't appear to be translated. However, sentence
(129) is embedded in a larger context where the storyteller makes an extensive
use of the quotative to tell her family's story (at that point her grandmother's
story). This is a way to mark that the information is from second-hand, i.e. that
'the speaker did not witness the talked-about events personally' (van Eijk 1997,
32.1.9 p202).

Evidential and participant-external modality

No combination of evidential and participant-external modality has been found.

Evidential and participant-internal modality

All the combinations of evidential and participant-internal modality are attested.
Notice that (130-a) combines the evidential *-an'* and *ka-...-a* morphology but
that the evidential precedes the *-a* suffix. This is probably to avoid an impossible
combination as *-a-an'*.[51]

(130)   a.   ka-q'ʷus-axʷ-án'-a
              ka-frighten-2SG.SBJ-an'-a
              'You look frightened.'   (van Eijk 1997, 32.2)
         b.   ka-xim'-a-kʷúʔ-tuʔ
              [disappear]-kʷuʔ-tuʔ
              'He disappeared, I heard.'   (van Eijk 1997, 32.3.2(d))

Epistemic and participant-external modals

Combinations of the epistemic enclitics *-k'a* and *-kəɬ* with the deontic one *-ka*
have not been found. We have just seen that there are three other possible
combinations: 1) an epistemic adverb with the participant-external enclitic, 2)
an epistemic adverb with a participant-external verb and 3) an epistemic enclitic
with a participant-external verb. From these three possibilities, I have only found
examples for 1) and 3). Example (131) combines the epistemic adverb *nsxʷákʷəkʷ*
with *-ka*. As expected, the epistemic has semantic scope over the deontic (goal-
oriented) enclitic.

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[51]This needs to be checked.

(131) λ'uʔ wáʔ-ka n-sxʷákʷəkʷ-a c'áqʷ-an'-əm. . .
just IMPF-ka 1SG.POSS-heart-a eat-TR-1PL
'But I think we had to eat them. . . ' (Matthewson 2005, (248) p98)

No example of the type of (131) has been found with the epistemic adverb *sx̌ək*. This is possibly due to the fact that *sx̌ək* is mainly used as a disambiguating expression (forcing a possibility reading) with the epistemic enclitics.

The second example combines the epistemic enclitic *-k'a* with the participant-external predicate *xʷʔan'*. The scope hypothesis is also respected.

(132) ʔáz̲-k'a sónaʔ kʷ-a-s xʷʔan'-tumúɬ-as
NEG-k'a though DET-IMPF-3SG.POSS allow-1PL-3SG
kʷ-ət-wá waʔ q'íq'ɬil kənátiʔ sáy'səz'
DET-1PL.SBJ-IMPF IMPF run DEIC play
'Even though we weren't supposed to, we ran around everywhere playing.'

(Matthewson 2005, (137) p202)

It remains to be checked whether combinations of the second form are possible.

Epistemic and participant-internal modals

The following examples combine the epistemic enclitic *-kəɬ* with the circumfix *ka-..-a*. However, Demirdache (1997, p112) argues that causative roots with *ka-. . . -a* under a modal operator (be it *-kəɬ* or *-k'a*) get an ability reading.

(133) a. ka-sək-s-as-á -kəɬ ti sq'úm'c-a ti twə́w'w'ət-a
ka-hit-TR-(3SG-)3SG-a -kəɬ DET ball-DET DET boy-DET
'The boy will/might be able to hit the ball.'

(Demirdache 1997, (24-a))

b. ka-ʕuy't-kán-a -kəɬ. . .
ka-sleep-1SG-a -kəɬ
'I might be able to sleep. . . ' (Davis et al. 2006, (20) p7)

c. ka-q'ʷəɬ-kan-á-kɬ
ka-scorch-1SG-a-kəɬ
'I might get scorched.' (van Eijk 1997, p17)

The natural interpretation of those sentences has the epistemic modal having scope over the participant-internal one. I have not found any of the other possible combinations in the literature but the following examples were provided by my informant.

(134) (Davis, pc)
a. sx̌ək ka-nas-kan-á kəɬ
perhaps ka-go-1SG-a kəɬ

    'Maybe I'll be able to go.'

 b. huz' k'a həm' t'uʔ ka-tsúkʷ-s-asa-a natcʷ
   AUX k'a həm' PART ka-finish-3SG-CAUS tomorrow
   'He should be able to finish that tomorrow.'

 c. ay t'uʔ n-sxʷákʷəkʷ kʷ-á-su   ka-úts'qʔ-a
   NEG PART 1SG.POSS-heart DET-NOM+IMPF-2SG.POSS ka-go.out-a
   ɬ-as   gap
   when-IMPF.3SBJ evening
   'I don't think you're going to be able to go out this evening.'

As expected, all the examples follow the scope hypothesis.

Participant-external and participant-internal

The only example found combines an irrealis -*ka* with the participant-internal circumfix:

(135) ka-qʷusxit-án-a-ka
   ka-shoot-1SG.SBJ-a-ka
   'I wish I could shoot it.'   (van Eijk 1997, 32.3.2(e))

In (van Eijk 1997, 32.5 p213-215), the contrast between enclitics (in particular -*ka*) after the indicative or the subjunctive is discussed. I already mentioned that -*ka* can have other readings, for instance, in combination with the subjunctive as in (135) 'it generally expresses a wish' (van Eijk 1997, p213). Following the series of examples provided in (van Eijk 1997, p214), it seems reasonable to assume that the following combination involving the indicative, and thus a participant-external reading, is possible:

(136) ka-qʷusxit-(ɬ)kan-a-ka
   ka-shoot-1SG-a-ka
   'I should be able to shoot it.'

The participant-internal circumfix can combine with the lexical verb $x^wəc'ən$. However in this case, the verb does not express a deontic meaning but its base lexical meaning.

(137) cʷʔay t'uʔ kw-s ka-xʷ´əts'-s-an-a ta sq´əqy'əcʷ-a
   NEG PART DET-NOM ka-force-CAUS-1SG.ERG-a DET boy-DET
   n-skuzaʔ kw-s nas-ts skul inátcʷas
   1SG.POSS-child DET-NOM go-3POSS school yesterday
   'I couldn't force my son to go to school yesterday.'   (Davis, pc)

Finally, we can conclude that the scope hypothesis seems to be valid for Lillooet although some combinations are not yet accounted for. Or in order to be on the

safe side, we can at least conclude that the hypothesis is surely not invalidated
by the Lillooet data.

2.5   Turkish

Turkish is an agglutinative language spoken mainly in Turkey. The standard word
order is SOV. The Turkish language has five suffixes for case, the accusative *-(y)I*,
the dative *-(y)A*, the locative *-DA*, the ablative *-DAn* and the genitive *-(n)In/-Im*.
Turkish has a rich set of TAM markers and a rich verbal morphology as can be
seen in figure 2.6. The negative marker *-mA* occurs on the verb before the TAM
markers (except the ability marker). The upper case vowels and consonants in

1	2	3	4	5
-(y)A	*-(y)Abil*	*-DI*	*-(y)DI*	*-DIr*
	(ability/possibility)	(perfective)	(past copula)	(generalizing
		-mIş (perfective/	*-(y)mIş*	modality)
		evidential)	(evidential	
		-sA	copula)	
		(conditional)	*-(y)sA*	
		-mAlI	(conditional	
		(obligative)	copula)	
		aorist		
		future		
		imperfective		

Figure 2.5: Order of some co-occuring tense/aspect/modality markers

figure 2.6 signal the use of vowel harmony and consonant alternation respectively
(Göksel and Kerslake 2005, p22-23 & 43). The upper case *D* consonant stands for
the voiceless/voiced pair 't'/'d' (Göksel and Kerslake 2005, p43). If the preceding
consonant is voiceless,[52] 't' is used and otherwise 'd' is used. The following table
represent the different vowels of the Turkish language (see (Lewis 1975, p15-18)
and (Göksel and Kerslake 2005, p10)).

	Unrounded		Rounded	
	Non-high	High	Non-high	High
Back	a	ı	o	u
Front	e	i	ö	ü

The vowel harmony of suffixes then comes in two types depending on the preceding
vowel: I-type and A-type.

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[52]The voiceless consonants of Turkish are: 'p', 't', 'k', 'f', 'h', 'ç', 'ş' and 's.'

Preceding vowel	I-type suffix	A-type suffix
a, ı	ı	a
o, u	u	a
e, i	i	e
ö, ü	ü	e

For instance, the obligative suffix *-mAlI* can take two forms. The first one, *-malı*, is attached to verbal stems like *oku-* 'read': the last vowel of the stem is a *u*, thus the *A* becomes a *a*, which turns the *I* into *ı*. The second, *-meli*, is attached to stems like *gel-* 'come' where the only vowel *e* induces *A* to be realized by *e* and thus *I* by *i*.

I'll assume with (Cinque 2001) that the Mirror Principle is correct, that is, "an outer suffix corresponds to a functional head higher than that corresponding to an inner suffix." Therefore with respect to table 2.6, a complex *Verb-(y)Abil-sA* with the ability and conditional suffixes is interpreted as *If able to Verb*.

Finally, Turkish sentences come in two types: nominal and verbal sentences. The predicate of verbal sentences is a verb, as in (138-a), whereas in the case of a nominal sentence it can be a noun, as in (138-b), an adjectival or a postpositional phrase.

(138)   a.   Bir mektup yaz-dı-m
             a   letter   write-PERF-1SG
             'I wrote a letter.'   (Göksel and Kerslake 2005, (12) p141)
      b.   Necla öğretmen.
             Necla teacher
             'Necla is a teacher.'   (Göksel and Kerslake 2005, (6) p120)

2.5.1   Turkish modal system

The Turkish modal system is 'unfortunately' too rich to be explained in a couple of pages. I will therefore present the main representatives of each modality type but will not aim at exhaustivity.

Participant-internal modality

Participant-internal Suffix
-(y)A/-(y)Abil

The participant-internal suffix comes in two distinct forms dependent on their position with respect to the negation marker: *-(y)A* occurs before, and *-(y)Abil* occurs after the negation marker *-mA*.[53] The suffix can express all types of ability,

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[53]I will gloss both markers as *-abil* throughout this section.

that is, learned ability as in (139-a), but also abilities due to external circumstances as in (139-b).[54]

(139) a. oku-yabil-ir-im
           read-ABIL-AOR-1SG
           'I am able to read.'   (Kornfilt 1997, 2.1.3.4.7)

       b. Hasan gelecek kış   üniversite-ye   gid-ebil-ecek
           Hasan next   winter university-DAT go-ABIL-FUT
           'Hasan will be able to go to the university next winter.'
                                                         (Kornfilt 1997, 2.1.3.2.2)

(140) a. anlı-ya-mı-yor
           understand-ABIL-NEG-AOR
           'He cannot understand.'

       b. Bugün ev-de   kal-a-ma-m
           today home-LOC stay-ABIL-NEG-AOR.1SG
           'I can't stay home today.'   (Göksel and Kerslake 2005, (5) p120)

The negation can also scope under the ability suffix to express the ability, or freedom, not to perform an action.

(141) söyle-me-yebil-mek
       say-NEG-ABIL-INF
       'to be able not to say'   (Göksel and Kerslake 2005, (90) p345)

Notice that combinations of the ability suffix with unaccusative verbs, as *korkmak* 'to fear' or *düşmek* 'to fall,' are mostly odd, except in the present tense with an epistemic interpretation (Savaşır 1986).

Finally the lexical constructions *kadir olmak* and *muktedir olmak* combining a noun meaning 'able, capable' and the auxiliary *olmak* can also be used to express participant-internal modality. I will however concentrate on the suffix of ability.

Participant-external modality

	Participant-external	
	Deontic	Goal-oriented
Suffix	*-(y)Abil*	*-(y)Abil*
	-mAlI	*-mAlI*
Lexical constructions	*gerek(-mek)*	*gerek(-mek)*
	lazım	*lazım*
	zorunda	*zorunda*
	izin verilmek	
	müsaade edilmek	

---

[54]The external circumstance is for instance Hasan's admission to the university.

Suffixes Göksel and Kerslake (2005, p352) suggest that *-mAlI* is mostly used deontically, i.e. to express "an obligation perceived or imposed by the speaker." However, the suffix is used to express all kinds of participant-external modality: deontic, weak deontic/advice and goal-oriented. First, example (142-a) shows a typical deontic use of *-mAlI*. In sentence (142-b), the suffix takes scope over negation and is interpreted consequently as 'must/should not' licensing a deontic/advice interpretation.

(142)   a.   oku-malı-y-ız
             read-NEC-COP-1PL.
             'We must read.'   (Kornfilt 1997, 2.1.3.4.6)
         b.   yapıl-ma-malı-dır
             be.done-NEG-NEC-GM
             'It should not be done.'

The goal-oriented use of *-mAlI* is exemplified in the following sentences. Sentence (143-a) is taken from instructions on how to preserve food and (143-b) shows a more traditional goal-oriented use with a want-conditional. Notice that sentence (143-a) involves a passive under the necessity modal yielding a generic reading. The necessity is obviously not imposed on the preserve but on the implicit agent 'if one wants to kill all bacteria, one has to cook the preserve well.'

(143)   a.   Konserve iyi   pişir-il-meli
             preserve   well cook-PASS-NEC
             'The preserve must be cooked well.'   (Corcu 2003, (8a))
         b.   Batı Rusya'nın   tavrını   değiştirmek istiyorsa   bunu
             west Russia'GEN attitude change   want-AOR-COND this
             anla-malı.
             understand-NEC
             'If the west wants to change Russia's behaviour, it has to under-
             stand that.'

The necessity suffix can also be used in a compound construction above the perfect suffix, i.e. *-mIş olmalı.*

(144)   6.30'a   kadar yola çık-mış ol-malı-yız.
         6.30'LOC by   set off-PERF AUX-NEC-1PL
         'We must be on the road by 6.30.'
                                              (Göksel and Kerslake 2005, (181) p366)

The suffix *-(y)Abil* can also be used for all participant-external meanings. In sentence (145-a) it expresses deontic modality and sentence (145-b) shows that the negative suffix in its deontic interpretation expresses a prohibition.

(145)   a.   bilgisayar-ım-ı   ne zaman ist-er-sen
             computer-1SG.POSS-ACC when   want-AOR-2SG.COND
             kullan-ABIL-ir-im
             use-ABIL-AOR-2SG
             'You can use my computer whenever you like.'
             [I give you permission.]   (Göksel and Kerslake 2005, (99) p347)
        b.   Burada otur-a-maz-sınız
             here   sit-ABIL-NEG.AOR-2PL
             'You can't sit here.' [I/We don't allow it.]
                                          (Göksel and Kerslake 2005, (100) p347)

The following sentence exemplifies a goal-oriented use of the suffix. The goal-oriented modal element is embedded under the adverb *acaba* expressing 'I wonder (if)' (Göksel and Kerslake 2005, p308).

(146)   Anne-m-in   kışın   üşü-mesi   için acaba   ne
        mother-1SG.POSS-GEN in.winter be.cold-NEG-mAsI için wonder what
        yap-ABIL-iriz?
        do-ABIL-AOR.1PL
        'I wonder what we can do so that my mother won't be cold in the winter?'[55]   (Göksel and Kerslake 2005, (81) p479)

Lexical constructions   There are two types of lexical constructions for participant-external modality, one for necessity and one for possibility.[56]   First, the necessity lexical constructions all express deontic and goal-oriented notions like *-mAlI*. However, whereas *-mAlI* was said to lean towards the deontic end of participant-external modality, those lexical constructions are mainly used for non-deontic modality (Göksel and Kerslake 2005, p235): they "present an objective obligation, that is, one arising from external factors operating independently of the speaker." These constructions involve a lexical element such as *gerek* or *lazım*

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[55]The purpose clause *-mAsI için* 'in order for, so that' is used when the clause has an overt separate subject; *-mAk için* 'in order to' is used when the subject of the purpose clause is the same as that of the superordinate clause (Göksel and Kerslake 2005, p479).

[56]There is also an interesting evaluative conditional construction that indirectly relates to participant-external modality:

(i)   Bugün burada temizlik yap-ıl-sa   iyi   ol-ur
      today here   cleaning do-PASS-COND good AUX-AOR
      'It would be good if some cleaning were done here today.'
                                          (Göksel and Kerslake 2005, (40) p495)

This construction is used "to express an evaluation (usually positive) of a certain possible action, often with the strong implication that the speaker wants or expects this action to be performed" (Göksel and Kerslake 2005, p495). This construction can thus be used to express strong advice or a polite order.

meaning 'necessary', or *zorunda* meaning 'compulsion'[57] and a non-finite clause denoting the action that is necessary.[58]

(147)   a.   Ankara'ya   git-me-m   lazım/gerek.
             Ankara'DAT go-INF-1SG.POSS necessary
             'I have to go to Ankara.'[59]
        b.   Ankara'ya   git-mek zorunda-yım
             Ankara-DAT go-INF   compulsion-1SG
             'I have to/am obliged to go to Ankara.'

(Göksel and Kerslake 2005, (118d) p351)

The gloss of sentence (147-b) makes it clear that a deontic reading is possible. This is also the case for the other lexical constructions. The sentences in (148) show that *gerek* can be used with the usual deontic/advice interpretation.

(148)   a.   Ahmet-in   gel-me-si   gerek-ecek.
             Ahmet-GEN come-INF-3SG.POSS necessary-FUT
             'Ahmet will have to come.'   (Wilson and Saygın 2001, (28))
        b.   Doktora görün-me-si   gerek.
             doctor   see-INF-3SG.POSS necessary
             'She should see a doctor.'   (Corcu 2003, (11))

Finally, the following sentence illustrates a traditional goal-oriented reading with a want-conditional and the lexical item *zorunda*.

(149)   Koalisyon, stratejik risk-ler-i   azalt-mak isti-yor-sa,
        coalition   strategic risk-PL-ACC reduce-INF want-IMPF-COND
        operasyonel risk-ler-i   üstlen-mek zorunda.
        operational risk-PL-ACC assume-INF have.to
        'The coalition, if it wants to reduce the strategic risks, must assume the operational risks.'

(BBC's Turkish press review, 03/04/2003)

The last lexical constructions are only used for deontic possibility and combine a noun meaning permission with a (passivized) verb meaning 'to give, to do': *izin*

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[57]This lexical element is actually more complex: it is composed of the noun *zor* meaning 'compulsion,' a noun compound and the locative case -*DA*.

[58]There is also a lexical construction for prohibition with *yasak olmak*:

(i)   90 gün içinde yasak   olu-yor
      90 days in   prohibited AUX-AOR
      'It will be prohibited in 90 days.'

[59]Literally: "My going to Ankara is necessary."

verilmek and *müsaade edilmek* 'to be allowed.'[60]

(150)   'to be allowed'
      a. izin   ver-il-mek
           permission give-PASS-INF
      b. müsaade   ed-il-mek
           permission do-PASS-INF

Notice that those lexical constructions expressing permission can be used under the deontic suffix *-mAlI* as in the following example.

(151)   Bush'un   terör-le   savaş-ı   bitir-me-si-ne   izin
        Bush'GEN terror-INSTR war-ACC finish-INF-3SG.POSS-DAT permission
        ver-il-meli
        give-PASS-NEC
        'Bush must be allowed to finish the war on terror.'
                          (BBC's Turkish press review, 01/11/2004)

Epistemic modality

Epistemic		
Verbal constructions	Adverbs	Suffix
olmalı	*herhalde*	*-(y)Abil*
olması gerek/lazım	*belki*	
olsa gerek	*galiba*	
olabilir		

Epistemic modality can be expressed through several means: with some adverbs, with verbal constructions and with suffixes.

Adverbs   I will first present some adverbs (but notice that the list is far from exhaustive). The adverb *herhalde* of sentence (152-a) means 'perhaps, probably, presumably, I expect;' *belki* of sentence (152-b) means 'perhaps, maybe' and *galiba* means 'probably, perhaps, I think' as in (152-c).

(152)   a. Telefon   numaram siz-de   vardır   herhalde.
          telephone number   you-DAT exist-GM perhaps
          'I expect you've got my telephone number.'
                         (Göksel and Kerslake 2005, (27) p218)
      b. Abla-m   belki   şarkı söyl-üyor-du
          sister-1SG.POSS maybe song sing-IMPF-PAST

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[60]The active forms of these constructions are respectively *izin vermek* and *müsaade etmek* 'to give permission.'

'Maybe my sister was singing songs.'

<div align="right">(Wilson and Saygın 2001, (25))</div>

    c.   Galiba   daha çok çalış-malı-sın
          probably more   work-NEC-2SG
          'Perhaps, you should work harder.'   (Corcu 2003, (6d))

Verbal constructions   All the verbal constructions involve a suffixed form of
the auxiliary *ol-*. The first construction combines the auxiliary with the necessity
suffix *olmalı* and expresses 'an inference drawn about a past or present event
or state from strong circumstantial evidence' (Göksel and Kerslake 2005, 344).
Sentence (153-a) is a nominal sentence but this construction can also be used
with a compound verb form involving a verb suffixed with the perfective *-mIş* as
in (153-b) or the progressive (Göksel and Kerslake 2005, p364).

(153)   a.   Kapı aşık, ev-de   ol-malı-lar
             door open home-LOC AUX-NEC-3PL
             'The door's open; they must be home.'

<div align="right">(Göksel and Kerslake 2005, (87) p345)</div>

        b.   Kayseri'yi   gör-müş ol-malı-yım   ama. . .
             Kayseri'ACC see-PERF AUX-NEC-1SG but
             'I must have seen Kayseri but. . .'

<div align="right">(Göksel and Kerslake 2005, (176) p365)</div>

The second construction involves the participant-external construction *-mA-POSS
gerek/lazım* of example (148) with the auxiliary *ol-* and, when used in the third
person form, it expresses a 'strong assumption based upon knowledge or other
relevant facts' (Göksel and Kerslake 2005, p344).

(154)   Bu saatt-e   Ali'nin iş-te   ol-ma-sı   lazım.
          this hour-DAT Ali'GEN work-LOC AUX-INF-3SG.POSS necessary
          'Ali must be at work at this hour.'

<div align="right">(Göksel and Kerslake 2005, (85) p344)</div>

The third construction expresses probability and combines the conditional form
of the auxiliary *ol-* with the lexical item *gerek* 'necessary.'

(155)   a.   En iyisi bu ol-sa   gerek.
             most good this AUX-COND necessary
             'This one is probably the best.'

<div align="right">(Göksel and Kerslake 2005, (83) p344)</div>

        b.   yukarı-da birisi   matkap kullanıyor ol-sa   gerek
             above-LOC someone drill   use-IMPF AUX-COND necessary
             'Someone upstairs must be using a drill.'

<div align="right">(Göksel and Kerslake 2005, (189) p368)</div>

The construction can be nominal as in (155-a) or form a compound with a lexical verb as in (155-b). In the last case, the embedded verb can be suffixed with the perfective or the progressive. In both cases, the judgment is made at speech time but about a past or present situation respectively (this is also the case for *olmalı* in example (153)).

Finally, the last construction is a possibility variant with the auxiliary verb suffixed by *-Abil*. It is used to express epistemic possibility and just as with the other constructions, it combines with an embedded verb suffixed with the perfective or the progressive.

(156) a. Ali'nin patronu onu sev-mi-yor   ol-ABIL-ir
           Ali'GEN boss   him like-NEG-IMPF AUX-ABIL-AOR
           'It's possible Ali's boss doesn't like him.'
                                          (Göksel and Kerslake 2005, (190) p368)
       b. Ayşe bu fotoğraf-ı   Hatice'ye   göster-miş
           Ayşe this photograph-ACC Hatice'DAT show-PERF
           ol-ABIL-ir
           AUX-ABIL-AOR
           'Ayşe may have shown this photograph to Hatice.'
                                          (Göksel and Kerslake 2005, (177) p365)

Suffix   The suffix *-Abil* can be used to express epistemic possibility (and even counterfactuality when combined with the past copula (Göksel and Kerslake 2005, (35) 12.1.1.3)).[61] Usually it then combines with the aorist as in sentence (157-a), and sometimes even with the future suffix as in (157-b).

(157) a. Yağmur yağ-ma-yabil-ir
           rain   rain-NEG-ABIL-AOR
           'It may not rain.'   (Göksel and Kerslake 2005, (104) p348)
       b. Bu ev-ler   birkaç yıl   sonra yık-ıl-ABIL-ecek
           this house-PL some year later destroy-PASS-ABIL-FUT
           'These houses may be demolished in a few years' time.'
                                          (Göksel and Kerslake 2005, (103) p348)

As can be seen in (157-a), the suffix *-Abil* in its epistemic interpretation has scope over negation as the mirror principle predicts. Furthermore, the pre-negation ability suffix *-yA-* can yield an epistemic interpretation when it is combined with the auxiliary *ol-*. In this case, the negation has scope over the epistemic modal.

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[61]Notice that the suffix *-DIr*, named 'generalizing modality marker' by Göksel and Kerslake (2005), is often translated as 'presumably, probably, certainly, must.' However its use is not strictly restricted to modality as defined in this dissertation. I will therefore leave its study as future research.

(158)   Osman Ankara'da   ol-a-maz.
        Osman Ankara'LOC AUX-ABIL-NEG
        'Osman can't be in Ankara.' (e.g. because I saw him in London an hour
        ago)   (Göksel and Kerslake 2005, (106) p348)

Evidential modality

I will incorporate the evidential suffix *-mIş* in the list of modals because it is
usually analyzed in the semantic literature as an epistemic modal with a presup-
position on the evidence used for its evaluation (see for example (Izvorski 1997)).

Evidential Suffix
-mIş

The suffix *-mIş* is usually translated as 'apparently, it seems.' First notice that
there are cases when this suffix can only express perfectivity (its other possible
interpretation). In particular, it is interpreted as perfective when it is attached
to a predicate followed by an auxiliary as *ol-* in (156-b).[62] The evidential suffix
can attach to verb stems up to position 3 in figure 2.6, as in sentence (159-a),
and to nominals as in (159-b).

(159)   a.   anl-ıyor-muş-sun
             understand-IMPF-miş-2SG
             'Apparently you understand/understood.'
                                          (Göksel and Kerslake 2005, p85)

        b.   evim-miş
             my.house-EV.COP
             'It is/was apparently my house.'
                                          (Göksel and Kerslake 2005, p85)

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[62]The suffix is also interpreted as a perfect when it occurs under the past copular suffix *-(y)DI*
as in (i-a) or under the conditional one *-(y)sA* as in (i-b), or under the generalizing modality
suffix *-DIr* as in (i-c), (Göksel and Kerslake 2005, p80):

(i)   a.   başla-mış-tı-k
           start-PERF-PAST.COP-1PL
           'We had started.'
      b.   anla-ma-mış-sa
           understand-NEG-PERF-COND.COP
           'If he has not understood'
      c.   gör-müş-ler-dir
           see-PERF-3PL-GM
           'They must have seen [it].'

This suffix is used in two distinct situations as an evidential marker. It can be used both as a reportative and as an inferential. The first case corresponds to a situation where the material embedded under the suffix has been obtained from some other source (person, newspaper, etc.). Notice that the suffix is then to be used mandatorily. The following conversation makes this clear.

(160)   (Göksel and Kerslake 2005, (134) p356-357)
          a.   (Ayşe, to Çiğdem): Anne-m   biraz rahatsız
                                   mother-1SG.POSS some ill
                ‘My mother is not very well.’
          b.   (Çiğdem, to Nesrin): Ayşe’nin   anne-si   biraz
                                     Ayşe’GEN mother-3SG.POSS some
                rahatsız-mış
                ill-miş
                ‘It seems Ayşe’s mother is not very well.’

The second use of the evidential suffix is in inferential statements, that is, when the speaker wants to express that the embedded sentence is not based on direct evidence but is the result of reasoning or inference as in example (161). Notice that, as can be expected, the negation scopes and is interpreted under the evidential element.

(161)   Gözlüğ-üm-ü   yan-ım-a   al-ma-mış-ım.
          glasses-1SG.POSS-ACC side-1SG.POSS-DAT have-NEG-miş-1SG
          ‘I seem not to have my glasses with me.’
                                        (Göksel and Kerslake 2005, (140) p358)

Conclusion

The Turkish modal system has several interesting properties. First, the system of suffix markers implements naturally the scope order of modal elements. Basically, the participant-internal suffix occurs under the participant-external or epistemic one and those in turn occur under the evidential suffix. I will go into more details about those combinations in the next section. Second, figure 2.7 suggests a full polyfunctionality of the modal system. I will follow (van der Auwera and Ammann 2005) and (van der Auwera et al. 2005, 253-254) and disregard the specific syntactic constructions needed to express a particular type of modality. That is, I will claim that although the suffix *-mAlI* is essentially a participant-external suffix, its interpretation as epistemic in verbal constructions with the auxiliary *ol-* qualifies it as a polyfunctional element. In the same way, although *gerek* is mainly used for participant-external modality, its use in the epistemic verbal construction *olsa gerek* illustrates its polyfunctionality. Therefore, I will disregard the fact that a particular interpretation is linked to a particular syntactic construction and thus I will consider the Turkish modal system as fully

	Participant-internal	Participant-external		Epistemic
		Deontic	Goal-oriented	
Suffix	*-(y)A/-(y)Abil*	*-(y)A/-(y)Abil* *-mAlI*	*-(y)A/-(y)Abil* *-mAlI*	*-(y)A/-(y)Abil*
Adverbs				*herhalde* *belki*
Verbal constructions				*olmalı* *olması gerek* *olabilir*
Lexical constructions		*gerek(-mek)* *lazım* *zorunda* *izin verilmek* *müsaade edilmek*	*gerek(-mek)* *lazım* *zorunda*	

Figure 2.6: The Turkish modal system

polyfunctional.

2.5.2   Combinations of modal items

Evidential modality

As figure 2.6 shows, the evidential marker can scope over both participant-internal and external suffixes and over epistemic ones. This is illustrated in the following examples.

(162)   a.   Oku-yabil-ecek-miş
              read-ABIL-FUT-EV.COP
              'Apparently he will be able to read [it].'
                                                    (Göksel and Kerslake 2005, (12) p78)
         b.   oku-malı-ymış-ız
              read-NEC-EV.COP-1PL
              '[They say that] we have to read.'   (Kornfilt 1997, (1293) p373)
         c.   Hasan orada olmalı-ymış
              Hasan there AUX.NEC-EV.COP
              '[They say that] Hasan must be there.'   (Margreet Dorleijn, p.c.)

Sentence (162-a) combines the evidential suffix with the ability suffix *-(y)Abil*; sentence (162-b) shows the participant-external suffix *-mAlI* under *-mIş* and (162-c) combines the evidential with the epistemic necessity construction *olmalı*. In all those examples, the evidential has scope over the other modal element.

I have not found any combinations involving the evidential suffix and modal adverbs. It is however difficult to imagine the interpretation that would obtain

from such a combination and I will actually assume that such combinations are at best marginal. I will first give an example of what such a combination could mean. Faller (2002, p249) argues for instance that in Quechua the modal enclitic *-puni* expressing 'high certainty' and the reportative evidential *-si* can be combined and express their meaning relative to the embedded proposition independently of each other.

(163)   Pilar-qa   t'anta-ta-puni-s   irqi-ta-qa   qu-rqa-n.
         Pilar-TOP bread-ACC-puni-si child-ACC-TOP give-PST1-3SG
         p='It was bread that Pilar gave to the child'
         certainly p and speaker was told that p   (Faller 2002, (215a) p249)

However, the situation in Turkish is not similar to that in Quechua. In particular, sentence (162-c) exemplifies the same suffix/enclitic combination as sentence (163) but is unambiguously interpreted with the evidential having scope over the epistemic. Therefore the epistemic judgment is assigned to the original source of the reportative. In Turkish, the modal adverbs and the evidential suffix are performative (Nuyts 2001) in the sense that they involve the speaker's commitment. For this reason, I do not expect them to be used (unambiguously) in the same sentence.

Epistemic and participant-internal

I will now turn to combinations of epistemic elements with participant-internal modals.

(164)   a.   Coşkun'u   ikna   ed-e-me-yebil-ir-im.
              Coşkun'ACC persuasion AUX-ABIL-NEG-ABIL-AOR-1SG
              'I may not be able to persuade Coşkun.'
                                          (Göksel and Kerslake 2005, (105) p348)
         b.   oku-yabil-miş   ol-ABIL-ir
              read-ABIL-PERF AUX-ABIL-AOR
              'He might have been able to read.'   (Cinque 2001, (10c))
         c.   Belki   bunca   zamandan sonra birbirimizi
              perhaps so.much time   after each.other
              tanı-ya-ma-yız
              recognize-ABIL-NEG-1PL
              'Maybe we won't be able to recognize each other after all this time.'
                                          (Göksel and Kerslake 2005, (94) p346)

In sentence (164-a), two ability suffix are combined on the same verbal stem. Unsurprisingly, the outer suffix is interpreted as epistemic and the inner one as participant-internal. The epistemic verbal construction *olabilir* in sentence (164-b) has an embedded verbal stem with the ability suffix and sentence (164-c)

exemplifies a combination with the epistemic adverb *belki*. All those examples are interpreted with the epistemic item having scope over the participant-internal one.

Epistemic and participant-external

I will first present some combinations involving the epistemic modal adverbs. Those adverbs have sentential scope and express the speaker's judgment. All the combinations in example (165) have thus an epistemic adverb with scope over a participant-external modal.

(165)   a.   Herhalde daha çok çalış-malı-sın
              perhaps   more   work-NEC-2SG
              'Perhaps you should work harder.'   (Corcu 2003, (7))
         b.   Bunlar-dan daha sonra söz   et-meli   belki
              these-from   much later remark AUX-NEC perhaps
              'Maybe those should be mentioned later.'   (Corcu 2003, (17))
         c.   Herhalde taşın-ma-mız   gerek
              perhaps   move-INF-1PL.POSS necessary
              'Perhaps, we must move.'   (Corcu 2003, (18))

The first two sentences, (165-a) and (165-b), contain respectively the adverbs *herhalde* and *belki* and the participant-external suffix *-mAlI*. The last example is a sentence with the lexical item *gerek*. The following sentence exemplifies a different type of combination with the epistemic verbal construction *olabilir*.

(166)   Hasan oku-yabil ol-ABIL-ir
         Hasan read-abil AUX-ABIL-AOR.
         'Hasan might be allowed to read.'   (Margreet Dorleijn, p.c.)

All the epistemic verbal constructions have scope over participant-external elements. Finally the two suffixes *-mAlI* and *-(y)Abil* can be combined to yield an epistemic over participant-external reading (see also (168-b)).

(167)   dans   ed-ebil-meli-siniz
         dance do-ABIL-NEC-2PL
         'You must be allowed to dance!'

Participant-external and participant-internal

The markers for participant-internal modality *-(y)Abil* and *-(y)A* combine with the lexical construction with *gerek* but also with the suffix *-mAlI* in agreement with figure 2.6.

(168)   a.   Rusya'yı   oku-yabil-me-si   gerek-iyor.
              Russian'ACC read-ABIL-INF-3SG.POSS necessary-IMPF

'It's necessary to be able to read Russian.'

b. oku-yabil-meli-yiz
    read-ABIL-NEC-1PL
    'We must be able to read.'   (Margreet Dorleijn, p.c.)

As expected, the interpretation follows the scope order participant-external > participant-internal and the Turkish modal system can be said to respect the general scope hypothesis for modality.

2.6 Tuvaluan

Tuvaluan is a Polynesian language belonging to the Samoic-Outlier subgroup and mainly spoken in Tuvalu (former Ellice Islands, consisting of nine islands). It has few morphological processes and can therefore be considered an isolating language.

Tuvaluan is a prepositional language, i.e. the noun precedes the adjective and the head precedes the relative clause and its basic word order is VSO (although word orders such as OVS and SV(S)O are also possible, in particular to mark focus or topic). In VSO sentences, an ergative-absolutive pattern of case marking is used (marked by prepositional markers):

(169)

V	S		O	
Intransitive Verb	$\emptyset/a$ ABS	Subject		
Transitive Verb	*nee* ERG	Subject	$\emptyset/a$ ABS	Direct Object

The general pattern is that the ergative preposition marks the post-verbal subjects (and pronominal traces) of transitive verbs whereas the transitive subject in preverbal position is marked for the absolutive case. Direct objects are always marked for absolutive case (i.e. even in preverbal position).

(170)

S		V	(S)		O	
$\emptyset/a$ ABS	Subject	Transitive Verb	*nee* ERG	trace	$\emptyset/a$ ABS	Direct Object

Tuvaluan has several possibilities for subordination. I will only present three of those constructions; the ones that are used in raising constructions. The choice of the strategy of subordination is dependent on the matrix verb used. Raising verbs (among which are the modal verbs) select the following types of complements (all of which are verb-initial). The first type is marked by the complementizer *o* which introduces a non-finite sentential complement. Most examples in this section use this strategy. The second marker is the subjunctive complementizer *kee* which can

be used interchangeably with *o* (with subtle syntactic and semantic differences) and also introduces non-finite complements, see (186-a). Finally the subordinate clause can be apposed to the right of the superordinate clause, the complement clause is then finite, see for instance (186-a) and (194). The language lacks a passive and an anti-passive construction.

The Tuvaluan language has a set of negators able to express sentence as well as constituent negation (Besnier 2000, p177). The negators follow the tense-aspect markers, conjunctions and the possible complementizers. The only hard constraint is that the negator must precede the negated element. Of course, this doesn't mean that all the material following the negator is negated.

> [T]he scope of sentence negation is context-dependent, insofar as the same construction can be used to negate entire propositions, or just the verb, or particular constituents. (Besnier 2000, p181)

This is illustrated by the following example,

(171)   Au seki fano ki Fiiti i   ttausaga koo teka
           1SG NEG go   to Fiji in the.year INC roll
           'I didn't go to Fiji last year. [Rather, I stayed here]'
           or 'It wasn't Fiji I went to last year.'
           or 'It wasn't last year that I went to Fiji.'   (Besnier 2000, (967) p181)

Tense, aspect and mood can be expressed though preverbal particles. For instance a quite frequent aspect particle is *koo*, the inchoative/perfective particle. The particle *e* is for instance used for universal tense (non-past), present tense as well as for the future as in (172-a), *ne* is the past particle and *kaa* and *maa* are used for the future as in (172-b) and (172-c) respectively.[63]

(172)   a.   Koe e   fano maataeao.
                2SG NPAST go   tomorrow
                'You're leaving tomorrow.'   (Besnier 2000, (2453) p476)
           b.   Koe kaa fano maataeao.
                2SG FUT go   tomorrow
                'You'll be leaving tomorrow [if everything goes well].'
                                                   (Besnier 2000, (2454) p476)
           c.   Koe maa fano maataeao.
                2SG PRC go   tomorrow
                'You might be leaving tomorrow [if you don't prevent it].'
                                                   (Besnier 2000, (2459) p477)

Finally, Tuvaluan has a raising rule that is triggered by a restricted set of verbs

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[63]Notice that Besnier (2000, (1.4.6) p.187) dubs *maa* the precautionary mood marker due to its negative connotation.

(among other modal and aspectual verbs).[64] The raising rule is optional, which is a common feature of the raising rules of the Polynesian languages discussed in (Chung and Seiter 1980). A quite unusual feature of the rule is that it "can target noun phrases of any grammatical role and may assign to the raised noun phrase a wide variety of grammatical cases in the superordinate clause" (Besnier 1988, p748).[65] The following examples show a raised transitive subject in (173-a) and a raised oblique argument in (173-b) (for a raised intransitive subject and its non-raised equivalent, see (176)).

(173)   (Besnier 1988, (21c) and (21e) resp.)

    a.   Koo ttau *Niu* o   ssala   (nee ia) tena manuia
        INC must Niu COMP look.for ERG 3SG his   luck
        'Niu must go and seek his fortune.'

    b.   Koo ttau *iaa Niu* o   faipati au ki ei
        INC must at Niu COMP speak 1SG to ANP
        'I must have a word with Niu.'

This feature sets it apart from the other Polynesian languages which can either only target subjects (Samoan, Tongan) or subjects and direct objects (Niuean) (Chung and Seiter 1980, p626-628). Notice that the case marking in the superor-

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[64]A 'comparable' set of verbs triggers a raising rule in other languages of the Polynesian family as shown in (Chung and Seiter 1980) for Samoan of the Samoic-Outlier and for Tongan and Niuean of the Tongic family.

[65]It should be noted that the raising analysis proposed by Besnier (2000) (based on (Besnier 1988)) has been contested by (Otsuka 2001). Otsuka (2001) argues along the line of (Otsuka 2000) (for Tongan) that the phenomenon at hand is a case of (empty) operator movement and that the 'raised' NP is actually base-generated as the matrix subject, that is, she argues for the following structure:

(i)   V NP$_i$ [OP$_i$ [V pro$_i$ NP]]

I will however keep the raising analysis for the following reasons. First, (Otsuka 2001) does not refute the different points of the argumentation of (Besnier 1988) in favour of a raising analysis (i.e. i. the raised NP originates in the subordinate clause, ii. the raised NP is a surface argument of the superordinate clause and iii. the raising rule is not a deletion rule), although she posits an analysis that is clearly incompatible with them. Second, Otsuka (2001) acknowledges that most of the problematic data that she presents for raising would not be accounted for by the operator movement analysis either. Third, notice that even under an operator movement analysis the NP that is base-generated as argument of the modal wouldn't need to be the subject of the complement clause but could as well be an oblique argument as in (173-b). This is problematic in its own right as an NP generated from a fixed position should not vary for case (Otsuka 2001, p353) as happens in (173-a) with the absolutive and (173-b) with oblique case. Most importantly, both analyses do not give support to a semantic analysis of those sentences in term of control à la Brennan (1993) which would need the raised argument to be the subject of the embedded clause (and not an oblique argument as in (173-b)). Finally, raising/operator movement is clearly optional and a sentence with, for instance, the modal verb *ttau* and a sentential complement is grammatical. This would, for the same reason, be highly problematic for a treatment of dynamic modality in Tuvaluan as proposed in (Brennan 1993).

dinate clause is partly determined by the raising verb itself (Besnier 2000, p113) and partly by the semantic constraints in (174).[66] For instance, the following table shows which modal verbs allow for ergative and absolutive case marking (modified from (Besnier 1988, p761)).

	nee ERG	$\emptyset/a$ ABS
kkafi 'capable'	+	+
mafai 'possible'	+	+
iloa 'know how to'	+	+
maua 'able to'	+	?
ttau 'must'	-	+
talia 'allow'	+	+

(174)   (Besnier 1988, p766-767)

(1)   "[T]he more oblique the noun phrase in the subordinate clause, the less likely it is to be raised,"

(2)   "the more oblique the noun phrase in the subordinate clause, the more obliquely marked it will be once raised to the superordinate clause."

In this section, all the examples without explicit references to their origin have been checked with my informant, Niko Besnier.

2.6.1   Tuvaluan modal system

Participant-internal modality

The participant-internal sub-system can be split up in two distinct parts. The first part consists of the items specialized for participant-internal modality: the lexical verb *iloa* and the modal verb *kkafi*; the second part consists of the modal verbs *maua* and *mafai* that have a participant-external interpretation as well.

Participant-internal	
Lexical verbs	Modal verbs
iloa	*kkafi*
	mafai
	maua

---

[66]This is probably one of the most unusual features of Tuvaluan raising. In particular, it contrasts sharply with the analysis proposed in (Seiter 1980) for Niuean. According to Seiter (1980), the (intransitive) raising verb *kamata* 'begin' takes a sentential subject. The raising rule takes this structure as argument. The subject or direct object is then raised and bears the grammatical relation that was attributed to the whole sentential complement, i.e. subject, and therefore gets marked as absolutive.

The verb *iloa* expresses 'to know/to know how' and is used to express both learned (sentence (175-a)) and internal ability (sentences (175-b) and (175-c)).

(175)   a.   E   iloa   nee ia o   faipati faka-Eelise...
               NPAST know-how ERG 3SG COMP speak in.way.of-Ellise
               'She can speak Ellicean...'   (Besnier 2000, (877) p164)
    b.   E   iloa katoa o   kkake tamataene Tuuvalu
               NPAST know all   COMP climb young.man Tuvalu
               'Tuvaluan young men can all climb [trees].'
                                         (Besnier 2000, (1329) p253)
    c.   Te tamaliki teena koo iloa   o   fano...
               the child   that INC know COMP go
               'That child is able to go...'   (Besnier 2000, (2587) p501)

The verb *kkafi* 'can' (but also 'to contain') is used for physical ability (also called dispositions by Hackl (1998)). As example (208) will show, physical ability goes hand in hand with a lack of control of the agent on the action denoted by the verb phrase. This might come as surprising in example (176) where the action is about climbing a coconut tree. However, the lack of control means that if you were to question this ability (How come he can climb a coconut tree?), the answers would be that he can do it because he can do it! Namely, he has two legs, two arms, etc., and therefore is capable of climbing a tree. The modal verb is often used with negation (Besnier 2000, p501) as in sentences (179-b). *Kkafi*, as the other modal verbs, is a raising verb, as is shown in (Besnier 1988). As I already mentioned, raising is optional and therefore both (176-a) and its raising equivalent (176-b) are grammatical.

(176)   'Niu is capable of climbing to the top of the coconut tree.'
                                       (Besnier 1988, (10a-b))
    a.   E   kkafi [o   kake Niu ki luga i te niu
               NPAST capable   COMP climb Niu to top at the coconut.tree
               teelaa]
               that
    b.   E   kkafi   nee Niu [o   kake ki luga i te niu
               NPAST capable ERG Niu   COMP climb to top at the coconut.tree
               teelaa]
               that

Now we turn to modal verbs that can express participant-internal as well as participant-external meaning. The first verb is *mafai* and is translated as 'can.'

(177)   a.   E   mafai katoa o   kaitaua au kia laatou
               NPAST can   all   COMP angry 1SG to 3PL

'I can get angry at them all.'[67]   (Besnier 2000, (1330) p253)

b. E   mafai katoa o   faka-t(t)agi nee au tamaliki kolaa
    NPAST can   all   CNT CAUS-cry   ERG 1SG child   those
    'I can make all those children cry.'   (Besnier 2000, (1334) p254)

The second modal verb is *maua*. It can express learned and physical ability and its non-modal meaning is 'have, get, obtain, acquire.'

(178)   Ttamaliki teenaa koo maua nee ia   o   saasaale
        the.child   that   INC can   ERG 3SG COMP walk
        'That child can already walk.'   (Besnier 2000, (2584) p500)

NEGation takes scope over all the participant-internal modals. The interpretation follows the surface order, i.e. 'not able to.'

(179)   a. E   see iloa   nee ia o   faipati faka-Eelise...
            NPAST NEG know-how ERG 3SG COMP speak in.way.of-Ellise
            'She can't speak Ellicean...'   (Besnier, p.c.)
        b. ...see kkafi nee   au o   sau   ki luga
               NEG capable ERG 1SG COMP lift to   up
            '[The suitcase is too heavy,] I can't lift [it] up.'
                                             (Besnier 2000, (562) p102)[68]
        c. Koe e   see mafai o   puli   i au
            2SG NPAST NEG can   COMP forgotten at 1SG
            'I cannot forget you.'   (Besnier 2000, (2350) p459)
        d. E   see maua o   too taku moe
            NPAST NEG get   COMP fall my   sleep
            'I cannot fall asleep.'   (Besnier 1988, (28a))

Of course, a negation can be present in the embedded clause to express 'able not to' as in the following example:

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[67]The different classes of Tuvaluan pronouns (personal, possessive, demonstrative and relative) are arranged along a (mandatorily marked) three-way number distinction: singular, dual or plural. Furthermore, a distinction is made between inclusion and exclusion (of the addressee) for 'non-singular numbers in the first person' (Besnier 2000, p380). The following table represents the simple paradigm of personal pronouns (Besnier 2000, table 2.3 p386),

	First-person inclusive	First-person exclusive	Second person	Third person
Singular		*au*	*koe*	∅, *ia*
Dual	*taaua*	*maaua*	*koulua*	*laaua*
Plural	*taatou*	*maatou*	*koutou*	*laatou*

For instance, *taaua* stands for 'you and I', whereas *taatou* stands for 'you and I and someone else', *maaua* for 'I and someone other than you' and *maatou* for 'I and at least two other than you.'

[68]Also as (Besnier 2000, (2588) p501).

(180) E   kkafi nee ia o   see faka-takavele nee au
      NPAST capable ERG 3SG COMP NEG CAUS-defeated ERG 1SG
      'He is capable of not getting defeated by me.'   (Besnier 1988, (25a))

Participant-external modality

This category can be split up in three different parts. The first one consists of the Tuvaluan modal verbs that are able to express all the spectrum of participant-external modality (the possibility modals can also express participant-internal modality). The second part consists of modal verbs expressing deontic modality only (mainly borrowings of Samoan). The last part consists of a mood marker for 'advice' and deontic modality.

	Participant-external	
	Deontic	Goal-oriented
Subjunctive marker	*kee*	
Modal verbs	*mafai*	*mafai*
	maua	*maua*
	ttau	*ttau*
	saoloto, taga, talia	
	tapu	

Modal verbs: full range of meanings   The modal verbs *mafai*, *maua* and *ttau* can express all the shades of participant-external modality, i.e. deontic as well as goal-oriented modality. Sentences (181-a) and (181-b) show the possibility modals *mafai* and *maua* in their permission reading, meaning 'allowed to,' and sentence (181-c) exemplifies the necessity modal *ttau* in its obligation reading.

(181)   a.   Koo see maua nee au o   aasi atu mo   koo ita
           INC NEG can   ERG 1SG COMP visit DEIC because INC displeased
           mai tootou   kaaiga
           DEIC 3PL.POSS family
           'I am no longer allowed to visit you because your relatives are angry
           at me.'   (Besnier 2000, (2585) p500)
      b.   A   ko ia laa koo fia   vau ki ei, a   koo see mafai
           and FOC 3SG then INC want come to ANP but INC NEG can
           laa. . .
           then
           'He then wanted to come along, but it wasn't allowed. . .'
                                       (Besnier 2000, (2581) p500)
      c.   Koo ttau o   taa   nee Vave a   ia   loa.
           PAST must COMP strike ERG Vave COMP 3SG indeed
           'Vave must kill himself.'   (Besnier 2000, (1119) p210)

Notice in particular that *maua* and *mafai* combine again with the negation in a transparent way, i.e. the interpretation follows the surface order.

Those verbs can also express non-deontic participant-external modality as the following example shows.

(182)   Konei mea kolaa e   mafai o   gaalue ei   taatou moo
        these thing those NPAST can   COMP work ANP 1PL.I in.order.to
        manuia tino   o ttou   kaaiga
        lucky   people of 1PL.I.POSS family
        'These are [some of] the things we can work [on] so that the members
        of our families have a good [life].'   (Besnier 2000, (512) p92)

Sentence (182) exemplifies the use of *mafai* in goal-oriented sentences but the sentence could as well contain *maua* for another possibility reading or *ttau* for a necessity reading. The more traditional form of goal-oriented sentences, involving a want-conditional, is also possible with all three modal verbs.

(183)   a. Kaafai e   fia   fano koe ki Tuvalu, koo ttau koe o   fano
            if   NPAST want go   2SG to Tuvalu INC must 2SG COMP go
            i   te   vaka nei
            on the ship this
            'If you want to go to Tuvalu, you have to board this ship.'
        b. Kaafai e   fia   fano koe ki Tuvalu, koo maua/mafai koe
            if   NPAST want go   2SG to Tuvalu INC can   2SG
            o   fano i   te   vakalele nei
            COMP go   on the plane   this
            'If you want to go to Tuvalu, you can take this plane.'

Finally, *ttau* can be used to express weak necessity (wish, advice), as in (184-a), and it combines with negation, by taking wide scope over it, i.e. to mean 'must not' as example (185) shows.

(184)   a. Maaloo   o te lalolagi koo ttau o   fusi fakatasi.
            government of the world   INC must COMP unite together
            'The world's governments should all unite.'
                                                    (Besnier 2000, (2478) p481)
        b. Moonise koo ttau o   aavaga kia Evotia
            Monise   INC must COMP marry to Evotia
            'Monise should get married to Evotia.'
                                                    (Besnier 2000, (2343) p458)

(185)   a. A   mea konaa see ttau o   faippatigina peelaa
            CNT thing those NEG must COMP speak.TR   thus
            'These things must not be talked about like that.'
                                                    (Besnier 2000, (259) p46)

> b. Koe see ttau lele eiloa o faipati ki ei.
> 2SG NEG must at-all indeed COMP speak to ANP
> 'You must not speak to her at all.' (Besnier 2000, (1025) p191)

Notice that in sentence (185-a), the subject of the transitivized (by the transitivizer *-gina*) verb is unexpressed. This construction is often used to express a general obligation reminiscent of the 'ought-to-be' interpretation of deontic modals of (Feldman 1986).

Modal verbs for deontic modality The first specialized modal verb for deontic modality is *tapu*. It expresses an interdiction. As example (186-b) shows, it can take a noun phrase as subject.

(186) a. Koe koo tapu koe kee/e toe faipati i loto i te
2SG INC forbidden 2SG SBJ/NPAST again speak in inside in the
maneapa o te fenua
maneaba of the island.community
'You mustn't speak again [publicly] in(side) the island community's
maneaba.' (Besnier 2000, (314) p55)

b. E tapu kkii loa sau tusi kiaa Vave.
NPAST forbidden very indeed 2SG.POSS letter to Vave
'You are not to write to Vave.' [lit.: 'A letter of yours to Vave is
strictly forbidden'] (Besnier 2000, (1020) p190)

The other three verbs, *talia*, *taga* and *saoloto*, are all borrowings from Samoan expressing permission with subtle differences in meaning. First, the transitive modal verb *talia* meaning 'to allow, allowed, can.' In its non-modal use, this verb means 'to accept, to receive' (Besnier 2000, p503).

(187) a. Ne talia eiloo nee laatou a Ppaalagi kee mmai o
PAST allow indeed ERG 3PL CNT Westerner SBJ come COMP
fakatuu telotou koloa i konei
CAUS.stand 3PL.POSS goods in here
'They allowed the white people to come and establish their store
here.' (Besnier 2000, (2599) p503)

b. Seiloga kee maua sau pepa folau, koo talia ei koe
not.unless SBJ get 2SG.POSS paper travel INC allow ANP 2SG
o fano i te vakalele
COMP go in the plane
'You won't be allowed to board the plane unless you have travel
documents.' (Besnier 2000, (559) p102)

The two arguments of the modal are (standardly) an ergatively marked subject and a 'direct object' complement clause as in (187-a). However, the subject of the

subordinate clause might be raised in object position of the superordinate one as in (187-b). In the same manner as example (185-a), the subject of the modal can be left unexpressed giving right to a 'generic' permission reading as in (187-b), i.e. an 'allowed'-reading. Finally, it combines with negation in a transparent way.

(188) a. E   see talia nee ia kee   taa   nee tena   aavaga
           NPAST NEG allow ERG 3SG COMP strike ERG 3SG.POSS spouse
           'She does not allow her husband to strike [someone else].'
                                            (Besnier 2000, (276) p49)
       b. Koo see toe   talia nee au kee foki   mai koe ki au me
           INC NEG again allow ERG 1SG SBJ return DEIC 2SG to 1SG COMP
           iaa   koe e   maasei
           COMP 2SG NPAST bad
           'I won't allow you to come back to [see] me because you're [a] bad
           [person].'   (Besnier 2000, (286) p51)

The second verb is the intransitive modal *taga* which means 'allowed, permitted.' The difference in meaning with *talia* is that this one "refers frequently to legal or customary permission that results from an interdiction being lifted" (Besnier 2000, p503). In the following sentence it is used with a nominalized clause. It can also be used with the usual *o*-subordination.

(189) Au koo taga   i te inu   kava
       1SG INC allowed in the drink liquor
       'I am of drinking age.'   (Besnier 2000, (2602) p503)

Finally, the intransitive verb *saoloto* is used in legal contexts and means literally 'free.'

(190) E   saoloto ki loto   i te maneapa.
       NPAST free   to middle in the maneaba
       '[He] is allowed inside the maneaba.'   (Besnier 2000, (2605) p503)

I have not found examples of the last two modals with negation but I see no reason to expect any other interpretation than 'not allowed.'

Mood marker   The debitive, subjunctive marker *kee* can be used to express orders and advice as 'should' (it is also used in imperatives). It takes scope over negation and cannot be used in goal-oriented sentences.

(191) a. Ioane kee manatua mai nee ia   au ...
           Ioane SBJ remember DEIC ERG 3SG 1SG ...
           'Ioane should think of me when...'   (Besnier 2000, (2575) p499)
       b. Koe kee see faipati ki ei
           2SG SBJ NEG speak to ANP

'You should not speak to her.'

The mood marker commits the speaker to (agreeing with) the source of the advice or order, i.e. it is performative in the sense of (Nuyts 2001).

Epistemic modality

	Epistemic	
Lexical verbs	Modal verbs	Adverbs
iku	*ttau*	*kaati*
	ailoga	*aati*
	taumate	*laa*

Epistemic modality can be expressed both with verbs and adverbs. There are two markers for epistemic necessity: the verb *iku* 'come to a conclusion, end up' (interpreted as epistemic/inferential 'must') and the modal verb *ttau*. The verb *iku* can take an *o*-complement clause, as in (192-a), or a finite apposed clause as in (192-b).

(192)   a. E   iku   o   vaia   te penitiini.
              NPAST end-up COMP watery the benzene
              'The petrol must have water in it.'   (Besnier 2000, (2578) p499)

        b. Telotou vaka e   iku   e   nofo i loto i te manu.
           3PL.POSS canoe NPAST end-up NPAST stay in inside in the school
           'Their canoe must be in the middle of the school of bonitos.'
                                       (Besnier 2000, (2579) p499)

        c. Koo ttau o   lima sefulu ana   tausaya
           INC must COMP five ten   3SG.POSS years
           'He must be 50 years old.'

The other two modal verbs, *see taumate* 'probably' and *ailoga* 'unlikely', express a (negative) notion of probability. The verb *taumate* which is a Samoan borrowing can only be used in combination with negation with the meaning 'probably', 'it's not unlikely.'

(193)   E   see taumate koo ne matea nee koe te vaegaa aamioga
        NPAST probable   PERF see   ERG 2SG the kind+of behaviour
        teenaa.
        that
        'You probably have witnessed this kind of behaviour.'
                                     (Besnier 2000, (1008) p188)

(194)   E   ailoga laa koe e   fano i te vaka nei
        NPAST unlikely then 2SG NPAST go   on the ship this

'It's unlikely that you'll be leaving on this boat trip.'

(Besnier 2000, (295) p52)

Sentence (194) also contains the downtoner *laa*. This adverbial hedge is postposed to the material it modifies and is sometimes translated as *then*. It can by itself have an epistemic reading, as in (195), but is often associated with other epistemic items such as *ailoga* in (194) or the modal adverbs *kaati/aati*, as in (196-a) and (196-b) respectively.[69]

(195)   Koo ffiu   laa   i koopai mo sua masi
         INC tired.of perhaps at porridge and soup cabin.biscuit
         '[She]'s probably had it with porridge and cabin biscuit soup.'

(Besnier 2000, (1546) p298)

Finally, the modal adverbs *kaati* and *aati* express epistemic possibility. Note that the use of the downtoner *laa* is not mandatory. Furthermore, sentence initial *kaati/aati* cannot appear in the scope of negation.

(196)   a.   Kaati   ne   soli   tuulaafono laa,...
              perhaps NPAST transgress law   then
              'Perhaps he had transgressed a law,...' (Besnier 2000, (249) p43)
         b.   Aati   laa se vaegaa kaaiga peelaa e   ppoi,   nee?
              perhaps then a kind.of family thus   NPAST stage.fright right
              'Perhaps stage fright runs in the family, right?'

(Besnier 2000, (2611) p505)

Conclusion

	Participant-internal	Participant-external		Epistemic
		Deontic	Goal-oriented	
Adverbs				*kaati/aati*
				laa
Verbs	*iloa*	*mafai*	*mafai*	*iku*
	kkafi	*maua*	*maua*	*ailoga*
	mafai	*ttau*	*ttau*	*ttau*
	maua	*saoloto, taga, talia*		*taumate*
		tapu		
Mood marker		*kee*		

---

[69]It can also modify imperatives, shifting their meaning from orders to suggestions (also in combination with polite downtoners, i.e. like English *please*):

(i)   Vau laa!
       come then
       '[Why don't you] come [here]?'   (Besnier 2000, (200) p35)

One of the main interesting issues concerning the Tuvaluan modal system is its use of raising verbs across types of modality, i.e. for participant-internal, external and epistemic modality. In particular, it shows that there is no necessary connection between the possible NP argument of the modal and the bearer of a particular ability, permission or obligation. Therefore, an analysis of participant-internal/external modality à la Brennan (1993) is not supported for Tuvaluan. Furthermore, the Tuvaluan modal system is not fully polyfunctional in the sense of (van der Auwera et al. 2005). The modal verbs that express participant-external possibility, such as *mafai* and *maua*, cannot be used for epistemic modality. However the necessity modal *ttau* can be used for both participant-external and epistemic modality.

2.6.2 Combinations of modal items

Epistemic and participant-internal modality

Combinations of the epistemic modal adverb *kaati* (and of the other adverbs) with participant-internal modality yield the expected scope order: epistemic modality over participant-internal.

(197) a. Kaati e/koo iloa nee ia o faipati
           perhaps NPAST/INC know-how ERG 3SG COMP speak
           faka-Eelise
           in.way.of-Ellice
           'Mayhe s/he can speak Ellicean.'
       b. Kaati e/koo kkafi o kake laatou ki luga i te
           perhaps NPAST/INC capable COMP climb 3PL   to top at the
           niu   teelaa
           coconut.tree that
           'Maybe they are able to climb to the top of this coconut tree.'
       c. Kaati e/koo mafai o ffuti nee Vave te paala
           perhaps NPAST/INC can   COMP pull ERG Vave the kingfish
           teelaa
           that
           'Maybe Vave is able to catch that kingfish.'
       d. Kaati e/koo maua nee Vave o saasaale
           perhaps NPAST/INC can ERG Vave COMP walk
           'Maybe Vave is able to walk (already).'

The adverbs are sentential adverbs and therefore cannot scope under the modal verbs, when in the same (superordinate) clause. They are also rejected when used in the embedded clause as in (198).

(198) #E   kkafi   o   kaati   kake laatou ki luga i te
       NPAST capable COMP perhaps climb 3PL   to top at the
       niu   teelaa
       coconut.tree that

The same interpretation can be obtained with the epistemic modal verbs, as can
be seen with *iku, ailoga* and *taumate* in sentences (199-a), (199-b) and (199-c)
respectively.

(199)   a.   Vave   e   iku   o   iloa   (nee ia)   o   faipati
              Vave NPAST end-up COMP know-how ERG 3M.SG COMP speak
              faka-Eelise
              in.way.of-Ellice
              'Vave must be able to speak Ellicean.'
         b.   E   ailoga laa   laatou e   maua o   kake ki
              NPAST unlikely downtoner 3PL   NPAST can   COMP climb to
              luga i te niu   teelaa
              top   at the coconut.tree that
              'It's unlikely that they are able to climb to the top of this coconut
              tree.'
         c.   E   see taumate koo   kkafi   o   kake laatou ki luga i
              NPAST probable   PERF capable climb COMP 3PL   to top at
              te niu   teelaa
              the coconut.tree that
              'They are probably able to climb to the top of this coconut tree.'

It is however not possible to combine the modal verbs in the reverse order. The
ungrammaticality of the sentences is not due to syntactic issues (the raising modal
verbs can be combined) but is thus semantically motivated.

(200)   a. #E   iloa   nee ia o   ailoga   e   saasale
                NPAST know-how ERG 3SG COMP unlikely NPAST walk
         b. #E   kkafi   o   iku   o   saasale Vave
                NPAST capable COMP end-up COMP walk   Vave
         c. #E   maua nee Vave o   see taumate koo saasale
                NPAST can   ERG Vave COMP probable   INC walk

We can thus conclude that epistemic modals have scope over participant-external
ones.

Epistemic and participant-external modality

The first example, sentence (201), is a combination of the epistemic adverb *kaati*
with the mood marker *kee.* The sentence is judged strange (Besnier, pc) as it

combines a marker for direct command *kee* and a marker for uncertainty *kaati*.

(201)   ?Kaati   koe kee faipati kiaa Vave
         perhaps 2SG SBJ speak   to   Vave
         'Maybe you should speak to Vave.'

The 'strangeness' of sentence (201) is due to the performative nature of the mood marker. That is, the speaker expresses with *kee* his opinion that something should be done. The modal adverb, having scope over the mood marker, blurs the interpretation by expressing a different opinion of the speaker (uncertainty).

The epistemic adverbs can be used with the verbs expressing all the nuances of participant-external modality as in (202) with *ttau* and *maua* in their deontic interpretation (notice that the sentences would also be correct without negation). The interpretation is then following the usual scope order, i.e. the sentences express an uncertainty about some participant-external modal. The combinations are also accepted for goal-oriented modal verbs as sentence (202-c) shows.

(202)   a.   Kaati   koo see toe   ttau foki au o   toe   vau kkonei
               perhaps INC NEG again must also 1SG COMP again come to.here
               'Perhaps I shouldn't really come back here again.'
                                                    (Besnier 2000, (258) p46)
         b.   Kaati e/koo see   maua nee ia   o   aasi   atu
               perhaps NPAST /INC NEG   can ERG 3SG COMP visit DEIC
               'Maybe he is not allowed/able to visit (you).'
         c.   Kaafai e   fia   fano koe ki Tuvalu, kaati   koo ttau koe
               if   NPAST want go   2SG to Tuvalu perhaps INC must 2SG
               o   fano i   te   vaka nei
               COMP go   on the ship this
               'If you want to go to Tuvalu, maybe you'll have to board this ship.'

Finally, the adverb also combines with the modal verbs dedicated to deontic modality in the expected way, i.e. expressing an uncertainty over some permission or obligation.

(203)   a.   Kaati   e/koo talia nee ia   a   laatou kee mmai
               perhaps NPAST /INC allow ERG 3F.SG CNT   3PL SBJ   come
               'Maybe she does not allow them to come.'
         b.   Kaati e/koo   tapu   ia e   fano ki Amsterdam
               perhaps NPAST/INC forbidden 3SG NPAST go   to Amsterdam
               'Maybe he must not go to Amsterdam.'

The previous examples all show combinations involving the epistemic adverb. However similar combinations are also possible with the epistemic modal verbs *iku, ttau, see taumate* and *ailoga*.

(204)   a.   E   iku   e/koo   ttau ia o   fano ki Amsterdam
              NPAST end-up NPAST/INC must 3SG COMP go   to Amsterdam
              'He must have to go to Amsterdam.'

         b.   E   ttau see maua nee ia o   aasi atu
              NPAST must NEG can   ERG 3SG COMP visit DEIC
              'He must not be allowed to visit you.'

         c.   E   see taumate koo talia nee ia   a   laatou kee mmai
              NPAST probable   INC allow ERG 3F.SG CNT 3PL   SBJ come
              'She probably doesn't allow them to come.'

         d.   E   ailoga laa   laatou e   maua o   kake ki
              NPAST unlikely downtoner 3PL   NPAST can   COMP climb to
              luga i te niu   teelaa
              top at the coconut.tree that
              'It's unlikely that they are allowed/able to climb to the top of this
              coconut tree.'

The reverse order with a participant-external modal having scope over an epis-
temic modal verb is not possible. For instance, the modal verb *ttau* cannot scope
over the adverb *kaati* as in (205-a). Furthermore the mood marker cannot scope
over the epistemic modal verbs, as (205-b) and (205-c) show, and the participant-
external modal verbs cannot scope over the epistemic one, as (205-d) and (205-e)
show.

(205)   a.   #E   ttau ia o   kaati   fano ki Amsterdam
                  NPAST must 3SG COMP perhaps go   to Amsterdam

         b.   #Vave kee ailoga   e   faipati ki ei
                  Vave SBJ unlikely NPAST speak to ANP

         c.   #Kee iku   o   vaia   te penitiini
                  SBJ end-up COMP watery the benzene

         d.   #E   tapu   koe e   iku   o   faipati ki Vave
                  NPAST forbidden 2SG NPAST end-up COMP speak to Vave

         e.   #E   ttau koe o   see taumate koo faipati ki Vave
                  NPAST must 2SG COMP probable   INC speak to Vave

Finally, combinations involving an epistemic modal verb and a goal-oriented one
are interpreted with the first having scope over the second.

(206)   a.   Kaafai e   fia fano koe ki Tuvalu, e   see taumate koo
              if   NPAST want go   2SG to Tuvalu NPAST probable   INC
              ttau koe o   fano i te vaka nei
              must 2SG COMP go   on the ship this
              'If you want to go to Tuvalu, its probable you'll have to board this
              ship.'

b. #Kaafai e   fia   fano koe ki Tuvalu, koo ttau koe o
   if   NPAST want go   2SG to Tuvalu INC must 2SG COMP
   iku   o   fano i   te vaka nei
   end-up COMP go   on the ship this

Participant-external and internal modality

The last kind of combinations involve participant-external and internal modality. It also straightforwardly respects the scope order: external modal over internal one.

(207)   Koo ttau koe o   maua/mafai/iloa o   faipati faka-Eelise
        INC must 2SG COMP can   COMP speak Ellicean
        'You must be able to speak Ellicean.'

(208)   ?Koo ttau koe o   kkafi   o   kake ki luga i te niu
         INC must 2SG COMP capable COMP climb to top at the coconut.tree
         teelaa
         that
         'You must be capable of climbing to the top of that coconut tree.'

<div align="right">(Besnier 1988, (15a))</div>

The combinations involving a participant-internal modal verb having in its subordinate clause a participant-external verb are judged ungrammatical,

(209)   #E iloa/kkafi nee ia o ttau o faipati faka-Eelise

Conclusion

The scope order, epistemic > participant-external > participant-internal, is respected. The ungrammatical combinations of modal verbs are not ruled out on their syntactic properties but because of their interpretations.

2.7   Typological conclusions

There are a few points that we need to check. First it is time to assess whether the typology of modality of (van der Auwera and Plungian 1998) is supported by our data, in particular, if the distinction between participant-internal, participant-external and epistemic across a possibility/necessity divide makes sense. Of course, we will also address the problems of combination of modals and of polyfunctionality.

I will first detail the findings of the previous sections for each type of modality, then address the issue of the combination of modals and finally conclude with polyfunctionality.

2.7.1 Participant-internal modality

The category of participant-internal modality is a special one for several reasons. First, it has never been the center of attention in formal semantics (not as deontic of epistemic modality have been). Second, whereas the divide between possibility and necessity is quite clear for the other two categories, it is not obvious whether it is a relevant distinction for participant-internal modality (some have for instance argued that there is no dual to ability). I will now present the different shades of meaning that are covered by the term participant-internal.

Ability

Participant-internal possibility, or ability (for short), can be expressed from four different perspectives: as physical ability or disposition, as learned/acquired ability or know how, as circumstantial ability and finally as indeterminate between those three options, i.e. all-round ability.

All-round All-round ability is expressed by the following items: *kunnen* in Dutch, *sìxú, sìgán* in the Fongbe cluster, *ka-...-a* in Lillooet, *-(y)Abil* in Turkish and *mafai, maua* in Tuvaluan. It is the most general way to express that the participant can perform the action/accomplishment denoted by the verb phrase. All these modals can however express other types of participant-internal modality depending on the context or the type of the embedded verb phrase. Therefore, all-round modality is not so much a type as a non-specified reading expressing the ability to perform an action.

I would like to distinguish further between two types within this category even though the difference is not marked in the grammars of the languages at hand. The distinction is between generic and occasional abilities (Thomason 2005). Generic ability means that under some (not specified) conditions (i.e. opportunities) an action/accomplishment can be performed by the participant whereas occasional ability means that the action accomplishment can be performed under fixed and determined conditions.

Physical ability/disposition Although physical ability corresponds to the most basic meaning of participant-internal modality, it is difficult to explain precisely what it amounts to. The only modal items of our data set that are 'specialized' for physical ability are the Korean noun-verb combination *nŭnglyŏk issta* (literally 'capability exist'), the Turkish *kadir olmak* and *muktedir olmak* (*kadir* also means 'powerful, strong' and *muktedir* 'virile, potent') and the Tuvaluan modal *kkafi* (see example (176)). The special feature of the Tuvaluan modal verb is that it connotes an ability over which one has no explicit control (Besnier, pc).

(210)   I can walk.

Why is sentence (210) true? Mainly because I have two functioning legs and so if I want to walk, I just do it! Basically, the modal verb *kkafi* imposes in sentence (176) a very coarse granularity on the action 'climbing to the top of a coconut tree' and expresses that Niu can perform this action in virtue of having the inherent attributes to do so (namely, legs, arms, strength...).

Notice that a modal verb like the Gungbe *sìgán* based on the root *gan* 'power, force' was in the beginning a physical ability modal.

learned/acquired ability, know how   Learned ability and know how are the other basic type of participant-internal modality. The Fongbe cluster, Korean, Lillooet and Tuvaluan all have an item dedicated to this meaning. The difference between learned and acquired ability is not grammaticalized in any of the languages of the sample. Knowledge is usually considered as the basis of epistemic modality and not of participant-internal modality, but we are dealing with a special kind of knowledge: knowledge about (the execution of) actions. This suggests that a specific subpart of our knowledge is dedicated to actions (or more precisely to planning).[70]

However, just as for physical ability, learned and acquired abilities can be of a basic kind. There is therefore a distinction between learned abilities and know how. For instance, consider the fact that I can speak French. This is a typical example of acquired ability but at the same time I would be in much pain trying to explain how I do it. There is no sensible way to reduce 'speaking French' into smaller known parts that when combined form the ability to speak French. When the action can be seen as decomposable into smaller parts both learned/acquired and know how readings are possible.

Although this type of modality is a subtype of participant-internal possibility, it doesn't imply an all-round ability reading. This is illustrated by the following Gungbe example.

(211)   a.   Ùn nyɔ́n   wè   ɖú   amon ùn má sìgán ɖú   wè
             1SG know-PERF dance dance but   1SG NEG can   dance dance
             éhé dìn
             this now
             'I know how to dance but I can't dance now.'   [G] (Aboh, pc)
        b.   #Ùn sìgán ɖú   wè   amon ùn má nyɔ́n   wè   ɖú
             1SG can   dance dance but   1SG NEG know-PERF dance dance
             'I can dance but I don't know how to.'   [G] (Aboh, pc)

Sentence (211-a) shows that it is perfectly fine to know how to do something

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[70]That participant-internal modality has to do with planning was also suggested in (Thomason 2005): "We have a very robust intuition that abilities are important in planning; in most practical cases when we are concerned to know whether we can do something, it is so that we can fit it into a plan."

without being able to perform it. However, the interpretation of the all-round modal *sìgán* is restricted to a dispositional reading (for instance, I cannot dance because my back hurts) or to a circumstantial reading (for instance, I have no time). The other way around is not possible as is exemplified in sentence (211-b). That is, I cannot claim to be able to dance (this time in an all-round reading) and at the same time say that I don't know how to do it.[71] This means that all-round ability do entail the 'know how' to do it.

Why would a language like Fongbe develope a learned ability/know how modal, and not Dutch or Turkish? I think the answer is quite easily motivated by the etymology of both possibility modals: *sìgán* for Gungbe and *kunnen* for Dutch (*-(y)Abil* for Turkish). On the one hand, the Dutch modal originates from a verb meaning 'to have the mental capacity, to know'[72] (Van Ostaeyen and Nuyts 2004, (16) p21), thus from a verb expressing precisely this kind of meaning (Turkish *-(y)Abil* comes from the verbal root *bil* of the verb 'to know,' see (Kornfilt 1997, p374) and (Schiering 2006)). In the diachronic process, the verb acquired the other shades of meaning of participant-internal modality but its presence blocked the development of a specialized element as it was possible to express this meaning all along. On the other hand, The Gungbe modal *sìgán* originates from two components: a verb for *sí-* and a noun meaning 'power, force' for *-gán*. Therefore the modal developed from a physical ability meaning to a wide-range ability modal. However, in the early stages of the process, the learned ability meaning was not covered by the modal. It was thus possible to recruit an item for this meaning and naturally, the verb *nyɔ́* 'to know' was the obvious candidate.[73]

Circumstantial   Circumstantial readings are expressing that the action/event can be performed because of external factors. This does not mean that it should be qualified as participant-external modality. There are quite a few specialized items for this type of modality: Dutch *in staat zijn*, Korean *kil issta*, *yǒyu issta* and *yǒci issta*. The Dutch modal verb *kunnen* in sentence (212) is a typical example of a circumstantial reading of an all-round modal. The circumstantial reading is somehow forced by the use of the particles combination *wel even*.

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[71]Notice that if it can be made explicit that I don't know how to dance this particular dance, the sentence makes sense (and entails that I know how to dance some other dance).

(i)   Ùn sìgán ɖú   wè   amon ùn má   nyɔ́n   wè   éhé ɖú
         1SG can dance dance but   1SG NEG know-PERF dance this dance
         'I can dance but I don't know how to dance this particular dance.'   [G] (Aboh, pc)

[72]'*Mentale capaciteiten hebben, kennen.*'

[73]Of course, the development of the two Gungbe modal items can have been simultaneous.

(212) Ik kan je band wel even plakken maar ik weet niet
      1SG can.SG your tire PART PART fix but 1SG know.SG NEG
      hoe het moet.
      how 3N.SG must
      'I can/could fix your tire (now) but I don't know how to do it.'

This sentence makes clear that it is indeed possible to express that one has the circumstantial ability to do something (in this case, free time) without having the know how. Notice furthermore that although the Dutch language has no specialized modal for learned/know how ability, this meaning can be expressed through a construction involving the verb *weten* 'to know' (with the interesting use of the participant-external necessity *moeten*).

Participant-internal necessity

At first sight, it is difficult to distinguish participant-internal necessity from its participant-external counterpart. However, the Dutch, Fongbe, Korean and Lillooet languages all express this meaning. We can separate the four languages in two 'groups': first Dutch, Fongbe and Korean which use the same modal item for participant-internal necessity as for participant-external necessity (and more precisely goal-oriented modality) and second Lillooet which uses the same item for ability and participant-internal necessity.

The members of the first group do not have dedicated participant-internal necessity items and make use of their participant-external counterparts. This is probably the main reason why the reading is most often misinterpreted as participant-external modality. None of *moeten, ɖó-ná* and *-ya hanta* are specialized deontic items and therefore it seems fair to say that participant-internal necessity 'recruits' the modal items from goal-oriented modality. However, it is different from goal-oriented modality in that there is no goal to be reached. The following Dutch example should make this point clear.

(213) Jan moet plassen.
      John must.SG pee
      'John must pee.'

It has been argued by (Hackl 1998, 20-24) that the modal in sentences such as (213) containing an intentional agent (John) is not a dual of participant-internal possibility but is instead a goal-oriented modal.[74] The problem with this position is thus to determine which goal(s) is/(are) pursued by the agent. 'John pees in order to attenuate the pressure on his bladder' would be a possible candidate.

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[74]Actually, Hackl (1998, p22) argues that (within Kratzer's framework) the modal has a bouletic ordering source (which he describes with purpose clauses). Recent investigations form (von Fintel and Iatridou 2004), (von Stechow, Krasikova and Penka 2004) and others have showed that such a treatment does not work.

Therefore, as a volitional agent, John chooses to pee in situations where his bladder is full. Sentence (213) would thus be true just in case John's bladder is full. The main problem with this line of reasoning is that it conflates two relatively close but not equivalent notions related to the agent: volition and control.[75] The most natural reading of sentence (213) is that, independently of John's volition, he has no control over the situation.

(214)   Ik   hoef   niet te   plassen.
            1SG need.1SG NEG PREP pee
            'I don't need to pee.'

Sentence (214) shows that negation can take scope over the participant-internal necessity in which case the participant is in control of the situation. All in all, the similarity of the interpretation of participant-internal and -external necessity accounts for the difficulty to disambiguate the readings but it also points to the solution: participant-internal necessity occurs when the participant has no control over the situation and there is no external goal.

On the other hand, Lillooet uses the same circumfix *ka...a* for participant-internal possibility and necessity. Interestingly, this circumfix is also used to express an accidental/suddenly reading. That explains its usual gloss in the literature as 'out of control.'

(215)   a.   ka-ʕʷə́-s-kan-a   ta   nʕúy'ttən-a
              ka-burn-TR-1SG-a DET bed-DET
              'I accidentally set my bed on fire.'   (Davis et al. 2006, (48a))
   b.   ka-q'ək'ʷč-kán-a
              ka-close.mouth-1SG-a
              'My mouth got closed suddenly.'   (Davis et al. 2006, (49a))

The 'out of control' reading of the circumfix is not exactly equivalent to the participant-internal necessity of the other group. It cannot be used for future events in which case Lillooet speakers select an auxiliary with the meaning 'going to.' Basically, If I predict that something is going to happen in the (near) future, it cannot be happening accidentally/suddenly. However a necessity reading is perfectly fine for generic events or past situations.

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[75]The notion of control is grammaticalized in some languages. In Lillooet, for instance, the directive transitivizer *-ən* indicates that the agent has "full control over the action denoted by the verb" (Demirdache 1997, p101) (this is also the case for some intransitivizers). The important point is that the directive suffix cannot combine with the participant-internal circumfix. In Central Pomo (Mithun 1991, p519-520) the case marking of pronouns distinguishes between a patient-case pronoun and an agent-case pronoun. Unsurprisingly, verbs like hiccough, sneeze, vomit or choke take a patient-case pronoun marking lack of control.

Conclusion

The most important conclusion is that participant-internal modality definitely deserves to be a modality type of its own. Foremost because all languages have specialized participant-internal elements which would support the status of this category as an independent one. Notice however that there is no specialized modal for participant-internal necessity (the default participant-internal reading of the Lillooet circumfix *ka...a* being ability). Finally all languages except Lillooet have participant-internal modals that are used for other purposes.

2.7.2 Participant-external modality

The first remark about this category is that it can be split up in two main parts: deontic modality and goal-oriented modality. The languages of the sample have modal items used for both types.[76]

Deontic modality

	Permission	Obligation	Prohibition
Dutch	*mogen, toegestaan*	*verplicht*	*verboden*
Fongbe		*ní, dándán*	
Korean	*-to/myŏn cohta, hŏka issta*	*-ci anhŭmyŏn an toeta, ponpun ita*	
Lillooet	*nliʕʼ^{w}c, nx^{w}ʔan'*	*x^{w}əcʼən*	
Turkish	*izin verilmek*		*yasak olmak*
Tuvaluan	*saoloto, taga*	*kee*	*tapu*

Figure 2.7: Specialized items for deontic modality

As figure 2.8 shows, the following meanings are grammaticalized in the sample: permission with for example *mogen* in Dutch or *taga* in Tuvaluan; obligation with for instance the Fongbe mood marker *ní* or the noun verb combination *ponpun ita* in Korean; prohibition with Dutch *verboden* and Tuvaluan *tapu*.

The negation is standardly interpreted as having wide scope over permission whereas it can scope either under or above modals of obligation (though one modal item cannot do both).

Two noticeable features are the Korean 'conditional' construction of deontic modality and the Lillooet enclitic *-ka* which can express both obligation and permission.

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[76]Although in regard to this point, the evidence of a use of the Lillooet deontic marker for goal-oriented readings is not decisive.

Goal-oriented modality

This type of modality has to do with planning and as such is also closely related to participant-internal modality. The goal is quite often expressed through a purpose clause or a want-conditional but when the context is clear, it does not have to be overtly realized.

Most goal-oriented systems (Dutch, Fongbe cluster, Turkish, Tuvaluan) have both a possibility and a necessity variant within the modal system. This is not the case for Korean which standardly uses a polite imperative in the possibility case. Finally, I have not found any evidence of a possibility reading in Lillooet.

Control vs raising

It has sometimes been argued in the literature[77] that there should be a distinction made in the English modal system between the raising modal verbs (epistemic and some deontic) and the control modal verbs (participant-internal and external).[78] Two languages of this sample definitely resist this kind of analysis of modal verbs: Dutch and Tuvaluan. First, Dutch deontic modals allow a non-verbal complement which is usually associated with raising constructions (Barbiers 2006, (36b)):

(216)   Jan mag   weg.
          John may.SG away
          'John is allowed to leave.'

This example would however fall under the control analysis of (Brennan 1993). Furthermore, although the behavior of participant-internal modals in English was an important motivation for a control analysis, their Tuvaluan counterparts (as well as most other Tuvaluan modals) are raising verbs:

(217)   'Niu is capable of climbing to the top of the coconut tree.'

                                                        (Besnier 1988, (10a-b))

          a. E   kkafi [o   kake Niu ki luga i te niu
              NPAST capable   COMP climb Niu to top at the coconut.tree
              teelaa]
              that
          b. E   kkafi nee Niu [o   kake ki luga i te niu
              NPAST capable ERG Niu   COMP climb to top at the coconut.tree
              teelaa]
              that

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[77](Jackendoff 1972), (Brennan 1993).

[78]Note that this analysis of English modal verbs has been criticized by among others (Wurmbrand 1999) and (Barbiers 2006).

2.7.3 Epistemic modality

One of the unifying features of the epistemic type is that all the languages have at least one adverb for epistemic possibility. Furthermore, those modal adverbs are strictly epistemic.

Dutch	Fongbe	Korean	Lillooet	Turkish	Tuvaluan
misschien	*bɔ̀yà*	*ama*	*sx̌ək*	*herhalde*	*kaati*
wellicht	*vlàfò*	*ŏccŏmyŏn*		*belki*	
mogelijk		*hoksi*		*galiba*	

As for the other type of modality, the Lillooet epistemic enclitic *-ka* is able to express both necessity (by default) and possibility. This behavior is also attested for the Korean *kŏs ita*.

Finally it is interesting to notice that the distinction between possibility and necessity is probably less relevant for epistemic than for the participant-external modality. As I have just mentioned all languages have an adverb for epistemic possibility, but this is not the case for epistemic necessity. Furthermore, epistemic necessity seems to be closely related to evidentiality (in particular to inferential readings). The Turkish suffix *-mIş* can for instance be used as inferential (not based on direct evidence), and this is the core meaning of the Lillooet enclitic *-an'* (based on direct evidence). It has also been argued by (de Haan 2000) that the Dutch modal verb *moeten* can also have an evidential reading.

2.7.4 Combinations of modal items

Although not all logically possible combinations have been tested, the languages of the sample exemplify the following scope order:

Proposition 2.7.1. When in a grammatical sentence two modal items are present in the same clause [modal1 modal2] or in a subordinating construction [modal1 [modal 2]], the interpretation necessarily follows the scope order:

<div style="text-align:center">Epistemic > Participant-external > Participant-internal</div>

I will work under the assumption that the remaining combinations also validate this scope order.

2.7.5 Polyfunctionality

The problem of polyfunctionality has been investigated from a cross-linguistic perspective in (van der Auwera et al. 2005).[79] In this study, 241 languages (with a sample bias for European languages) have been examined and a distinction has been established between three way categories of languages:

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[79] I would like to thank Johan van der Auwera for pointing this out to me.

1. Fully polyfunctional: the language contains at least one polyfunctional possibility modal and one polyfunctional necessity modal.

2. Partially polyfunctional: the language contains a polyfunctional modal for either possibility or necessity but not both.

3. Not polyfunctional: there is no polyfunctional modal in the language.

Concerning the sample of six languages of this dissertation, we can conclude the following: Dutch, the Fongbe cluster and Turkish qualify as full polyfunctional languages whereas Lillooet is a not polyfunctional at all. Two languages are semi-polyfunctional: Korean and Tuvaluan (the first has a polyfunctional possibility modal *su issta*, the second a necessity one *ttau*). So far we can only conclude that

Full	Semi	None
Dutch	Korean	Lillooet
Fongbe cluster	Tuvaluan	
Turkish		

Figure 2.8: Polyfunctionality in the languages of the sample

although polyfunctionality would seem to be more represented in our sample, it is by no means a norm. I will therefore present the results of (van der Auwera et al. 2005, table 2 p255) in order to get a better cross-linguistic picture of this topic.

	Number of languages
Fully polyfunctional	49
Partially polyfunctional	54
Not polyfunctional	123

The table makes clear that more than half of the languages of the sample do not display any polyfunctionality. Actually this can be contrasted with the data from (Haspelmath, Dryer, Gil and Comrie 2005, Interactive Reference Tool) for the Indo-European family.

	Number of languages
Fully polyfunctional	21
Partially polyfunctional	8
Not polyfunctional	3

We can thus conclude with (van der Auwera et al. 2005) that polyfunctionality is typical of European languages (the three non-polyfunctional languages are not

European). All this confirms the fact that polyfunctionality is not a universal feature of modal systems and that a separation of the epistemic and participant realms is supported.

Chapter 3

Formal semantics of modality

The analysis developed by Kratzer in (Kratzer 1978, Kratzer 1981, Kratzer 1991) is probably the most influential analysis of modality within the field of formal semantics. Its impact is still present in a lot of recent work on modality. The backbone of the theory uses some intuitions and tools from modal logic and adapts them to the analysis of the semantics of modal elements. In this chapter, I will first explain the main ideas of this theory of modality and then present some interesting extensions.

3.1   Kratzer's semantics of modality

The goal of (Kratzer 1981) is to present a unified analysis of the *notional category of modality* as used in German.[1] It is quite important to understand the different meanings of *unified* in the previous sentence. Kratzer aims at providing an analysis of modality that, at the same time, clarifies the relation between modality and conditional sentences and analyzes the *means of grading and comparing possibilities* (Kratzer 1981, 290) in natural language. This is one way of interpreting *unified*. However, the most important way in which the analysis can be said to be unifying is in its ability to analyze the different types of modality (say epistemic, deontic, dynamic) in a uniform way.

   One could ask why we would like to analyze those different classes of meanings, i.e. epistemic, deontic and dynamic, in a uniform way. This is actually asking why we should treat all the members of the category of modality in a uniform fashion. Part of the answer lies in the fact that they apparently do share some shades of meaning. For instance, the category of modality has something to do with the

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[1]The formal framework, however, is not language specific and has been therefore used by Kratzer and others for the analysis of modality in many other languages. The fact that there is no syntactic category corresponding to modality does not however make this framework syntax-neutral in its vision of modality: modal elements are analyzed as modal verbs.

concepts of possibility and necessity.[2] A probably more important incentive for a unified analysis is the fact that modal verbs in German, as in English, can receive different interpretations in different utterances as exemplified in the following sentences from (von Fintel 2006, p2) with the semi-modal *have to*:

(1)   a.   It has to be raining.
             [after observing people coming inside with wet umbrellas; epistemic]
         b.   Visitors have to leave by six pm.   [hospital regulations; deontic]
         c.   You have to go to bed in ten minutes.   [stern father; bouletic]
         d.   I have to sneeze.[given the current state of ones nose; circumstantial]
         e.   To get home in time, you have to take a taxi.   [telelological]

All this would suggest that a unified analysis is called for.

3.1.1   Relative modality

The core insight of Kratzer's theory is that modals are **not ambiguous but context-dependent**. For instance, the modal *have to* in sentence (1) is interpreted epistemically in context 1, whereas in context 2 it is interpreted deontically. The main thread from (Kratzer 1978), (Kratzer 1981) and (Kratzer 1991) is that the apparent ambiguity or polysemy of *have to* in the sentences of (1) is a consequence of the context dependent nature of modal verbs. The formalization of this idea in Kratzer's analysis leads to the following logical form:

(2)   Operator [intensional context *b*] [proposition]

Namely, all the examples in (1) have in common the following three ingredients:

1. A (neutral) **operator**, i.e. the modal verb: *have to.*

2. An **intensional context**: in example (1-a) this context would probably have two parts, a factual part, "people come inside with wet umbrellas," and a normative world knowledge part "when umbrellas are wet, it is raining."

3. A proposition in the **nuclear scope** of the modal verb: "It is raining" in sentence (1-a).

The logical form of (2) will serve as the basis for the interpretation of the different types of modality. Modals are thus conceived as generalized quantifiers, that is, they are operators relativized by an intensional contextual parameter and with a sentence/proposition in their nuclear scope. The operator determines the modal force (which is encoded in the modal item) of the proposition. For instance, the

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[2]Or even more specifically with both at the same time, see (van der Auwera and Plungian 1998, 80): "We propose to use the term "modality" for those semantic domains that involve possibility and necessity as paradigmatic variants, that is, as constituting a paradigm with two possible choices, possibility and necessity."

modal verb *must* has universal force, i.e. it expresses necessity, whereas *may* is existential, i.e. it expresses possibility. However the operator itself does not encode the type of modality expressed. This parameter is fixed by the contextually determined conversational background b.[3] But the role of the conversational background is also to fix the premises against which the modal operates. Therefore the context-dependence analysis rests on two major assumptions:

1. There are such things as neutral modals.

2. There are such things as conversational backgrounds.

Both points are linked and I'll explain the argument of (Kratzer 1991) with the help of the following sentences.

(3)   Kratzer (1991, (5) p639)
   a.   Jockl must have been the murderer.
   b.   In view of the available evidence, Jockl must have been the murderer.

(4)   Kratzer (1991, (6) p640)
   a.   Jockl must go to jail.
   b.   In view of what the law provides, Jockl must go to jail.

According to Kratzer, the paraphrases (3-b) and (4-b) of sentences (3-a) and (4-a) show that neutral modals exist. The paraphrases consist of an "in view of..." adverbial phrase and a 'must' sentence. These 'must' are of course modal items, but of what kind? Kratzer argues that they are neutral modals. Basically, if they were the same as the common types of modals (epistemic, deontic...), we would be able to paraphrase them too; but the first adverbial phrase would then be redundant. Hence the 'must' in both paraphrases are actually one and the same object: a neutral modal. Furthermore, this neutral modal is not ambiguous but genuinely neutral in that its type is specified by the "in view of..." adverbial phrase: an epistemic one in (3-b), a deontic one in (4-b).

   The difference between a neutral and a non-neutral modal is that the non-neutral one does not require a specific adverbial phrase and is therefore open to different interpretations. This piece of information can be provided by the context of use. If we look again at the logical form in (2), the operator is thus a neutral modal determining the modal force of the proposition but which needs a conversational background to fix its interpretation. The conversational background determines the type of modality expressed.

   Thus modal sentences need a (contextually given) conversational background to express a proposition. The conversational background corresponds to a set of

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[3]Here I go against the notational tradition of using f to denote the conversational background. The b will also stand for modal base when I will introduce the other kind of conversational background, the ordering source o.

propositions from which a conclusion is drawn, i.e. in example (3-a), the propositions of the conversational background are about the 'available evidence' in the murder case at hand: "*Jockl's fingerprints are on the murder weapon*", "*Jockl was at the crime's place at the time of the murder*", etc. . . This evidence depends on the context, or world, we're in. In other circumstances the "available evidence" might have been different. To formalize those ideas I need to introduce some notions from possible-worlds semantics. This framework in its traditional form is a truth-conditional framework, that is, it embraces the slogan "*you know the meaning of a sentence if you know the conditions under which it is true.*" Possible worlds semantics offers a way to formalize this intuitive idea. Basically, we will identify propositions with the set of possible worlds in which they are true.

Definition 3.1.1. Let W be the set of possible worlds. A proposition is a subset of W, that is, a proposition is a set of worlds. The set of all propositions is $\mathcal{P}(W)$.

Let $[\![\varphi]\!]$ be the proposition expressed by sentence φ (where φ is a formula without modal operators) and w a possible world ($w \in W$) then,[4]

> *sentence φ is true in w*   iff   *w is an element of $[\![\varphi]\!]$, i.e. $w \in [\![\varphi]\!]$.*

This means that once we postulate the possible worlds, we can define propositions in terms of them.[5] Suppose, for example, that there are only three different possible worlds w_1, w_2 and w_3, i.e. $W = \{w_1, w_2, w_3\}$. Then $p = \{w_2, w_3\}$ is a proposition, as it is a subset of W. It is furthermore the proposition that is true in w_2 and w_3 but false in w_1.

> *sentence φ is false in w*   iff   *w is not an element of $[\![\varphi]\!]$, i.e. $w \notin [\![\varphi]\!]$*
>   iff   *sentence $\neg\varphi$ is true in w, i.e. $w \in [\![\neg\varphi]\!]$.*

Conversational backgrounds stand for the "in view of" adverbial phrases. For instance, "in view of what we know" is an epistemic conversational background. It is dependent on which world we are in. We may after all not know the same things in different worlds. However, what we know in some particular world will be some propositions, i.e "*Jockl's fingerprints are on the murder weapon*" and "*Jockl was at the crime's place at the time of the murder.*" Therefore conversational backgrounds are best formalized as functions from possible worlds into sets of propositions.

Definition 3.1.2. A conversational background is a function from possible worlds to sets of propositions:[6]

$$b : W \rightarrow \mathcal{P}(\mathcal{P}(W))$$

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[4]Here and throughout, "iff" stands for *if and only if.*

[5]It is also possible to go the other way around and postulate first propositions and then define worlds.

[6]$\mathcal{P}(\mathcal{P}(W))$ corresponds to the set of sets of propositions.

In the murder investigation world w, the conversational background "what we know" is $b(w) = \{$Jockl's fingerprints are on the murder weapon, Jockl was at the crime's place at the time of the murder$\}$. Sometimes the conversational background is explicit in the form of a "in view of" adverbial phrase. However it is most of the time not expressed explicitly and is therefore provided by the context. How this precisely works is, in the standard framework, left unresolved.[7] Notice that a sentence which does not involve any modal operator does not need a contextually provided conversational background.

Definition 3.1.3. $[\![\varphi]\!]^b$ denotes the proposition expressed by sentence φ in the context of the conversational background b. Furthermore, if φ does not contain a modal operator, then for all conversational backgrounds b and b', $[\![\varphi]\!]^b = [\![\varphi]\!]^{b'}$. Therefore, when a sentence does not contain any modal operator, we can drop the superscript and use $[\![\varphi]\!]$.

Definition 3.1.4. Logical consequence and logical compatibility:

- A proposition p **follows from** a set of propositions Σ iff p is true in all the worlds where all the propositions of Σ are true.

- A proposition p is **compatible with** a set of propositions Σ iff there is a world where p and all the propositions of Σ are true.

We can now define the neutral necessity and possibility modals.

Definition 3.1.5. Let b be a conversational background, φ a non-modal sentence. *Nec* and *Poss* are the neutral modal operators of, respectively, necessity and possibility. They are defined as follows: for all worlds $w \in W$,

$$w \in [\![\text{Nec } \varphi]\!]^b \quad \text{iff} \quad [\![\varphi]\!] \text{ follows from } b(w),$$

that is, the sentence Nec φ is true in world w given the conversational background b if and only if φ is true in all worlds where all the propositions of $b(w)$ are true.

$$w \in [\![\text{Poss } \varphi]\!]^b \quad \text{iff} \quad [\![\varphi]\!] \text{ is compatible with } b(w),$$

that is, the sentence Poss φ is true in world w given the conversational background b if and only if there is a world where φ and all the propositions of $b(w)$ are true.

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[7]Kratzer (1981, p311) proposes that some rule of accommodation takes care of this problem. She refers to this process as "black magic". Frank (1997) provides a way out of the black magic by formalizing the context-dependence of conversational backgrounds within a Discourse Representation Theory framework.

Accessibility relation based on a conversational background

Another way to grasp the previous definitions is to look at the conversational background b in a slightly different way, namely, as determining a set of accessible possible worlds. A conversational background b is a function from worlds to sets of propositions, hence in a world w, $b(w)$ is a set of propositions (representing for instance "what is known", "what the law provides", etc. . .). The set of propositions $b(w)$ uniquely determines a set of accessible worlds in the following manner:

Definition 3.1.6. Let b be a conversational background and w a world. The set of worlds **accessible** from a world $w \in W$ according to b is $\cap b(w)$, i.e. the set of worlds such that if world $v \in W$ belongs to $\cap b(w)$ then all the propositions of $b(w)$ are true in v.[8]

It is then possible to define an accessibility relation R_b given a conversational background b and to reformulate definition 3.1.5 accordingly.

Definition 3.1.7. Let b be a conversational background and φ a non-modal sentence. For all $w, w' \in W$:

- wR_bw' iff $w' \in \cap b(w)$, which means that a world w' is accessible from a world w if and only if all the propositions of $b(w)$ are true in w'.

- $w \in [\![\text{Nec } \varphi]\!]^b$ iff for all w' such that wR_bw', φ is true in w', which means that a proposition is a necessity if it is true in all accessible possible worlds.

- $w \in [\![\text{Poss } \varphi]\!]^b$ iff there is a w' such that wR_bw' and φ is true in w', which means that a proposition is a possibility if it is true in some accessible possible world.

Problem

A serious problem with the analysis so far is that propositions with a necessity modal like 'must' turn out stronger than simple propositions (under the assumption that the accessibility relation is based on knowledge).[9] Knowledge is veridical, therefore if in world w I know that p, proposition p is true in w. Hence, if an epistemic conversational background b models what the agent knows about the world he is in (partial information), all the propositions in $b(w)$ are true in w; in the "accessibility version", w is always accessible from itself, i.e. the relation R_b is reflexive.

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[8]$b(w) = \{p_1, p_2, p_3, \cdots\}$ with $p_1, p_2, \ldots$ propositions, i.e sets of worlds.
Therefore $\cap b(w) = p_1 \cap p_2 \cap p_3 \cdots = \{v \in W : v \in p_1 \& v \in p_2 \& \cdots\}$, i.e. if v belongs to $\cap b(w)$ then p_1, p_2, etc. . . are true in v.
[9]This was already noticed in (Karttunen 1972, p12-13).

(5)   a.   Jockl must be the murderer.
       b.   Jockl is the murderer.

However, it seems that (5-b) is a somewhat stronger sentence than (5-a). Under the previous analysis the proposition expressed by sentence (5-a) entails the one expressed by sentence (5-b). That is, if sentence (5-a) is true in, say w, then in all accessible worlds from w sentence (5-b) is true, but w is accessible from w, hence sentence (5-b) is true in w. This is clearly not a desirable feature of a theory of epistemic modality.

3.1.2   Double relativity

The analysis in terms of a conversational background is not powerful enough to account for the meaning of modality. In order to remedy this problem, Kratzer (1981) proposes to represent the meaning of modality with not one, but two conversational backgrounds. The first one will be called the modal base: it has the same function as the conversational backgrounds in the previous section, that is, it determines a set of accessible possible worlds. The second conversational background will be used to provide an ordering of the accessible worlds and is therefore called an ordering source o. We must now define how a set of propositions, call it O, can order worlds. This is done by defining a partial order $\leqslant_O$ based on O in the following way:

Definition 3.1.8. For all w, $w' \in W$,

$$w \leqslant_O w' \quad \text{iff} \quad \{p : p \in O \ \& \ w' \in p\} \subseteq \{p : p \in O \ \& \ w \in p\}, \ and$$
$$w <_O w' \quad \text{iff} \quad w \leqslant_O w' \ and \ w' \nleqslant_O w$$

The partial order $\leqslant_O$ orders the worlds with respect to their compliance with the propositions in O, i.e. $\{p : p \in O \ \& \ w \in p\}$ is the set of propositions of O that are true in world w. Hence a world w is at least as close to O as a world w' if and only if all the propositions from O that are true in w' are also true in w. Finally a world w is (strictly) closer to O than a world w' if and only if w is at least as close to O as w' but w' is not at least as close to O as w.

Example 3.1.9. Let O be the set containing the following propositions: $p_1 =$ "you have a driving license", $p_2 =$ "your car is insured" and $p_3 =$ "you have less than half a gram alcohol per liter blood", $O = \{p_1, p_2, p_3\}$.

We can distinguish 8 different types/sets of worlds in terms of these 3 propositions.[10] For instance, world w_4 is the world where you don't have a driving license but your car is insured and you are sober. The 0 in figure 3.1 means that

---

[10]To simplify the discussion I will talk directly of worlds (see figure 3.1). However, it should remain clear that a world like w_2 is just a representative of the set of worlds that make propositions p_1 and p_3 true and p_2 false.

	p_1	p_2	p_3
w_0	1	1	1
w_1	1	1	0
w_2	1	0	1
w_3	1	0	0
w_4	0	1	1
w_5	0	1	0
w_6	0	0	1
w_7	0	0	0

Figure 3.1: Possible worlds that can be distinguished in terms of 3 propositions

w_4, for instance, does not belong to p_1 (therefore p_1 is false in w_4), and the 1s mean that w_4 belongs to p_2 and p_3 (and thus both propositions are true in w_4).

We have for instance that $w_2 \leqslant_O w_6$, i.e. a world such as w_2, where the only deviance from the norm O is that your car is not insured, is closer to O than a world where your car is not insured and you don't have a driving license. Formally,

$$\{p : p \in O \ \& \ w_6 \in p\} = \{p_3\} \subseteq \{p : p \in O \ \& \ w_2 \in p\} = \{p_1, p_3\}.$$

Notice finally that the ordering is partial, that is, the worlds w_1 and w_2 cannot be ordered by $\leqslant_O$: driving drunk does not comply more with O than driving without insurance, nor vice versa.

The choice of propositions in example 3.1.9 is of course not random. The propositions express rules to be followed by anyone who respects the regulations for driving a car: the deontic conversational background "what the driving laws provide". This conversational background functions as an ordering source and thus orders the accessible worlds according to their compliance with its propositions.

From now on, modals will be relative to two conversational backgrounds: the modal base b (determining the set of accessible worlds for each world) and the ordering source o (ordering the set of accessible worlds),

- modal base $b : W \to \mathcal{P}(\mathcal{P}(W))$ determines a set of propositions and thus the accessible worlds $\cap b(w)$ from any $w \in W$,

- ordering source $o : W \to \mathcal{P}(\mathcal{P}(W))$ determines the partial order $\leqslant_{o(w)}$ based on the propositions in $o(w)$.

We must now reformulate definition 3.1.5 to account for this double dependency. I will first give Kratzer's original definition of necessity and possibility (definitions 3.1.10 and 3.1.11) and then introduce a simplified version.

Definition 3.1.10. (Kratzer 1991, p644):

A proposition p is a **necessity** in a world w with respect to a modal base b and an ordering source o iff the following condition is satisfied: for all $u \in \cap b(w)$ there is a $v \in \cap b(w)$ such that

1. $v \leqslant_{o(w)} u$ and

2. for all $z \in \cap b(w)$: if $z \leqslant_{o(w)} v$, then $z \in p$.

Definition 3.1.11. (Kratzer 1991, p644):

A proposition p is a **possibility** in a world w with respect to a modal base b and an ordering source o iff the negation of p is not a necessity in w with respect to b and o, i.e. iff the following condition is satisfied: there is a $u \in \cap b(w)$ such that for all $v \in \cap b(w)$, if $v \leqslant_{o(w)} u$ then there is a $z \in \cap b(w)$ such that $z \leqslant_{o(w)} v$ and $z \in p$.

To summarize, all modal items are analyzed as quantifiers over possible worlds. Which worlds are to be quantified over is contextually determined: only the "closest" accessible worlds according to the ordering source are considered. However the definitions don't capture the notion of "closest" possible world directly, as such worlds may not exist, and they therefore remain quite complicated. I will now present a simplification of those definitions.

Definition 3.1.12. Take a modal base b, an ordering source o and a world $w \in W$, then the closest accessible worlds from w are the elements of the set $C^{b,o}(w)$ with,

$$C^{b,o}(w) = \{u \in \cap b(w) : \ for \ all \ v \in \cap b(w), \ if \ v \leqslant_{o(w)} u \ then \ u \leqslant_{o(w)} v\}$$

Notice that, if the ordering source is empty, the closest worlds are just the accessible worlds, i.e. $C^{b,\emptyset}(w) = \cap b(w)$.

The problem is that the set $C^{b,o}(w)$ can be empty for some conversational backgrounds b and o and world w.

$$C^{b,o}(w) = \emptyset \ \ iff \ \ for \ all \ u \in \cap b(w), \ there \ is \ a \ v \in \cap b(w) \ such \ that \ v <_{o(w)} u$$

This means that, for instance, the set of closest worlds is empty in case all the accessible worlds are members of an infinite descending chain ordered by $o(w)$ (with $\bullet$ being a placeholder for some possible world),

$$\cdots <_{o(w)} \bullet <_{o(w)} \bullet <_{o(w)} \bullet$$

We can however assume without much loss of generality that such a situation will not occur (the Limit Assumption (Lewis 1973, p19)) and that therefore the set of closest accessible worlds from a world will be non-empty and uniquely determined by a modal base and an ordering source. The examples I will cover in this dissertation do not involve an infinity of worlds, or at least not an infinity of propositions in the ordering source. The assumption is thus harmless. Finally, the definition for necessity and possibility will be the following:

Definition 3.1.13. Let b and o be two conversational backgrounds and φ a sentence. For all $w \in W$:

- $w \in [\![\text{Nec } \varphi]\!]^{b,o}$ iff for all $u \in C^{b,o}(w)$, $u \in [\![\varphi]\!]^{b,o}$.
  A proposition is a necessity if and only if it is true in all the closest worlds.

- $w \in [\![\text{Poss } \varphi]\!]^{b,o}$ iff there is a $u \in C^{b,o}(w)$, $u \in [\![\varphi]\!]^{b,o}$.
  A proposition is a possibility if and only if it is true in (at least) one of the closest worlds.

Restrictions on conversational backgrounds

The definitions in 3.1.13 do not explain how modals end up being interpreted as belonging to a particular interpretive class, say deontic or epistemic. In the simple version of the formalism (with only one conversational background), it was quite straightforward: the conversational background determined the type of modality. We now have a modal base and ordering source. According to Kratzer, modal bases come in essentially two flavours: epistemic and circumstantial, and both types of modal bases are realistic, i.e. "they assign to every possible world a set of facts of that world" (Kratzer 1991, p646).[11]

Modal base b	Ordering source o	Interpretive class
Epistemic	empty	epistemic
"what is known"	stereotypical:	epistemic
	"what is normal"	(1-a)
	"the normal course of events"	
Circumstantial	"what the law provides"	deontic
"the relevant	"the hospital regulations"	deontic: (1-b)
circumstances"	"My mother's orders"	deontic
	"what I/you/they want"	bouletic: (1-c)
	(possibly empty) stereotypical	circumstantial: (1-d)
	"what your/our/their goals are"	teleological: (1-e)

Figure 3.2: Modal base, ordering source and modality type.

- Circumstantial modal bases assign to any world w certain relevant facts of w.

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[11] As the terminology should make clear, the epistemic modal bases will induce an epistemic interpretation given the adequate ordering source. The circumstantial modal bases will induce the other types of modality.

- Epistemic modal bases are about knowledge and the available evidence but come in a number of different flavours: "what I know", "what Bill knows", "what the weatherman said".[12]

The ordering sources restrict the accessible worlds determined by the modal bases and determine the closest of the accessible worlds. Note that the previous table is not meant as an exhaustive list of the possibilities of combination but just as an example of the most common types of modality.

3.1.3 Example

As we have seen, one of the problems of the analysis with only one conversational background is that 'must' turns out to express something stronger than expected, i.e. (5-a) implies that Jockl is the murderer.

(5-a)   Jockl must be the murderer.

Imagine the following context preceding the utterance of (5-a):

Example 3.1.14. You are investigating a murder case with your assistant. So far, the only suspect is a man named Jockl. He has no alibi at the time of the murder and was arrested in proximity to the crime scene. Your assistant comes rushing in your office with the results of the analysis of the murder weapon (which was also found in the neighborhood): the fingerprints match Jockl's. You say (5-a) to your assistant with the satisfaction of a job well done.

The modal in (5-a) is naturally interpreted epistemically. This is because the context provided by example 3.1.14 is an epistemic modal base of the kind "what we know about the murder" containing the following propositions (in the world of evaluation):[13]

(6)   "Jockl has no alibi": ¬*alibi*,
       "Jockl was arrested near the crime scene": *scene*,
       "Jockl's fingerprints are on the murder's weapon": *fingerprint*.[14]

---

[12]I think that the commitment to realistic modal bases for epistemic modality is too strong. Epistemic modals are unfortunately not always about knowledge (realistic) but can also be about beliefs (which need not be veridical).

(i)   In view of what the Bible teaches, the sun must revolve around the earth.

Well, according to modern day astronomy, it goes the other way around. However, I'd like to call the interpretation of the above example epistemic, even though the modal base is not realistic. The sentence expresses an inference based on some piece of information.

[13]Basically the modal base contains the investigators' knowledge of the particular circumstances of the crime. In this respect, the difference made between epistemic and circumstantial modal bases seem quite tenuous.

[14]¬*alibi*, *scene* and *fingerprint* are meant to stand for the propositions expressed by the sentences.

Furthermore we entertain along with this epistemic modal base, a stereotypical ordering source of the kind "what is normal/typical in a murder case." A good candidate proposition, that is, a proposition qualifying as typical of this kind of situations, could be:

(7)   "if [you are arrested near to the crime scene, your fingerprints are on the murder weapon and you don't have an alibi], then you're the murderer."
         $scene \wedge fingerprint \wedge \neg alibi \rightarrow murderer$

First notice that the ordering source is crucial to avoid the undesirable inference, that is, if the ordering source is empty, *must p* does imply *p*. The two relevant questions then are: what kind of worlds are the closest accessible worlds? Is it the case that in all those worlds Jockl is the murderer? First, the accessible worlds are worlds that comply with the propositions of (6).

$$\cap b(w) = \{v \in W \mid v \notin alibi, \ v \in scene, \ v \in fingerprint\}$$

The ordering source (7) contains only one proposition;[15] the closest worlds are thus the worlds of $\cap b(w)$ that make this proposition true. But the worlds in $\cap b(w)$ make the antecedent of (7) true, therefore the closest worlds are the ones that make the consequent true too. The closest worlds are thus worlds where Jockl is the murderer!

$$C^{b,o}(w) = \{u \in \cap b(w) \mid u \in murderer\}$$

However that does not imply that Jockl is the murderer. Suppose, for instance, that the fingerprint evidence was actually forged and that Jockl is not the murderer. Still, the modal base (6) represents what the researcher knows in this world. From this evidence and the normalcy conditions of the ordering source, the officer can truthfully conclude that Jockl must indeed be the murderer, even though *we* know better.

The situation is unfortunately not so simple as it seems. A much more complex machinery is needed to account for the normalcy conditions of the ordering source.[16] In particular, the notion of normality usually goes hand in hand with non-monotonicity: although the officer's conclusion based on the modal base (6) and the ordering source (7) seems intuitively correct, it would not be so anymore if he were to learn that the evidence had been forged. The new modal base corresponding to "what the officer knows" would be:

$$b'(w) = \{\neg alibi, \ scene, \ fingerprint, \ forged\}$$

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[15]The correct formulation should be: the ordering source (same thing for the modal base) relative to the world of the investigation contains only one proposition. I tend not to mention the world parameter when it is not absolutely needed.

[16]To appreciate the amount of work needed in formalizing these issues, the reader is referred to the implementation in (Frank 1997, definition of the normalcy selection function * p109-113 & section 5.2).

The problem is that the modal base $b'(w)$ combined with the original ordering source (7) still entails that Jockl must be the murderer. The proposition of the ordering source is actually too strong.

Intuitively what we would like to say is that, if we have the evidence at hand and there is nothing strange or abnormal about it, then Jockl is the murderer.[17] Formally, we have an extra proposition *abnormal* expressing that there is something abnormal. The ordering source contains then two propositions:

$$o'(w) = \{ \quad \neg alibi \wedge scene \wedge fingerprint \wedge \neg abnormal \rightarrow murderer$$
$$forged \rightarrow abnormal \qquad \qquad \}$$

The closest worlds are the worlds of $\cap b'(w)$ that make all the sentences of $o'(w)$ true. In particular, as *forged* is true in all worlds of $\cap b'(w)$, *abnormal* will be true in the worlds of $C^{b',o'}(w)$ (otherwise the conditional *forged* $\rightarrow$ *abnormal* would be false). The other conditional of $o'(w)$ is thus vacuously true as its antecedent is false. Therefore, the closest worlds do not decide whether the proposition *murderer* is true and thus (5-a) is false.

Notice however that the new ordering source is what is needed to account for the intuition that sentence (5-a) is less strong than (5-b). This means that, in the original example, the modal base actually had to contain the proposition $\neg abnormal$.

3.2 Extensions of the standard framework

3.2.1 Goal-oriented modality

As we have seen in the previous chapter, goal-oriented modality is the subset of participant-external modality that is concerned with plans. In (van der Auwera and Plungian 1998), goal-oriented modals are used as typical examples of participant-external modality. They consist of a main clause containing a modal and a purpose *to*-clause.

(8)   (van der Auwera and Plungian 1998, (2a-b))
   a.   To get to the station, you can take bus 66.
   b.   To get to the station, you have to take bus 66.

In the recent semantic literature, this has been most often linked to conditional constructions involving the verb *want* called *anankastic conditionals*.[18]

(9)   If you want to go to Harlem, you have to take the A train.

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[17]The formalization of this idea is just a propositional implementation of circumscription in the vein of (McCarthy 1980).

[18]The term is due to (von Wright 1963) and has since then been used by (Sæbø 2001), (von Fintel and Iatridou 2004), (Huitink 2004) and (von Stechow, Krasikova and Penka 2006).

As the literature has shown ((Sæbø 2001), (von Fintel and Iatridou 2004), (Huitink 2004) and (von Stechow et al. 2006)), a compositional analysis of anankastic conditionals is quite difficult to obtain. As the precise compositional mechanism behind the use of a bouletic verb such as *want* is not the point of this dissertation, I will concentrate on the construction involving a purpose clause.

I will now present the theory developed in (von Fintel and Iatridou 2004)[19] as it remains quite close to the standard framework.[20] The main idea is to treat the purpose-clause as introducing a *designated goal* that takes precedence over the other propositions of the ordering source. Therefore, the designated goal is meant to play the role of an ordering source of its own.

Definition 3.2.1 (Adapted from (von Fintel and Iatridou 2004)). Let p and q be two propositions, w a world, b and o a modal base and an ordering source respectively.

1. *to p, ought to q* is true in w relative to a modal base $b(w)$ and an ordering source $o(w)$ iff all the $o(w)$-best worlds in $b(w)$ where p is achieved are q-worlds.

2. *to p, must q* is true in w relative to a modal base $b(w)$ and an ordering source $o(w)$ iff all the worlds in $b(w)$ where p is achieved are q-worlds.[21]

Example 3.2.2. Assume the world of evaluation is w. The truth conditions for sentence (8-b) are the following (using part 2 of definition 3.2.1 with $p =$ "you go to the station" and $q =$ "you take bus 66"): sentence (8-b) is true in w with respect to b and o
iff all the worlds in $b(w)$ where p is achieved are q-worlds
iff all the accessible worlds where you go to the station are worlds where you take bus 66.

We can reformulate part 2 of definition 3.2.1 to fit within our notation.

Proposition 3.2.3. Let w be the world of evaluation, b and o the modal base and ordering source respectively and assume that $b(w) \not\vdash \neg p$ (i.e. we cannot conclude from the propositions in $b(w)$ that p is false and thus some worlds in $\cap b(w)$ are p-worlds):

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[19]It should be noted by the reader that (von Fintel and Iatridou 2004) is a 'preliminary draft of work in progress.' For evident practical reasons, I will not repeat this every time I mention this work but I hope the reader will keep it in mind when I will come to explain some of its problems.

[20]The *must* clause of definition 3.2.1 is actually equivalent to the proposal in (Huitink 2004, (21) with $<_{g(w)}$ instead of $\leqslant_{g(w)}$).

[21]It is however important to realize that, as it stands, part 1 of the definition makes wrong predictions. I will come back to this in the section dedicated to the problems of the standard framework.

> *to p, must q* is true in w relative to b and o iff
> all the worlds in $b(w)$ where p is achieved are q-worlds   iff
> for all $v \in C^{b,\emptyset}(w)$ such that $v \in [\![p]\!]^{b,o}$: $v \in [\![q]\!]^{b,o}$ iff
> for all $v \in C^{\{p\}\cup b,\emptyset}(w)$: $v \in [\![q]\!]^{b,o}$ iff
> for all $v \in C^{b,\{p\}}(w)$: $v \in [\![q]\!]^{b,o}$

The last part of the equivalences is also the definition of (Huitink 2004). The proposition shows that it does not matter whether you treat the *designated goal* as being the only member of the ordering source or as a member of the circumstantial modal base. Notice finally that the assumption, $b(w) \nvdash \neg p$, is only needed for the last step of the equivalence, that is, if $\neg p$ does follow from $b(w)$, $C^{\{p\}\cup b,\emptyset}(w)$ will be empty whereas $C^{b,\{p\}}(w) = \cap b(w)$.

The treatment of goal-oriented modality in definition 3.2.1 is inspired by the treatment of the interaction of conditionals with modals proposed by (Kratzer 1991). I will therefore proceed with a short overview of this part of the theory. Furthermore we will see that the interaction of modality with (deontic) conditionals is one of the big problems of the standard framework.

3.2.2 Modals and conditionals

The main intuition in (Kratzer 1981) and (Kratzer 1991) regarding conditional modality is that the if-clause restricts the domain of quantification of the overt modal. The following definition formalizes this intuition:

Definition 3.2.4 (Modals and conditionals)**.** For any propositions p and q, world w, modal base b, and ordering source o:

1. 'If p, must q' is true in w relative to b and o *iff*
   for all $v \in C^{b',o}(w)$ with $b'(w) = b(w) \cup \{p\}$, $v \in [\![q]\!]^{b,o}$, that is,
   q is true in all the closest (by $o(w)$) of the worlds determined by $b(w)$, that make p true.

2. 'If p, may q' is true in w relative to b and o *iff*
   there is a $v \in C^{b',o}(w)$ with $b'(w) = b(w) \cup \{p\}$ such that $v \in [\![q]\!]^{b,o}$, that is,
   q is true in at least one of the closest (by $o(w)$) of the worlds determined by $b(w)$, that make p true.

Basically, the antecedent restricts the modal base of the modal element. This is best seen in an example.

Example 3.2.5 (From (von Fintel and Iatridou 2004))**.** We are in world w and you are living in Cambridge, Massachusetts. As a law-abiding citizen you know that "the Cambridge traffic regulations require that driveways not be obstructed and that first time offenders pay a \$25 fine." Then the following sentence is true:

(10)   If John obstructed his neighbor's driveway, he has to pay a \$25 fine.
         (von Fintel and Iatridou 2004, (6) p4)

The standard framework nicely captures this result. The salient deontic ordering source o contains two propositions,[22]

$$o(w) = \{\neg obstruct, obstruct \rightarrow pay.fine\}$$

Obviously the best deontic worlds are the one that make both propositions true which is the case when driveways are not obstructed. Therefore the best worlds are worlds where driveways are not obstructed. What the definition says is that the antecedent of the conditional restricts the accessible worlds to worlds where John obstructed the driveway. We can assume that the modal base determining the accessible worlds is empty (we don't know anything special in this situation and therefore any world is accessible). Formally, 'If *obstruct*, must *pay.fine*' is true in w relative to b and o

iff for all $v \in C^{b',o}(w)$ with $b'(w) = b(w) \cup \{obstruct\}$, $v \in [\![pay.fine]\!]^{b,o}$

iff for all $v \in C^{b',o}(w)$ with $b'(w) = \emptyset \cup \{obstruct\}$, $v \in [\![pay.fine]\!]^{b,o}$

iff for all v such that $v \in [\![obstruct]\!]$ and $v \in [\![pay.fine]\!]$, $v \in [\![pay.fine]\!]^{b,o}$.

3.2.3   Brennan: the epistemic/root distinction

Brennan (1993) developed a revision of Kratzer's framework where participant-internal modals (and some deontic ones) have a special type of modal base that distinguish them from epistemic modals. The core idea behind this revision can be found in the following quote from Kratzer (1991, p.650):

> "...the distinction between modals with circumstantial and modals with epistemic modal bases which is at the heart of our proposal may correlate with a difference in argument structure."[23]

The difference in argument structure referred to by Kratzer (1991) corresponds roughly to the difference between raising and control verbs. This type of analysis

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[22]There is a slight complication that is not accounted for by the framework. The Cambridge traffic regulations (and for that matter, a large part of the body of laws in any country) formulate a prohibition, i.e *driveways must not be obstructed*, and (accessorily) what happens if this prohibition is not respected, namely the penalty *you must pay a \$25 fine*. Notice that my formalization of the penalty rule does not involve a deontic modal and features a material implication. The reasons are simple: i) it is, I think, the implicit common practice in those examples as in (von Fintel and Iatridou 2004), ii) it fits the intuitions about truth-conditions — but more problematic, iii) a modal and a conditional (new style) would both need a context to be evaluated, that is, a modal base and a deontic source. We would need conversational backgrounds inside a conversational background which does not seem very intuitive (nor easily formalizable).

[23]See Brennan (1993, p.5): "...[Kratzer] leaves open the possibility that there are also structural differences (in argument structure, for example) between them."

was already advocated by Jackendoff (1972). He develops an analysis of modal auxiliaries where epistemic and root modals (participant-internal and external) correspond to raising verbs and control verbs respectively. However both types of modals are considered to belong to the same syntactic class of (modal) auxiliaries, the difference being in their respective interpretation rules. I will now present some of the arguments that led Brennan (1993) to analyze epistemic, deontic and participant-internal modals as different semantic entities.

Epistemic/root distinction

Brennan argues for a clear contrast between epistemic and root modals. Whereas epistemic modals are sentence operators (S-operators), root modals are verb phrase operators (VP-operators). The first clue for this analysis comes from the behaviour of quantified NPs with epistemic and root modals respectively.

(11)   (Brennan 1993, 1. & 2. p34)
   a.   Every radio may get Chicago stations and no radio may get Chicago stations.
   b. #Every radio can get Chicago stations and no radio can get Chicago stations.

Consider (11-a) in its epistemic reading. It can be uttered to express one's uncertainty about which Chicago radio stations can be listened to from one's house (with probably different tuners of different quality). Maybe they all receive signals from Chicago stations but maybe they don't (all of them). This can be represented as follows:

(12)   Two "logical" forms for example (11-a) under an S-operator analysis:
   a. $\text{might}(\forall x[radio(x) \rightarrow get.Chicago.stations(x)])$ &
        $\text{might}(\forall x[radio(x) \rightarrow \neg get.Chicago.stations(x)])$
   b. $\forall x[radio(x) \rightarrow (\text{might}(get.Chicago.stations(x))$ &
        $\neg\text{might}(get.Chicago.stations(x)))]$ [24]

Notice that whereas the logical form in (12-a) represents a contingent proposition, (12-b) is a contradiction as soon as there are some radios in the domain. Sentence (11-a) is thus correct inasmuch as it is interpreted as (12-a). Sentence (11-b) seems however to resist this interpretation and sounds contradictory. Under the analysis as S-operator, it should turn out contingent under the logical form (12-a). This suggests that sentence (11-b) can only be analyzed as (12-b). It seems therefore unwarranted to analyze the participant-internal modal as an S-operator because we would then have to explain why the logical form in (12-a) is not available.

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[24]This logical form is obtained by quantifying into the scope of the modal (with a special mechanism). It is compatible with an S-operator analysis of modal items.

Another piece of evidence is the possibility of using expletive subjects (like *there* and *it*) with epistemic (and some deontic) modals but not with participant-internal ones.

(13)   Epistemic (Brennan 1993, 21 a. & b. p.41):
        a.   It may be raining.
        b.   There may be some eggs in the refrigerator.

(14)   Deontic (Brennan 1993, 25 a. & b. p.42):
        a.   It must be quiet in the reading room at all times.
        b.   There must be three lifeguards on duty.

(15)   Dynamic:
        a.   John can be on time for the kickoff.
        b. #There can be John on time for the kickoff.

Brennan claims that one of the reasons for the failure of example (15-b) is that "the expletive subject... is not the sort of thing to which properties can be attributed" (Brennan 1993, p.43) and the ability reading is doing just that.

The most decisive evidence for a VP-analysis of participant-internal (and some deontic) modal operators comes from their interaction with predicates denoting a symmetric relation.

Definition 3.2.6. A relation R is symmetric iff $\forall x, y$, if Rxy, then Ryx.

Brennan identifies two main classes of predicates that correspond to this definition: predicates with the comitative *with*, as in (16), and equivalence relations, as in (17).

(16)   a.   The president shook hands with John.
        b.   John shook hands with the president.

(17)   a.   Silvio is as tall as Romano.
        b.   Romano is as tall as Silvio.

The symmetry of those predicates makes the inferences from (16-a) to (16-b) and (17-a) to (17-b) valid.[25] When an epistemic modal is added to those sentences, the inference pattern remains valid:

(18)   a.   Silvio may be as tall as Romano.
        b.   Romano may be as tall as Silvio.

Obviously, if one is possible, the other is possible too. However this inference pattern does not hold when the modal is deontic or participant-internal. This is clearer in the participant-internal case.

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[25]And vice versa from b. to a. sentences.

(19)   Dynamic:
      a.   Silvio can be as tall as Romano.
      b.   Romano can be as tall as Silvio.

Think of the following situation: Silvio is actually shorter than Romano, but we know he often uses high heels to compensate for his height, hence sentence (19-a) is true. By using high heels, Silvio is able to be as tall Romano. This however does not imply the truth of sentence (19-b) (at least not in this scenario).

(20)   Deontic:
      a.   The president must shake hands with John.
      b.   John must shake hands with the president.

The deontic case is ambiguous precisely at the separation line between ought-to-do/ought-to-be readings of the modality.[26] Basically, the ought-to-do inference is not valid whereas the ought-to-be is. Consider the following context for the ought-to-do interpretation: the president's campaign director for the coming elections ordered him to shake hands with John who is very popular (and we all know that the president obeys blindly anything his campaign director tells him). Therefore sentence (20-a) is true but (20-b) is not (or at least, without further information, need not be), i.e. that the president has a particular obligation (involving John somehow) does not make John have this obligation too. The ought-to-be reading is natural in the following context: the president's advisor, who wants the popularity of his boss to increase, thinks that shaking hands with John would be a very clever move in the campaign. He tells (20-a) to his secretary meaning that she has to take care of it. Obviously, it is the secretary that has an obligation, not the president. Furthermore, the secretary has the obligation to make a certain state of affairs come true, i.e. that "the president shakes hands with John", but this amounts to the same as "John shakes hands with the president". Hence, in this context, we can infer (20-b) from (20-a).[27]

The conclusion from the interaction of modals with symmetric relations is that, while epistemic modals are consistent with an analysis as S-operators, deontic modals[28] are sometimes S, sometimes VP-operators (depending for instance on whether the addressee of the obligation/permission is or is not the subject of the sentence) and participant-internal modals are always VP-operators.

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[26]See (Feldman 1986).

[27]Notice that in Kratzer's theory, this analysis of ought-to-do/ought-to-be deontic modals in terms of VP/S-operators can be accounted for by different conversational backgrounds: one expressing the president's duties, the other expressing the secretary's duties, respectively.

[28]The same arguments hold for goal-oriented modality. We can therefore replace deontic by participant-external modality.

	Epistemic	Participant-external	Participant-internal
Kratzer	S-operator	S-operator	S-operator
Brennan	S-operator	S & VP-operator	VP-operator

Formalization

Brennan (1993) implements this analysis within Kratzer's framework. She has to change the notion of modal base for participant-internal and (some) deontic modals (namely for those that function as control verbs). Furthermore she has to split the definitions of the neutral modal operators depending on the type of modal base they accept. Intuitively we have the two following operators for necessity: must_S and must_{VP}.

(21)   a.   John must be home.   (epistemic)
              $\text{must}_{\text{S}}(\textit{John is home})$
        b.   John must pay taxes.   (VP-deontic)
              $(\text{must}_{\text{VP}}(\lambda x.x \textit{ pays taxes}))(\textit{John})$

The analysis of epistemic modals remains the same and thus the definitions of the previous sections remain unchanged for epistemic modality. The VP modal operates on verb phrases and takes a subject as argument. It also gets new modal bases for deontic and participant-internal modality. They are functions of an individual and a world and yield a set of properties.[29] A conversational background was, up to now, a function from a possible world to a set of propositions, that is, a function $b : W \to \mathcal{P}(\mathcal{P}(W))$. I will illustrate Brennan's definitions with the help of the example she provides:

(22)   Joan lives in Racine and is registered to vote. She may [i.e. has the right to] vote in Racine's mayoral election.   (Brennan 1993, 87.p65)

Definition 3.2.7. Conversational backgrounds for VP-modals are functions from world-individual pairs to set of properties. Let D be the domain of individuals,

$$b : W \times D \to \mathcal{P}(\text{set of properties})$$

The conversational background assigns to any world-individual pair $\langle w, d \rangle$, the set of relevant properties that the individual d has in world w (Brennan 1993, 84. p65).

In example (22), the conversational background b is a function that assigns to the pair $\langle w, joan \rangle$ the property of living in Racine and the property of being registered to vote, i.e.

$$b(w, joan) = \{\lambda v \lambda x[\textit{Live.in.Racine}(x) \textit{ in } v], \lambda v \lambda x[\textit{Registered.to.vote}(x) \textit{ in } v]\}.$$

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[29]See Brennan (1993, p.65-68).

As usual, conversational backgrounds determine an accessibility relation. However, it is now dependent on a world and an individual (Brennan 1993, (82) p64).

Definition 3.2.8 (Accessibility keyed to an individual)**.** The accessibility relation is based on the content of a contextually determined conversational background b, i.e. a world w' is accessible from a world w for an individual d with respect to the conversational background b,

$$\langle w, d \rangle R w' \text{ iff } for \ all \ P \in b(w, d), \ w' \in \mathcal{P}(d).$$

Therefore, a world w' is accessible for an individual d in world w in case all the properties assigned to this individual in the base world hold for the individual in w'.

In example (22), a world w' is thus accessible from w for Joan, $\langle w, joan \rangle R w'$, if it satisfies the following condition:

$$w' \in \lambda v[Live.in.Racine(joan) \ in \ v] \text{ and } w' \in \lambda v[Registered.to.vote(joan) \ in \ v].$$

Finally, the VP-modals are analyzed as functions that take as argument (the intension of) an intransitive verb phrase and return an intransitive verb phrase. The modal is interpreted relative to a contextually determined contextual background of the type described in definition 3.2.7. In example (22), the deontic modal *may* takes as argument the intransitive verb phrase *vote in Racine's mayoral election*, and is interpreted relative to the conversational background b such that

$$[\![\lambda y[may(vote.in.Racine's.mayoral.election(y) \ in \ w)]\!]^{b(w,x)}$$

denotes the set of individuals x that are allowed to vote for the mayor's election in Racine, i.e. (Brennan 1993, see 90. p67),

> the set of individuals x such that, there is a world w' accessible from w for x (with respect to b) such that, x votes in the mayoral election in w'.

The extension thus makes it possible to account for the data about quantified NPs and symmetric predicates. Crucially the fact that the conversational backgrounds are tied to the subject makes the modal predicate asymmetric, i.e. accessible worlds are not shared: an accessible world for an individual d need not be accessible for individual d'.

Chapter 4

Some problems of the standard framework

I will in this chapter confront the standard framework and its extensions with some problems. I will begin by questioning the key notions of the context-dependent analysis of modality. I will then discuss some problems related to participant-internal and participant-external modality and will conclude by showing that the standard framework cannot account for the scope order revealed by the previous data.

4.1 Polyfunctionality and context-dependence

The first problem is quite simple but remains usually unnoticed. It is the fact that, contrary to expectations, conversational backgrounds do not determine the type of modality. This is easily explained but I will first give the motivation for the argument.

The standard framework is based on the assumption that the solution to the problem of polyfunctionality is context-dependence: in a nutshell, modals are not polyfunctional, they are context-dependent. I will advocate in the last chapter for a framework where modals can be polysemous. Therefore each type of modality provides its semantic definitions for modal elements.

	Epistemic	Participant-external	Participant-internal
Standard framework	Nec 3.1.13	Nec 3.1.13	Nec 3.1.13
	Poss 3.1.13	Poss 3.1.13	Poss 3.1.13
Polysemy framework	must_{ep}	must_{deo} / must_{goal}	$\text{must}_{p.int}$
	may_{ep}	may_{deo} / may_{goal}	$\text{may}_{p.int}$

In such a framework, a modal verb like *may* can for instance be epistemic or deontic, i.e. *may* is ambiguous between may_{ep} and may_{deo}. Obviously we need within such a framework a way to resolve the ambiguity, that is, to determine

which of the two definitions (i.e. which type) is used in a given sentence. I would like to claim that this ambiguity is often resolved by the context. However, as I do not plan to provide such a contextual mechanism/parameter, I will instead show that the standard framework also needs one and thus has no particular advantage on this point. Both frameworks are equally in need of a contextual parameter to determine the type when a polyfunctional modal is used. I will finally assume that a solution to this problem in one framework should work for both.

4.1.1 Ineffability of conversational backgrounds

My claim is thus that the context-dependence of the standard framework takes care of the content of the conversational background but does not assign a type to them. As a consequence the standard framework needs an extra contextual parameter to determine the type of modality involved in an modal sentence.[1] I will for convenience call such a parameter TYPE. I will now present the argument supporting this claim and conclude that all is not negative for the standard framework as the existence of such a parameter solves a problem which is otherwise not accounted for.

As we have seen in definition 3.1.2, a conversational background is a function from worlds to sets of propositions.

$$cb : W \rightarrow \mathcal{P}(\mathcal{P}(W))$$

Those conversational backgrounds are supposed to stand for (among others, see figure 3.2) the following types of functions:

- deontic: "what the law provides,"

- epistemic: "what we know,"

- circumstantial: "what the relevant circumstances are."

This brings us to the question: How can we distinguish epistemic, deontic or circumstantial conversational backgrounds? The problem can be made more vivid if we place ourselves in a particular world, say w, where a modal sentence is assessed. We can now in more formal terms characterize the conversational backgrounds as subsets of $\mathcal{P}(\mathcal{P}(W))$, that is, as sets of propositions. First, we will look at the difference between epistemic and circumstantial conversational backgrounds. Obviously, the difference between the two is quite crucial as, according to figure 3.2, it is what makes the difference between the epistemic and ability modals of example (1).

(1)   a.   Fabrice might watch the game.

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[1]This parameter is needed under the assumption that the theory is further not modified.

b. Fabrice can watch the game.

As we evaluate those sentences in world w, we can reduce the conversational backgrounds to sets of propositions. It seems only fair to say that the epistemic modal base ("what is known") might be represented by any (consistent) set of propositions.[2] But in fact the very same set might represent the relevant circumstances of this situation as well. There is no reason to assume that the circumstantial modal base should be in any way different from the epistemic modal base. Consider example (1) in the following context: it is 2.50pm on Saturday and we all know that France is playing England at 3.00pm in the Six Nations rugby tournament. Furthermore we know that Fabrice is home (and has a television receiving the game). In such a context, both sentences in example (1) can be used truthfully and both modal bases contain the same pieces of information (and, crucially, need not contain more information).[3] Second, we can ask ourselves what kind of sentences are supposed to determine a deontic conversational background. In example 3.2.5 for instance, the sentence *the driveways are not obstructed* is part of the deontic ordering source "Cambridge traffic regulations." But such a sentence might as well be part of a circumstantial or epistemic modal base. Imagine in fact that we know that John in example 3.2.5 is a law-abiding citizen but that he inadvertently obstructed his neighbor's driveway. If we acknowledge that the fact that John is a law-abiding citizen means that the stereotypical ordering source in such a situation is identical to the deontic ordering source we can thus conclude that the following epistemic sentence is true:

(2) John must have paid a \$25 fine.

There is nothing inherently epistemic, deontic or circumstantial about a sentence and the same is true of sets of sentences. What is deontic in one example is stereotypical in the next. The only hard distinction between conversational backgrounds is the informal label we use to refer to them. Therefore we need the parameter TYPE to determine to what kind of modality we are dealing with.

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[2]Although we could also add some more constraints on the accessibility relation (serial, transitive, euclidean) to obtain a less naive notion of knowledge. Let R_b be the accessibility relation induced by the modal base b.

(M) Reflexive: for all w, wR_bw.

(D) Serial: for all w there is a v such that wR_bv.

(4) Transitive: for all u, v, w, if wR_bv and vR_bu then wR_bu.

(5) Euclidean: for all u, v, w, if wR_bv and wR_bu then vR_bu.

The main explicit constraint on modal bases in (Kratzer 1991) is that they are realistic, that is, $w \in \cap b(w)$ for all w which amounts to saying that the corresponding accessibility relation is reflexive.

[3]Notice that we can even assume an empty stereotypical ordering.

4.1.2   Non-polyfunctional modals

Consider an adjectival phrase like *to be able to* or verbal constructions like *to be allowed to*, *to be obliged to*, etc. Those modals are not ambiguous with respect to which interpretation they allow: *to be able to* is interpreted as a participant-internal modality, and *to be allowed to*, *to be obliged to* are interpreted as deontic modals no matter what the context is.

The solution mostly used to avoid this problem is to say that the modal items have some compatibility restrictions with respect to the kind of modal bases they allow. Such an analysis is proposed in (Rullmann, Matthewson and Davis 2006, p21) and hinted at in (von Fintel 2006). The non-polyfunctional modals are modeled as normal context-dependent modals, the only difference being that they also have a presupposition on the kind of conversational backgrounds they accept.

This feature is surely needed for the Lillooet language as its modal elements are not polyfunctional. The definition of (Rullmann et al. 2006) for the deontic modal enclitic *-ka* can be transposed into our notation as follows:[4]

Definition 4.1.1 (Deontic *-ka* in Lillooet). Let p be a proposition, w a world, b and o a modal base and an ordering source respectively.

- $ka(p)$ in w relative to b and o is only defined if b is circumstantial and o deontic,

- if defined, $ka(p)$ is true in w relative to b and o *iff* for all $v \in C^{b,o}(w)$, $v \in [\![p]\!]^{b,o}$.

However we have just seen that there is no genuine way to determine the type of a conversational background. We thus need to adapt the definition by adding an extra parameter. A minimal change to the standard framework would be to make formal the loose practice of referring to the conversational backgrounds with modality types. For instance, we can attach a label to the conversational backgrounds.

Definition 4.1.2 (Deontic *-ka* in Lillooet revised). Let p be a proposition, w a world, b_1 and b_2 two conversational backgrounds and TYPE1 and TYPE2 some labels (epistemic, deontic, circumstantial...) attached to the conversational backgrounds.

- $ka(p)$ in w relative to TYPE1:b_1 and TYPE2:b_2 is only defined if TYPE1 is "circumstantial" and TYPE2 is "deontic,"[5]

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[4]The definition in (Rullmann et al. 2006) is more involved. Here, I neglect the problem of variability of force of the Lillooet modals and only render their default necessity reading. Obviously, this is not a definitive definition.

[5]To be more precise, $ka(p)$ in w relative to TYPE1:b_1 and TYPE2:b_2 is only defined if TYPE1 or TYPE2 is "circumstantial" and TYPE1 or TYPE2 is "deontic."

- if defined, $ka(p)$ is true in w relative to circumstantial:b_1 and deontic:b_2 *iff* for all $v \in C^{b_1,b_2}(w)$, $v \in [\![p]\!]^{b_1,b_2}$.

In this variant of the standard framework, the modal element selects an already available conversational background of the correct type. The type is not determined by the content but is just a label.[6] This sketch shows that those modals can be accounted for in the standard framework if we add an extra parameter.

4.1.3 Polyfunctional modals

However, the previous definition cannot be the whole story. In the case of polyfunctional modals, we can find examples where the context fixes the interpretation over an overt (type-specific) conversational background.

Suppose we are discussing the upcoming trial of the suspected criminal, Jockl. The trial has not yet began and we wonder what the outcome will be, I say,

(3)   In view of what the law provides, Jockl may be executed.

The overt conversational background 'what the law provides' surely determines a deontic background. However in sentence (3), I'm not saying that the suspect is allowed to be executed but that in view of what Jockl is accused of having done by the prosecution, say a cool-blooded murder (circumstantial modal base), and in view of the laws held in this state (death penalty is legal: deontic ordering source), it is possible that he will get sentenced to death. In this example it seems that the modal should get a deontic interpretation, which is counterintuitive. We can thus conclude that an overt deontic conversational background does not necessarily determine the type of modality. Finally the context provides a circumstantial modal base and an overt deontic ordering source but the modal is still interpreted epistemically. This suggests that the contextual parameter TYPE that determines the nature of the modality involved (in this case epistemic) is of a different nature than a label attached to conversational backgrounds. In particular it is independent of the nature of the conversational background.

4.1.4 Conclusion

I have argued that the common practice in the standard framework of naming the conversational backgrounds according to a type of modality does not make them be of a certain type. Therefore contextually given conversational backgrounds fix the content against which a modal proposition will be evaluated but do not fix the type of modality. I have thus concluded that a new contextual parameter

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[6]This method is also used in (Frank 1997) which implements the standard framework in DRT. There is an explicit 'deontic' DRS referent D that can be picked up anaphorically by deontic modals for their interpretation.

is needed to determine the type of modality involved in a particular utterance and that this very same parameter could be used in a polysemy framework (as presented in the last chapter) for the same purpose. Is this to say that both types of theories are equal in the light of this problem? As shown in example (3), the extra contextual parameter TYPE can indeed override an overt conversational background in the specification of the modality involved: the sentence is interpreted as epistemic with the TYPE parameter being epistemic (the context of the conversation is about concluding information from information) but with an overt deontic conversational background. This might be problematic in the case of non-polyfunctional modals in the standard framework if we model the context-dependency as a presupposition on the context. In the same context as example (3) for instance, the following sentence would not have its presupposition satisfied.

(4)   Jockl is allowed to defend himself.

The modal obviously forces it own interpretation as deontic: it needs to accommodate its own TYPE parameter. This is reminiscent of the *black magic* invoked in (Kratzer 1981, p311):

> "If the utterance of an expression requires a complement of a certain kind to be correct, and the context just before the utterance does not provide it, then ceteris paribus and within certain limits, a complement of the required kind comes into existence."

Obviously this problem does not occur in the polysemy framework as the modal element *to be allowed to* would only have one semantics: may_{deo}. In this respect the polysemy framework makes easily the economy of the *black magic*.

4.2   Participant-internal modality

I will now present some problems for the standard framework in connection with participant-internal modality. There are mainly two big problems for a possible worlds analysis of participant-internal modality. First, the asymmetry between possibility and necessity is not easily accounted for. Second, some inferences licensed by the framework are clearly unwarranted.

4.2.1   Asymmetry

The problem of the asymmetry of participant-internal modality consists in the fact that whereas cross-linguistically the possibility meaning has specialized modal items to express it, the necessity reading is quite rare, confined to an interpretation involving the loss of control of the participant and has no dedicated modal

item. Furthermore although the dual of a participant-internal possibility is equivalent to a participant-internal necessity, it has been noticed by (Hackl 1998, p6-7) that the reverse is not true.

(5) a. I must pee.
     b. I am not able not to pee.

In example (5), both sentences (no matter how clumsy the dual sounds) express the fact that the agent cannot, or will not be able, control his bladder.

(6) a. I can swim.
     b. I do not have to not swim / I need not not swim.

However, in example (6), the second sentence does not express the unstoppable urge to swim of the agent. It does not have a participant-internal reading.

All those facts are not easily accounted for in the standard framework. As we already noticed, a participant-internal sentence (i.e. circumstantial) is characterized by a circumstantial modal base and a possibly empty stereotypical ordering source. It differs from an epistemic interpretation just in the "type" of modal base involved (and we have seen that this distinction is not as perspicuous as it seems). However epistemic possibility and necessity are dual[7] and this is clearly not the case for participant-internal modality. The fact that the framework relies so heavily on the context to fix most of the parameters of the interpretation makes it difficult to explain the asymmetry. Basically the framework relies on neutral modal operators that characterize the force of the expression (possibility or necessity). Given an ability sentence and thus an appropriate participant-internal context (coupled with a neutral possibility operator), we should be able to form without any problem the necessity version of the sentence by replacing the possibility operator by a necessity one. However the odds that such an operation will deliver a participant-internal necessity sentence are very small.

(7) Context: You know that John has taken more than 40 hours of driving lessons over the last months. When seeing you one day he tells you:
     a. I can drive a car now!
     b. #I must drive a car now![8]

Notice finally that the distinctions introduced by (Brennan 1993) will not help either. Having a modal base coupled to an individual does not necessarily restrict

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[7]I do not mean by that that any modal item expressing epistemic possibility/necessity is meaningful in such a case. For instance, epistemic *might* does not embed under negation and therefore cannot be used to construct a dual of epistemic possibility. However, *can* has an epistemic reading under negation and can form the dual.

[8]It is actually easy to find an appropriate reading for this sentence, that is, a goal-oriented reading (something like "Now that I have invested so much, I have to drive a car in order to make it worthwhile").

the neutral operators to possibility. However it does give an explanation of why participant-internal modals do not like expletive subjects.

4.2.2   Disjunctive abilities

The standard framework is propositional and theoretically any proposition, no matter how complex, can be embedded under a modal operator. Here we will not consider very complicated propositions but only simple disjunctions of simple propositions. As remarked in (Kenny 1976) and (Brown 1988) (among others), any modal logic of ability as possibility modal based on system K satisfies the following theorem[9]

$$can(\varphi \vee \psi) \rightarrow (can\ \varphi \vee can\ \psi)$$

This theorem is also valid in the standard framework. However when it comes to participant-internal modality, this theorem is clearly deceptive. Witness the following argument adapted from (Kenny 1976, p215):

Example 4.2.1. Take a pack of playing cards and place the cards in front of you with their backs up. Obviously, having done the preceding, you have the ability to pick out a card on request, therefore the sentence (8-a) is true.

(8)   a.   You can pick up a card.
       b.   You are not able to pick a black card.
       c.   You are not able to pick a red card.

However, as the cards are displayed with their backs up, you cannot pick up a black card on request (and neither can you pick up a red one), thus the sentences (8-b) and (8-c) are both true. But, of course, a card from the pack is either a black or a red card, thus, when you pick up a card you either pick up a black or a red card. The following propositions are thus equivalent.

(9)   a.   You pick up a card.
       b.   You pick up a black or a red card.
       c.   You pick up a black card or you pick up a red card.

But now we can conclude from sentence (8-a) and the previous equivalences proposition (10-a) which with the theorem entails (10-b).

(10)   a.   You can pick up a black or a red card.
       b.   You can pick up a black card or you can pick up a red card.

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[9]The modal logic K is the logic based on propositional logic to which the following two axioms are added:

1.   Necessitation rule: If φ is a theorem of K, then so is *must* φ.

2.   Distribution axiom: $must(\varphi \rightarrow \psi) \rightarrow (must\ \varphi \rightarrow must\ \psi)$

The last proposition is in contradiction with the intuition that sentences (8-b) and (8-c) are both true!

The example makes clear that you cannot distribute disjunction and the ability modal (as would for instance be possible with epistemic modality). That you can pick up a card does not mean that you have the ability to pick out a black card or the ability to pick out a red card. As Kenny (1976) shows, "similar counterexamples can be constructed in connection with any other discriminatory skill."

4.2.3   Inference from epistemic modality

The last problem concerning participant-internal modality is inspired by an argument in the literature that aims at explaining why something can be circumstantially possible while not epistemically possible. I will first explain the argument as presented in (Kratzer 1991, p646) and then show that under the same assumptions, the truth of an epistemic sentence entails the truth of its participant-internal counterpart.

Example 4.2.2 (Hydrangeas). "Suppose I acquire a piece of land in a far away country and discover that the soil and climate are very much like at home, where hydrangeas prosper everywhere. Since hydrangeas are my favorite plants, I wonder whether they would grow in this place and inquire about it. The answer is (11-a), i.e. in such a situation, the proposition expressed by (11-a) is true.

(11)   (Kratzer 1991, (21a-b))
        a.   Hydrangeas can grow here.
        b.   There might be hydrangeas growing here.

It is true regardless of whether it is or isn't likely that there are hydrangeas in the country we are considering. All that matters is climate, soil, the special properties of hydrangeas, and the like. Suppose now that the country we are in has never had any contact whatsoever with Asia or America, and the vegetation is altogether different from ours. Given this evidence, my utterance of (11-b) would express a false proposition. What counts here is the complete evidence available. And this evidence is not compatible with the existence of hydrangeas." (Kratzer 1991, p646)

The situation described in this example shows that an epistemic sentence like (11-b) can be false while its circumstantial counterpart (11-a) is true. Therefore, we know that no hydrangeas are growing in the area but that the conditions are such that hydrangeas would grow if we planted some.[10] Within the stan-

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[10]Notice the surprising use of universal force to express circumstantial ability. This was already noticed by (Thomason 2005).

epistemic modal base $\supseteq$ circumstantial modal base

$\downarrow$ $\downarrow$

{epistemic worlds} $\subseteq$ {circumstantial worlds}

$w_{\text{hydrangeas}}$ $w_{\text{hydrangeas}}$
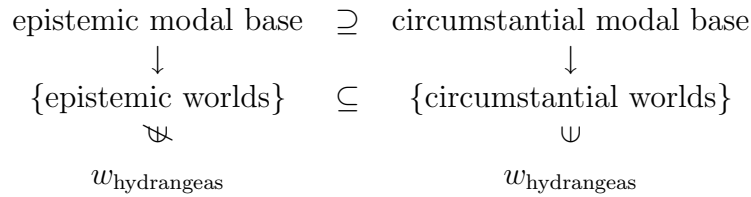
Figure 4.1: Modal bases and accessible worlds in the hydrangeas example.

dard framework, sentence (11-a) is analyzed as a circumstantial modal with a circumstantial modal base and an empty ordering source (pure circumstantial) and sentence (11-b) has an epistemic modal base and a (not necessarily) empty ordering source (Kratzer 1991, p646). As shown in figure 4.1, the circumstantial modal base is a subset of the epistemic one: as (Kratzer 1981, p302-303) puts it, for the circumstantial modal base, it can happen that "we have to neglect certain facts [...], although we might be aware of them" (this is also expressed in (Kratzer 1991, p646), though less explicitly). In the case at hand, we have to neglect the fact that seeds of hydrangeas have never made it to this faraway country. This means that the set of epistemically accessible worlds is included in the set of circumstantially accessible worlds (this is bigger because it discriminates between less propositions). Consequently, there might be a circumstantially accessible world where hydrangeas grow that is not epistemically accessible as the example showed. Therefore, *can* does not entail *might*.

This argument is, as far as I can see, making the right diagnosis: when concerned with circumstantial ability, only certain facts (from our knowledge) are relevant. However, even though the diagnostic is essentially right, it has unwarranted consequences in the framework. It should be obvious from figure 4.1 that with the same kind of reasoning we can conclude that *might* entails *can*: if something is epistemically possible, it is a circumstantial possibility too. If I think that hydrangeas might be growing here, it would seems that I would better think that they can grow here too. Unfortunately, this line of reasoning is not valid and it poses a very serious problem for the standard framework. Witness the following example:

Example 4.2.3 (Hydrangeas strike back)**.** Suppose this time the climate in this faraway country is very much like home (temperate) but I do not know about the soil (at home the soil is alkaline, but on this piece of land I do not know whether it is alkaline or acid). As a matter of fact, I know that pilgrims had hydrangea seeds with them when they discovered this piece of land. Suppose finally that I know

that hydrangeas need a temperate climate and an alkaline soil[11] to grow.[12] In this situation, sentence (11-b) is true. It is possible that the soil is alkaline, that the pilgrims planted some hydrangeas and thus that they still grow in the region. However, sentence (11-a) is not true in the present situation (as would follow in the standard framework); it is not false either but it is undecided awaiting for further knowledge about the soil's pH.

In the previous example, my ignorance about some external factor (the soil's pH) leads to an undetermined truth value of the ability modal. Notice however that the problem is not any different if we change the source of knowledge. The problem is that any circumstantial modal base based on an epistemic modal base compatible with a proposition p will also make this proposition true.[13]

4.3 Participant-external modality

4.3.1 The content of a deontic ordering source

As we have seen, the standard framework analyzes modal elements as context-dependent logical operators. Therefore, (neutral) modal elements express a conclusion from some evidence (provided by the context). Even if this analysis can be argued for on intuitive grounds for epistemic modality, I will argue that it is less attractive for deontic modality. Assume that we discuss new measures against tobacco adopted in some countries and I tell you the following:

(12)   In the Netherlands, they may not sell cigarettes to people under 16.

The natural reading of this sentence is deontic. Sentence (12) says that it is forbidden to sell cigarettes to people younger than 16. First notice that *may not* has the following logical form: $\neg may$, which is equivalent to $must\neg$. The modal base b is a circumstantial conversational background which we can take to be empty, i.e. all the worlds are still accessible. The deontic ordering source o is the

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[11]The last assumption is only tailored for the example and is in fact false. If I trust Wikipedia (`http://en.wikipedia.org/wiki/Hydrangea_macrophylla`), hydrangeas are cultivated in 'many climates' and the only influence of the soil's pH on the plant (Hydrangea macrophylla) is on the color of the flowers: they are blue in acid soils, pink in alkaline soils and purple in neutral soils. I hope horticulturists will nevertheless be able to get the point of this example.

[12]The reader will surely have noticed that this is a goal-oriented construction.

[13]Notice that this example is even more interesting because it shows an obvious connection between participant-internal modality and goal-oriented modality.

(i)   a.   Hydrangeas might be able to grow here.
       b.   If the soil is alkaline, hydrangeas can grow here.
       c.   In order to grow, hydrangeas need a temperate climate and an alkaline soil.

traditional "what the law provides" restricted to the Netherlands, i.e. "what the law provides in the Netherlands." The truth of sentence (12) is determined as follows in world w:

$$w \in [\![\neg \text{may } (\textit{they sell cigarettes to people} < \textit{16})]\!]^{b,o} \qquad \text{iff}$$
$$w \notin [\![\text{may } (\textit{they sell cigarettes to people} < \textit{16})]\!]^{b,o} \qquad \text{iff}$$
$$\text{for all } u \in C^{b,o}(w): \ u \notin [\![\textit{they sell cigarettes to people} < \textit{16}]\!]$$

The sentence is thus true if in all closest accessible worlds with respect to the laws of the Netherlands, cigarettes are not sold to people under 16. At first this seems to be a good analysis of the sentence, however I didn't specify (on purpose) the ordering source "what the law provides in the Netherlands." We can actually be more specific about its content. The ordering source of sentence (12) can be replaced by "what the first paragraph of article 8 of the 'Tabakswet' dated from March 10, 1988 provides."

(13)   Tabakswet, Article 8, alinea 1: It is **forbidden** [to sell tobacco products to persons under 16].[14]

Therefore, what is usually considered to be the typical deontic conversational background itself contains a deontic sentence. Obviously this is problematic as we would need a context for the interpretation of this deontic sentence. The intuition is that the modal element of sentence (13) is not context-dependent in any way. The sentence fixes a norm. Therefore, by saying sentence (12) I just quote the law (applied to some individuals) and if challenged to explain why it is forbidden to sell cigarettes to teenagers, I might just argue that it is because the law says so! That the youth should be protected against the danger of smoking is a justification of why the law was approved, not of why it is forbidden to sell tobacco to teenagers. The standard framework cannot easily account for this fact and needs to disguise the real ordering source by removing the modal elements of the sentences it contains (as in example 3.2.5).

Notice that some laws only make reference to the sanction given if some action is performed. This is precisely how the equivalent Massachussetts law is formulated:

Whoever sells a cigarette [. . .] to any person under the age of eighteen shall be punished by a fine of not less than one hundred dollars [. . .].[15]

The deontic conversational background consists of a sentence saying that if you do sell cigarettes to minors, you will be punished by a fine. Even in such a case we

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[14]Artikel 8, 1: Het is verboden bedrijfsmatig of anders dan om niet tabaksproducten te verstrekken aan een persoon van wie niet is vastgesteld dat deze de leeftijd van 16 jaar heeft bereikt. (`http://wetten.overheid.nl/`)

[15](Section 6, Chapter 270, Part IV of the General Laws of Massachussetts, `http://www.mass.gov/legis/laws/mgl/270-6.htm`).

would like to say that it is forbidden to sell cigarettes to minors in Massachussetts (and not only that it is preferable not to do it in order to avoid the sanction). But within the standard framework the sentence is not true anymore as a world where you sell cigarettes to minors and pay the fine is one among the closest worlds.

4.3.2 Zvolenszky's problem

This problem was first noticed in sentences involving conditionals and pertains to the way those conditionals interacts with modals, i.e. the way the contextual information and the antecedent of the conditional fix the accessible worlds. This problem is probably as old as the field of deontic logic but was first discussed with respect to the standard framework by (Frank 1997). I will first present the argument as developed in (Zvolenszky 2002) and then give it a twist to highlight the problem at hand.[16]

Original version

To explain the core of the argument, we have to look at the interplay between modals and conditionals. For instance, the following example involves an epistemic modal and a conditional clause.

(14)   If John is home, he must be watching the game.

The intuition about this sentence is that the if-clause restricts the set of best worlds of the modal, i.e. in the assessment of the epistemic modal, I only need to check what is the case in the worlds where the antecedent 'John is home' is true. This intuition is modeled in definition 3.2.4, i.e. 'If p, it must be that q' is true in w relative to b and o *iff* q is true in all the worlds of $C^{b',o}(w)$ with $b'(w) = b(w) \cup \{p\}$.

    Zvolenszky (2002) noticed that with this analysis of modality and conditionals, all sentences of the form 'if p, then it must be that p' come out true. It is surely not that problematic in the epistemic case: if John is home, then of course he must be home! However, it does not seem to fit correctly our intuitions about deontic sentences. Consider the following example:

Example 4.3.1. We all know that Britney Spears has a contract with the cola brand Pepsi, and this contract has a special clause about drinking cola in public, i.e. sentence (15-a) is true due to her engagement with Pepsi.[17] A problem arises when we look at sentence (15-b). Intuitively, knowing that sentence (15-a) is true, the sentence should be false. However, the analysis provided in definition 3.2.4 predicts this sentence is true and this in virtue of its form alone.

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[16]This section can also be found as a part of (Nauze to appear).

[17]Actually sentence (15-a) is quite probably a clause of her contract, that is, a part of her contractual obligations.

(15)   a.   If Britney Spears drinks cola in public, she must drink Pepsi.
            propositional form: *If cola, it* must *be that pepsi*
        b.   If Britney Spears drinks Coke in public, she must drink Coke in public.
            propositional form: *If coke, it* must *be that coke*

How does definition 3.2.4 work in this case? First we have to determine the modal base b and the ordering source o. The sentences in (15) are deontic; the modal base b is therefore circumstantial[18] and the ordering source o deontic, based on Britney's contract with Pepsi. Assume the actual world is w.

1. Sentence (15-a) is true in w with respect to b and o if the proposition *pepsi* is true in all the best of the *cola*-worlds, i.e. in $C^{\{cola\},o}(w)$.
   The *cola*-worlds are worlds where she drinks Coke, Pepsi or any other cola brand. However, the best of those worlds with respect to her contract are *pepsi*-worlds and therefore, proposition (15-a) is true.

2. Sentence (15-b) is true in w with respect to b and o if *coke* is true in all the best of the *coke*-worlds, i.e. in $C^{\{coke\},o}(w)$.
   Obviously, the *coke*-worlds are worlds where Britney is drinking Coke. All those worlds violate her Pepsi-contract to some degree but the subset consisting of the best worlds will thus only contain *coke*-worlds. Thereore *coke* will be true in all the worlds of $C^{\{coke\},o}(w)$ and sentence (15-b) is true in w.

The natural conclusion from this example is that all the sentences of the form 'if p, then it must be that p' turn out to be vacuously true in this framework (for any proposition p, modal base b, ordering source o and world w, it is the case that p is true in all worlds of $C^{b',o}(w)$ with $b'(w) = b(w) \cup \{p\}$). This is clearly unwarranted for deontic modality!

A problem for Zvolenszky?

Zvolenszky (2002) presents revisions of definition 3.2.4 that were proposed in the literature to solve this problem. One of these revised definitions involves the presence of a covert modal operator in the definition of conditionals.[19] The effect of this move is to ensure that sentence (15-b) is not trivially true because the

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[18]I will make the same simplifying assumption as (Zvolenszky 2002) and assume that the modal base is empty. This means intuitively that there are no particular facts relevant to the situation at hand and that all worlds are considered possible.

[19]This revision assumes two separate definitions: one for modality (definition 3.1.13) and one for conditionals, which are now defined with respect to a covert modal base and ordering source (similar to definition 3.2.4 without overt modal):
'If p, then q' is true in w relative to b and o *iff* q is true in all the worlds of $C^{b',o}(w)$ with $b'(w) = b(w) \cup \{p\}$.

proposition of the if-clause is not added to the overt modal base but to the covert one: the sentence is now interpreted as 'if Britney drinks Coke in public, it is because she must drink Coke in public.'

However, this revised definition runs into problems too. In particular, it is not better suited to account simultaneously for sentences (15-a) and (15-b) than the original definition. The revised definition encounters problems with sentence (15-a) which is intuitively not equivalent to 'if Britney drinks a cola in public, it is because she must drink Pepsi in public.'

	Definition 3.2.4	Revised definition
sentence (15-a)	true in w	#false in w#
sentence (15-b)	#trivially true#	false in w

Geurts (2004) argues that Zvolenszky's problem is actually 'ill-founded' because she fails to recognize that the conditional sentences of the form (15-a) and (15-b) are ambiguous between an overt (definition 3.2.4) and a covert (revision) reading (i.e. we do not need to have a simultaneous account).This ambiguity leads to the fact that two interpretations are possible: in the case of sentence (15-b), one trivially true (overt reading), one contingent (covert reading). According to (Geurts 2004), a cooperative hearer will then choose to interpret the sentence assuming the informative interpretation, i.e. the covert reading. This may well be, but as it stands, the same explanation is not going to work for sentence (15-a). Both readings are informative; they are just not true in the same circumstances!

On the one side, Zvolenszky (2002) proves convincingly that a unified analysis of conditional modals is doomed to be problematic for the deontic case. On the other, Geurts (2004) explains the problem away by arguing that we should not have a unified analysis. The core problem is then to decide when the conditional antecedent restrict the deontic modal base (overt reading) and when not (covert reading). I will now argue that the problem pointed out by Zvolenszky is actually not restricted to conditional environments and thus that Geurts' solution is not adequate.

Modified version

Zvolenszky (2002) and Geurts (2004) only looked at conditional sentences whereas the problem of deontic modality is pervasive. The modification of the original argument is meant to show that the problem is not only linked to the definition of conditionals within the standard possible-worlds framework but that it actually relates to the problem of determining the relevant circumstantial evidence for the (deontic) modal.

Consider the following context: A and B are two jurists working for Pepsi. They both know that Britney has a contract with their firm, and they know the terms of the contract. They are watching television when this conversation takes place.

(16)   A: Look, Britney is drinking cola in public.
         B: [according to her contract] She must drink Pepsi then... Can you see
         which brand she is drinking?

After A's utterance in example (16), A and B know that Britney is drinking cola.
Intuitively, the sentence uttered by B is true: Britney's contract specifies that
she has the obligation to drink Pepsi when she drinks cola in public. According
to definition 3.1.13 with w the actual world,

B's utterance is true in w *iff* the proposition *pepsi* is true in all the worlds of
$$C^{b,o}(w).$$

The ordering source $o(w)$ is based on Britney's contract with Pepsi. The question
is thus whether the modal base contains the proposition *cola* corresponding to
A's utterance. The modal base for a deontic modal is a circumstantial one:

$$b: w \rightarrow \{propositions\ stating\ the\ relevant\ circumstances\ in\ w\}$$

Suppose $b(w)$ does not contain *cola*, i.e. *cola* $\notin b(w)$, then some worlds in $\cap b(w)$
will be *cola* worlds and some worlds won't. Obviously Britney's contract does
not force her to drink cola (even Pepsi) in public all the time, so there is a world
$w_{no\_cola} \in \cap b(w)$ where she doesn't drink a cola (and doesn't violate any other
part of her contract) that is one of the best worlds, $w_{no\_cola} \in C^{b,o}(w)$. But in
w_{no_cola} she doesn't drink a Pepsi. Therefore, if the proposition *cola* is not in the
modal base, B's utterance is false in w. Intuitively, B's utterance is true, so by
contraposition, *cola* is in the modal base $b(w)$.[20] Thus A's utterance becomes part
of the modal base, that is, the relevant facts/circumstances for the evaluation of
the deontic modal.[21] But now, imagine the conversation was not (16) but instead,

(17)   A: Look, Britney is drinking Coke in public.
         B: Well, according to her contract, she must drink Coke.

Intuitively, B's utterance is false but with the same reasoning as for example (16),
it is predicted to be true by our formal machinery. The problem is that, this time,
adding A's utterance to the modal base does not seem to be warranted for the
evaluation of the modal in B's utterance. If we add A's utterance to the modal
base, B's utterance become automatically true! The pair of examples (16) and
(17) runs into exactly the same problem as the pair (15-a) and (15-b) but without
any conditional clause involved.

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[20]This line of reasoning is of course far from satisfying but it exposes the main weakness of the
standard framework: there is no steady guideline to determine the content of the conversational
backgrounds (in particular, the content of the modal base). We have thus to reason from
intuitions about the truth of sentences.

[21]Notice that a proposition of the form 'if you drink cola in public, then you drink Pepsi'
belonging to the ordering $o(w)$ (i.e. a 'conditional' obligation) would ensure the truth of B's
utterance.

Is there a hope to find a way to determine the relevant circumstances in deontic cases (i.e. a way to decide whether a proposition p is an element of the modal base or not)? I do not think so.

(18)   A: Look, Britney is drinking Coke in public.
         B: According to her contract, she must pay a fine! She must not drink Coke in public!

B's utterance in example (18) seems more likely to be true than not (Britney's contract surely contains a clause about penalties in case of breach and, of course, she is not allowed to drink Coke in public). If we reproduce the same reasoning involved for sentence (16) on B's first utterance (assuming it is true), we obtain that A's utterance is part of the modal base. But then, B's second utterance will be predicted to be false by the framework (under the same modal base and ordering source) which is not warranted. Vice versa, if A's utterance is not a part of the modal base, then B's first utterance is predicted to be false and the second true! A way out would be to assume two different contexts for the two modals. However it seems that both sentences are only dependent on the fact stated by A and on the contract between Britney and Pepsi and I do not see any reason why the second modal (i.e. its contextually determined modal base) would neglect A's utterance (other than to make the sentence true).[22]

Conclusion

Therefore Zvolenszky's problem makes obvious that in the case of deontic modality, you cannot at the same time i) keep track of the contextual dependence on facts (via the modal base) and ii) check the satisfiability of the modal in virtue of those facts, without running into trouble. The following quote from (Zvolenszky 2002) is a nice way to conclude this section as it illustrates the solution to those problems.

> "Normative facts hold in a possible world solely because they are normative facts of that possible world."

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[22]Furthermore a skeptic trying to entertain this argument would have to explain why the reading with one circumstantial modal base is ruled out in this situation and not in others. That is, the skeptic would have to make explicit how to determine the different modal bases. To my knowledge, the only serious attempt at such clarification is (Frank 1997). This attempt is however not completely satisfactory. Frank (1997) implements the standard framework within Discourse Representation Theory. In this framework, deontic modals pick up accessible context referents that stand for the conversational backgrounds. To avoid the problem of deontic conditionals and its modified version, she poses a *context reduction* constraint (Frank 1997, (29) p186) on deontic contexts that aims at making the deontic context independent of the proposition in the scope of the modal. However, as (Zvolenszky 2002) noticed, this method triggers another problem with conditionals, namely that *if p, must p* is equivalent to *must p* (the context reduction blocks the contribution of the antecedent).

Zvolensky's insight is that duties, rights, permissions or prohibitions are as much a part of the facts holding in a possible worlds as any other proposition. I will implement such an idea in the last chapter.

4.3.3   Goal-oriented modality

This section presents some problems for the extension of the standard framework developed to account for goal-oriented modality.

Designated *goal*?   The goal-oriented analysis of (von Fintel and Iatridou 2004) rests on the identification of the purpose clause (or the *want*-conditional) as a *designated goal*. Furthermore the goal is treated as an ordering source that orders the accessible worlds. This is in line with the usual treatment of bouletic modality in the standard framework. The problem arises with the *ought* part of definition 3.2.1 repeated here:

1.   *to p, ought to q* is true in w relative to a modal base $b(w)$ and an ordering source $o(w)$ *iff* all the $o(w)$-best worlds in $b(w)$ where p is achieved are q-worlds.

The ordering source plays a crucial role and the problem is caused by the priority of the ordering source over the designated goal in this definition (contrary to the intentions displayed in (von Fintel and Iatridou 2004, p14)). If we transcribe this definition into the formal notation we have used so far, we obtain the following:

Definition 4.3.2.   *to p, ought to q* is true in w relative to b and o *iff* for all $v \in C^{b,o}(w)$ such that $v \in [\![p]\!]^{b,o}$, $v \in [\![q]\!]^{b,o}$.

In order to make the problem clear, I will present an example of unwarranted predictions made by definition 4.3.2. The following example is from (von Fintel and Iatridou 2004) where it is argued that the definition solves the problem of conflicting goals. I will argue against this claim.

Example 4.3.3. Assume the actual world is w. I know that you want to go to Hoboken, that is, $Hoboken \in o(w)$. Furthermore, we all know that you cannot go to Hoboken and to Harlem simultaneously, that is, $Hoboken \rightarrow \neg Harlem \in b(w)$. Consider the following two sentences:

(19)   a.   To go to Harlem, you ought to take the A train.
          b.   To go to Harlem, you ought to take the PATH train.

In the actual world, only the first sentence is true, however, if we apply definition 4.3.2 under reasonable assumptions we obtain that both sentences are true.

> *to Harlem, you ought to q* is true in w relative to b and o *iff*
> for all $v \in C^{b,o}(w)$ such that $v \in [\![Harlem]\!]^{b,o}$, $v \in [\![q]\!]^{b,o}$

What kind of worlds belong to $C^{b,o}(w)$? It seems reasonable, in this situation, to assume that the modal base $b(w)$ does not decide whether you go to Hoboken or to Harlem, therefore there are *Hoboken*-worlds in $b(w)$. We can also safely assume that the ordering source is consistent and that the other propositions contained in the ordering source are not decided by the modal base (for example we could simplify the situation by having $o(w) = \{Hoboken\}$). Therefore, every world belonging to $C^{b,o}(w)$ will be a world that respects all the propositions of $b(w)$ and that makes the proposition *Hoboken* of the ordering source true. We can thus conclude that every world of $C^{b,o}(w)$ will make the proposition *Harlem* false as $Hoboken \rightarrow \neg Harlem \in b(w)$. Therefore, $\{v \mid v \in C^{b,o}(w) \ \& \ v \in [\![Harlem]\!]\} = \emptyset$ and the sentence *to Harlem, you ought to q* is trivially true in w independently of proposition q.

To solve this problem and keep the insight that the purpose clause introduces a designated goal, we have to let it precede the ordering source o in definition 3.2.1.

Definition 4.3.4. *to p, ought to q* is true in w relative to b and o *iff* all the $o(w)$-best worlds in the $\{p\}$-best worlds of $b(w)$ are q-worlds, that is, for all $v \in C^{C^{b,\{p\}},o}(w)$, $v \in [\![q]\!]^{b,o}$.[23]

In this definition we let the designated goal order the modal base first. It takes precedence over other considerations (represented by the ordering source). The worlds so obtained are then ordered by the ordering source o. However, we have already seen that $C^{b,\{p\}}(w) = \cap(b(w) \cup \{p\})$ if $b(w) \not\vdash \neg p$. Therefore we can simplify definition 4.3.4 with the following proposition.

Proposition 4.3.5. If $b(w) \not\vdash \neg p$, the following is the case:
to p, ought to q is true in w relative to b and o *iff* for all $v \in C^{b \cup \{p\},o}(w)$, $v \in [\![q]\!]^{b,o}$.

This truth-condition makes the right prediction in the above-mentioned scenario as only worlds that make *Harlem* true are ordered by the ordering source (making the presence of *Hoboken* in it irrelevant). The question is thus whether it is legitimate to call the purpose-clause argument a designated *goal* when it must actually be added to the circumstantial modal base and not function as an ordering source (as is usually the case for goals in the standard framework). Furthermore, this treatment of the purpose-clause is similar to the semantics for conditional sentences and thus, in the anankastic case, this means that the verb *want* is actually not contributing to the meaning of the sentence.

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[23]Notice that the notation $C^{C^{b,\{p\}},o}(w)$ is abusive as $C^{b,\{p\}}(w)$ is not a set of propositions but is a set of worlds. We would actually have to take the set of propositions that are true in those worlds.

Zvolenszky again

The previous argument shows clearly that the treatment of goal-oriented modality is heavily influenced by the treatment of conditional clauses. As is to be expected, Zvolenszky's problem carries over directly to goal-oriented modality:

(20)   a.   If you want to go to Harlem, you have to go to Harlem.
        b.   To go to Harlem, you have to go to Harlem.

Within the framework developed so far, those sentences should strike us as mere tautologies. It is however my opinion that those sentences are just nonsensical and missing the point. This is surely the case for (20-b) but also for (20-a) as a goal-oriented sentence. The only reasonable interpretation of (20-a) would be something in the folk psychology vein of 'you have to follow your desires'—but not a goal-oriented interpretation!

The diagnostic is simple. Going to Harlem is the designated goal you want to achieve and it is not itself an essential (sub-)condition to achieve the goal. This idea is formalized in von Fintel and Iatridou (2004, p19) as follows:

Definition 4.3.6 (Essential part of a way of achieving something)**.** Let w be a world, p and q two propositions and b a modal base,

q is an essential part of a way of achieving p in w *iff*
there is a set P of propositions such that, $b(w), P, \{q\} \vdash p$ but $b(w), P \nvdash p$.

Obviously, this not enough as, with this definition, p is always an essential part of a way of achieving p (as long as $b(w) \nvdash p$ of course). Therefore we have to upgrade the definition to a *non-trivial* essential part:

Definition 4.3.7 (Non-trivial essential part of a way of achieving something)**.** Let w be a world, p and q two propositions and b a modal base,

q is a non-trivial essential part of a way of achieving p in w *iff*
$q \nvdash p$ and there is a set P of propositions such that, $b(w), P, \{q\} \vdash p$ but
$$b(w), P \nvdash p.$$

However, this just amounts to forbidding purpose-clauses from which the designated goal follows and as such is not a very convincing solution to this problem. Furthermore, problems seem to crop up again with more complex sentences. Definition 4.3.7 does not prevent the following sentence from being true in the framework:

(21)   To go to Harlem, you have to go to Harlem or stay home.

Definition 3.2.1 makes this sentence true as all the worlds in $C^{b,\{Harlem\}}(w)$ (for some w) are worlds where the proposition *Harlem* is true. Therefore, the disjunction containing *Harlem* is true too and this even if you explicitly know (as could

be expected) that staying home will not get you to Harlem. Regarding definition 4.3.7, we can check that *going to Harlem or staying home* is a non-trivial essential part of a way of achieving *going to Harlem*:

1. *Harlem* $\lor$ *stay* $\nvdash$ *Harlem* (first part of the definition) and,

2. if we take the set of proposition P to be $P = \{\neg stay\}$, we obtain that $b(w), \{\neg stay\}, \{Harlem \lor stay\} \vdash Harlem$ but $b(w), \{\neg stay\} \nvdash Harlem$ (under the assumption that the circumstances are not so that going out —not staying home— entails going to Harlem).

Notice finally that sentence (21), contrary to (20-b), does not sound off the point but plainly false. The disjunction introduces two different ways to achieve the goal of going to Harlem but staying home is surely not a way to go somewhere. These results are not (yet) accounted for in this framework. One might advocate a pragmatic solution for the oddity of sentence (20-b) but this line of defense would not be as efficient for (21).

Goal-oriented possibility

The problem pointed out by (Nissenbaum 2005) is, as (von Fintel and Iatridou 2004) acknowledges, "devastating." In a nutshell, if we define a counterpart of definition 3.2.1 of goal-oriented necessity for possibility (in the usual way), we end up making true any sentence of the form '*to p, can q*' with q being any sentence that is true in some of the closest worlds that make p true.

Definition 4.3.8 (Goal-oriented possibility). For any proposition p and q, world w, and b and o a modal base and an ordering source. We can define goal-oriented possibility in two different ways: either we let the ordering source play a secondary role (part 1) or we remove it all together (part 2) and treat it as a possibility counterpart of *must*.

1. To p, can q is true in w relative to b and o *iff*
   there is $v \in C^{b',o}(w)$ with $b'(w) = b(w) \cup \{p\}$, $v \in [\![q]\!]^{b,o}$.

2. To p, can q is true in w relative to b and o *iff*
   there is a $v \in C^{b,\{p\}}(w)$ such that $v \in [\![q]\!]^{b,o}$.

The example goes as follows.

Example 4.3.9 (Pedro Martinez). We all know that in the actual world w there are two ways to go to Harlem: the A train and the C train. This means that both sentences are true in w:

(22)   a.   To go to Harlem, you can take the A train.
            b.   To go to Harlem, you can take the C train.

Furthermore, we know that Pedro Martinez[24] is in the C train, i.e. *Martinez* $\in$ $b(w)$ and that one of your goals in life is to kiss him, that is, $kiss \in o(w)$. But then, the following sentences are also true,

(23)   a.   To go to Harlem, you can kiss Pedro Martinez.
        b.   To go to Harlem, you ought to kiss Pedro Martinez.

Obviously, the truth of the *ought to* sentence implies the truth of the *can* sentence with part 1 of the definition above which in turn implies the truth of the sentence with part 2. I will thus only spell out the truth-conditions of the '*ought to*' sentence (assuming as usual that $b(w) \nvdash \neg Harlem$):

> *to Harlem, ought to kiss* is true in w relative to b and o *iff*
> for all $v \in C^{b \cup \{Harlem\}, o}(w)$, $v \in [\![kiss]\!]^{b,o}$.

In $b(w) \cup \{Harlem\}$, there are worlds where you take the C train. But from those worlds, those where you kiss Pedro Martinez are best with respect to $o(w)$ and therefore the sentence is true.

This result is clearly unwarranted. It is argued in (von Fintel and Iatridou 2004) that those sentences "*signal that [kiss] is an essential part of a way of achieving [Harlem]*" and that this fact accounts for the oddity of the above mentioned *ought to* sentence. It is quite clear that kissing Pedro Martinez is not an essential part of a way of going to Harlem, that is, for all set P of propositions, if $f(w), P, \{kiss\} \vdash Harlem$ then $f(w), P \vdash Harlem$. Therefore, if we consider that goal-oriented modality is defined by both 4.3.7 and 4.3.8 as (von Fintel and Iatridou 2004), we correctly account for the intuitions. However, I think that in the case of goal-oriented possibility the two-part definition is not what we are after. Consider the following example:

Example 4.3.10. It is a well-known fact about the New York City subway that you can step in a train at every station where you can step out of one and vice versa, that is, taking the A train is an essential part of a way of going to Harlem and going to Harlem is also an essential part of a way of taking the A train. But then, the following two sentences are equivalent:

(24)   a.   To go to Harlem, you can take the A train.
        b.   To take the A train, you can go to Harlem.

First notice that the context makes it obvious that the conditions of 4.3.7 are fulfilled. With respect to definition 4.3.8 (I will use part 2 of the definition as I have not given any explicit ordering source), the truth-conditions of sentences (24-a) and (24-b) are:

---

[24]Pedro Martinez is a successful baseball player.

To Harlem, can A train is true in w relative to b and o *iff*
there is a $v \in C^{b,\{Harlem\}}(w)$ such that $v \in [\![A\ train]\!]^{b,o}$ *iff*
there is a $v \in \cap b(w)$ such that $v \in [\![Harlem]\!]^{b,o}$ and $v \in [\![A\ train]\!]^{b,o}$ *iff*
there is a $v \in C^{b,\{A\ train\}}(w)$ such that $v \in [\![Harlem]\!]^{b,o}$ *iff*
To A train, can Harlem is true in w relative to b and o

This means that according to the definitions (and in the set of worlds just defined), the two sentences are semantically interchangeable. They are equivalent. Definition 4.3.8 is such that the truth of any goal-oriented possibility entails the truth of the reverse goal-oriented possibility (obtained by swapping the goal and the condition: To a, can b becomes To b, can a).

Intuitively we do express different propositions even in the context of example 4.3.10. This example shows that *being an essential part of achieving something* is all there is to goal-oriented possibility.

4.4 Combinations of modals

The last problem concerns the combination of modal items. As we have seen in chapter 2, we can formulate a semantic universal about the possible combinations of modal items.

(25)   Semantic scope of modality: Epistemic > Participant-external > Participant-internal

When multiple modal items are combined in a sentence, the interpretation follows the scope order of (25). Witness the following sentence.

(26)   John may have to pay more taxes.
       a.   It might be the case that John has (will have) the obligation to pay more taxes.
       b.   It might be the case that John has (will have) to pay more taxes (in order to reach some other goal).
       c. #It is allowed that John certainly pays more taxes.

Sentence (26) contains two modals: *may* and *have to*. These two modals are notoriously polyfunctional and we could thus expect that this polyfunctionality would cause ambiguities in the interpretation of sentence (26). However, in accordance with the scope order (25), it is not the case. In (26-a) and (26-b), *may* of (26) is paraphrased with the epistemic *might* and *have to* is paraphrased with the deontic *to have the obligation to* or the goal-oriented *have to* respectively. Similarly in (26-c), *may* of (26) is paraphrased with the deontic *to be allowed* and *have to* is paraphrased with the epistemic adverb *certainly*. However, the only interpretations of (26) possible are (26-a) and (26-b), i.e. *may* is epistemic

and *have to* participant-external.[25] Sentence (26-c) just does not make any sense. The following examples show that the scope order is not restricted to epistemic and deontic modality or even to combinations of only two modals.

(27)   a.   Epistemic > Participant-internal:
              (after such a difficult course) They must be able to prove this theo-
              rem.
        b.   Deontic > Participant-internal:
              They must be able to prove this theorem (otherwise they won't pass).
        c.   Goal-oriented > Participant-internal:
              In order to qualify, you must be able to run the 100 meters in 11
              seconds.
        d.   Epistemic > Participant-external > Partcipant-internal:
              You may have to be able to drive.

Sentence (27-a) involves an epistemic *must* whereas sentence (27-b) has a deontic one, (27-c) a goal-oriented one and sentence (27-d) combines three different modals, two of which are the polyfunctional modals *may* and *have to*. In the same way as for (26), the natural interpretation of sentence (27-d) involves an epistemic *may* and a deontic *have to*. All these English examples as well as the cross-linguistic data from the previous chapter favor the semantic universal (25) about the relative scope of modal items.

After the discussion in 4.1, it should not come as a big surprise that the standard framework does not provide a ready-made solution to the problem of modal combinations. It is mentioned in both (Kratzer 1981, p295) and (Kratzer 1991, p641). In both cases, the reader is referred to (Kratzer 1978) for a discussion of combinations of modals. There is however no explicit discussion of this problem as such, but instead some examples involving combinations of modals are used in (Kratzer 1978, p.144-147) to argue for the analysis of conversational backgrounds as functions from worlds to set of propositions (instead as just sets). The accurate reference is actually (Kratzer 1976).[26] Kratzer (1976, p13-15) proposes a very simple solution which consists in saying that the problem is not real, that is, combinations of deontic modality above epistemic modality are possible.

(28)   Und auch in Zukunft muß diese Schnecke [...] Saugfüße   haben
        and also in future   must this snail   suction.feet have
        können...
        might
        And even in the future, this snail must possibly have suction feet. (Kratzer
        1976, p14)

---

[25]I neglect the possibility of John being a compulsive tax payer, that is, with *have to* as participant-internal necessity.

[26]I would like to thank Kai von Fintel for pointing that out.

The context of the previous sentence is that of a despot willing to control information. It is argued in (Kratzer 1976, p14) that the first modal, *müssen*, is deontic and the second modal, *können*, is epistemic. However, I think that the explanation given for the epistemic reading of the second modal actually shows why this is not a counterexample. What the despot means with (28) is that all the **information** to be provided in the future should be compatible with the snail having suction feet.[27]

(29)   It must be so that, according to the information provided, the snail might have suction feet.

Therefore, the despot puts requirements on the type of information to be provided. The second modal does not stand for the uncertainty of an agent (neither that of the speaker or that of the addressee of the obligation) as a typical epistemic modal would. I will thus not consider this type of examples[28] as a counterexample to the scope order of modality.

On the formal side, the standard analysis faces a problem with combinations of modals. First, definition 3.1.13 doesn't make clear what should happen in case two modals occur in the same construction. The following options seem however possible:

1. There is only one modal base b and ordering source o.

2. There are two pairs of modal base and ordering source, one for each modal: (b_1, o_1) and (b_2, o_2).

Obviously, option 1 will not be able to explain the interpretation of sentence (26) as two different interpretive types are present in the salient reading. This leaves us with no other choice than option 2. We can rephrase definition 3.1.13 to fit example (26) as follows:

Definition 4.4.1 (Combinations of modals)**.** For any sentence S (possibly modal), world w, and pairs (b_1, o_1) and (b_2, o_2).

'it may be that S' is true in w relative to (b_1, o_1) and (b_2, o_2) *iff*
S is true in at least one of the worlds of $C^{b_1, o_1}(w)$ with respect to b_2 and o_2.

---

[27]As (Kratzer 1976, p14) puts it: "...Philophys [name of the despot] befiehlt, daß alle ihm in Zukunft vorgelegten Berichte so sein müssen, daß sie es nicht ausschließen, daß Paryphanta Hochstetteri [name of the snail] Saugfüße hat."

[28]Another way to construct such examples is to use a mental state predicate between the two modals or to force the availability of an agent for the epistemic modal (with for instance an overt conversational background):

(i)   a.   John must believe I might come.
       b.   It must be so that, according to John, I might come.

   If we apply this definition to sentence (26), we obtain that (26) is true in world w relative to (b_1,o_1) and (b_2,o_2),

   iff there is a world $w' \in C^{b_1,o_1}(w)$ where 'John must pay more taxes' is true with respect to b_2 and o_2,

   iff there is a world $w' \in C^{b_1,o_1}(w)$ such that 'John pays more taxes' is true in all the worlds of $C^{b_2,o_2}(w')$.

Assume we have two pairs of contextual parameters (b_1,o_1) and (b_2,o_2) and that one is epistemic and the other deontic. If (b_1,o_1) is epistemic, we obtain reading (26-a). If (b_1,o_1) is deontic, we obtain reading (26-c). The analysis provided so far does not prohibit reading (26-c). There is no special status attached to the fact of being an epistemic or a deontic modal base: both are just functions from worlds to sets of propositions. The analysis treats epistemic and deontic sentences in a uniform way but this is precisely what causes a problem here.

   A straightforward solution would be to stipulate somehow that the contextual parameters are ordered as in (25). The epistemic context would then be triggered before the participant-external one in definition 4.4.1. But obviously, a mere stipulation is not completely satisfying.

   Notice that the extension of the standard framework proposed by (Brennan 1993) will not solve the problem either. To be more precise, it can only solve part of the problem. S-operators cannot scope under VP-operators. Remember the distinction from example (21): S-operators take a sentence as argument whereas VP-operators take an intransitive verb phrase.

(21)   a.   John must be home.   (epistemic)
              $\text{must}_{\text{S}}(\textit{John is home})$
        b.   John must pay taxes.   (VP-deontic)
              $(\text{must}_{\text{VP}}(\lambda x.x \text{ pays taxes}))(\textit{John})$

(30)   John may have to pay more taxes.

        a.   Epistemic > deontic:
              $\text{may}_{\text{S}}((\text{must}_{\text{VP}}(\lambda x.x \text{ pays more taxes}))(\textit{John}))$
        b.   Deontic > epistemic:
              $\#(\text{may}_{\text{VP}}(\text{must}_S(\lambda x.x \text{ pays more taxes})))(\textit{John})$
              $\#(\text{may}_{\text{VP}}(\text{must}_S(\textit{John pays more taxes})))(\cdots)$

The result is quite trivial. Epistemic modals are sentence operators and therefore can embed other modal sentences such as participant-external and internal ones as (30-a) shows. But with this analysis, an interpretation of example (30) as a deontic modal having scope over an epistemic one is blocked because the sentence would then not be semantically well-formed. The possible interpretations are shown in (30-b). Either the epistemic modal has to take as argument an intransitive verb phrase (which is not possible) or it takes the whole sentence in

its scope and the deontic modal may$_{\text{VP}}$ has to take as argument a whole sentence (which is not possible).

However this analysis fails to cover the whole range of data. First, we have seen that Brennan (1993) acknowledges that some deontic modals are S-operators. Therefore the analysis cannot explain with the same argument why the following sentence is ruled out.

(31) #Tax forms have to maybe be filled out in ink.   (deontic > epistemic)
      must$_{\text{S}}$(may$_{\text{S}}$(*tax are filled out in ink*))

Finally, the rationale for this analysis makes only sense for languages that have modals with a raising/control distinction. Brennan's analysis was made with respect to English but it has since convincingly been argued in (Wurmbrand 1999) and (Wurmbrand and Bobaljik 1999) that the English modal verbs all involve raising. Furthermore we have seen that in a language like Tuvaluan even participant-internal modals clearly involve raising. This makes clear that an analysis based on the control/raising distinction will thus not be suited to account for the cross-linguistic data.

Chapter 5
Update semantics framework

In this chapter I will develop a semantics of modality tailored to address the problem of combinations of modal items. As we have seen in the previous chapters, the interpretation of these combinations follows a certain scope order. Furthermore, this scope order is not easily accounted for from the perspective of the standard framework. The (presumably) universal nature of the scope order is the main incentive to depart from the standard framework and develop a new system. This new framework will provide a toy example of the mechanisms at hand. Obviously I do not aim for complete coverage of all the diversity found in the data chapter as well as most of the subtle nuances of meaning that are inherent to modal expressions. I will nevertheless try to hint at possible improvements whenever possible.

First, let us remember the typology of modality we begun with:

Participant-internal	Participant-external		Epistemic
	Deontic	Goal-oriented	
Ability	Permission	Possibility	Possibility
Needs	Obligation	Necessity	Necessity

With respect to this typology, the strength of the standard framework is to offer a uniform analysis of modality. All three kinds of modality rely on the same basic interpretation. However, this strength is also its weakness when it comes to combinations of modals as we have seen that there is no direct explanation for the scope order restriction when we posit a uniform framework.

The framework I will present is in the line of update systems of (Veltman 1996). The main difference between an update framework and a truth-conditional one can be first grasped by a comparison of the slogans. The slogan of the truth-conditional semantics of the previous chapter was,

> *"you know the meaning of a sentence if you know the conditions under which it is true"*

whereas the slogan of update semantics frameworks is,

> *"you know the meaning of a sentence if you know the change it brings about in the information state of anyone who accepts the news conveyed by it."*

The crucial departure from the traditional framework is that we now model the (change of) information of an (idealized) agent. That is, the update system models the effect of sentences/propositions on the information of an agent. To define an update system we need three ingredients: a language, a set of information states and an update function.

Definition 5.0.2 (Update system (Veltman 1996))**.** An update system is a triple $\langle L, \Sigma, [\,] \rangle$ with L a language, Σ a set of information states and $[\,] : L \to (\Sigma \to \Sigma)$ a function that assigns to each sentence φ an operation $[\varphi]$ from states to states.

I will first describe a simple framework for epistemic and deontic modality. This framework is simple enough to make clear what the basic idea of the system is.

5.1   Epistemic and deontic modality

This system is only meant to describe a first semantics of epistemic modality (namely epistemic *might*) and the deontic modals *may* and *must* within an update framework. The system will be propositional, like the truth-conditional framework presented in chapter 3. This is of course an idealization but it is enough to account for the main intuitions.

The definition of an update system is quite straightforward: the first step is to define the syntax of its (formal) language. That is in line with the traditional methodology in formal linguistics that consists in giving a precise formulation of the syntax of the language studied, then its semantics and finally turning to pragmatic considerations.

However, this methodology is not tenable in our current situation! The main intuition is that the property to be accounted for (the scope hierarchy) is intimately intertwined with the architecture of our system, and in particular with the architecture of the information states. As such, the prediction would actually be that the structure of the system and the semantics of modal expressions restrict the range of "felicitous sentences" with modal combinations. That is, predictions about syntax (or grammaticality) would actually be the end product of the analysis. It is therefore problematic and, in this setup, counterintuitive to begin with a precise syntactic definition. Formally, the syntax of the language will not be specified, although its ingredients can be explicitly given. Summing up, we will not define the notion of grammatical or syntactic well-formedness but will consider all possible strings of symbols alike. Which strings of symbols are interpretable will then be decided by the meaning of those symbols.

Definition 5.1.1 (Ingredients of the language). $\mathcal{D}$ is a set of atomic declarative sentences. We also have the usual boolean connectives: negation $\neg\varphi$, conjunction $\varphi \wedge \psi$ and disjunction $\varphi \vee \psi$ as well as the conditional 'ifφ, ψ', the epistemic mightφ and the deontic mayφ and mustφ.

As I just mentioned the crucial step in the definition of the update system is made in the design of the information states. We have seen that the main problem of the standard framework is that epistemic and deontic modals are defined in a unified fashion. This is not only problematic for an account of combinations of modal items but also, for instance, in the case of deontic conditionals. The problem as we characterized it was that deontic information should not depend on accessible worlds but should be an integral part (though of a different nature) of any world/situation. One way to implement this idea is to say that the notion of a world is too coarse for the task at hand and that under the notion of a "world" falls two distinct types of information: factual information and deontic information.

standard framework :   world

our framework :   (factual information   ,   deontic information)
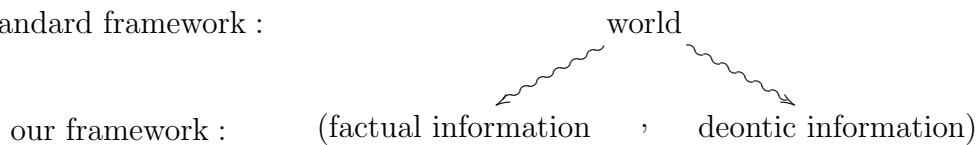
That kind of move has already been illustrated for imperatives in (Portner 2003) and (Mastop 2005) through the use of To-Do lists. Intuitively, the idea is that deontic modals operates on a different level of information. The basic unit is not a world anymore but a possibility, that is, a pair consisting of a *situation* and a *deontic plan*.

Definition 5.1.2 (Possibilities). A possibility is a pair (s, δ) consisting of a situation s and a non-empty deontic plan δ.

I will first explain the difference between a *world* and a *situation*. Intuitively, a world is specified by giving the totality of facts that are true in it, therefore if we take a set of basic sentences as primitive, a world is a total characteristic function of this set, i.e. a function $w : \mathcal{D} \to \{0, 1\}$. Therefore a world decides every possible declarative sentence. Obviously, this is a very strong commitment if a world is supposed to represent the information (or shared information) available for an agent (a set of agents respectively). Here, the change in terminology is also a change in practice. A situation is not meant to decide every sentence but only to represent the part of the world an agent is aware of in some circumstances. Therefore formally, a situation is a set of pairs consisting of an atomic declarative and a "truth value."

Definition 5.1.3 (Situations). A situation is a subset s of $\mathcal{D} \times \{1, 0\}$.[1]

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[1] As can be expected, 1 stands for true and 0 for false.

Notice that situations are not partial functions but sets of pairs. That is, a situation can contain one and the same atomic declarative in two different pairs, i.e. as true and false. Furthermore, a situation need not be informed about all possible atomic declaratives, but can represent just those declarative sentences the holder of the information state is aware off.

Deontic plans will serve a similar purpose as to-do lists in (Mastop 2005).[2] That is, they are the recipient of deontic information. However, to-do lists in the work of the previously cited authors are basically simple sets (of properties and of atomic imperatives respectively). This works fine as long as the intention is to model imperatives only. But this is not going to work easily now that we have two kinds of deontic statements possible, i.e. obligations and permissions. Both kinds of statements should be easily read off the deontic plan associated with a possibility. To solve this problem, it is enough to model the deontic plans as sets of to-do lists. In (Portner 2003) and (Portner 2007), to-do lists are sets of properties (bound to an agent). As we restrict ourselves to a kind of propositional framework, it is simple enough to let to-do lists be of the same form as situations.

Definition 5.1.4 (Deontic plans and to-do lists)**.** A to-do list is a subset of $\mathcal{D} \times \{1, 0\}$. A deontic plan is a set δ of to-do lists.

Notice that there is still a major difference between Portner's definition of a to-do list and deontic plans. As I just mentioned, Portner's to-do lists are bound to an agent which, in our framework, wouldn't necessarily be the same as the one of the information state at hand. Therefore, the deontic plan as it is defined in 5.1.4 actually represents the known deontic information about possibly different agents. It is as such much more similar to the standard framework. However, the present framework can be extended without much trouble[3] to deal with agents in the same fashion as the framework of (Portner 2007) (by binding deontic plans to agents). As it arguably does not influence the problem of combinations of modals, for the sake of simplicity I will not distinguish between agents' deontic plans.

Deontic plans are thus the recipients of deontic information and are made of to-do lists. The deontic plans are best seen as guidelines for actions (or at this stage of the formalization as guidelines for states of affairs to be reached). In order to be morally good, the agent must fulfill some part of its deontic plan. This means that he must at least fulfill one of the to-do lists in his deontic plan.[4]

Example 5.1.5 (Deontic plans)**.** The following sets are examples of deontic plans. I will also use sometimes a more visual representation of to-do lists based on the

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[2]The framework developed in (Mastop 2005) was partly inspired by the notion of to-do list of (Portner 2003) and unpublished work of Frank Veltman. There is however a difference in implementation as the last framework is a static truth-conditional framework.

[3]Mainly at the expense of more complicated definitions.

[4]I abstract here from the fact that there might be uncertainty about deontic plans too.

idea that a to-do list contains things you have to do $\langle d, \underline{1} \rangle$ and things you must not do $\langle d, \underline{0} \rangle$. This notation is most useful when a lot of sentences are present in the to-do list.

	do's	don'ts
to-do list:	⋮	⋮
	⋮	⋮

1. $\{\{\langle a, 1 \rangle\}\} = \{\;\boxed{\;a\;\;}\;\}$ is a deontic plan with only one to-do list containing only one atomic declarative (positively): it represents an obligation to do a.

2. $\{\{\emptyset\}, \{\langle a, 1 \rangle\}\} = \{\;\boxed{\;\;\;\;}\;,\;\boxed{\;a\;\;}\;\}$ contains two to-do lists: the empty one and $\{\langle a, 1 \rangle\}$. As the empty to-do list is part of the deontic plan this means that there are no obligations, i.e. doing nothing is morally acceptable/desirable. Furthermore, a is permitted.

3. In $\{\{\langle a, 1 \rangle, \langle b, 1 \rangle\}, \{\langle b, 1 \rangle, \langle c, 0 \rangle\}, \{\langle b, 1 \rangle\}\} = \{\;\boxed{\begin{smallmatrix} a \\ b \end{smallmatrix}\;\;}\;,\;\boxed{\;b\;|\;c\;}\;,\;\boxed{\;b\;\;}\;\}$, b is an obligation as it is present in all to-do lists. Furthermore, it is the only obligation and the other declaratives are thus permissions.

We have now defined possibilities and can finally turn to information states which are, as is standard in update semantics, sets of possibilities.

Definition 5.1.6 (Information states)**.** An information state σ is a set of possibilities.

Before we turn to the definition of the update functions, I will give some examples of possibilities.

Example 5.1.7 (Possibilities and the minimal information state)**.** Consider a simple language based on the set $\mathcal{D} = \{p, q, r\}$ of simple declarative sentences. We can single out some interesting "types" of possibilities (s, δ):

1. The minimal possibility is $(\emptyset, \{\emptyset\})$ consisting of an empty situation $\emptyset$ (there are no known facts) and of an empty deontic plan $\{\emptyset\}$ (there is no known deontic information), i.e. a plan having as only to-do list the empty to-do list $\emptyset$.

2. $(\{\langle p, 1 \rangle, \langle q, 1 \rangle, \langle r, 0 \rangle\}, \{\emptyset\})$ is a possibility with a situation with complete factual information and an empty deontic plan. The situation amounts to a world in the truth-conditional framework.

3. $(\{\langle q, 1 \rangle\}, \{\emptyset, \{\langle p, 1 \rangle\}\}), (\{\langle p, 0 \rangle, \langle r, 1 \rangle\}, \{\{\langle p, 1 \rangle, \langle r, 0 \rangle\}, \{\langle p, 1 \rangle\}\})$ are two possibilities with non-empty situations and deontic plans.

4. $(\{\langle q, 1\rangle, \langle q, 0\rangle, \langle r, 1\rangle\}, \{\emptyset, \{\langle p, 1\rangle\}\})$ is a possibility with a situation containing contradictory information (about q).

5. $(\{\langle p, 0\rangle\}, \{\{\langle p, 1\rangle\}, \{\langle p, 1\rangle, \langle r, 0\rangle\}, \{\langle p, 1\rangle, \langle p, 0\rangle\}\})$ is a possibility with a deontic plan containing a to-do list with contradictory information (about p).

Information states are thus sets of possibilities. A special information state is the minimal information state, that is, the information state with the least (consistent) information possible. The minimal information state $\mathbf{0}$ is the state containing only the minimal possibility, i.e. $\mathbf{0} = \{(\emptyset, \{\emptyset\})\}$.

Obviously, the last two possibilities of example 5.1.7 are special in a negative way. They both describe contradictory information. On the one hand, a situation that takes a particular sentence to be both true and false is an impossible situation. On the other hand, there is no intuitive rationale yet for deciding that a deontic plan with an impossible to-do list (remember that at this point in the formalization to-do lists and situations are the same kind of objects) is an impossible deontic plan, but this will fall out of the definition of updates with deontic sentences. The main concept at hand here is the consistency of a situation or to-do list.

Definition 5.1.8 (Consistency)**.** A situation or to-do list s is consistent iff there is no $a \in \mathcal{D}$ such that $\langle a, 1\rangle$ and $\langle a, 0\rangle$ belong to s.

Example 5.1.9. Remember the list notation of to-do lists: the empty to-do list is ☐☐. A to-do list that is a superset of $\boxed{a\ |\ a}$ for some $a \in \mathcal{A}$ is not consistent.

Therefore, the last two possibilities of example 5.1.7 are such that the situation of the first is not consistent and that the deontic plan of the second contains a to-do list that is not consistent. The idea is that when an information state contains a possibility that is either not consistent because of its situation or because of a to-do list of its deontic plan, something has gone wrong with our information. In the first case, the factual information is not consistent while in the second, the deontic information is not consistent. Within the update semantics tradition, this means that there are two ways to be in an absurd information state.

Definition 5.1.10 (Absurd information state)**.** The absurd state is a set of states denoted by $\bot$. It is defined as follows:

- $\emptyset \in \bot$, $\Lambda = \{\emptyset\} \in \bot$,

- for any information state σ, $\sigma \cup \Lambda \in \bot$.

The empty set characterizes failure through factual information, while Λ stands for failure through deontic information.[5]

---

[5]I will develop the notion of failure through deontic information later on when discussing the updates with deontic modals.

Although formally the absurd state is a set of states, I will for simplicity refer to it as an information state.

There are two differences between the update semantics framework of (Veltman 1996) and the one presented here. Firstly, factual information is partial. We moved from worlds to situations that just render some small set of facts. The consequence is that the system will not be eliminative but additive, and is best modeled with not one but two "update" functions: a positive update and a negative update.[6] Secondly, the updates operate not only on information states but also on deontic plans as a result of the split in types of information. I will present the update functions with declarative sentences, the boolean connectives, the conditional and finally with the modal items after having introduced the key concept of acceptance.

Definition 5.1.11 (Acceptance).

- A sentence φ is accepted by the information state σ (write $\sigma \Vdash \varphi$) *iff* $\sigma \uparrow \varphi = \sigma$

- For φ and ψ two sentences, $\varphi \Vdash \psi$ *iff* for any information state σ, ψ is accepted by $\sigma \uparrow \varphi$.

Acceptance is what replaces the notion of entailment of the truth-conditional framework in update semantics. Basically, a sentence is accepted in an information state when it does not add any new information to it.

Definition 5.1.12 (Sentential update of information states). Take $p \in \mathcal{D}$, and σ an information state.[7]

$$\sigma \uparrow p = \{(s \cup \{\langle p, 1\rangle\}, \delta) \mid (s, \delta) \in \sigma \ \& \ s \cup \{\langle p, 1\rangle\} \ consistent\}$$
$$\sigma \downarrow p = \{(s \cup \{\langle p, 0\rangle\}, \delta) \mid (s, \delta) \in \sigma \ \& \ s \cup \{\langle p, 0\rangle\} \ consistent\}$$

Therefore, updating one's information state with a declarative sentence is adding positively the sentence consistently to the situations of the possibilities: p is the case in the resulting information state. Downdating is then a similar operation but adds the sentence negatively: p is not the case in the resulting information state. Finally, it is important to see that updating and downdating with atomic sentences does not bring any change in the deontic information.

Example 5.1.13. Consider a simple language based on the set $\mathcal{D} = \{p, q\}$ of simple declarative sentences; we have then the following:

1. $\mathbf{0} \uparrow p = \{(\{\langle p, 1\rangle\}, \{\emptyset\})\}$; $\mathbf{0} \uparrow p = \mathbf{0} \uparrow p \uparrow p$.

---

[6]I will often use the bare term *update* to refer to *positive update* and the term *downdate* to refer to a *negative update*. It should however be clear to the reader that the term *downdate* is not meant to suggest a kind of revision.

[7]I will follow the traditional practice in update semantics and invert the correct notation by writing $\sigma \uparrow p$ instead of $[p]_{up}(\sigma)$ (and obviously $\sigma \downarrow p$ instead of $[p]_{down}(\sigma)$).

2. $(\mathbf{0} \downarrow q) \uparrow p = \{(\{\langle p,1 \rangle, \langle q,0 \rangle\}, \{\emptyset\})\}.$

3. $((\mathbf{0} \downarrow q) \uparrow p) \uparrow q = \perp$ because the only possibility we obtain with the update, $\{\langle p,1 \rangle, \langle q,0 \rangle, \langle q,1 \rangle\}$, is not consistent.[8]

4. $(\mathbf{0} \uparrow p) \downarrow p = (\mathbf{0} \downarrow p) \uparrow p = \perp.$

As this example makes clear, the sequential use of an update and a downdate with the same sentence leads to the absurd state. This is quite clearly the behavior that we expect for a sequential update of a sentence and its negation. That is, the crucial role of negation is to make a switch in update function. I will now introduce the up- and downdates for the boolean connectives. Notice that, in contrast to the update with atomic sentences (that only change the information of situations, i.e. about facts in the world), the up- and downdates with the boolean connectives are defined on information states as well as on deontic plans in the same manner. This is not problematic as both entities, information states and deontic plans, are themselves defined as sets of objects (possibilities and to-do lists respectively).

Definition 5.1.14 (Boolean connectives)**.** Let χ be an information state or a plan, and φ a (possibly complex) sentence.

$$
\begin{array}{rclcrcl}
\chi \uparrow \neg\varphi & = & \chi \downarrow \varphi & \quad & \chi \downarrow \neg\varphi & = & \chi \uparrow \varphi \\
\chi \uparrow (\varphi \vee \psi) & = & (\chi \uparrow \varphi) \cup (\chi \uparrow \psi) & \quad & \chi \downarrow (\varphi \vee \psi) & = & (\chi \downarrow \varphi) \downarrow \psi \\
\chi \uparrow (\varphi \wedge \psi) & = & (\chi \uparrow \varphi) \uparrow \psi & \quad & \chi \downarrow (\varphi \wedge \psi) & = & (\chi \downarrow \varphi) \cup (\chi \downarrow \psi)
\end{array}
$$

The rules of update and downdate are easily explained. I will begin with the rules for negation. Updating with the negation of a sentence is downdating with the sentence without negation. Thus in the case of simple declarative sentences, if someone accepts the sentence $\neg p$, he is willing to add $\langle p,0 \rangle$ (i.e. "p is not the case") to his information state. And downdating with the negation of a sentence is updating with the sentence without negation.

Example 5.1.15 (Negation)**.** Let $p \in \mathcal{D}$, φ be a sentence and σ an information state.

1. $\mathbf{0} \uparrow \neg p = \mathbf{0} \downarrow p = \{(\{\langle p,0 \rangle\}, \{\emptyset\})\}.$

2. $\mathbf{0} \downarrow \neg p = \mathbf{0} \uparrow p = \{(\{\langle p,1 \rangle\}, \{\emptyset\})\}.$

3. $(\mathbf{0} \uparrow \varphi) \uparrow \neg\varphi = (\mathbf{0} \uparrow \neg\varphi) \uparrow \varphi = \perp; (\mathbf{0} \downarrow \varphi) \downarrow \neg\varphi = (\mathbf{0} \downarrow \neg\varphi) \downarrow \varphi = \perp.$

---

[8]Notice that formally, we should write here that $((\mathbf{0} \downarrow q) \uparrow p) \uparrow q = \emptyset \in \perp$, but as already mentioned, I will mostly treat the absurd state as an information state (even though it is a set of information states). I will only be more precise when I want to stress the type of failure that leads to the absurd state.

The update of a conjunction is also straightforward: it is the sequential update of the first and the second conjunct.

Example 5.1.16 (Update with conjunction). Let p, $q \in \mathcal{D}$, φ be a sentence and σ an information state.

1. $\mathbf{0} \uparrow (p \wedge q) = (\mathbf{0} \uparrow p) \uparrow q = \{(\{\langle p, 1\rangle, \langle q, 1\rangle\}, \{\emptyset\})\}$.

2. $\mathbf{0} \uparrow (\varphi \wedge \neg\varphi) = \mathbf{0} \uparrow (\neg\varphi \wedge \varphi) = \bot$.

It is important to notice that although the updates and downdates so far literally add information, they are eliminative at the possibility level. There is information growth at the level of the information state that correlates with the possible elimination of possibilities. Atomic updates, negation and conjunction (of simple declarative sentences) can only decrease the number of possibilities in an information state. This is different in the case of the update with disjunction. The update with a disjunction is the union of the updates with the disjuncts and therefore, if the updates with both disjuncts do not lead to the absurd state (and add new information), it adds new possibilities to the resulting update. Disjunctions can be a source of uncertainty.

Example 5.1.17 (Disjunction). Let p, $q \in \mathcal{D}$ and σ be an information state.

1. $\mathbf{0} \uparrow (p \vee q) = (\mathbf{0} \uparrow p) \cup (\mathbf{0} \uparrow q) = \{(\{\langle p, 1\rangle\}, \{\emptyset\}), (\{\langle q, 1\rangle\}, \{\emptyset\})\}$.

2. $\mathbf{0} \uparrow (p \vee \neg p) = (\mathbf{0} \uparrow p) \cup (\mathbf{0} \downarrow p) = \{(\{\langle p, 1\rangle\}, \{\emptyset\}), (\{\langle p, 0\rangle\}, \{\emptyset\})\}$.

3. $(\mathbf{0} \uparrow \neg q) \uparrow (p \vee q) = \{(\{\langle q, 0\rangle\}, \{\emptyset\})\} \uparrow (p \vee q) = \{(\{\langle q, 0\rangle\}, \{\emptyset\})\} \uparrow p \cup \{(\{\langle q, 0\rangle\}, \{\emptyset\})\} \uparrow q = \{(\{\langle p, 1\rangle, \langle q, 0\rangle\}, \{\emptyset\})\}$.

Finally, the downdates of conjunction and disjunction are defined so as to respect the following intuitive equivalences $\varphi \vee \psi \equiv \neg(\neg\varphi \wedge \neg\psi)$ and $\varphi \wedge \psi \equiv \neg(\neg\varphi \vee \neg\psi)$. In the case of the first equivalence the explanation goes as follows: the downdate with $\varphi \vee \psi$ is a downdate with $\neg(\neg\varphi \wedge \neg\psi)$, but a downdate with negation is an update with the non-negated formula, i.e. an update with $\neg\varphi \wedge \neg\psi$. The last formula is a conjunction and therefore the original downdate is actually the consecutive update with $\neg\varphi$ and $\neg\psi$, that is, the consecutive downdate with φ and ψ. The same sort of explanation can be given for the second equivalence.

Definition 5.1.18 (Conditional). Let χ be an information state or a deontic plan,[9] and φ and ψ (possibly complex) sentences.

$$\chi \uparrow \text{if } \varphi, \psi \quad = \quad \chi \downarrow \varphi \cup \chi \uparrow \varphi \uparrow \psi$$

i.e. if φ, $\psi \equiv \neg\varphi \vee (\varphi \wedge \psi)$.

---

[9]This will disappear from the final analysis as I do not believe that genuine conditionals appear under deontic operators, but I do not want to rule out this possible combinations yet.

The reader is probably wondering why a conditional operator is needed when a conditional could simply be defined as in the truth-conditional framework as $\varphi \rightarrow \psi \equiv \neg\varphi \vee \psi$.

	φ	ψ	$\varphi \rightarrow \psi$	
	1	1	1	$\longleftrightarrow \psi$
	1	0	0	
$\neg\varphi \longleftrightarrow$	0	1	1	$\longleftrightarrow \psi$
$\neg\varphi \longleftrightarrow$	0	0	1	

The point is that the standard framework is in some sense an eliminative framework, i.e. we have complete information about the truth conditions of sentences in worlds (even though we might not know in which world we are). The update system I have introduced so far is however not eliminative but additive. In such a system adding the same kind of information twice matters. As we can see in the above truth table for the conditional, by defining a conditionals as $\neg\varphi \vee \psi$ we create overlapping conditions in the case the antecedent is false and the consequent is true (i.e. third line of the truth table). This has no consequence in the truth-conditional framework but is problematic in this update system: were we to learn that $\neg\varphi$ is actually the case (i.e. update with $\neg\varphi$), we would then have a bias toward ψ (versus $\neg\psi$).

Example 5.1.19. Let p and $q \in \mathcal{D}$.

1. $\mathbf{0} \uparrow (\neg p \vee q) = \mathbf{0} \downarrow p \cup \mathbf{0} \uparrow q = \{(\{\langle p, 0\rangle\}, \{\emptyset\}), (\{\langle q, 1\rangle\}, \{\emptyset\})\}$.

2. $(\mathbf{0} \uparrow (\neg p \vee q)) \uparrow \neg p = \{(\{\langle p, 0\rangle\}, \{\emptyset\}), (\{\langle p, 0\rangle, \langle q, 1\rangle\}, \{\emptyset\})\}$.

The chosen definition of the conditional singles out all the different cases of the truth-conditional framework but does this only once each time. Therefore, the redundancy in the case the antecedent is false and the consequent is true is only expressed once.[10]

			φ	ψ	$\varphi \rightarrow \psi$
$\sigma \uparrow \varphi \uparrow \psi$	update with φ and ψ	$\longleftrightarrow$	1	1	1
			1	0	0
	downdate with φ leaves open	$\longleftrightarrow$	0	1	1
$\sigma \downarrow \varphi$	up/downdates with ψ	$\longleftrightarrow$	0	0	1

Example 5.1.20. Let p and $q \in \mathcal{D}$.

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[10]The same effect can be achieved by defining the conditional as if $\varphi, \psi \equiv ((\neg\varphi \wedge \psi) \vee (\neg\varphi \wedge \neg\psi)) \vee (\varphi \wedge \psi)$. But I will argue this version is less intuitive, in particular when the consequent is a non-epistemic modal.

1. $\mathbf{0} \uparrow$ if p, $q = \mathbf{0} \downarrow p \cup (\mathbf{0} \uparrow p) \uparrow q = \{(\{\langle p, 0 \rangle\}, \{\emptyset\}), (\{\langle p, 1 \rangle, \langle q, 1 \rangle\}, \{\emptyset\})\}$.

2. $(\mathbf{0} \uparrow$ if p, $q) \uparrow \neg p = \{(\{\langle p, 0 \rangle\}, \{\emptyset\})\}$.

We can see with examples 5.1.19 and 5.1.20 that the update with a conditional if φ, ψ is indeed different from an update with $\neg\varphi \vee \psi$. Although both formulas $(\neg\varphi \vee (\varphi \wedge \psi)$ and $\neg\varphi \vee \psi)$ are truth-conditionally equivalent in propositional logic, this is not any more the case in this update system.

I will now introduce the update with epistemic possibility.[11] In simple terms, an update with *might* adds to the information state a copy of itself where the embedded sentence is the case. Furthermore, the definition is meant to be compatible with the insight of (Groenendijk, Stokhof and Veltman 1996) that *might* functions as a test on the information state but improves on it by stating that one can become aware of a new possibility with an epistemic possibility. The crucial property of epistemic modality is that it operates on whole information states, i.e. on the knowledge of the agent.

Definition 5.1.21 (Epistemic possibility). Let φ be a sentence.[12]

$$\sigma \uparrow \text{ might } \varphi = \begin{array}{l} \sigma \cup \sigma \uparrow \varphi \quad \text{if } \sigma \text{ is an information state such that } \sigma \uparrow \varphi \notin \bot, \\ \bot \text{ otherwise} \end{array}$$

We can now turn to the definitions of the updates with deontic information. Recall that we split the traditional unit of information, the world, into two distinct pieces, a situation and a deontic plan. Formally a deontic plan is made of to-do lists which, so far, are the same kind of entities as situations (that is, sets of pairs of sentences and "truth values"). The idea is that a to-do list in a deontic plan represents a set of morally desirable state of affairs. A deontic plan may contain different to-do lists and the agent may choose freely which to-do list(s) to fulfill (or not).

Notice that at this point it is not possible to represent different holders of obligations/permissions and thus any sentence in a to-do list is interpreted as a

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[11]Epistemic necessity will not be discussed and is left for future work. Its definition would probably be similar to the defaults in (Veltman 1996).

[12]We could thus stay closer to the original insight by defining for instance epistemic possibility as follows:

$$\sigma \uparrow \text{ might } \varphi \quad = \quad \begin{array}{ll} \sigma & \text{if } \sigma \uparrow \varphi \cap \sigma \neq \emptyset \\ \sigma \cup \sigma \uparrow \varphi & \text{if } \sigma \uparrow \varphi \cap \sigma = \emptyset \text{ and } \sigma \uparrow \varphi \notin \bot \\ \bot & \text{otherwise} \end{array}$$

where the update is a test if the information is already part of the information state. There are surely many ways to model epistemic possibility even better but the main insight and property that is relevant for this work is that it operates on information states. I will therefore use this simple definition.

desirable state of affairs for the addressee (even though the obligation/permission might not be directed at the addressee).

A deontic plan is a set of to-do lists. Therefore, its update with some atomic declarative sentence will result in the set of to-do lists to which we add this declarative much as in the case of the update of a whole information state with an atomic declarative. The only difference is that the update with atomic declaratives does not check for consistency and we therefore need to define the notion of a consistent deontic plan. The downdate is then defined as can be expected.

Definition 5.1.22 (Simple deontic information). Let δ be a deontic plan and $a \in \mathcal{D}$.

$$\begin{aligned}
\delta \uparrow a &= \{t' \mid t' = t \cup \{\langle a, 1 \rangle\} \; for \; some \; t \in \delta\} \\
\delta \downarrow a &= \{t' \mid t' = t \cup \{\langle a, 0 \rangle\} \; for \; some \; t \in \delta\}
\end{aligned}$$

Definition 5.1.23 (Consistent part of a deontic plan). Let δ be a deontic plan.

$$(\delta)_{cons} = \{t \in \delta \mid t \; is \; consistent\}$$

Example 5.1.24 (Some updates of deontic plans). Let $a, b \in \mathcal{D}$ be some simple declaratives.

1. $\{\;\boxed{\vdots\,|\,\vdots}\;, \ldots, \boxed{\vdots\,|\,\vdots}\;\} \uparrow a = \{\;\boxed{\begin{smallmatrix}a\\\vdots\end{smallmatrix}\,|\,\vdots}\;, \ldots, \boxed{\begin{smallmatrix}a\\\vdots\end{smallmatrix}\,|\,\vdots}\;\}$

2. $\{\;\boxed{\vdots\,|\,\vdots}\;, \ldots, \boxed{\vdots\,|\,\vdots}\;\} \downarrow a = \{\;\boxed{\vdots\,|\,\begin{smallmatrix}a\\\vdots\end{smallmatrix}}\;, \ldots, \boxed{\vdots\,|\,\begin{smallmatrix}a\\\vdots\end{smallmatrix}}\;\}$

3. $(\{\;\boxed{\,|\,}\;, \boxed{\,|\,a}\;\} \uparrow a)_{cons} = (\{\;\boxed{a\,|\,}\;, \boxed{a\,|\,a}\;\})_{cons} = \{\;\boxed{a\,|\,}\;\}$

4. $\{\;\boxed{\,|\,}\;\} \uparrow (a \vee b) = \{\;\boxed{\,|\,}\;\} \uparrow a \cup \{\;\boxed{\,|\,}\;\} \uparrow b = \{\;\boxed{a\,|\,}\;\} \cup$
$\{\;\boxed{b\,|\,}\;\} = \{\;\boxed{a\,|\,}\;, \boxed{b\,|\,}\;\}$

The main question is thus when such an update takes place. The answer is obviously that those updates are triggered by deontic modal operators. But before turning to the update rules for modal operators I would like to make the ideas behind the formalization clear. First, remember that at this stage we abstract from the fact that we deal with a particular agent's information state and thus treat the deontic information much as in the standard framework as representing all the relevant obligations and permissions in a uniform fashion irrespectively of their bearer. Thus a deontic plan is a moral guideline for permissible and mandatory actions/states of affairs to be reached. As those deontic plans are sets of to-do lists, the guideline is that a moral agent has to try to fulfill at least one of the to-do lists in the deontic plan. A simple obligation is thus best represented by a pair of an atomic declarative and a truth value (i.e. $\langle a, 1 \rangle$) present in every

to-do list of the deontic plan whereas a permission is such a pair that is present in only some to-do list(s).

I will now give some discourse effects that need to be incorporated in the framework.

(1)   a.   You may take an apple... # You must not take an apple.
         b.   You must take an apple... # You're allowed not to take an apple.

(2)   a.   You must not go to the movies.... # Maybe you may go to the movies.
         b.   You're allowed not to go to the movies... # Maybe you must go to the movies.

(3)   a.   If it rains, you may go to the movies. # You must not go to the movies.
         b.   If it rains, you must go to the movies. # You're allowed not to go to the movies.

(4)   a.   If it rains, you may go to the movies. # Maybe you may not go to the movies.
         b.   If it rains, you must go to the movies. # Maybe you don't have to go to the movies.

What is clear from examples (1), (2), (3) and (4) is that someone cannot update his information state successfully with the second sentence if his state supports the first. That is, one cannot update successfully with the second sentence without giving up somehow the first (but that is some kind of revision and is a whole different problem). For instance in example (1-a), one cannot accept to have the obligation to refrain from taking an apple when one already has the permission to take one, without giving up this permission. The same observation holds in the case of conditional obligations and permissions as in example (3). Furthermore example (3) also shows that modus tollens is not a valid argument with deontic information. More precisely the argument schema cannot be used as the update with the second sentences in (3) leads to the absurd state (which thus makes the argument vacuously valid in update semantics). Therefore deontic information cannot help decide about the antecedent of a deontic conditional. Notice that in examples (3) and (4) with conditional deontic sentences it is really the consecutive sequence of the two sentences that is problematic. If some time after the first sentence has been accepted the hearer comes to learn (i.e. accept) the negation of the antecedent, the second sentence might be accepted too.[13]

---

[13]There are however some examples where it would seem that sequences as in (3) are not that problematic. Consider the following example: you are at work but need to use a car. You ask a colleague whether you can use the company car and he responds.

(i)   If the boss is not around, you may use the company car. Let me check!

(5)   If it rains, you may go to the movies. . . It doesn't rain. . . You must not go
        to the movies.
        $\mathbf{0} \uparrow$ if *rain, movies* $\uparrow \neg rain \uparrow$ must$\neg movies$
        $= \{(\{\langle rain, 0\rangle\}, \{\{\langle movies, 1\rangle\}\})\}$, for instance.

(6)   a.   Maybe you're allowed to take an apple. . . You must not take an apple.
        b.   Maybe you must take an apple. . . You're allowed not to take an apple.

Deontic modals under epistemic uncertainty can be discarded as the previous ex-
ample makes clear. Uncertainty over obligations and permissions can be updated
with more specific information. Finally, the deontic part of the update system
has to take care of the problem of free choice permission.

(7)   a.   You may take an apple or a pear $\models$ You may take an apple.
        b.   You may take an apple or a pear $\models$ You may take a pear.
        c.   You may take an apple or a pear $\not\models$ You may take an apple and a
               pear.

The solution to this problem will be a semantic one contrary to other recent
proposals, such as for instance (Schulz 2007), which take a pragmatic approach.
    To define the updates and downdates with may and must, we need some
additional definitions. I will proceed with the definition of the extension of a
deontic plan.

Definition 5.1.25 (Extension). A plan δ' extends a plan δ iff for every $t \in \delta$,
there is some $t' \in \delta'$ such that $t \subseteq t'$.

Example 5.1.26 (Extension of plans).

1. Any non-empty plan (even an inconsistent plan) extends the empty plan
   $\{\emptyset\}$.

2. $\{\{\langle a, 1\rangle\}\}$, the plan where a is the only obligation and nothing else is per-
   mitted, extends $\{\emptyset, \{\langle a, 1\rangle\}\}$, the plan where a is the only permission and
   nothing is mandatory.

The colleague comes back a couple of minutes later and says,

(ii)   Sorry, you may not use the company car.

I think two different pragmatic phenomena are occurring in this example. The first one is an
instance of closed world reasoning on the first conditional, that is, the conditional is reinterpreted
as an equivalence (the information state is thus also updated with *If the boss is around, you
may not use the company car*). As such an update with the second sentence leaves to the absurd
state. However under the maxim of quality, the speaker (who obviously shares the information
about the deontic conditional) is saying what he thinks to be "true", which means he must have
some evidence that the boss is around.

That is, a deontic plan that extends another plan is such that each to-do list of the original is included in some list of the extension. If a possibility is such that the update of its deontic plan with an obligation does not extend the original plan (i.e. the obligation contradicts some permission), it is removed from the information state. But as we have seen, in the case of an update with an obligation, we want to account for example (1). That is, adding an obligation to a possibility/deontic plan should not remove any permissions. We thus need an extra condition that guarantees that an update with a deontic obligation is only felicitous if it does not add any non-deontic information, i.e. the eventual deletion of possibilities should not change the overall content of this information. I will dub this property factual subsistance.

Definition 5.1.27 (Factual subsistance). An information state σ factually subsists in an information state σ' *iff* for all $(s, \delta) \in \sigma$ there is a δ' such that $(s, \delta') \in \sigma'$.

Example 5.1.28 (Factual subsistance of information states).

1. The minimal information state $\{(\emptyset, \{\emptyset\})\}$ (the state with no knowledge whatsoever) does not factually subsist in the state $\{(\{\langle hungry, 1 \rangle\}, \{\emptyset\})\}$ (a state where I know that the dog is hungry) but it does in a state where I know that the dog might be hungry $\{(\emptyset, \{\emptyset\}), (\{\langle hungry, 1 \rangle\}, \{\emptyset\})\}$.

2. The minimal information state $\{(\emptyset, \{\emptyset\})\}$ factually subsists in a state where the only thing I know is that the dog must eat $\{(\emptyset, \{\{\langle eat, 1 \rangle\}\})\}$.[14]

3. The state $\{(\{\langle hungry, 0 \rangle\}, \{\emptyset\}), (\{\langle hungry, 1 \rangle\}, \{\langle eat, 1 \rangle\})\}$ results from the update of the minimal information state with the sentence "if the dog is hungry, he must eat/be fed." It does not subsist in the state where the dog is not hungry but you are allowed to feed it, $\{(\{\langle hungry, 0 \rangle\}, \{\emptyset, \{\langle eat, 1 \rangle\}\})\}$.

Factual subsistance is a condition that applies to any update with deontic information as we have seen in example (3). Finally, we see that a deontic plan can contain information about obligations as well as permissions by the fact that it consists of different to-do lists. When updating with a permission we therefore want to add some to-do lists that contain it as well as the current obligations of the plan. However we do not want to add any superfluous information and we thus have to add the permission not as a copy of all to-do lists but only as a copy of the minimal set of to-do lists representing the current obligations. I will call this set the base.

Definition 5.1.29 (Base[15]). The set $\delta_b = \{s \in \delta \mid there\ is\ no\ s' \in \delta\ s.t.\ s' \subset s\}$ is called the base of a plan δ. It represents the duties of plan δ, that is intuitively, you have to do a in δ *iff* you have to do it in δ_b.

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[14]Obviously, it is not the dog that has the obligation but the holder of the information state that has to see to it that the dog gets fed.

[15]The same kind of concept is termed the minimum in (Mastop 2007)

Example 5.1.30 (Bases of deontic plans).

1. The empty plan is its own base: $\{\emptyset\}_b = \{\emptyset\}$

2. A deontic plan with no obligations and only permissions has the empty plan as base: $\{\emptyset, \{\langle a, 1\rangle\}, \{\langle b, 0\rangle\}\}_b = \{\emptyset\}$.

3. $\{\{\langle a, 1\rangle\}, \{\langle a, 1\rangle, \langle b, 0\rangle\}\}_b = \{\{\langle a, 1\rangle\}\}$, a is the only duty of the deontic plan $\{\{\langle a, 1\rangle\}, \{\langle a, 1\rangle, \langle b, 0\rangle\}\}$.

4. $\{\{\langle a, 1\rangle\}, \{\langle a, 1\rangle, \langle c, 1\rangle\}, \{\langle b, 1\rangle\}, \{\langle b, 1\rangle, \langle c, 1\rangle\}\}_b = \{\{\langle a, 1\rangle\}, \{\langle b, 1\rangle\}\}$. Notice that the base of this deontic plan does not represent a simple obligation (i.e. an obligation of a simple declarative). The base shows that the holder of this deontic plan has to do either a or b.

We can now introduce the definitions for the modal operators *may* and *must*. A final observation that needs to be made is that I will consider that the deontic modal operators *may* and *must* are each others dual as in the following sentences:

(8)   logical form: must¬*smoke*

   a.   You must not smoke in the building.
   b.   It is forbidden to smoke in the building.

(9)   logical form: ¬may *smoke*

   a.   You may not smoke in the building.
   b.   It is not allowed to smoke in the building.

Definition 5.1.31 (Deontic updates of information states). Let α be a sentence and σ an information state. If σ factually subsists in the update,

$$\sigma \uparrow \text{may } \alpha \;=\; \{(s, \delta \cup (\delta_b \uparrow \alpha)_{cons}) \mid (s, \delta) \in \sigma \;\&\; (\delta_b \uparrow \alpha)_{cons} \text{ extends } \{\emptyset\} \uparrow \alpha\}$$
$$\sigma \downarrow \text{may } \alpha \;=\; \{(s, (\delta \downarrow \alpha)_{cons}) \mid (s, \delta) \in \sigma \;\&\; (\delta \downarrow \alpha)_{cons} \text{ extends } \delta \text{ and } \{\emptyset\} \downarrow \alpha\}$$

$$\sigma \uparrow \text{must } \alpha \;=\; \{(s, (\delta \uparrow \alpha)_{cons}) \mid (s, \delta) \in \sigma \;\&\; (\delta \uparrow \alpha)_{cons} \text{ extends } \delta \text{ and } \{\emptyset\} \uparrow \alpha\}$$
$$\sigma \downarrow \text{must } \alpha \;=\; \{(s, \delta \cup (\delta_b \downarrow \alpha)_{cons}) \mid (s, \delta) \in \sigma \;\&\; (\delta_b \downarrow \alpha)_{cons} \text{ extends } \{\emptyset\} \downarrow \alpha\}$$

$$=\; \Lambda \text{ otherwise.}$$

First, it is important to notice the following crucial property of these updates: deontic sentences only operate directly on deontic plans although they may eliminate possibilities when their deontic update is not successful. I will now discuss the different updates. For instance, the positive update with a permission may α performs the following operations:

1. for every possibility (s, δ) in the information state, take the base of the deontic plan (the obligation of this plan) and update it with the embedded sentence. Consider the consistent subset of this update,

(a) if it extends the minimal deontic plan updated with the embedded sentence, replace (s, δ) by $(s, \delta \cup (\delta_b \uparrow \alpha)_{cons})$ (i.e. add to the plan to-do lists containing the former obligations augmented with the new "permission"),

(b) otherwise remove (s, δ) from the information state,

2. return

(a) the information state obtained by the steps in 1 if no factual information is lost,

(b) Λ otherwise.

In other words, when updating an information state σ with a deontic permission may α, we first form the set containing the possibilities consistently updated with the permission without removing any obligations, that is, $\{(s, \delta \cup \delta_b \uparrow \alpha) \mid (s, \delta) \in \sigma \ \& \ (\delta_b \uparrow \alpha)_{cons} = \delta_b \uparrow \alpha\}$. Finally, if σ factually subsists in it, this set becomes the new information state.

Successful updates with permissions give the agent the choice to choose a to-do list containing it as its moral guideline (of things to do/accomplish). This choice of the agent makes clear that once the permission is successfully added to his information state he has gained the right to perform it.

Example 5.1.32 (Updates with permissions)**.** Here are some examples of updates with permissions.[16]

1. $\mathbf{0} \uparrow$ may $a = \{(\emptyset, \{\emptyset\})\} \uparrow$ may $a = \{(\emptyset, \{\ \boxed{\ \ \ }\ \})\} \uparrow$ may a

   $= \{(\emptyset, \{\ \boxed{\ \ \ } \ \} \cup (\{\ \boxed{\ \ \ }\ \}_b \uparrow a)_{cons})\}$ by Definition 5.1.31,[17]

   $= \{(\emptyset, \{\ \boxed{\ \ \ }\ \} \cup \{\ \boxed{a\ \ }\ \})\}$ by definitions 5.1.22 and 5.1.29,

   $= \{(\emptyset, \{\ \boxed{\ \ \ }\ , \ \boxed{a\ \ }\ \})\}$

2. $\{(\emptyset, \{\{\langle a, 0\rangle\}\})\} \uparrow$ may $a = \{(\emptyset, \{\ \boxed{\ \ a}\ \})\} \uparrow$ may $a = \Lambda$ by Definition 5.1.31 because the information state $\{(\emptyset, \{\ \boxed{\ \ a}\ \})\}$ does not subsist in the update:

   by definition 5.1.29, $\{\ \boxed{\ \ a}\ \}_b = \{\ \boxed{\ \ a}\ \}$ and thus,

   $\{\ \boxed{\ \ a}\ \}_b \uparrow a = \{\ \boxed{a\ a}\ \}$ and $(\{\ \boxed{a\ a}\ \})_{cons} = \emptyset$ by definitions 5.1.22 and 5.1.23.

   but $\emptyset$ does not extend $\{\ \boxed{\ \ \ }\ \} \uparrow a = \{\ \boxed{a\ \ }\ \}$ which means the following for the set of definition 5.1.31:

   $\{(\emptyset, \{\ \boxed{\ \ a}\ \} \cup (\{\ \boxed{\ \ a}\ \}_b \uparrow a)_{cons}) \mid (\{\ \boxed{\ \ a}\ \}_b \uparrow a)_{cons} \ extends \ \{\ \boxed{\ \ \ }\ \}_b \uparrow a\} = \emptyset$ and obviously $\{(\emptyset, \{\ \boxed{\ \ a}\ \})\}$ does not subsist in $\emptyset$.

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[16]I will only work out some of them completely and let the reader check that the other claims hold.

[17]As $(\{\ \boxed{\ \ \ }\ \}_b \uparrow a)_{cons} = \{\ \boxed{a\ \ }\ \} = \{\ \boxed{\ \ \ }\ \}_b \uparrow a$.

3. $\{(\{\langle p,0\rangle\},\{\emptyset\}), (\{\langle p,1\rangle\},\{\{\langle a,0\rangle\}\})\} \uparrow \text{may } a = \Lambda$ because the update deletes the second possibility as can be seen from the previous example (irrespective of the factual information), i.e. the update would result in the following information state $\{(\{\langle p,0\rangle\},\{\emptyset,\{\{\langle a,1\rangle\}\}\})\}$ in which the original state does not factually subsist.

4. $\mathbf{0} \uparrow \text{may}(a \vee b) = \{(\emptyset, \{\ \boxed{\ \ }\ \} \cup (\{\ \boxed{\ \ }\ \}_b \uparrow (a \vee b))_{cons})\}$ by definition 5.1.31,
   $= \{(\emptyset, \{\ \boxed{\ \ }\ \} \cup (\{\ \boxed{\ \ }\ \}_b \uparrow a \cup \{\ \boxed{\ \ }\ \}_b \uparrow b)_{cons})\}$ by definition 5.1.14
   $= \{(\emptyset, \{\ \boxed{\ \ }\ \} \cup (\{\ \boxed{a\ \ }\ \} \cup \{\ \boxed{b\ \ }\ \})_{cons})\}$ by example 5.1.30 and definition 5.1.22,
   $= \{(\emptyset, \{\ \boxed{\ \ },\ \boxed{a\ \ },\ \boxed{b\ \ }\ \})\}.$
   Therefore $\mathbf{0} \uparrow \text{may}(a \vee b) \Vdash \text{may } a$ as $\{\ \boxed{\ \ },\ \boxed{a\ \ },\ \boxed{b\ \ }\ \}_b = \{\ \boxed{\ \ }\ \}.$

We can now turn to the update with a deontic obligation of the form 'must α'. The idea is that whatever the present permissions/rights are, i.e. whatever to-do lists are present in the deontic plans, they should all be made to contain α. That is, α is an element of any to-do list and thus is a mandatory action/state of affairs to be reached. Formally, the definition goes as follows:

1. for every possibility (s, δ) in the information state, update the deontic plan with the embedded sentence and consider the consistent subset of this update,

   (a) if it extends the original deontic plan and the minimum update with the obligation (respectively: all the to-do lists of the original deontic plan are a subset of some element of the updated plan and thus no permission has been removed; and no part of the meaning of the obligation is lost),[18] then replace (s, δ) by $(s, (\delta \uparrow \alpha)_{cons})$

   (b) otherwise remove (s, δ) from the information state,

2. return

   (a) the information state obtained by the steps in 1 if no factual information is lost,

   (b) Λ otherwise.

In an update with a deontic obligation, a possibility is removed any time its deontic plan contains a to-do list that is not consistent with the embedded sentence.

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[18]This condition, $(\delta \uparrow \alpha)_{cons}$ extends $\{\emptyset\} \uparrow \alpha$, accounts for a central idea of the framework in (Veltman 2007): if you are not allowed to do a, then the update with the obligation to do a or b leads to the absurd state. Therefore obligations are not completely disconnected from permissions.

Example 5.1.33 (Updates with obligations)**.**

1. $\mathbf{0} \uparrow \text{must } a = \{(\emptyset, \{\,\boxed{}\,\})\} \uparrow \text{must } a = \{(\emptyset, (\{\,\boxed{}\,\} \uparrow a)_{cons})\} = \{(\emptyset, \{\,\boxed{a\ \ }\,\})\}.$

2. $\mathbf{0} \uparrow \text{may} \neg a \uparrow \text{must } a = \{(\emptyset, \{\,\boxed{}\,,\,\boxed{\ \ a}\,\})\} \uparrow \text{must } a = \Lambda$ because:
   $(\{\,\boxed{}\,,\,\boxed{\ \ a}\,\} \uparrow a)_{cons} = (\{\,\boxed{a\ \ }\,,\,\boxed{a\ a}\,\})_{cons} = \{\,\boxed{a\ \ }\,\}$ which
   does not extend $\{\,\boxed{}\,,\,\boxed{\ \ a}\,\}$. Therefore the condition of definition
   5.1.31 is not fulfilled for the only possibility in the information state and
   the original information state does not subsist in the update.

3. $\mathbf{0} \uparrow \text{must}(a \vee b) = \{(\emptyset, \{\,\boxed{a\ \ }\,,\,\boxed{b\ \ }\,\})\}.$
   Ross's paradox (*you must post the letter* $\models$ *you must post the letter or burn it*) does not occur in this system, i.e. $\text{must } a \not\Vdash \text{must}(a \vee b)$, for instance:
   $\mathbf{0} \uparrow \text{must } a = \{(\emptyset, \{\,\boxed{a\ \ }\,\})\}$

   $\neq \mathbf{0} \uparrow \text{must } a \uparrow \text{must}(a \vee b) = \{(\emptyset, \{\,\boxed{a\ \ }\,,\,\boxed{\begin{smallmatrix}a\\b\end{smallmatrix}\ }\,\})\}.$

   It is also nice to notice that once you know you have the duty to do a and $a \vee b$, you actually get the right to do b:
   $\mathbf{0} \uparrow \text{must } a \uparrow \text{must}(a \vee b) = \mathbf{0} \uparrow \text{must}(a \vee b) \uparrow \text{must } a \Vdash \text{may } b.$[19]

Finally the deontic modal operators are considered to be dual and therefore the downdates are equivalent to the updates with the opposite modal and a negation, i.e. the downdate with *may* is an update with *must not*, and the downdate with *must* is an update with *may not*.

Observation 5.1.34. Let σ be an information state and $a, b \in \mathcal{D}$ two declarative sentences.

1. If σ is not the absurd state and $\sigma \Vdash \neg\text{may } a$, then $\sigma \uparrow \text{may}(a \vee b) \in \bot$.
   For instance, $\mathbf{0} \uparrow \neg\text{may } a \Vdash \neg\text{may } a$ i.e. $\{(\emptyset, \{\,\boxed{\ \ a}\,\})\} \Vdash \neg\text{may } a$, but
   $\{(\emptyset, \{\,\boxed{\ \ a}\,\})\} \uparrow \text{may}(a \vee b) = \Lambda$ because $(\{\,\boxed{\ \ a}\,\}_b \uparrow (a \vee b))_{cons} =$

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[19]The system does however make a prediction that is somewhat troublesome: $\mathbf{0} \uparrow \text{must}(a \vee b) \not\Vdash \text{must}(a \vee b)$ as $\mathbf{0} \uparrow \text{must}(a \vee b) = \{(\emptyset, \{\,\boxed{a\ \ }\,,\,\boxed{b\ \ }\,\})\}$ and $\mathbf{0} \uparrow \text{must}(a \vee b) \uparrow (a \vee b) = \{(\emptyset, \{\,\boxed{a\ \ }\,,\,\boxed{b\ \ }\,,\,\boxed{\begin{smallmatrix}a\\b\end{smallmatrix}\ }\,\})\}$. Obviously this result is not warranted but it can be surmounted in at least two ways. A first solution is to loosen the definition of acceptance in a way similar to (Mastop 2005, p105). The other solution is to change the (relevant part of the) definition of the update with deontic necessity for instance as follows:

$$\sigma \uparrow \text{must } \alpha = \{(s, \delta) \mid (s, \delta) \in \sigma \,\&\, (\delta \downarrow \alpha)_{cons} = \emptyset \,\&\, \delta_b \text{ extends } \{\emptyset\} \uparrow \alpha\} \cup \{(s, (\delta \uparrow \alpha)_{cons}) \mid (s, \delta) \in \sigma \,\&\, ((\delta \downarrow \alpha)_{cons} \neq \emptyset \text{ or } \delta_b \text{ does not extend } \{\emptyset\} \uparrow \alpha) \text{ but } (\delta \uparrow \alpha)_{cons} \text{ extends } \delta\}.$$

$\{\ \boxed{b\ |\ a}\ \}$

does not extend $\{\ \boxed{\ \ |\ \ }\ \} \uparrow (a \vee b) = \{\ \boxed{a\ |\ \ }\ ,\ \boxed{b\ |\ \ }\ \}$.

2. $\mathbf{0} \uparrow \mathrm{may}(a \vee b) \uparrow \neg\mathrm{may}(a \wedge b) \notin \perp$,

$\mathbf{0} \uparrow \mathrm{may}(a \vee b) = \{(\emptyset, \{\ \boxed{\ \ |\ \ }\ ,\ \boxed{a\ |\ \ }\ ,\ \boxed{b\ |\ \ }\ \})\}$ as example 5.1.32 shows
and

$\mathbf{0} \uparrow \mathrm{may}(a \vee b) \uparrow \neg\mathrm{may}(a \wedge b) = \{(\emptyset, \{\ \boxed{\ \ |\ b}\ ,\ \boxed{a\ |\ b}\ ,\ \boxed{\ \ |\ a}\ ,\ \boxed{b\ |\ a}\ \})\}$.

These two examples show that the condition in the update with a permission is precisely what is needed. The condition is on $(\delta_b \uparrow \alpha)_{cons}$ where α is the embedded sentence under the deontic permission and δ_b represents the duties of deontic plan δ cleaned out of the rights. One important thing to check when updating with a permission is that it does not conflict with duties. As such, the condition $(\delta_b \uparrow \alpha)_{cons} \neq \emptyset$ would do the trick. However, the first update in this example would not fail with this condition, for instance $\mathbf{0} \uparrow \neg\mathrm{may}\ a \uparrow \mathrm{may}(a \vee b) \notin \perp$. A stronger condition would be to ask for $\delta_b \uparrow \alpha$ to be fully "consistent", that is, $(\delta_b \uparrow \alpha)_{cons} = \delta_b \uparrow \alpha$ and the embedded permission is consistent with all the duties. Now it is the second update that goes wrong, $\mathbf{0} \uparrow \mathrm{may}(a \vee b) \uparrow \neg\mathrm{may}(a \wedge b) \uparrow \mathrm{may}(a \vee b) \in \perp$. Therefore, this condition is too strong. What we need is that the sentence embedded under the permission does not conflict with the duties but also that the update does add the whole permission expressed by the sentence, i.e. $(\delta_b \uparrow \alpha)_{cons}$ extends $\{\emptyset\} \uparrow \alpha$.

It is important to notice why a specialized deontic absurd state is needed. This is best seen in the context of conditional sentences. Suppose you know you are allowed to go to the movies. This happens for instance after having updated the minimal information state with the sentence,

(10)   You may go to the movies.
        $\mathbf{0} \uparrow \mathrm{may}\ go = \{(\emptyset, \{\emptyset, \{\langle go, 1 \rangle\}\})\} \Vdash \mathrm{may}\ go$

In such a state, going to the movies is a right, an unrestricted permission you have obtained. Therefore any conditional sentence (such as the one following) trying to restrict this right is in contradiction with it (or better said, restricting a right after it has been issued is something that a theory of revision has to deal with but is not the point of an update system).

(11)   If the weather is nice, you may not go to the movies.

Assume that the failure condition (factual subsistance) is removed from definition 5.1.31, that is, an update with a deontic sentence on an information state is either the updated information state or the empty set. Were we now to update the information state obtained after sentence (10), we would have a successful update and obtain an information state that supports the information that we may go to the movies and that the weather is not nice:

$$\mathbf{0} \uparrow \text{may } go \uparrow \text{if } nice, \neg\text{may } go$$

$$= \quad \mathbf{0} \uparrow \text{may } go \downarrow nice \ \cup \ \mathbf{0} \uparrow \text{may } go \uparrow nice \uparrow \neg\text{may } go$$

$$= \quad \{(\{\langle nice, 0\rangle\}, \{\ \boxed{\ \ } \ , \ \boxed{go\ \ } \ \})\} \ \cup$$
$$\{(\{\langle nice, 1\rangle\}, \{\ \boxed{\ \ } \ , \ \boxed{go\ \ } \ \})\} \downarrow \text{may } go$$

but $(\{\ \boxed{\ \ } \ , \ \boxed{go\ \ } \ \} \downarrow go)_{cons} = (\{\ \boxed{\ go} \ , \ \boxed{go\ go} \ \})_{cons} = \{\ \boxed{\ go} \ \}$

which does not extend $\{\ \boxed{\ \ } \ , \ \boxed{go\ \ } \ \}$,

$$= \quad \{(\{\langle nice, 0\rangle\}, \{\ \boxed{\ \ } \ , \ \boxed{go\ \ } \ \})\} \ \cup \ \emptyset$$

$$= \quad \{(\{\langle nice, 0\rangle\}, \{\ \boxed{\ \ } \ , \ \boxed{go\ \ } \ \})\}$$

This shows that a mechanism is needed to prevent updates with deontic information deciding about factual information. Notice that this mechanism cannot be replaced by the simplest idea of not allowing deontic updates to return the empty set. Why this is so should become clear with the study of sentences combining an epistemic modal above a deontic one.

5.1.1 Epistemic above deontic modality

As we have seen in chapter 2, not all combinations of modal items are grammatical. However epistemic modals can combine with deontic ones when they take wide scope. In particular the following type of sentence is grammatical:

(12)   a.   You might have to go to Amsterdam.
       b.   You might be allowed to go to Amsterdam.[20]

In view of the definition of epistemic possibility, the update with sentence (12-a) on an information state is successful just in case the deontic update is successful on this very same state:

$$\sigma \uparrow \text{might must } go \notin \bot \text{ iff } \sigma \uparrow \text{must } go \neq \Lambda$$

I will now present the update with those sentences on the minimal information state (for the sake of simplicity).

$$\mathbf{0} \uparrow \text{might must } go$$

$$= \quad \mathbf{0} \cup \mathbf{0} \uparrow \text{must } go \qquad\qquad \text{as } \mathbf{0} \uparrow \text{must } go \notin \bot$$

$$= \quad \{(\emptyset, \{\emptyset\})\} \cup \{(\emptyset, \{\{\langle go, 1\rangle\}\})\}$$

$$= \quad \{(\emptyset, \{\emptyset\}), (\emptyset, \{\{\langle go, 1\rangle\}\})\}$$

The update of the minimal information state with sentence (12-a) results in the addition to this minimal state of a possibility in which to go to Amsterdam is an obligation. The update with sentence (12-b) is similar except that in the new possibility going to Amsterdam is a right not an obligation:

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[20]Notice that there are two different temporal interpretations of these sentences under the epistemic modal. The obligation or permission is either already holding for the agent (overlapping with the speech time) or its start is located in the future.

$$\mathbf{0} \uparrow \text{might may } \textit{go}$$
$$= \quad \{(\emptyset, \{\emptyset\}), (\emptyset, \{\emptyset, \{\langle go, 1\rangle\}\})\}$$

Observation 5.1.35. From these updates we can deduce that all the following updates are successful:

1. $\mathbf{0} \uparrow \text{might must } \textit{go} \uparrow \text{must } \textit{go} = \{(\emptyset, \{\{\langle go, 1\rangle\}\})\}$.

2. $\mathbf{0} \uparrow \text{might must } \textit{go} \uparrow \text{must}\neg\textit{go} = \{(\emptyset, \{\{\langle go, 0\rangle\}\})\}$.

3. $\mathbf{0} \uparrow \text{might must } \textit{go} \uparrow \neg\text{must } \textit{go} = \{(\emptyset, \{\emptyset, \{\langle go, 0\rangle\}\})\}$.

4. $\mathbf{0} \uparrow \text{might must } \textit{go} \uparrow \text{may } \textit{go} = \{(\emptyset, \{\emptyset, \{\langle go, 1\rangle\}\}), (\emptyset, \{\{\langle go, 1\rangle\}\})\}$.

5. $\mathbf{0} \uparrow \text{might must } \textit{go} \uparrow \text{may } \textit{go} \uparrow \neg\text{must } \textit{go} = \{(\emptyset, \{\emptyset, \{\langle go, 1\rangle\}, \{\langle go, 0\rangle\}\})\}$.

The fourth update is the only one with two possibilities. This is the case because the permission update does not resolve the uncertainty about whether we have to go or not. This ambiguity is resolved when we update with the sentence *You don't have to go to Amsterdam* as in 5.

From the previous examples we can see why the deontic absurd state cannot be the empty set: in the case of a deontic modal embedded under an epistemic one, new deontic information can help decide between possibilities.

5.1.2   In the scope of deontic modals

Within this update system, we can now give an explanation of the fact that deontic modals cannot scope over epistemic ones. As will become clear, this property is due to the architecture of the system: epistemic modals operate on whole information states whereas deontic modals operate on deontic plans (inside possibilities). Formally, it is enough to see an example with the minimal information state to understand the failure to update with this combination of modals:

(13)   #You must might go to Amsterdam.

$$\mathbf{0} \uparrow \text{must might } \textit{go}$$
$$= \quad \{(\emptyset, (\{\emptyset\} \uparrow \text{might } \textit{go})_{cons}) \mid (\{\emptyset\} \uparrow \text{might } \textit{go})_{cons} \textit{ extends } \{\emptyset\}\},$$
$$\quad \text{if it factually subsists in } \mathbf{0},$$
$$= \quad \textit{failure}$$
$$\text{as} \quad \{\emptyset\} \uparrow \text{might } \textit{go} \text{ is not defined because } \{\emptyset\} \text{ is no information state.}$$

In the general case, the situation remains the same, that is, the *might* update would have to be accomplished on a deontic plan which is a different kind of entity from an information state. The first is a set of to-do lists whereas the second is a set of possibilities and we have already seen that to-do lists and possibilities

are different entities. But the update with *might* is only defined on information states and therefore the update cannot be completed and fails. Notice that the problem is not that the update would lead to the absurd state (as an update with a sentence and its negation would do) but that it cannot proceed because of the mismatch between the operator and the (state/plan) argument of the update.

Maybe more surprising is the fact that we cannot stack deontic operators either. Therefore the following sentences (as combinations of two deontic modal items) leads to failure too.

(14) a. #You must have to go to Amsterdam.
      b. #You must be allowed to go to Amsterdam.
      c. #You are allowed to have to go to Amsterdam.
      d. #You are allowed to be allowed to go to Amsterdam.

The same kind of reason as for epistemic modality can be given, that is, deontic modals operate on information states. This might seem curious at first but is all easily explained. Deontic modals give information about the world and as such operate on whole information states, however the information they deliver is of deontic nature and therefore acts upon the deontic plans of the information state's possibilities. But the deontic plans are only defined for atomic updates and boolean combinations thereof. Thus their update with a deontic modal fails. We can demonstrate this with the update of the minimal information state with sentence (14-a).

$$\mathbf{0} \uparrow \text{must must } \textit{go}$$
$$= \{(\emptyset, (\{\emptyset\} \uparrow \text{must } \textit{go})_{cons}) \mid (\{\emptyset\} \uparrow \text{must } \textit{go})_{cons} \textit{ extends } \{\emptyset\}\},$$
$$\text{if it factually subsists in } \mathbf{0},$$
$$= \textit{failure}$$
$$\text{as} \quad \{\emptyset\} \uparrow \text{must } \textit{go} \text{ is not defined because } \{\emptyset\} \text{ is no information state.}$$

It should be noted that sentence (14-b) is not necessarily ungrammatical. However I want to argue that the grammatical reading of this sentence is different from the update with must may *go*. It is important to remark that the grammatical subject needs not be the holder of the obligation. Consider first the case where the subject is the person to which the obligation is addressed, that is, the update is of the form $\sigma \uparrow \text{must}(\text{``}\textit{you are allowed to go to Amsterdam}\text{''})$. Therefore the hearer has indeed to add a sentence as an obligation to its deontic plans. Intuitively the sentence to be added is not itself a permission but a state to be reached, i.e. the hearer has to see to it that he gets the permission to go to Amsterdam. As the previous formulation indicates it seems that the sentence embedded under the obligation is added as a whole to the deontic plans. Within the update system this would be made possible by the introduction of a lexical counterpart to the deontic modal operator, that is, some lexical element *permission* (and constraints on its use with respect to what must be the case in the deontic plans). In the

second case, the subject is not the addressee of the obligation but it is directed to someone else, say MrX. The sentence can thus be paraphrased by *MrX must see to it that you are allowed to go to Amsterdam.* It seems only fair to suppose that the covert holder of the obligation, MrX, is attributed this obligation because he indeed can do something about your permission, i.e. he has authority on this matter. Therefore the sentence is probably better paraphrased by *MrX must allow you to go to Amsterdam* where the verb of the embedded sentence is active. However, I have not provided any semantic definition for the active verb *to allow* but only for its passive counterpart *to be allowed to.* It seems again fair to suppose that sentence (14-b) thus means that MrX should have in all his to-do lists *I allow you to go to Amsterdam.*

In conclusion, the semantics of modal items given in this chapter make the following predictions:

1. Epistemic modals can scope over deontic ones.

2. Epistemic modals cannot be interpreted under deontic ones.

3. Deontic modal operators cannot be stacked.

5.2   Goal-oriented and participant-internal modality

For completeness, I will now provide a semantics for the two missing modal categories of goal-oriented and participant-internal modality. In our typology, goal-oriented modality is a subpart of participant-external modality, just as deontic modality is. It would therefore be appropriate to give a semantics to these modals that is in line with the semantics given above for deontic modals. For the sake of simplicity, I will however remove deontic information from the formalization in order to keep the definitions as short as possible. This means that we again have to define possibilities although information states remain the same (that is, sets of possibilities). In the previous section, possibilities were an ordered pair of a situation and of a deontic plan. We now want to be able to speak about goals and the ways to achieve them but still independently of what is the case, the situation. I will thus replace the deontic plan by the appropriate entity to account for goal-oriented modals. In the first part of this section, I will present a formalization of goal-oriented modality without ability (i.e. without incorporating participant-internal modals). In the second part, the semantics of participant-internal modality and their close relationship with goal-oriented modality will be discussed.

5.2.1 Goal-oriented modality: a first sketch

Goal-oriented modality is a part of participant-external modality just as deontic modality is. It should therefore not be surprising that the remark issued for deontic modality holds for this kind of modality too: goal-oriented modality has to do with planning and this kind of information is distinct from factual information. We can almost take over the previous picture literally:

standard framework :   world

our framework :   (factual information   ,   planning information)
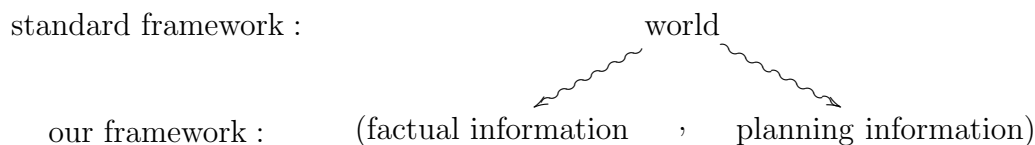
That is, information about plans and the ways to achieve them is independent from information about facts. The question is now what kind of information is a plan exactly? To answer this question, we first have to remember the "logical" form of goal-oriented sentences.

(15)   a.   To go to Texel, you have to take a boat.
        b.   To go to Texel, you can take the ferry.

Those sentences have two parts. First there is a goal argument[21] (here the goal is to go to Texel) and then a condition on the possible plans to achieve this goal. In sentence (15-a) the condition expresses that every plan to achieve the goal is a plan where you take a boat whereas in sentence (15-b) the condition expresses that a possible plan is a plan where you take the ferry.[22] Formally I will stay in line with definition 5.1.4 and call a plan a set of to-do lists. However we need

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[21]Notice that I will for ease of presentation only consider the case of goal-oriented sentences where the covert argument of the goal is identical to the subject position of the condition (which will be the holder of the information state designated by *you*). This is a very common kind of goal-oriented sentence but is by no means the only one. The subject of the condition can of course also be different from the addressee as in (i-a) and if an overt argument is provided to the goal the subject of the condition can be different as in (i-b). Furthermore, just as in the case of deontic modals, the covert argument of the goal can be provided by the context (e.g. the addressee). This is particularly the case when the condition features an expletive subject or a "stative" sentence.

(i)   a.   To win the game, John must score two points.
       b.   In order for the Netherlands to qualify for the next round, Germany has to beat France.
       c.   To kitesurf, it must be windy.
       d.   To play at night, the lights must be on.

This simplification is in line with the one made regarding deontic modals. The precise formalization in the general case will unfortunately have to be left for later work.

[22]Notice also that the conditions of a goal-oriented sentences can be divided in two main types: actions/events and states. In sentence (15-a), for instance, the condition is an action/event, *you take the boat*, but in the following sentence it is a state, *you are older than 21*:

to represent plans to achieve a goal. This will be done by taking the ordered pair of the goal and its plan, i.e. $(goal, plan)$. Obviously there is more to a plan than just the ways to go to Texel and therefore a planning system will be a set of ordered pairs of a goal and its plan. Notice that to have a plan for a particular goal in a planning system does not mean to have the will to achieve this goal but just to have the knowledge of how to achieve it if wanted or needed.

Definition 5.2.1 (Planning system)**.** A planning system is a set of ordered pairs consisting of a goal (a sentence of the language)[23] and a plan. As in definition 5.1.4, a plan is a set of to-do lists. I will use the uppercase Π to denote a planning system and lowercase π to refer to plans.

Example 5.2.2 (Some planning systems)**.**

1. The minimal planning system Π_0 is the empty planning system, i.e. there is no information about goals and how to achieve them.

2. $\Pi_1 = \{(Texel, \{ \boxed{\text{boat}\ \ } \})\}$ is the planning system that, as we will see, is obtained by updating the minimal planning system with sentence (15-a).

3. $\Pi_2 = \{(Texel, \{ \boxed{\begin{array}{l}\text{boat}\\ \text{ferry}\end{array}} , \boxed{\begin{array}{l}\text{boat}\\ \text{rent}\end{array}} \})\}$ is the planning system with only one goal, going to Texel, where sentence (15-a) is still the case (you have to take a boat) but where you know you have a choice between taking the ferry or renting your own boat.

4. $\Pi_3 = \{(Texel, \{ \boxed{\text{boat}\ \ } \}), (Boston, \{ \boxed{\text{plane}\ \ } \})\}$ contains two goals, going to Texel and going to Boston, with their respective (partial) plans.

(i)   To drink alcohol in this state, you have to be older than 21.

I will in this section only discuss the action/event type of condition. The distinction will however become important in the discussion of participant-internal modality.

[23]The goal part of goal-oriented sentence is obviously not a sentence from a syntactic point of view but is more a kind of a verb phrase. To be more precise, the goal argument can be analyzed similarly to purpose clauses in (Bach 1982, p42), that is, as structures of the form:

1. *to VP*,

2. *For NP to VP*.

I will assume as a simplification that the *VP* of 1 is controlled by the subject of the condition (in the second form –which I will not discuss– the *VP* is controlled by the *NP*). Therefore I will treat the goal as a simple (untensed) declarative *Subject VP*. Notice that the goal part of goal-oriented sentences displays some differences from purpose clauses (for instance the latter cannot be preposed (Bach 1982, p36)). As such those goals look more like Bach's *in-order-to* clauses even though the match is not perfect.

Finally it is questionable whether we should add complex VP's to the analysis (with negation, conjunction etc. . .). Those more complex goals will not be discussed either.

It is also important to realize that the plan associated with a goal is by no means sufficient to achieve the goal. For instance, I might be aware that to go to Boston I must take the airplane, as in 4 of example 5.2.2, but still not know (as is the case in planning system Π_3) how to take the airplane.

Definition 5.2.3 (Possibilities and information states). A possibility is an ordered pair (s, Π) consisting of a situation s and a planning system Π. An information state is a set of possibilities and the minimal information state is $\mathbf{0} = \{(\emptyset, \emptyset)\}$.

As should be clear from the above examples, part of the meaning of a goal-oriented sentence is to do the following:

1. add a goal/plan pair to the planning system if there was no such pair with this goal,

2. otherwise update the plan of this goal with the expressed condition.

For instance the update of the minimal planning system with sentence (15-a) adds a new goal/plan pair to the planning system such that the goal is to go to Texel and the plan says that you have to take a boat. However this is not enough. At this stage we would add for any new goal-oriented sentence with a goal not yet present in the planning system a new pair. This is insufficient in two cases.

In the first case, the planning system contains for instance a pair $(a, \{\{\langle b, 1 \rangle\}\})$ and gets updated with a sentence of the form *to b, have to c*, that is, the goal of the sentence is present as part of a plan to achieve another goal.

$$(a, \{\{\langle \underline{b}, 1 \rangle\}\}) \in \Pi \text{ updated with } to \ \underline{b}, \text{ have to } c$$

Consider you have been told sentence (15-a) (for instance, you hold planning system Π_1 of example 5.2.2) and now you are told the following sentence:

(16)   To take a boat, you have to go to the seaport.

Obviously the result of an update with this sentence will be at least to add a goal/plan pair (for instance $(boat, \{\{\langle seaport, 1 \rangle\}\})$ if nothing is known about this goal in the information state) to the planning system of all possibilities. However we surely get to know more than just that, in particular, the following sentence should intuitively be accepted:

(17)   To go to Texel, you have to go to the seaport.

There is thus some kind of transitivity at work. Sentence (16) not only creates its own goal/plan pair but also influences the plans where its goal appears as a means to achieve another goal. Intuitively the update with sentence (16) should proceed as follows:

1. add the goal/plan pair $(boat, \{\; \boxed{\text{seaport} \quad}\; \})$ to the planning system and

2. update the pair ($Texel$, { $\boxed{\text{boat}\;}$ }) to ($Texel$, { $\boxed{\begin{array}{l}\text{boat}\\ \text{seaport}\end{array}}$ }).

Therefore an update with a goal-oriented sentence with goal a also has to update all the pairs where a appears not as a goal but as part of the plan.

In the second case, the planning system contains for instance a pair $(a, \{\{\langle b, 1\rangle\}\})$ and gets updated with a sentence of the form *to c*, have to a, that is, a plan to achieve the condition of the goal-oriented sentence is already known.

$$(\underline{a}, \{\{\langle b, 1\rangle\}\}) \in \Pi \text{ updated with } to\ c,\ have\ to\ \underline{a}$$

Suppose you do not have any known plans (the planning systems are empty) and you learn sentence (16). The planning system then becomes $\{(boat, \{\boxed{\text{seaport}\;\;}\})\}$. Now you are told sentence (15-a). Just as before we would like to accept sentence (17). This means that the update should add consistently the plan that might be known for the condition of the goal-oriented sentence:

1. add to the planning system the goal/plan pair ($Texel$, { $\boxed{\text{boat}\;}$ }) to which the already known plan to achieve *boat* is added. Thus add to the planning system ($Texel$, { $\boxed{\text{boat}\;}$ $\cup\;\boxed{\text{seaport}\;}$ }) = ($Texel$, { $\boxed{\begin{array}{l}\text{boat}\\ \text{seaport}\end{array}}$ }).

The last case shows that the basic update of a plan with a sentence (condition) within a planning system must be completed by the update with the plan of this sentence as goal if available. This is the right moment to give the definition of the basic update of a plan within a planning system.

Definition 5.2.4 (Basic update of a plan). Let π be a plan of a planning system Π and $a \in \mathcal{D}$.

$$\begin{aligned}
\pi \uparrow a \;=\; & \{t' \mid \;\; t' = t \cup \{\langle a, 1\rangle\} \cup s \; for\ some\ s \in \tau,\ if\ (a, \tau) \in \Pi, \\
& \qquad and\ s = \emptyset\ otherwise,\ and\ for\ some\ t \in \pi\} \\
\pi \downarrow a \;=\; & \{t' \mid t' = t \cup \{\langle a, 0\rangle\} \; for\ some\ t \in \pi\}
\end{aligned}$$

Example 5.2.5. Let $(Boston, \{\{\langle airplane, 1\rangle\}, \{\langle boat, 1\rangle\}\})$ be a pair in a planning system Π. Intuitively this pair represents for instance the information that to go to Boston you have to either take the airplane or the boat. Assume further that we have to add a new pair (due to the update with a goal-oriented sentence) for which the condition is that you have to go to Boston. That is, the plan for this new goal will be the following:

$$\begin{aligned}
& \{\emptyset\} \uparrow Boston \\
=\; & \{t' \mid t' = \emptyset \cup \{\langle Boston, 1\rangle\} \cup s \; for\ some\ s \in \{\{\langle airplane, 1\rangle\}, \{\langle boat, 1\rangle\}\}\} \\
& because\ (Boston, \{\{\langle airplane, 1\rangle\}, \{\langle boat, 1\rangle\}\}) \in \Pi \\
=\; & \{\{\langle Boston, 1\rangle\} \cup \{\langle airplane, 1\rangle\},\ \{\langle Boston, 1\rangle\} \cup \{\langle boat, 1\rangle\}\} \\
=\; & \{\{\langle Boston, 1\rangle, \langle airplane, 1\rangle\},\ \{\langle Boston, 1\rangle, \langle boat, 1\rangle\}\}
\end{aligned}$$

The first case discussed above will be taken care of by the definition of an update with a goal-oriented sentence. The idea is that a goal-oriented sentence changes also pairs of the planning system where the goal appears in a to-do list.

Definition 5.2.6 (Update with *to a,* have to φ)**.** Let σ be an information state, $a \in \mathcal{D}$ a simple declarative and φ a sentence. Π^a will denote the set containing the updated goal/plan pair with a as goal of a planning system Π:

$$\Pi^a = \{(a, (\pi^a \uparrow \varphi)_{cons}) \mid \pi^a = \pi \ if \ (a, \pi) \in \Pi, \{\emptyset\} \ otherwise\}\}$$
$$\text{if } (\pi^a \uparrow \varphi)_{cons} \text{ extends } \pi^a,$$
$$\emptyset \text{ otherwise.}$$

Furthermore, Π^d (for $d \neq a$) will denote the set containing the update of pair $(d, \pi^d) \in \Pi$. As explained before the update consists in updating the to-do lists containing a:

$$\Pi^d = \{(d, \{t \mid t \in \pi^d \ \& \ \langle a, 1\rangle \notin t\} \cup (\{t \mid t \in \pi^d \ \& \ \langle a, 1\rangle \in t\} \uparrow \varphi)_{cons})\}$$
$$\text{if } (\{t \mid t \in \pi^d \ \& \ \langle a, 1\rangle \in t\} \uparrow \varphi)_{cons} \text{ extends } \{t \mid t \in \pi^d \ \& \ \langle a, 1\rangle \in t\},$$
$$\emptyset \text{ otherwise.}$$

Finally, the update of information state σ with the goal-oriented sentence *to a,* have to φ is as follows: if σ factually subsists in the update,

$$\sigma \uparrow to \ a, \text{ have to } \varphi = \{(s, \Pi^a \cup \bigcup_{d \neq a}^{(d,\pi)\in\Pi} \Pi^d) \mid (s, \Pi) \in \sigma \ \& \ \Pi^a \neq \emptyset \ \& \ \bigcap_{d \neq a}^{(d,\pi)\in\Pi} \Pi^d \neq \emptyset\}$$

$$= \Lambda \text{ otherwise.}$$

Finally notice that $\sigma \uparrow to \ a, \neg\text{can } \varphi = \sigma \uparrow to \ a, \text{ have to} \neg\varphi.$

Therefore the update with *to a,* have to *b* is a "two-step" process: first the planning system has to be updated for the goal *a* as argument by *b* and everything that is needed to achieve *b* (i.e. the plan of *b*), then if *a* belongs to the to-do list of some plan of the planning system (with a goal different from *a*), we update this to-do list with *b* and everything that is needed to achieve *b*. As for deontic updates, we end up in the absurd state whenever contradictory information about plans is added.

Example 5.2.7 (Some updates with goal-oriented necessity)**.**

1. $\mathbf{0} \uparrow to \ a,$ have to $b = \{(\emptyset, \emptyset)\} \uparrow to \ a,$ have to $b = \{ \ (\emptyset, \{ \ (a, \{ \boxed{\text{b} \quad} \}) \ \}) \ \},$

2. $\mathbf{0} \uparrow to \ a,$ have to $b \uparrow to \ b,$ have to $c = \{(\emptyset, \{(a, \{ \boxed{\begin{array}{c} \text{b} \\ \text{c} \end{array}} \}), (b, \{ \boxed{\text{c} \quad} \})\})\},$

   and $\mathbf{0} \uparrow to \ a,$ have to $b \uparrow to \ b,$ have to $c \Vdash to \ a,$ have to $c,$

3. $\mathbf{0} \uparrow to\ a$, have to $b \uparrow to\ c$, have to $a = \{(\emptyset, \{(a, \{\ \boxed{\text{b}\ \ }\ \}), (c, \{\ \boxed{\begin{array}{c}\text{a}\\\text{b}\end{array}}\ \})\})\}$,

   and $\mathbf{0} \uparrow to\ a$, have to $b \uparrow to\ c$, have to $a \Vdash to\ c$, have to b,

4. administrative loophole: $\mathbf{0} \uparrow to\ a$, have to $b \uparrow to\ b$, have to $a =$
   $\{(\emptyset, \{(a, \{\ \boxed{\begin{array}{c}\text{a}\\\text{b}\end{array}}\ \}), (b, \{\ \boxed{\begin{array}{c}\text{a}\\\text{b}\end{array}}\ \})\})\}$.

Definition 5.2.8 (Update with *to a*, can φ)**.** Let σ be an information state, $a \in \mathcal{D}$ a simple declarative and φ a sentence. Π^a will denote the set containing the updated goal/plan pair with a as goal of a planning system Π:

$$\Pi^a \;=\; \begin{array}{l} \{(a, \pi^a \cup (\pi^a_b \uparrow \varphi)_{cons}) \mid \pi^a = \pi\ if\ (a, \pi) \in \Pi, \{\emptyset\}\ otherwise\}\} \\ if\ (\pi^a_b \uparrow \varphi)_{cons}\ extends\ \{\emptyset\} \uparrow \varphi, \\ \emptyset\ otherwise. \end{array}$$

Furthermore, Π^d (for $d \neq a$) will denote the set containing the update of pair $(d, \pi^d) \in \Pi$:

$$\Pi^d \;=\; \begin{array}{l} \{(d, \pi^d \cup (\{t \mid t \in \pi^d\ \&\ \langle a, 1 \rangle \in t\}_b \uparrow \varphi)_{cons})\} \\ if\ (\{t \mid t \in \pi^d\ \&\ \langle a, 1 \rangle \in t\}_b \uparrow \varphi)_{cons}\ extends\ \{\emptyset\}_b \uparrow \varphi, \\ \emptyset\ otherwise. \end{array}$$

Finally, the update of information state σ with the goal-oriented sentence *to a*, can φ is as follows: if σ factually subsists in the update,

$$\sigma \uparrow to\ a,\ can\ \varphi = \{(s, \Pi^a \cup \bigcup_{d \neq a}^{(d,\pi) \in \Pi} \Pi^d) \mid (s, \Pi) \in \sigma\ \&\ \Pi^a \neq \emptyset\ \&\ \bigcap_{d \neq a}^{(d,\pi) \in \Pi} \Pi^d \neq \emptyset\}$$

$$=\ \Lambda\ otherwise.$$

Finally notice that $\sigma \uparrow to\ a, \neg have\ to\ \varphi = \sigma \uparrow to\ a,\ can\neg\varphi$.

Example 5.2.9.

1. $\mathbf{0} \uparrow to\ a$, can $b = \{(\emptyset, \{(a, \{\ \boxed{\ \ }\ ,\ \boxed{\text{b}\ \ }\ \})\})\}$,

2. $\mathbf{0} \uparrow to\ a$, can $b \uparrow to\ a$, can $c = \{(\emptyset, \{(a, \{\ \boxed{\ \ }\ ,\ \boxed{\text{b}\ \ }\ ,\ \boxed{\text{c}\ \ }\ \})\})\}$,

3. $\mathbf{0} \uparrow to\ a$, can $b \uparrow to\ b$, can $c = \{(\emptyset, \{(a, \{\ \boxed{\ \ }\ ,\ \boxed{\text{b}\ \ }\ ,\ \boxed{\begin{array}{c}\text{b}\\\text{c}\end{array}}\ \}),$
   $(b, \{\ \boxed{\ \ }\ ,\ \boxed{\text{c}\ \ }\ \})\})\}$.

Epistemic and goal-oriented modality

As the reader might already expect, combinations of epistemic and goal-oriented modality are only meaningful when the epistemic modal scopes over the deontic one.

(18)   a.   To go to Texel, you might have to rent a boat.
        b. #To go to Texel, you have to maybe rent a boat.

Formally this means that a sentence of the form of (18-a) corresponds to an update with $\text{might}(to\ Texel,\ \text{have to}\ rent)$.

$$
\begin{aligned}
& \mathbf{0} \uparrow \text{might}(to\ Texel,\ \text{have to}\ rent) \\
=\ & \{(\emptyset, \emptyset)\} \uparrow \text{might}(to\ Texel,\ \text{have to}\ rent) \\
=\ & \{(\emptyset, \emptyset)\} \cup \{(\emptyset, \emptyset)\} \uparrow to\ Texel,\ \text{have to}\ rent \\
=\ & \{(\emptyset, \emptyset)\} \cup \{(\emptyset, \{(Texel, \{\{\langle rent, 1\rangle\}\})\})\} \\
=\ & \{(\emptyset, \emptyset),\ (\emptyset, \{(Texel, \{\{\langle rent, 1\rangle\}\})\})\}
\end{aligned}
$$

The update with a sentence of the form *to a*, have to might φ fails for the same reason as in the deontic case: plans cannot be updated with a might-sentence (which operates on information states). Stacking goal-oriented operators also causes a failure in interpretation as those sentences need to be interpreted on information states, not on plans. We can therefore complete the predictions made in the previous section as follows:

1. Epistemic modals can scope over participant-external ones.

2. Epistemic modals cannot be interpreted under participant-external ones.

3. Participant-external modal operators cannot be stacked.[24]

5.2.2   Participant-internal modality

Participant-internal modality is the last level of the system. The main intuition I would like to convey is that the contribution of an ability sentence is twofold: on the one side it is just a simple declarative sentence stating a fact about the world we are in, but on the other side it triggers a process of control of this information with respect to the information contained in the planning system. I will thus add an operator for ability to the language:

---

[24]At this point this statement is too strong as I have not yet provided the general system that models both deontic and goal-oriented modals. This is however quite easy to see that such a system is obtained by redefining possibilities as triples (s, δ, Π) of a situation s, a deontic plan δ and a planning system Π (and by reformulating the updates accordingly).

Definition 5.2.10. For any simple declarative sentence $a \in \mathcal{D}$, the sentence *able a* is also in the language.[25]

As we will see, some of the simplifying assumptions concerning deontic and goal-oriented modals made earlier turn out to be counterintuitive for ability. In particular it is difficult to avoid altogether the topic of agency. So far we mainly restricted ourselves to sentences involving the agent or holder of the information state as being the addressee of obligation/permissions or as being the agent of the goal-oriented sentences. I claim that this simplification is harmless in the sense that it is only meant to highlight the ideas behind the definitions. I would like to continue the presentation of the system with the same assumptions. However this means that in the case of participant-internal modality, we would have to deal with a sentence such as the following one:

(19)   You are able to go to Texel.

It seems clear that you are the best judge to confirm or not this sentence and that my saying so to you should not change your information state much. This is not the case if, for instance, the subject of the same sentence is John.

(20)   John is able to go to Texel.

In particular by updating your information state with this sentence you should also be able to conclude (remembering sentence (15-a)) that John is able to take a boat. This means that we also need a planning system for John in our information state.[26] Instead of a simple possibility $(s, \delta, \Pi) \in \sigma$ where the deontic plan and the planning system are those of the holder of the state, we would need to expand the notions of deontic plans and planning systems to sets of agents δ's and Π's, i.e. something like the following:

$$(s, \{(me, \delta_{me}), (John, \delta_{john}), ...\}, \{(me, \Pi_{me}), (John, \Pi_{John}), ...\})^{27}$$

---

[25]We might change the definition of consistency depending on the strength we want to attribute to ability sentences. By that I mean that we might add to the definition of consistency that a consistent situation or to-do list may not contain simultaneously $\langle a, 1 \rangle$ and $\langle able\ a, 0 \rangle$. However I make the choice to assume that we cannot in general conclude statements about ability from the (possibly accidental) occurrence of an event. Notice for instance that the Lillooet participant-internal modal *ka-...-a* can express both meanings, accidental and ability, and that we surely cannot conclude an ability sentence from the accidental reading.

[26]The reader might already have realized that the *you* in sentence (15-a) is most often interpreted generically. That is, this planning information applies to all agent and is therefore by default on all agent's planning systems. Of course, some planning information is agent-specific. Notice that we might as well have deontic information pertaining to John. This move which would be necessary in a complete formalization provides a solution to the problem of symmetric predicates as the addressee of the obligation/permission is singled out. Therefore the sentence *John must shake hands with Bob* with the symmetric predicate *shake hands with* does not entail *Bob must shake hands with John.*

[27]Notice that we would probably need a kind of generic planning system for planning informa-

In order to keep things simple I will neglect this issue and continue the exposition of the system without mentioning agency as the mechanisms at hand only depend on the fact that an agent and "his" planning system can be identified.

We need to come back to the problems of the standard framework with participant-internal modality noted in the previous chapter. There were three main problems:

1. The asymmetry of participant-internal modality: possibility vs necessity (where the first is pervasive and the second marginal).

2. Embedded disjunction (Kenny 1976).

3. Epistemic possibility entails participant-internal possibility.

I will not provide a radical solution for the first two problems. In the case of the asymmetry, I propose to analyze participant-internal necessity as a dummy category corresponding to the use of two negations with participant-internal possibility: participant-internal *have to* := ¬able¬. However, only simple declaratives will be allowed in this section under the ability operator. The full formalization will thus have to be left as future work. This being said Kenny's problem is taken care of in a trivial but of course not satisfying way: boolean combinations are not yet allowed under ability. Contrary to the two first problems, the last one is solved in a non-trivial way. Ability statements as able a are statements as simple declaratives: they are the case or not. Epistemic modality does not say anything about ability unless it embeds an ability modal. Therefore we cannot in general conclude an ability statement from an epistemic one.

I will now turn to the formalization. Goal-oriented and participant-internal modality are intimately connected. In particular, it is natural to pose the following conditions for participant-internal modality given the interpretation of goal-oriented sentences:[28]

1. if you are able to do something, you are able to do the things that are necessary to do it. For all $a, b \in \mathcal{D}$: *to a*, have to *b*; able $a \Vdash$ able *b*.

2. If you are not able to do something, then you are not able to do the things which necessitate it to be done. For all $a, b \in \mathcal{D}$: *to a*, have to *b*; ¬able *b* $\Vdash$ ¬able *a*.

---

tion that is not linked to an agent (world knowledge). Remember the example of last chapter, *Hydrangeas can grow here*, where we surely do not want to analyze hydrangeas as agents.

[28]At this stage the list of conditions does not aim at exhaustivity. For instance, the following conditions all make sense too:

1. For all $a, b, c \in \mathcal{D}$: ¬able *b*; *to a*, have to $(b \vee c) \Vdash$ *to a*, have to *c*.

2. For all $a, b \in \mathcal{D}$: able *a*; *to a*, have to *b* $\Vdash$ able *b*.

Those conditions suggest in particular that the update for goal-oriented sentences with have to should be amended. This is easily done with the help of definition 5.2.11. Replace $(\pi^a \uparrow \varphi)_{cons}$ in definition 5.2.6 by $(\pi^a_{exec[s]} \uparrow \varphi \cup \overline{\pi_{exec[s]}})_{cons}$.

3. For all $a, b, c \in \mathcal{D}$: *to* a, *have to* $(b \vee c)$; $\neg$*able* b; *able* $a \Vdash$ *able* c.

The first two conditions speak for themselves but the last one is in need of a deeper analysis. In the last case, we know what is necessary to achieve a goal a: either do b or do c. By the fact that we also know that the goal can be achieved but b can't, we neglect the to-do lists containing b and conclude that c can be achieved. That is, we concentrate on the to-do lists that are executable.

Definition 5.2.11 (Executable to-do lists). Let (s, Π) be a possibility. The set of executable to-do lists of a goal/plan pair in Π with respect to the situation is the set of all to-do lists that do not contain an action that the agent is not able to perform in this situation:

$$\pi_{exec[s]} = \{t \mid t \in \pi \ \& \ if \ \langle able \ a, 0\rangle \in s, \ \langle a, 1\rangle \notin t\},$$

with $\pi - \pi_{exec[s]} = \overline{\pi_{exec[s]}}$.

The main difference between a normal declarative sentence and a participant-internal modal is that the participant-internal modal triggers a kind of consistency check with respect to the planning system that will add the relevant participant-internal information that can be derived from the update. That is, the update with a participant internal sentence triggers a planning system check:

Definition 5.2.12 (Planning system check). Let s be a situation and Π a planning system. The set $(s)_\Pi$ is the situation that obtains by the addition of relevant participant-internal sentences deduced from participant-internal sentences in s and the planning system Π:

$$(s)_\Pi = s \cup$$

$$\bigcup_{\substack{a \in \mathcal{D}, \\ \langle able\ a, 1\rangle \in s}} \{\langle able \ d, 1\rangle \mid \langle d, 1\rangle \in \bigcap \pi^a_{exec[s]}, \ \pi^a = \begin{array}{l} \pi, \ if \ (a, \pi) \in \Pi, \\ \{\emptyset\} \ otherwise \end{array} \} \cup$$

$$\bigcup_{\substack{a \in \mathcal{D}, \\ \langle able\ a, 0\rangle \in s}} \{\langle able \ d, 0\rangle \mid \begin{array}{l} \langle a, 1\rangle \in \bigcap \pi^d_{exec[s-\{\langle able\ a, 0\rangle\}]}, \\ for \ some \ d \ such \ that \ (d, \pi^d) \in \Pi \end{array} \}$$

We can now give a definition of participant-internal modality.

Definition 5.2.13 (Participant-internal update). Let σ be an information state, $a \in \mathcal{D}$ a simple declarative.

$$\sigma \uparrow able \ a \ = \ \{((s \cup \{\langle able \ a, 1\rangle\})_\Pi, \Pi) \mid \begin{array}{l} (s, \Pi) \in \sigma \ \& \\ (s \cup \{\langle able \ a, 1\rangle\})_\Pi \ consistent \end{array} \}$$

$$\sigma \downarrow able \ a \ = \ \{((s \cup \{\langle able \ a, 0\rangle\})_\Pi, \Pi) \mid \begin{array}{l} (s, \Pi) \in \sigma \ \& \\ (s \cup \{\langle able \ a, 0\rangle\})_\Pi \ consistent \end{array} \}$$

Example 5.2.14. Suppose you know the following goal-oriented sentences:

(21)   a.   To go to Texel, you have to take the ferry or go with a rental boat.
          b.   To go with a rental boat, you must drive the boat.

This gives the information state (as update on the minimal information state),

$$\mathbf{0} \uparrow \text{(21-a)} \uparrow \text{(21-b)}$$

$$= \; \{(\emptyset, \{ \; (Texel, \{ \; \boxed{\text{ferry} \;\;} , \; \boxed{\begin{array}{c} \text{boat} \\ \text{drive} \end{array}} \}) \; , \; (boat, \{ \; \boxed{\text{drive} \;\;} \}) \; \})\}$$

which we will abbreviate as $\{(\emptyset, \Pi_0)\}$. I will now go through the steps of the update with *John is able to go to Texel*:

$$\mathbf{0} \uparrow \text{(21-a)} \uparrow \text{(21-b)} \uparrow \text{able } Texel = \{ \; (\{\langle \text{able } Texel, 1\rangle\}, \; \Pi_0) \; \}$$

Proof sketch:

$$\mathbf{0} \uparrow \text{(21-a)} \uparrow \text{(21-b)} \uparrow \text{able } Texel$$
$$= \; \{((\emptyset \cup \{\langle \text{able } Texel, 1\rangle\})_{\Pi_0}, \Pi_0) \mid (\emptyset \cup \{\langle \text{able } Texel, 1\rangle\})_{\Pi_0} \; consistent\}$$
by definition 5.2.13
$$= \; \{((\{\langle \text{able } Texel, 1\rangle\})_{\Pi_0}, \Pi_0) \mid (\{\langle \text{able } Texel, 1\rangle\})_{\Pi_0} \; consistent\}$$
$$= \; \{ \; (\{\langle \text{able } Texel, 1\rangle\}, \; \Pi_0) \; \}$$

because

$$(\{\langle \text{able } Texel, 1\rangle\})_{\Pi_0} = (s_1)_{\Pi_0}$$
$$= \; \{\langle \text{able } Texel, 1\rangle\} \cup \bigcup_{\substack{a \in \mathcal{D} \\ \langle \text{able } a, 1\rangle \in s_1}} \{\langle \text{able } d, 1\rangle \mid \langle d, 1\rangle \in \bigcap \pi^a_{exec[s_1]},$$
$$\pi^a = \pi \; if \; (a, \pi) \in \Pi, \; \{\emptyset\} \; otherwise\}$$
$$= \; \{\langle \text{able } Texel, 1\rangle\} \cup \{\langle \text{able } d, 1\rangle \mid \langle d, 1\rangle \in \bigcap \pi^{Texel}_{exec[s_1]}, \; (Texel, \pi^{Texel})$$
$$\in \Pi_0\} \; with \; \bigcap \pi^{Texel}_{exec[s_1]} = \{\langle ferry, 1\rangle\} \cap \{\langle boat, 1\rangle, \langle drive, 1\rangle\} = \emptyset$$
$$= \; \{\langle \text{able } Texel, 1\rangle\}$$

 Q.E.D

Therefore, by learning that John is able to go to Texel, we cannot derive extra information. But now if we learn that John is not able to drive a boat, we obtain this information state:

$$\mathbf{0} \uparrow \text{(21-a)} \uparrow \text{(21-b)} \uparrow \text{able } Texel \uparrow \neg \text{able } drive$$
$$= \; \{ \; (\{\langle \text{able } Texel, 1\rangle, \langle \text{able } drive, 0\rangle, \langle \text{able } ferry, 1\rangle, \langle \text{able } boat, 0\rangle\}, \; \Pi_0) \; \}$$

Proof sketch:

$$\mathbf{0} \uparrow (21\text{-a}) \uparrow (21\text{-b}) \uparrow able\ Texel \uparrow \neg able\ drive$$

$$= \{((\{\langle able\ Texel, 1\rangle\} \cup \{\langle able\ drive, 0\rangle\})_{\Pi_0}, \Pi_0) \mid (\{\langle able\ Texel, 1\rangle\} \cup$$
$$\{\langle able\ drive, 0\rangle\})_{\Pi_0}\ consistent\} \qquad \text{by definition } 5.2.13$$

$$= \{((\{\langle able\ Texel, 1\rangle, \langle able\ drive, 0\rangle\})_{\Pi_0}, \Pi_0) \mid (\{\langle able\ Texel, 1\rangle,$$
$$\langle able\ drive, 0\rangle\})_{\Pi_0}\ consistent\}$$

$$= \{\ (\{\langle able\ Texel, 1\rangle, \langle able\ drive, 0\rangle, \langle able\ ferry, 1\rangle, \langle able\ boat, 0\rangle\},\ \Pi_0)\ \}$$

because

$$(\{\langle able\ Texel, 1\rangle, \langle able\ drive, 0\rangle\})_{\Pi_0} = (s_2)_{\Pi_0}$$

$$= \{\langle able\ Texel, 1\rangle, \langle able\ drive, 0\rangle\} \cup$$

$$\bigcup_{\substack{a \in \mathcal{D} \\ \langle able\ a, 1\rangle \in s_2}} \{\langle able\ d, 1\rangle \mid \langle d, 1\rangle \in \bigcap \pi^a_{exec[s_2]},\ \pi^a = \begin{array}{l} \pi\ if\ (a, \pi) \in \Pi, \\ \{\emptyset\}\ otherwise \end{array} \}$$

$$\cup \bigcup_{\substack{a \in \mathcal{D} \\ \langle able\ a, 0\rangle \in s_2}} \{\langle able\ d, 0\rangle \mid \begin{array}{l} \langle a, 1\rangle \in \bigcap \pi^d_{exec[s_1]}, \\ for\ some\ d\ s.t.\ (d, \pi^d) \in \Pi \end{array} \}$$

$$= \{\langle able\ Texel, 1\rangle, \langle able\ drive, 0\rangle\} \cup$$

$$\{\langle able\ d, 1\rangle \mid \langle d, 1\rangle \in \bigcap \pi^{Texel}_{exec[s_2]},\ with\ \pi^{Texel}_{exec[s_1]} = \{\ \{\langle ferry, 1\rangle\}\ \}\} \cup$$

$$\{\langle able\ boat, 0\rangle \mid \langle drive, 1\rangle \in \bigcap \pi^{boat}_{exec[s_1]} = \{\langle drive, 1\rangle\}\}$$

$$= \{\langle able\ Texel, 1\rangle, \langle able\ drive, 0\rangle, \{\langle able\ ferry, 1\rangle, \langle able\ boat, 0\rangle\}$$

Q.E.D

Combinations with participant-internal modality

Given the definition of participant-internal modality it is quite obvious that it should be possible to embed it under the other types of modality but that the reverse should be uninterpretable. This is due to the fact that, when interpreted on information states, ability sentences are basically simple declarative sentences that trigger a checking mechanism on the planning systems. This mechanism is just not triggered when an ability sentence updates plans. In this case the ability sentence is just treated as a simple declarative sentence.

Therefore epistemic modals can embed participant-internal sentences and the reverse is not interpretable.

(22) a.   John might be able to go to Texel.
      b. #John is able to maybe go to Texel.

It is also easy to realize that deontic modals easily embed participant-internal modals[29] but that the reverse is not interpretable either.[30]

---

[29]To be formal and precise, we need to reformulate definition 5.1.22 to allow ability sentences.

[30]Notice that the system cannot yet predict the fact that permission sentences embedding an

(23) a. (In view of what his contract provides) John must be able to speak Dutch for his new job.
      b. #John is able to have to speak Dutch for his new job.

Finally although combinations with goal-oriented modality need some more work, notice first that ability cannot scope over goal-oriented modals just as it could not scope over other modals. Goal-oriented modals may embed ability statements:

(24) a. To play polo, you must be able to ride a horse.
      b. #To play polo, you are able to have to ride a horse.

As such this sentence is not a problem, that is, the update works as it should. However, we run into trouble if we further update with the sentence *John can play polo*. The constraint on participant-internal modality fails as it should add the ill-formed ⟨able able *polo*, 1⟩. This problem is easily solved although it comes at the expense of more involved definitions. Notice first that the problem is in some sense not limited to participant-internal modality. Remember the hydrangeas example of last chapter:[31]

(25) a. In order for hydrangeas to grow, the climate must be temperate.
      b. Hydrangeas can grow here.

From these two sentences we do not want to conclude (26-a), as the definitions would do, but (26-b).

(26) a. #The climate is able to be temperate.[32]
      b. The climate is temperate.

The sentence embedded under the goal-oriented sentence, (26-b), is clearly stative. I claim that ability sentences also are stative and that this property explains the data. The idea is that when a stative sentence is required to achieve a goal and when we know that this goal can be achieved by an agent then we know that this

----

ability often sound strange.

(i)   John may be able to speak Dutch.

This kind of sentence mainly makes sense for a theater director that is giving shape to a character. A possible explanation for this problem is that the deontic modal gives to the grammatical subject *John* some choice but that having an ability is not something that is decided by an agent but something that needs to be acquired.

[31]If the reader is distracted by the fact that, as already mentioned, hydrangeas are not easily seen as agents, he can use the following variant:

(i) a. To read a book in the tent at night, John must have a flashlight.
     b. John can read a book in the tent at night.

[32]I use the modal *able to* here on purpose as the variant with *can, the climate can be temperate*, does not sound as bad although it loses its pure ability reading and has an occasional reading.

sentence, and not the sentence under ability, is the case:

$$\{\ (\emptyset, \{(a, \{\ \boxed{\begin{array}{c}\text{state}\\\hline\text{event}\end{array}}\ \})\})\ \} \uparrow \text{able } a$$

$$=\ \{\ (\{\langle \text{able } a, 1\rangle, \langle \text{state}, 1\rangle, \langle \text{able event}, 1\rangle\}, \{\ \boxed{\begin{array}{c}\text{state}\\\hline\text{event}\end{array}}\ \})\})\ \}$$

We therefore need to improve the second part of definition 5.2.12 of the planning system check by differentiating between types of sentences (states vs events). Events add an ability statement to the situation whereas states add themselves. We can rephrase the original condition as follows:

1. If you are able to do something, you are able to do the actions (perform the events) that are necessary to do it and the preconditions/states that need to be the case are the case.

I will not give the precise formulation of the new rule as it should be obvious that the change is not problematic as soon as we can differentiate in the language between states and events. That is what the following definition does.

Definition 5.2.15. We make a distinction between events and states in the language. Within the set of simple declarative sentences $\mathcal{D}$, we therefore have a split between events and states: $\mathcal{D} = \mathcal{D}_{state} \cup \mathcal{D}_{event}$. For any simple declarative sentence $a \in \mathcal{D}$, the sentence able a is a state.

The last remark is that the second part of definition 5.2.12 also needs to account for this new distinction in the language. The intuitive formulation of the condition becomes thus:

2. If you are not able to perform some event x or some precondition/state y is not the case, then you are not able to do the things which necessitate x to be done or y to be the case.

$$\{\ (\emptyset, \{(a, \{\ \boxed{\begin{array}{c}\text{state}\\\hline\text{event}\end{array}}\ \})\})\ \} \uparrow \neg\text{state}$$

$$=\ \{\ (\{\langle \text{able } a, 0\rangle, \langle \text{state}, 0\rangle\}, \{\ \boxed{\begin{array}{c}\text{state}\\\hline\text{event}\end{array}}\ \})\})\ \}$$

Obviously definition 5.2.12 can be amended without problem to take this idea into account. However, this is a departure from the idea expressed at the beginning of this section that the ability modals trigger a planning system check. This last step necessitates also performing the planning system check when we update with (negated) stative sentences. We could for instance generalize the planning system check to any update with simple declaratives (including ability sentences) in definition 5.1.12. I will unfortunately have to leave this for future work.

Conclusion

Before formulating in some detail what has been achieved in this dissertation, I will give a short overview based on the comments on the typological approach of section 1.1.3. I therefore repeat here the characterization of this approach by (Croft 2003, p2) and figure 1.1 that incorporates this characterization within the methodology of this dissertation.

1. typological classification based on surface structure   (descriptive part)

2. typological generalization   (language universals)

3. functional-typological approach   (external explanation of the universals)
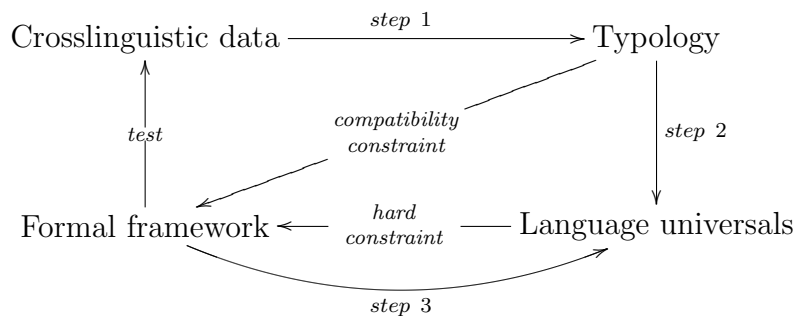
The first step consisted in the description of the six modal systems and the confirmation that the chosen typology of modality was correctly describing the relevant categories encountered in the data. The second step was to acknowledge the fact that based on this typology we can formulate an unrestricted universal on the combinations of modal items. Finally the last step was to provide a formal semantic framework where the restrictions on combinations of modal items are accounted for.

219

As promised in the introduction, I will now sketch the last step of this method which consists in making explicit the relationship between on the one hand the data of the languages and on the other the typology and its language universals. The method used to connect both kinds of information is the construction of a semantic map. A semantic map consists of two parts: first the structure of the typology which is represented in a diagram form (called the semantic or conceptual space) and second the language-particular information represented by "bounded regions on the diagram" (Croft 2003, p133). Instead of using the labels of the typology (participant-internal, external, etc...) we can actually use the operators of the last chapter (to which I add the operator *need* as label for the dual of *able* and the epistemic necessity *must* which has been left undefined). The links between the modal meanings express that some modal element in some
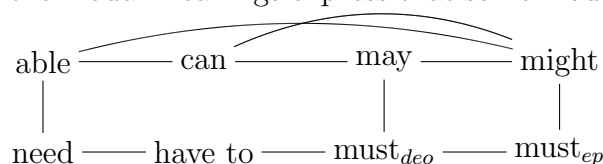
Figure 5.1: Semantic space of modality

language could express both linked meanings. The other way around, if there is no direct link between two values it means that we have not found any language where a modal element only expressed these two meanings without expressing the intermediate meanings too. For instance, there is no direct link between the participant-internal *able* and the deontic possibility *may* as none of the languages of the sample has a modal item expressing both without expressing goal-oriented possibility. The diagram can be partitioned in two different ways. On the vertical axis, we can distinguish the possibility and necessity partitions.
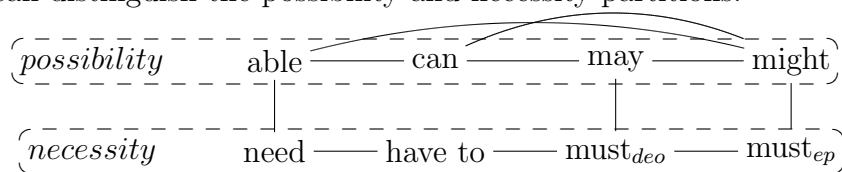
On the horizontal axis we can distinguish the different types of modality discussed in this dissertation.
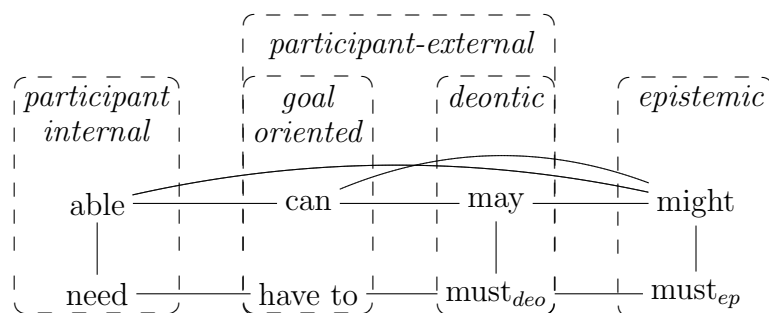
We can now represent language-specific information as bounded regions of the semantic space. I will present one instantiation of the semantic map for every language.

(27)   *kunnen* (Dutch):

$$\text{able} \text{—} \text{can} \text{—} \text{may} \text{—} \text{might}$$
$$\text{need} \text{—} \text{have to} \text{—} \text{must}_{deo} \text{—} \text{must}_{ep}$$
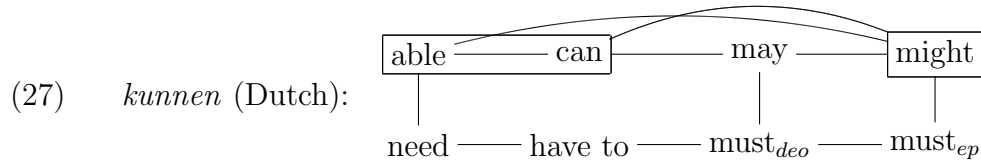
The Dutch possibility modal *kunnen* is the reason why there is a link between the goal-oriented *can* and epistemic *might* in our diagram. This possibility modal does not express deontic modality (the dedicated deontic possibility modal being *mogen*). We can see that the polyfunctionality of a modal item amounts to its domain covering more than one type on the horizontal axis.

(28)   *sìgán* (Gbe):

$$\text{able} \text{—} \text{can} \text{—} \text{may} \text{—} \text{might}$$
$$\text{need} \text{—} \text{have to} \text{—} \text{must}_{deo} \text{—} \text{must}_{ep}$$
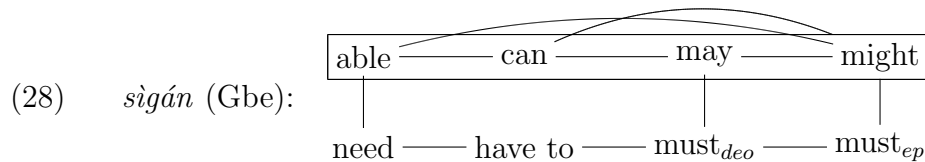
The Gbe possibility modal *sìgán* is a good example of a fully polyfunctional modal item. It covers the whole axis of possibility meanings. The necessity modal *ɖó-ná* follows the same pattern for necessity.

(29)   *-ya hata* (Korean):

$$\text{able} \text{—} \text{can} \text{—} \text{may} \text{—} \text{might}$$
$$\text{need} \text{—} \text{have to} \text{—} \text{must}_{deo} \text{—} \text{must}_{ep}$$
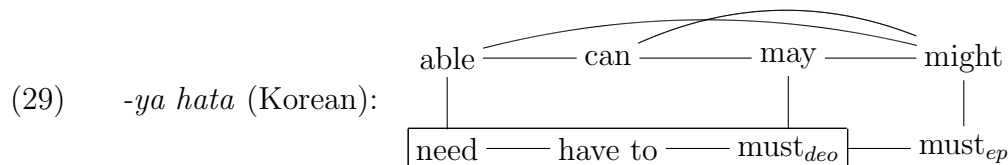
The Korean necessity modal *-ya hata* covers participant-internal and external necessity but does not express epistemic modality. The link between the ability meaning *able* and epistemic *might* accounts for the behavior of the Korean possibility modal *su issta* that in its standard use expresses participant-internal and epistemic modality. However, we have already mentioned that the situation might be more complicated. It is quite certain that this modal cannot express goal-oriented modality but it can express deontic modality, although only to express deontic necessity in special negative constructions (Wymann 1996b, p111-113). The question is thus whether this deontic reading occurs in fossilized constructions (which is the choice made for the current semantic space as *su issta* does not express deontic modality in stand-alone constructions) or whether these constructions can be decomposed into negative elements and a full-fledged deontic modal *su issta* (in which case the link in the semantic space should not be between *able* and *might* but between *able* and *may*).

(30)   *-k'a* (Lillooet):

$$
\begin{array}{ccccccc}
\text{able} & \!\!-\!\!\!- & \text{can} & \!\!-\!\!\!- & \text{may} & \!\!-\!\!\!- & \boxed{\text{might}} \\
| & & & & | & & | \\
\text{need} & \!\!-\!\!\!- & \text{have to} & \!\!-\!\!\!- & \text{must}_{deo} & \!\!-\!\!\!- & \boxed{\text{must}_{ep}}
\end{array}
$$
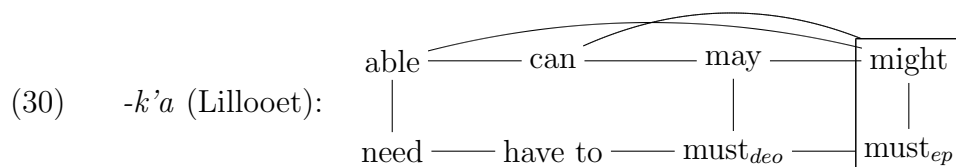
The Lillooet enclitic *-k'a* exemplifies a peculiar behavior with respect to the other languages of the sample. The enclitic is not polyfunctional but instead covers two meanings on the vertical axis: it can express both necessity and possibility. The same is the case for the deontic enclitic *-ka* and for the participant-internal circumfix *ka-...-a*. The problem for our framework will thus be to explain why the necessity reading is the default one.

(31)   *herhalde* (Turkish):

$$
\begin{array}{ccccccc}
\text{able} & \!\!-\!\!\!- & \text{can} & \!\!-\!\!\!- & \text{may} & \!\!-\!\!\!- & \boxed{\text{might}} \\
| & & & & | & & | \\
\text{need} & \!\!-\!\!\!- & \text{have to} & \!\!-\!\!\!- & \text{must}_{deo} & \!\!-\!\!\!- & \text{must}_{ep}
\end{array}
$$
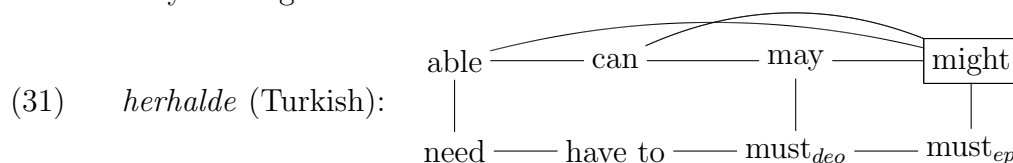
The Turkish epistemic possibility adverb *herhalde* covers only one coordinate of the semantic space. This is a very common pattern as we have seen that all the languages of the sample have an equivalent adverb expressing the same meaning. Notice also that the Turkish verbal suffix *-AbIl* is fully polyfunctional. The situation is less clear for the necessity suffix as the epistemic meaning only occurs in verbal constructions. I will leave this decision (whether it is polyfunctional or not) for future work. It is however important to notice that whatever the outcome will be, it can be accounted for in this model.

(32)   *ttau* (Tuvaluan):

$$
\begin{array}{ccccccc}
\text{able} & \!\!-\!\!\!- & \text{can} & \!\!-\!\!\!- & \text{may} & \!\!-\!\!\!- & \text{might} \\
| & & & & | & & | \\
\text{need} & \!\!-\!\!\!- & \boxed{\text{have to} \; \!\!-\!\!\!- \; \text{must}_{deo} \; \!\!-\!\!\!- \; \text{must}_{ep}}
\end{array}
$$
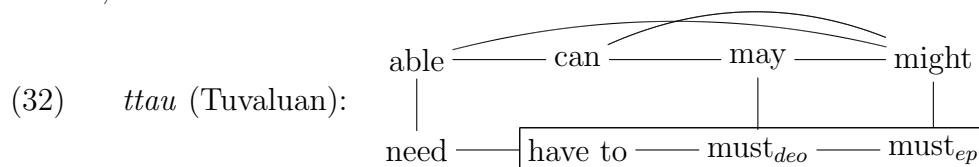
Finally, we conclude this short overview of language-specific modal elements with the Tuvaluan necessity modal *ttau* which can express all the necessity meanings but the participant-internal one. With the help of the semantic map we can now easily compare (parts of) the modal systems of different languages. The modal meanings of our update system form the semantic space and language-particular modals are bounded regions of this space. Based on this representation and our data we can also formulate a new (tentative) unrestricted universal:

> Modal elements can only have more than one meaning along a unique axis of the semantic space: they either vary on the horizontal axis and thus are polyfunctional in the original sense of expressing different types of modality or they vary on the vertical axis and can express possibility and necessity, but they cannot vary on both axes.

I will now recapitulate what has been done in this dissertation. In the first two chapters, I have successively introduced the core ideas of the typological

approach to linguistics, discussed some typologies of modality and presented the modal systems of six languages from different phyla. The sample of languages was chosen so as to show some of the diversity of the syntactic/semantic interface of modal systems. Part of the motivation for the second chapter was to provide a description of the salient features of the modal systems of those six languages and to provide the relevant references in the literature in the hope of facilitating future work on modality. The chosen typology (a simplification of (van der Auwera and Plungian 1998)) proved to be an adequate tool to investigate and classify modal items within languages. Finally, I gave the status of unrestricted universal to the scope order of combinations of modal items:

Epistemic > Participant-external > Participant-internal.

Obviously, the size of the sample is not consequent enough to treat this claim as a linguistic truth. However I consider this claim to be solid enough (particularly in view of its explanation sketched in the last chapter) to place the burden of proof on anyone who would like to challenge it.

In the third chapter, I presented the truth-conditional framework of modality developed in (Kratzer 1976) up to (Kratzer 1991) and its extensions, in particular the treatment of goal-oriented modality as proposed in (von Fintel and Iatridou 2004). I have presented the following problems for this framework: the unwarranted entailments of ability statements with an embedded disjunction, the entailment of ability sentence from their epistemic counterparts, the presence of deontic sentences in natural candidates as deontic ordering sources, the problem of trivially true conditionals with deontic modality and goal-oriented modality, a problem for goal-oriented possibility and most importantly the problem of combinations of modal items. If there is only one thing to remember from this chapter, it is that the standard framework cannot as it stands account for the pattern of combinations of modal items.

In the last chapter, I presented an update semantics framework of modality. This system is based on the idea that a polysemous framework is better suited to account for the data and that the dependence on the context is relevant across the board but only when a polyfunctional modal is used. Furthermore the different types of modality operate on different layers of the architecture and therefore the pattern of combinations of modals is easily accounted for. Epistemic modality is a type of modality that operates on the top level of the architecture, the information state (which represents all the information an agent is aware of). Participant-external modality operates on the plans of the possibilities of the information state. Participant-internal modality works just as a plain declarative sentence but with an extra consistency check with respect to the goal-oriented modality system. Furthermore this framework solves naturally most of the problems encountered with the standard framework and some more such as free choice permission.

Obviously, the update semantics framework in its current state is just a toy example of what a fully-fledged modal system should look like. The basic archi-

tecture is solid but a lot of additions and improvements are still needed. First some modals and types of modality have just not been discussed in this dissertation and would need to be added to form a more complete picture. I have for instance not treated bouletic modality i.e. the type of modality concerned with desires. Furthermore I have not provided a semantics for epistemic necessity (I just suggested that it should probably be inspired by the treatment of defaults in (Veltman 1996)). Thus far the additions that are needed to complete the coverage of the framework. Furthermore the system needs improvements to become more than a toy example. For instance in the case of participant-external modality we would need to be able to distinguish between different agents.

(33)   Malcom must walk the dog and Dewey must clean his room.

In particular, the update with the previous sentence in your information state should result in the update of Malcolm and Dewey's respective deontic plans and not of yours as is the case in the present situation. Our framework only deals at this point with the plans of the addressee and as such cannot distinguish between different agents. Finally, it is necessary to add something to represent information about other agent's information. The obvious way to do that would be to add an information state at some level inside the main information state (probably as an extra element of possibilities) for every relevant agent in some situation. Notice that this does not necessarily lead to problems of circularity in this framework as the embedded information state does not necessarily need to contain information states itself.

All in all it is quite clear that a lot of facets of this framework can be improved. However, with all its faults, the framework is faithful to the idea that any theory of modality should first and foremost be able to describe and account for the language universals concerning modality.

List of abbreviations

1/2/3	first/second/third person		INC	inchoative
ABIL	ability suffix		IND	indicative
ABS	absolutive case		INF	infinitive
ACC	accusative case		INS	insistance marker
A:	adnominalizing suffix		INSTR	instrumental
ADV	adverb		INTR	intransitivizer
ANP	anaphor		LOC	locative
ANT	anterior		NOM	nominative case
AOR	aorist		NPAST	non past
AUX	auxiliary		NEG	negation
CAUS	causative		NLR	nominalizer
COMP	complementizer		NEC	obligative suffix
CNT	contrastive marker		PL	plural
COND	conditional		PART	particle
COP	copula		PAST	past
CSFX	connective suffix		PASS	passive
DAT	dative case		POSS	possessive
DEF	definite		PRC	precautionary mood
DEIC	deictic		PREF	prefix
DEM	demonstrative		PREP	preposition
DET	determiner		PRES	present
DIR	directive transitivizer		PROG	progressive
ERG	ergative case		REL	relative clause
EV	evidential		SFX	suffix
F/M/N	feminine/masculine/neuter		SG	singular
FOC	focus		SUBJ	subject
FUT	future		SBJ	subjonctive
GEN	genitive case		TOP	topic
GM	generalizing modality		TR	transitivizer
I	inclusive		VSFX	verbal suffix
IMPF	imperfective			

Samenvatting

Modaliteit is een breed taalkundig begrip. Het is een noemer onder welke allerlei betekenissen vallen en het kan door zeer verschillende grammaticale categorieën worden uitgedrukt. Denk bijvoorbeeld aan de volgende zinnen:

(1)   a.   De deur moet op slot.
      b.   Misschien is Jan thuis.

In zin (1-a) noemt men de betekenis van het werkwoord *moeten deontisch*. De zin drukt een verplichting uit: dat de deur op slot moet. De betekenis van het bijwoord *misschien* in zin (1-b) wordt *epistemisch* genoemd. Het gaat hier om conclusies die kunnen worden getrokken op basis van kennis/informatie. Als we bijvoorbeeld langs het huis van Jan lopen en het licht zien branden kunnen we (1-b) concluderen. Andere belangrijke betekenissen die onder de noemer modaliteit vallen zijn *capaciteit* (over het vermogen om bepaalde acties uit te voeren) en doel-gerichte modaliteit (over mogelijke of noodzakelijke acties om een doel te bereiken). Bovendien kunnen niet alleen werkwoorden en bijwoorden modaliteit uitdrukken maar ook bijvoorbeeld bijvoeglijke naamwoorden, lexicale constructies, suffixen en enclitica (hoewel de laatste mogelijkheid niet aanwezig is in het Nederlands).

De doelstelling van dit proefschrift is om modaliteit te bestuderen vanuit zowel een typologisch als een formeel semantisch oogpunt. Het typologische perspectief omvat hier het onderzoek naar modale systemen in verschillende talen en heeft als doel het ontrafelen van universele structuren daarin. Ik zal in het bijzonder laten zien dat er een universele beperking geldt voor combinaties van modale elementen. De resultaten van dit typologische onderzoek gebruik ik vervolgens als input voor de formele semantiek.

Het proefschrift is als volgt ingedeeld. Ik begin het eerste hoofdstuk met een beknopte inleiding over de concepten en de belangrijkste begrippen binnen de typologie. Het tweede deel van dit hoofdstuk is gewijd aan het belangrijkste onderwerp van dit proefschrift, modaliteit. Ik presenteer een aantal typologieën

van modaliteit ontwikkeld door (Palmer 2001), (Hengeveld 2004) en (van der Auwera and Plungian 1998) en kies uiteindelijk voor de laatste typologie als uitgangspunt voor het onderzoek naar modaliteit in het tweede hoofdstuk.

Het tweede hoofdstuk omvat het onderzoek naar de modale systemen van zes talen: Nederlands, Gbe (cluster), Koreaans, Lillooet, Turks en Tuvaluaans. Hierbij geef ik voor elke taal afzonderlijk eerst een overzicht van de modale elementen en vervolgens neem ik het probleem van de modale combinaties onder de loep. In het laatste gedeelte van dit hoofdstuk zijn de resultaten samengevat en kom ik tot de formulering van een *semantic universal* over de combinaties van modale elementen.

Het derde hoofdstuk gaat over de formele theorie van modaliteit. Ik bespreek hierin voornamelijk de theorie van Angelika Kratzer in (Kratzer 1976) tot (Kratzer 1991). In deze serie artikelen stelt ze een context-afhankelijke analyse van modaliteit voor. Nog steeds vormt deze de ruggengraat van de meeste semantische werken op het gebied van modaliteit. Met het oog op enkele interessante voorbeelden zal ik tevens ingaan op een aantal uitbreidingen van deze theorie geformuleerd door (Brennan 1993) en (von Fintel and Iatridou 2004).

In het vierde hoofdstuk worden enkele problemen besproken waartegen de analyse van Kratzer, inclusief uitbreidingen, niet bestand is. De kwestie van de modale combinaties uit het vorige hoofdstuk zal hier met name problematisch blijken te zijn.

In het vijfde hoofdstuk construeer ik een *update semantics* raamwerk voor modaliteit. Als basisprincipe heb ik de typologie van modaliteit uit het tweede hoofdstuk geïmplementeerd en de *semantic universal* over de combinaties van modale elementen ingevoerd als een beperking voor dit raamwerk. De verschillende typen van modaliteit opereren op verschillende plaatsen in deze semantische theorie (weliswaar op zeer gelijke wijze). Dit maakt het mogelijk om op een elegante manier de combinaties van modalen en ook het grootste gedeelte van de problemen van het standaard raamwerk te verklaren. Een ander belangrijk punt, tenslotte, is dat er een expliciete verbinding wordt gemaakt tussen doel-gerichte modaliteit en capaciteit.

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