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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 contextdependent 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	$must_{ep}$	$must_{deo} / must_{goal}$	$must_{p.int}$
	\max_{ep}	\max_{deo} / \max_{goal}	$\max_{p.int}$

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.

$$cb: W \to \mathcal{P}(\mathcal{P}(W))$$

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.

¹This 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.

- (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 .

²Although 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.

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.

³Notice 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 participantinternal 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

⁴The 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.

⁵To 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

⁶This 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 dual⁷ 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

 $^{^{7}}$ 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.

⁸It 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 theorem⁹

$$can(\varphi \lor \psi) \to (can \ \varphi \lor can \ \psi)$$

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.

- 1. Necessitation rule: If φ is a theorem of K, then so is must φ .
- 2. Distribution axiom: $must(\varphi \to \psi) \to (must \ \varphi \to must \ \psi)$

 $^{^9\}mathrm{The}$ modal logic K is the logic based on propositional logic to which the following two axioms are added:

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 participantinternal 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-

 $^{^{10}{\}rm Notice}$ the surprising use of universal force to express circumstantial ability. This was already noticed by (Thomason 2005).

 $\begin{array}{cccc} \text{epistemic modal base} &\supseteq & \text{circumstantial modal base} \\ \downarrow & & \downarrow \\ \{\text{epistemic worlds}\} &\subseteq & \{\text{circumstantial worlds}\} \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & \\ & & & & \\ & & & & \\ & & & \\ & & &$

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 soil¹¹ 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 contextdependent 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

¹¹The 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.

¹³Notice 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:

$w \in [\neg \max (they \ sell \ cigarettes \ to \ people < 16)]^{b,o}$	iff
$w \notin [may (they sell cigarettes to people < 16)]^{b,o}$	iff
for all $u \in C^{b,o}(w)$: $u \notin [they sell cigarettes to people <$	<i>16</i>]

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 to sell to sell to reader 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

¹⁴Artikel 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.

¹⁶This section can also be found as a part of (Nauze to appear).

 $^{^{17}{\}rm Actually}$ 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 circumstantial¹⁸ 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. Therefore 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

166

 $^{^{18}}$ 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.

¹⁹This 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):

^{&#}x27;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) sentence (15-b)	true in <i>w</i> #trivially true#	#false in w # 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: $w \to \{ \text{propositions stating the relevant circumstances in } w \}$

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 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.

168

²⁰This 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.

²¹Notice 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."

²²Furthermore 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 $v \in \llbracket Harlem \rrbracket^{b,o}, v \in \llbracket q \rrbracket^{b,o}$ 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 $Hoboken \to \neg Harlem \in b(w)$. 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 $v \in C^{b \cup \{p\}, o}(w), v \in \llbracket q \rrbracket^{b, o}$.

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.

²³Notice 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 $b(w), P \not\vdash p$.

Obviously, this not enough as, with this definition, p is always an essential part of a way of achieving p (as long as $b(w) \not\vdash p$ 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* $q \not\vdash p$ and there is a set P of propositions such that, $b(w), P, \{q\} \vdash p$ but $b(w), P \not\vdash p$.

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 $b'(w) = b(w) \cup \{p\}, v \in \llbracket q \rrbracket^{b,o}$.
- 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 $v \in \llbracket q \rrbracket^{b,o}$.

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 Martinez²⁴ 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 $b(w) \not\vdash \neg Harlem$):

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:

²⁴Pedro 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 > Participantinternal

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 theorem.
 - b. Deontic > Participant-internal: They must be able to prove this theorem (otherwise they won't pass).
 - 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)

 $^{^{25}{\}rm I}$ neglect the possibility of John being a compulsive tax payer, that is, with have~to as participant-internal necessity.

 $^{^{26}\}mathrm{I}$ 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 examples²⁸ 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 .

- (i) a. John must believe I might come.
 - b. It must be so that, according to John, I might come.

²⁷As (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."

²⁸Another 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):

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)
		$must_{S}(John \ is \ home)$	
	b.	John must pay taxes.	(VP-deontic)
		$(must_{VP}(\lambda x.x \ pays \ taxes))(John)$	
(30)	Jol	an may have to pay more taxes	

- (30) John may have to pay more taxes.
 - a. Epistemic > deontic: may_S((must_{VP}(λx.x pays more taxes))(John))
 b. Deontic > epistemic: #(may_{VP}(must_S(λx.x pays more taxes)))(John) #(may_{VP}(must_S(John pays more taxes)))(···)

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_{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) $must_{S}(may_{S}(tax \ are \ filled \ out \ in \ ink))$

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.