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Modality

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schieden geblieben, die durch verschiedene konzessive Konnektiva in einer Sprache ausdrückbar ist. In den Untersuchungen von Brauße (1983a) für das Deutsche, Borkin (1980) für das Englische und Morel (1980) für das Französische liegen hier interessante Ansätze vor. Zu den offenen Problemen gehört aber letztlich auch noch die Frage, die im Mittelpunkt der vorausgegangenen Ausführungen stand: eine präzise Beschreibung des Beitrages von konzessiven Konjunktionen, die über die genannten Wahrheitsbedingungen hinausgeht und als 'konzessive Präsupposition' bezeichnet wurde.

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8. Literatur (in Kurzform)

Abraham 1975 · Anscombre 1976 · Anscombre/Ducrot 1976 · Bartori 1975 · Borkin 1982 · Brauße 1983a · Burnham 1911 · Curme 1931 · van Dijk 1977a · Ducrot 1973 · Ducrot 1980b · Haiman 1974 · Halliday/Hasan 1976 · Hartung 1964 · Heidolph et al. 1981 · Hermodsson 1978 · Klein 1980 · König 1985a · König 1985b · König 1985c · König 1988 · König 1989 · Lakoff 1971 · Lang 1977 · Lerch 1929 · Levinson 1983 · Löbner 1986 · Mazzoleni 1988 · Moeschler/de Spengler 1981 · Morel 1980 · Pusch 1975 · Quirk 1954 · Quirk et al. 1972 · Reichenbach 1947 · Toulmin 1958 · Valentin (ed.) 1983 · Wunderlich 1980

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29. Modality

„... while it is not absolutely impossible, it is nonetheless quite difficult for Nature to construct an angel from an extant phylogeny. In addition to the arms and the legs of a human, an angel has a set of wings along its back, and wings are complex structures sculpted of muscles, bones, and nerves (an angel's wings are covered with feathers). ... the back of a mammal has no preexisting structures that can be stretched or shrunk, folded or bent into a wing. To make an angel, the fundamental ground plan of the existing elements must be tampered with and new structures must be generated without precedent. This Nature cannot easily do ..." Michael J. Katz (1987)

1. Relative Modality

Modality has to do with necessity and possibility. In a language like English, modality can be expressed by auxiliaries as in (1),

(1) New structures must be generated.
New structures can be generated.

by adjectives, adverbs and nouns as in (2),

(2) This is not absolutely impossible.
This is a remote possibility.
Possibly, we will return soon.

by suffixes as in (3),

(3) Such thoughts are not expressible in any human language.

or else modality may be inherent in the verb as in (4):

(4) (4) This car goes twenty miles an hour.

Modal words have usually been thought to be ambiguous. (5) illustrates the **epistemic** reading of *must*

(5) Jockl must have been the murderer.
(in view of the available evidence, Jockl must have been the murderer)

(6) is an example for the **deontic** reading of *must*:

(6) Jockl must go to jail.
(in view of what the law provides, Jockl must go to jail)

(7), (8), and (9) contain modals which have a **circumstantial** interpretation:

(7) Jockl must sneeze.
(in view of the present state of his nose etc., Jockl must sneeze)
(8) Jockl can lift the rock.
(given the weight of the rock and the condition of Jockl's muscles etc., Jockl can lift this rock)
(9) Jockl couldn't see the train arrive.
(given that Jockl is short sighted and the train was far away, Jockl couldn't see the train arrive)

Sentences (5) to (9) are accompanied by a paraphrase spelling out how the modal in each sentence is to be understood. The modal in (5) means 'necessary in view of the available evidence'. The *must* in (6) means 'necessary in view of the law'. The different occurrences of *can* in (7) to (9) mean 'possible given the relevant circumstances'.

You will have noted that each of the paraphrases given contains itself a modal. What do *those* modals mean? Take the paraphrase for sentence (5). In this paraphrase, *must* doesn't mean 'necessary in view of the available evidence'. If it did, the phrase *in view of the available evidence* would be redundant. The modal in the paraphrase for sentence (5), then, is a 'neutral' sort of modal, and so are the modals in the other paraphrases. Neutral modals are not ambiguous. They come with a phrase like *in view of ...* or *given that ...* specifying the kind of modality involved. Non-neutral modals lack such an *in view of ...* or *given that ...* phrase. Hence one and the same expression is open to a variety of interpretations. The existence of neutral modals suggests that non-neutral modals are not truly ambiguous. They just need a piece of information to be provided by the context of use. The only difference between neutral and non-neutral modals, then, is that the kind of modality is linguistically specified in the former, but provided by the non-linguistic context in the latter. Modality is always **relative modality**. This was clearly seen by C. S. Peirce:

„... first let me say that I use the word *information* to mean a state of knowledge, which may range from total ignorance of everything except the meanings of words up to omniscience; and by informational I mean relative to such a state of knowledge. Thus by 'informationally possible', I mean possible so far as we, or the person considered know. Then the *informationally possible* is that which in a given information is not perfectly known not to be true. The informationally necessary is that which is perfectly known to be true ... The information considered may be our actual information. In that case, we may speak of what is possible, necessary or contingent, *for the present*. Or it may be some hypothetical state of knowledge. Imagining ourselves to be thoroughly acquainted with all the laws of nature and their consequences, but be ignorant of all particular facts, what we should then not know not to be true is said to be *physically possible*; and the phrase *physically necessary* has an analogous meaning. If we imagine ourselves to know what the resources of men are, but not what their dispositions and their desires are, what we do not know will not be done is said *practically possible*; and the phrase *practically necessary* bears an analogous signification. Thus the possible varies its meaning continually. We speak of things *mathematically* and *metaphysically possible*, meaning states of things which the most perfect mathematician or metaphysician does not qua mathematician or metaphysician know not to be true."
(Peirce 1933: 42 f.)

2. The Semantics of Modal Words: A First Attempt

We have seen that modal words require for their interpretation a specification of the kind of modality involved. This specification can be given by linguistic or non-linguistic means. Linguistic means for specifying the necessary piece of information are phrases like *in view of what we know, given the regulations, in view of what the law provides* and what have you. In what follows, let us confine our attention to those cases of modals where the kind of modality is specified by the context of use. We will consider sentences like (5) to (9) above. Such sentences express a proposition only if a context parameter specifying the kind of modality has been fixed. To make our ensuing discussion a little bit more precise, we have to review a few notions of possible worlds semantics.

Propositions

Utterances of sentences express propositions. In possible worlds semantics, a proposition is identified with the set of possible worlds in which it is true. Suppose we are given a set W of possible worlds. A proposition is then a subset of W.

Truth of a proposition

A proposition p is true in a world $w \in W$ iff $w \in p$. Otherwise, p is false in w.

Logical consequence
A proposition p follows from a set of propositions A iff p is true in all worlds of W in which all propositions of A are true.

Consistency
A set of propositions A is consistent iff there is a world in W where all propositions of A are true.

Logical Compatibility
A proposition p is compatible with a set of propositions A iff $A \cup \{p\}$ is consistent.

Conversational backgrounds
A conversational background is the sort of entity denoted by phrases like *what the law provides, what we know* etc. Take the phrase *what the law provides*. What the law provides is different from one possible world to another. And what the law provides in a particular world is a set of propositions. Likewise, what we know differs from world to world. And what we know in a particular world is a set of propositions. The denotation of *what the law provides* will then be that function which assigns to every possible world the set of propositions p such that the law provides that p in that world. And the denotation of *what we know* is that function which assigns to every possible world the set of propositions we know in that world. Quite generally, conversational backgrounds are functions which assign to every member of W a subset of the power set of W.

We are now in the position to make a first attempt at writing down what the meaning of modals like *must*, or *can* might be (parallel analyses would be given to other modal words like *might, necessarily* or *possibly*). Syntactically, modal words are sentence operators at some level of logical form. If you prefix a sentence with a modal you get another sentence. The result expresses a proposition once a conversational background has been provided by the context of use. Where α is any sentence and f is any conversational background, let us write $[\alpha]^f$ for the proposition expressed by α with respect to f. If α contains a modal, the proposition expressed by α will crucially depend on the parameter f. If α doesn't contain a modal, f does not have any work to do. That is, $[\![\textit{The roof is falling down}]\!]^f$ is the set of possible worlds in which the roof is falling down. For reasons of simplicity, we will not deal with cases where a sentence may contain several modals each requiring a different conversational background. (See Kratzer 1978 for a more dynamic interpretation.) For any sentence a and any conversational background f we have:

Definition 1

$[\textbf{must } \alpha]^f =$ $\{w \in W: [\alpha]^f \text{ follows from } f(w)\}$
$[\textbf{can } \alpha]^f =$ $\{w \in W: [\alpha]^f \text{ is compatibel with } f(w)\}$

According to these definitions, the proposition expressed by my utterance of sentence (10)

(10) Jockl must have been the murderer (in view of what we know).

is true in a world w if and only if it follows from what we know in w that Jockl is the murderer. And the proposition expressed by my utterance of sentence (11)

(11) Jockl might have been the murderer (in view of what we know).

is true in a world w if and only if it is compatible with what is known in w that Jockl is the murderer.

The analysis correctly predicts that modal statements of the sort we have considered so far are contingent, they are neither necessarily true nor necessarily false. That Jockl must have been the murderer (in view of what we know) is a fact of our world, but it is not a necessary truth. Had our knowledge been different, it might not have implied anymore that Jockl is the murderer.

The analysis also tells us that the meaning of *must* is related to the meaning of *can* in a certain way. *Must* and *can* are duals of each other (and so are *must* and *might, necessarily* and *possibly*). This means that the propositions expressed by the following two sentences are logically equivalent (for a given conversational background):

(12) a. We must rehearse for the play.
b. We cannot not rehearse for the play.

If it is necessary to rehearse for the play, then it is not possible not to rehearse for the play. Likewise, the propositions expressed by the following two sentences are logically equivalent (for a given conversational background):

(13) a. We can rehearse for the play.
b. It's not the case that we must not rehearse for the play.

If it is possible to rehearse for the play, then it is not necessary not to rehearse for the play. So far, our analysis isn't really any different from the customary analysis of modals in terms of **accessibility relations.** (See Hughes & Cresswell 1968 or Bull & Segerberg 1984 for good introductions and further refer-

ences.) Let us see why. An accessibility relation is a binary relation on the set of all possible worlds. Intuitively, accessibility relations correspond to notions like 'is epistemically accessible from', 'is deontically accessible from' etc. A world w′ is epistemically accessible from a world w if and only if w′ is compatible with everything we know in w. A world w′ is deontically accessible from a world w if and only if w′ is compatible with everything the law provides in w. For any sentence a and any accessibility relation R, we have:

Definition 2

$[\textbf{must } \alpha]^R = \{w \in W: w' \in [\alpha]^R, \text{ for all } w' \text{ such that } wRw'\}$

$[\textbf{can } \alpha]^R = \{w \in W: w' \in [\alpha]^R, \text{ for some } w' \text{ such that } wRw'\}$

Note now that every conversational background f uniquely determines an accessibility relation R_f as follows:

Definition 3

For all $w,w' \in W$: wR_fw' iff $w' \in \cap f(w)$

This means that we could just as well specify the meaning of *must* and *can* in terms of the accessibility relation determined by the conversational background under consideration. For any sentence a and any conversational background f, we might have the following two definitions which are equivalent to the ones given above (definition 1):

Definition 4

$[\textbf{must } \alpha]^f = \{w \in W: w' \in [\alpha]^f, \text{ for all } w' \text{ such that } wR_fw'\}$

$[\textbf{can } \alpha]^f = \{w \in W: w' \in [\alpha]^f, \text{ for some } w' \text{ such that } wR_fw'\}$

Let us briefly stop here, and summarize what we have accomplished so far. We have been looking at a semantic analysis of modals which ultimately boils down to the analysis of modality familiar from modal logic (let us call this analysis the **standard analysis**). The standard analysis correctly accounts for the relativity of modality, the contingency of modal statements, and the duality of *must* and *can* (and similar pairs). In the remainder of this contribution, I am going to point out some shortcomings of the standard analysis and make a different proposal (originally made in Kratzer 1981).

3. Some Shortcomings of the Standard Analysis

3.1 Inconsistencies

In Kratzer (1977), I consider a case which roughly goes as follows:

Judgments

Let us imagine a country where the only source of law is the judgments which are handed down. There are no hierarchies of judges, and all judgments have equal weight. There are no majorities to be considered. There is one judgment which provides that murder is a crime. Never in the whole history of the country has anyone dared to attack this judgment. There are other judgments, however. Sometimes, judges have not agreed. Here is an example of such a disagreement: Judge A decided that owners of goats are liable for damage their animals inflict on flowers and vegetables. Judge B handed down a judgment providing that owners of goats are not liable for damage caused by their animals. Owners of gardens have to construct adequate fencing. This means that the set of propositions corresponding to the judgments handed down in the country we are considering is an inconsistent set of propositions.

The standard analysis cannot cope with such a situation. It would predict that (given our scenario) the propositions expressed by the following two sentences should both be true:

(14) in view of what the judgments provide
  a. Murder is necessarily a crime.
  b. Murder is necessarily not a crime.

On the other hand, the propositions expressed by the following two sentences should both be false:

(15) in view of what the judgments provide
  a. Owners of goats are possibly liable for damage caused by their animals.
  b. Owners of goats are possibly not liable for damage caused by their animals.

Since the set of propositions which form the content of the law in the world under consideration is inconsistent, every proposition follows from it, and no proposition is compatible with it. These consequences are all the more annoying since we have clear intuitions as to what should and should not come out true in our case: Murder must be a crime, and goat owners might or might not be liable for damage caused by their animals.

3.2 Conditionals

Conditionals are another area where the flaws of the standard analysis make their presence unpleasantly felt. A good example is the so called **Samaritan Paradox** of deontic logic. (There is an extensive literature on the interaction of deontic modal operators and con-

ditionals. See e. g. Åqvist 1984 for an overview and detailed references. See also Feldman 1986.)

Here is a version of the paradox: Suppose that the law provides that nobody be murdered. Suppose furthermore that the law provides that if a murder occurs, the murderer will go to jail. The following two sentences give the relevant content of the law:

(16) a. No murder occurs.
b. If a murder occurs, the murderer will go to jail.

Given the standard analysis of modality and the standard analysis of conditionals (in terms of a two-place connective interpreted as material implication), we predict that (for a conversational background like 'in view of what the law provides') the propositions expressed by the following sentences should all be true:

(17) It is necessary that
a. if a murder occurs, the murderer will go to jail.
b. if a murder occurs, the murderer will be knighted.
c. if a murder occurs, the murderer will be given $ 100.
d. if a murder occurs, the murderer will be fined $ 100.
...

While the set of propositions which constitute the content of what the law provides in our scenario is consistent, it has nevertheless strange implications. It implies any old conditional whose antecedent is the proposition 'a murder occurs'. At this point, we don't yet know which of our assumptions has to be blamed for this ugly consequence. Is it the standard analysis of modals, or is it the standard analysis for conditionals? We will see shortly that an adequate analysis for modality will naturally lead to a very different analysis of conditionals.

3.3 Graded Notions of Modality

Modal words are gradable in many ways. Here are a few examples.

(18) a. It is barely possible to climb Mount Everest without oxygen.
b. It is easily possible to climb Mount Toby.
c. They are more likely to climb the West Ridge than the Southeast Face.
d. It would be more desirable to climb the West Ridge by the Direct Route.

On the standard analysis of modality, the notion of, say, possibility is captured through the notion of logical compatibility. Now a proposition is or isn't compatible with a set of propositions. It cannot be more or less compatible. Or barely compatible, or easily compatible. The standard analysis, then, cannot cope with graded notions of possibility.

4. Graded Modality in the Epistemic Domain

To get a better understanding of what is involved in graded modality, let us take a closer look at modal notions in one selected domain, the domain of epistemic modality. The example we are going to examine is from Kratzer (1981).

The murder

Girgl has been murdered on his way home. The police begin an investigation. Certain conclusions may be drawn from what is known about the circumstances of the crime. Utterances of the following sort might have occurred in such a situation:

(19) a. Michl must be the murderer.
b. Michl is probably the murderer.
c. There is a good possibility that Michl is the murderer.
d. Michl might be the murderer.
e. There is a slight possibility that Michl is the murderer.
f. There is a slight possibility that Michl is not the murderer.
g Michl is more likely to be the murderer than Jakl.

The police inspector does not know what the real world looks like in every detail. Yet he can draw conclusions from the evidence available to him. At any time, this evidence is compatible with a set of worlds which, for all he knows, could be the real world. These worlds are the *epistemically accessible* worlds. Some worlds among the epistemically accessible worlds are more far-fetched than others. A world where Jakl is the murderer is much more far-fetched than a world where Michl has killed Girgl. Michl has never really liked Girgl, but Jakl got along very well with him. Even more far-fetched are worlds where someone from another town, from another country, from another continent, or another planet has murdered Girgl. Far-fetched in which respect? With respect to what is actually the case in the real world? This doesn't seem right since, sometimes, things which are almost impossible turn out to be true. This is

what usually happens in good detective stories. The most unlikely candidate turns out to be the murderer. If it is pretty far-fetched that someone from another continent or another planet has killed Girgl, then it is because such events don't correspond to the *normal course of events.* Normally you need a motive for murdering someone. A man from another planet is likely to lack such a motive. It couldn't have been for money. There is no evidence that Girgl was robbed. All his money was found on him. In view of the normal course of events, it is far-fetched that somebody from another planet murdered Girgl.

In this example, the epistemic conversational background ('in view of the available evidence') determines for every world the set of worlds which are epistemically accessible from it. It forms the **modal base**. There is a second conversational background involved in the above pieces of modal reasoning. We may want to call it a *stereotypical* conversational background ('in view of the normal course of events'). For each world, the second conversational background induces an *ordering* on the set of worlds accessible from that world. It functions as the **ordering source**.

Quite generally, a set of propositions A induces a partial ordering $\leq_A$ on W in the following way (Lewis 1981):

Definition 5
For all w, w′ ∈ W, for any A ⊆ ℘(W):
$w \leq_A w'$ iff {p: p ∈ A and w′ ∈ p} ⊆ {p: p ∈ A and w ∈ p}

A world w is at least as close to the ideal represented by A as a world w′ iff all propositions of A which are true in w′ are true in w as well.

We can now define an interesting set of modal notions which correspond to the modal expressions occurring in the sentences (19a) to (19g). These modal notions are **doubly relative**. They depend on two conversational backgrounds. (The definition of modal notions given here differ from the ones presented in Kratzer 1981. I'd like to thank Fred Landman for pointing out a mistake in Kratzer 1981 which is corrected here.)

Definition 6
A proposition p is a **necessity** in a world w with respect to a modal base f and an ordering source g iff the following condition is satisfied:

For all $u \in \bigcap f(w)$ there is a $v \in \bigcap f(w)$ such that $v \leq_{g(w)} u$ and for all $z \in \bigcap f(w)$: if $z \leq_{g(w)} v$, then z ∈ p.

The definition is in the spirit of Lewis (1981). Roughly, it says that a proposition is a necessity if and only if it is true in all accessible worlds which come closest to the ideal established by the ordering source. The definition would be less complicated if we could quite generally assume the existence of such 'closest' worlds.

Definition 7
A proposition p is a **good possibility** in a world w with respect to a modal base f and an ordering source g iff there is a world $u \in \bigcap f(w)$ such that for all $v \in \bigcap f(w)$: if $v \leq_{g(w)} u$, then v ∈ p.

Definition 8
A proposition p is a **possibility** in a world w with respect to a modal base fand an ordering source g iff -p is not a necessity in w with respect to f and g.

Definition 9
A proposition p is **at least as good a possibility** as a proposition q in a world w with respect to a modal base f and an ordering source g iff for all u such that $u \in \bigcap f(w)$ and u ∈ q there is a $v \in \bigcap f(w)$ such that $v \leq_{g(w)} u$ and v ∈ p.

Definition 9 requires that for every accessible q-world there is an accessible p-world which is as least as close to the ideal.

Definition 10
A proposition p is a **better possibility** than a proposition q in a world w with respect to a modal base f and an ordering source g iff p is at least as good a possibility as q but q is not at least as good a possibility as p in w with respect to f and g.

Definition 11
A proposition p is a **weak necessity** in a world w with respect to a modal base f and an ordering source g iff p is a better possibility than -p in w with respect to f and g.

Definition 12
A proposition p is a **slight possibility in a** world w with respect to a modal base f and an ordering source g iff p is a possibility and -p is a weak necessity in w with respect to f and g.

Let us relate these modal notions to the modal expressions we encountered in the sentences (19a) to (19g):

necessity	*must*
weak necessity	*probably*
good possibility	*there is a good possibility that*
possibility	*might*

slight possibility	*there is a slight possibility that*
better possibility	*is more likely than*

This list is a short way of giving meaning rules of the following sort:

$[\alpha]^{f,g}$ = **probably** $[\alpha]^{f,g}$ = {w ∈ W: $[\alpha]^{f,g}$ is a weak necessity in w with respect to f and g}

Sentences are now quite generally interpreted with respect to two parameters. One fixing the modal base, the other one fixing the ordering source.

Given meaning rules of this sort, we obtain a number of predictions concerning relations between the propositions expressed by utterances of sentences (19a) to (19g) (repeated here for convenience):

(19) a. Michl must be the murderer.
b. Michl is probably the murderer.
c. There is a good possibility that Michl is the murderer.
d. Michl might be the murderer.
e. There is a slight possibility that Michl is the murderer.
f. There is a slight possibility that Michl is not the murderer.
g. Michl is more likely to be the murderer than Jakl.

Keeping modal base and ordering source constant, the proposition expressed by (19a) implies the proposition expressed by (19b). If a proposition is necessary, it is also probable (though not 'merely' probable). The proposition expressed by (19b) implies the proposition expressed by (19c). If a proposition is probable it is also a good possibility. The proposition expressed by (19c) implies the proposition expressed by (19d). If a proposition is a good possibility, then it is a possibility. The proposition expressed by (19e) implies the proposition expressed by (19d). If a proposition is a slight possibility, it is nevertheless a possibility. The propositions expressed by (19a) and (19f) are incompatible with each other. If a proposition is a necessity its negation cannot be a possibility, not even a slight one. The proposition expressed by (19f) is compatible with the propositions expressed by (19b, c, d, e). Furthermore, we predict that if Michl is more likely to be the murderer than Jakl, and Jakl is more likely to be the murderer than Jockl, then Michl is more likely to be the murderer than Jockl. It has often been observed that I make a stronger claim in uttering (20a) than in uttering (20b) (Karttunen 1972, Groenendijk & Stokhof 1975, Lyons 1977, Kratzer 1981):

(20) a. She climbed Mount Toby.
b. She must have climbed Mount Toby.

These utterances present a problem if we assume that *must* receives a 'purely' epistemic interpretation, the usual approach within the confines of the standard analysis. On our approach, a purely epistemic interpretation would be one where the modal base is epistemic (a function which assigns to every possible world a set of propositions which constitute a body of knowledge in that world), while the ordering source is the *empty conversational background* (the function which assigns the empty set to every possible world). If (20b) had a purely epistemic interpretation, the proposition expressed by (20b) would imply the proposition expressed by (20a) but not vice versa. That is, (20b) would make a stronger claim than (20a). Since this is contrary to our intuitions, we have good reasons to assume that *must* in (20b) shouldn't be interpreted as a pure epistemic modal. In our framework this amounts to saying that the ordering source is not empty. In uttering (20b) rather than (20a), I convey that I don't rely on known facts alone. I use other sources of information which are more or less reliable. These other sources may include facts concerning the normal course of events, a map, a tourist guide or hearsay. If the ordering source for the modal in (20b) is, say, a conversational background assigning to every world the set of propositions which represent the normal course of events in that world, then the proposition expressed by (20b) will not imply the proposition expressed by (20a) anymore. There are worlds w such that among all the worlds which are compatible with what we know in w, those which come closest to the normal course of events in w don't include w itself (never mind that there may not be any 'closest' worlds of the required kind). (The phenomenon illustrated by (20a) and (20b) has been used to argue for a treatment of modality as proposed in **data semantics** (Veltman 1984, Landman 1986). In data semantics, (20b) doesn't imply (20a). But unfortunately, (20a) is predicted to imply (20b).)

5. Two Basic Kinds of Modal Reasoning

In modal reasoning, a conversational background may function as a modal base or as an ordering source. The modal base deter-

mines the set of accessible worlds (for a given world). The ordering source imposes an ordering on this set.

In English, as in other languages, we have to distinguish two kinds of modal bases. The difference can be illustrated by the following example. Consider sentences (21a, b):

(21) a. Hydrangeas can grow here.
b. There might be hydrangeas growing here.

The two sentences differ in meaning in a way which is illustrated by the following scenario.

Hydrangeas

Suppose I acquire a piece of land in a far away country and discover that 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 (21a). In such a situation, the proposition expressed by (21a) is true. It is true regardless of whether it is or isn't likely that there are already 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 contacts whatsoever with Asia or America, and the vegetation is altogether different from ours. Given this evidence, my utterance of (21b) would express a false proposition. What counts here is the complete evidence available. And this evidence is not compatible with the existence of hydrangeas.

(21a) together with our scenario illustrates the pure **circumstantial** reading of the modal *can*. The pure circumstantial reading of modals is characterized by a circumstantial modal base and an empty ordering source. (21b) together with our scenario illustrates the epistemic reading of modals. The **epistemic** reading of modals is characterized by an epistemic modal base (the ordering source may or may not be empty here). Epistemic and circumstantial modal bases are both *realistic modal bases*. That is, both kinds of conversational backgrounds assign to every possible world a set of propositions which are true in that world. Yet circumstantial and epistemic conversational backgrounds involve different kinds of facts. In using an epistemic modal, we are interested in what else may or must be the case in our world given all the evidence available. Using a circumstantial modal, we are interested in the necessities implied by or the possibilities opened up by certain sorts of facts. Epistemic modality is the modality of curious people like historians, detectives, and futurologists. Circumstantial modality is the modality of rational agents like gardeners, architects and engineers. A historian asks what might have been the case, given all the available facts. An engineer asks what can be done given certain relevant facts.

We have seen in the preceding section how epistemic modal bases may interact with non-empty ordering sources. In the following section we will investigate the interplay between circumstantial modal bases and different sorts of normative ordering sources.

6. Ordering Sources for Circumstantial Modal Bases

Like all conversational backgrounds functioning as modal bases, circumstantial conversational backgrounds are realistic conversational backgrounds. They assign to every possible world a set of facts of that world. Formally, a realistic conversational background is a function f such that for all $w \in W$, $w \in \bigcap f(w)$. The empty conversational background will now come out as a limiting case of a realistic one.

Circumstances create possibilities: the set of possible worlds compatible with them. These worlds may be closer or further away from

what the law provides
what is good for you
what is moral
what we aim at
what we hope
what is rational
what is normal
what you recommended
what we want
...

To all of those ideals correspond normative conversational backgrounds. Those conversational backgrounds can function as ordering sources for a circumstantial modal base. As a result, we get graded notions of modality as manifested in the following sentence:

(22) Given your state of health you'd be better off going to Davos than to Amsterdam.

A typical utterance context for (22) would be a situation where I talk to someone with tuberculosis. The person's state of health is not very good and the climate in Amsterdam would be detrimental to her. On the other

hand, the climate in Davos is well-known for its soothing effect on the lungs. Given the relevant facts (modal base) and what is good for the person (ordering source), going to Davos is a better option than going to Amsterdam. The modal notion on which my statement is based is the notion of a 'better possibility', which we discussed in connection with epistemic modality. What is different are the conversational backgrounds involved. In particular, we always have a circumstantial modal base when we speak about "options".

A circumstantial modal base is also required by any sort of inherent modality as illustrated by sentence (4) above. And any modality expressed by the suffixes *-ible* or *-able* will likewise have a circumstantial modal base.

7. Overcoming Inconsistencies

We have seen that letting the interpretation of sentences with modals depend on two parameters rather than only one gives us suitable graded modal notions, thereby overcoming one of the shortcomings of the standard analysis. We will now see that the very same device avoids all problems with inconsistencies, thereby overcoming another drawback of the standard analysis.

Recall the example we discussed above. We are in a country practicing something like English Common Law. We have one judgment concerning murder, which has never been called into question. And we have two judgments concerning the liability of goat owners, which happen to contradict each other. We had clear intuitions as to what is necessary or possible in view of what the law provides in the country under consideration. Yet the standard analysis could not account for the case. On the new analysis, what the law provides would function as ordering source, being a normative conversational background. Let's assume that the modal base is empty (not a necessary assumption). If the modal base is empty, it follows that for each world, the set of accessible worlds is the set of all possible worlds. For each world compatible with our scenario, all possible worlds will now be ordered as to how close they come to what the law provides in that world. There is no world in which all three judgments are true, of course. The set of all worlds can be partitioned into three mutually disjoint subsets:

Type 1 worlds in which murder is not a crime

Type 2 worlds in which murder is a crime and goat owners are liable for damage caused by their animals

Type 3 worlds in which murder is a crime and goat owners are not liable for damage caused by their animals

Type 1 worlds are further away from the ideal (set by the ordering source for the worlds we are considering) than type 2 or type 3 worlds.

Type 2 worlds and type 3 worlds are those worlds which come closest to the ideal. Take their union. In all the worlds in the resulting set murder is a crime. There are some worlds in which goat owners are liable, and there are others in which they are not. If *must* is interpreted as necessity and *can* as possibility in the sense of definitions 6 and 8, it follows that the propositions expressed by (14a), (15a), and (15b) are true, given our scenario, but the proposition expressed by (14b) comes out false (the sentences are repeated below from section 3). These predictions square well with our intuitions.

(14) in view of what the judgments provide:
  a. Murder is necessarily a crime.
  b. Murder is necessarily not a crime.

(15) in view of what the judgments provide:
  a. Owners of goats are possibly liable for damage caused by their animals.
  b. Owners of goats are possibly not liable for damage caused by their animals.

Let us now look at another example. The example involves what has been called **practical inferences**. (See e. g. Anscombe 1957, von Wright 1963, Kenny 1966, Feldman 1986.)

Suppose that the whole content of my desires consists of exactly three propositions. I want to become popular, I don't want to go to the pub (more precisely: I want not to go to the pub), and I want to hike in the mountains. All three of my desires have equal weight. As a matter of fact, I live in a world where it is an unalterable fact that I will become popular if and only if I go to the pub. I ask you: Given the unalterable facts and my desires, what should I do? (Note that I am not asking for a recommendation. I am asking for an inference. All that matters are the relevant facts and my desires.) You might give me any of the following answers, for example.

(23) In view of the relevant facts and your desires:
  a. You should go to the pub.
  b. You should not go to the pub.

c. You could refrain from going to the pub and still become popular.
d. You could go to the pub.
e. You could also not go to the pub.
f. You should hike in the mountains.

In a world of the sort described above, the propositions expressed by (23a, b, c) are false. The propositions expressed by (23d, e, f) are true. The modal base we are dealing with here is a circumstantial one ('in view of the relevant facts'). The ordering source is **bouletic** ('in view of what I want'). Such combinations of conversational backgrounds are typical for practical inferences. In our case, both conversational backgrounds assign consistent sets to the worlds compatible with our scenario. The facts are consistent, facts always are. And what I want is consistent, too. Yet there is a conflict between the relevant facts and what I want. Not everything I want can be realized.

The standard analysis cannot account for cases of this sort. Lacking the distinction between ordering source and modal base, it would have to lump together facts and desires. This would simply result in an inconsistent set. All necessity statements would come out true. All possibility statements would come out false. On the new analysis, the relevant facts form the modal base. What I want constitutes the ordering source. For the worlds we are considering, all the accessible worlds are worlds in which I become popular if and only if I go to the pub. These worlds are now ordered as to their closeness to what I want. The set of accessible worlds can be partitioned into four pairwise disjoint subsets:

Type 1 worlds in which I don't hike in the mountains, don't go to the pub, and don't become popular
Type 2 worlds in which I don't hike in the mountains, do go to the pub, and become popular
Type 3 worlds in which I do hike in the mountains, don't go to the pub, and don't become popular
Type 4 worlds in which I do hike in the mountains, do go to the pub, and do become popular

Type 1 worlds and type 2 worlds are worlds in which only one of my wishes is realized. They are thus further away from what I want than type 3 or type 4 worlds. Type 3 worlds and type 4 worlds are as close to what I want as we can ever get. Take the union of the two sets and you have the set of those accessible worlds which come closest to what I want. In all of those worlds, I hike in the mountains. In some of them I go to the pub and become popular. In others I don't become popular and don't go to the pub. The right predictions for sentences (23a—e) follow once we establish the right correspondences. *Should* corresponds to necessity, *could* corresponds to possibility (in the sense of definitions (6) and (8)). It seems, then, that the new analysis is indeed capable of successfully dealing with inconsistencies. Our next step will now consist in showing that it offers a solution to the Samaritan Paradox and similar problems.

8. Conditional Modality

Consider the following sentence:

(24) If a murder occurs, the jurors must convene
(in view of what the law provides).

Given the standard analysis of modals and the standard analysis of conditionals in terms of a two place connective, we have two options for formalizing this sentence.

Option 1

[A murder occurs] ⊃ must [the jurors convene]

Option 2

Must [a murder occurs ⊃ the jurors convene]

Neither options is viable. We know already that option 2 leads to the Samaritan Paradox. So option 2 must be discarded. Option 1 is just as bad. On this analysis, the proposition expressed by (24) is automatically true if no murder occurs in the world under consideration. And if a murder does indeed occur, the sentence is predicted to be true just in case it follows from what the law provides that the jurors convene. But the whole conditional and its antecedent could very well be true without the law implying any such thing. The example suggests that we should think about conditionals in a very different way. Suppose we interpret conditional sentences like (24) as follows:

Definition 13

$[\![\textbf{if } \alpha\textbf{, must } \beta]\!]^{f,g} = [\![\textbf{must } \beta]\!]^{f',g}$, where for all $w \in W$, $f'(w) = f(w) \cup \{[\![\alpha]\!]^{f,g}\}$

The analysis implies that there is a very close relationship between *if*-clauses and operators like *must.* They are interpreted together. For each world, the *if*-clause is added to the set of propositions the modal base assigns to that

world. This means that for each world, the *if*-clause has the function of restricting the set of worlds which are accessible from that world.

Let us now return to example (24). The example involves a deontic conversational background. Being normative, this conversational background constitutes the ordering source. The modal base is initially empty, no factual premises have to be considered. The effect of the *if*-clause is to change the modal base in a systematic way. For every world, the new set of accessible worlds is the set of all worlds in which a murder occurs. The proposition expressed by (24) is then true in a world w just in case the jurors convene in all accessible worlds which come closest to what the law provides in w. (Roughly. We cannot always assume that there are such closest worlds.) Given such an analysis, it is easy to see that the Samaritan Paradox cannot arise. Recall the structure of the paradox. In our case, we would assume that in some world w, the whole content of what the law provides in w can be given by the following two sentences (where the conditional in (25b) is to be interpreted as material implication):

(25) a. No murder occurs.
b. If a murder occurs, the jurors convene.

We have just seen that the proposition expressed by (24) is predicted to be true in w just in case the jurors convene in all those worlds in which a murder occurs and which come closest to what the law provides in w. We are only allowed to consider worlds in which a murder occurs. Hence we have to drop the part of the law requiring that no murder occur. There are worlds in which a murder occurs and in which the proposition expressed by (25b) is true. In all of those worlds, the jurors convene. But these worlds are precisely the worlds in which a murder occurs and which come closest to what the law provides in w. But then the proposition expressed by (24) is correctly predicted to be true in w.

The analysis given in definition 13 can be extended to other kinds of conditionals. Conditionals with other modals in the consequent, for example (like probability conditionals). In Kratzer (1978), I argue that we should treat bare conditional sentences like

(26) If she has seen the place, she loves it.

as **implicitly modalized.** These sentences would then contain a non-overt necessity operator.

Their logical form would be as specified in definition 13. We would obtain different kinds of conditionals in specifying the parameters f and g in different ways. **Material implication** would be the result of an empty ordering source and a *totally realistic* modal base. A conversational background is totally realistic if it assigns to every world a set of facts which characterize it completely (a function f such that for every $w \in W$, $\bigcap f(w) = \{w\}$). **Strict implication** would arise under the impact of an empty modal base and an empty ordering source. In Kratzer (1981), I show that we can even consider **counterfactual conditionals** as special cases of conditionals of the sort that fall under definition 13. They would be characterized by an empty modal base and a totally realistic ordering source.

9. The Semantic Field of Modal Expressions

In our preceding discussion, we showed that an interpretation of modals which is relativized to two parameters is able to avoid three shortcomings of the standard analysis. The improved analysis makes us expect that differences between modal expressions in different languages can be captured in terms of three dimensions:

Dimension 1 **modal force:** necessity, weak necessity, good possibility, possibility, slight possibility, at least as good a possibility, better possibility, maybe others

Dimension 2 **modal base:** circumstantial versus epistemic (possibly further differentiations within these groups, like knowledge coming from certain sources, facts of a special kind)

Dimension 3 **ordering source:** deontic, bouletic, stereotypical etc.

Not every kind of modal base can combine with every kind of ordering source. Epistemic modal bases take ordering sources related to information: What the normal course of events is like, reports, beliefs. Circumstantial modal bases take ordering sources related to laws, aims, plans, wishes. Within these constraints, there are many possibilities. As an illustration, let us look at some German modals. The following list gives an overview of their idiosyncratic restrictions.

	modal force	modal base	ordering source
muss	necessity	no restrictions	no restrictions
kann	possibility	no restrictions	no restrictions
darf	possibility	circumstantial	deontic, teleological ('in view of certain aims')
$soll_1$	necessity	circumstantial	bouletic ('in view of certain wishes')
$soll_2$	necessity	empty	hearsay
wird	weak necessity	epistemic	doxastic ('in view of certain beliefs')
dürfte	weak necessity	epistemic	stereotypical

In the earlier transformational literature, we often find a distinction between root and epistemic modality (Perlmutter 1971, Ross 1969a, Jackendoff 1972). On our proposal, this distinction has a direct counterpart. **Root modality** comprises all occurrences of modals with a circumstantial modal base. **Epistemic modality** comprises all occurrences of modals with an epistemic modal base. Ross and Perlmutter both assumed that modals are verbs embedding a sentence. Epistemic modals were claimed to be intransitive, root modals were claimed to be transitive. Evidence of the following kind was given for the transitivity of root modals:

(27) a. Die Kinder dürfen gerne draußen schlafen.
b. Die Kinder dürften gerne draußen schlafen.

Dürfen is a root modal. (27a) says that the person who gives permission for the children to sleep outside is happy to do so. *Dürften* is an epistemic modal. (27b) says that it is likely that the children will enjoy sleeping outside. On Perlmutter's and Ross' analysis, root *may* has an implicit argument referring to the one who gives permission. Williams (1985) arrives at a similar conclusion discussing the following sentences from Chomsky (1981):

(28) a. *The books were sold without PRO reading them.
b. The books can be sold without PRO reading them.

Williams suggests that the reason why PRO can be controlled in (28b), but not in (28a) is partly due to the fact that the root modal *can* has an implicit argument which can act as a controller. In this case, the implicit argument would be the one for whom it is possible to sell the books. It is interesting to note that the same sentence with an epistemic modal is as bad as (28a):

(28) c. *The books might have been sold without reading them.

The examples discussed above suggest that 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.

There is an enormous literature concerning the expression of modality in different languages (see Palmer 1986 for an overview and references). Since there is no consensus as to the categorization of different types of modalities, the data offered don't always contribute to a coherent picture of the semantics of modal words.

10. Short Bibliography

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