Modals, negation, concord, and polarity

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1. Introduction: modals, negation, concord, and polarity

This article discusses the interplay between modals and negation by focusing on two issues: (i) the scopal interaction between negation and modal verbs; and (ii) the (dis)simmilarities between negative concord and modal concord. Both phenomena have in common that analyzing them requires not only knowledge about the nature and linguistic behavior of modality, but also of negation.

Below I briefly introduce the two phenomena. After that, in Sections 2 and 3 respectively, I discuss the scopal interaction between negation and modal verbs, and the (dis)simmilarities between negative concord and modal concord, in more detail. Section 4 spells out some more general conclusions.

1.1 The scopal interaction between negation and modals

When a clause contains more than one scope-taking element, the question always arises as to what determines their relative scope relations, especially when these scope relations are not reflected by their surface order. This question is particularly prevalent when it comes to negation and modals. To see this, consider the following minimal pair:

(1) a. Mary mustn't leave
b. Mary can't leave

Even though the surface orders between the modal and the negation are the same in (1), their scopal construals are different. (1) means that it is obligatory that Mary doesn't leave (□>¬), while (2) means that is not possible/allowed that Mary leaves (¬>◊). This pattern reflects a rather strong cross-linguistic tendency that possibility modals tend to scope below negation, whereas certain necessity modals in certain languages outscope negation while others do not (Iatridou & Zeijlstra 2013). For instance, English *need to*, unlike *must*, takes scope below negation (*Mary doesn't need to leave*). And the German cognate of *must*, *muessen*, again unlike English *must*, takes narrow scope with respect to negation:

(2) Marie muss nicht abfahren ¬>□
Mary must not leave
'Mary doesn't need to leave'

The question is then what determines the scopal order between negation and modals, across languages and within languages. It is this question that we discuss in the second section of this article.

1.2 Modal concord

The second phenomenon discussed in this chapter concerns modal concord. Take the following example:

(3) The students must obligatorily register themselves (Huitink 2008)

What (3) means is that it is obligatory that the students register themselves; not that it is obligatory that it is obligatory that the students register themselves. On its most natural reading, the sentence does not have an iterative modal reading but a single one, despite the presence of both the modal auxiliary *must* and the modal adverb *obligatorily*. This phenomenon is referred to as modal concord because of its strong (superficial) resemblance with negative concord, the phenomenon illustrated in (4) for Italian where two elements that can independently yield negation (*non* and *nessuno*), jointly yield a single negative reading and not a doubly negative one.

(4) Non ha telefonato a nessuno Italian
Not has called to nobody (Zanuttini 1991)
'She hasn't called anybody'

A guiding question in the study of modal concord has been to what extent negative concord and modal concord can be analyzed on a par or not. It is this question, that we will discuss in detail in section 3.

2. The scopal interaction between negation and modals

2.1 The pattern

Let's now look at the scopal interactions between negation and modals. We start with describing some cross-linguistic observations concerning modal verbs. First, we look at modals with a

circumstantial modal base (focusing on deontic modals) (2.3 CIRCUMSTANTIAL AND ABILITY MODALS), followed by a discussion of modals with an epistemic modal base (2.1 EPITEMIC MODALITY).

Existential modals ('◊') with a circumstantial modal base in English and, as far as I know, also in other languages scope under negation (at least under neutral intonation):

(5) a. Mary can't leave ¬ > ◊
b. Mary may not leave ¬ > ◊

However, things are different with respect to universal modals. While some universal modals with a circumstantial modal base take scope below negation as well, others take wide scope with respect to negation. English *have to* and *need to* take narrow scope; *must*, *should*, and *ought* take wide scope with respect to negation (even though, as we will see later on, there are still subtle differences between different types of universal modals with respect to their scopal interaction with negation).

(6) a. Mary doesn't have to leave ¬ > □
b. Mary doesn't need to leave ¬ > □

(7) a. Mary mustn't leave □ > ¬
b. John oughtn't to leave □ > ¬
c. John shouldn't leave □ > ¬

These patterns are not specific for English. Similar facts have been reported for other languages, such as Catalan, Dutch, German, Greek, Hindi and Welsh (see van der Auwera and Bhatt 1999, von Fintel and Iatridou 2007, Homer 2015, Iatridou and Zeijlstra 2013, Nauze 2010, Jeretič 2021a,b, Picallo 1990, Rubinstein 2014 and Willis 2019). See de Haan (1997, 2013) and van der Auwera (2001) for typological overviews (1.5 EMPIRICAL FOUNDATIONS OF MODALITY: EXPRESSING MODALITY ACROSS LANGUAGES). For instance, in German, existential modals take all scope below negation. German *sollen* ('should') like its English cognate takes wide scope with respect to negation. And German *must*, like English *have to*, but unlike English *must*, takes scope below negation:

(8) a. Marie kann nicht abfahren ¬>◊

Mary must not leave
'Mary doesn't need to leave'

b. Marie soll nicht abfahren □>¬
Mary should not leave
'Mary shouldn't to leave'

c. Marie muss nicht abfahren ¬>□
Mary must not leave
'Mary doesn't have to leave'

Note that it is not the case that only universal modals that surface above negation must outscope negation. The embedded version of (8)b, where *soll* appears lower in the structure (given that German is a V-to-C language in main clauses), also has the reading where *soll* outscopes negation:[1]

(9) … dass Marie nicht abfahren soll □>¬
… that Mary not leave should
'… that Mary shouldn't to leave'

In the domain of epistemic modals, the pattern is even more diverse. Here, both existential and universal modals are split between those that take scope below negation and those that take scope above it. Existential *can* and *could* take scope below negation; *may* and *might*, by contrast, take high scope with respect to negation. The universal modals discussed above behave similarly in their scopal properties with respect to negation when they are used epistemically.

(10) a. Mary can't be in her office ¬ > ◊
b. Mary couldn't be in her office ¬ > ◊

(11) a. Mary may not be in her office ◊ > ¬
b. Mary might not be in her office ◊ > ¬

(12) a. Mary doesn't have to be in her office ¬ > □

[1] There are many more examples of languages where a universal modal that surfaces below negation takes scope above it, for instance, Greek, Italian and Spanish. See Iatridou and Zeijlstra for more examples and discussion.

b. Mary doesn't need to be in her office ¬ > □

(13) a. Mary mustn't be in her office □ > ¬

b. John oughtn't be in her office □ > ¬

c. John shouldn't be in her office □ > ¬

2.2 Accounts

Three approaches have been formulated to account for this. One approach seeks the solution in syntax: in (5) and (6) the modal occupies a lower position than in (7) (see a.o. Cormack & Smith 2002, Butler 2003; see also Hacquard 2006, 2011 and Ramchand 2018 for discussion).

Another approach seeks the solution in the fact that certain modal verbs are polarity-sensitive. Iatridou & Zeijlstra (2013) and Homer (2015), for instance, argue that in English, *must*, unlike *can*, is a Positive Polarity Item (PPI), and therefore has to take wide scope with respect to negation. Giannakidou & Mari (2018 *et seq*) also apply a polarity-based approach to certain modal adverbs that are PPI-like, such as *possibly* (witness **Mary isn't possibly ill*) (see also Shields 2006) (4.4 MODALITY IN ADJECTIVES AND ADVERBS).

Finally, other scholars (most notably Jeretič 2021a,b) take the pattern in (5)-(13) to be the result of strengthening. Jeretič (2021a), for instance, takes both *must* and *need to* to take syntactic scope under negation, but argues that negated *must*, but not negated *need to*, undergoes strengthening by means of exhaustification (along the lines of Bar-Lev & Fox 2020) into a necessity modal outscoping negation.

All three approaches have particular advantages but also face certain challenges. These pros and cons will be discussed in this chapter.

2.2.1 Structurally different positions

As one of the first attempts to account for these facts, Cormack and Smith (2002) propose that there are two structural positions for modals in the clausal spine; one below negation and one above negation:

(14) CP > TP > Mod_1P > NegP > Mod_2P

Modals that take scope below negation are in Mod_2P, while modals take scope above negation

are in Mod_1P. Which position a modal occupies is lexically specified.

In the same vein, Butler (2003) enriches the Cormack and Smith's (2002) proposal by assuming that there are four positions for modals (one for universal epistemic modals, one for existential epistemic modals, one for universal root modals, and one for existential root modals, as well as two positions for negation.

(15) $Mod_{Universal,Epistemic}P > NegP > Mod_{Existential,Epistemic}P > \ldots > Mod_{Universal,Root}P > NegP > Mod_{Existential,Root}P$

Both proposals cannot fully capture the attested facts. For one, it is unclear what determines why the clausal spine must be like this. The generalization that existential root modals do not take scope under negation does not follow from anything in these proposals. Note that this template cannot be just universally foxed either, given the observed variation (for instance, the scopal behavior of German *must* does not straightforwardly follow). More importantly, the positions for the different modals does not correspond to their surface position. Cormack and Smith's (2002) do not provide a mechanism that accounts for why certain modals should appear higher in the structure than others, even though their surface position remains the same (as is the case for English *can* and *must*). Butler presumes that all modals are base-generated in a low position and covertly move at LF to the positions where they are interpreted. At the same time, here it is not clear why negation sometimes occupies a high position (with epistemic modals) and sometimes a low one (with root modals). Again, the surface position of the negation seems to be the same in both cases. For these, and other reasons, in more recent times, other scholars pursed more semantic approaches.

2.2.2 Polarity-sensitivity

Another approach to account for the scopal behavior of modals is by Iatridou & Zeijlstra (2013) and Homer (2015). They argue that (universal) modals that outscope negation are, unlike all other modals, Positive Polarity Items (PPIs).

Their starting point is first that also Negative Polarity Items (NPIs) verbs have been attested in the domain of modals. English *need* (the *need* that does not select *to*-infinitivals) as well as its German and Dutch translations (*brauchen* and *hoeven*, respectively) are all NPIs, as the following examples show:

(16) a. Mary need*(n't) leave

b. Hans braucht *(nicht) zu gehen (German)
Hans needs not to go
'Hans doesn't have to go'

c. Petra hoeft *(niet) te vertrekken (Dutch)
Petra needs not to leave
'Petra doesn't have to leave'

Given that PPIs generally surface in domains where NPIs appear (cf. Van der Wouden 1994), it is likely to expect that modal PPIs can be attested as well.

Second, it turns out that modals that outscope negation share several relevant distributional properties (when it comes to negation) with better known PPIs, such as English *some*. Szabolcsi (2004) shows that PPI like *some* can actually take scope below negation in four different types of environments: (i) under contrastive/metalinguistic negation; (ii) when an intervening element appears in between the PPI and its anti-licenser; (iii) when the anti-licenser is extra-clausal; and (iv) when the anti-licenser itself appears under a higher NPI-licensing elements (at least, when the PPI is a so-called weak PPI). As (i) and (iii) speak for themselves, let me focus here on (ii) and (iv).

As for (ii), even though a clause with a PPI in the immediate scope of an anti-licensing operator is bad, when the PPI is not in the immediate scope of the anti-licenser, another intervening element may shield the PPI from the anti-licenser, resulting in a fine sentence again (cf. Kroch 1979; Szabolcsi 2004 and references therein). This is illustrated in the following examples taken from Szabolcsi (2004).

(17) a. John didn't offend someone because he was malicious (but because he was stupid) √ not > because ... > some

b. Not every student said something √ not > every > some

Now, if a modal that outscopes negation is a PPI, it should also be able to appear under the scope of negation (or any other anti-licensing operator) as long as some other scope-taking element intervenes between that operator and that modal. As is shown below, this is indeed the case. The examples below (taken from Iatridou & Zeijlstra) have the scopal construals *negation* > *because* > *must*, and *negation* > *always* > *must*, respectively.

(18) a. She must not marry him because he looks good but because he is a good linguist √ negation > because > must

b. I mustn't always take the garbage outside. Many times my son does that √ negation > always > must

As for (iv), a striking fact about PPIs is that, while they cannot be in the immediate scope of a clausemate negation/anti-additive operator, this configuration becomes licit for weak PPIs when this negation/ anti-additive operator is in the scope of an NPI licensing environment. This has been first observed by Baker (1970) and is also discussed at length in Szabolcsi (2004) (see also Homer 2015). Again, this applies to English *must* as well, which can take scope below negation in such contexts.

(19) a. If he mustn't work tonight, he is allowed to go out with his boyfriend √ ¬ > must

b. Every boy who mustn;t work tonight, is allowed to go out with his boyfriend √ ¬ > must

That PPIs modals must outscope negation is almost trivially true. However, the question emerges as to why other modals must take scope below negation. For NPI modals that may be trivial, but why should polarity-insensitive modals take scope under negation?

Here, Iatridou & Zeijlstra argue that such modals are base-generated in a position below negation (arguably somewhere in the verbal domain) and subsequently raise across negation to the head of IP. Iatridou & Zeijlstra then argue that due to such instances of raising being instances of head movement, those modals reconstruct to their base position, unless (as in the case of modal PPIs), this would lead to ungrammaticality.

However, such a mechanism cannot be fully correct. For one, it would be unclear why in an example like (20) *must* can (but doesn't have to) outscope negation. It doesn't undergo head movement above the surface position of the subject.

(20) Nobody must leave √ must > ¬

√ ¬ > must

Iatridou & Zeijlstra here argue that the modal must undergo Quantifier Raising (QR). Also, Homer (2015) shows that when a PPI modal like *must* is negated, it must undergo covert raising,

as it can then, and then only, also take scope over other scope-taking elements that surface above negation. For instance, (21) can receive a scopal construal *must* > *exactly one* > *negation*:

(21) Exactly one pin mustn't be knocked dow (Homer 2015)

However, the idea that either head movement or QR are responsible for wide scope taking of modals is problematic. In addition, Jeretič and Thoms (2023) show that in order to maintain a head movement analysis for wide scope taking, several assumptions about head movement need to be made that are hardly tenable.

Homer (2015), who also reduces *must*'s scopal properties to its PPI-hood, argues that QR in itself is not constrained enough to explain the scope-taking behavior of English must. For instance, in the following two examples, *must* cannot take wide scope over the adverb or the negation.

(22) John often must stir this pot, otherwise the risotto will scorch

√ often > must

* must > often

(23) Not everyone must jog

√ ¬ > everyone > must

* must > ¬ > everyone

Instead, Homer argues that there is some last resort mechanism dubbed *Escape* that only allows *must* to take higher scope if otherwise it will end up in an ungrammatical environment.

However, postulating a different scope-taking mechanism appears to be a big step to explain one particular set of phenomena. In this light, Francis (2018) argues that other cases of what appear to be clear instances of QR also do not always give rise to readings that might be expected to be possible. For instance, (24) does not allow a reading where *three books* QRs over the negated subject either. Apparently, she argues, other factors may determine whether QR effective takes place. She, therefore, presumes that QR may work differently for heads and phrases.

(24) Not everyone read three books

√ ¬ > everyone > three

* three > ¬ > everyone

Another criticism that might apply to proposals in terms of polarity-sensitivity is that stating that modals like *must* are PPIs does not yet explain why they have this behaviour. Iatridou & Zeijlstra stay agnostic here, but Zeijlstra (2017) shows that Chierchia (2006, 2013)'s theory of NPI-hood can be straightforwardly applied to such modals and explain why they are PPIs. In a nutshell. Zeijlstra shows that the mechanism that for Chierchia renders certain indefinites/existentials NPIs, renders universal quantifiers PPIs, but only if they do not surface below the scope of negation.

Zeijlstra shows that if *must* surfaces under negation, it may have a wide scope reading of *must*, but doesn't have to. In (20), where *must* is below *nobody* in the surface structure, for many speakers of English is indeed ambiguous between a low and a high scope reading of the modal. However, once the modal surfaces above a negative DP, as in (25), it can have wide scope only:

(25) Mary must read no book
√ must > ¬
* ¬ > must

2.2.3 Strengthening

Apart from the above-mentioned challenges, Homer observes that there are still differences between different types of modals when it comes to their scopal behaviour. For one, he shows that *should*, unlike *must*, can take scope across negation in higher clauses.

To see this, take the following minimal pair:

(26) a. The doctor doesn't think that John should jog — √ think > should > ¬
b. The doctor doesn't think that John must jog — * think > must > ¬

((26)a) allows for a reading where *should* seems to take scope above negation but below *think*. *Must* doesn't do so ((26)b). The reason, for him, is that both *think* and *should*, unlike *must*, are so-called *Neg-raisers*. Neg-raisers are predicates like *think*, *believe*, or *expect* that can give rise to readings where the negation in the matrix clause seems to be interpreted in the embedded clause. Other predicates, like *claim*, *predict* or *say* don't show this behavior:

(27) a. Suzanne doesn't think that Mary is ill — √ think > ¬
b. Suzanne doesn't claim that Mary is ill — * claim > ¬

If *should* like *think* (but unlike *must*) is indeed a Neg-raising predicate, these facts in (26) immediately follow.

Note that being a Neg-raiser or not is not the only difference between *must* and *should*. As Iatridou & Zeijlstra show, *must* is a so-called weak PPI (that is only anti-licensed under anti-additive elements), while *should* is a strong PPI. It is anti-licensed in any downward entailing context, based on examples like the ones below:

(28)	a.	Few students should leave	√ should > few; *few > should
	b.	Few students must leave	√ must > few; √ few > must
(29)	a.	At most five students should leave	√ should > at most five * at most five > should
	b.	At most five students must leave	√ must > at most five √ at most five > Must

Hence, this may suggest that there are indeed two differences between *must* and *should*: one in terms of PI-strength and one in terms of Neg-raising.

Another approach that employs the notion of strengthening to account for the wide scope of verbs like *must* is Jeretič (2001a,b) (see also Jeretič & Thoms 2003). Jeretič takes modals like *must* to lack scalar alternatives. The reason is that even though modals like *may* or *can* appear to be scalar alternatives to *must*, their semantic distribution is not the same. For instance, *must* can express teleological modal flavor, *may* cannot (Jeretič 2001a):

(30) a. #In order to go to Harlem, you may take the A train.
b. In order to go to Harlem, you must take the A train.

Similarly, *can* is not a scalemate of *must*, she argues, since the behavior of *can* in *Sequence-of-Tense* constructions is different:

(31) a. #When I turned 5, my mom told me I can begin doing chores.
b. When I turned 5, my mom told me I must begin going out alone.

For this, she reasons that *must* lacks any scalar alternatives.

As a next step, she argues that scope-taking items without scalar alternatives obligatory

introduce domain alternatives and are to be strengthened under exhaustification (along the lines of Bar Lev & Fox 2020) (7.2 MODLAITY AND DISCOURSE PARTICLES). This strengthening enriches a LF with a scopal construal ¬>□ into one with the construal □>¬. To see this, first take Bar Lev & Fox (2020) denotation of their exhaustifier *EXH*:

(67) $[\![\text{EXH}]\!](C)(p)(w) \equiv \forall q \in IE(p, C)[\neg q(w)] \wedge \forall r \in II(p, C)[r(w)]$

a. $IE(p, C) = \cap\{C' \subseteq C: C' \text{ is a maximal subset of C, s.t. } \{\neg q : q \in C'\} \cup \{p\} \text{ is consistent}\}$

b. $II(p, C) = \cap\{C'' \subseteq C: C'' \text{ is a maximal subset of C, s.t. } \{r : r \in C''\} \cup \{p\} \cup \{\neg q : q \in IE(p, C)\} \text{ is consistent}\}$

What this amounts to is that every domain alternative that can be assigned false consistently with the prejacent, must be taken to be false; and that every alternative that can be assigned true consistently with the prejacent (and the falsity of the alternatives that have to be taken to be false) must be taken to be true.

Now let's apply *EXH* to a sentence S = *You must not go* where *must* has a domain of quantification consisting of two worlds (w_1, w_2) and where *must* takes base scope below negation. Then *You must not go* has the following set of domain alternatives (Alt(S)):

(32) $\text{Alt(S)} = \{\text{you must}_{\{w1,w2\}} \text{ not go, you must}_{\{w1\}} \text{ not go, you must}_{\{w2\}} \text{ not go}\}$

Given that none of these alternatives are innocently excludable (i.e. they cannot all be negated consistently with the prejacent) and that all of these alternatives are innocently includable (i.e. they can all be true consistently with the prejacent, applying EXH to Alt(S) and (S), gives us the following:

(33) $\text{EXH(Alt(S))(S)} = \neg\forall w \in \{w1, w2\}.go(w) \wedge \neg\forall w \in \{w1\}.go(w) \wedge \neg\forall w \in \{w2\}.go(w) = \forall w \in \{w1, w2\}.\neg go(w)$

This way, a modal like *must* will end up having a wide scope reading over negation even though it does not undergo head movement or QR. In Jeretič (2001a,b) more cases are discussed, as well as the effect of actuality inferences on the (in)possibility of strengthening.

Jeretič (2001a,b) indeed has the advantage of not using head movement or QR for deriving the wide scope readings of certain modals. On top of that, it also uses a mechanism that

is nowadays also employed in other cases of meaning strengthening such as Neg-raising (see Mirazzi & Zeijlstra 2021, 2025, Jeretič 2022, Staniszewski 2022).

At the same time, it is not fully clear what determines whether some element is a scalar alternative of another one. That *can* is not a scalar alternative of *must* already seems *prima facie* more intuitive than that *may* is a scalar alternative of *must*. Also, Jeretič needs to make various additional assumptions to ensure that *have to* (which she discusses in some detail) or *need to* are not strengthened under negation. Moreover, it is at odds with approaches that take alternatives not to be lexical but rather conceptual (Buccola et al. 2021). In such approach, every logically dual is a scalar alternative, irrespective of whether this dual is lexicalized or not.

Finally, Giannakidou and Mari (2018) formulate a proposal that in some sense is an intermediate between the PPI and the strengthening approaches. They argue that modal verbs like English *must*, and also certain modals adverbs, such as *probably* or *definitely*, are PPIs, but that their PPI-hood results from a homogeneity condition on their ultimate domain of quantification (1.3 THE CONSTRUCTION OF MODAL DOMAINS - THE KRATZERIAN VIEW, 2.4 MODAL FLAVOUR-SYNTAX INTERACTIONS) (just as EXH is designed to capture homogeneity effects). In short, they argue that the domain of quantification of PPI modals is controlled by a meta-evaluation, which ranks ideal, stereotypical worlds in the modal base as better possibilities than the non-ideal worlds in it. This set of ideal worlds is then taken to be homogeneous insofar as the prejacent of the modal is concerned. Hence, negating one world in this set amounts to negating all of them, which gives rise to the effect that negation always appears to take scope below the modal. An advantage of their theory is that it is not restricted to verbal modal PPIs only, but also to adverbial ones.

At the same time, this approach does not readily capture the landscape of modal verbs with respect to their polarity-sensitivity. It takes universal modals to be subject to ranking of ideal worlds, whereas this ranking must be neutralized with existential and non-PPI universal modals. But it is not really clear why there could not be existential PPI-modals in this system. Also, Giannakidou and Mari argue that universal non-PPI modals should be typologically much rarer than PPI ones, a predicton that as of yet has not been corroborated.

2.3 Summing up

Looking at the landscape of modal verbs, the relative scope of a modal with respect to negation is not trivially determined. Several approaches, each with their pros and cons, have been proposed to account for these effects, of which I have outlined the most important ones above.

It should be added, though, that this does not fully capture the overall picture of how modals scope with respect to negation. For one, I focused for illustrative purposes only on English, but enlarging the empirical landscape will lead to many more subtle (and less subtle) effects that need to be explained. Moreover, other modals can also take particular scope with respect to negation. *Probably* or *possibly* are modal adverbs that behave PPI-like (see Mari & Giannakidou 2018). For more discussion of all the relevant facts, I refer to the primary literature referred to in this section.

3. Modal concord vs negative concord

3.1 The pattern

If two modal elements are of the same modal flavour (epistemic/deontic/bouletic/…) (2.1 EPISTEMIC MODALITY, 2.2 PRIORITY MODALITY, 2.3 CIRCUMSTANTIAL AND ABLITY MODALS) and have similar quantificational force (universal/existential) (3.1 MODAL FORCE AND ITS RELAIZATION ACROSS LANGUAGES), the most salient reading is mostly not a cumulative one, but a concord reading where the semantics seems to contain only one modal operator. This phenomenon, dubbed modal concord, has first been observed by Halliday (1970) and Lyons (1977), and has first been analysed by Geurts & Huitink (2006), who coined the term. Their examples are in (34)–(35) for existential epistemic modal concord and for universal deontic modal concord, respectively.

(34) You may possibly have read my little monograph upon the subject
'The speaker thinks that it is possible that you read his little monograph'
?'The speaker thinks that it is possible that it is possible that you read his little monograph'

(35) Power carts must mandatorily be used on cart paths where provided
'It is obligatory that power carts are used on cart paths where provided'
?'It is obligatory that it is obligatory that power carts are used on cart paths where provided'

Before aiming to account for this phenomenon, however, it should first be established whether modal concord is indeed a grammatical phenomenon or whether the concord readings can be derived by entailment. An argument that shows that the latter cannot be fully correct comes from Geurts & Huitink (2006), who have argued that, if modal concord readings can be

semantically derived via entailment, this entailment is restricted to the domain of epistemic modality and does not apply, for instance, to the domain of deontic modality. The fact that epistemic modality may allow for concord readings is due to the fact that the principles of *Veridicality* (36) and *Positive Introspection* (37) apply.

(36) Veridicality:

$\Box\phi \rightarrow \phi$ (knowledge is factive)

(37) Positive Introspection:

$\Box\phi \rightarrow \Box\Box\phi$ ($\equiv \Diamond\Diamond\phi \rightarrow \Diamond\phi$)

Thus, the concord reading of (34) can be taken to be a result of the application of the Principle of Positive Introspection. However, (36) and (37) do not hold for deontic modality. If something is obligatory or desirable, its truth is not guaranteed, and, likewise, if something is obligatory, it is not necessarily the case that it is obligatory that it is obligatory. Hence, the instances of deontic modal concord as in (35) demonstrate that modal concord readings, at least for deontic modality, cannot be explained by entailment as a consequence of (36) and (37).[2,3]

A second argument is that modal concord can only be established between a modal auxiliary and another modal element as is shown in (38)-(39) from Zeijlstra (2008a). An expression consisting of two non-auxiliary modal elements (like lexical modal verbs or modal adverbs) of the same type cannot yield a modal concord reading, as shown in (40)-(42). This also strongly indicates that modal concord is a grammatical phenomenon since the syntactic status of modal auxiliaries appears to be relevant and not so much their semantics.

(38) The general demands that the troops must leave modal concord

[2] Moreover, it is even doubtful whether Veridicality always applies to epistemic modality in natural language (cf. Karttunen 1972; von Fintel & Gillies 2010; Giannakidou & Mari 2018). Take, for instance, the following examples:

(i) This must be Alesia
(ii) This is Alesia

It is not trivial that (i) entails (ii). Therefore, the principles of Veridicality and Positive Introspection may not be the cause of the existence of Modal Concord readings in a straightforward way.

[3] Note that this not mean that the alternatives of, say, (35) with only one modal are synonymous to each other*: Power carts must be used on cart paths where provided* conveys something different than *Power carts are used mandatorily on cart paths where provided*, as the latter comes with the inference that power carts are used this way, while the former does not (see also 2.5 THE DIVERSITY CONDITION ACROSS MODAL FLAVOURS).

(39) John must obligatorily read the books modal concord

(40) The general demands that the troops are required to leave * modal concord

(41) John mandatorily obligatorily read the books * modal concord

(42) Inflectional morphemes are required obligatorily by the syntax * modal concord

Finally, it can be shown that Modal concord obeys syntactic locality constraints such as strong islands. The minimal pair in (43) and (44) demonstrates that whereas modal concord may be established by a modal verb in the matrix clause and a modal auxiliary in the complement clause, modal concord cannot be realised if one of the two modal elements is located in an adjunct. Modal concord is only possible within the same clause, or in the complement of an attitude verb. (cf. Zeijlstra 2008a).

(43) [The general demands that [[when the soldiers surrender] they must behave correctly]]
modal concord

(44) [The general demands that [[when the soldiers must surrender] they behave correctly]]
*modal concord

Hence, it appears that modal concord is a grammatical phenomenon in its own right, with further legitimizes the question whether it should be analyzed on a par with negative concord.

3.2 Accounts

Over the last decades, several approaches have been formulated to account for modal concord. The first one, due to Geurts & Huitink (2006), takes modal concord to be the result of lexical ambiguity. The next one, Zeijlstra (2008a), proposes a full parallel between modal concord and negative concord. This approach has received some criticism by Grosz (2010), though. Finally, Huitink (2012), Grosz (2010) and Anand & Brasoveanu (2010) take modal concord to be (partially) different from negative concord and argue that meaning contributions of modal verbs/auxiliaries and adverbs may be more complex than they appear.

3.2.1 Lexical ambiguity

Geurts and Huitink propose that modal concord reduces to the lexical ambiguity of modal adverbs. An adverb like *necessary*, for them, denotes either its standard meaning or it is a functional element that checks of its argument is semantically identical. In order to implement this, they define the following function:

(45) $||P \div Q|| = ||P||$ if $||P|| = ||Q||$, otherwise undefined (P, Q of type (st)(st))

They also introduce the following checking operator ©:

(46) $||©|| = \lambda Q \lambda P.||P \div Q||$

Take now the following LF:

(47) [[©necessarily must][Barney sneeze]]

Here the adverb *necessary* checks whether its argument *must* is semantically identical. If so, the meaning of *necessarily must* becomes just *necessarily*. If *must* were absent, © would not have made any semantic contribution.

Although the mechanism indeed predicts the concord readings in constructions with modal concord between a modal adverb and a modal auxiliary as in (44), this analysis still faces several problems.

First, it presupposes that adverbs such as *necessarily* or *must* are semantically identical. This is not the case. The only correspondence between *must* and *necessary* are that both are modal operators with universal quantificational force, where *necessarily must* and *must* may be deontic. But *necessarily* is semantically much richer, which becomes clear if it is compared to other modal adverbs, such as *obligatorily*. Whereas *necessarily* denotes some kind of a necessity, *obligatorily* denotes an external deontic source.

Second, when applied to modal adverbs, it predicts that sequences of modal adverbs also should give rise to concord readings, contrary to fact. A sentence such as (48) cannot receive a modal concord interpretation, though.

(48) John necessarily obligatorily registers himself

The problem here seems to be that it is a particular property of auxiliaries that they may be part of a modal concord construction (as two modal elements that are not auxiliaries never establish modal concord relation), and therefore it is unlikely to encode this property in the lexical semantics of modal adverbs.

3.2.2 Modal concord is syntactic agreement

Against this background, Zeijlstra (2008a) explores the hypothesis that modal concord is an instance of syntactic agreement, just like negative concord. The reason is that negative concord is also known to be a grammatical phenomenon in the sense that the negative concord reading cannot be derived by entailment (though see De Swart & Sag 2002 for an alternative view), and that it is subject to syntactic locality; negative concord cannot be established across island boundaries as the following example from Zeijlstra (2022) involving an adjunct island shows:

(49) *Gianni non lavora per guadagnare niente
Gianni NEG works in.order.to earn NEG-thing
'Gianni doesn't work in order to earn anything'

Zeijlstra then assumes that modal concord is an instance of syntactic agreement, just as he argued for negative concord in (Zeijlstra 2004, 2008b, 2022). Adopting the framework proposed in this theory and applying it to modality, every modal element is said to have a particular formal modal feature, which is either semantically active or semantically vacuous. In the latter case, it must be dominated by a modal element that carries a semantically interpretable modal feature.

As a starting point, given the fact that (in languages like English) the quantificational force of modal elements seems lexically encoded (unlike modal flavour), Zeijlstra assumes that modal features are only specified for quantificational force. Modal flavour can be determined by the context of the utterance. Therefore, for him, the featural decomposition of modal elements should not exceed the distinction with respect to the modal quantificational force, and he postulates the following four modal features:

(50) a. [i∃-MOD]
b. [u∃-MOD]
c. [i∀-MOD]
d. [u∀-MOD]

Then, both existential and deontic modal concord constructions can be naturally analysed in terms of syntactic feature-checking (51)–(52), where he takes modal adverbs to carry an interpretable feature and modal auxiliaries an uninterpretable one. This, then, derives the constraint that only modal auxiliaries can trigger modal concord readings and not just any combination of modal adverbs.

(51) You may perhaps have read the book
[$_{CP}$ You perhaps$_{[i\exists\text{-MOD}]i}$ may$_{[u\exists\text{-MOD}]}$ [have read the book]]

(52) The students must obligatorily register themselves
[$_{CP}$ The students obligatorily$_{[i\forall\text{-MOD}]i}$ must$_{[u\forall\text{-MOD}]}$ [register themselves]]

Cases where the auxiliary is the only overt modal element are then taken to involve a covert modal operator (53)-(54).

(53) Mary may be home
[John $OP_{\exists\text{-MOD}[i\exists\text{-MOD}]}$ may$_{[u\forall\text{-MOD}]}$ [$_{VP}$ be home]]

(54) Mary must go home
[John $OP_{\forall\text{-MOD}[i\forall\text{-MOD}]}$ must$_{[u\forall\text{-MOD}]}$ [$_{VP}$ go home]]

Of course, many questions arise, e.g. how the restriction on the same type of modal flavour can be explained, or why the auxiliary, carrying the uninterpretable modal feature, may raise across the adverb.

However, it turns out that the analysis above already faces some challenges. Grosz (2010) has presented examples, such as (55) below, involving modal concord where the quantificational force of the adverb and the auxiliary are different, but where negation still ensures that the overall quantificational status of the negated auxiliary and the adverb are the same. In (55), a modal concord reading appears, even though *mandatorily* is a universal modal and *may* an existential one. He also shows that a negated auxiliary (that takes scope below this negation) of the same quantificational force can no longer give rise to a modal concord reading, as shown in (56).

(55) *You are now entering a secure area of this public facility. We would now like to specify the*

rules that make up our special security standards. Nothing forces us to have these security standards, yet we have them, as we are special.

In view of our special security standards, you mandatorily may not cross the yellow line without a special permit issued by the facility head-quarters.

(56) #You mandatorily need not stay in this area.

These facts are hard to maintain under a syntactic agreement approach along the lines sketched above.

3.2.3 The meaning of modal adverbs

Naturally, the question arises as to how modal concord must then be analysed. This has been subject of some more recent approaches to modal concord that all aim at providing a less standard semantics for modal adverbs (cases of cross-clausal modal concord are being kept out of the equation here).

Huitink (2012) proposes that adverbs like *obligatorily* can be used to fill the ordering source argument slot of modal auxilary. Then, an adverb like *obligatorily* should receive a denotation as in ((57)b) (along the standard denotion for *must* in ((57)a from Kratzer 1981, 1991) (1.3 THE CONSTRUCTION OF MODAL DOMAINS - THE KRATZERIAN VIEW, 2.4 MODAL FLAVOUR-SYNTAX INTERACTIONS).

(57) a. $[[must]] = \lambda f \lambda g \lambda p \lambda w.\ \max_{g(w)} \bigcap f(w) \subseteq [[p]]$

b. $[[obligatory]] = \lambda w \lambda p.$p is obliged in w

It is clear that if *obligatorily* has this interpretation, then *must obligatorily* jointly expresses a single modal quantifier, one that ranges over the possible worlds that best satisfy the obligations in the evaluation world (given that *obligatorily* solely provides the ordering source argument and does not act as a quantifier over worlds itself). This way, modal concord can be accounted for.[4]

[4] See also Giannakidou and Mari (2018), who propose an account similar in sprit for what they call modal harmony, the phenomenon where combinations of modal verbs and adverbs of different force appear to give rise to single modal readings, as in (i). This phenomenon is crucially different from modal concord and (cross-linguistically) more restricted, though.

(i) So there must maybe be some glitch somewhere along the line or something that makes this happen. (Giannakidou and Mari 2018: (11))

In additon, the syntactic locality condition also follows given that that the modal base and ordering source are generally arguments within the projection of the modal. But it is not clear why the modal auxiliary and adverb have to have the same quantificational force.

Huitink's novel analysis which takes *obligatorily* just to be a domain restrictor, does not predict this requirement. To resolve that, Huitink adopts a version of Zeijlstra's agreement theory, where she assumes that *obligatorily* still comes with an uninterpretable feature [$u_{\forall\text{-MOD}}$]. This can be checked by *must*, which for her carries [$i_{\forall\text{-MOD}}$], but not by *may*, which carrying [$i_{\exists\text{-MOD}}$] cannot check this feature. However, as we saw above, this step will enter the same kind of problems that Grosz identified for Zeijlstra's theory.

Grosz (2010) himself assumes that the core semantics of adverbs like *obligatorily* or *mandatorily* is not that of a modal element (a quantifier over possible worlds) either but rather that of a degree modifier over modal elements. In addition, he takes the matching requirement in modal strength (not force *per se*, as negated *may* and positive *must* act alike when it comes to modal concord) and the restrictions on the modal type to be the result of definedness conditions.

Mandatorily then, for him, is not a modal element but rather a degree modifier that has a definedness condition that its complement M expresses deontic modality and is positive with respect to the scale of necessity, as in (56):

(58) [[Mandatorily]] = λMλpλw : M expresses deontic modality ∧ M is positive.
∃d[d = max(SM) ∧ M(d)(p)(w)]
where max(SM) is the maximum of the (upper or totally closed) scale of M
and *is positive means* that NECESSITY(p)(w) exceeds the degree that M combines with.

Since a prejacent containing *must p* or *may not p* meets these requirements, the modal concord readings directly follow.

This approach can thus account for the observed restrictions on modal concord. At the same time the more direct connection between meaning of a modal adverbs and their stem is lost under this approach. After all, *It is obligatory that …* or *It is mandatory that …* still are real modal expressions and not expressions involving degree modifiers. This way, the meanings of *obligatorily* or *mandatorily* can no longer follow in a transparent way from the meanings of *obligatory* or *mandatory*.

Finally, Anand and Brasoveanu (2010) propose that in a combination of a modal adverb and a modal auxiliary, the two modals make an independent meaning contribution: they each apply to the sentence radical (i.e. the prejacent without the two modals) rather than that the adverb

applies to a prejacent with *must*, or that *must* applies to a prejacent containing *obligatorily*. As long as those meaning contributions do not contradict each other, a modal concord reading follows. Thus, modal adverbs contribute their own modal quantification 'parasitic' on the auxiliary's modal domain. Modal concord readings are then derived as in (59):

(59) $[[\text{adverb modal}]](f_{\text{modal base}})(p_{\text{sentence radical}}) = 1$ iff
$[[\text{adverb}]](f)(p)=1$ and
$[[\text{modal}]](f)(p)=1$

For them, *must* again has the standard Kratzerian semantics in ((57)a). *Obligatory* also has a universal modal meaning that selects a deontic modal base:

(60) $[[\text{obligatorily}]]=\lambda M.\lambda w.\lambda f.\lambda pst: f \text{ is deontic. } M(w)(f)(p) \wedge \bigcap f(w) \subseteq p$

Now, the modal concord reading of (52) follows. It means that it is obligatory that the students register themselves and that the students must register themselves

However, the requirement that the (overall) modal force be the same of the adverb and the (negated) modal auxiliary does not follow yet. To see this, take

(61) #The students must legitimately register themselves

Why can't (61) simply mean that it is legitimate that the students register themselves and that the students must register themselves? Here, Anand and Brasoveanu assume that *legitimately* has an existential modal semantics (as in (62)).

(62) $[[\text{legitimately}]]=\lambda M.\lambda w.\lambda f.\lambda pst: f \text{ is deontic. } M(w)(f)(p) \wedge \bigcap f(w) \cap p=/=\emptyset$

Next, Anand and Brasoveanu take *legitimately(f)(p)* to come with an obligatory implicature that $\bigcap f(w) \not\subset p$. That clearly contradicts the meaning contribution of *must* in (61). As long as this implicature is non-cancelable, the oddity of (61) follows.

Of course, the question arises why this implicature is not cancelable, an issue Anand and Brasoveanu address in their work. Also, the question remains open why two adverbs could not give rise to a modal concord reading, if each adverb can make an independent modal meaning contribution. In addition, the question arises why modal adverbs do not take direct scope over a

modal prejacent. In other words, how is the semantics in (59) compositionally derived? This is something that for Anand and Brasoveanu should follow from more general requirements on the interpretation of adverbs, but it is not fully clear how.

3.3 Summing up

Modal concord has been a grammatical phenomenon in need of an explanation for quite a long time. Originally, 'simple' hypotheses, known from studies to other concord phenomena, have been applied (lexical ambiguity, feature checking), but more recently, it has been assumed that modal concord is a thornier problem and requires a clearer demarcation between the semantics of modal auxiliaries and adverbs. Needless to say, even though progress has been made, many questions are still open.

4. Conclusions

In this chapter we have looked at the workings of modality by focusing on its comparison and interaction with negation. What can we learn about modality in this respect?

This chapter started out by looking at negation. Generally speaking, negation is hypothesized to take scope from a fixed position in the clausal structure. If modals can then take scope either below or above negation, one cannot straightforwardly maintain the same for modality. The question arises whether this hypothesis is too simple, or whether the scope-taking mechanisms underlying modality are less straightforward and simple than that of negation. The latter seems to be the case. The most powerful approaches to modal scope-taking allude to more complex ways of scope-taking than negation does. Modals may undergo overt or covert movement, due to polarity-sensitivity or (other) strengthening requirements, and end up taking scope from other positions in the clause than their surface positions. In comparison to negation, modality seems to work in more complex ways.

The same we observed for combinations of modals. Whereas multiple instances of negation in a clause may either give rise to a double negation or a negative concord reading for grammatical reasons (for instance, feature checking), combinations of modal verbal auxiliaries and other modal elements can also give rise to iterative and non-iterative readings. Again, we saw that the way modal concord emerges does, however, not look as straightforward as negative concord. Again, modality seems to work in a more complex and harder to understand way than negation.

Of course, the scopal interaction between negation and the readings of clauses with more than one modal or negative element are not the only possible areas of comparison. The behavior of

modals in Neg-raising construction, the differences between weak and strong necessity modals when it comes to negation, or the realization of negatively marked modals could also be cases where the workings of negation and modality can be compared with each other. And presumably there are many more areas. But what we have seen so far, is that when it comes to modals grammar may sometimes work in more intricate ways than one would prima facie assume.

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