Coordination and additivity in modal discourses*

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1 Introduction

In a modal discourse consisting of two sentences, the second sentence may be interpreted as being conditional on the scenario introduced in the first sentence. An example of this is in (1-a); the sentence in (1-b) is a paraphrase of the second sentence in (1-a). This discourse processing phenomenon is known as modal subordination (Roberts 1989, Stone 1999, Brasoveanu 2010, and others).

(1) a. A wolf might walk into the house. It would eat you
b. If a wolf walked into the house, it would eat you

It is well-known that modal subordination is subject to various constraints. For example, the modal in the second sentence is sometimes – say, when the first sentence is a negation – required to have counterfactual morphology (2) (cf. Frank 1997).

(2) Mary didn't buy a microwave. She {would / #will} never use it

This paper looks at constraints on modal discourses of a rather different sort. We investigate, first, the properties of coordinated modal discourses and, second, the restrictions imposed on modal subordination by (scalar) additive particles. The first family of examples that we study exhibits an asymmetry between coordinated sequences in which the antecedent clause contains an existential modal (◇-□ sequences) and those in which the antecedent clause contains a universal modal (□-□ sequences). To a first approximation, the generalization is that only the former examples yield felicitous modal subordination discourses. If the coordinator is left out, the difference between ◇-□ and □-□ sequences disappears. Interestingly, this pattern is not endemic to modal *subordination* discourses but is found in modal discourses more generally – e.g. the facts sketched in (3) obtain even if the restrictor of the second modal is expressed overtly.

(3) a. [$\Diamond_B$ p] and [$\Box_{B'}$ q]. ✓ B' = B∩p
b. ?[$\Box_B$ p] and [$\Box_{B'}$ q]. # B' = B∩p
c. [$\Diamond_B$/$\Box_B$ p]. [$\Box_{B'}$ q]. ✓ B' = B∩p

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The second family of examples involves discourses in which the initial sentence contains a scalar additive particle $even$. The presence of the particle seemingly blocks modal subordination if the initial sentence is an existential modal sentence. However, if the first sentence contains a universal modal (and there is no overt coordinator), the second sentence may be interpreted conditionally.

(4) a. [$\Diamond_B$ p] (and) [$\Box_{B'}$ q]. ✓ B' = B∩p
b. [$\Diamond_B$ even p] (and) [$\Box_{B'}$ q]. # B' = B∩p
c. [$\Box_B$ even p]. [$\Box_{B'}$ q]. ✓ B' = B∩p

We argue that the main culprits for the asymmetries in (3)-(4) are, perhaps unsurprisingly, and and $even$. More precisely, we argue that the described patterns are necessitated by the discourse effects connected to and and the additive entailments triggered by $even$. In the process of justifying and explaining this, we hope to shed some new light on the discourse properties of certain modal sequences, as well as the role of strength in modal anaphora resolution.

Section 2 deals with the first paradigm – the coordination asymmetry. We begin by reviewing the data, whereupon a naive dynamic semantics account of the pattern is presented and discarded. A different type of analysis is pursued in Section 3, in which we build on a discourse-structural treatment of the conjunction and. Section 4 introduces the second paradigm – the $even$ asymmetry. After reviewing some independent constraints on anaphora resolution, a pragmatic account of the data is sketched: modal subordination is blocked when it is weaker than the insubordinate interpretation. Section 5 points out some avenues for future research.

2 Modal sentences in coordination

We describe a modal subordination asymmetry between coordinated $\Diamond$-$\Box$ and $\Box$-$\Box$ sequences. A naive dynamic analysis of the data is sketched. Two knock-down arguments against such an analysis are presented, the second one of which indicates that the phenomenon at hand is not restricted to modal subordination.

2.1 Basic data

There has been a lot of interest in recent years in the syntactic and semantic properties of conjunctions of an imperative clause and a declarative clause (IaDs) (Schwager 2006, Russell 2007; Iatridou 2008 for an overview). An example of an IaD is given in (5); (5-b) fleshes out the meaning of the second conjunct in (5-a).

(5) a. Go to school and you will be happy
b. = If you go to school, you will be happy

There is quite some variation between the different types of IaDs as well as their analyses; we refer the reader to the references mentioned above. For our purposes,

the most interesting aspect of the IaD discussion involves the asymmetry between IaDs and conjunctions of a universal priority modal and a universal future modal sentence[1] (Iatridou 2008). In particular, the former, as we have seen in (5), but not the latter, given in (6), allow a conditional interpretation. Moreover, Iatridou notes that the latter sequences require additional effort to be properly understood.

(6) a. ?You must go to school and you will be happy
b. $\neq$ If you go to school, you will be happy

The asymmetry between (5) and (6) is unexpected if imperatives and universal modals are as closely related as some researchers have assumed (cf. Schwager 2006). However, not all conjunctions of modal sentences resist a conditional interpretation: if the universal modal in (6) is swapped with an existential modal (7), the sequence becomes felicitous and allows for a conditional reading.

(7) a. You can go to school (and) you will be happy
b. = If you go to school, you will be happy

Furthermore, if the connector and is dropped in (6), the discourse becomes acceptable and a conditional interpretation of the second sentence becomes possible (Iatridou 2008). This is shown in (8).

(8) a. You must go to school. You will be happy
b. = If you go to school, you will be happy

We conclude that the pattern described above is conditioned by two parameters: (i) whether the first deontic modal is existential or universal and (ii) whether the sentences are conjoined by and or juxtaposed. Any treatment of the phenomenon thus needs to explain how the interaction of modal force and the connector and comes to yield the pattern in (6)-(8).

	juxtaposition	and
◇-□ seq.	✓	✓
□-□ seq.	✓	#

Table 1: The coordination asymmetry.

[1] We restrict our attention primarily to sequences $\Box p \,\&\, \Box q$ in which the initial modal has deontic or teleological flavor for the following reason: if the universal modal were epistemic, it would be hard to establish whether we are dealing with modal subordination/conditionalization in the second sentence or not. Namely, after processing the epistemic $\Box p$, it would be established that all epistemically accessible worlds are p-worlds. Accordingly, the restrictor of the second modal would contain solely p-worlds on both an unconditional and a conditional interpretation (see below).

2.2 A naive dynamic analysis

There is a set of facts from the nominal anaphora domain that at first sight resembles the data described above. Namely, there is an asymmetry between existential and universal quantificational phrases with respect to their ability to bind anaphoric elements that are not in their syntactic scope: the existential QPs may and universal QPs may not bind (singular) pronouns that they do not c-command. This is sketched in (9) and (10), where W(x) corresponds to *She was whistling*.

(9) a. A girl$_1$ entered the room. She$_1$ was whistling
b. $\exists$x[G(x) & E(x) & W(x)]

(10) a. Every girl$_1$ entered the room. #She$_1$ was whistling
b. $\forall$x[G(x) $\rightarrow$ E(x)] & W(x)

The difference in binding potential of existential and universal quantifiers is captured in dynamic semantics: existential quantifiers are (externally) dynamic, while universal quantifiers are (externally) static. That is, the so-called donkey equivalence in (11) is valid, while a parallel equivalence for universal quantifiers is not (12). These donkey (non-)equivalences underly the facts described in (9)-(10).

(11) $(\exists x\phi \;\&\; \psi) \equiv \exists x(\phi \;\&\; \psi)$

(12) $\forall x(\phi \rightarrow \xi) \;\&\; \psi \not\equiv \forall x(\phi \rightarrow \xi \;\&\; \psi)$

Now, it is commonly assumed that modal subordination involves anaphora resolution: the domain of the second modal, $will$, is anaphorically recovered from the context – the preceding sentence. Since this assumption is unobjectionable, the binding restrictions of quantifiers in the nominal domain should transpose to the modal domain. That is, the existential modal quantifier can, which parallels *a girl* in (9), can bind the modal anaphor in the second conjunct, while the universal modal quantifier $must$, which parallels *every girl*, cannot.

However, we have seen above that this asymmetry disappears in juxtaposition (8). This presents a wrinkle for the naive dynamic theory sketched above, though not much is required to iron it out. Namely, it has been observed that even in the nominal domain universal quantifiers sometimes can bind anaphors across sentences (telescoping) (Roberts 1989):

(13) Every degree candidate walked to the stage. He took his diploma from the Dean and returned to his seat

A naive dynamic theorist could now follow the less naive researchers in treating the binding in (13) as being licensed by a special rescue strategy. And she could then claim that this rescue strategy is also at work in the modal domain (8). Finally, in coordinated sentences such a strategy is blocked by and, whose meaning is strictly function composition. The naive theorist is temporarily in the clear and her account

now relies on both parameters attenuated above: and and the role of modal force.

2.3 Rejecting the naive dynamic analysis

We present two reasons to reject the naive dynamic analysis: the first objection is theory-internal and is conditioned by how $plural$ anaphora are treated in dynamic semantics, while the second objection is based on facts that indicate that the puzzle at hand is not a puzzle about anaphora. First: A dynamic semanticist cannot remain naive in light of plural pronouns. Namely, already Evans has pointed out that plural pronouns can have universal quantifiers as antecedents (cf. Nouwen 2003 for discussion). This holds both for coordinated and juxtaposed sentences.

(14) a. Few senators admire Kennedy and they are very junior
b. Every boy came to the party and they enjoyed themselves

The generalization is that whenever we have a quantificational structure Q(A)(B), where A is the restrictor and B is the nuclear scope, the reference set A∩B is unconditionally made salient. This reference set can then be picked up by a subsequent anaphor. There are different ways of how to analyze the introduction of the reference set as a discourse referent (cf. Kamp and Reyle 1993, Nouwen 2003); for our purposes it is only important that it is always accessible. Although a naive dynamic theorist could now argue that there is a crucial difference between the nominal and the modal domain in that the latter does not have plural anaphora, this strategy is not tenable. Namely, practically any analysis that the naive theorist could provide for the ◊-□ sequences would require the anaphor of the second modal to be resolved to the (maximal) plurality (or set) of worlds in which the antecedent proposition is satisfied: if the restrictor of the second modal were resolved to just a singleton set provided by the antecedent (15-b), the sentence *he will be happy* would falsely be considered true if John were happy only in one of the many worlds in which he goes to school; only an analysis in which the anaphor refers to the entire refset of the antecedent sentence is thus sensible (15-c). And once this resolution is allowed, there is no principled way to restrict it to just the existential modals.

(15) a. John can$_B$ go to school and he will be happy
b. #∃w[[J. goes to school in w ∧ w∈B] & ∀w'∈{w}[J. is happy in w']]
c. ∃W[W=Max({w | J. goes to school in w ∧ w∈B} & ∀w∈W[John is happy in w]]

Second: the coordination asymmetry is not restricted to anaphora resolution contexts (Philippe Schlenker p.c.). Namely, the counterparts of (6)-(7) with overt restrictors, i.e. if-clauses corresponding to the nuclear scope of the first modal, exhibit the same pattern that we see in modal subordination discourses:

(16) a. ?You must go to school and if you do, you will be happy
b. You must go to school. If you do, you will be happy

(17) a. You can go to school and if you do, you will be happy
b. You can go to school. If you do, you will be happy

The conclusion that should be drawn from this is that we should not construct our analysis of (6)-(7) as primarily an analysis of modal subordination. Namely, (16)-(17) parallels (6)-(7) but does not contain relevant modal anaphora, so the second sentence is in effect anaphorically independent of the first sentence.

3 Coordination and discourse

We have seen that there are two determinants in the coordination asymmetry: the force of the first modal and the presence of and. This section describes (i) a discourse-based analysis of and as well as (ii) the discourse glue in modal sequences at hand. The behavior summarized in Table 1 is derived from the interaction of (i) and (ii). Along the way, we look at modal complement anaphora, as well as two types of sequences exhibiting the coordination asymmetry which are not subsumed by Table 1.

3.1 Discourse relations in coordination

The connector and has an import beyond a simple boolean semantics that is commonly assigned to it. This is reflected in coordinated sentences exhibiting discourse patterns distinct from those of their juxtaposed counterparts. Already Bar-Lev and Palacas (1980) have observed that and precludes certain relations between the two conjuncts (they list exemplification, conclusivity and explanation). This is illustrated in (18) (Txurruka 2003): the discourse in (a) naturally conveys that Max's falling is $explained$ by him slipping on a banana peel; this reading is unavailable for (b) which, to the extent it is acceptable, only has a list reading.

(18) a. Max fell. He slipped on a banana peel
b. ?Max fell and he slipped on a banana peel

It has been noted by many researchers (e.g. Asher 1993, Asher and Lascarides 2003) that discourse is hierarchically structured and that different relations may obtain between the sentences in discourse. These relations fall into two broad categories: coordinating and subordinating discourse relations. The main coordinating relations are: NARRATION, (CONDITIONAL) RESULT, PARALLEL, CONTRAST, LIST; the main subordinating relations are: ELABORATION, REFORMULATION, EXPLANATION, JUSTIFICATION (cf. Asher and Vieu 2005 for qualifications).

Accordingly, Txurruka assumes that and indicates that a coordinating relation obtains between its two arguments. If we assume that π_1 and π_2 are appropriate semantic representations of the two sentences in conjunction, the semantic contribution of and can be rendered as in (19) – no such restriction holds for juxtaposition. In (20), we give two immediate consequences of such a characterization of and.

(19) a. $and(\pi_1, \pi_2) \rightarrow$ COORD(π_1, π_2)
b. COORD(π_1, π_2) :$\Leftrightarrow \exists$R $\in$ {NARRATION, RESULT, ...}: R(π_1, π_2)

(20) $and(\pi_1, \pi_2) \rightarrow \neg$EXPLANATION($\pi_1$, π_2), $\neg$JUSTIFICATION(π_1, π_2)

The corollary in (20) immediately explains the pattern in (18): in the juxtaposed sequence, the subordinating EXPLANATION relation between the two sentences is possible; in the coordinated sequence, this is precluded by the presence of and which forces the relation between the sentences to be coordinating, say, LIST.

Interestingly, this analysis sheds light on an intriguing pattern observed with the so-called complement anaphora. An example of complement anaphora in the nominal domain is in (21-a) – $they$ can be resolved to the MPs that did not attend the meeting. (21-b) points to a restriction on complement anaphora discourses that is relevant to the current section – the continuation required for felicitous complement anaphora must be of the 'reason why not there' type (Moxey and Sanford 1993).

(21) a. Few of the MPs attended the meeting. They were too busy
b. Few of the MPs attended the meeting. #They slept the next day

The 'reason why not there' type of continuation can be classified in the discourse-perspective adopted here as EXPLANATION. Accordingly, if this relation is necessary for complement anaphora to be possible, the account described above predicts that complement anaphora should be marginal if and is inserted between the respective sentences. This prediction is borne out:

(22) #Few of the MPs attended the meeting and they were too busy

A similar effect has been observed in IaD discourses (Iatridou 2008): (23-a) conveys exclusively that if you *don't* park here, you will be towed; the strongly preferred interpretation of the juxtaposed sequence in (23-b) is that if you do park here, you will be towed (cf. the scale of rhetorical defaults for this preference). The explanation of these readings is arguably the same as in the nominal domain: the complement set of the imperative in (23) corresponds to *you park here*; since complement anaphora is only possible if EXPLANATION relation obtains between the respective sentences, only the non-coordinated (23-b) can have the reading that if you park here, you will be towed.

(23) a. Don't park here and you will be towed
b. Don't park here. You will be towed

3.2 Discourse-subordination in modal discourses

We propose that the coordination asymmetry between $\Diamond$-$\Box$ and $\Box$-$\Box$ sequences follows from the fact that only in the former case can the two sentences stand in a coordinating relation and thus satisfy the requirement imposed by and. Let us turn first to the $\Box$-$\Box$ sequence in (6): there is an obligatory dependency between imposing an

obligation and obtaining of the propositional argument of the second modal in this type of examples. Roughly, the second modal sentence deals with the topic of the first sentence in that the set of worlds of which it predicates something includes all the (epistemically accessible) worlds compatible with what is allowed/commanded (see below) (cf. Txurruka 2003 for topic parasitism in subordinating relations). Furthermore, this dependency is also an explanation (or justification) of the deontic modal sentence. This effectively triggers an EXPLANATION (or JUSTIFICATION) relation between the two conjuncts. This is depicted in (24): your going to school is an obligation (π_1); the modally subordinate sentence (π_2) conveys that if you go to school, you will be happy; this justifies imposing the obligation.

(24) a. π_1 = you must go to school, π_2 = you will be happy
b. EXPLANATION(π_1,π_2) $\rightsquigarrow$ $\neg$COORD(π_1,π_2)

In case the first sentence contains an existential modal (permission), the situation is different. On the one hand, the second sentence does not deal with all the (epistemically accessible) worlds compatible with what is commanded/allowed. On the other hand, the second sentence in the sequence does not have to – and partly cannot – be classified as explaining the import of the first sentence. This is so even if the propositional argument of the second modal is clearly hearer-(un)desirable. Let us flesh out the intuitive difference between the universal and existential modal antecedents: (i) If the first sentence is a universal modal sentence $\Box p$, it is established that all the (best) deontically accessible worlds are p-worlds. A further property is then predicated of the (epistemically accessible) p-worlds in the subsequent sentence. This further predication then functions as an explanation (or justification) of the p-obligation from the first sentence. (ii) If the first sentence is an existential modal sentence $\Diamond p$, it is established that some of the deontically accessible worlds are p-worlds. Furthermore, the hearer may infer that not all deontically accessible worlds are p-worlds. A hearer-desirable property is then predicated of the p-worlds. This further predication $could$ serve as an explanation of why $some$ of the deontically accessible worlds are p-worlds. But it could not by itself yield an explanation (or justification) for why *not all* deontically accessible worlds are p-worlds. Accordingly, we conclude that without a further inference process the primary discourse relation in a coordinated $\Diamond$-$\Box$ sequence is CONDITIONAL RESULT, a coordinating discourse relation.

(25) a. π_1 = you can go to school, π_2 = you will be happy
b. CONDRESULT(π_1,π_2) $\rightsquigarrow$ COORD(π_1,π_2); ?EXPLANATION(π_1,π_2)

There are two further pieces of data that conform to the analysis sketched here but are not subsumed by Table 1: a discourse with a negated antecedent sentence ($\neg$-$\Box$) and a discourse with a conditional antecedent sentence ($\rightarrow$-$\Box$). Two examples of $\neg$-$\Box$ sequences are given in (26). Their behavior parallels that of $\Box$-$\Box$ sequences: a

$\neg$-$\Box$ sequence is infelicitous if there is and between the two sentences. The reason for this state of affairs parallels the reasons given above: the most salient discourse relation between the two sentences is EXPLANATION which is ruled out by the presence of and. However, if we are dealing with an insubordinate reading of the modal and the relation between the conjuncts is coordinating, a coordinated $\neg$-$\Box$ is unproblematic, as it is shown in (27) (RESULT).

(26) a. ?John didn't drink and he would become sick
b. John didn't drink. He would become sick

(27) John didn't drink and he drove home safely

The construction of coordinated $\rightarrow$-$\Box$ examples is slightly more complicated since we do not want to parse the second sentence as being conjoined to the consequent of the first sentence. We achieve this by embedding the sentences under an attitude verb and by having overt complementizers. What we find is a behavior parallel to $\Diamond$-$\Box$ sequences: the second sentence in (28-a) happily receives the modally subordinate interpretation that if Edna forgets to fill the birdfeed, the birds will be hungry; the same holds for the famous non-coordinated (28-b) (Roberts 1989). Assuming that embedded sentences also form a structured discourse, this is not surprising: the second sentence in (28) does not stand in a subordinating discourse relation to the first sentence – the relation that obtains is rather CONDITIONAL RESULT or possibly LIST, both of which are coordinating.

(28) a. John believes [that if Edna forgets to fill the birdfeeder, she'll feel bad] and [that the birds will be hungry]
b. If Edna forgets to fill the birdfeeder, she'll feel bad. The birds will be hungry

To summarize, we have proposed to derive the coordination asymmetry described in Table 1 from general discourse coherence considerations. We have seen that and imposes a restriction that the discourse relation between the conjuncts is coordinating and not subordinating. We have argued that in a $\Box$-$\Box$ sequence, the modally subordinate second sentence necessarily stands in a discourse-subordinating relation to the first sentence; this is not the case for $\Diamond$-$\Box$ sequences. The treatment was extended to $\neg$-$\Box$ and $\rightarrow$-$\Box$ discourses.

4 Modal (in)subordination and blocking

This section tackles the $even$ asymmetry. After introducing the core data, the main ingredients of our analysis are presented. The final subsection explains the puzzle.

4.1 Basic data

It was shown above that the second sentence in a ◊-□ sequence is preferably interpreted as being conditional on the scenario described in the first sentence. This is illustrated in (29): you getting the grade C is conditional on you giving me $100. Moreover, there is an implicature that you will get a C *only* if you give me $100. This phenomenon is known as conditional strengthening (cf. von Fintel 2001).

(29) a. You can give me $100 (and) you will get a C
b. If you give me $100, you will get a C
c. If you don't give me $100, you won't get a C

The strengthened inference in (29) disappears if a scalar additive particle *even* is inserted in the first sentence (30). More precisely, (30-a) licenses both inferences in (30-b)-(30-c); it can be paraphrased by (30-d). If the first modal is replaced with a universal one (and the coordinator is left out), the strengthened meaning of the second sentence seems to become available again; we defer the description of the exact felicity conditions of (31-a) to a different occasion.

(30) a. You can even give me $100 (and) you will get a C
b. If you give me $100, you will get a C
c. If you don't give me $100, you will get a C
d. No matter what, you will get a C

(31) a. ?You must even give me $100. You will get a C
b. If you even give me $100, you will get a C

	conditional	unconditional
◊-□ seq.	✓	(dispref.)
□-□ seq.	✓	(dispref.)
◊-*even*-□ seq.	(dispref.)	✓
□-*even*-□ seq.	✓	(dispref.)

Table 2: The *even* asymmetry.

Let us briefly consider and reject one possible analysis of the asymmetry: *even* takes scope over the sequence of two sentences. Besides the non-standard syntax inherent in such a proposal (*even* taking scope over two sentences), it is not obvious that it makes a correct prediction for non-modal environments. For example, although buying one lottery ticket is more likely than buying n>1 lottery tickets (cf. the infelicity of (32-a)), it is less likely that you buy one lottery ticket and win than that you buy n>1 lottery tickets and win. Hence, the theory under consideration incorrectly predicts (32-b) to be felicitous:

(32) a. ?John bought even one$_F$ lottery ticket

b. ?John bought even one$_F$ lottery ticket (and) he won

4.2 Theoretical background

There are four ingredients to our analysis of the facts represented in Table 2: (i) the additive contribution of $even$, (ii) the dynamic semantics of modals and modal subordination, (iii) the nature of the ordering source in the discourses at hand, and (iv) a strength restriction on anaphora resolution. All of the ingredients but (iii) are standard and independently motivated.

(i) We begin by describing the import of the most obvious player in the $even$ asymmetry – the scalar additive particle. Although there is some debate as to what exactly are the different contributions of $even$, it is commonly assumed that it triggers two inferences – the scalar and the additive/existential inference. For our purposes, only the second one is relevant. It is illustrated in (33).

(33) a. Sara read even Ulysses$_F$
b. even$_C$ [Sara read Ulysses$_F$]
c. Additive inference: $\exists$q$\in\{$p | $\exists$x(p = that Sara read x)$\}$: q $\neq$ that Sara read Ulysses $\wedge$ q is true in w*

(ii) The second ingredient of our analysis is the semantics of modals and modal subordination. We adopt a simplified version of modal dynamic semantics developed by Brasoveanu (2010). Both quantifiers can and $must$ introduce referents W' into the discourse that correspond to the respective modal's nuclear scope (34). In our examples, the first sentence contains a priority modal and we accordingly assume that the ordering source o is either deontic or teleological, while the modal base b is epistemic (or circumstantial). The second sentence contains an epistemic future modal $will$ which takes an empty ordering source. We ignore the temporal import of $will$ and treat it as having the meaning identical to (34-b).

(34) a. $\text{can}_{o,b}^{W'\sqsubseteq W} \rightsquigarrow \lambda \text{p}_{st}.\lambda \text{w}_s.\ \max_{W'\sqsubseteq W}(\text{p(W')}) \wedge \text{Best}_{o(w)}(\cap \text{b(w)}) \cap \text{p} \neq \emptyset$
b. $\text{must}_{o,b}^{W'\sqsubseteq W} \rightsquigarrow \lambda \text{p}_{st}.\lambda \text{w}_s.\ \max_{W'\sqsubseteq W}(\text{p(W')}) \wedge \text{Best}_{o(w)}(\cap \text{b(w)}) \subseteq \text{p}$

There are two important factors to the lexical items can and $must$ (and their translations): (a) they introduce a new discourse referent – the set of worlds W' – that are (b) part of a referent W. The value of W needs to be appropriately resolved: discourse-initially it is the set of all possible worlds, while later in the discourse it can be, for example, resolved to referents introduced by the preceding modals. Finally, p(W') stands for p holding in every world in W', while maximalization $\max_{W'\sqsubseteq W}$(p(W')) conditions W' to be the maximal subset of W such that p(W').

(iii) As we pointed out in our discussion of the coordination puzzle, an important role in (modal) discourses is played by coherence: e.g. we have seen that the type of discourse relation that obtains between two sentences in a coordinated modal discourse bears on its felicity. We assume that there is a further, slightly dif-

ferent type of entanglement of the two sentences in the $even$-discourses discussed in this section: the second sentence partly determines the interpretation of the first sentence. More precisely, the propositional argument of the modal in the second sentence constitutes the ordering source of the modal of the first sentence, which in $even$-examples has a teleological flavor.

(iv) The final ingredient of our analysis is a restriction on the resolution of anaphoric elements (cf. Dalrymple et al. 1998). It simply states that when the meanings of a sentence under different anaphora resolutions stand in an entailment relation, the resolution that yields the strongest reading is picked (Strongest Meaning Hypothesis). We assume that if different resolutions do not yield meanings that stand in an entailment relation, the preference for a maximally coherent discourse determines which resolution is picked.

4.3 Analysis

The conditional reading of the second sentence in ◇-□ and □-□ sequences is prominent due to conditional strengthening, i.e. the implicature that for the worlds not contained in the restrictor, the nuclear scope of the modal does not hold. This strengthening process to a biconditional interpretation is reflected in the (b)- and (c)-inferences in (29); it is informally sketched in (35).

(35) $S(\Box(p,q)) = \Box(p,q) \;\&\; \Box(\neg p,\neg q) = \Box(p,q) \;\&\; \Box(q,p)$

We first analyze the examples without the scalar additive particle. The sequence in (29) has the representation in (36). The relevant anaphoric element in the second modal sentence is W" which can be resolved either to the antecedent provided in the previous sentence – the set of worlds in which you give me $100 – or to the default referent – the set of all possible worlds W.

(36) $\text{can}_{o,b}^{W' \sqsubseteq W}$ [you give me $100] and $\text{will}_{o,b}^{W''' \sqsubseteq W''}$ [you get a C]

a. Resolution 1: W" = W' = $\{w \mid$ you give me $100 in w $\wedge$ w$\in$W$\}$

b. Resolution 2: W" = W

After strengthening, the two resolutions yield meanings that are not in an entailment relation (37) – an application of Strongest Meaning Hypothesis is unwarranted, so no interpretation is precluded on that basis. The preference for a conditional interpretation then follows from the preference for a maximally coherent discourse.

(37) a. $S(\text{will}_{o,b}^{W'' \sqsubseteq W'}$ [you get a C]) $\not\Leftarrow \not\Rightarrow$ $S(\text{will}_{o,b}^{W'' \sqsubseteq W}$ [you get a C])

b. If you give me $100, you will get a C & If you don't give me $100, you won't get a C $\not\Leftarrow \not\Rightarrow$ You will get a C, no matter what

The insertion of $even$ into the existential modal sentence results in the additive inference in (38-b). For the sake of exposition, we assume the set of alternatives C

is constituted as in (38-c).[2] Since we are assuming that the ordering source of can consists of the propositional complement of $will$ (assumption (iii) in the preceding subsection), the additive import of the sentence is (39).

(38) a. even_C [$\text{can}_{o,b}^{W' \sqsubseteq W}$ [you [give me \$100]$_F$]]
b. $\exists$q$\in$C: q $\neq$ that you can give me \$100 $\wedge$ q is true in w*
c. C = $\{\Diamond$(you give me \$100), $\Diamond$(you don't give me \$100)$\}$

(39) $\exists$w $\in$ $\text{Best}_{\{that\ you\ get\ a\ C\}}(\cap$b(w*))[you don't give me \$100 in w]

The additive presupposition in (39) now plays a crucial role in forcing the unconditional interpretation of the second modal sentence. Namely, as in (36), the modal $will$ can either be restricted to the set of worlds in which you give me \$100 or to the set of all possible worlds:

(40) even_C [$\text{can}_{o,b}^{W' \sqsubseteq W}$ [you give me \$100]$_F$] and $\text{will}_{o,b}^{W''' \sqsubseteq W''}$ [you get a C]
a. Resolution 1: W" = W' = $\{$w | you give me \$100 in w $\wedge$ w$\in$W$\}$
b. Resolution 2: W" = W

We saw that these resolutions yield – after strengthening – meanings that do not stand in an entailment relation (37), rendering Strongest Meaning Hypothesis inapplicable. However, this is not the case anymore in $\Diamond$-$even$-$\Box$ sequences. Namely, the strengthened meaning of the second sentence under Resolution 1 – if you give me \$100, you will get a C & if you don't give me \$100, you won't get a C – contradicts the additive presupposition of the first sentence (39) – it is possible that you don't give me \$100 and you get a C. Accordingly, the strengthening is blocked. The resultant meaning of the second sentence under Resolution 1 is entailed by the meaning of the sentence under Resolution 2 (41). Thus, Strongest Meaning Hypothesis can apply and selects Resolution 2 as the preferred interpretation. This is the so-called unconditional interpretation.

(41) (Res.2) $\text{will}_{o,b}^{W'' \sqsubseteq W}$ [you get a C] $\not\Leftrightarrow$ (Res.1) $\text{will}_{o,b}^{W'' \sqsubseteq W'}$ [you get a C]

Finally, in the case of $\Box$-$even$-$\Box$ sequences, no parallel blocking obtains. This is due to the interaction of the force of the modal and $even$: the propositional argument of the universal modal in the additive inference must be consistent with the proposition that you give me \$100, say, that you pay me lunch (43) – otherwise the sentence would have contradictory entailments.

(42) even_C [$\text{must}_{o,b}^{W' \sqsubseteq W}$ [you give me \$100]$_F$] and $\text{will}_{o,b}^{W''' \sqsubseteq W''}$ [you get a C]
a. Resolution 1: W" = W' = $\{$w | you give me \$100 in w $\wedge$ w$\in$W$\}$
b. Resolution 2: W" = W

[2]The crucial point for our analysis is only that the meanings of the complements of can in the respective alternatives are mutually exclusive. An option would also be to treat the additive inference as being universal instead of existential (cf. Lycan 1991).

(43) $\forall$w $\in$ Best$_{\{that\ you\ get\ a\ C\}}$($\cap$b(w*))[you buy me lunch in w]

Accordingly, the additive presupposition of the first sentence does not block the strengthening of the second sentence under Resolution 1; this is so not least because the first sentence entails that all the worlds in which you get a C are worlds in which you buy me lunch and give me $100. The strengthening thus applies, rendering the two resolutions mutually non-entailing and Strongest Meaning Hypothesis inapplicable, parallel to the derivation of (36). Discourse coherence dictates that Resolution 1 is picked.

To summarize, we have shown that in $\Diamond$-*even*-$\Box$ sequences an inference is triggered that blocks the strengthening of the conditional interpretation of the second sentence. The non-strengthened conditional interpretation of the second sentence is entailed by an *un*conditional interpretation of the sentence, and this latter interpretation is selected by Strongest Meaning Hypothesis. In $\Diamond$-$\Box$ sequences no presuppositions are triggered that would block the strengthening of the second sentence. Thus, both a conditional and an unconditional interpretation of the second sentence are available. The former is preferred for discourse coherence reasons.

5 Concluding remarks

We presented two case studies on the effects of *and* and the scalar additive particle *even* on modal discourses. Our introduction to the coordination puzzle began with data concerning IaDs, which we then largely ignored. They pattern like $\Diamond$-$\Box$ sequences: they allow a conditional interpretation (5); *even* forces an unconditional interpretation – (44) conveys that you will get a C, no matter what.

(44) Give me even $100 and you will get a C

Although these facts make a treatment of the imperative clause as a kind of an existential modal sentence tempting, it is not clear that this is the correct way to proceed: e.g. unlike the initial sentences of the modal discourses studied above, the imperatives in (5)/(44) are not perceived as expressing a command or a permission. We leave the exploration of these complex issues for a different occasion.

In our analysis of the coordination asymmetry, we relied on the treatment of conjunction developed in (Txurruka 2003). An alternative would be to build on the proposal by Zeevat and Jasinskaja (2007) who assign *and* an additive semantics. Accordingly, the asymmetry between the coordinated $\Diamond$-$\Box$ and $\Box$-$\Box$ sequences would arguably be derived from the distinctness condition inherent to additivity. The question of how distinctness should be characterized for modal sentences at hand is an intriguing one.

References

Asher, Nicholas. 1993. Reference to abstract objects in discourse. Springer.

——, and Alex Lascarides. 2003. Logics of conversation. Cambridge University Press.

——, and Laure Vieu. 2005. Subordinating and coordinating discourse relations. Lingua 115.591–610.

Bar-Lev, Z., and A. Palacas. 1980. Semantic command over linguistic priority. Lingua 51.137–46.

Brasoveanu, Adrian. 2010. Decomposing modal quantification. Journal of Semantics forthcoming.

Dalrymple, Mary, Makoto Kanazawa, Yookyung Kim, Sam Mchombo, and Stanley Peters. 1998. Reciprocal expressions and the concept of reciprocity. Linguistics and Philosophy 21.159–210.

von Fintel, Kai. 2001. Conditional strengthening: a case study in implicature. Technical report, MIT.

Frank, Anette, 1997. Context Dependence in Modal Constructions. Stuttgart University dissertation.

Iatridou, Sabine. 2008. De modo imperativo. Technical report, MIT.

Kamp, Hans, and Uwe Reyle. 1993. From discourse to logic. D. Reidel.

Lycan, W.G. 1991. Even and even if. Linguistics and Philosophy 14.115–150.

Moxey, Linda M., and Anthony J. Sanford. 1993. Communicating quantities: A psychological perspective. Lawrence Erlbaum.

Nouwen, Rick, 2003. Plural pronominal anaphora in context: dynamic aspects of quantification. Utrecht University dissertation.

Roberts, Craige. 1989. Modal subordination and pronominal anaphora in discourse. Linguistics and Philosophy 12.683–721.

Russell, Benjamin. 2007. Imperatives in conditional conjunction. Natural Language Semantics 15.131–166.

Schwager, Magdalena, 2006. Interpreting imperatives. University of Frankfurt/Main dissertation.

Stone, Matthew. 1999. Reference to possible worlds. Technical report, Rutgers University.

Txurruka, I.G. 2003. The natural language conjunction and. Linguistics and Philosophy 26.255–285.

Zeevat, H., and K. Jasinskaja. 2007. and as an additive particle. In Language, Representation and Reasoning: Memorial Volume for Isabel Gomez Txurruka, ed. by Kepa Korta Aurarnague, Mixel and Jesus M. Larrazabal. Bilbao: UPV-EHU.