

Modification of DPs by epistemic modal adverbs

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Abstract

I argue that when epistemic modal adverbs form constituents with DPs, the modal takes scope only over the DP. In contrast with sentences with higher adjoined adverbs, sentences with modal-modified DPs carry actuality entailments. Composition of type $\langle st, st \rangle$ modals and type $\langle se \rangle$ DP intensions is mediated by shifting the DP into a property-type expression by a variant of Partee’s IDENT. Precedent comes from work on Concealed Questions (Frana 2006, Schwager 2008) and Grosu’s (2003, 2007) analysis of Transparent Free Relatives.

1 Introduction

Epistemic modal adverbs are standardly treated as type $\langle st, st \rangle$ propositional operators. Recently, however, it has been observed that epistemic modal adverbs can apparently modify subpropositional material, including numerals (Zaroukian 2011) and adjectives (Cinque 2010).

- (1) a. **Numeral-modifying:** Mary met with possibly 15 students.
b. **Adjective-modifying:** They found a probably precancerous mole on John’s back.

Much less has been said about the modification of DPs by epistemic modal adverbs (2). While Ernst (1984) discusses their syntax — arguing that modal adverbs form constituents with DPs — there has not yet been discussion of how the intension of a DP (3a) can be modified by an epistemic modal adverb with a familiar type $\langle st, st \rangle$ meaning (3b) (Kratzer 1981).

- (2) **DP-modifying:**
- a. Mary ate $[_{DP}$ possibly $[_{DP}$ the most expensive pizza in Amherst $]$].
b. Mary drank $[_{DP}$ perhaps $[_{DP}$ {an / the} American bourbon $]$].
c. Mary is meeting with $[_{DP}$ probably $[_{DP}$ a nurse practitioner $]$].
- (3) a. $\llbracket the\ most\ expensive\ pizza\ in\ Amherst \rrbracket = \lambda w' \iota y [\text{most expensive pizza in Amherst}(y, w')]$
b. $\llbracket possibly \rrbracket = \lambda p_{st} \lambda w [\exists w'' \in \text{EPI-MB}(w) [p(w'')]]$
c. $\llbracket \text{IDENTIFY} \rrbracket = \lambda \mathcal{X}_{se} \lambda z_e \lambda w' [z = \mathcal{X}(w')]$ (Frana 2010)

This paper puts forth such an analysis. I maintain familiar entries for modal adverbs. I argue that adverbs compose with DPs that are shifted into properties via IDENTIFY (3c), an intensional form of Partee’s (1986) IDENT (Frana 2006, 2010). The modal and shifted DP then compose through Function Composition.

Under this account, modal adverbs that form constituents with DPs only take scope over that DP. This prediction is verified by sentence pairs like (4). When the modal adverb takes scope over the verb *ate* as in (4a), the sentence is felicitous in a context where it is unknown whether Mary ate anything. By contrast, epistemic uncertainty introduced by the DP-modifying modal

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in (4b) is restricted to the identity of the object eaten by Mary: in at least one of the speaker's epistemic alternatives w' , what Mary ate in w' is *the most expensive pizza in Amherst* in w' . It must be the case, however, that Mary ate something.

- (4) Context: Mary visited Amherst yesterday and planned to eat a pizza lunch at Athena's, which you know makes the most expensive pizza in Amherst. You know that Mary anticipated having to skip lunch, however, so perhaps she didn't eat anything. You say,
- a. Mary [_{VP} possibly [_{VP} ate the most expensive pizza in Amherst.]]
 - b. #Mary ate [_{DP} possibly [_{DP} the most expensive pizza in Amherst.]]

The paper proceeds as follows. Section 2 presents empirical evidence for the syntax and truth conditions of modal-modified DPs. Section 3 presents the formal analysis, building in part on analyses of Concealed Questions (Frana 2006, 2010; Schwager 2008) and Transparent Free Relatives (Grosu 2003, 2007). Section 4 concludes and presents directions for further work.

2 Syntactic and Semantic Scope of Modal Adverbs

Against a parenthetical analysis: Although this paper focuses on modification of DPs by epistemic modal adverbs, this position can also be occupied by other typically sentential adverbial expressions, including speaker-oriented adverbs as in (5a) and clause embedding fragments argued to behave like sentential adverbs (5b) (Jackendoff 1972).¹

- (5) a. Mary ate {possibly/regrettably/unfortunately} the most expensive pizza in Amherst.
 b. Mary ate {I believe/I think} the most expensive pizza in Amherst.

Since all of the expressions that I argue can modify DPs can also function as sentence-modifying expressions, we must rule out an alternative analysis of sentences like (5) in which the adverb is a sentential modifier that is linearized in sentence medial position (6):

- (6) Possibly Mary ate the most expensive pizza in Amherst. → Mary ate, possibly, the most expensive pizza in Amherst.

Linearization of *possibly* as in (6) would occur on analogy to other adverbs that function as parenthetical expressions. When linearized in sentence medial position, parenthetical adverbs are pronounced with obligatory comma intonation (prosodic breaks) around the adverb. Furthermore, the semantic scope of parenthetical adverbs does not depend on their linear position in the sentence (Ernst 2002). Regardless of its linear position, the adverb *happily* in (7) takes scope over the entire sentence (Mary's missing her sister's birthday was a happy occurrence).

- (7) Happily Mary missed her sister's birthday. → Mary missed, happily, her sister's birthday.

Ernst (1984) observes that the modal adverbs in sentences like (8) lack comma intonation:

- (8) a. Mary ate possibly the most expensive pizza in Amherst.
 b. Mary walked towards possibly a Canadian doctor.

¹Non-epistemic modals cannot modify DPs, e.g. (i). I leave explanation of this restriction to future work.

- (i) *Mary accidentally ate {obligatorily / deliberately} the worst pizza at the cooking competition.
 Cannot mean: Mary accidentally ate something which was deliberately / obligatorily the worst pizza at the cooking competition.

The next subsection shows that unlike parenthetical adverbs, the linear position of prosodically integrated modal adverbs determines their scope. These two pieces of evidence point away from a parenthetical analysis of the adverbs in (8).

Scope of modal adverbs: Further evidence against a parenthetical analysis of DP-modifying modal adverbs comes from their fixed scope. While parenthetical adverbs are interpreted as having sentential scope regardless of their linear position, non-parenthetical adverbs have fixed scope (Jackendoff 1972). For example, *happily* in (9a) can only modify the VP (Mary missed her sister’s birthday in a happy manner) and cannot be interpreted as having scope over the entire sentence. Given their fixed scope, non-parenthetical adverbs are ungrammatical when they cannot be interpreted in situ, as Ernst (2002) argues is the case for sentences like (9b,c).

- (9) a. Mary happily missed her sister’s birthday.
- b. *Mary missed happily her sister’s birthday.
- c. *Mary looked forward to happily her sister’s birthday.

The grammaticality of examples like (8) demonstrates that non-parenthetical modal adverbs can be interpreted in object positions. When interpreted in such positions, modal adverbs only take scope over the DP. Examples in this section demonstrate that, as a result of their low scope, sentences with DP-modifying adverbs carry an actuality entailment. I use ‘actuality entailment’ to mean that the (a) sentences are only licit if there was an event of Mary eating something (10). By contrast, the (b) sentences, where adverbs adjoin higher in the structure (e.g. at VP), are felicitous in both types of scenarios.²

- (10) Context: Mary visited Amherst yesterday and she ate at Athena’s pizza. You can’t remember whether Athena’s or Antonio’s has the most expensive pizza. You say,
 - a. Mary ate [_{DP} possibly [_{DP} the most expensive pizza in Amherst]].
 - b. Mary [_{VP} possibly [_{VP} ate the most expensive pizza in Amherst]].
- (11) Context: Mary visited Amherst yesterday and planned to eat a pizza lunch at Athena’s, which you know makes the most expensive pizza in Amherst. You know that Mary anticipated having to skip lunch, however, so perhaps she didn’t eat anything.
 - a. #Mary ate [_{DP} possibly [_{DP} the most expensive pizza in Amherst]].
 - b. Mary [_{VP} possibly [_{VP} ate the most expensive pizza in Amherst]].

Note that the sentences above contained DPs containing superlative-marked adjectives. One may be tempted to argue that the adverb only composes with the adjective in these cases, particularly since Cinque (2010) argues that modal adverbs can in general compose with adjectives (e.g. ‘There was a probably precancerous mole on John’s back’). I argue that such an analysis cannot be maintained. Modal adverbs are still licit in examples like (12) in which there is no adjective for the modal to modify. As before, the (a) sentences with modal-modified DPs again carry actuality entailments while (b) sentences do not:

- (12) Context: You know that Mary felt unwell today and went to the health center. She wasn’t sure if she’d be seeing a doctor or a nurse. I ask you where Mary is. You say,
 - a. Mary is meeting with [_{DP} possibly [_{DP} a doctor]] at the health center.
 - b. Mary is [_{VP} possibly [_{VP} meeting with a doctor at the health center]].

²All sentences considered contain verbs with transparent object positions. I set aside the question of whether actuality entailments arise when modal-modified DPs are taken as object by verbs with opaque object positions.

- (13) Context: You know that Mary felt unwell today but could not decide whether to see a doctor at the health center or go home and rest. Later on we see that Mary's desk is empty and I ask you where Mary is. You say,
- a. #Mary is meeting with [_{DP} possibly [_{DP} a doctor]] at the health center.
 - b. Mary is [_{VP} possibly [_{VP} meeting with a doctor]] at the health center.

Examples like (14) further demonstrate that even when a DP does contain an adjective, the modal can still take scope over the entire DP. The speaker's uncertainty in (14) is not about whether what Mary ate was the best, but rather what type of food it was.³

- (14) Context: Mary went on part of a tour of New York restaurants known for serving the best versions of a particular dish (hamburger, pizza, spaghetti). You know she ate at just one restaurant, but you don't know which. I ask you what Mary did. You say,
Mary ate possibly the best pizza in New York.

This section has shown that because the verb is always outside of the scope of a DP-modifying modal adverb, sentences with such adverbs always carry actuality entailments.

3 Analysis

Composition of the modal and DP: I argued above that unlike other sentential adverbs (e.g. *happily*), modal adverbs can be interpreted when they only scope over a DP.

- (15) a. *Mary missed happily her sister's birthday.
b. Mary ate possibly the most expensive pizza in Amherst.

Assuming that modal adverbs are of type $\langle \text{st}, \text{st} \rangle$ (16a) regardless of their syntactic attachment site, the puzzle is how they can compose with a type $\langle \text{se} \rangle$ DP intension (16b) (MEPA = *the most expensive pizza in Amherst*).⁴

- (16) a. $\llbracket \text{possibly} \rrbracket = \lambda p_{st} \lambda w [\exists w'' \in \text{EPI-MB}(w) [p(w'')]]$
b. $\llbracket \text{the most expensive pizza in Amherst} \rrbracket = \lambda w' \iota y [\text{MEPA}(y, w')]$

I argue that composition of the modal adverb and a DP is made possible by first type shifting the denotation of the definite description into a property via IDENTIFY:

- (17) a. $\llbracket \text{IDENTIFY} \rrbracket = \lambda \mathcal{X}_{se} \lambda z_e \lambda w' [z = \mathcal{X}(w')] \quad \langle \text{se}, \text{est} \rangle$
b. $\llbracket \text{IDENTIFY the most expensive pizza in Amherst} \rrbracket = \lambda z_e \lambda w' [z = \iota y [\text{MEPA}(y, w')]]$

Precedent for this approach to modal-modified DPs comes from two sources. First, precedent for the type shifter comes from Frana (2006, 2010) — who introduces the name IDENTIFY — and Schwager (2008), who use a similar type shifter in their accounts of Concealed Questions (18), which can also be analyzed as type $\langle \text{se} \rangle$ DP intensions composing with type $\langle \text{st}, \text{st} \rangle$ expressions (factive verbs):

- (18) Mary knows [IDENTIFY [_{DP} the capital of Italy]].

³Prosodic prominence — perhaps Focus marking — on *pizza* in (14) helps to bring out the intended reading.

⁴More accurately, modal adverbs compose with the intension of a DP. Regardless of where they occur in the sentence, modals always require access to intensions.

Second, this analysis of modal-modified DPs makes them similar in semantics to Transparent Free Relatives under Grosu’s (2003, 2007) treatment:

- (19) a. John was attacked by [_{TFR} what seemed to be *a student*].
 b. John is a [_{TFR} what Mary would call *unique*] individual. (adapt. Grosu 2003)

Grosu (2003, 2007) analyzed TFRs as structurally similar to standard free relatives (e.g. ‘Mary ate what John cooked’).⁵ TFRs are always headed by bare *what* and characteristically contain an intensional operator. The core semantic content of the TFR is expressed by the pivot (italicized in (19)) which can be a DP (19a) or property (19b). When the pivot is a DP as in (19a), it is taken as argument by a copula with an equative-specificational semantics.⁶ The entry of IDENTIFY in (17) only differs from (20)— one of Romero’s (2005) entries for the specificational copula — in the order of composition with its intensional and extensional arguments. Higgins (1973) notes that order of composition is a general point of flexibility in specificational sentences.

$$(20) \quad \llbracket be_{SPEC} \rrbracket = \lambda z_e \lambda \mathcal{X}_{se} \lambda w' [z = \mathcal{X}(w')] \quad (\text{Romero 2005})$$

TFRs have a number of similarities with modal-modified DPs. In particular, the intensional operator in a TFR only takes scope within the clause containing the pivot; it does not take scope over the matrix verb. As a result, sentences with TFRs — like sentences with modal-modified DPs — carry actuality entailments. I illustrate this in (21) with a TFR based on a modal-modified DP familiar from discussion above:

- (21) Context from (11): #Mary ate what is possibly the most expensive pizza in Amherst.

Once IDENTIFY is admitted into our account of modal-modified DPs, composition between the modal and type shifted DP could be handled in two ways. First, we could maintain as much of the TFR structure as possible and argue that modal-modified DPs are reduced relative counterparts to TFRs. Following Bhatt’s (2006) Direct Predication analysis of reduced relatives, a modal-modified DP could have the syntax in (22). The structure is identical to a TFR except that we replace *what* with semantically vacuous PRO (which is then abstracted over) and the specificational copula with IDENTIFY.

$$(22) \quad \lambda y \text{ [possibly [}_{SC} \text{ PRO}_y \text{ IDENTIFY } \textit{the most expensive pizza in Amherst} \text{]]}$$

Alternatively, we could argue that the type shifted DP can compose with the modal adverb via Function Composition (23).

$$(23) \quad \begin{array}{ll} \text{Shifted DP: } f = \lambda z \lambda w' [z = \iota x [\text{MEPA}(x, w')]] & \langle e, st \rangle \\ \text{Modal: } g = \lambda p_{st} \lambda w [\exists w'' \in \text{EPI-MB}(w) [p(w'')]] & \langle st, st \rangle \\ \text{Output: } (g \circ f) & \langle e, st \rangle \\ & = \lambda y (\lambda p_{st} \lambda w [\exists w'' \in \text{EPI-MB}(w) [p(w'')]]) (\lambda w' [y = \iota x [\text{MEPA}(x, w')]]) \\ & = \lambda y \lambda w [\exists w'' \in \text{EPI-MB}(w) [y = \iota x [\text{MEPA}(x, w'')]]] \end{array}$$

Both analyses maintain a type $\langle st, st \rangle$ entry for modal adverbs and do not require us to treat sentential adverbs capable of modifying DPs as lexically ambiguous in any way. I leave to further work comparison of the two analyses. In discussion below, I will assume the Function Composition analysis since it is representationally simpler.

⁵For an alternative treatment of TFRs, see van Riemsdijk (2000).

⁶Equivalently, the DP could first be shifted into a property via Partee’s (1986) IDENT and then compose with a predicative copula (Rothstein 2001).

Composition of modal-modified DPs and verbs: Both the reduced relative and Function Composition analyses produce modified DPs of type $\langle e, st \rangle$. There are several options for composing this expression with the rest of the clause. First, we could have the expression move above the verb and subject, leaving behind a trace of type e (24a). The predicate produced by lambda abstraction could compose with the modified DP through Predicate Modification followed by Existential Closure.⁷

- (24) a. $[[\text{possibly IDENTIFY the most expensive pizza in Amherst}] \lambda x \text{ Mary ate } x]$
 b. $\llbracket (24a) \rrbracket = \lambda z \lambda w' [\lambda y \lambda w [\exists w'' \in \text{EPI-MB}(w) [y = \iota x [\text{MEPA}(x, w'')]]](z)(w') \ \& \quad \text{PM}$
 $\quad [\lambda x \lambda s [\text{Mary ate } x \text{ in } s]](z)(w')$
 c. $\exists z \lambda w' [\exists w'' \in \text{EPI-MB}(w') [z = \iota x [\text{MEPA}(x, w'')]]] \ \& \ \text{Mary ate } z \text{ in } w' \quad \text{EC}$
 ‘There exists a z such that Mary ate z in w' and in some world w'' epistemically accessible from w' , z is the most expensive pizza in Amherst.’

Second, we could treat modal-modified DPs as specific indefinites, having them compose with a type $\langle est, e \rangle$ choice function f that returns some member of the set denoted by the modified DP. The returned entity composes in situ with the verb and the choice function is existentially quantified over (as in (25); Reinhart 1997) or given by the context (Kratzer 1998).

- (25) $\exists f [\text{Mary ate } f(\lambda z \lambda w [\exists w'' \in \text{EPI-MB}(w) [z = \iota x [\text{MEPA}(x, w'')]])]]$

Third, the modified DP could compose with a definiteness (or maximalization) operator on analogy with free relatives (Jacobson 1995).

- (26) $\llbracket \text{DEF} \rrbracket (\lambda y \lambda w [\exists w'' \in \text{EPI-MB}(w) [y = \iota x [\text{MEPA}(x, w'')]]])$
 $= \iota z \lambda w' [\exists w'' \in \text{EPI-MB}(w') [y = \iota x [\text{MEPA}(x, w'')]]]$

Of these three approaches, the first two make the right predictions while the third is untenable. The following example shows that modal-modified DPs can appear in contexts where there is not a single unique referent for the modal-modified description.⁸ This is expected given the existential quantification in the first two approaches but unexpected under the third.

- (27) Context: You went to a wine tasting yesterday. You arrived late and missed the descriptions of each wine and only got to try one of the samples on the table. You know there was to be one American, one Chilean, and one Argentinian wine. The wine you drink is white; you know that the US produces a lot of white wine. You say,
 I drank possibly the American wine.

The only requirement imposed by a definite determiner within the modified DP in (27) is that in each accessible alternative w' , there be a unique referent for the description within that alternative w' . If context (27) were minimally changed such that the speaker knew there to be two American wines, the target sentence could no longer be uttered.⁹

⁷This operation could also be modeled as a case of composition through Restrict, a mode of composition that Chung and Ladusaw (2001) propose for the composition of predicates with properties. Composition through Restrict does not change the predicate's degree of saturation so Existential Closure must still follow.

⁸This is another point of similarity between modal-modified DPs and TFRs. Sentence (27) could have contained TFRs rather than a modal-modified DP. Grosu (2003) pursues a strategy for composition of TFRs with verbs similar to the first strategy outlined above, arguing that they are lifted from properties into existentially quantified expressions which then raise to compose.

⁹It is, of course, not generally impossible for modal adverbs to occur within the scope of definite determiners. When they do, however, the uniqueness requirement of the definite determiner returns and the modal appears to only take scope over the adjective, e.g., *Mary drank the possibly American wine* is only felicitous if the context contains a unique wine describable as ‘possibly American.’

4 Summary and Discussion

I have demonstrated that when epistemic modal adverbs form syntactic constituents with DPs, the modal takes scope only over the DP: the world variable of the verb is not bound by the modal. As a result, sentences with modal-modified DPs — but not sentences with higher adjoined adverbs — carry actuality entailments. The puzzle was: how can we maintain a type $\langle st, st \rangle$ entry for modal adverbs while allowing them to compose with type $\langle se \rangle$ DP intensions? Drawing on proposals for similar puzzles arising for Transparent Free Relatives and Concealed Questions, I argued that DPs are shifted into property type prior to composition with adverbs.

One direction for further work is comparison of modal-modified DPs with Collins Conjunctions (Collins 1988, Schein 1997). Strings like (28) are ambiguous between the DP-modifying reading addressed in this paper and the Collins Conjunction reading. In the Collins Conjunction reading, it appears that the adverb takes scope over an unpronounced instance of *brought*. Unlike sentences with DP-modifying modals, Collins Conjunction sentences lack an actuality entailment for the modal-modified individual. The structural difference underlying the ambiguity seems related to the adverb's height: DP-modifying modals are lower than Collins Conjunction modals. This is supported by sentences which contain adverbs in both positions (29).

- (28) Mary brought a cake and [possibly the most expensive pizza in Amherst] to the party.
- a. **DP-modifying:** Mary brought two things: a cake and something which is possibly the most expensive pizza in Amherst.
 - b. **Collins Conjunction:** Mary brought a cake and possibly also brought the most expensive pizza in Amherst.
- (29) Mary brought a cake and possibly [perhaps the most expensive pizza in Amherst].

There is, however, a similarity between adverbs in both positions: neither position permits non-epistemic modals (fn. 2 above, Vicente 2013). What is the source of this restriction?

A second direction to explore is the binding possibilities of DP-modifying modal adverbs. While world (or, situation) variables of DPs can be bound non-locally, world variables of adverbial quantifiers on the clausal spine must be bound by the closest operator (Percus 2000). The world variable of *always* in (30) can only be bound by *think* ($w2$), and not by $w1$. Were the latter possible, (30) is predicted to be true if my brother (or who Mary believes to be my brother) won every actual game round.

- (30) $\lambda_1 w1$ [Mary thinks [λ_2 my brother($w2/w1$) always($w2/*w1$) won the game]].

What happens when an adverbial quantifier modifies a DP? While the modal certainly can be locally bound, it appears that it can alternatively be bound by the same expression that non-locally binds the DP's situation variable, e.g. $w1$:

- (31) Context: Mary had pizza served from a box with Athena's logo on it. I know that Athena's is among the most expensive in town. Mary is visiting and does not know this. Unknown to Mary, her pizza was actually from Don's, which is the cheapest in town. I report Mary's belief, saying:
- a. Mary thinks she ate possibly the most expensive pizza in Amherst.
 - b. $\lambda_1 w1$ [Mary thinks [λ_2 she ate [possibly the most expensive pizza in Amherst($w1$)]]]

As discussion of modal modification of DPs increases, it will be interesting to continue to compare the behavior of DP-modifying adverbs with modals along the clausal spine.

Finally, as noted in the introduction, DPs are not the only subpropositional constituents to

be modified by epistemic modal adverbs. Although the modification of type $\langle e, st \rangle$ adjectives (1b) is expected under my analysis, it is not clear how it can extend to numerals (1a). Will it be necessary to treat numeral-modifying modals as approximators with an added modal component (Zaroukian 2011)? Or is a single, familiar semantics for modal adverbs tenable?

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