

Variable force
modals

Incomplete Modal Paradigms

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Virtual NYI #4– January 2022

Modal Force
and Modal
Flavors:
Lexical vs.
Contextual

Variable Force
Modal

From Universal
to Existential
 $\forall \rightarrow \exists$

From
Existential to
Universal
 $\exists \rightarrow \forall$

Variable force modals

Modal Force and Modal Flavors: Lexical vs. Contextual

Variable Force Modal

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From Existential to Universal $\exists \rightarrow \forall$

► Readings

- Hacquard, Valentine (to appear). Logic and the lexicon: Insights from modality. In A. Papafragou, J. Trueswell, and L. Gleitman (eds.) *The Oxford Handbook of the Mental Lexicon*. Oxford.
- Deal, Amy Rose. 2011. Modals without scales. *Language* 87.
- Bochnak, M. Ryan. 2015. Underspecified modality in Washo. *Proceedings of the eighteenth and nineteenth workshop on structure and constituency in the languages of the Americas*.

► Additional, Optional Readings

- Rullmann, Hotze, Lisa Matthewson H Davis. 2008. Modals as distributive indefinites. *Natural Language Semantics* 16. 317–357.
- Vander Klok, Jozina 2013. Pure possibility and pure necessity modals in Paciran Javanese. *Oceanic Linguistics*, 52(2).
- Vander Klok, Jozina Vera Hohaus. 2020. Weak necessity without weak possibility: The composition of modal strength distinctions in Javanese. *Semantics and Pragmatics* 13(12).

Variable force modals

Modal Force and Modal Flavors: Lexical vs. Contextual

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From Universal to Existential $\forall \rightarrow \exists$

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- ▶ There are two parameters that determine the interpretation of a given modal:
- ▶ **modal force**, whether the modal encodes a force of necessity (universal quantification over worlds) or possibility (existential quantification over worlds);
- ▶ **modal flavor** or type of modality, roughly the background against which a modal claim is made (e.g., epistemic, deontic, circumstantial).
- ▶ These parameters are subject to cross-linguistic variation.

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- ▶ Given that there are two relevant parameters of variation, there are four types of modals that are logically possible.

		MODAL FLAVOR	
		<i>lexical</i>	<i>contextual</i>
MODAL FORCE	<i>lexical</i>	Javanese (mesthi, kudu)	English (must, may)
	<i>contextual</i>	St'át'imcets (ka/k'a)	Washo (-eʔ)

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Modal Force and Modal Flavors: Lexical vs. Contextual

Lexically specified Modal Force and Contextual Modal flavors: English

- ▶ Generally in English, modal force is lexically specified, while modal flavor is contextually determined.
 - (1) Mary **must** be in her room.
 - epistemic (given what we know) or deontic (given the rules); necessity only
 - (2) Mary **may** be in her room.
 - epistemic or deontic; possibility only

Lexically specified Modal flavors: Paciran Javanese

- ▶ Only *mesthi* is compatible with epistemic necessity claims.

Epistemic context: 'They can't be hiding in the box', says the policeman. 'It's too small. And they can't be hiding under the bed. It's too low...'

(3) cah loro iku **mesthi/#kudu** sengidan nek ngguri-ne selambu
 child two DEM EPIS.NEC/DEON.NEC hide at behind-DEF curtain
'They must be hiding behind the curtain'

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Lexically specified Modal flavors and Modal Force: Paciran Javanese

- ▶ Only *kudu* is compatible with deontic necessity claims.

Deontic context: A while later, Mary gets better from her cold. Her friends come over and ask her to come play outside. Mary says, “Sorry, I can’t come out to play...”

(4) PR-ku <uw>akeh yo **kudu** /#mesthi tak=kerjak-no.
 homework-my <INT>many yes DEON.NEC/ EPIS.NEC 1SG.CL=work-APPL
‘I have so much homework, I have to work on it!’

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Contextual Modal Force and Lexically specified Modal flavors: Lilloet Salish

- ▶ Rullmann et al. (2008) have shown that in St'át'imcets (Lilloet Salish), modal flavor is lexically specified, while modal force is determined contextually.
- ▶ There are two modals: the epistemic *k'a* and the deontic *ka*

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Contextual Modal Force and Lexically specified Modal flavors: St'át'imcets

► *k'a* can express both necessity and possibility epistemic modality.
'I don't really remember what we did with the leftover.'

(7) wa7 **k'a** qelh-n-ás nilh kw s-ts'áqw-an,-em
 IMPF **INFER** put.away-DIR-3ERG FOC DET NOM-eat-DIR-1PL.ERG
 lh-kalál-as
 COMP-soon-3CONJ
'Maybe she put it away and we ate it later.'

Context: Jim Hoffmann thought he saw a sasquatch and came running back with huge terrified eyes.

(8) ka-q'us-tum'-á **k'a** wi7
 CIRC-frighten(CAUS)-PASS-CIRC **INFER** EMPH
*'It really **must** have frightened him.'*

CONTEXTUAL MODAL FORCE AND LEXICALLY SPECIFIED MODAL FLAVORS: ST'ÁT'IMCETS

- *ka* can express both necessity and possibility deontic modality.

(9) lán-lhkacw **ka** áts'x-en ti kwtámts-sw-a
 already-2SG.SUBJ **DEON** see-DIR DET husband-2SG.POSS-DET
 'You must/can/may see your husband now.'

Contextual Modal flavors and Modal Force: Washo

- ▶ Bochnak (2015) has shown that Washo has modals whose force and flavor are contextually determined.
- ▶ The modal use of *-éʔ* is compatible with necessity, weak necessity, and possibility claims, and is also compatible with a variety of modal flavors, including deontic, metaphysical, epistemic, bouletic, generic, and pure circumstantial.

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Contextual Modal flavors and Modal Force: Washo

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- ▶ *-éʔ* is compatible with both deontic possibility and deontic necessity modal claims.

Context: A friend comes to visit, and brings her dog along. You don't want the dog to come in the house.

- (10) *súku* *baŋáya* *ʔ-éʔ-i-š-gi* *k-éʔ-i*
 dog outside 3-COP-IMPF-SG-REL 3-MOD-IMPF
 'The dog **has to** stay outside.'

Context: At a school dance, you see a shy boy who wants to talk to a girl but isn't. You ask your friend if that boy is allowed to talk to that girl. Your friend responds: "Yes. . ."

- (11) *me:hu* *šáwlamhu-hak'a* *wagayáyʔ-i-gi* *k'-éʔ-i*
 boy girl-with talk-IMPF-REL 3-MOD-IMPF
 'The boy **is allowed to** talk to the girl.'

Contextual Modal flavors and Modal Force: Washo

- ▶ *-éʔ* is compatible with both epistemic possibility and epistemic necessity modal claims.

Context: You are planning to drive over the mountains. It's started to snow, and you know that whenever it snows, the road over the mountains is closed.

- (12) déʔeš-áŋaw-i-š yewéš gum-beyéc'ig-i-gi k'-eʔ-i
 snow-good-IMPF-SG road REFL-close-IMPF-REL 3-MOD-IMPF
 'It's snowing a lot, so the road **must** be closed.'

Context: You hear a knock at the door. You can't see who it is, but can see that the person looks about the same height as Beverly.

- (13) bévali k'-éʔ-hel-i-gi k'-éʔ-i
 Beverly 3-COP-SUBJ-IMPF-REL 3-MOD-IMPF
 'It **might** be Beverly.'

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- ▶ Languages differ in the type of modal quantifiers they make use of.
- ▶ Languages that have both universal and existential quantification over worlds (English, Paciran Javanese)
- ▶ Languages that make use of only one type (Washo, St'át'imcets, Nez Perce).
 - ▶ only universal quantification (St'át'imcets, Washo),
 - ▶ only existential quantification (Nez Perce, Ecuadorian Siona, Kinande).

Modal quantifiers	\exists, \forall	\forall	\exists
Languages	English	Washo, St'át'imcets	Nez Perce, Ecuadorian Siona, Kinande

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From Universal to Existential

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Universal quantification as a default: St'át'imcets, Washo

- ▶ Rullmann et al. (2008) propose that St'át'imcets modals are unambiguously universal,
- ▶ The (apparent) existential readings come about through a pragmatic mechanism of weakening, similar to implicit domain restriction on quantificational noun phrases (see e.g. Westerståhl 1985; von Stechow 1994; Martí 2003, Stanley and Szabó 2000).

(14) Everybody smiled.

$$\forall x [[\text{person}(x) \wedge R(x)] \rightarrow \text{smiled}(x)]$$

- ▶ An implicit free predicate variable R, which receives its value from the context, restricts the universal quantifier.
- ▶ The presence of R amounts to a pragmatic mechanism for weakening the force of the quantifier.

Modal Force and Modal Flavors: Lexical vs. Contextual

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Domain restriction via a modal choice function

- ▶ Rullmann et al. (2008) provide an analysis that makes use of a choice function
- ▶ It is similar to implicit domain restriction accounts in that it involves a restriction that weakens the force of modal.

Domain restriction via a modal choice function

- ▶ A choice function is a function that applies to a set and returns an individual from that set (e.g. Kratzer 1998; Matthewson 1999; Reinhart 1997).
- ▶ Rullmann et al. posit a modal choice function, which applies to a non-empty set of worlds, but instead of picking out a single world from that set, it returns a subset of worlds from that set.

(15) A function f of type $\langle st, st \rangle$ is a modal choice function iff for any set of worlds $W, f(W) \subseteq W$ and $f(W) \neq \emptyset$

Modals in St’át’imcets (and Washo)

- ▶ St’át’imcets involves two parameters which together determine the set of worlds that are being quantified over: the modal base B and the modal choice function
- ▶ The choice The modal itself then acts as a universal quantifier over worlds in $f(B(w))$.

(16) $\llbracket \text{MODAL} \rrbracket^{c,w}$ is only defined if c provides a modal base B.
 $\llbracket \text{MODAL} \rrbracket^{c,w} = \lambda f_{\langle st, st \rangle} . \lambda p_{\langle s, t \rangle} . \forall w' [w' \in f(B(w)) \rightarrow p(w')]$

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- ▶ Under this analysis, variable force is derived from the size of the set of worlds picked out by the choice function.
- ▶ The smaller the subset of worlds chosen, the weaker the modal force.
- ▶ In the case where the choice function is an identity function, the entire set of worlds in the modal base is universally quantified over, resulting in a necessity interpretation.
- ▶ In the case where the choice function returns a proper subset of worlds in the modal base, the result is a possibility interpretation.

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Existential quantification as a default: Nez Perce, Ecuadorian Siona, Kinande

- ▶ It has been observed that there are languages whose modals are unambiguously interpreted as a possibility modal under a clause-mate negation (Ecuadorian Siona, Kinande) or in downward-entailing environments (Nez Perce).
- ▶ In upward-entailing environments, however, they can be interpreted as either possibility or necessity modals (although there might be restrictions as in Ecuadorian Siona).

Existential quantification as a default: Nez Perce

- ▶ Deal (2011) observes that the Nez Perce root modal *-o'qa* only has a variable force interpretation in upward-entailing environments.
- ▶ In downward-entailing environments only a possibility reading is available.

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Existential quantification as a default: Nez Perce

- ▶ In upward-entailing environments, both possibility and necessity readings are available.

Context: A friend is preparing for a camping trip. I am taking this person around my camping supplies and suggesting appropriate things. I hand them two blankets and say:

(17) 'inehne-**no**'qa 'ee kii lepit cickan
 take-MOD you DEM two blanket
 'You can take these two blankets.'
 'You should take these two blankets.'

(Nez Perce; Deal 2011)

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Existential quantification as a default: Nez Perce

- ▶ Under negation, only a possibility reading is available.

Context: You are explaining to someone who thinks they have to leave that in fact it's not necessary for them to leave.

(18) # weet'u 'ee kiy'-o'qa
 not you go-MOD

Consultant: "That's a different conversation, not this one. You're just saying weet'u 'ee kiyo'qa, 'you can't go'." (Nez Perce; Deal 2011)

Existential quantification as a default: Ecuadorian Siona

- ▶ Jeretič & Case (2020) and Jeretič (2021) argue that the root modal *ba'iji* in Ecuadorian Siona is in fact a possibility modal that is strengthened to necessity in certain contexts.

Existential quantification as a default: Ecuadorian Siona

- ▶ Depending on the QUD (Jeretič, 2021)), the root modal *ba-'i-ji* can be interpreted as possibility or necessity modal.

(20) Sai-ye **ba-'i-ji**
 go-inf be-impf-3sg
 'We *must* go.'

Context: My friend and I want to get to the other side of the river. I ask: can we cross the river?

(21) Tsiaya je'e-ñe **ba-'i-ji**
 river cross-INF be-IMPf-ASRT
 '(Yes), we *can* cross the river.'

(Ecuadorian Siona, Jeretič 2021)

Existential quantification as a default: Ecuadorian Siona

- ▶ Under clausemate negation, the modal can only be interpreted as a possibility modal.

Context: A child talks badly to his father. His mother scolds him.

- (22) Më'ë ja'quë-re ja-je caye **beo-ji**.
 2SG father-OBJ DEM-like speak neg.cop-IMP-3SG
 'You cannot talk to your father like that.'

Context: I have to wash the clothes every day, except today.

- (23) # Iye mo'se tsoa-ye **beo-ji**, a'i sihuayë.
 this day wash-INF NEG.COP-3SG very happy.1SG
int. 'I don't have to wash today, I am very happy.'
 #'I must not wash today, I am very happy.'

(Ecuadorian Siona, Jeretič & Case 2021)

Existential quantification as a default: Ecuadorian Siona

- In other DE environments, the root modal is ambiguous between a possibility modal and a necessity modal.

(24) Sai-ye **ba-'i-to**, sa-si-'i.
go-inf be-IMPf-COND go-FUT-OTH
'If I can/must go, I will go.'

(Ecuadorian Siona, Jeretič 2021)

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Existential quantification as a default: Kinande

- ▶ Newkirk(2021) shows that Kinande (Bantu J, DRC) has a variable-force modal prefix *anga*.

Existential quantification as a default: Kinande

- ▶ She shows that the meaning of *anga* varies, but only between possibility and weak necessity, never to strong necessity.

- (25) Kabunga a-**anga**-na-sya oko kalhasi ko munabwire
 Kabunga 3SG-MOD-T-come PREP class PREP today
 ‘Kabunga might come to class today’
 ‘Kabunga should be coming to class today’
 #‘Kabunga must be coming to class today’
- (26) Kambere si-**anga**-bi-a eká yó lino
 Kambere NEG-MOD-be-FV home PREP now
 #‘Kambere doesn’t have to be at home now.’
 ‘Kambere can’t be at home now.’

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Existential quantification as a default: Kinande

► *anga* loses its ambiguity when negated.

- (27) Kambere si-**anga**-bi-a eká yó lino
 Kambere NEG-MOD-be-FV home PREP now
 #‘Kambere doesn’t have to be at home now.’
 ‘Kambere can’t be at home now.’

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Existential-as-default languages

Languages	Positive clause	under Negation	other DE
Nez Perce	\exists/\forall	\exists	\exists
Ecuadorian Siona	\exists/\forall	\exists	\forall/\exists
Kinande	\forall/\exists	\exists	\forall/\exists

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Modals without Scales (Deal, 2011)

- ▶ Deal proposes that the Nez Perce possibility modal *-o'qa* is compatible with necessity force in upward entailing environments because of a lack of a necessity modal that would otherwise give rise to a scalar implicature.

Implicatures

- ▶ Conversational participants communicate and infer meanings beyond literal content.
- ▶ In producing and interpreting sentences, speakers and hearer also process information about other sentences that could have been said (Horn 1972, Gazdar 1979, Hirschberg 1991, Levinson 2000).
- ▶ The alternative linguistic forms that a speaker chooses not to use affect the interpretation of the sentence they choose to utter.

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Scalar implicatures

- ▶ Scale are sets of Lexical elements ordered by informativeness <some(\exists), all(\forall)>, <not all ($\neg\forall$), no ($\neg\exists$)>, <can, have to>
- ▶ Uttering a weaker term on the scale (e.g., some) can trigger the generation of a scalar implicature.
- ▶ A scalar implicature is the negation of a stronger alternative (Some but not all).
- ▶ The scalar implicature tied to the Horn scale <some, all> keeps your utterance weak.

(29) Mary ate some of the cookies. \rightarrow Mary ate some, but not all, of the cookies.

(30) Not all students came. \rightarrow Not all students came, but some did.
 ($\neg\neg\exists \Leftrightarrow \exists$)

Scalar implicatures

- ▶ What would happen if a language had a quantifier system consisting only of *some*?
- ▶ Quantifiers in such a language would not generate scalar implicatures.

(31) Mary ate some of the cookies. \rightarrow Mary ate some (or maybe all) of the cookies.

(32) No student came. \rightarrow No student came.

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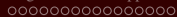
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Languages with only a possibility modal

- ▶ In languages that lack a necessity modal, a possibility modal is compatible with a necessity reading in upward-entailing environments.
- ▶ A negated possibility modal is strong, and thus is not compatible with a weaker (negated necessity) reading.



Neg-raising

Pragma-semantic approaches to NR and their challenges

References

Neg-raising

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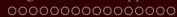
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Attitude verbs

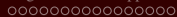
- ▶ Following Jaakko Hintikka (1962), attitude verbs (want, believe, think, hope, etc.), i.e., verbs that concern mental states, are analyzed as universal quantifiers over possible worlds.
- ▶ The domain of quantification of the quantifier denoted by attitude verbs:
 - ▶ The possible worlds compatible with the attitude holder's beliefs/desires in the world of evaluation



Neg-raising

Neg-raising

- ▶ Certain negated predicates (e.g. *think*, *believe*, *want*) invoke a reading where the negation is interpreted in the embedded clause. For example, (1-a) implies (1-b).
 - (1) a. John doesn't think Bill left.
 - b. John thinks Bill didn't leave.
- ▶ Most other predicates do not trigger such readings. (2-a) cannot be interpreted as (2-b).
 - (2) a. John doesn't claim Bill left.
 - b. John claims Bill didn't leave.



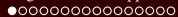
Neg-raising

Pragma-semantic approaches to NR and their challenges

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Approaches to Neg-raising

- ▶ There are two main family of approaches to Neg-raising.
 - ▶ Standard approaches to NR are (Bartsch, 1973; Gajewski, 2005, 2007; Homer, 2015; Romoli, 2012, 2013; Zeijlstra, 2018), which all at aim at explaining NR in semantic-pragmatic terms.
 - ▶ Syntactic approaches to NR have also been proposed (Fillmore, 1963; Horn, 1978; Collins & Postal, 2014), but face many more problems (see Mirrazi & Zeijlstra (2021)).



Neg-raising

Pragma-semantic approaches to NR and their challenges

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Pragma-semantic approaches to NR and their challenges



Neg-raising

- ▶ The pragma-semantic approach takes NR readings to be the result of the interaction of the assertion and an excluded middle statement. This excluded middle statement is lexically encoded on a particular group of predicates known as Neg-Raising Predicates (NRPs from now on). This approach has two versions:
 - ▶ NRPs come with an excluded middle *presupposition* (Gajewski, 2005, 2007).
 - ▶ NRPs have excluded middle *alternatives* (Romoli, 2012, 2013).

The presuppositional approach

- ▶ *Excluded middle presupposition*: The speaker is opinionated about the truth or falsity of the embedded proposition.
- ▶ The NR reading is a logical consequence of this presupposition and the literal meaning of the sentence, as shown in (3).

(3) not [NRP [S]]

Assertion: \neg NRP (S)

Presupposition: $\text{NRP (S)} \vee \text{NRP } \neg(\text{S})$ (Gajewski 2005; p.14).

\therefore NRP $\neg(\text{S})$

The presuppositional approach

- ▶ Let's apply this account to (4-a) to get the NR reading in (4-b) .

(4) a. John doesn't think that Bill left.

b. John thinks that Bill didn't leave.

- ▶ With the excluded middle presupposition that the speaker thinks that either Bill left or Bill didn't leave, (4-a) entails (4-b) .

(5) **Assertion:** It's not the case that John thinks Bill left. (4-a)

Presupposition: John thinks Bill left \vee John thinks Bill didn't leave.

\therefore John thinks Bill didn't leave. (4-b)

Presuppositions

Presuppositions are typically characterized by two properties:

- ▶ They have a particular epistemic status, in that they are typically taken for granted by conversation participants
- ▶ They display a characteristic projection behavior, in the sense that they interact in specific ways with logical operators.

Testing discourse-oldness: *Hey wait a minute...*

- ‘*Hey wait a minute! I didn’t know that p*’ is a good response to an utterance of S if p is a presupposition of S.
- (6) The king of France is bald.
- a. Hey wait a minute! I didn’t know that there was a king of France.
 - b. # Hey wait a minute! I didn’t know that someone was bald.

Projection behavior

- ▶ The hallmark of presuppositions is projection (Langendoen and Savin, 1971).

- (7) a. The king of France is bald.
 b. *inference* \rightsquigarrow **There is a king of France.**

- ▶ Now consider these sentences:

- (8) a. The king of France isn't bald. (*negation*)
 b. If the king of France is bald, he'll be overthrown. (*antecedent of a conditional*)
 c. Is the king of France is bald? (*question*)
 d. It is possible that the king of France is bald. (*possibility modal*)
inference \rightsquigarrow **There is a king of France.**

Problems for the presuppositional approach

① Projection behavior of the excluded middle

- ▶ The excluded middle doesn't behave like other presuppositions. For instance, it doesn't project through conditionals (9-a) or questions (9-b) (Romoli, 2012; Križ, 2015), and it doesn't pass the so-called "*Hey, wait a minute*" test (10) (Križ, 2015).

(9) a. If Mary doesn't think that Bill should be hired, she will say so at the next faculty meeting.

b. Does Mary think that Bill should be hired?

(10) a. Mary doesn't think that Bill should be hired.

b. # Hey, wait a minute! I didn't know that she necessarily has an opinion about that.

Problems for the presuppositional approach

② Non-NR reading without a presupposition failure

- ▶ There are contexts under which NRPs receive a non-NR reading without resulting in a presupposition failure (Homer, 2015).

(11) a. Unlike many people nowadays, my great-grandparents didn't want to spend a lot of time on the internet.

b. \nrightarrow My great-grandparents wanted not to spend all their spare time on the internet.

(12) At a job interview. . .

a. I don't want to make a lot of money, you know.

b. \nrightarrow I want not to make a lot of money.

Problems for the presuppositional approach

② Non-NR reading without a presupposition failure

- ▶ In many contexts, the universal (or even existential) projection of an excluded middle presupposition from the scope of negative indefinites is too strong:

(13) *It's the first day of school; before entering the (new) school your mom tells you:*

- a. Remember, nobody here thinks you're stupid.
 - b. ↯ Everybody here thinks you're not stupid.
 - c. ↯ Somebody here thinks you're not stupid.
- For the NR reading to be true, not only everybody should have an acquaintance relation with you but also have an opinion about whether or not you're stupid.

Problems for the presuppositional approach

③ Neg-raising reading of non-NRP predicates

- ▶ In certain contexts, certain non-NRPs, like non-factive *know*, dubbed *cloud of unknowing*-predicates, nevertheless get a NR reading, as illustrated below.

(14) Trump: I can overturn the result of the election.

Constitutional lawyer: I don't know/ am not sure that's constitutionally possible, sir.

(15) a. Anthony: you know why?

b. Uncle Junior: I don't know that I give a f***. Sopranos,
S1.Ep6

Problems for the presuppositional approach

③ Neg-raising reading of non-NRP predicates

- ▶ The examples below from Horn (2014) show that such predicates can also license strict NPIs in their complement, a general footprint of NR.

- (16) a. I don't know that Santa comes around these parts until Christmas Eve.
 ~> I know that Santa doesn't come around these parts until Christmas Eve.
- b. I can't say I've cooked myself a full meal in weeks, if not months.
 ~> I can say I've not cooked myself a full meal in weeks, if not months.

The implicature approach

- ▶ To circumvent problems concerning the presuppositional account of NR, Romoli (2012, 2013) proposes a scalar implicature account of NR.
- ▶ Instead of assuming NR reading is the result of the excluded middle presupposition, Romoli (2012, 2013) derives it as an implicature.
- ▶ NRPs have the excluded middle statement as a lexical alternative.

The implicature approach

(17) $Alt(\mathbf{think} p(x)) = \{ \mathbf{think}_x p, \mathbf{think}_x p \vee \mathbf{think}_x \neg p \} = \{ \square_x p, \square_x p \vee \square_x \neg p \}$

(18) a. John doesn't believe that it is raining.

b. $\neg \mathbf{believe}_j p$

(19) a. $Alt(\neg \mathbf{believe}_j p) = \{ \neg \mathbf{believe}_j p, \neg(\mathbf{believe}_j p \vee \mathbf{believe}_j \neg p) \}$

b. $\llbracket EXH \rrbracket(\neg \mathbf{believe}_j p) = \neg \mathbf{believe}_j p \wedge \neg \neg(\mathbf{believe}_x p \vee \mathbf{believe}_j \neg p) = \neg \mathbf{believe}_j p \wedge (\mathbf{believe}_j p \vee \mathbf{believe}_j \neg p)$

c. $\mathbf{believe}_j \neg p$



The implicature approach

- ▶ Any scalar implicature account of NR has the advantage of not running into the projection problems of the presuppositional account (as mentioned in ①).
- ▶ as the generation of scalar implicatures depends on the contextual relevance of particular alternatives, the problem addressed in ② doesn't arise either.



Problems for the implicature approach

- ▶ Romoli's special implementation at the same time relies on two unmotivated assumptions:
 - The implicature calculation is based on the assumption that NRPs have excluded middle statement as a 'lexical' alternative. But this lexical alternative is hardly pronounceable and is not attested elsewhere (Križ, 2015).
 - Romoli's account cannot solve problem ③.



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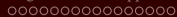
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Neg-raising without Excluded middle

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Observations we want to account for:

② Non-NR reading with NR predicates

- ▶ In many contexts, the universal (or even existential) projection of an excluded middle presupposition from the scope of negative indefinites is too strong:

(1) *It's the first day of school; before entering the (new) school your mom tells you:*

- Remember, nobody here thinks you're stupid.
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Observations we want to account for:

③ NR reading of non-NR predicates

- ▶ In certain contexts, certain non-NRPs, like non-factive *know*, dubbed *cloud of unknowing*-predicates, nevertheless get a NR reading, as illustrated below.

(2) Trump: I can overturn the result of the election.

Constitutional lawyer: I don't know/ am not sure that's constitutionally possible, sir.

(3) a. Anthony: you know why?

b. Uncle Junior: I don't know that I give a f***. Sopranos, S1.Ep6

Insight from modals without scales

- ▶ Uttering a weaker term on the scale $\langle \text{some}(\exists), \text{all}(\forall) \rangle$ can trigger the generation of a scalar implicature.
(4) Mary ate some of the cookies. \rightarrow Mary ate some, but not all, of the cookies.
- ▶ If a language lacks the stronger lexical item on the scale $\langle \text{some}(\exists), \text{all}(\forall) \rangle$, scalar implicatures are not generated.
(5) Mary ate some of the cookies. \rightarrow Mary ate some (or maybe all) of the cookies.

Insight from modals without scales

- ▶ Neg-raising modals lack an existential counterpart $\langle \neg\forall, \neg\exists \rangle$ (Jeretič, 2021).
- ▶ This overgenerates a Neg-raising reading for almost all universal modals, like strong modals *have to*, *must*.

Insight from modals without scales

- ▶ Neg-raising modals are existential modals that lack universal counterpart (Staniszewski, 2021).
 $\langle \exists, \forall \rangle$
- ▶ A major change to our understanding of attitude predicates like *think*, *believe*,...

Our analysis aims

- ▶ to keep our standard treatments of NR predicates as universal modals.
- ▶ to avoid overgenerating NR readings for all universal modals.

→ Duality $\neg\forall \Leftrightarrow \exists\neg$

- ▶ to produce the effect of an incomplete scale

$\langle \exists\neg, \forall\neg \rangle$

→ Sub-domain alternatives

- ▶ We propose a new implementation of scalar implicature account that can solve problems ①-③, without the need for unmotivated assumptions like Romoli's.
- ▶ Our analysis has two components:
 - *(Strict) duality*: $\neg\forall \Leftrightarrow \exists\neg$ under presupposition preservation
 - *Strengthening of subdomain alternatives* (Chierchia, 2013)
- ▶ The Exhaustivity operator can apply to a strict logical equivalences of an LF.
- ▶ We follow Buccola et al. (2021) in taking alternatives being objects at level of LF, and not necessarily linguistic objects (words/phrases).

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Strict Duality

- ▶ The literal meaning of **negated** NRPs is equivalent to: $\exists w \in W: \neg p(w)$.
(by strict duality: $\neg \forall w \in W: p(w) \Leftrightarrow_{strict} \exists w \in W: \neg p(w)$)
- ▶ This weak existential reading can be further subject to strengthening.

Strict Duality

- ▶ Logical equivalence in a trivalent system, where the possible truth-values are $\{1,0,\#\}$ and presupposition failure is marked by the third truth-value, is defined as follows:

(6) **Strict equivalence**

$p \Leftrightarrow_{strict} q$ iff $p \Rightarrow_{strict} q$ and $q \Rightarrow_{strict} p$

(7) \Rightarrow_{strict} **entailment**

$p \Rightarrow_{strict} q$ iff $\forall w : \llbracket p \rrbracket(w) = 1 \Rightarrow \llbracket q \rrbracket(w) = 1$

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Strict Duality

- ▶ Strict duality is presupposition-preserving.
- ▶ Consequently, Strict duality does not hold for all modals.
- ▶ Modals might carry presuppositions that block duality: e.g. factive *know*

Strict Duality doesn't always hold.

Assume $\diamond K_p$ is the existential dual knowledge operator of $\square K_p$.

- ▶ If the existential knowledge operator also carries the factivity presupposition that the embedded p is true, the dual rule is not valid.

$$(8) \quad \underline{p(w) = 1. \neg \square K p(w)} \Leftrightarrow_{\text{STRICT}} \underline{\neg p(w) = 1. \diamond K \neg p(w)}$$

- ▶ Even when $\diamond K_p$ doesn't carry any presupposition, the strict duality is still not valid. In a world where the factivity presupposition is not satisfied, $\neg \square K p(w)$ is # but $\diamond K \neg p(w)$ is true.

$$(9) \quad \underline{p(w) = 1. \neg \square K p(w)} \Leftrightarrow_{\text{STRICT}} \diamond K \neg p(w)$$

Duality blocking predicates are never Neg-raisers.

- ▶ Since Strict duality does not hold for these predicates, no weak existential reading can be derived that can, in turn, be further strengthened.
→ **strictly non-NRPs**, like factives, never yield NR readings
- ▶ This means that it is not NRPs that are special in allowing NR inferences; it is rather strictly *non-NRPs* that are special in not allowing them.

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Exhaustification

- ▶ Parallel to the implicature account of Free Choice (Fox, 2007; Bar-Lev & Fox, 2017), and Homogeneity (Bassi & Bar-Lev, 2018; Magri, 2014; Bar-Lev, 2020), we take strengthened readings to be the result of the application of an exhaustivity operator at LF.
- ▶ Modals trigger subdomain alternatives (Bassi & Bar-Lev, 2018; Jeretič, 2021; Staniszewski, 2021).
- ▶ Note that exhaustification of modals only involves domain alternative and not scalar alternatives

Innocent Exclusion + Innocent Inclusion–based Exhaustification

We adopt the definition of the exhaustivity operator (EXH) by Bar-Lev & Fox (2017)

(10) Innocent Exclusion + Innocent Inclusion–based exhaustivity operator:

$$\llbracket \text{EXH} \rrbracket^{IE+II}(C)(p)(w) \Leftrightarrow \forall q \in \text{IE}(p, C)[\neg q(w) \wedge \forall r \in \text{II}(p, C)[r(w)]]$$

(11) Given a sentence p and a set of alternatives C :

a. $\text{IE}(p, C) = \bigcap \{C' \subseteq C : C' \text{ is a maximal subset of } C, \text{ s.t.}$

$$\{\neg q : q \in C'\} \cup \{p\} \text{ is consistent } \}$$

b. $\text{II}(p, C) = \bigcap \{C'' \subseteq C : C'' \text{ is a maximal subset of } C, \text{ s.t.}$

$$\{r : r \in C''\} \cup \{p\} \cup \{\neg q : q \in \text{IE}(p, C)\} \text{ is consistent } \}$$

Innocent Exclusion + Innocent Inclusion–based Exhaustification

- ▶ EXH takes a proposition (p), and a set of alternatives (C) as arguments, and returns the conjunction of all of the negated innocently excludable (IE) alternatives, and all of the asserted (assigned *true*) innocently includable (II) alternatives.
 - The IE alternatives are all those that can be assigned *false* consistently with the prejacent.
 - The II alternatives are those that can be assigned *true* consistently with the prejacent and the falsity of all IE alternatives.
- ▶ **We don't just negate alternatives, we also assert the ones that can be true!**

Homogeneity

(12) a. The kids laughed.

b. \rightsquigarrow All of the kids laughed

- ▶ Basic semantics of definite descriptions is existential.

(13) a. \llbracket the kids laughed $\rrbracket = \text{Kelly laughed} \vee \text{Jane laughed}$

b. $Alt = \{ \text{Kelly laughed}, \text{Jane laughed}, \text{Kelly laughed} \vee \text{Jane laughed} \}$

- ▶ Which alternatives can we negate without contradicting the assertion, and not making random choices? **NONE**
- ▶ Which alternatives can we assert without contradicting the assertion and negated alternatives, and not making random choices? **ALL**

Homogeneity

- (14) EXH^{IE+II} (*Alt*(Kelly laughed \vee Jane laughed))=
a. **Asserted proposition:** Kelly laughed \vee Jane laughed **AND**
b. **Negating Alternatives= \emptyset AND**
c. **Asserting Alternatives= Kelly laughed AND Jane laughed AND**
Kelly laughed \vee Jane laughed=
d. **Kelly laughed AND Jane laughed= All the kid laughed**

Neg-raising

Driving the Neg-raising reading The NR reading is then derived via application of EXH, starting with the LF corresponding to the basic weak reading ($\exists w \in W: \neg p(w)$).

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Driving the Neg-raising reading

Let's assume the speaker's belief worlds consists of three worlds w_1 , and w_2 .

- ▶ The alternatives generated from replacing the domain variable with its subsets in the weak, existential reading are given in (15).

$$(15) \exists w \in \{w_1, w_2\}: \neg p(w), \exists w \in \{w_1\}: \neg p(w), \exists w \in \{w_2\}: \neg p(w)$$

- No alternatives can be consistently negated.
- The assertion of all alternatives is consistent with the truth of the asserted proposition (and negated alternatives).

Driving the Neg-raising reading

- Upon exhaustification, we will have (16), which is equivalent to the NR reading.

$$(16) \text{ EXH}^{IE+II}(\text{Alt}(\exists w \in \{w_1, w_2\}: \neg p(w))) \quad \underline{(\exists w \in \{w_1, w_2\}: \neg p(w))} = \\ \exists w \in \{w_1, w_2\}: \neg p(w) \wedge \exists w \in \{w_1, w_2\}: \neg p(w) \wedge \exists w \in \{w_1\}: \\ \neg p(w) \wedge \exists w \in \{w_2\}: \neg p(w) = \forall w \in \{w_1, w_2\}: \neg p(w)$$

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Driving the weak (non-NR) reading

- ▶ There are certain contexts where the NR reading does not arise, as in (17).

(17) *It's the first day of school, before entering the school your mom tells you:*

Remember, nobody here thinks you're stupid.

- ▶ Following Bar-Lev's (2018; 2020) account of non-maximal readings of definite plurals, we take the non-NR reading to be the result of pruning all the subdomain alternatives which involve singleton sets (i.e. $\{w_1\}$, $\{w_2\}$).

Driving the weak (non-NR) reading

- By applying EXH to this set of alternatives, we get the weak non-NR reading.

$$(18) \text{ a. } \exists w \in \{w_1, w_2\}: \neg p(w)$$

$$\text{b. EXH}^{IE+II}(\text{Alt}(\exists w \in \{w_1, w_2\}: \neg p(w))) \quad (\exists w \in \{w_1, w_2\}: \neg p(w)) = \\ \exists w \in \{w_1, w_2\}: \neg p(w) \wedge \exists w \in \{w_1, w_2\}: \neg p(w)$$

Neg-raising

- ▶ Under this view, the (un)availability of strengthened (NR) readings for duality-allowing universal modals depends on which set of alternatives EXH applies over.
 - When EXH applies over the whole set of subdomain alternatives, we get the strengthened reading.
 - When EXH applies over the subset remained after pruning singleton sets, we get the weak reading.

Pruning alternatives

- ▶ Pruning is a mechanism to reduce the set of alternatives to only those that are plausible and relevant in a given context.

- (19) a. **Maxim of Relevance:** Every utterance must be relevant to Q.
b. **Weakening:** Pruning can only weaken the meaning (Crnič et al., 2015).
c. **Minimal pruning:** Don't prune more than necessary to satisfy.

(Bar-Lev, 2020)

Pruning singleton alternatives

- ▶ Singleton set alternatives are normally pruned when modals express objectivity or evidentiality, as is the case with strong modals like *must* or *have to*.
- ▶ The reason is that the domain of quantification (and therefore the set of domain alternatives) of such strong modal has to include the actual world.
- ▶ Following Kratzer (2012), we argue that such singleton propositions are too specific to be cognitively viable. For an actual human to believe a singleton proposition, they have to be omniscient in a strong sense. Their beliefs have to be so specific that they are able to distinguish the actual world from all other possible worlds.

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- ▶ The (novel) observation that (2), repeated below, has a NR reading, even though non-factive *know* doesn't always give rise to them, shows that the ability to trigger a NR reading must *not* be a lexical property of predicates.

(20) Trump: I can overturn the result of the election.

Constitutional lawyer: I don't know/ am not sure that's constitutionally possible, sir.

- ▶ Our approach to NR is the only approach that can account for this observation.

Neg-raising

- ▶ All current theories of NR, including Križ's suggestion to take NRPs as involving not universal quantification over worlds, but homogeneous distributive predication over a plurality of worlds, take NRPs to be a special class of verbs with some unique *lexically-encoded* property enabling them to yield NR readings.
- ▶ Since the calculation of implicatures is context-dependent, we predict that every negated universal modal whose presuppositions do not block duality, like non-factive *know* and *be sure* in (2), can get a NR-reading, provided that the whole set of subdomain alternatives is contextually relevant.

Neg-raising

- ▶ There are contexts under which NRPs receive a non-NR reading without resulting in a presupposition failure
- ▶ In certain contexts, some non-NRPs (e.g. non-factive know) can get a NR reading.
 - the ability to trigger a NR reading is *not* a lexical property of predicates.

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- ▶ We propose a new implementation of scalar implicature account that solves these problems. Our analysis has two components:
 - **Strict duality:** $\neg\forall \Leftrightarrow \exists\neg$ under presupposition preservation
 - **Strengthening of subdomain alternatives**

Neg-raising

- ▶ We predict that negated universal modals whose presuppositions don't block duality *can* get a NR reading.
- ▶ The (un)availability of NR readings for duality-allowing modals is reduced to whether EXH applies over the whole set of subdomain alternatives (strengthened reading) or over a subset after pruning singleton sets (weak reading).
- ▶ A non-NR reading is the result of pruning the subdomain alternatives which are singleton sets.

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