Some remarks on exhaustification (and NPIs)

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Goals for today

Issues involving primarily NPIs

- Provide further arguments for (i) **exhaustification** in NPI licensing (at least as a rescue mechanism) and for (ii) an **environment-based characterization** of the NPI licensing condition by studying new, predicted cases of **exhaustification failure.**
- In developing these arguments, provide support for **mass nouns** having (at least at some level of representation) divisive meanings (non-atomic, homogeneous, supplementary).
- Make further steps towards explaining **variation among (weak) NPIs** solely in terms of the semantic properties of the NPIs (and independent mechanisms in grammar).

Issues involving primarily Exhaustification

- Present a new puzzle involving facts about so-called **obviations of exhaustification failures**, which are problematic for recently prevailing **conditions on pruning.**
- Introduce and discuss another potential dimension of **variation among modals.**

1 *Any*

The basic facts.

(1) a. No / Every / #Some [boy who read any book] arrived.
b. No / #Every / #Some boy [read any book].

The NPI Licensing Condition. The distribution of *any* can to a large extent be captured by the condition in (2) (e.g., Homer 2010; Gajewski 2011; Chierchia 2013; Crnič 2019b for arguments for such a formulation of the condition; e.g., Ladusaw 1979; von Fintel 1999 for alternatives).

(2) *Any NP* is acceptable only if it is contained in a constituent S such that for all DPs, DP $\subseteq$ *any NP* and S[any NP/DP] defined, it holds S $\Rightarrow$* S[any NP/DP] (where S[any NP/DP] is identical to S except that all occurrences of *any NP* are replaced by occurrences of DP). We say that S is **Strawson downward-entailing** (with respect to the NPI).

* *The condition may have to be relativized to context: specifically, the entailment relation may have to be replaced by the weaker contextual entailment (e.g., Heim 1984) or the even weaker lower likelihood relation (cf. Lahiri 1998; Crnič 2014). See Section 9 for such a weakening.*

Illustration of the representative entailment relations:

(3) a. Every / No boy who read any book arrived.
b. $\Rightarrow_s$ Every / No boy who read two books arrived.

(4) a. Every / Some boy read a(ny) book.
b. $\not\Rightarrow_s$ Every / Some boy read two books.

2 Free Choice *Any* Challenge

***Any* in existential modal sentences.** A violation of the condition in (2):

(5) John is allowed to read any book.

(6) a. John is allowed to read any book.
b. $\not\Rightarrow_s$ John is allowed to read two books.

Why is *any* acceptable in (5)? What is the relation of (5) to the DE cases above?

Suggestive entailment patterns.

(7) a. John is allowed to read any book.
b. $\Rightarrow_s$ John is allowed to read any long book.

(8) Paraphrase of the meanings in (7):
a. Every book is such that John is allowed to read it.
b. $\Rightarrow_s$ Every long book is such that John is allowed to read it.

Revision. Switch from *any*-DPs to their domains (Kadmon & Landman, 1993)

(9) *Any NP* is acceptable only if it is contained in a constituent S such that for all **NP's, NP'**$\subseteq$**NP** and **S[NP/NP']** defined, it holds S $\Rightarrow$* **S[NP/NP']** (where S[NP/NP'] is identical to S except that all occurrences of NP are replaced by occurrences of NP').

How do we get to the universal import in the paraphrases in (8) from an underlying existential one? (Another direction: *any* is ambiguous, and its disambiguations are subject to distinct licensing conditions, e.g., Ladusaw 1979; Dayal 1998.)

Options for deriving universal import.

1. **Constitutive of the meaning of NPIs:** Kratzer 2005; Menéndez-Benito 2010

   (10) [∀ [◇ [Exc [John read any book]]]]

2. **External mechanism #1:** e.g., Kadmon & Landman 1993; Lahiri 1998 (cf. Aloni 2007)

   (11) [Gen$_x$ [◇ [John read [any book x]]]]

3. **External mechanism #2:** e.g., Chierchia 2013; Dayal 2013; Crnič 2017, etc.

   (12) [exh [◇ [John read any$_D$ book]]]

We provide new arguments for option 3. They are based on predicted cases of **Failure of Exhaustification.** Two representative examples in which exhaustification short-circuits:

(13) John is #(not) allowed to donate any blood.

(14) John is #(not) allowed to donate any more money than Sue.

3 Exhaustification and Free Choice *Any*

3.1 Exhaustification in grammar

Exhaustification operator (Bar-Lev & Fox, 2017)

(15) $[\![\text{exh}_R\ \text{S}]\!] = 1$ iff
   a. $\forall \text{S'} \in \text{Excl(S)} \cap \text{R}: [\![\text{S'}]\!] = 0$, and
   b. $\forall \text{S'} \in \text{Incl(S)}: [\![\text{S'}]\!] = 1$.

(16) a. John is allowed to read any book.
   b. [exh$_R$ [◇ [John read any$_D$ book]]]

Defining Excl and Incl Formal alternatives (Katzir 2007; also Trinh & Haida 2015)

(17) ALT(S) = {S' | S' is derived from S by substitution of lexical elements with other lexical elements and by substitution of the constituents with their sub-constituents}

(18) ALT([◇ [John read any$_D$ book]]) =
   {[◇ [John read any$_{D'}$ book]], [◇ [John read every$_{D'}$ book]] | D'⊆D}

   (the restriction to sub-domains, following Krifka and Chierchia, need perhaps not be stipulated, see Crnič 2018, 2019a for discussion)

Innocently Excludable alternatives (Fox, 2007)

(19) $\text{Excl(S)} = \bigcap\{\text{M} \mid \text{M is a maximal subset of ALT(S)}$
$\text{such that } \{\neg[\![\text{S'}]\!] \mid \text{S'} \in \text{M}\} \cup \{[\![\text{S}]\!]\} \text{ is consistent}\}$

(20) $\text{Excl}([\Diamond\ [\text{John read any}_D\ \text{book}]]) =$
$\{[\Diamond\ [\text{John read every}_{D'}\ \text{book}]] \mid \text{card(D'} \cap \text{book)} \geq 2 \wedge \text{D'} \subseteq \text{D}\}$

Innocently Includable alternatives (Bar-Lev & Fox, 2017)

(21) $\text{Incl(S)} = \bigcap\{\text{M} \mid \text{M is a maximal subset of ALT(S)}$
$\text{such that } \{[\![\text{S'}]\!] \mid \text{S'} \in \text{M}\} \cup \{\neg[\![\text{S'}]\!] \mid \text{S'} \in \text{Excl(S)}\} \text{ is consistent}\}$

(22) $\text{Incl}([\Diamond\ [\text{John read any}_D\ \text{book}]]) =$
$\{[\Diamond\ [\text{John read any}_{D'}\ \text{book}]] \mid \text{D'} \cap \text{book} \neq \emptyset \wedge \text{D'} \subseteq \text{D}\}$

Putting the pieces together Free choice meaning (an approximate representation – we will be assuming *de re* construals of the quantification domain of *any* throughout for simplicity)

(23) $\Diamond$(John read a book in D)

$\forall \text{D'}\ (\text{D'} \subseteq \text{D} \wedge \text{D'} \cap [\![\text{book}]\!] \neq \emptyset \rightarrow \Diamond(\text{J read a book in D'})$
$\Big(\wedge\ \forall \text{D'}(\text{card(D'} \cap \text{book)} \geq 2 \wedge \text{D'} \subseteq \text{D} \rightarrow \neg\Diamond(\text{J read every book in D'}))\Big)$

(24) Every non-empty domain of books is such that John is allowed to read a book in it.
$\Leftrightarrow$ Every book is such that John is allowed to read it.

3.2 Aside: Existence inferences

What the paraphrases in (24) have, but (23) crucially lacks, are the presuppositions that the respective domains that are not empty (assuming existence is presupposed in strong quantifiers,according to Barwise & Cooper 1981, etc). (See Crnič 2019b for discussion.)

(25) a. Every book is such that John is allowed to read it.
b. $\Rightarrow_s$ / $\not\Rightarrow$ Every 2000 year old book is such that John is allowed to read it.

Strong construal of *any*. (e.g., Diesing 1992; Büring 1998 for possible derivations)

(26) $[\![\text{John is allowed to read [any}_D\ \text{book]}]\!]$ is defined only if
(it is circumstantially possible that) there are books in D.

Some supporting evidence:

(27) There may #(not) be any girl in the garden.

Summary. Two independent operations are employed as rescue mechanisms in order to allow *any* in existential modal sentences to satisfy the NPI Licensing Condition in (9).

- ○ Exhaustification ($\rightsquigarrow$ free choice inferences)
- (○ Strong construal of indefinites ($\rightsquigarrow$ existence presupposition))

In the following, we will focus on examples in which exhaustification short-circuits.

4 Background: Failure of Exhaustification

Missing scalar implicatures. (e.g., Krifka 1999)

(28) John weighs 80 kg.

$\rightsquigarrow$ ¬John weighs 81 kg.

(29) John weighs more than 80 kg.

$\not\rightsquigarrow$ ¬John weighs more than 81 kg.

We follow Fox & Hackl 2006 in deriving these missing implicatures (see also Gajewski 2009).

Alternatives and exhaustification. (We ignore the alternatives entailed by the sister of *exh*.)

(30) ALT(John weighs more than 80 kg) =

{John weighs more than d' | d' > 80kg}

(31) $[\![\text{exh}_R$ John weight more than 80 kg$]\!]$ = 1 iff

a. $\forall$S' $\in$ Excl(John weighs more than 80 kg) $\cap$ R: $[\![$S'$]\!]$ = 0, and

b. $\forall$S' $\in$ Incl(John weighs more than 80 kg): $[\![$S'$]\!]$ = 1.

What alternatives in (30) are in Excl and Incl?

Density and some of its consequences.

(32) For every d and d' such that d<d', there exists d'' such that

John weighs more than d'

$\overrightarrow{\not\equiv}$ John weighs more than d''

$\overrightarrow{\not\equiv}$ John weighs more than d.

(33) John weighs more than 80 kg.

$\Rightarrow$ There exists d>80 kg $\wedge$ John weighs more than d.

(34) For every d and d' such that d<d',

[John weighs more than d ∧ ¬John weighs more than d'] is consistent.

Maximal sets of excludable alternatives. Assume that there is a maximal set of excludable alternatives, X, in ALT(John weighs more than 80 kg):

(35) [John weighs more than 80kg ∧ ∀S∈X: ¬S] is consistent ∧ X is a maximal such subset of ALT(John weighs more than 80 kg).

X must be proper subset of ALT(John weighs more than 80 kg):

(36) X ⊂ ALT(John weighs more than 80 kg)

Consequence of density:

(37) For any alternative in ALT(John weighs more than 80 kg) that is not in X, say, *John weighs more than d* for some d>80 kg,

[John weighs more than 80 kg ∧ ¬John weighs more than d] is consistent.

Thus, X cannot be a maximal set of excludable alternatives. Consequently, exhaustification of *John weighs more than 80kg* yields a contradiction (Fox & Hackl, 2006; Gajewski, 2009).

(38) Excl(John weighs more than 80 kg) =

$\bigcap\{M \mid M$ is a maximal subset of ALT(John weighs more than 80 kg) such that $\{\neg[\![S']\!] \mid S' \in M\} \cup \{[\![S]\!]\}$ is consistent$\} =$

$\bigcap \emptyset =$ the set of all alternatives

Failure of Exhaustification. In certain configurations – in particular, when there are **no maximal sets of excludable alternatives** in the set of formal alternatives to a sentence – exhaustification systematically leads to a contradiction and thus cannot apply. If there are grammatical requirements for it to apply in these configuration, we should end up with ungrammaticality.

In the following, we zoom in on two such cases of exhaustification failure.

5 Mass nouns

5.1 Prediction

Definitions of divisiveness. (see, e.g., Rothstein 2010; some alternative formulations of divisiveness would serve just as well for our purposes)

(39) P is divisive if and only if

(non-atomicity) $\forall x\ (Px \rightarrow \exists y\ (y \sqsubset x \wedge P(y))$.

(homog.) $\forall x(Px \rightarrow \forall y\ (y \sqsubseteq x \rightarrow Py))$

(weak suppl.) $\forall x \forall y\ (Px \wedge y \sqsubset x \rightarrow \exists z(x = y \sqcup z \wedge \neg O(yz)))$

Some consequences of divisiveness.

(40) For every x in a divisive predicate P, for every $y \sqsubseteq x$,

it holds that y is in P, and $[\lambda z.\ z \sqsubseteq y]$ is a divisive subset of P.

(41) For every divisive P, there are divisive P^*,$P^{**} \subseteq P$ such that $P^* \cap P^{**} = \emptyset$ and $P^* \cup P^{**} = P$.

Alternatives and exhaustification. (For notational simplicity, we use predicate logic formulas to represent both the truth conditions and the respective LFs in the following.)

(42) $[\![S]\!] = 1$ iff $\Diamond(\exists x\ (Px \wedge Qx))$ *(where P divisive, Q homogeneous)*

(43) $ALT(S) = \{\Diamond(\exists x(P'x \wedge Q(x))) \mid P' \subseteq P \wedge P'$ divisive$\}$

(It is safe to ignore the stronger universal quantifier alternatives.)

(44) $[\![exh_R\ S]\!] = 1$ iff

a. $\forall S' \in Excl(S) \cap R$: $[\![S']\!] = 0$, and

b. $\forall S' \in Incl(S)$: $[\![S']\!] = 1$.

What alternatives in (43) are in Excl and Incl?

Maximal sets of excludable alternatives. Assume that there is a maximal set of excludable alternatives, X, in ALT(S):

(45) $[\Diamond(\exists x(Px \wedge Qx)) \wedge \forall S \in X: \neg S]$ is consistent $\wedge$ X is a maximal such subset of ALT(S).

The domains of *any* in the alternatives in X cannot span the domain D:

(46) $\bigsqcup\bigcup\{P' \mid \Diamond(\exists x(P'x \wedge Qx)) \in X\} \sqsubset \bigsqcup P$

The sum of all the elements in the domains of 'any' in the alternatives in X is a proper part of the sum of the elements in the domain of 'any' in the sentence.

Thus, there must be a proper part of ⨆P, none of whose parts are a part of an element in the domain of *any* in the alternatives in X (due to weak supplementation, cf. Simons 1987):

(47) There exists a divisive P' ⊆ P such that
i. ⨆P' does not overlap with $\bigsqcup\bigcup\{P' \mid \Diamond(\exists x(P'x \wedge Qx)) \in X\}$, and thus
ii. $\Diamond(\exists x(P'x \wedge Q(x))) \notin X$, and for all $P^* \subseteq P'$, $\Diamond(\exists x(P^*x \wedge Q(x))) \notin X$.

Consequence of divisiveness:

(48) There exists $P^*, P^{**} \subseteq$ that P' such that
$[\Diamond(\exists x(P^*x \wedge Qx)) \wedge \neg\Diamond((\exists P^{**}x \wedge Qx))]$ is consistent.

Thus, X cannot be a maximal set of excludable alternatives. Consequently, an exhaustification of S would yield a contradiction.

(49) Excl(S) = $\bigcap\{M \mid M$ is a maximal subset of ALT(S) such that $\{\neg[\![S']\!] \mid S' \in M\} \cup \{[\![S]\!]\}$ is consistent$\} = \bigcap \emptyset$ = the set of all alternatives

Claim: *Any* with mass nouns in existential modal sentences instance the above schema.

5.2 Mass nouns and divisiveness

Two assumptions about mass nouns.

(50) Divisiveness Hypothesis (cf. Cheng 1973, also Link 1983, Landman 1991)
Mass nouns in natural language denote divisive predicates.

(51) Homogeneity Constraint (Lønning 1983)
Mass quantifiers may only combine with a homogeneous main predicates.

Illustration:

(52) a. Some water boiled.
b. Most water is wet.

(53) a. #Some water weighs 2 grams.
b. #Most water is heavy.

Predicted consequence and confirmation.

(54) ***Any* and divisive predicates**
An occurrence of *any* in an existential modal sentence cannot be rescued by exhaustification (over the subdomains of *any*) since this leads to a contradiction.

(55) a. #John is allowed to drink any water.
b. #Mary may donate any blood.

(56) a. #[exh$_C$ [◇ [John drink any$_D$ water]]] *(contradictory inference due to exh)*
b. #[◇ [John drink any$_D$ water]] *(NPI Licensing Condition violated)*

Note that this prediction does not extend to other occurrences of *any*!

(57) a. John didn't drink any water.
b. [neg [John drink any$_D$ water]] *(NPI Licensing Condition satisfied)*

Obviation by coercion/packaging. (cf., e.g., Pelletier 1975)

(58) I drank some beers.

(59) a. We are allowed to drink any beer.
b. [◇ [we drink any$_D$ [PCKG beer]]]
c. [◇ [[any$_D$ [PART [∪ beer]]] [DKP λx we drink x]]]

5.3 Consequences for grammar

Neat mass nouns.

(60) a. #John is allowed to buy any furniture.
b. #John may sell any silverware.

Arguments for non-divisiveness (in addition to ontological non-divisiveness)

(61) John moved more furniture than Mary.

Possible reading: John moved more pieces of furniture than Mary (though not a bigger weight, volume, etc., of furniture).

Architecture. Count (and Mass) as part of functional vocabulary (cf. Borer 2005). At some level of representation there may be room for individuation, to be conditioned by the context.

(62) Count nouns: [any [Count NP]]

(63) Mass nouns: [any [κ [Mass NP]]]

Summary. On the assumption that domains of mass quantifiers are **divisive,** we predict exhaustification to fail to yield free choice inferences (consistent inferences) when it associates with them. Accordingly, occurrences of *any* **cannot satisfy the NPI Licensing Condition** in existential modal sentences when their complement is a mass noun.

6 Differential quantifiers

6.1 Some background

Differentials as predicates. (e.g., Schwarzschild 2005; see Solt 2015 for an alternative)

(64) a. John is taller than Mary.
b. $\exists$M(M([Mary's height, John's height]))

(65) a. John is 2cm taller than Mary.
b. $[\![2cm]\!]$([Mary's height, John's height])
c. $[\![2cm]\!](I) = 1$ iff $\mu(I) \geq 2cm$

Quantity differentials

(66) a. John is much taller than Mary.
b. $\exists$M(M([Mary's height, John's height]) $\wedge$ stnd(M))
c. $[\![much]\!](\mathscr{M}) = 1$ iff $\exists$M($\mathscr{M}$(M) $\wedge$ stnd(M))

(67) a. John read many more books than Mary.
b. $\exists$M(M([the # of books read by M, the # of books read by J]) $\wedge$ stnd(M))

Further compositional details

(68) $[\![er]\!](Q)(P)(M) = 1$ iff M(P\Q)

(69) [much λM [[[er M] λd Mary is d-tall] [λd John is d-tall]]]

***Any* differentials.** (70) and (71) satisfy the NPI Licensing Condition in (9).

(70) a. John isn't any$_D$ taller than Mary.
b. $\neg\exists$M(M$\in$D $\wedge$ M([Mary's height, John's height]))

(71) a. John didn't read any$_D$ more books than Mary.
b. $\neg\exists$M(M$\in$D $\wedge$ M([the # of books read by M, the # of books read by J]))

(72) $[\![\text{any}_D]\!](\mathscr{M}) = 1$ iff $\exists$M(M$\in$D $\wedge$ $\mathscr{M}$(M))
where D = {$[\![1nm]\!]$, $[\![1cm]\!]$, $[\![3in]\!]$, ...} = the set of all predicates of intervals (the set may have some contextually determined upperbound - a strongest predicate)

Consequence of density.

(73) For every M in the domain of *any*, there exists M' such that M $\supsetneqq$ M'.

6.2 Prediction

Free choice *any* differentials.

(74) a. #John is allowed to be any taller than Mary.
b. [exh [◇ [John is any$_D$ taller than Mary]]]

(75) ALT([◇ [John is any$_D$ taller than Mary]]) =
{[◇ [John is any$_{D'}$ taller than Mary]] | D'⊆D}

Exhaustification and missing maximal sets. Assume that there exists a maximal set of excludable alternatives, X, in ALT([◇ [John is any$_D$ taller than Mary]]):

(76) [◇(∃M(M∈D ∧ M([Mary's height, John's height])) ∧ ∀S∈X: ¬S] is consistent ∧ X is a maximal such subset of ALT([◇ [John is any$_D$ taller than Mary]]).

X must be a proper subset of ALT([◇ [John is any$_D$ taller than Mary]]). More specifically, there must be an element that is in the domain of *any* in the sentence but not in the alternatives in X:

(77) X ⊂ ALT([◇ [John is any$_D$ taller than Mary]])

(78) There exists some M* in D such that ◇(M*([Mary's height, John's height])) and
M* ∉ ⋃{D' | ◇(∃M(M∈D' ∧ M([Mary's height, John's height])) ∈ X}

Consequence of density:

(79) There exists some M** in D such that
[◇(M**([M's height, J's height])) ∧ ¬◇(M*([M's height, J's height]))] is consistent.

Thus, X cannot be a maximal set of excludable alternatives. Consequently, exhaustification of *John is allowed to be any taller than Mary* yields a contradiction.

(80) Excl([◇ [John is any$_D$ taller than Mary]]) = ⋂∅ = the set of all alternatives

Summary. On the assumption of density of differentials, we predict exhaustification to fail to yield free choice inferences (consistent inferences) when it associates with a domain of all differentials. Accordingly, occurrences of *any* **cannot satisfy the NPI Licensing Condition** in existential modal sentences when its complement is a domain of differentials.

7 Variation

Chierchia 2013 pursues an ambitious goal: to account for the variation among NPIs in terms of their semantic properties, of what 'licensing' operators they are accompanied by, and of the properties of these operators (non-recursive vs. recursive *exh*; *even*; strong vs. weak variants).

(81) *any* is accompanied by 'recursive *exh*'

$\rightsquigarrow$ free choice occurrences admitted

(82) *ever* is accompanied by 'non-recursive *exh*'

$\rightsquigarrow$ free choice occurrences not admitted

A slightly different strategy can be pursued in light of the above discussion: the distribution of *any*-NPIs was shown to fall out from the semantic properties of the domains of the NPIs alone.

(83) a. *any* + non-divisive domain $\rightsquigarrow$ free choice occurrences admitted
b. *any* + divisive domain $\rightsquigarrow$ free choice occurrences not admitted

Can this latter strategy be extended to other (weak) NPIs?

***Ever* and intervals.** We assume that *ever* quantifies over non-singleton intervals (or that the interval structure is non-atomic) (cf. Kamp 1979, Benthem 1983, Landman 1991 for discussion).

(84) a. John didn't ever$_D$ arrive.
b. $\neg\exists$I(I$\in$D $\wedge$ past(I) $\wedge$ $\exists$e (John arrived in e $\wedge$ τ(e) $\subseteq$ I))

Alternatives and exhaustification.

(85) a. #John is allowed to ever$_D$ arrive.
b. [exh [$\Diamond$ [John ever$_D$ arrive]]]

(86) ALT([$\Diamond$ [John ever$_D$ arrive]]) = {[$\Diamond$ [John ever$_{D'}$ arrive]] | D'$\subseteq$D $\wedge$ D' non-singleton}

Exhaustification and missing maximal sets. Assume that there exists a maximal set of excludable alternatives, X, in ALT([$\Diamond$ [John ever$_D$ arrive]]):

(87) [$\Diamond$($\exists$I(I$\in$D $\wedge$ $\exists$e (J arrived in e $\wedge$ τ(e) $\subseteq$ I)) $\wedge$ $\forall$S$\in$X: $\neg$S] is consistent
$\wedge$ X is a maximal such subset of (86).

X must be a proper subset of ALT([$\Diamond$ [John ever$_D$ arrive]]). More specifically:

(88) $\bigcup\bigcup${D' | [$\Diamond$ [John ever$_{D'}$ arrive]] $\in$ X} $\subset$ $\bigcup$D
There are intervals in D that do not overlap with any of the intervals that are in any of the domains of any in the excludable alternatives in X.

Consequence:

(89) There exists some I^* in D such that $\Diamond(\exists e$ (J arrived in e $\wedge$ $\tau(e) \subseteq I^*))$, and I^* does not overlap with $\bigcup\bigcup\{D' \mid [\Diamond$ [John ever$_D$ arrive]] $\in X\}$.

Given density, it follows that there are further excludable alternatives:

(90) There exists some I^{**} in D such that $I^{**} \subset I^*$ and $[\Diamond(\exists e$ (J arrived in e $\wedge$ $\tau(e) \subseteq I^{**})) \wedge \neg\Diamond(\exists e$ (J arrived in e $\wedge$ $\tau(e) \subseteq I^* \backslash I^{**}))]$ is consistent.

Thus, X cannot be a maximal set of excludable alternatives. Consequently, exhaustification of *John is allowed to ever arrive* yields a contradiction.

(91) Excl([$\Diamond$ [John ever$_{D'}$ arrive]]) = $\bigcap\emptyset$ = the set of all alternatives

The ingredients of the account:

- The NPI Licensing Condition
- Exhaustification (as a rescue mechanism)
- (Strong construal as a rescue mechanism)
- Lexical differences between the NPIs
  - Domain of *any*: determined by its resource domain + complement
  - Domain of *ever*: resource domain of non-singleton intervals

Variation:

- *any* + count nouns $\rightsquigarrow$ ✓ DE environments; ✓ existential modals
- *any* + mass nouns $\rightsquigarrow$ ✓ DE environments; ✗ existential modals
- *ever* $\rightsquigarrow$ ✓ DE environments; ✗ existential modals

8 Issues in exhaustification and obviation

8.1 Universal Modals and No Failure of Exhaustification

Recall that measure phrase comparatives lack scalar implicatures:

(92) John weighs more than 80 kg.

$\not\rightsquigarrow$ ¬John weighs more than 81 kg.

Scalar implicatures can be generated if the MP comparatives are appropriately embedded:

(93) You are required to weigh more than 80 kg (to box as a heavy weight).

$\rightsquigarrow$ ¬You are required to weigh more than 81 kg.

Fox & Hackl 2006 argue that this state of affairs is in fact expected on their proposal: all universal modal alternatives can be jointly negated with the sentence being true, so we do not run into a problem of not finding a maximal set of excludable alternatives. (Again, we are ignoring the alternatives that are entailed by the sentence.)

(94) Assumption about formal alternatives in (Fox & Hackl, 2006):

ALT(You are required to weigh more than 80 kg) =

{You are required to weigh more than d | d $>$ 80 kg}

Facts about density and universal quantification:

(95) John weighs more than 80 kg.

$\Rightarrow$ There exists d$>$80 kg $\wedge$ John weighs more than d.

(96) $\Box$(John weighs more than 80 kg)

$\not\Rightarrow$ There exists d$>$80 kg $\wedge$ $\Box$(John weighs more than d)

Maximal set of excludable alternatives.

(97) Excl(S) = ALT(You are required to weigh more than 80 kg)

(98) $\Box$(you weigh more than 80kg) $\wedge$ $\forall$d$>$80kg: ¬$\Box$(you weigh more than d)

One Modal Base compatible with this state of affairs:

(99) {w | $\exists$d (d $>$ 80kg $\wedge$ you weigh d in w)}

Hope. If the account of *any* with mass nouns/differentials is on the right track, we should expect a similar (modal) obviation effect. The reasoning behind this would be identical to the above.

(100) Excl($\Box$(you drank any$_D$ water)) = {$\Box$(you drank any$_{D'}$ water) | D'$\subset$D}

However ...

8.2 First hitch: Universal modals and NPIs

Failure of NPI licensing. There may be independent factors mitigating against this hope.

(101) a. John can read any book.
b. #John must read any book.

This is expected, all else equal, on the exhaustifiction approach sketched out above: since exhaustification fails to yield a structure that would satisfy the condition in (9), NPIs are not licensed (see Crnič 2017, 2019b for further discussion).

(102) a. [exh [□ [John must read any D book]]]
b. □(John read a book in D) ∧ ∀D': D'⊆ D → ¬□(John read a book in D')

Possible exceptions. There is a class of operators that have been analyzed as (Strawson) monotone modals (e.g., von Fintel 1999), which do license NPIs (cf. Kadmon & Landman 1993; Giannakidou 1999; Crnič 2019b, among others). *Any* famously exhibits high degree of context-sensitivity in these sentences (see Kadmon & Landman 1993 for an extensive description).

(103) a. I am glad that we got any tickets.
b. Mary hopes there is any food left.

Could these provide support for our conclusions? Perhaps. An account is sketched below. There are potential reasons why this account may be better off than a non-monotonic one. Consider the negated counterparts of (103), which do not seem to exhibit context-sensitivity.

(104) a. I am not glad that we got any tickets.
b. Mary doesn't hopes there is any food left.

8.3 Second hitch: Too many alternatives

The fact that embedding MP comparatives under universal quantifiers allows them to trigger scalar implicatures is **not** in fact predicted on our treatment of *exh*. (While we only discuss modal obviation in the following, the issue extends also to the obviation by nominal, etc., quantifiers.)

(105) You are required to weigh more than 80 kg (to box as a heavy weight).

⇝ ¬You are required to weigh more than 81 kg.

The problem. Recall our characterization of *exh* (Bar-Lev & Fox, 2017):

(106) $[\![\text{exh}_R\ \text{S}]\!] = 1$ iff
a. $\forall \text{S'} \in \text{Excl(S)} \cap \text{R}: [\![\text{S'}]\!] = 0$, and
b. $\forall \text{S'} \in \text{Incl(S)}: [\![\text{S'}]\!] = 1$.

The problematic feature of the definition is that the pruning of alternatives only happens after Innocently Excludable alternatives have been determined, that is, all the formal alternative feature in determining the Innocently Excludable ones (as in Katzir 2014; Bar-Lev & Fox 2017; this is not the case in, e.g., Fox 2007; Trinh & Haida 2015).

(107) You are required to weigh more than 80 kg.

(108) ALT(107) = {□(you weigh more than d), ◇(you weigh more than d) | d>80kg}

Given this, there are **no maximal subsets of excludable alternatives** of (108). The reasoning is identical to the one sketched in Section 4: for any alternative *you are allowed to weigh more than d)*, there is a d'<d such that *you are allowed to weigh more than d'* is consistent with ¬◇(you weigh more than d). But since not all alternatives can be negated in this manner (this would contradict the sentence), we can't find a maximal set of excludable alternatives.

(109) Excl(□(you weigh more than 80 kg)) = $\bigcap\emptyset$ = the set of all the alternatives

9 Revisions

- The NPI Licensing Condition cannot be stated with respect to Strawson entailment, as we already hinted at in the definitions in (2)/(9). (See also Crnič 2014, 2019b for further arguments to this effect, though the conclusions there are less conservative than below.)
- Pruning of at least some alternatives must be possible prior to determining Innocently Excludable alternatives (at least if we assume dense scales, cf. Fox & Hackl 2006). (See also Trinh 2019 for a related discussion and an alternative.)

From Strawson- to contextual Strawson-entailment. (cf. Heim 1984; there may be reasons for further weakening of the condition to involve likelihood)

(110) *Any NP* (used in a context c) is acceptable only if it is contained in a constituent S such that for all NP', NP'⊆NP and S[NP/NP'] defined, it holds S $\Rightarrow_c$ S[NP/NP'].

Early pruning of certain alternatives. *Ad hoc* revision, following Fox 2007.

(111) $[\![\text{exh}_{i,R}\ S]\!] = 1$ iff

a. $\forall S' \in \text{Excl(i)(S)} \cap R: [\![S']\!] = 0$, and

b. $\forall S' \in \text{Incl(S)}: [\![S']\!] = 1$.

(112) Excl(i)(S) is defined only if i ∈ {ALT(S), P(S)}. If defined,

$$\text{Excl(i)(S)} = \bigcap\{M \mid M \text{ is a maximal subset of i such that } \{\neg[\![S']\!] \mid S' \in M\} \cup \{[\![S]\!]\} \text{ is consistent}\}$$

(113) P(S) is the smallest subset of ALT(S) such that (i) S∈P(S) and (ii) if S'∈P(S) and S" can be derived from S' by replacement of a single scalar item with an alternative, and S' does not entail S", S"∈P(S). (Fox, 2007)

10 Back to universal modals and NPIs

How do the revisions help? This may not be immediately obvious (which is good).

(114) #John must read any book.

(115) Excl(John must read any book) = {□(you weigh more than d) | d>80kg}

Exhaustification without pruning (the NPI Licensing Condition violated):

(116) □(John read a book in D) ∧ ∀D': D'⊆ D → ¬□(John read a book in D')

(117) For some D' ⊆ D,

a. □(John read a book in D) ∧ ∀D': D'⊆ D → ¬□(John read a book in D')

b. $\not\Rightarrow_c$ □(John read a book in D') ∧ ∀D": D"⊆ D' → ¬□(John read a book in D")

However, if **all the universal modal alternatives are pruned,** we may in principle get NPI licensing in appropritate contexts – since only the existential free choice inferences are generated (recall that Incl may include all existential modal subdomain alternatives).

(118) □(John read a book in D) ∧ ∀D': D'⊆D ∧ D'∩book ≠ ∅ → ◇(John read a book in D')

(119) For all D' ⊆ D and an appropriate c,

a. □(J read a book in D) ∧ ∀D': D'⊆D ∧ D'∩book≠∅ → ◇(J read a book in D')

b. $\Rightarrow_c$ □(J read a book in D')∧∀D": D"⊆D'∧D"∩book≠∅ → ◇(J read a book in D")

(120) Context: ∀D'⊆D∩book → (□(John read a book in D) ⇒ □(John read a book in D'))

Mass nouns, differentials, and *ever*. Similar reasoning extends to *any* with mass nouns and in differentials. The maximal set of excludable alternatives includes the set of all the universal modal alternatives that do not entail the sentence (see Section 8.1).

(121) a. I wish I had drank any water before leaving for the trip.

b. ?Jim hoped that he will be any taller than his father.

c. We are glad that we ever got a word in.

This corroborates the hope expressed above, and provides further (admittedly tenuous) support for the type of analysis put forward above (tenuous since there a non-monotone analyses of these modals that have been utilized to account for these facts without invoking exhaustification). But what is the difference between the different modals?

Pruning of universal modal alternatives and variation. It has been observed by Crnič et al. 2015 that negated universal inferences appear to be stronger with modal than nominal quantifiers.

(122) [All of my brother have been married to a woman, one of them has also been married to a man:] **Every** brother of mine has been married to a man or a woman.

(123) [In order to be admitted to the gym, you have to wear gym shoes, but a shirt is optional, though encouraged:]

a. ?You **have** to wear shoes or a shirt to the gym.
b. ?You are **required** to wear shoes or a shirt to the gym.

However, there seem to be differences across different types of modals. The cut seems to parallel the cut between modals that do and those that do not allow for NPIs in their scope.

(124) [John is visiting Boston this year and is a big sports fan, esp. baseball and football.]

a. I **would like/want** to see the Red Sox or the Patriots this season.
b. I **hope** that I will see the Red Sox or the Patriots this season.
c. Mary **wishes** she had gone to see the Red Sox or the Patriots last season.
d. ?I have to see the Red Sox or the Broncos this season.

Speculation: The ease of pruning of modal alternatives may be conditioned by them being (un)defined in the context (desire predicates are presuppositional, e.g., Heim 1992).

Two **independently needed** revisions of the system – revision of the assumptions about pruning and *exh* due to obviation; revision of the NPI Licensing Condition due to NPIs in non-monotone environments – allow us to make the **modal obviation predictions,** as well as get at the **context-sensitive licensing of NPIs** in the scope of certain universal modals.

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