From implicatures to NPI-licensing

1. Monotonicity again

- Recall: for a propositional function, we define its monotonicity pattern based on whether it reverses and preserves the direction of entailment in its propositional argument.

(1) For a one-place propositional operator $\pi$, its monotonicity is defined as follows:
   a. $\pi$ **upward-entailing** (UE) iff for any two sentences $p$ and $q$ s.t. $p \Rightarrow q$: $\pi(p) \Rightarrow \pi(q)$;
   b. $\pi$ **downward-entailing** (DE) iff for any two sentences $p$ and $q$ s.t. $p \Rightarrow q$: $\pi(p) \Leftarrow \pi(q)$;
   c. $\pi$ is **non-monotonic** (NM) iff $\pi$ is neither UE nor DE.

Example:

(2) Mary is a semanticist. $\Rightarrow$ Mary is a linguist.
   a. Possibly, Mary is a semanticist. $\Rightarrow$ Possibly, Mary is a linguist. (UE)
   b. Mary isn’t a semanticist. $\Leftarrow$ Mary isn’t a linguist. (DE)
   c. If Mary is a semanticist, we will hire her. $\Leftarrow$ If Mary is a linguist, we will hire her. (DE)

- To discuss the monotonicity pattern of a non-propositional function, we need the notion of **generalized entailment**, which is cross-categorically defined for items of any **entailing type**.

(3) **Entailing type**
   a. $t$ is a basic entailing type.
   b. If $\tau$ is an entailing type, then for any type $\sigma$, $\langle \sigma, \tau \rangle$ is an entailing type.

(4) **Generalized entailment** ‘$\Rightarrow$’ (Fintel 1999)
   a. If $\phi, \psi$ are of type $t$, $\phi \Rightarrow \psi$ iff $\phi$ is false or $\psi$ is true.
   b. If $\beta, \gamma$ are of an entailing type $\langle \sigma, \tau \rangle$, $\beta \Rightarrow \gamma$ iff for all $\alpha$ s.t. $\alpha$ is of type $\sigma$: $\beta(\alpha) \Rightarrow \gamma(\alpha)$.

- The basic case (4a) is defined based on truth values: a truth-value entails another iff it is not the case that the first is true and the second is false.
- In (4b), a function entails another iff the result of applying the first function to any argument entails the result of applying the second function to the same argument.

E.g. $[\text{smart student}] \Rightarrow [\text{student}]$, because for any $x$ of type $e$, $[\text{smart student}](x) \Rightarrow [\text{student}](x)$.
- All the aforementioned cases can also be understood from a set-theoretic perspective: for any two sets $A$ and $B$, $A \Rightarrow B$ iff $A \subseteq B$.

- The (non-)monotonicity of a function (here ‘$\Rightarrow$’ stands for generalized entailment.)

(5) For a function $f$ of type $\langle \sigma, \tau \rangle$, its monotonicity is defined as follows:
   a. $f$ is DE iff for all $x$ and $y$ of type $\sigma$ s.t. $x \Rightarrow y$, $f(y) \Rightarrow f(x)$.
   b. $f$ is UE iff for all $x$ and $y$ of type $\sigma$ s.t. $x \Rightarrow y$, $f(y) \Leftarrow f(x)$.
   c. $f$ is NM iff $f$ is neither DE nor UE.
Example: A quantificational determiner has two arguments — a restrictor (the left argument) and a scope (the right argument).

(6) \[ S \]
    \[ DP \]
    \[ D \]
    \[ every \]
    \[ NP \]
    \[ (RESTRCTOR) \]
    \[ CN \]
    \[ cat \]
    \[ VP \]
    \[ (SCOPE) \]
    \[ V_{itr} \]
    \[ meows \]

Consider the monotonicity pattern in the restrictor and the scope of a quantificational determiner:

(7) \[ [\text{smart student(s)}] \Rightarrow [\text{student(s)}] \]
   a. Some smart student(s) passed the exam. \[ \Rightarrow \] Some student(s) passed the exam. (UE)
   b. Every smart student passed the exam. \[ \Leftarrow \] Every student passed the exam. (DE)
   c. No smart student passed the exam. \[ \Leftarrow \] No student passed the exam. (DE)

(8) \[ [\text{invited Andy and Billy}] \Rightarrow [\text{invited Andy}] \]
   a. Some student invited both Andy and Billy. \[ \Rightarrow \] Some student invited Andy. (UE)
   b. Every student invited both Andy and Billy. \[ \Rightarrow \] Every student invited Andy. (UE)
   c. No student invited both Andy and Billy. \[ \Rightarrow \] No student invited Andy. (DE)

• The (non-)monotonicity of an environment (after Gajewski 2007)

(9) a. If \( \alpha \) is of type \( \delta \) and \( A \) is a constituent that contains \( \alpha \), then \( A \) is DE w.r.t. \( \alpha \) iff the function \( \lambda x. [A[\alpha/v]]\{v\mapsto x\} \) is DE, where \( A[\alpha/v] \) is the result of replacing \( \alpha \) with a trace \( v \) in \( A \). (E.g., “every \( A \) is \( B \)” is DE w.r.t. \( A \) since \( \lambda x. [\text{every } A/v_{(e,t)}] \) is \( B\{v\mapsto x\} \) is DE.)
   b. UE and NM environments are defined analogously.

Exercise: For each of the following determiners, determine the monotonicity pattern in its restrictor and in its scope: few, at most three, less than three, at least three, no more than three, many
2. Negative Polarity Items (NPIs)

- NPIs (e.g., any, ever) must appear in DE environments (Fauconnier 1975, 1979; Ladusaw 1979). Prototypical DE environments include:

  (10) Under the semantic scope of negation or other negative adverbial
   a. John didn’t read any papers.
   b. * John read any papers.
   c. I never/rarely/seldom read any books about syntax.
   d. * I sometimes/always/sometimes read any books about syntax.

(11) Within the scope of negative quantifiers
   a. Few/no/at most 3 students read any papers.
   b. * Many/most students read any papers.

(12) In the left argument of universal quantifiers
   a. Every student who has read any papers passed the exam.
   b. * Every student who has read some papers passed any exams.
   c. * Some student who has read any papers passed the exam.

(13) In the antecedent of conditionals
   a. If John knows any big names, he will be invited.
   b. * If John is invited, he will know any big names.

(14) Without
   a. John came without any pen or pencil.
   b. * John came with any pen or pencil.

- The following NPI-licensing environments don’t seem to be DE at the first sight, but there can be a way to define them as DE:

  (15) The restrictor of only
   a. Only JOHN met with anything
   b. * Only anyone met with John.

(16) Questions (polar questions and wh-questions)
   a. Did you buy any tomatoes?
   b. Who read any books?

(17) Adversative predicates (doubt, be surprised)
   a. I doubt that John invited any student.
   b. I am surprised that John said anything at the meeting.

(18) Comparatives
   a. John is taller/shorter than anybody.
   b. John is nastier than ever.

(19) against (cf. for)
   a. Susan voted against every approving any of the proposals.
   b. * Susan voted for every approving any of the proposals.

- The grammatical (G-)view (Fox 2007, Chierchia et al. 2012, among others) was first introduced to analyze scalar implicatures. (See the last handout.)

Chierchia (2006, 2013) extends the G-view to NPI-licensing with assumptions compatible with the strict DE condition. The main assumptions are:

- The determiner *any* is lexically equivalent to the existential quantifier *some* but has a grammatical feature [D].¹ This feature obligatorily activates a set of domain (D)-alternatives.

\[
\begin{align*}
(20) & \quad \text{a. } [\text{any}_D] = \lambda f \lambda A \exists x \in D[A(x) \land f(x)] \\
& \quad \text{b. } \text{D-ALT(any}_D) = \{A f \lambda A \exists x \in D'[A(x) \land f(x)] \mid D' \subseteq D\}
\end{align*}
\]

- In syntax, the [D] feature must be checked off by a c-commanding \(O_D\)-operator. In semantics, exercising an \(O_D\)-operator affirms the assertion of the prejacent and negates all the D-alternatives that are not entailed by the assertion of the prejacent.

\[
\begin{align*}
(21) & \quad \text{[}O_D(S)\text{]}^w = 1 \iff [S](w) = 1 \land \forall \phi \in \text{D-ALT(S)}[[S] \not\subseteq \phi \rightarrow \phi(w) = 0]
\end{align*}
\]

- Consequences:

  - If the prejacent of \(O_D\) is UE w.r.t. *any*, the above exhaustification yields contradiction, causing ungrammaticality. For example:

\[
\begin{align*}
(22) & \quad \text{* John read any papers.} \\
& \quad \text{a. LF: } O_D \{s \text{ John read any}_D \text{ papers}\} \\
& \quad \text{b. } [S] = \exists x \in D\{\text{paper}(x) \land \text{read}(j, x)\} \\
& \quad \text{c. } \text{D-ALT(S)} = \{\exists x \in D'[\text{paper}(x) \land \text{read}(j, x)] \mid D' \subseteq D\} \\
& \quad \text{d. } \forall D'[D' \subseteq D \rightarrow \exists x \in D'[\text{paper}(x) \land \text{read}(j, x)]] \\
& \quad \text{(for any } D' \text{ such that } D' \subseteq D, \text{ John read no paper in } D'.) \\
& \quad \text{e. } [O_D(S)] = [S] \land (22d) = \bot \\
& \quad \text{(} # \text{ John read a paper in } D, \text{ but for any } D' \text{ s.t. } D' \subseteq D, \text{ he read no paper in } D'.)
\end{align*}
\]

A mini model:

\[
\begin{align*}
(23) & \quad \text{a. } D = \{p_1, p_2\} \\
& \quad \text{b. } [S] = R(j, p_1) \lor R(j, p_2) \\
& \quad \text{c. } \text{D-ALT(S)} = \{R(j, p_1) \lor R(j, p_2), R(j, p_1), R(j, p_2)\} \\
& \quad \text{d. } [O_D(S)] = R(j, p_1) \lor R(j, p_2) \land \neg R(j, p_1) \land \neg R(j, p_2) = \bot
\end{align*}
\]

- The above contradiction can be avoided if the prejacent of \(O_D\) is DE w.r.t. *any*: the D-alternatives are all entailed by the assertion, and thus the \(O_D\)-operator doesn’t affect semantics. Hence, *any* is licensed in DE contexts.

\[
\begin{align*}
(24) & \quad \text{John didn’t read any papers.} \\
& \quad \text{a. LF: } O_D \{s \text{ not } [\text{John read any}_D \text{ papers}]\} \\
& \quad \text{b. } [S] = \neg \exists x \in D\{\text{paper}(x) \land \text{read}(j, x)\} \\
& \quad \text{c. } \text{D-ALT(S)} = \{\neg \exists x \in D'[\text{paper}(x) \land \text{read}(j, x)] \mid D' \subseteq D\} \\
& \quad \text{d. } [O_D(S)] = [S] = \neg \exists x \in D\{\text{paper}(x) \land \text{read}(j, x)\]
\end{align*}
\]

**Discussion:** How does Chierchia’s analysis explain the licensing of NPIs in the antecedent of a conditional? Write out the steps.

¹Chierchia (2006, 2013) also assumes that *some* and *any* have a [σ] feature which activates scalar alternatives. This assumption not relevant to NPI-licensing, but plays a role in the computation of scalar implicatures and free choice inferences.
4. **Only: An NPI-licenser and NPI-unicenser**

4.1. **The NPI-licensing effect of only**

- NPIs can be licensed in the right argument of DP-*only* or the unfocused part under VP-*only*, although these environments are not DE.

\( \text{(25) Right argument of DP-*only*}} \)

\( \begin{align*}
\text{a. Only JOHN}_F \text{ read any papers.} \\
\text{b. } \ast \text{ JOHN}_F \text{ read any papers.}
\end{align*} \)

\( \text{(26) Unfocused part under VP-*only*}} \)

\( \begin{align*}
\text{a. Mary only gave any books to JOHN}_F. \\
\text{b. } \ast \text{ Mary gave any books to JOHN}_F.
\end{align*} \)

\( \text{Only JOHN}_F \text{ ate vegetables for breakfast.} \)

\( \text{Mary only gave fruit to JOHN}_F. \)

\( \therefore \text{ Only JOHN}_F \text{ ate kale for breakfast.} \)

\( \therefore \text{ Mary only gave apples to JOHN}_F. \)

- **The Strawson DE analysis of NPI-licensing** (von Fintel 1999):

  A (weak) NPI is only grammatical if it appears in the argument of a Strawson DE function. The Strawson DE condition grants the presuppositions of the consequent sentence when the validity of a downward inference is assessed.

\( \text{(27) A function } f \text{ of type } \langle \sigma, \tau \rangle \text{ is Strawson DE iff} \)

\( \text{for all } x \text{ and } y \text{ of type } \sigma \text{ s.t. } x \Rightarrow y \text{ and } f(x) \text{ is defined: } f(y) \Rightarrow f(x). \)

“Only+NP” is a Strawson DE function: only presupposes the truth of its propositional prejacent (Horn 1969); the scope of “only+NP” is DE when the prejacent presupposition of only is satisfied:

\( \text{(28) } [\text{only}_C] = \lambda p \lambda w : p(w) = 1.\forall q \in C[p \not\subseteq q \rightarrow q(w) = 0] \quad \text{(After Horn 1969, Rooth 1985)} \)

\( \text{(29) Kale is a vegetable.} \)

\( \text{John ate kale for breakfast.} \)

\( \therefore \text{ Only JOHN}_F \text{ ate kale for breakfast} \)


  Chierchia extends the G-view of NPI-licensing to the licenser only: the unfocused part of the asserted exhaustivity inference is DE and hence forms an NPI-licensing environment.

\( \text{(30) Only JOHN}_F \text{ read any papers.} \)

\( \begin{align*}
\text{a. } & \quad \text{O}_D [\text{only } [\text{JOHN}_F \text{ read any}_D \text{ papers }]] \\
\text{b. Presupposition of S: } & \quad \lambda w. \exists x \in D[p\text{paper}_w(x) \land \text{read}_w(j, x)] \quad \text{(John read some papers in the total domain } D.) \\
\text{c. Assertion of S: } & \quad \lambda w. \forall y \in D_e [\exists x \in D[p\text{paper}_w(x) \land \text{read}_w(y, x)] \rightarrow y \leq j] \\
\text{d. D-ALT(S) = } & \quad \{[\text{only } [\text{JOHN}_F \text{ read any}_D' \text{ papers }]] : D' \subseteq D \} \\
\text{ = } & \quad \{\lambda w. \forall y \in D_e [\exists x \in D'[p\text{paper}_w(x) \land \text{read}_w(y, x)] \rightarrow y \leq j] : D' \subseteq D \}
\end{align*} \)

The prejacent presupposition (30b) is irrelevant for assessing the [D] feature of the weak NPI *any* (Gajewski 2011). The asserted component (30c) is DE w.r.t. the domain variable *D*. Therefore, *any* is licensed in (30), as it would be in any DE environments.
4.2. The NPI-unlicensing effect of *only* (Xiang 2017)

- Unsurprisingly, *only* cannot license an NPI that appears in its F-associate:

\[(31)\]
\[\begin{align*}
& a. \text{Only [some/*any students]}_F \text{ saw John.} \\
& b. \text{Mary only gave [some/*any books]}_F \text{ to John.}
\end{align*}\]

However, the part of an *only*-clause where an NPI can appear is not always equivalent to the part that is not F-associated with *only*. (Drubig 1994, Wagner 2006)

\[(32)\]
\[\begin{align*}
& a. \text{Only [some/*any BOYS]}_F \text{ arrived.} \\
& b. \text{John only read [some/*any PAPERS]}_F, \text{ (he didn’t read any books).}
\end{align*}\]

- DP-*only* doesn’t license an NPI that appears within its left argument, regardless of whether this NPI is part of its focus associate.
- VP-*only* doesn’t license an NPI if this NPI and the focused item appear within the same island.

- Xiang (2017): *Only* is not just an NPI-licenser but also an “NPI-unlicenser.”

- Recall Chierchia (2006): an NPI is not licensed if assessing its [D] feature yields a contradiction. Thus, an OD-operator “unlicenses” an NPI if its argument is non-DE w.r.t. this NPI.
- New assumption: *Only* also can check off [D] in syntax and triggers exhaustification over D-alternatives in semantics. Thus, by locality:

\[(33)\]
\[\text{Only any BOYS}_F \text{ arrived.} \]
\[\text{a. Traditional G-view} \quad \text{b. New analysis} \]

\[
\begin{array}{c}
\text{S} \\
\text{only} \\
\text{arrived} \\
\text{DP} \\
\text{any}_D \text{BOYS}_F \\
\end{array}
\quad
\begin{array}{c}
\text{S} \\
\text{only} \\
\text{arrived} \\
\text{DP} \\
\text{any}_D \text{BOYS}_F \\
\end{array}
\]

- If the prejacent clause of *only* is non-DE w.r.t. an NPI, using *only* to exhaustify the D-alternatives of the prejacent clause returns an inference that contradicts the prejacent presupposition, making the NPI unlicensed.

\[(34)\] Semantics of DP-*only*
\[\begin{align*}
& a. \text{[only}(\alpha_T)(P_{(\tau,\varnothing)})\text{]} = \lambda w. \forall a \in [\alpha]^f \cdot [P](a)(w) = 1 \to [P](\{\alpha\}^0) \subseteq [P](a) \\
& b. \text{Presupposition: } [P](\{\alpha\}^0)
\end{align*}\]

Computation of (33b):

\[(35)\]
\[\begin{align*}
& a. [\text{any}_D \text{BOYS}_F]^0 = \lambda f. \exists x \in D[B(x) \land f(x)] \\
& b. [\text{any}_D \text{BOYS}_F]^f = \{\lambda f. \exists x \in D[g(x) \land f(x)] : g \in D_{(e,s,t)}\} \\
& c. [\text{any}_D \text{BOYS}_F]^d = \{\lambda f. \exists x \in D'[B(x) \land f(x)] : D' \subseteq D\} \\
\end{align*}\]
d. \[ [S] = \lambda w. \forall P \in [\text{any}_D \text{BOYS}_F]^f_d | P([\text{left}]) (w) \rightarrow [\text{any}_D \text{BOYS}_F]^0([\text{left}]) \subseteq P([\text{left}]) \]

downarrow

e. \[ \lambda w. \forall P \in [\text{any}_D \text{BOYS}_F]^d | P([\text{left}]) (w) \rightarrow [\text{any}_D \text{BOYS}_F]^0([\text{left}]) \subseteq P([\text{left}]) \]
\[ = \forall D' | D' \subset D \rightarrow \exists x \in D' [B(x) \wedge L(x)] \]
(For any proper subdomain \( D' \), no boy in \( D' \) left.)

f. Presupposition of S: \( \exists x \in D [B(x) \wedge L(x)] \)
(Some boys in the total domain \( D \) left.)

g. (35e) contradicts (35f). For example, let \( D = \{a, b\} \), then:
(35e) = \( \neg L(a) \wedge \neg L(b) \) (Neither a nor b left.)
(35f) = \( L(a) \lor L(b) \) (a or b left.)

– In the case of VP-\textit{only} association, the above contradiction can be avoided by F-movement, which is however island-sensitive.

(36) Mary only gave any books to JOHN\(_F\).

a. \#Without F-movement

(i) Without \( O_D \)

(ii) With \( O_D \)

b. \textit{OK} With F-movement