Functional indefinites as conventional implicatures (handout)

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- **Functional indefinites** (e.g., *a certain* NP) pattern with conventional implicatures (CIs) in terms of their projection behavior.
- We provide a unified account to these patterns based on the notion of **propositions as types**, which allows CIs to "take scope".

1 Background

- **Functional indefinites (FIs)**
  - Indefinites can take exceptionally wide scope (Fodor & Sag, 1982).

    (1) If [a (certain) professor comes], Sandy will leave. ($\exists >$ if)

  - Some of them (e.g., *a certain* NP) allow a functional interpretation (Schwarz, 2001).[1]

    (2) Every student praised a certain professor. (e.g., their advisor)

    - The speaker (somewhat secretively) indicates a specific function from the set of students.
    - In this case: $\forall x.\, \mathtt{std}(x) \supset \mathtt{praise}(x, f(x))$ (where $f = \mathtt{advisor}$)

- **Conventional implicatures (CIs)**
  - CIs are not-at-issue meanings that must be new to the discourse (Potts, 2005).
  - Prototypical case: **appositive relative clauses (ARCs)**

    (3) Sandy, who is away, will return tomorrow.
      a. CI: Sandy is away.
      b. At-issue: Sandy will return tomorrow.

2 Observation: Parallels between FIs and ARCs

- **Projection** The content of FIs (as well as ARCs) is **projective**, i.e., not subject to entailment-canceling operators (Geurts, 2010).
  - We write φ_p for a projective meaning p associated with the proposition φ.

    (4) $\mathrm{Op}(\varphi_p) \implies p$
      a. It is not true that Sandy praised a certain professor. $\implies$ There is a professor.
      b. It is not true that Sandy, who is away, will return tomorrow. $\implies$ Sandy is away.

[1]FIs do not cover all the instances of exceptionally wide-scope indefinites (see Schwarz (2001) for details). We do not handle the non-functional cases here.

- **Universal projection**
  - When embedded in the scope of a quantifier, both FIs/ARCs can yield a universally quantified implication (like presuppositions).

(5) $\mathrm{Op}(Q[x](A)(\varphi_p)) \implies \forall x \in A.\, p$

a. If [every student makes progress in a certain area], nobody will flunk the exam.
$\implies$ For each student, there is an area. (e.g., their weakest one) (Schlenker, 2006)

b. If [every woman$_i$ has bid farewell to Nate, who gave her$_i$ some great advice], we can close off the session.
$\implies$ For each woman, Nate gave her some great advice. (adapted from Zhao (2023))

(6) Example with a negative quantifier

a. No boy$_i$ talked with a certain female relative of his$_i$. (e.g., his mother)

b. No Tibetan monk$_i$ thinks the Dalai Lama, who is his$_i$ spiritual mentor, would ever cave to Chinese pressure tactics.

  - Note: The interpretation in (5) is not a simple narrow-scope reading, since the scope of the quantifier must be confined inside the conditional antecedent (a scope island).

- **Crossover-like effect**
  - The functional interpretation is subject to a structural constraint reminiscent of the **weak crossover** effect (Chierchia, 2001).

(7) a. A certain technician inspected every plane. (*functional interpretation)
Cf. *Her$_i$ mother praised every girl$_i$.

  - We observe a similar effect for ARCs: the universal implication does not arise for an ARC attached to the subject + a quantifier in the object position.

(7) b. *Nate, who gave her$_i$ some great advice, bid farewell to every woman$_i$.

Q. How can we give **a unified account** to these facts?

- Promising direction: **the existential implication of FIs is a CI** (like ARCs).

(9) Sandy met a certain professor.

a. CI: There is a professor x.

b. At-issue: Sandy met x.

- However, there is a critical issue with the existing theories of CIs.
  - The previous account of universal projection of CIs (e.g., Martin (2016)) employed the pragmatic mechanism of **telescoping** (Roberts, 1987), which permits exceptional pronominal binding.

(10) Each degree candidate$_i$ walked to the stage. He$_i$ took his$_i$ diploma from the dean and returned to his$_i$ seat.

  - This allows binding into an ARC, as if the ARC were a subsequent sentence.

(11) Every woman$_i$ has bid farewell to Nate. [who gave her$_i$ some great advice]

- However, this type of pragmatic approach does not readily account for **why telescoping does not apply to the crossover cases like (7b)**.

  (12) Nate bid farewell to every woman$_i$. [who gave her$_i$ some great advice]

- **Challenge:** we need to derive universal projection in a way sensitive to the structural relationship between quantifiers and FIs/ARCs.
  - Our approach: **treat FIs/ARCs as scope-taking expressions** (cf. Zhao (2023))

3 Framework: Propositions as types

- We adopt a framework named Dependent Type Semantics (DTS) (Bekki & Mineshima, 2017)
  - In this framework, propositions are identified with **the type of its proofs**, based on the so-called Curry-Howard correspondence (Howard, 1980).
  - This allows **quantification over the proofs of a proposition**.

    (13) Every student sneezed. $\rightsquigarrow$ $(x : \mathtt{e}) \to \Big((u : \mathtt{std}(x)) \to \mathtt{snz}(x) \Big)$

    For each entity x, and for each proof u of $\mathtt{std}(x)$, $\mathtt{snz}(x)$ holds. $(\simeq \forall x_{\mathtt{e}}.\, \mathtt{std}(x) \supset \mathtt{snz}(x))$

  - Two basic type constructors (the underlying system is called dependent type theory)
    - Function type $(x : A) \to B$ (which corresponds to $\forall x \in A.B$ and $A \supset B$)
    - Product type $(x : A) \times B$ (which corresponds to $\exists x \in A.B$ and $A \wedge B$)

- **CI type** (Matsuoka et al., 2024)
  - We assume that CIs are translated into a type of the form $(x \lhd A) \times B$.

    (3) Sandy, who is away, will return tomorrow. $\rightsquigarrow$ $(u \lhd \mathtt{away}(\mathtt{s})) \times \mathtt{rtn}(\mathtt{s})$

  - This is an underspecified representation.
    - After semantic composition, the CI is added to the context apart from the at-issue content (cf. Anderbois et al. (2015)).
    - As a result, CIs project out of the scope of operators, as exemplified below.

CI computation for (4b)

$$\Gamma \;\Big|\; \neg\Big((v \lhd \mathtt{away}(\mathtt{s})) \times \mathtt{rtn}(\mathtt{s}) \Big) \longrightarrow \begin{cases} \text{Context: } \Gamma, \boxed{v : \mathtt{away}(\mathtt{s})} \\ \text{At-issue: } \neg\mathtt{rtn}(\mathtt{s}) \end{cases}$$

added to Γ

CI (projected)

  - Notes on the details
    - The context is formalized as a list of variable declarations $x_1 : A_1, \ldots, x_n : A_n$.
    - The computation is defined as part of an operation called **type checking**, which also performs anaphora resolution (similarly to a version of Discourse Representation Theory, e.g., van der Sandt (1992)).
  - **Upshot**
    - CI types take scope, meaning that they can have scopal interaction with quantifiers!

4 Account

- The lexical entry for FIs includes a CI type (hence, we predict the same behavior as ARCs).

(14) a certain $\rightsquigarrow$ $\lambda n.\lambda p.\ (u \lhd (x : \mathtt{e}) \times n(x)) \times p(\pi_1 u)$ (n: restrictor, p: nuclear scope)

  - Here, π_1 is the function that takes the first element a of a pair $\langle a, b\rangle$.

(9) Sandy praised a certain professor.

$$\rightarrow \begin{cases} \text{Context: } \Gamma, u : (x : \mathtt{e}) \times \mathtt{prof}(x) \quad \text{(CI: there exists a professor } x) \\ \text{At-issue: } \mathtt{praise}(\mathtt{s}, \pi_1 u) \quad (\pi_1 u \text{ refers to the 1st element of } u, \text{ i.e., } x) \end{cases}$$

- **Proposal** (for deriving universal projection)
  - Intuition: A CI type can be functionally dependent on the variables that it is in the scope of.

> Def. Suppose $(x \lhd A) \times B$ is in the scope of variables $x_1 : A_1, \ldots x_n : A_n$. Then, its type checking may add $f : (x_1 : A_1) \to \ldots \to (x_n : A_n) \to A$ to the context and replace x with $fx_1 \ldots x_n$.

  - We derive a universally quantified CI as below (Note: n^* abbreviates $(x : \mathtt{e}) \times n(x)$).

CI computation for the conditional antecedent of (5b)

$$\Gamma \mid (x : \mathtt{e}) \to \Big((u : \mathtt{std}(x)) \to \Big((v \lhd \mathtt{area}^*) \times \mathtt{prog}(x, \pi_1 v)\Big)\Big) \longrightarrow \begin{cases} \text{Context: } \Gamma,\ \underbrace{f : (x : \mathtt{e}) \to \Big((u : \mathtt{std}(x)) \to \mathtt{area}^*\Big)}_{\text{For each student, there is an area}} \\ \text{At-issue: } (x : \mathtt{e}) \to \Big((u : \mathtt{std}(x)) \to \mathtt{prog}(x, \pi_1(fxu))\Big) \end{cases}$$

- What about the crossover-like effect?
  - In cases like (7), the CI type takes scope over the quantifier, so the above mechanism for universal projection cannot be applied.

CI computation for (7a)

$$\Gamma \mid (u \lhd \mathtt{tech}^*) \times \Big((y : \mathtt{e}) \to \big((v : \mathtt{plane}(y)) \to \mathtt{insp}(\pi_1 u, y)\big)\Big)$$

no functional dependency

  - Notes on the details
    - We must make sure that the quantifier $(x : \mathtt{e})$ does NOT take inverse scope over the CI type $(u \lhd A)$, in which case universal projection would be incorrectly ruled in.
    - This can be handled with **the same restriction as the standard weak crossover cases**. In DTS, pronouns are also represented as a scope-taker, written $(x \mathbin{@} A) \times B$.

(15) Her mother praised every girl. $\rightsquigarrow$ $(x \mathbin{@} \mathtt{e}) \times \Big((y : \mathtt{e}) \to \big((u : \mathtt{girl}(y)) \to \mathtt{praise}(\mathtt{mom}(x), y)\big)\Big)$

    - Crossover can be derived by assuming that pronouns are not subject to inverse scope (Matsuoka et al., 2025). We apply this restriction to CI types as well.

Summary: We uniformly predict the projection behavior of FIs/appositives via their **scopal relations** with quantifiers, which is made possible by the **propositions-as-types approach**.

$(x : A) \gg (y \lhd B) \cdots$ ✓ $(x : A) \to B$ $\qquad$ $(y \lhd B) \gg (x : A) \cdots$ ✗ $(x : A) \to B$

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