What GQ Theory is Good For (Cont.)

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1 Review

- Intransitive predicates (AdjPs like \textit{(is) vegetarian} and VPs like \textit{drinks}) denote properties: sets of individuals.

\begin{equation}
\text{[is vegetarian]}_M = \{x: \text{x is vegetarian in } M\}
\end{equation}

- DPs in subject position denote properties of properties: sets of sets of individuals.

\begin{equation}
\text{[Everyone]}_M = \{X: D_M \subseteq X\}
\end{equation}

- DPs and intransitive predicates combine to form sentences, which denote truth values in a model.

\begin{equation}
\text{[Everyone is vegetarian]}_M = \text{True} \text{ iff } \\
\text{a. } [\text{is vegetarian]}_M \in [\text{Everyone]}_M \text{ iff } \\
\text{b. } \{x: \text{x is vegetarian in } M\} \in \{X: D_M \subseteq X\} \text{ iff } \\
\text{c. } D_M \subseteq \{x: \text{x is vegetarian in } M\}
\end{equation}

Today:

- A slightly different (but equivalent) formulation of this analysis (functions vs sets).
- Higher order properties of GQs.
- Empirical generalizations: NPIs and existentials.

2 The Functional View of GQs

\textbf{Definition 2.1 Characteristic function.} The characteristic function \(f\) of a subset \(X\) of a domain \(D\) is a function from the elements of \(D\) into the set \{True, False\} such that:

1. For all \(x \in D\), if \(x \in X\), then \(f(x) = \text{True}\).
2. Otherwise, \(f(x) = \text{False}\).

Last class, we viewed the semantic denotations of constituents as sets, but we can equivalently view them as their characteristic functions.

- Intransitive predicates denote properties: functions from individuals to truth values.

\begin{equation}
\text{[vegetarian]}_M = \text{the function } VEGETARIAN, \text{ such that }
\end{equation}
For all \( x \in D_M \), \( \text{VEGETARIAN}(x) = \text{True} \) iff \( x \in \{ y : y \text{ is vegetarian in } M \} \).

b. \[ \text{vegetarian}_M = \lambda x(x \in \{ y : y \text{ is vegetarian in } M \}) \].
c. \[ \text{vegetarian}_M = \lambda x(x \text{ is vegetarian in } M) \].

- Subject DPs denote generalized quantifiers: functions from properties to truth values.

(5) a. \[ \text{everyone}_M = \lambda P(D_M \subseteq P) \text{, such that} \]
   - For all properties \( P \), \( \text{EVERYONE}(P) = \text{True} \) iff for all \( x \in D_M \), \( P(x) = \text{True} \).
   - \( \lambda P \). For all \( x \in D_M \), \( P(x) = \text{True} \).

As is common, we’ll alternate between these two perspectives indiscriminately.

(6) \[ \text{everyone}_M = \lambda P(D_M \subseteq P) \].

A new interpretation rule:

(7) **Function Application** (Heim and Kratzer, 1998)

If \( \alpha \) has the form \( \beta \gamma \), then \( [\alpha] = \text{True iff } [\beta]([\gamma]) = 1 \).

(8) Recall our example model \( M \):

a. \( D_M = \{ \text{Lisa, Bart, Homer} \} \)
b. \[ [\text{Lisa}]_M = \text{Lisa}; [\text{Bart}]_M = \text{Bart}; [\text{Homer}]_M = \text{Homer}. \]
c. \[ [\text{(is) vegetarian}]_M = \{ \text{Lisa} \}. \]
d. \[ [\text{drinks}]_M = \{ \text{Homer} \}. \]

\[ [\text{Everyone is vegetarian}]_M = \text{False} \]

\[ \lambda P(D_M \subseteq P)(\lambda x(x \text{ is vegetarian})) = \text{F} \]

\[ [\text{Everyone}]_M = \lambda P(D_M \subseteq P) \]

\[ [(\text{is) vegetarian}]_M = \lambda x(x \text{ is vegetarian in } M) \]

2.1 **Determiners**

Clearly, *everyone, no one* etc. are not syntactically atomic constituents.

(9) a. **Every** girl is vegetarian.
b. **No** man drinks.

How are DPs composed to yield generalized quantifiers?

(10) a. \[ [\text{every}] = ? \]
b. \[ [\text{some}] = ? \]
c. \[ [\text{no}] = ? \]
[everything]_M = \lambda P(D_M \subseteq P)

[thing]_M = ?
[ every]_M = ?

Analysis:

- NPs (like other intransitive predicates) denote properties (i.e. sets of individuals/functions from individuals to truth values).

  (11) a. \([\text{thing}]_M = D_M / \lambda x(x \in D_M)\).
  b. \([\text{girl}]_M = \{x : x \text{ is a girl in } M\} / \lambda x(x \text{ is a girl in } M)\).

- Determiners denote functions from properties to generalized quantifiers.

  (12) a. \([\text{every}]_M = \lambda P \lambda Q(P \subseteq Q)\)
  b. \([\text{some}]_M = \lambda P \lambda Q(P \cap Q \neq \emptyset)\)
  c. \([\text{no}]_M = \lambda P \lambda Q(P \cap Q = \emptyset)\)

\([\text{Every girl is vegetarian}]_M = \text{True iff } \{x : x \text{ is a girl}\} \subseteq \{y : y \text{ is vegetarian}\}\)

\([\text{every girl}]_M = \lambda Q(\{x : x \text{ is a girl}\} \subseteq Q)\)
\([\text{vegetarian}]_M = \lambda y(y \text{ is vegetarian})\)

\([\text{every}]_M = \lambda P \lambda Q(P \subseteq Q)\)
\([\text{girl}]_M = \lambda x(x \text{ is a girl in } M)\)

Exercise:

(13) a. \([\text{Four girls}]_M = ?\)
  b. \([\text{Half of the girls}]_M = ?\)
  c. \([\text{Four}]_M = ?\)

3 NPI Licensing Conditions

- The unified treatment of DPs (and other expressions) as generalized quantifiers allows us make new generalizations over subclasses of GQs.

- Such generalizations are useful for explanation empirical patterns in natural languages.

Example 1: NPI licensing.

Example 2: Licensing in the pivot of existential constructions.

3.1 NPI Distribution

What properties characterize the distribution of expressions like \textit{at all} and the existential use of \textit{any}?
(14) a. John doesn’t like the movie **at all**.
b. John didn’t see **anyone**.

(15) a. *John likes the movie **at all**.
b. #John saw anyone.
   
   If ok, only free choice: ‘John saw anyone that he wanted...’

**Observation:** **At all** and existential **any** are ungrammatical outside the scope of a certain kind of operator.

- They are *licensed* within the scope of sentential negation (**not**).
- Elements such as **at all** and existential **any** are called **negative polarity items** (NPIs).

**Which elements (in addition to **not**) can license **any** and **at all**?**

1. Negative DPs like **no one** and **nothing**.

   (16) a. No one likes John **at all**.
b. No one ate anything.

   (17) a. John saw nothing **at all**.
b. Mary give nothing to anyone.

2. ‘Semi-negative’ DPs like **few**.

   (18) a. Few girls like John **at all**.
b. Few girls ate anything.

3. Negative adverbs like **never** and PPs like **without**.

   (19) a. John has never been to Poland **at all**.
b. Mary has never broken anything.

   (20) a. John left without yelling **at all**.
b. Mary left without forgetting anything.

4. In the ‘restriction’ of universal quantifiers like **everyone**.

   (21) a. Everyone who likes John **at all** came to his party.
b. Everyone who read anything passed the test.

   (22) Note:
   
a. *Everyone likes John **at all**.
b. *Everyone likes anything.

5. Negative verbs like **refuse** and **doubt**.

   (23) a. Mary refused to eat **at all**.
b. Mary refused to eat anything.
(24)  a. Mary doubted that John liked her at all.
    b. Mary doubted that John read anything.

6. In *if* clauses of conditionals and questions.

(25)  a. If Mary likes John at all, she’ll come to his party.
    b. If Mary read anything, she’ll pass the test.

(26)  a. Did you go to school at all today?
    b. Did Mary read anything today?

7. Some other constructions...

Is there a morphological explanation for NPI distribution?

- **Don’t think so:** What morphology do *if*, *few*, and *no one* share?

Is there a syntactic explanation for NPI distribution?

- Klima (1964): There is a [+affective] feature in the syntax that is present on NPI licensors, which licenses NPIs.

Questions about this analysis:

- What determines the distribution of the [+affective] feature?
  - Why does *no one* bear it, but not *someone*?
  - Does *everyone* bear it or not?
- **More generally:** The distribution of the NPI licensing property is not conditioned by properties that are important for the syntactic analysis of linguistic data.
- We find licensing splits within a single syntactic category (*Someone* vs *No one*).
- Licensors have many different syntactic categories: DPs, adverbs, PPs, Cs, verbs...

**Conclusion:** A natural syntactic characterization of NPI licensors is not possible.

No need to despair! A natural semantic categorization of NPI licensors is possible.

### 3.2 The Ladusaw-Fauconnier Generalization

(27) **The Ladusaw-Fauconnier Generalization:**

The expressions that license NPIs like *at all* and *any* are just those who denote *monotone decreasing* (a.k.a. *downward entailing*) functions.

A specific definition (for our purposes):

**Definition 3.1** *Monotone decreasing.* Let $f$ be a generalized quantifier (i.e. function from properties to truth values), then $f$ is monotone decreasing iff for all properties $P, Q$, such that $P \subseteq Q$, if $f(Q) = True$, then $f(P) = True$.

Detailed argument that *no one* is decreasing:
(28) For all \( P, Q \), \([\text{No one}]_M(P) = \text{True} \iff D_M \cap P = \emptyset\).

\([\text{drinks vodka}]_M \subseteq [\text{drinks}]_M\).

(29) a. If no one drinks, then no one drinks vodka.
   b. If \([\text{No one drinks}]_M = \text{True}\), then \([\text{No one drinks vodka}]_M = \text{True}\).

(30) If \( D_M \cap [\text{drinks}]_M = \emptyset \),
Since \([\text{drinks vodka}]_M \subseteq [\text{drinks}]_M\),
\( D_M \cap [\text{drinks vodka}]_M = \emptyset \).

\[\therefore \text{no one is decreasing}.\]

Other NPI licensors show this pattern:

(31) a. If nothing happens around here, then nothing happens quickly around here.
   b. If John has never been to Poland, then John has never been to Wroclaw.
   c. If John did not come to the party, then John did not come to the party early.
   d. If few students came to the party, then few students came to the party early.

(32) a. If John left without yelling, then John left without yelling loudly.
   b. If John refused to ride the roller coaster, then John refused to ride the roller coaster happily.

Many expressions are not downward entailing/do not denote decreasing functions:

- These expressions do not license NPIs.

(33) John left the party \(\not\rightarrow\) John left the party early.

(34) a. False: If something happens around here, then something happens quickly around here.
   b. False: If John has twice been to Poland, then John has twice been to Wroclaw.
   c. False: If four girls came to the party, then four girls came to the party early.
   d. False: If many students came to the party, then many students came to the party early.

(35) a. False: If John left after yelling, then John left after yelling loudly.
   b. False: If John accepted to ride the roller coaster, then John accepted to ride the roller coaster happily.

3.2.1 Summary

Through looking at a principled subset of the generalized quantifiers denoted by natural language expressions (the \textit{decreasing} functions), we can identify a semantic generalization that underlies the syntactic distribution of a certain class of expressions in languages like English (the NPIs).
• We can make formal generalizations that go beyond syntactic category.

Full disclosure: It is well known that the Ladusaw-Fauconnier generalization does not cover all the NPI licensors (in an immediately obvious way).

• It still forms the heart of the majority of theories of NPI licensing in the literature.

4 Pivot of Existential Sentences

Existential sentences in English have an expletive there subject, a copula, an object DP called the pivot, and a main predicate.

(36) There are bugs eating the corn.

As observed by Milsark (1974), not all DPs are licensed as the pivot of an existential construction.

• Existential sentences reveal a distinction between weak and strong noun phrases.

(37) Weak Noun Phrases
a. There is a dinosaur in my backyard.
b. There are three dinosaurs in my backyard.
c. There are many dinosaurs in my backyard.
d. There are no dinosaurs in my backyard.

(38) Strong Noun Phrases
a. *There is every dinosaur in my backyard.
b. *There are most dinosaurs in my backyard.
c. *There are both dinosaurs in my backyard.
d. *There are all dinosaurs in my backyard.

Question: How should we analyze the weak/strong distinction?

Hypothesis 1: Is it a syntactic distinction?

• Argument against H1: No independent syntactic basis for classifying determiners like three, many, no, most, every.

Conclusion: We have a similar puzzle to NPI licensing.

• We see that the syntactic distribution of linguistic constituents is determined by their semantic properties.

• Weak DPs have an ‘existential’ meaning that strong DPs lack.

Observation:

Through looking at the properties of the generalized quantifiers that DPs denote, we can get a formal characterization of this ‘existential-ness’.

One characterization (Keenan (1987; 2003)):
The DPs that can occupy the pivot position in an English existential construction are exactly those that have symmetric determiners.

**Definition 4.1 Symmetric determiner.** A determiner $D$ is symmetric iff for all properties $P, Q$, $(D(P))(Q) = (D(Q))(P)$.

\[(\text{no})_M = \lambda P \lambda Q (P \cap Q = \emptyset)\]

\[(\lambda P \lambda Q (P \cap Q = \emptyset) = \lambda P \lambda Q (Q \cap P = \emptyset)\]

Natural language tests:

(41) **Weak Noun Phrases**
- a. A dinosaur is in my backyard $\iff$ One thing in my backyard is a dinosaur.
- b. Three dinosaurs are in my backyard $\iff$ Three things in my backyard are dinosaurs.
- c. Many dinosaurs are in my backyard $\iff$ Many things in my backyard are dinosaurs.
- d. No dinosaurs are in my backyard $\iff$ No things in my backyard are dinosaurs.

(42) **Strong Noun Phrases**
- a. Every dinosaur is in my backyard $\niff$ Every thing in my backyard is a dinosaur.
- b. Most dinosaurs are in my backyard $\niff$ Most things in my backyard are dinosaurs.
- c. Both dinosaurs are in my backyard $\niff$ Both things in my backyard are dinosaurs.
- d. All dinosaurs are in my backyard $\niff$ All things in my backyard are dinosaurs.

**Summary:**

Through studying the formal properties of generalized quantifiers, we can arrive at new semantic empirical generalizations concerning the distribution of linguistic expressions in natural language.

5 Next Class

1. Quantified noun phrases in direct object position.

(43) John likes everyone.

2. Scope and the syntax of quantification.

(44) Everyone likes someone.

**References**


