Quantificational Variability Effects

1. Introduction

• Quantified indirect questions are subject to quantificational variability (QV) effects (Berman 1991):

(1) a. John mostly knows who came.

\[ \forall x \left[ x \text{ came} \right] \text{ [John knows that } x \text{ came]} \]

b. John mostly knows which paper each student presented. (\forall\text{-question})

\[ \forall x \left[ x \text{ is a student} \right] \text{ [John knows which paper } x \text{ presented]} \]

c. John mostly knows which student presented which paper. (multi-wh question)

\[ \forall x \left[ x \text{ is a student} \land x \text{ presented a paper} \right] \text{ [John knows which paper } x \text{ presented]} \]

• Quantity adverbials that introduce QV effects:

\[ \text{mostly, for the most part, in part, to a large extent} \]

• QV effects are commonly observed in indirect questions with responsive predicates (Lahiri 2002); they are also observed with rogative predicates in limited cases (Beck & Sharvit 2002).

(2) Responsive

a. John mostly remembers which students came. (veridical)

\[ \forall x \left[ x \text{ is a student} \land x \text{ came} \right] \text{ [John remembers that } x \text{ came]} \]

b. For the most part, John is sure about which students came. (non-veridical)

\[ \forall x \left[ x \text{ is a student} \land x \text{ (conceivably) came} \right] \text{ [John is sure that } x \text{ came]} \]

(3) Rogative

a. For the most part, John wonders/asked which students came.

\[ \forall x \left[ x \text{ is a student} \land x \text{ came} \right] \text{ [John wonders/asked that } x \text{ came]} \]

b. For the most part, who will be admitted depends on the committee.

\[ \forall x \left[ \text{whether } x \text{ will be admitted depends on the committee} \right] \]

Today we will focus on indirect questions with veridical responsive predicates and consider only single-wh questions.
2. Two representative approaches

2.1. The proposition-based approach (Lahiri 1991, 2002; a.o.)

- **First attempt**: The quantity adverb quantifies over the set of atomic true propositional answers of the embedded question. (Lahiri 1991, 2002)

(4) John mostly knows \[Q\] which students came.
\[\approx \text{Most } q \left[ q \text{ is an atomic true answer of } Q \right] \text{[John knows } q]\]

\[
\begin{array}{c}
\text{mostly} \\
\text{VP}
\end{array}
\begin{array}{c}
\text{John knows } t_i
\end{array}
\begin{array}{c}
\text{which students came}
\end{array}
\begin{array}{c}
\text{Q_i}
\end{array}
\]

a. \[\text{MOST } q \left[ w \in p \in \text{AT}(Q) \right] \text{[know}(j, q)\right] \]
b. \[\text{AT}(Q) = \{ p : p \in Q \land \forall q \in Q[p \subseteq q \rightarrow q = p] \}\]

(The set of propositions in \(Q\) that only entail each of themselves.)

**Example**

(5) John mostly knows which students came.
\((w: \text{among the consider four students, } abc \text{ came but } d \text{ didn’t.})\)

a. \[\text{AT}(Q) = \{ \text{came}(a), \text{came}(b), \text{came}(c), \text{came}(d) \}\]
b. \[\text{QV inference: Most } q \left[ q \in \{ \text{came}(a), \text{came}(b), \text{came}(c) \} \right] \text{[John knows } q]\]

- **Issues about recovering the atomic propositional answers:**

  **Discussion 1**: With the presence of an ANS-operator in the LF, will we be able to recover the claimed quantification domain of *mostly*? Why or why not?
Discussion 2: Dayal (1996) treats the pair-list reading of a multi-wh/∀-question as denoting a set of conjunctive propositions. Under this assumption, we won’t able to recover the domain of a matrix quantification adverb (Lahiri p.c. to Dayal).

(6) \[ \text{[which student read which book]} = \left\{ \begin{array}{l}
\text{read}(s1, b1) \land \text{read}(s2, b2) \land \text{read}(s3, b3) \\
\text{read}(s1, b1) \land \text{read}(s2, b1) \land \text{read}(s3, b3) \\
\ldots
\end{array} \right. \]

(7) John mostly knows which student read which book.
≈ For most true propositions \( p \) of the form ‘student \( x \) read book \( y \), John knows \( p \).

• A problem with attempt 1:
The definition in (4a) cannot extend to mention-some questions.

(8) John (# mostly) knows [where we can get coffee]_{MS}.

• Second attempt: The quantity adverb quantifies over the set of atomic propositional answers that are entailed by certain complete true answer.

(9) \[ [\text{John mostly knows Q}]^w = 1 \text{ if and only if} \]
\[ \exists p \in \text{ANS}(Q)(w)[\text{MOST } q [p \subseteq q \land q \in \text{At}(Q)][\text{know}(j, q)]] \]
(For some complete true answer of Q, John knows most of the atomic possible answers of Q that are entailed by this max-informative true answer.)

(10) John mostly knows which students came.
\((w: \text{among the consider four students, abc came but d didn’t.})\)
  a. \( \text{ANS}(Q)(w) = \{\text{came}(a \oplus b \oplus c)\} \)
  b. \( \text{AT}(Q) = \{\text{came}(a), \text{came}(b), \text{came}(c), \text{came}(d)\} \)
  c. \( \text{QV inference: Most } q [q \in \{\text{came}(a), \text{came}(b), \text{came}(c)\}][\text{John knows } q] \)

The QV inference schematized in (9) captures the infelicity of using mostly in (10): the quantification domain of mostly must be non-singleton, while a mention-some answer of the embedded question names only an atomic place and supplies only a singleton quantification domain.
2.2. The subquestion-based approach (Beck & Sharvit 2002)

- The quantity adverb quantifies over the set of sub-questions of the embedded question. (Beck & Sharvit 2002)

(11) John mostly knows \([Q \text{ which students came}]\).
\[\approx \text{Most } Q' [Q' \text{ is a relevant sub-question of } Q] \text{ [John knows } Q']\]

(12) \((w: \text{ among the consider four students, abc came but d didn't.})\)
   a. ‘For most students who came, John knows that they came.’
      Relevant subquestions: \{did a came?, did b came?, did c came?\}
   b. ‘For most students, John knows whether they came.’
      Relevant subquestions: \{did a came?, did b came?, did c came?, did d came?\}

2.3. Challenges from questions with collective predicates

2.3.1 The challenge

- The challenge: It is difficult to extend the proposition-based account to cases where the embedded questions take a collective predicate. (Schwarz 1993)

(13) John knows for the most part which professors formed the committee.
\[\approx \text{Most } x \ [x \text{ is one of the profs who formed the committee}] \text{ [John knows that } x \text{ is one of the professors who formed the committee]}\]
\[\vdash \text{Most } p \ [p \text{ an atomic true answer to which profs formed the committee}] \text{ [John knows } p]\]
\[\vdash \text{Most } Q' [Q' \text{ is a relevant sub-question of ‘which profs formed the committee’}] \text{ [John knows } Q']\]

More examples:

(14) a. For the most part Al knows which students formed the bassoon quintet.
   b. For the most part Al knows which soldiers surrounded the fort.
   c. John mostly knows [who can serve on the committee]_{MS}. (cf. ??)

2.4. Williams (2000)

- Williams (2000) proposes a way to maintain the proposition-based approach:
  - the answers of the embedded question take a sub-distributive form:
    \[\{x \text{ is part of a group that formed the committee }: x \text{ is an atomic professor}\}\]
  - This reading is derived if \textit{which} takes a collective semantics.

(15) Which professors formed the committee?
\[\approx \text{‘Which professors } x \text{ is s.t. } x \text{ is part of the professors that formed the committee?’}\]
   a. \[\left[\text{which}_3\right] = \lambda A_{(e,t)} \lambda P_{(e,t)} \lambda p_{(s,t)} \exists x \in A[p = \lambda w.3y \in A[y \geq x \land P_w(y)]]\]
   b. \[\left[\text{which professors}_@ \ f.t.c.\right] = \lambda p. \exists x[\ast \text{ professor}_@ (x) \land p = \lambda w.3y[\ast \text{ professor}_@ (y) \land y \geq x \land f.t.c.w(y)]]\]
\[= \{\lambda w.3y[\ast \text{ professor}_@ (y) \land y \geq x \land f.t.c.w(y)]: x \in \ast \text{ professor}_@\}\]
\[((x \text{ is part of a group of professors } y \text{ such that } y \text{ formed the committee: } x \text{ is professor}(s)))\]
2.4.1 Problems with William (Xiang 2016: ch. 1)

- William’s idea that (15) admits a sub-divisive reading, cannot account for the following contrast:

(16) a. Who is one of the professors that formed the committee, for example?
    b. Which professors formed the committee, # for example?

*For example* cannot be used in a question that has only one true answer:

(17) a. Which boy came, # for example?
    b. Is it raining, # for example?
    c. Which person or people $x$ is such that only $x$ came, # for example?

Proposal: The use of *for example* indicates that the questioner is tolerant of a partial answer, or more precisely, a true proposition in the Hamlin set that is asymmetrically entailed by a complete true answer. Hence, *for example* presupposes the existence of such answers.

(18) $[Q, \text{for example}]^w$ is defined only if $\exists q[w \in Q \land \exists p \in ANS_{FOX}(Q)(w)[p \subset q]]$.

The infelicity of using *for example* in (16b) suggests that *which profs formed a committee* admits only a collective reading, under which this question can have only one true answer. Conversely, if it could take a sub-distributive reading, the use of *for example* wouldn’t be infelicitous in (16b), contra fact.

3. A short answer-based approach (Xiang 2016)

- Xiang (2016: ch. 1) defines a question as a topical property:

(19) a. $[\text{which students came}] = \lambda x[\text{*student}_0(x) = \text{1.came}(x)]$
    b. $[\text{which profs formed the committee}] = \lambda x[\text{*professor}_0(x) = \text{1.f.t.c}(x)]$

- A topical property can supply both propositional answers and short answers. Hence, we can derive the domain of the quantity adverb based on a **short answer** of the embedded question.

The quantity adverb quantifies over either (i) or (ii):

(i) the set of atomic subparts of some complete true propositional answer,

(ii) the set of atomic subparts of some complete true short answer.

- Based on a propositional complete true answer:

(20) $[[\text{John mostly knows Q}]^w = 1 \text{ if and only if} \exists p \in ANS(Q)(w)[\text{MOST} q[p \subseteq q \land q \in \text{At}(Q)][\text{know}(j, q)]]$

(For some complete true answer of Q, John knows most of the atomic possible answers of Q that are entailed by this max-informative true answer.)

- Based on a short complete true answer: 

\[1\]

Note that the following schematization is incorrect:

(21) $\exists x \in ANS^S([Q])(w)[\text{MOST} y[y \in \text{At}(x)][\text{know}_w(j, \lambda w'. \exists z \in ANS^S([Q])(w')[y \subseteq z])]]$
(22) \[ \text{John mostly knows } Q^w = 1 \text{ if and only if} \]
\[ \exists f_{CH} \exists x \in \text{ANS}^S([Q])(w)[\text{MOST } y(y \in \text{AT}(x))[[\text{know}_{w}(j, \lambda w'.y \leq f_{CH}[\text{ANS}^S([Q])(w')])]] \]
(For some \( x \) that is a complete true short answer of \( Q \), most \( y \) that are atomic parts of \( x \) are such that John knows that \( y \) is a part of some particular complete true short answer of \( Q \).)

**Example:**

(23) John knows for the most part \([Q \text{ which professors formed the committee}]\).

\( w: \text{the committee is formed by five professors abcde} \)

a. \( \text{ANS}^S([Q])(w) = \{a \oplus b \oplus c \oplus d \oplus e\} \)

b. \( \text{AT}(a \oplus b \oplus c \oplus d \oplus e) = \{a, b, c, d, e\} \)

c. \( \text{QV inference:} \)
\[ \lambda w.\exists f_{CH}[[\text{MOST } y(y \in \{a, b, c, d, e\})[[\text{know}_{w}(j, \lambda w'.y \leq f_{CH}[\text{ANS}^S([Q])(w')])]] \]

In (23), the proposition-based QV inference is blocked because the embedded question has only one true answer, while the quantification domain of mostly cannot be singleton.

**Discussion:** If the embedded question takes a distributive reading, what inference is predicted by the short answer-based approach?

(24) John mostly knows which students came.

**Exercise:** Derive the QV inference of the following quantified indirect mention-some question.

(25) John mostly knows \([\text{who can serve on the committee}]_{\text{MS}}\).