Pluralities in Concealed Questions, Interrogative Clauses and Individuals

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Seventeenth Amsterdam Colloquium
December 16-18, 2009

1. Introduction.

- The underlined Nouns Phrases (NPs) in (1) have been called 'Concealed Questions' (CQ, henceforth) because sentences that embed them typically have the same truth-conditional meaning as the corresponding versions with a full-fledged embedded interrogative clause, as illustrated in (2) (Heim 1979):

(1) a. John knows <u>the price of milk</u>.
b. They announced <u>the winner of the contest</u>.
c. <u>The temperature of the lake</u> depends on <u>the season</u>.

(2) a. John knows how much the milk costs.
b. They announced who won the contest.
c. How warm the lake is depends on what season it is.

- Concealed questions arising from definite NPs:
$Know_{CQ}$ + INTENSION of the NP (Romero 2005, Aloni 2007; see also Lasersohn 2005).

(3) Mary knows / guessed / revealed / forgot **the** capital of Italy.

(4) a. $[\![know_{interr}]\!](q_{<s,<<s,t>,t>>})\ (z)\ (w) = 1$ iff $\forall w' \in Dox_z(w)\ [\ q(w') = q(w)\ ]$
b. $[\![know_{CQ}]\!]\ (x_{<s,e>})\ (z)\ (w) = 1$ iff $\forall w' \in Dox_z(w)\ [\ x(w') = x(w)\ ]$

(5) $[\![$*the capital of Italy*$]\!]$ = $\lambda w.\ \iota x_e$ [capital-of-Italy(x,w)]

(6) $[\![$*Mary knows the capital of Italy*$]\!]$ =
$\lambda w.\ \forall w' \in Dox_m(w)\ [\ \iota x_e$[capital-of-Italy(x,w')] = ιx_e[capital-of-Italy(x,w)]]

(7) The waiter remembers / knows **the** dishes you ordered.
$\lambda w.\ \forall w' \in Dox_{waiter}(w)$ [σx_e[*dish(x,w') & order(you,x,w')] =
σx_e[*dish(x,w) & order(you,x,w)]]

- Concealed questions arising from quantificational NPs (QuNPs):

(9) The waiter remembered **some / most** dishes you ordered.

(10) $[\![$*most dishes that you ordered*$]\!]$ =
$\lambda Q_{<e,<s,t>>}.\ \lambda w.$ MOST x_e [dish(x,w) & order(you,x,w)] [Q(x)(w)]

PROBLEM: The intension (10) of the quantificational NP_{CQ} does not match the type of the λ-slot. That is, a definite NP provides its intension, but a QuNP fails to combine properly.

- Previous solutions to CQs with quantifiers:
  - Frana (2006): make the λ-slot of *know* be of property type (or higher), as in the case of *look for* (Zimmermann 1993). But see OBSERVATION 1 below.
  - Schwager (2008) and Roelofsen and Aloni (2008, 2009): conceptual covers and salient properties. We will no review this here, but you can ask me in the question period.
  - Heim (2009) building on Frana (2009): Fox' trace conversion plus intensionalization. We will not review this here, but you can ask in the question period.

- GOAL: to sketch a solution to $QuNPs_{CQ}$ that maintains the basic definite analysis (6)-(7).
IDEA: in the same way that adverbials like *to some extent* and *for the most part* quantify over subquestions of a question, *some* and *most* can quantify over sub-individual concepts (sub-ICs) of a CQ individual concept.

(11) The waiter remembered [$_{CQ}$ **some / most** dishes you ordered].
≈
The waiter **to some extent / for the most part** remembered [$_{InterrCP}$ what dishes you ordered].

- Plot:
  §2. Background on QVE with interrogative clauses.
  §3. Three empirical observations about CQs with quantifiers.
  §4. First step towards an analysis.
  §5. A fourth empirical observation.
  §6. Second step towards an analysis.
  §7. Conclusions and further issues.

2. Background on Q(uantification) V(ariability) E(ffect) with interrogative clauses.

(12) John knows for the most part who cheated on the final exam.

- Berman (1991): quantification over individuals; embedding verb takes proposition.

(13) Most x [x cheated on the final exam]
[John knows that x cheated on the final exam]

- Lahiri (1991, 2000, 2002): quantification over propositions (true answers to the question); embedding verb takes proposition.

(14) Most p [p is an answer to 'which students cheated on the final exam' and p is true]
[John knows p]

- Beck and Sharvit (2002):
Their observation: Some verbs that only embed questions (e.g. *depend* and generic uses of *decide* and *determine*) allow for QVE: (15)-(18).
Their proposal: quantification over subquestions; embedding verb takes subquestion.

(15) Who will be admitted depends for the most part (exclusively) on this committee.
(16) * That John will be admitted depends on this committee.

(17) The committee mostly decides which candidates will be admitted.
(18) ? The committee decides that Fritz will be admitted.

(19) A la Berman:
Most x [x will be admitted]
[that x will be admitted depends on the committee]

(20) A la Lahiri:
Most p [p is an answer to 'who will be admitted' and p is true]
[p depends on this committee]

(21) Beck and Sharvit:
Most Q' [Q' is a relevant subquestion of 'who will be admitted']
[Q' depends on this committee]

(22) Q' is a subquestion of Q
iff it is possible that the answer to Q' provides a partial answer to Q. That is,
iff $\exists w' \exists p$ [Ans-strg(Q')(w') $\rightarrow$ p $\wedge$ p is a partial answer to Q]

3. Three empirical observations about CQs with quantifiers.

■ Observation 1: The quantification introduced by the quantifier of a CQ is not part of the intensional object fed into the λ-slot of *know*, but it is external to it. That is, as it was suggested above, the (roughly) correct paraphrase is not (23a), but (23b).
This is shown in (24)-(26).

(23) John knows most of the code.
a. ≠ "John knows what series of digits have the property of being most of the code."
b. = John for the most part knows what series of digits the code has."

(24) Scenario: Unbeknownst to the public/spies, the secret code is 60 digits long. Spy A got the first 15 digits, spy B the first 20 digits and spy C the first 57 digits. None of them knows what proportion of the code their finding amounts to.

(25) No spy knows most of the code.
➯ False in scenario (24).
That is, the sentence cannot be understood as "No spy knows what series of digits have the property of being most of the code".

(26) Look at this. This is what spy C knows of the code. If she knew that she is so close to having the complete code, she'd be unstoppable. # Luckily, she doesn't know most of the code, so she may get discouraged and give up.

■ Observation 2:

- At least in some languages (e.g. Spanish and Catalan), CQs occur quite productively with *know*-type embedding verbs (*know, remember, reveal, tell*, etc.), with *depend*-type embedding verbs, and with *ask*-type embedding verbs. [See Nathan (2006) and Percus (2009) for English.]

(27) - Señor Conde Lucanor -dijo Patronio-, para que sepáis lo que más os conviene hacer en este negocio, me gustaría contaros lo que sucedió a un rey moro con tres pícaros granujas que llegaron a palacio.
Y el conde le preguntó lo que había pasado.
'- Count Lucanor -said Patronio-, in order for you yo know what (*lit*. the that) is most advantageous for you in this business, I would like to tell you what (*lit*. the that) happened to an Arab king with three naughty urchins that arrived in the palace.
And the count **asked** him what (*lit*. the that) had happened.'
http://www.ciudadseva.com/textos/cuentos/esp/juanma/lucanor/32.htm

(28) Lo que haga Marga esta semana depende de ti.
The that does-Subjunct M this week depends on you
'The things Marga goes this week depend on you.'

- Interestingly, in these languages, CQs admit quantificational determiners and adverbs of quantification with *know*-type embedding verbs and with *depend*-type embedding verbs, but they are very awkward with *ask*-type embedding verbs. This parallels the facts about QVE with interrogatives: (29)-(31).

(29) With *know*:
a. Juan sabe en su mayor parte qué estudiantes copiaron en el examen. Adv + Interr
'Juan knows for the most part which students cheated on teh exam.'
b. Juan sabe en su mayor parte los estudiantes que copiaron en el examen. Adv + CQ
'Juan knows for the most part the students who cheated on the exam.'
c. Juan sabe la mayoría de los estudiantes que copiaron en el examen. Det + CQ
'Juan knows most students who cheated on the exam.'

(30) With *depend*: Adv + Interr
a. En su mayor parte, qué haga Marga esta semana depende (exclusivamente) de ti.
'For the most part, what$_{\text{INTERR}}$ Marga does this week depends (exclusively) on you.
b. En su mayor parte, lo que haga Marga esta semana depende (exclusivamente) de ti.
'For the most part, the things (*lit*. the that) Marga does this week depend (exclusively) on you.' Adv + CQ
c. La mayor parte de lo que haga Marga esta semana depende de ti.
'Most of what Marga will do this week depends on you.' Det + CQ

(31) With *ask*:
a. # En su mayor parte, me preguntó qué había comido.
'For the most part, s/he asked me what$_{\text{INTERR}}$ I/she/he had eaten.' Adv + Interr
b. # En su mayor parte, me preguntó lo que había comido. Adv + CQ
'For the most part, s/he asked me the things (*lit*. the that) I/she/he had eaten.'
c. * Me preguntó la mayor parte de lo que había comido. Det + CQ
'S/he asked me most of what I had eaten.'

(32) Observation 2: the three types of quantification follow the same pattern:

	know	*depend*	*ask*
Adv + Interrogative	✓	✓	*
Adv + CQ	✓	✓	*
Det + CQ	✓	✓	*

■ OBSERVATION 3: CQs with quantificational determiners and with adverbs of quantification differ in the kinds of sub-individual concepts they can quantify over.

- Quantifying over ***whether*-subquestions** (or "whether" sub-individual concepts):

(33) For the most part, John knows which students cheated.

(34) Most Q' [Q' is a relevant subquestion of 'which students cheated']
[John knows Q']

(35) Set of *whether*-subquestions:
{Did student 1 cheat?, Did student 2 cheat?, Did student 3 cheat? ...}

(36) For the most part, John knows the students who cheated on the exam.
↳ Adv + CQ: ✓ set (35).

(37) John knows most students who cheated on the exam.
↳ Det + CQ: ✓ set (35).

- Quantifying over **subquestions** induced **by a cumulative plural NP**:

(38) Luise knows for the most part which books these professors recommended.

(39) {Which books did professor 1 recommend?, Which books did professor 2 recommend?, Which books did professor 3 recommend?, ...}

(40) For the most part, Luise knows the books that these professors recommended.
↳ Adv + CQ: ✓ set (39).

(41) Luisa knows most books that these professors recommended.
↳ Det + CQ: * set (39).

- Quantifying over **subquestions** induced **by a distributive plural NP**:

(42) For the most part, how well these children do depends (exclusively) on their families.

(43) {How well does child 1 do?, How well does child 2 do?, ...}

(44) En su mayor parte, el rendimiento diario de estos niños depende exclusivamente del ambiente familar.
'For the most part, the daily performance of these children depends exclusively on the family athmosphere.'
↳ Adv + CQ: ✓ set (43).

(45) # La mayor parte del rendimiento diario de estos niños depende exclusivamente del ambiente familiar.
#'Most of the daily performance of these children depends exclusively on the family athmosphere.'
↳ Det + CQ: * set (43).

- Quantifying over **subquestions** induced **by a pair-list answer**:

(46) Luise mostly knows what everyone did.

(47) {What did person 1 do? What did person 2 do?, What did person 3 do?, ...}

(48) For the most part, Luisa knows the activities that everyone did.
↳ Adv + CQ: ✓ set (47).

(49) Luisa knows most activities that everyone did.
↳ Det + CQ: * set (47).

(50) Observation 3: Det + CQ is more restriced wrt what kinds of sub-ICs we may quantify over:

	"whether" sub-qu/IC	Sub-qu/IC based on distributive plural NP	Sub-qu/IC based on cumulative plural NP	Sub-qu/IC based on pair-list answers
ADV + INTERROGATIVE	✓	✓	✓	✓
ADV + CQ	✓	✓	✓	✓
DET + CQ	✓	*	*	*

4. First step towards an analysis.

4.1. Beck and Sharvit's (2002) analysis of Adv + Interrogative

■ Definitions:

(51) Q' is a subquestion of Q (=(22))
iff it is possible that the answer to Q' provides a partial answer to Q. That is,
iff $\exists w' \exists p$ [Ans-strg(Q')(w') $\rightarrow$ p $\wedge$ p is a partial answer to Q]

(52) A set Part(Q)(w) of questions Q' is a division of Q into subquestions in w iff these subquestions taken together exhaust the original question. More formally: iff
i. For each Q' $\in$ Part(Q)(w), Q' is a subquestion of Q; and
ii. Either a. $\cap${Ans-wk(Q')(w): Q' $\in$ Part(Q)(w)} = Ans-wk(Q)(w)
or b. $\cap${Ans-strg(Q')(w): Q' $\in$ Part(Q)(w)} = Ans-strg(Q)(w)

■ Example of adv + interrogative quantifying over *whether*-subquestions:

(53) For the most part, John knows which students cheated.

(54) λw. Most Q' [Q' $\in$ Part([[*which students cheated*]])(w)]
[John knows Q' in w]

(55) {Did student 1 cheat?, Did student 2 cheat?, Did student 3 cheat?}

■ Example of adv + interrogative quantifying over subquestions induced by a distributive plural NP:

(56) For the most part, how well these children do depends (exclusively) on their families.

(57) λw. Most Q' [Q' ∈ Part(⟦*how well these children do*⟧)(w)]
[Q' depends on their families in w]

(58) {How well does child 1 do?, How well does child 2 do?, How well does child 3 do?}

4.2. Analysis of *for the most part / to some extent* + CQ

■ Proposed definition ("∪" as summation of individuals)

(59) A set Part($x_{<s,e>}$) of individual concepts $y_{<s,e>}$ is a division of $x_{<s,e>}$ into sub-individual concepts iff:
For all w ∈ Dom(x): ∪{y(w): y ∈ Part(x)} = x(w).

■ Example of adv + CQ quantifying over "whether" sub-individual concepts (sub-ICs):

(60) For the most part, Juan knows the students that cheated on the final exam.

(61) λw. Most $y_{<s,e>}$ [C($y_{<s,e>}$) ∧ $y_{<s,e>}$ ∈ Part(⟦*the students that cheated*⟧)(w)]
[John knows $y_{<s,e>}$ in w] [1]

(62) ⟦*the students that cheated on the final exam*⟧ =
λw'. σz_e [*student(z,w') ∧ cheated(z,w')]
E.g.

$$\begin{bmatrix} w_{100} & \text{-->} & 1+2+3 \\ w_{101} & \text{-->} & 2 \\ w_{102} & \text{-->} & \# \end{bmatrix}$$

(63) { λw. ιz_e[student(z,w) ∧ z=stud1 ∧ cheated(z,w)],
λw. ιz_e[student(z,w) ∧ z=stud2 ∧ cheated(z,w)],
λw. ιz_e[student(z,w) ∧ z=stud3 ∧ cheated(z,w)] }
E.g.

$$\left\{ \begin{bmatrix} w_{100} & \text{-->} & 1 \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \begin{bmatrix} w_{100} & \text{-->} & 2 \\ w_{101} & \text{-->} & 2 \\ w_{102} & \text{-->} & \# \end{bmatrix} \begin{bmatrix} w_{100} & \text{-->} & 3 \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \right\}$$

■ Example of adv + CQ quantifying over sub-ICs induced by a cumulative plural NP:

(64) For the most part, Luisa knows the books that these professors recommended.

(65) λw. Most $y_{<s,e>}$ [C($y_{<s,e>}$) ∧ $y_{<s,e>}$ ∈ Part(⟦*the books these profs recommened*⟧)(w)]
[Luisa knows $y_{<s,e>}$ in w]

(66) ⟦*the books that these professors recommended*⟧ =
λw'. σz_e [*book(z,w') ∧ **recommend(these.professors,z,w')]

[1] C in (61) and in later formulas restricts the quantification to natural concepts, in order to avoid e g splitting of [<w_{100},2>, <w_{101},2>] in (63) into two separate unnatural concepts [<w_{100},2>] and [<w_{101},2>]

E.g.

$$\begin{bmatrix} w_{100} & \text{-->} & a+b+c+d+e \\ w_{101} & \text{-->} & e+f+g \\ w_{102} & \text{-->} & \# \end{bmatrix}$$

(67) { λw. σz_e[*book(z,w) ∧ recommend(prof1,z,w)],
λw. σz_e[*book(z,w) ∧ recommend(prof2,z,w)],
λw. σz_e[*book(z,w) ∧ recommend(prof3,z,w)] }
E.g.

$$\left\{ \begin{bmatrix} w_{100} & \text{-->} & a+b+c \\ w_{101} & \text{-->} & e \\ w_{102} & \text{-->} & \# \end{bmatrix} \begin{bmatrix} w_{100} & \text{-->} & b \\ w_{101} & \text{-->} & f \\ w_{102} & \text{-->} & \# \end{bmatrix} \begin{bmatrix} w_{100} & \text{-->} & d+e \\ w_{101} & \text{-->} & g \\ w_{102} & \text{-->} & \# \end{bmatrix} \right\}$$

4.3. Analysis of *most / some* + CQ.

■ Proposed definitions:

(68) A set Part($x_{<s,e>}$) of individual concepts $y_{<s,e>}$ is a division of $x_{<s,e>}$ into sub-individual concepts iff: (=(59))
For all w ∈ Dom(x): ∪{y(w): y ∈ Part(x)} = x(w).

(69) ⟦$most_{CQ}$⟧ =
λ$P_{<e,st>}$.λ$Q_{<se,st>}$.λw. MOST $y_{<s,e>}$ [C($y_{<s,e>}$) ∧ $y_{<s,e>}$ ∈ Part(λw'.σz_e[P(z)(w')]) ∧
$y_{<s,e>}$ is a constant function]
[Q($y_{<s,e>}$)(w)]

■ Example of quantificational Det + CQ quantifying over "whether" sub-ICs:

(70) John knows most students who cheated on the final exam.

(71) ⟦*students who cheated on the final exam*⟧ =
λz_e.λw'. *student(z,w') ∧ cheated(z,w')

(72) λw. MOST $y_{<s,e>}$ [C($y_{<s,e>}$) ∧
$y_{<s,e>}$ ∈ Part(λw'.σz_e[⟦*students who cheated on the final exam*⟧(z)(w')]) ∧
$y_{<s,e>}$ is a constant function]
[John knows $y_{<s,e>}$ in w]

(73) λw'. σz_e [⟦*students who cheated on the final exam*⟧ (z)(w')] =
λw'. σz_e [*student(z,w') ∧ cheated(z,w')] (=(62))
E.g.

$$\begin{bmatrix} w_{100} & \text{-->} & 1+2+3 \\ w_{101} & \text{-->} & 2 \\ w_{102} & \text{-->} & \# \end{bmatrix}$$

(74) { λw. ιz_e[student(z,w) ∧ z=stud1 ∧ cheated(z,w)], (=(63))
λw. ιz_e[student(z,w) ∧ z=stud2 ∧ cheated(z,w)],
λw. ιz_e[student(z,w) ∧ z=stud3 ∧ cheated(z,w)] }
E.g.

$$\left\{ \begin{bmatrix} w_{100} & \text{-->} & 1 \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \begin{bmatrix} w_{100} & \text{-->} & 2 \\ w_{101} & \text{-->} & 2 \\ w_{102} & \text{-->} & \# \end{bmatrix} \begin{bmatrix} w_{100} & \text{-->} & 3 \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \right\}$$

- Example of quantificational Det + CQ failing to quantify over sub-ICs induced by a cumulative plural NP:

(75) For the most part, Luisa knows the books that these professors recommended.

(76) [[*books that these professors recommended*]] =
$\lambda z_e.\lambda w'.$ *prof(z,w') ∧ **recommend(z,w')

(77) λw. MOST $y_{<s,e>}$ [C($y_{<s,e>}$) ∧
$y_{<s,e>} \in$ Part(λw'.σz_e[[*books that these profs recommended*]](z)(w')]) ∧
$y_{<s,e>}$ is a constant function]
[Luisa knows $y_{<s,e>}$ in w]

(78) λw'. σz_e [[[*books that these professors recommended*]] (z)(w')] =
λw'. σz_e [*book(z,w') ∧ **recommend(these.professors,z,w')] (=(66))

E.g. [w_{100} --> a+b+c+d+e
w_{101} --> e+f+g
w_{102} --> #]

(79) { λw. σz_e[*book(z,w) ∧ recommend(prof1,z,w)], (=(67))
λw. σz_e[*book(z,w) ∧ recommend(prof2,z,w)],
λw. σz_e[*book(z,w) ∧ recommend(prof3,z,w)] }

E.g. { [w_{100} --> a+b+c, w_{101} --> e, w_{102} --> #] [w_{100} --> b, w_{101} --> f, w_{102} --> #] [w_{100} --> d+e, w_{101} --> g, w_{102} --> #] }

✎ Quantification over these $y_{<s,e>}$ is ruled out, since *most*, as defined in (72), quantifies over constant functions.

4.4. Interim summary.

- Three empirical observations about CQs with quantifiers (e.g. *most*, *some*):
  - OBSERVATION 1: the quantifier isn't part of the intensional argument, but external to it.
  - OBSERVATION 2: in languages where CQs are productive enough to run the test, the three types of quantification --Adv + interrogative, Adv + CQ and Det + CQ-- follow the same pattern with respect to embedding verb-types *know*, *depend* and *ask*.
  - OBSERVATION 3: Det + CQ is more restriced wrt what kinds of sub-ICs we may quantify over, as Det + CQ can only quantify over "whether" sub-concepts.

- Proposed analysis so far:

In the ADV + CQ construction: ADV quantifies over **any** (natural) sub-individual concepts of the original individual concept.
In the DET + CQ construction: DET builds the sum individual concept and it quantifies over **constant** (natural) sub-individual concepts of it.

- Open question:

Both ADV + CQ and DET + CQ are defined using the Part set. *For the most part* quantifies over the entire set. Why should *most* quantify only over a particular subset of it? What makes the two quantification constructions different?

5. A fourth observation.

- OBSERVATION 4: pluralities of individuals (type e) show same pattern as in observation 3.

(80) a. For the most part, John read the books that these professors recommended.
b. For the most part, John can achieve the performance that those brilliant students achieved on the test.
c. For the most part, John liked what each child did.

(81) a. John read most (of the) books that these professors recommended.
b. # John can achieve most of the performance that those brilliant students achieved on the test.
c. John liked most of what each child did.

- THUS, the difference between Adv+CQ and Det+CQ is just an instance of a more general contrast between Adv+Plural and Det+Plural.

6. Second step towards an analysis.

6.1. Nakanishi and Romero (2004)

- Basic data:

(82) Most of the students cooked. ⇨ "majority of the students"

(83) For the most part, the students cooked. ⇨ "majority of times"
⇨ "majority of the students"

(84) [In this dorm, the students in each room form a team to do household chores.]
Q: What tasks did the students from Room A perform last month?
A: For the most part, the students in Room A cooked.

(85) Most of the boys lifted the piano. ✓collective, ✓distributive
(86) For the most part, the boys lifted the piano. * collective, ✓distributive

- Idea: *Most* quantifies directly over individuals whereas *for the most part* quantifies indirectly over them by quantifying over events (cf. Fintel 1994 for indef.; Löbner 2000).

- Analysis:

(85) Truth conditions for 'Most of NP VP':
$\exists x'$ [$x' \leq$[[NP]] ∧ $|x'| > 1/2|$[[NP]]$|$ ∧ $\forall x''$[$x'' \leq x' \rightarrow$ [[VP]](x'')]]]
Consider the (possibly plural) individual [[NP]], e.g. x. There is a (possibly plural) x' that is major part of x such that for all subindividuals x'' of x', [[VP]](x'') holds.

(86) Truth conditions of 'For the most part NP VP':
$\exists e$ [p(e) ∧ $\exists e'$ [$e' \leq e$ ∧ $|e'| > 1/2|e|$ ∧ $\forall e''$[$e'' \leq e' \rightarrow q(e'')$]]]
There is a general (possibly plural) event e for which p(e) holds and there a (possibly plural) event e' that is a major part of e such that for all subevents e'' of e', q(e'') holds.
RESTRICTOR p = the meaning of the non-focused material
NUCLEAR SCOPE q = the meaning of the focused material.

6.2. Quantification over a plural sum of individuals: direct and indirect.

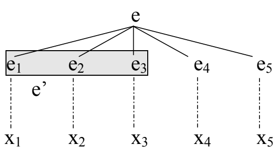
(87) John read most of the books that these professors recommended.

(88) $\lambda w.\ \exists x'\ [\ x' \leq [\![\textit{the books that these profs recommended}]\!](w)\ \wedge$
$|x'| > 1/2|[\![\textit{the books that these profs recommended}]\!](w)|\ \wedge$
$\forall x''[\ x'' \leq x' \rightarrow \text{John read } x'' \text{ in } w\ ]\ ]$

(89) For the most part, John read$_F$ the books that these professors recommended.

(90) $\lambda w.\ \exists e\ [\ e \text{ is in } w \wedge \text{Agent}(e, john) \wedge \text{Theme}(e, [\![\textit{the books that these profs recomm.}]\!](w))$
$\wedge\ \ \exists e'\ [\ e' \leq e\ \ \wedge\ \ |e'| > 1/2|e|\ \ \wedge\ \ \forall e''[\ e'' \leq e' \rightarrow \text{read}(e'')\ ]\ ]\ ]$

(91)



e: Agent(e,john) ∧ Theme(e,σu[books-the profs-recom(u,w)])
e_1, e_2, e_3: read(e_1); read(e_2); read(e_3)
$x_1+x_2+x_3+x_4+x_5$ = these.profs

6.3. Quantification over a plural sum of individual concepts: direct and indirect.

■ Dividing an individual concept into a plural sum of sub-individual concepts.

(92) A sum of individual concepts $x_{1,<s,e>} + x_{2,<s,e>} + ... + x_{n,<s,e>}$ is a plural division of an individual concept $z_{<s,e>}$, PL-DIV(z), iff:
i. For all $x \leq x_{1,<s,e>} + x_{2,<s,e>} + ... + x_{n,<s,e>}$, x is a (possibly partial) constant function, and
ii. For all $w \in Dom(x)$: $x_1(w) + x_2(w) + ... + x_n(w) = z(w)$.

■ Analysis of sentences:

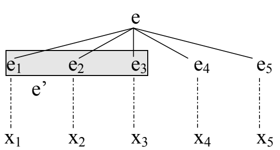
(93) John knows most (of the) books that these professors recommended.

(94) $\lambda w.\ \exists x'\ [\ x' \leq \text{PL-DIV}([\![\textit{the books that these profs recommended}]\!])\ \wedge$
$|x'| > 1/2|\text{PL-DIV}([\![\textit{the books that these profs recommended}]\!])|\ \wedge$
$\forall x''[\ x'' \leq x' \rightarrow \text{John knows } x'' \text{ in } w\ ]\ ]$

(95) For the most part, John knows the books that these professors recommended.

(96) $\lambda w.\ \exists e\ [\ e \text{ is in } w \wedge \text{Agent}(e, john) \wedge \text{Theme}(e, [\![\textit{the books that these profs recomm.}]\!])$
$\wedge\ \ \exists e'\ [\ e' \leq e\ \ \wedge\ \ |e'| > 1/2|e|\ \ \wedge\ \ \forall e''[\ e'' \leq e' \rightarrow \text{know}(e'')\ ]\ ]\ ]$

(97)



e: Agent(e,john) ∧ Theme(e, λw' σu[books-the profs-recom(u,w')])
e_1, e_2, e_3: know(e_1); know(e_2); know(e_3)
$x_1+x_2+x_3+x_4+x_5$ = the.profs

7. Conclusions and further issues.

■ Four empirical observations about CQs with quantifiers (e.g. *most*, *some*):

- OBSERVATION 1: the quantifier in the CQ NP is not part of the intensional argument fed into the verb, but external to it.
- OBSERVATION 2: in languages where CQs are productive enough to run the test, the three types of quantification --Adv+interrogative, Adv+CQ and Det+CQ-- follow the same pattern with respect to embedding verb-types *know*, *depend* and *ask*.
- OBSERVATION 3: Det+CQ is more restriced than Adv+CQ wrt what kinds of sub-individual concepts we may quantify over, as the former can only quantify over "whether" sub-concepts.
- OBSERVATION 4: Det+Plural is more restricted than Adv+Plural in a way parallel to observation 3.

■ Tentatively proposed analysis:

In the **DET + CQ** construction: the original individual concept is divided into a sum of constant sub-individual concepts. DET operates over this sum directly, exactly as it does with plain individuals. There is no parallel construction DET + INTERROGATIVE. In the **ADV + CQ** construction: ADV quantifies directly over events and indirectly --through a mapping from events to other objects-- over sub-individual concepts, exactly as it quantifies indirectly over plain individuals. By extension, in the ADV + INTERROGATIVE construction, ADV quantifies directly over events and indirectly over sub-questions.

■ Further issues: here we have only tackled simple CQs with quantifiers in the so-called set reading. The findings need to be extended to the readings in (98a) and (99).

(98) John knows every phone number. (Heim 1979)
a. Pair reading: John knows that Ann's number is 503, that Bill's number is 431, etc.
b. Set reading: John knows of every phone number that it is a phone number.

(99) John knows every price that Fred knows. (based on Heim 1979)
a. Reading A: John knows every price that Fred does.
b. Reading B: John knows what prices Fred knows.

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Appendix

- If this talk was on the right track, one thing that we have learn is that, besides *know* taking typical, non-constant individual concepts, as in (100), *know* can also combine with constant individual concepts, as in (101).

(100) Mary knows the capital of Italy.
a. $[\![know_{CQ}]\!]$ ($\lambda w.\ \iota x_e$ [capital-of-Italy(x,w)]) (m) (w_0)

$$\begin{bmatrix} w_{100} & \text{-->} & \text{rome} \\ w_{101} & \text{-->} & \text{venice} \\ w_{102} & \text{-->} & \text{trieste} \end{bmatrix}$$

(101) John knows most (of the) students that cheated on the final exam.
a. Most $x_{<s,e>}$ in PL-DIV($[\![$*the students that cheated*$]\!]$): $[\![know_{CQ}]\!]$ (x) (j) (w_0)

$$\begin{bmatrix} w_{100} & \text{-->} & 1 \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \quad \begin{bmatrix} w_{100} & \text{-->} & 2 \\ w_{101} & \text{-->} & 2 \\ w_{102} & \text{-->} & \# \end{bmatrix} \quad \begin{bmatrix} w_{100} & \text{-->} & 3 \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix}$$

- Romero's (2005) analysis of Heim's A/B ambiguity for definite CQs:

(102) John knows the price that Fred knows. (Heim 1979)

(103) **Reading A**: 'John knows the same price that Fred knows.'
There are several relevant questions about prices:
'How much does the milk cost?'
'How much does the oil cost?'
'How much does the ham cost?'
Fred knows the answer to exactly one of these questions, e.g., to the first one.
John knows the answer to this question too.

(104) **Reading B**: 'John knows what price Fred knows.'
There are several relevant questions about prices:
'How much does the milk cost?'
'How much does the oil cost?'
'How much does the ham cost?'
Fred knows the answer to one of these questions, e.g., to 'How much does the milk cost?'. Then, there is the "meta-question" asking which of these questions is the one whose answer Fred knows. John knows the answer to the meta-question. That is, John knows that the question about prices whose answer Fred knows is 'How much does the milk cost?'.

(105) a. Reading A: $[\![$*know*$]\!]$ + EXTENSION of *[$_{NP}$ the price that Fred knows]*.
b. Reading B: $[\![$*know*$]\!]$ + INTENSION of *[$_{NP}$ the price that Fred knows]*.

(106) $[\![$*the price that Fred knows*$]\!]$ =
$\lambda w^*.\ \iota x_{<s,e>}$ [price(x,w*) & $\forall w'' \in Dox_f(w^*)$ [x(w") = x(w*)]]

(107) a. $[\![know_1]\!](x_{<s,e>})(z)(w) = 1$ iff $\forall w'' \in Dox_z(w)$ [x(w") = x(w)]
b. $[\![know_2]\!](x_{<s,<s,e>>})(z)(w) = 1$ iff $\forall w'' \in Dox_z(w)$ [x(w") = x(w)]

(108) **Reading A**: *Know$_1$* + <s,e>-extension of the NP:
$\lambda w.\ \forall w' \in Dox_j(w)$ [$\iota x_{<s,e>}$ [price(x,w) & $\forall w'' \in Dox_f(w)$ [x(w") = x(w)]] (w') =
$\iota x_{<s,e>}$ [price(x,w) & $\forall w'' \in Dox_f(w)$ [x(w") = x(w)]] (w)]

(109) **Reading B**: *Know$_2$* + <s,<s,e>>-intension of the NP:
$\lambda w.\ \forall w' \in Dox_j(w)$ [$\iota x_{<s,e>}$ [price(x,w') & $\forall w'' \in Dox_f(w')$ [x(w") = x(w')]] =
$\iota x_{<s,e>}$ [price(x,w) & $\forall w'' \in Dox_f(w)$ [x(w") = x(w)]]]

- A/B ambiguity with quantificational CQs:

(110) John knows most (of the) prices that Fred knows.

(111) **Reading A**: The quantificational CQ quantifies-in; *know$_1$* combines with trace $t_{<s,e>}$.
Most $x_{<s,e>}$ [price(x,w) & $\forall w'' \in Dox_f(w)$ [x(w") = x(w)]]
[$\forall w'' \in Dox_j(w)$ [x(w") = x(w)]]
E.g. $x_{milk,<s,e>}$, $x_{oil,<s,e>}$, etc.

(112) **Reading B:** PL-DIV + intension of definite CQ.
Most $x_{<s,e>}$ [x in PL-DIV($\lambda w'.\sigma z_{<s,e>}$.price(z,w') & $\forall w'' \in Dox_f(w')$ [z(w") = z(w')])]
[$\forall w'' \in Dox_j(w)$ [x(w") = x(w)]]

$$\begin{bmatrix} w_{100} & \text{-->} & z_{milk,<s,e>} + z_{oil,<s,e>} \\ w_{101} & \text{-->} & z_{ham,<s,e>} \\ w_{102} & \text{-->} & \# \end{bmatrix}$$

$$\begin{bmatrix} w_{100} & \text{-->} & z_{milk} \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \quad \begin{bmatrix} w_{100} & \text{-->} & z_{oil} \\ w_{101} & \text{-->} & \# \\ w_{102} & \text{-->} & \# \end{bmatrix} \quad \begin{bmatrix} w_{100} & \text{-->} & \# \\ w_{101} & \text{-->} & z_{ham} \\ w_{102} & \text{-->} & \# \end{bmatrix}$$

- Heim's pair / set ambiguity, and its combination with the A/B ambiguity

(113) John knows most phone numbers. (Heim 1979)
a. **Pair reading**: John knows that Ann's number is 503, that Bill's number is 431, etc. (up to most relevant people).
b. **Set reading**: John knows of most phone numbers that they are phone numbers.

(114) John knows most phone numbers Fred knows.
a. **Reading A, pair**: Fred knows that Ann's number is 503, that Bill's number is 431, etc. For most of those phone numbers, John knows that too.
⇨ As in (111).
b. **Reading A, set**: Fred knows of several phone numbers that they are phone numbers. For most of those phone numbers, John knows that they are phone numbers too.
⇨ As in (111), except that the $x_{<s,e>}$ quantified over are constant functions.
c. **Reading B, pair**: Fred knows what Ann's number is, what Bill's number is, etc. For most of those questions, John knows that Fred knows the answer to them.
⇨ As in (112).
d. **Reading B, set**: Fred knows that 503 is a phone number, that 431 is a phone number, etc. For most of those propositions, John knows that Fred knows them.
⇨ As in (112), except that the $z_{<s,e>}$ quantified over are constant functions.