Solving the dilemma between uniqueness and mention some*

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1. Introduction

Most *wh*-questions admit only exhaustive answers. For example, to properly answer (1), the addressee needs to specify all the attendants to the party, as in (1a). If the addressee can only provide a non-exhaustive answer, then he needs to indicate the incompleteness of his answer. For instance, he can mark his answer with a prosodic rise-fall-rise contour (in the following indicated by '.../'), as in (1b). We call (1a) a *complete answer* while (1b) a *partial answer*. If a partial answer is not properly marked, such as taking a falling tone as in (1c) (in the following indicated by '\'), it gives rise to an undesired exhaustivity inference.

(1) Who went to the party?
(*w: only John and Mary went to the party.*)

a. John and Mary.
b. John did .../ $\rightsquigarrow$ *I don't know who else did.*
c. #John did.\ $\rightsquigarrow$ *Only John did.*

Nevertheless, $\Diamond$-*questions* (i.e., questions containing an existential priority modal) admit also non-exhaustive answers (Groenendijk & Stokhof 1984). For instance, the $\Diamond$-question (2) can be naturally answered by specifying one or all of the chair candidates, as in (2a) and (2b)/(2c), respectively. Moreover, while being non-exhaustive, the answer (2a) does not need to carry an ignorance mark: it does not yield an exhaustivity inference even if taking a falling tone. We call answers like (2a) "mention-some (MS) answers" while answers like (2b)/(2c) "mention-all (MA) answers". Questions admitting and rejecting MS answers are called " MS questions" and "MA questions", respectively.

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(2) Who can chair the committee?
(*w: only John and Mary can chair*)

a. John.\ $\not\rightsquigarrow$ *Only John can chair.*
b. John and Mary.\
c. John or Mary.\

Singular *wh*-items trigger *uniqueness effects*: a singular *wh*-question has only one true answer. For instance, (3a) is incoherent because the question implies that *only one of the boys came*, which contradicts the second clause. Numeral-modified *wh*-items also trigger uniqueness effects. For example, the question in (4) implies that *only two of the boys came*, which contradicts the second clause.

(3) a. 'Which professor came? # I heard that many professors did.'
b. 'Which professors came? I heard that many professors did.'
c. 'Who (among the professors) came? I heard that many professors did.'

(4) 'Which two boys came? # I heard that three boys did.'

2. The dilemma

2.1 Dayal's presupposition

Dayal (1996) defines question roots as Hamblin sets and derives complete true answers from Hamblin sets via a presuppositional $\textsc{Ans}_D$-operator: $\textsc{Ans}_D(Q)(w)$ returns the unique strongest true answer of Q in w and presupposes the existence of this strongest true answer. The strongest true answer is the true answer that entails all the true answers.

(5) $\textsc{Ans}_D(\mathrm{Q})(w)$
$= \exists p[w \in p \in \mathrm{Q} \wedge \forall q[w \in q \in \mathrm{Q} \rightarrow p \subseteq q].\iota p[w \in p \in \mathrm{Q} \wedge \forall q[w \in q \in \mathrm{Q} \rightarrow p \subseteq q]$

The presupposition of Ans_D, henceforth called *Dayal's presupposition*, captures the uniqueness effects of singular *wh*-items: in a singular question, the presupposition of $\textsc{Ans}_D$ is satisfied iff this question has a unique true answer which names a singularity. **First**, following standard ontology of individuals (Sharvy 1980; Link 1983), Dayal assumes that a singular NP denotes a set of atomics, while a plural NP denotes a set consisting of both atomics and sums. For instance, with two boys a and b taken into considerations, we have $boy' = \{a,b\}$ and $boys' = {*}boy' = \{a,b,a \oplus b\}$. **Next**, applying this idea to *wh*-phrases, Dayal gets an $\exists$-quantifier quantifying over atomic boys for *which boy*, and one quantifying over both atomic and sum boys for *which boys*. **Finally**, the Hamblin set denoted by the plural question (6a) includes plural propositions, while the one denoted by the singular question (6b) doesn't.[1] Hence, in the given scenario, (6b) has a strongest true answer $came'(a \oplus b)$, while (6a) does not. Employing $\textsc{Ans}_{Dayal}$ in (6a) yields a presupposition failure.

[1]For simplicity, I use Q_w to represent the full set of true answers of Q in w: $Q_w = \{p : w \in p \in Q\}$.

(6) (*w: Among the boys, only Andy and Billy came.*)

a. Which boy came? $\mathrm{Q}_w = \{came'(a), came'(b)\}$

b. Which boys came? $\mathrm{Q}_w = \{came'(a), came'(b), came'(a \oplus b)\}$

Briefly speaking, under Dayal's account, for a question being able to take multiple true answers and constantly being defined, the answer space (i.e., the Hamblin set) of this question must be closed under conjunction.

Dayal's presupposition leaves no space for MS: it predicts that only exhaustive answers can be complete answers, while MS answers are non-exhaustive. Hence, Dayal would have to attribute the acceptability of MS to pragmatic factors: MS answers are partial answers that are sufficient for the conversational goal of the question (Groenendijk & Stokhof 1984; van Rooij 2004; a.o.). Under this view, (2a) is acceptable because the goal of asking (2) is just to find a qualified committee chair.

While acknowledging the role of pragmatics in blocking MS, I disagree that the availability of MS is purely due to pragmatics. MS is a special form of non-exhaustivity: a MS answer specifies exactly one possible choice, rather than any sub-list of possible choices. **First**, when answering a matrix $\diamond$-question, mention-intermediate (MI) answers (i.e., non-exhaustive answers that specify multiple choices) like (7b) must be ignorance-marked, unlike MS answers like (7a). This contrast is unexpected under the pragmatic view, since MI answers are sufficient for a "mention-one" conversational goal.

(7) Who can chair the committee? (*w: only John, Mary, and Sue can chair.*)

a. John.\ $\not\rightsquigarrow$ *Only John can chair.*

b. John and Mary.../

b′ #John and Mary.\ $\rightsquigarrow$ *Only John and Mary can chair.*

Second, indirect $\diamond$-questions admit MS and MA readings, but not MI readings. But a conversational goal can be naming any amount of chair candidates. For instance, the following scenario has a "mention-three" goal: the dean wants to make plans for a committee and wants to meet three people who can chair this committee. In this scenario, a pragmatic account incorrectly predicts (8) to take the odd reading (8c): (8) is true iff John knows three or more candidates, and false if John knows less than three candidates. A semantic account does not have this prediction: complete answers derived from the possible logical forms of an MS-question are either mention one or mention all, not intermediate.

(8) John knows who can chair the committee.

a. For some individual x who can chair, John knows that x can chair. $\surd$

b. For every individual x who can chair, John knows that x can chair. $\surd$

c. For some three individuals xyz who each can chair, John knows that xyz each can chair. $\times$

2.2 Fox's generalization of mention-some

To derive MS grammatically, Fox (2013) weakens the definition of completeness: any *maximally informative* (MaxI) true answer counts as a complete true answer; a true answer is MaxI iff it is not asymmetrically entailed by any of the true answers. MS answers are MaxI true answers that are non-exhaustive. Formally, Fox defines the $\textsc{Ans}_F$-operator as follows: $\textsc{Ans}_F(\mathrm{Q})(w)$ returns the set of MaxI true answers of Q. Fox predicts the following *generalization of MS*: a question takes a MS reading iff it can have multiple MaxI true answers.

(9) $\textsc{Ans}_F(\mathrm{Q})(w) = \{p : w \in p \in \mathrm{Q} \wedge \forall q[w \in q \in \mathrm{Q} \rightarrow q \not\subset p]\}$

Compare the questions in (10). Underlining marks the MaxI true answers. With an answer space closed under conjunction, the basic *wh*-question (10a) has and can have only one MaxI true answer, which is also the strongest true answer. In contrast, the $\Diamond$-question (10b) can have multiple ones, which are all MS answers.

(10) a. Who came to the party?
(*w: only J and M came to the party.*)
$Q_w = \{came'(j), came'(m), \underline{came'(j \oplus m)}\}$

b. Who can chair the committee?
(*w: only J and M can chair; single-chair only.*)
$Q_w = \{\underline{\Diamond chair'(j)}, \underline{\Diamond chair'(m)}\}$

While leaving space for MS, Fox still rules out some good MS answers. Both answers of (11) are intuitively proper MS answers; but the plain meaning of (11a) is asymmetrically entailed by that of (11b). Thus, Fox predicts (11a) to be partial, contra the fact. To solve this problem, Xiang (2016a) proposes that the $\Diamond$-modal embeds an O-exhaustifier associated with the *wh*-trace, based on the intuition that the interpretation of (11a) involves exhaustivity scoping beneath the possibility modal *can*: *it is possible to have only AB serve on the committee*. This O-operator creates a non-monotonic environment w.r.t. the *wh*-trace, which therefore prevents (11b) from being entailed by (11a) and preserves (11b) as MaxI.

(11) Who can serve on the committee?
(*w: the committee can be made up of AB or ABC.*)

a. Andy and Billy. $\Diamond O[serve'(a \oplus b)]$

b. Andy, Billy, and Cindy. $\Diamond O[serve'(a \oplus b \oplus c)]$

(12) $O(p) = \lambda w.p(w) \wedge \forall q \in \mathscr{A}lt(p)[p \not\subseteq q \rightarrow \neg q(w)]$ (Chierchia et al. 2013)
(p is true, any alternatives of p not entailed by p are false.)

A dilemma arises between Dayal's presupposition and Fox's generalization of MS: if a question has multiple MaxI true answers instead of a unique strongest true answer, Dayal predicts it to be undefined, while Fox predicts it to be MS. If we follow Dayal's presupposition, MS can never be grammatically licensed, as discussed in section 3.1. Alternatively, if we stick to Fox's generalization of MS and discard Dayal's presupposition, we cannot capture the uniqueness effects of singular and numeral-modified *wh*-items. For example in (6a), repeated below, both true answers are MaxI; therefore, Fox's generalization of MS predicts (13) to be a MS question, which is apparently incorrect.[2]

(13) Which boy came?
(*w: Among the boys, only Andy and Billy came.*)
$\mathrm{Q}_w = \{\underline{came'(a)}, \underline{came'(b)}\}$

3. Questions with non-monotonic collective predicates

Dayal (1996) and Fox (2013) have considered only questions with distributive predicates. In a question of this sort, its answer space is closed under conjunction as long as the NP-complement of the *wh*-phrase denotes a set closed under sum.

Nevertheless, this generalization does not extend to questions with non-monotonic collective predicates. For example, (14) clearly admits only MA and is not subject to uniqueness. If the quantificational domain of *which boys* is $*boy'$, as Dayal assumes, then the Hamblin set yielded by (14) would be (14a). This set, however, is not closed under conjunction; moreover, it has no strongest true member under a discourse that the boys formed multiple independent teams. Hence, Dayal predicts a uniqueness effect, and Fox predicts a MS reading. Both predictions are problematic.

(14) Which boys formed a team?
(*w: the boys formed two teams in total: ab formed one, and cd formed one.*)

a. $\mathrm{Q} = \{form'(x) : x \in *boy'_{@}\}$
b. $\mathrm{Q}_w = \{form'(a \oplus b), form'(c \oplus d)\}$
c. $\textsc{Ans}_D(\mathrm{Q})(w)$ is undefined (# uniqueness)
d. $\textsc{Ans}_F(\mathrm{Q})(w) = \{form'(a \oplus b), form'(c \oplus d)\}$ (# MS)

4. My proposal

I will firstly introduce a hybrid approach to compose questions, which takes aspects from both Karttunen Semantics and categorial approaches. Under this approach, the ANS-operator can interact with short answers (viz., the items in the quantificational domain of a *wh*-item). Next, I argue that the quantificational domain of a plural or number-neutral *wh*-item is *polymorphic*: it consists of not only individuals but also generalized conjunctions and disjunctions. To fulfill Dayal's presupposition in a MS question, we just need to interpret generalized conjunctions with wide scope.

[2]Fox (2013) provides a solution to this dilemma based on innocent exclusion and Spector's (2007) diagnose of higher-order answers. But this solution fails in $\Diamond$-questions with a universal quantifier. See details in Xiang (2015, 2016b).

4.1 A hybrid approach of question semantics

I define the root denotation of a question as a *topical property* (written as '**P**'), namely a λ-abstract ranging over propositions, as exemplified in (15). It maps a short answer (e.g., *John*) to a propositional answer (e.g., *John came*). Dom(**P**) is the set of short answers, and Range(**P**) is the Hamblin set.

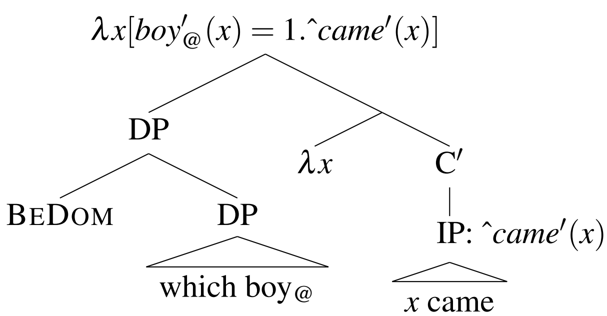
(15) Which boy$_@$ came?
$$\mathbf{P} = \lambda x_e[boy'_@(x) = 1.\hat{}came'(x)]$$

Unlike the traditional categorical approaches, I treat *wh*-items as $\exists$-quantifiers (*à la* Karttunen 1977). Next, I propose a new type-shifter BEDOM which converts an $\exists$-quantifier $\mathscr{P}$ into a *domain restrictor*: BEDOM($\mathscr{P}$) applies to a function θ and restricts the domain of θ with the quantificational domain of $\mathscr{P}$ (viz., the set BE($\mathscr{P}$).[3])

(16) BEDOM($\mathscr{P}$)
$$= \theta_\tau.\iota P_\tau[[\text{Dom}(P) = \text{Dom}(\theta) \cap \text{BE}(\mathscr{P})] \wedge \forall\alpha \in \text{Dom}(P)[P(\alpha) = \theta(\alpha)]]$$

As exemplified in (17), BEDOM(which boy) applies to a property defined for any individuals and returns a property defined only for atomic boys.

(17)



Next, the topical property directly enters into an answerhood-operation, returning the set of complete true answers. To adapt ANS_F to the proposed question semantics, we need the ANS-operator to be applied to a topical property **P**. Given that the range of **P** is equivalent to the Hamblin set, I define the ANS-operator as in (18): ANS(**P**)(w) returns the set of MaxI true members in the range of **P**.

(18) ANS(**P**)(w)
$$= \{\mathbf{P}(\alpha) : \alpha \in \text{Dom}(\mathbf{P}) \wedge w \in \mathbf{P}(\alpha) \wedge \forall\beta \in \text{Dom}(\mathbf{P})[w \in \mathbf{P}(\beta) \rightarrow \mathbf{P}(\beta) \not\subset \mathbf{P}(\alpha)]\}$$

[3]The type-shifter BE converts an $\exists$-quantifier $\mathscr{P}$ to the quantificational domain of $\mathscr{P}$.

(i) a. $\text{BE}(\mathscr{P}) = \lambda x[\mathscr{P}(\lambda y.y = x)]$ (Partee 1987)
b. $[\![\text{which boy}]\!] = \lambda f.\exists x \in boy'_@[f(x)]$
c. $\text{BE}(\text{which boy}) = boy'_@$

4.2 Quantificational domains of *wh*-items

Under the traditional view, the quantificational domain of a *wh*-item is the set of individuals denoted by the *wh*-complement. In contrast, I argue that the domain of a plural or number-neutral *wh*-item is *polymorphic*: it consists of not only individuals but also generalized disjunctions and conjunctions.

Spector (2007, 2008) makes the first empirical argument for the existence of higher-order items in the domain of *wh*-words. He observes that elided disjunctions can be used as complete answers of questions with a universal modal (called "□-questions" henceforth), as exemplified in (19a), where the disjunction takes scope below the universal modal.

(19) "What does John have to read?" "*Syntax* or *Morphology*."

a. 'John has to read S or M, and the choice is up to him.' (*have to* > *or*)
b. 'John has to read S or M, I don't know which exactly.' (*or* > *have to*)

To obtain the reading (19a), the disjunction must be interpreted as a generalized quantifier (GQ) as in (20a) and taking scope below the □-modal. Hence, Spector proposes that the *wh*-word *what* can quantify over GQs.

(20)

a. $[\![\textit{Syntax} \text{ or } \textit{Morphology}]\!] = s \vee m = \lambda P_{\langle e,t \rangle}[P(s) \vee P(m)]$
b. $[\![(19\text{a})]\!] = \Box[(s \vee m)(\lambda x.read'(j,x))] = \Box[read'(j,s) \vee read'(j,m)]$

Furthermore, Fox (2013) observes that disjunctions cannot completely answer a singular □-question, as exemplified in (21). Using Spector's diagnose, Fox conjectures that the quantificational domain of the singular phrase *which book* does not include GQs.

(21) "Which book does John have to read?" "*Syntax* or *Morphology*."

a. #'John has to read S or M, and the choice is up to him.' (*have to* > *or*)
b. 'John has to read S or M, I don't know which exactly.' (*or* > *have to*)

Evidence from questions with collective predicates shows that the quantificational domains of plural and number-neutral *wh*-items consist also generalized conjunctions. The infelicity of (22a) suggests that the predicate *formed a team* supports only collective readings. Hence, (22b) suffers presupposition failure because the factive *know* embeds a false collective declarative. Surprisingly, the corresponding indirect question (22c) does not suffer presupposition failure (cf. (22d)).

(22) (*w: The boys formed two teams in total: ab formed one, and cd formed one.*)

a. #The boys formed a team. (collective)
b. #John knows [that **the boys** formed a team].
c. John knows [**which boys** formed a team].
d. #John knows [**which two boys** formed a team].

Moreover, (22c) intuitively implies that John knows the conjunctive inference that *ab formed a team, and cd formed a team*. The conjunctive closure clearly does not come from the collective predicate *formed a team* or anywhere within the question nucleus, otherwise (22a) would be true. I argue that this conjunctive is obtained from the *wh*-phrase, namely the domain of *which boys* includes also generalized conjunctions like $a \oplus b \wedge c \oplus d$, and hence that the embedded question in (22c) can take (23b) as a possible answer. In comparison, the presupposition failure of (22d) suggests that conjunctions are excluded from the quantificational domain of *which two boys*.

(23) a. $[\![ab \text{ and } cd]\!] = a \oplus b \wedge c \oplus d = \lambda P_{\langle e,t \rangle}[P(a \oplus b) \wedge P(c \oplus d)]$
b. $\textit{form-team}'(a \oplus b) \wedge \textit{form-team}'(c \oplus d)$

In sum, higher-order are only available in the domain of plural or number-neutral *wh*-items. Hence, we can conclude that the domain of a *wh*-item includes higher-order elements iff the denotation of its NP-complement is closed under sum. To capture this generalization formally, I propose that the *wh*-closure contains a *dagger (†)-operation*, as in (24).

(24) $[\![\text{which } A]\!] = \lambda B.\exists \alpha \in [\dagger A \cap B]$

The †-operation closes a set A under generalized conjunction and disjunction iff A itself is closed under sum, as schematized in (25). Conjunction and disjunction are defined cross-categorically as in (26). Some concrete examples are given in (27).

(25) $$\dagger A = \begin{cases} \textsc{min}\{X : A \subseteq X \wedge \forall \tau \forall Y_{\langle \tau,t \rangle}[Y \subseteq X \wedge Y \neq \varnothing \rightarrow \bigvee Y \in X \wedge \bigwedge Y \in X]\} & \text{if } {*A} = A \\ A & \text{otherwise} \end{cases}$$
(if A is closed under sun, then $\dagger A$ is the minimal superset of A that is closed under conjunction and disjunction; other wise $\dagger A = A$.)

(26) a. $\alpha_\tau \wedge \beta_\tau = \{P_{\langle \tau,t \rangle} : \alpha \in P\} \cap \{P_{\langle \tau,t \rangle} : \beta \in P\} = \lambda P_{\langle \tau,t \rangle}[P(\alpha) \wedge P(\beta)]$
b. $\alpha_\tau \vee \beta_\tau = \{P_{\langle \tau,t \rangle} : \alpha \in P\} \cup \{P_{\langle \tau,t \rangle} : \beta \in P\} = \lambda P_{\langle \tau,t \rangle}[P(\alpha) \vee P(\beta)]$

(27) With two boys a and b taken into considerations, we have:
a. $$\textsc{Be}([\![\text{which boys}]\!]) = \dagger{*}\text{boy}' = \left\{ \begin{array}{l} a,\, b,\, a \oplus b, \\ a \wedge b,\, a \vee b,\, a \wedge a \oplus b,\, ... \\ (a \wedge b) \vee b,\, ... \end{array} \right\}$$
b. $\textsc{Be}([\![\text{which boy}]\!]) = \dagger\text{boy}' = \{a, b\}$

In case that the domain of a *wh*-item is polymorphic, the semantic type of the topical property is determined by the type of the highest *wh*-trace. This is so BEDOM(*wh*P) always returns something of the same type as its sister node. Consider the □-question (28) for an illustration. This question, as Spector (2007, 2008) observes, is ambiguous between an individual reading (28a) and a higher-order reading (28b).

(28) What does John have to read?

a. 'What is an item x such that John has to read x?'
[BEDOM(what) λx [$\Box$ [John read x]]]

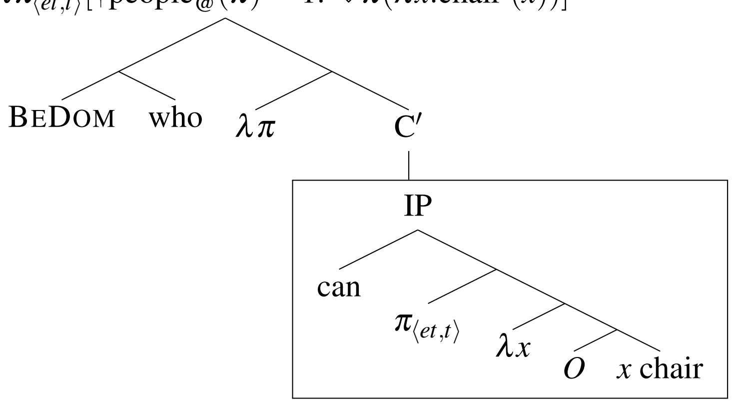
b. 'What is a generalized quantifier π such that John has to read π?'
[BEDOM(what) $\lambda\pi$ [$\Box$ $\pi_{\langle et,t\rangle}$ λx [John read x]]]

Under the proposed analysis, this ambiguity can be reduced to a structural ambiguity within the question nucleus, namely whether or not the *wh*-word takes an IP-internal QR before the *wh*-movement. If BEDOM(what) directly moves to [Spec, CP] from its base position, then it has only one *wh*-trace which is of type e, and hence the topical property is only defined for elements of type e. Alternatively, if BEDOM(what) takes an IP-internal QR (from x to π) before reaching [Spec, CP], its *wh*-movement creates a higher-order trace of type $\langle et,t\rangle$, and thus the topical property is a property of generalized quantifiers.[4]

4.3 Deriving mention-some

I propose the following LF to derive the topical property of MS.

(29) Who can chair the committee?
$\mathbf{P}_{\langle ett,st\rangle} : \lambda\pi_{\langle et,t\rangle}[\dagger\text{people}'_{@}(\pi) = 1.\hat{\ }\Diamond\pi(\lambda x.\text{chair}'(x))]$



The question nucleus (viz., the IP part) has three features. **First**, BEDOM(who) takes a local QR (from x to π) and then a *wh*-movement to [Spec, CP]. These movements create two traces: an individual trace x and a higher-order trace π. Hence, the obtained $\mathbf{P}$ is a property of GQs (of type $\langle ett,st\rangle$). This feature rules in GQs as possible short answers, which, as we will see soon, is important for distinguishing MS questions and questions that are subject to uniqueness. **Second**, the higher-order trace π scopes below the $\Diamond$-modal.[5] **Last**, as discussed in (11), the $\Diamond$-modal embeds an exhaustivity O-operator associated with the individual *wh*-trace x.

[4]Following Cresti (1995) and Rullmann (1995), we can say that the derivation of a higher-order reading involves *semantic reconstruction*.

[5]If the higher-order trace π scopes above the $\Diamond$-modal, the answer space will be closed under conjunction, yielding a conjunctive MA reading.

The obtained topical property yields the following answer space. Arrows indicate entailment relations. This answer space consists of three types of answers: conjunctive answers (row 1-2), individual answers (row 3), and disjunctive answers (row 4-5).

(30)

$$\begin{tikzcd}
 & \Diamond[Of(a)\wedge Of(b)\wedge Of(a\oplus b)] & \\
\Diamond[Of(a)\wedge Of(b)] & \Diamond[Of(a)\wedge Of(a\oplus b)] & \Diamond[Of(b)\wedge Of(a\oplus b)] \\
\Diamond Of(a) \arrow[d] \arrow[dr] & \Diamond Of(b) \arrow[dl] \arrow[dr] & \Diamond Of(a\oplus b) \arrow[dl] \arrow[d] \\
\Diamond[Of(a)\vee Of(b)] \arrow[dr] & \Diamond[Of(a)\vee Of(a\oplus b)] \arrow[d] & \Diamond[Of(b)\vee Of(a\oplus b)] \arrow[dl] \\
 & \Diamond[Of(a)\vee Of(b)\vee Of(a\oplus b)] &
\end{tikzcd}$$

Conjunctive
(contradictory)

Individual
(independent)

Disjunctive
(partial)

Due to the presence of a local O-operator, the conjunctive answers are all contradictory, and the individual answers are all semantically independent (regardless of whether f is treated as distributive or collective). Disjunctive answers are asymmetrically entailed by some individual answers. Moreover, as illustrated in (31), a disjunctive answer equals the disjunction of the corresponding individual answers; hence, disjunctive answers are always partial: whenever a disjunctive is true, there must be a true individual answer that asymmetrically entails this disjunctive answer. In sum, only individual answers can be MaxI. This prediction captures the observation that a MS answer specifies only one possible choice.

(31)

$$\begin{tikzcd}
\Diamond Of(a) \arrow[dr] & \vee \arrow[d, leftrightarrow] & \Diamond Of(b) \arrow[dl] \\
 & \Diamond[Of(a)\vee Of(b)] &
\end{tikzcd}$$

For the sake of simplicity, the rest discussion ignores the answers based on sums like $a\oplus b$. The following square represents the answer space of (29) in the given scenario. Shading marks the true answers, and underlining marks the MaxI true answers. Observe that both individual answers are MaxI true answers. Hence $\text{Ans}(\mathbf{P})(w) = \{\Diamond Of(a), \Diamond Of(b)\}$.

(32) Who can chair the committee?
(*w: only Andy and Billy can chair; single-chair only*)

$$\begin{tikzcd}
 & \Diamond[Of(a)\wedge Of(b)] & \\
\underline{\Diamond Of(a)} \arrow[dr] & \vee \arrow[d, leftrightarrow] & \underline{\Diamond Of(b)} \arrow[dl] \\
 & \Diamond[Of(a)\vee Of(b)] &
\end{tikzcd}$$

4.4 Solving the dilemma

Adapting to the proposed question semantics, I schematize Dayal's presupposition as in (33), where the $\textsc{Ans}_{D'}$-operator is operated on a topical property **P**. This revision makes it possible for $\textsc{Ans}_{D'}$ to interact with the items in Dom(**P**), namely the short answers.

(33) $\textsc{Ans}_{D'}(\mathbf{P})(w)$ is defined iff
$\exists\alpha \in \text{Dom}(\mathbf{P})[w \in \mathbf{P}(\alpha) \wedge \forall\beta \in \text{Dom}[w \in \mathbf{P}(\beta) \rightarrow \mathbf{P}(\alpha) \subseteq \mathbf{P}(\beta)\}]]$
(there is an item α in Dom(**P**) s.t. $\mathbf{P}(\alpha)$ is the strongest true member in Range(**P**).)

To salvage the dilemma between Dayal's presupposition and Fox's generalization of MS, I propose the following repair strategy: in search of the strongest true answer, short answers that are GQs can be interpreted as if they took wide scope. Technically, this wide scope reading can be obtained by type-shifts, such as *internal lift* (Shan & Barker 2006), (written as '$\upuparrows$'). Compared with canonical Montague lift (written as '$\uparrow$'), internal lift forces a higher type expression to take wide scope.[6]

(34) a. $\alpha = \lambda f_{\langle\tau,t\rangle}.\alpha(\lambda x_\tau.f(x))$ $\langle\tau t,t\rangle$
b. $\alpha^{\uparrow} = \lambda\theta_{\langle\tau tt,t\rangle}.\theta(\lambda f_{\langle\tau,t\rangle}.\alpha(\lambda x_\tau.f(x)))$ $\langle\langle\tau tt,t\rangle,t\rangle$
c. $\alpha^{\upuparrows} = \lambda\theta_{\langle\tau tt,t\rangle}.\alpha(\lambda x_\tau.\theta(\lambda f_{\langle\tau,t\rangle}.f(x)))$ $\langle\langle\tau tt,t\rangle,t\rangle$

Using this technique, I weaken Dayal's presupposition as in (35), which allows the strongest true answer to be obtained based on a internally lifted variant of a short answer.

(35) $\textsc{Ans}(\text{P})(w)$ is defined iff
$\exists\alpha \in \text{Dom}(\text{P})\exists\alpha'\{\alpha,\alpha^{\upuparrows}\}[w \in \text{P}(\alpha') \wedge \forall\beta \in \text{Dom}(P)[w \in \text{P}(\beta) \rightarrow \text{P}(\alpha') \subseteq \text{P}(\beta)]]$
(there is an α in Dom(P) s.t. for some α' that is a type-lifted variant of α, $\text{P}(\alpha')$ is true and entails all the true propositions in Range(P).)

To be more concrete, consider (36) for a demonstration. We start with a topical property for MS (36a), which is compositionally derived based on the LF in (29). The domain of this property is a set of generalized conjunctions and disjunctions over human individuals. Compare (36d) and (36e): while composing with the same **P**, a basic generalized conjunction $a \wedge b$ yields a contradiction, but the internally lifted conjunction $(a \wedge b)^{\upuparrows}$ yields a conjunctive MA answer.

(36) Who can chair the committee?
(*w: Only Andy and Billy can chair; only single-chair is allowed.*)
a. $\mathbf{P} = \lambda\pi_{\langle et,t\rangle}[\dagger\text{people}'_{@}(\pi) = 1.\hat{}\Diamond\pi(\lambda x.\text{chair}'(x))]$
b. $a \wedge b = \lambda P[(j \wedge m)(\lambda x.P(x))] = \lambda P[P(a) \wedge P(b)]$
c. $(a \wedge b)^{\upuparrows} = \lambda\theta[(a \wedge b)(\lambda x.\theta(\lambda P.P(x)))] = \lambda\theta[\theta(\lambda P.P(a)) \wedge \theta(\lambda P.P(b))]$

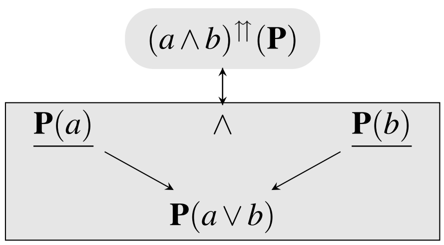
[6] There are other type-shifting operations to obtain this wide scope reading.

d. $\mathbf{P}(a \wedge b) = \Diamond[Ochair'(a) \wedge Ochair'(b)]$ $(\Diamond > \wedge)$

e. $(a \wedge b)^{\upuparrows}(\mathbf{P}) = \Diamond Ochair'(a) \wedge \Diamond Ochair'(b)$ $(\wedge > \Diamond)$

See the figure in (37) for a more intuitive illustration. Although the original answer space (the squared part) has no strongest true answer, a true proposition obtained based on $(a \wedge b)^{\upuparrows}$ entails all the true answers, which therefore fulfills the presupposition of ANS in (35). Applying ANS picks out the MaxI true propositions in the original answer space, yielding a set of MS answers.[7]

(37) (*w: only Andy and Billy can chair; single-chair only*)



This repair strategy preserves the merits of Dayal's presupposition: type-shifting a non-scopal element has no scopal effect. *Which boy* lives on a set consisting of only atomic boys, which is therefore the only possible domain for the topical property of (38).

(38) Which professor can chair?
$\mathbf{P} = \lambda x[\text{prof}'_{@}(x) = 1.\hat{}\Diamond\text{chair}(x)]$

Type-shifting an atomic element, whichever operation is employed, does not change the corresponding propositional answer. For instance, let a stand for the atomic boy *Andy*, $\mathbf{P}(a)$ and $a^{\uparrow}(\mathbf{P})$ both return the singular answer that *a can chair*.[8] Hence, the proposed repair strategy makes no change to the answer space. In the case that multiple boys came, the presupposition of ANS is not satisfied, which therefore explains the uniqueness requirement. This analysis also extends to numeral-modified questions.

4.5 Questions with collective predicates

Adding generalized conjunctions to the quantificational domain of *wh*-items, the proposed analysis can easily predict the MA reading of questions with collective predicates.

The topical property of (39) can be a property defined for (i) individuals in $*boy'_{@}$ or (ii) generalized conjunctions and disjunctions over $*boy'_{@}$, yielding an individual reading

[7] The proposed analysis for preserving MS relies on the scope ambiguity of generalized conjunctions. Accordingly, MS readings are higher-order readings, which create topical properties defined for GQs. Moreover, the derivation of a higher-order reading involves scope reconstruction, which is sensitive to weak islands (Spector 2007, 2008). For these reasons, I predict that MS readings are subject to weak island constraints.

[8] As Simon Charlow (p.c.) points out, the internal-lift operation is not defined on a proper name. But it is possible to internally lift a lifted proper name: $(a^{\uparrow})^{\upuparrows} = \lambda\theta.a(\lambda x.\theta(\lambda P.P(x))) = \lambda\theta.\theta(a^{\uparrow})$.

and a higher-order reading, respectively. The individual reading yields an answer space that cannot satisfy the Dayal's presupposition. While the higher-order reading yields an answer space closed under conjunction, giving rise to the desired the MA reading.

(39) Which boys formed a team?
(*w: the boys formed two teams in total: ab formed one, and cd formed one.*)

a. What is an item x s.t. x is a plural boy and x formed a team?
  (i) LF: [BEDOM(which boys) λx [x form a team]]
  (ii) $\mathbf{P} = \lambda x_e[\dagger{*}boy'_@(x) = 1.\hat{}form'(x)]$
  (iii) True answers: $\{form'(a \oplus b), form'(c \oplus d)\}$

b. What is a GQ π s.t. π is a conjunction/disjunction over boys and that π formed a team?
  (i) LF: [BEDOM(which boys) $\lambda\pi$ [$\pi_{\langle et,t\rangle}$ λx [x form a team]]]
  (ii) $\mathbf{P} = \lambda\pi_{\langle et,t\rangle}[\dagger{*}boy'_@(\pi) = 1.\hat{}\pi(\lambda x.form'(x))]$
  (iii) True answers: $\{form'(a \oplus b), form'(c \oplus d), form'(a \oplus b) \wedge form'(c \oplus d)\}$

Since the proposed repair strategy makes no difference to individual readings, the weakened presupposition of ANS defined in (35) has the same effects as Dayal's presupposition: in case that the considered boys formed multiple teams, (39) cannot obtain a strongest true answer based on individual boys; hence the individual reading is ruled out due to presupposition failure.

5. Conclusions

This paper has been centered on the dilemma between uniqueness and MS. I propose that, in search of the strongest true answer, short answers with scopal effects can be interpreted as if they took a wide scope. Technically, I weaken Dayal's presupposition by allowing the strongest true answer to be obtained based on an internally lifted variant of a short answer.

In the case of a non-scopal item, type-lifting makes no difference. Therefore, if a question takes an individual reading, this repair strategy makes no difference. Therefore my solution preserves the merits of Dayal's presupposition in interpreting questions with uniqueness requirements and questions with non-monotonic collective predicates.

By contrast, in the case of a GQ, applying internal lift yields a wide scope reading of this quantifier. Hence, if a question takes a higher-order reading, it can always obtain a strongest true answer based on a generalized conjunction. MS readings are thus preserved in $\Diamond$-question admitting higher-order readings.

References

Chierchia, Gennaro, Danny Fox, & Benjamin Spector. 2012. The grammatical view of scalar implicatures and the relationship between semantics and pragmatics. In *An international handbook of natural language meaning*, ed. Claudia Maienborn, Klaus von Heusinger, & Paul Portner, 2297–2332. Mouton de Gruyter.

Cresti, Diana. 1995. Extraction and reconstruction. *Natural Language Semantics* 3:79–122.

Dayal, Veneeta. 1996. *Locality in wh quantification*, volume 62. Springer Science & Business Media.

Fox, Danny. 2013. Mention-some readings of questions. *MIT seminar notes* .

Groenendijk, Jeroen, & Martin Stokhof. 1984. On the semantics of questions and the pragmatics of answers. *Varieties of formal semantics* 3:143–170.

Hausser, Roland, & Dietmar Zaefferer. 1979. Questions and answers in a context-dependent Montague grammar. In *Formal semantics and pragmatics for natural languages*, 339–358. Springer.

Karttunen, Lauri. 1977. Syntax and semantics of questions. *Linguistics and philosophy* 1:3–44.

Link, Godehard. 1983. The logical analysis of plurals and mass terms: A lattice-theoretic approach .

Rullmann, Hotze. 1995. Maximality in the semantics of *wh*-constructions. Doctoral dissertation, University of Massachusetts at Amherst.

Shan, Chung-chieh, & Chris Barker. 2006. Explaining crossover and superiority as left-to-right evaluation. *Linguistics and Philosophy* 29:91–134.

Sharvy, Richard. 1980. A more general theory of definite descriptions. *The philosophical review* 89:607–624.

Spector, Benjamin. 2007. Modalized questions and exhaustivity. In *Proceedings of Semantics and Linguistic Theory*, 282–299.

Spector, Benjamin. 2008. An unnoticed reading for wh-questions: Elided answers and weak islands. *Linguistic Inquiry* 39:677–686.

Van Rooij, Robert, & Katrin Schulz. 2004. Exhaustive interpretation of complex sentences. *Journal of logic, language and information* 13:491–519.

Xiang, Yimei. 2015. Mention-some readings of questions: Complexities from number-marking. In *Proceedings of Amsterdam Colloquium 20*.

Xiang, Yimei. 2016a. Complete and true: A uniform analysis for mention-some and mention-all questions. In *Proceedings of Sinn und Bedeutung 20*.

Xiang, Yimei. 2016b. Interpreting questions with non-exhaustive answers. Doctoral dissertation, Harvard University.

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