Quantifier scope in questions

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It is well known that some quantifiers in questions allow for *pair-list* answers. An intuitive way to paraphrase the meaning of such a question, so that a pair-list answer is expected, is to let the quantifier take wide scope (1).

(1) What did every student read? $\approx$ For every student x, what did x read?
Alice read *Martin Chuzzlewit*, Bob read *Nicholas Nickleby*, and Carol read *Oliver Twist*.

However, as is also well known, and experimentally shown by van Gessel & Cremers (2020), for a variety of quantifiers, such wide-scope readings (henceforth $Q > ?$ readings) in matrix questions are either marked (but still somewhat acceptable) or even non-existent (2).

(2) What did two/most/fewer than three/no students read?
For ?two/?most/??fewer than three/#no students, what did they read?

In this paper, we extend inquisitive semantics with Charlow's (2020) theory of scope-taking for alternatives to integrate different notions of alternatives used in analyses of questions and indefinites in a principled way, and account for the gradient acceptability shown in (1) and (2), i.e., the $Q > ?$ reading is (i) perfectly available for *every*, (ii) non-existent for *no*, (iii) possible but marked for numerals and *most*, and less acceptable for *fewer than three*.

Basic setup In inquisitive semantics, clauses denote a non-empty, downward-closed set of classical propositions, henceforth called a *Proposition* (type T). The informative content of a Proposition P is defined as the union of all the classical propositions in it, i.e., $\texttt{info}(P) = \bigcup P$. A simple declarative sentence such as (3a) denotes a Proposition containing its classical denotation $\mathbf{read}(\mathbf{o})(\mathbf{c})$ and all its subsets (we define $S^{\downarrow}$, the downward closure of a set S, as $\{p \mid \exists s[s \in S \wedge p \subseteq s]\}$). The negation of a Proposition P is defined as the Proposition containing the classical negation of $\texttt{info}(P)$ and all its subsets (3b). The Proposition denoted by a question represents its *resolution conditions*, i.e., classical propositions that would resolve the issue raised by the question (3c, 3d). Compositionally, an interrogative complementizer introduces an operator $\langle ? \rangle$, which (i) ensures inquisitiveness by mapping a Proposition P to $P \cup \mathbf{not}(P)$ if P only has one maximal element (3c) and otherwise leaving P unchanged, and (ii) presupposes the informative content of the resulting Proposition (notationally, presuppositions follow the $\bullet$). The presupposition of a polar question is trivially satisfied (3c). In a wh-question (3d), the wh-word *what* takes a function from individuals to Propositions, applies this function to each individual in the relevant domain, and returns the union of all the resulting Propositions, and finally $\langle ? \rangle$ further adds an existential presupposition.

(3)a. $[\![\text{Carol read } \textit{Oliver Twist}]\!] = \{\mathbf{read}(\mathbf{o})(\mathbf{c})\}^{\downarrow}$ $\qquad \texttt{info}([\![(3a)]\!]) = \mathbf{read}(\mathbf{o})(\mathbf{c})$

b. $[\![\text{not}]\!] = \mathbf{not} = \lambda P.\{\neg\texttt{info}(P)\}^{\downarrow}$ $\qquad \mathbf{not}([\![(3a)]\!]) = \{\neg\mathbf{read}(\mathbf{o})(\mathbf{c})\}^{\downarrow}$

c. $[\![\text{Did Carol read } \textit{Oliver Twist}?]\!] = \langle ? \rangle([\![(3a)]\!]) = \{\mathbf{read}(\mathbf{o})(\mathbf{c}), \neg\mathbf{read}(\mathbf{o})(\mathbf{c})\}^{\downarrow} \bullet \top$

d. $[\![\text{What did Carol read?}]\!]$ $\qquad [\![\text{what}]\!] = \lambda F_{eT}.(\bigcup_{x \in D_e} F(x))$

$= \langle ? \rangle([\![\text{what}]\!](\lambda x.\{\mathbf{read}(x)(\mathbf{c})\}^{\downarrow})) = \{\mathbf{read}(\mathbf{m})(\mathbf{c}), \mathbf{read}(\mathbf{n})(\mathbf{c}), \mathbf{read}(\mathbf{o})(\mathbf{c})\}^{\downarrow} \bullet (\exists x.\mathbf{read}(x)(\mathbf{c}))$[1]

[1]Note that the Proposition also includes, e.g., $\mathbf{read}(\mathbf{m} \oplus \mathbf{n})(\mathbf{c})$, but there is no need to explicitly list it because *read* is distributive, i.e., $\mathbf{read}(\mathbf{m} \oplus \mathbf{n})(\mathbf{c}) \subseteq \mathbf{read}(\mathbf{m})(\mathbf{c})$, and the Proposition is downward-closed.

Universal quantifier Universal quantifiers are analyzed using set intersection (just like conjunctions), e.g., *every student* denotes $\lambda F_{eT}.\bigcap_{x:\mathbf{student}(x)} F(x)$. The $Q > ?$ reading (1) is derived by letting *every student* take wide scope (4). According to (4), any classical proposition p that resolves the question is such that for every student y, there is some x such that p entails that y read x. (We further assume that the presuppositions project universally.)

(4) $[\![\text{every student}]\!](\lambda y.\{\mathbf{read}(\mathbf{m})(y), \mathbf{read}(\mathbf{n})(y), \mathbf{read}(\mathbf{o})(y)\}^{\downarrow} \bullet (\exists x.\mathbf{read}(x)(y)))$
$= \{p_{\mathbf{a}} \wedge p_{\mathbf{b}} \wedge p_{\mathbf{c}} \mid p_y \in \{\mathbf{read}(\mathbf{m})(y), \mathbf{read}(\mathbf{n})(y), \mathbf{read}(\mathbf{o})(y)\}^{\downarrow}\} \bullet (\forall y \exists x.\mathbf{read}(x)(y))$

Negative quantifier When **not** takes scope above a wh-question such as (3d), the informative content will contradict the presupposition. Therefore, we can treat *no student* as $\lambda F_{eT}.[\![\text{every student}]\!](\mathbf{not}(F))$ and straightforwardly account for its lack of $Q > ?$ readings.

Numerals and most We assume an adjectival analysis for numerals (bare or modified) and *most*. On the one hand, they can take scope within the DP and be seen as a modifier of the head noun and the DP denotes a set of pluralities that satisfy the modified head noun (5).

(5) a. $[\![\emptyset_{\text{some}} \text{ two students}]\!] = \{x \mid \mathbf{students}(x) \wedge \#x = 2\}$

b. $[\![\emptyset_{\text{some}} \text{ fewer than three students}]\!] = \{x \mid \mathbf{students}(x) \wedge \#x < 3\}$

c. $[\![\emptyset_{\text{some}} \text{ most students}]\!] = \{x \mid \mathbf{students}(x) \wedge \#x > \frac{\#(\bigoplus_{y:\mathbf{students}(y)} y)}{2}\}$

To ensure that we are getting pair-list rather than cumulative answers, we define a distributivity operator D as $\lambda F_{eT}.\lambda x.\bigcap_{y \in \mathbf{Atoms}(x)} F(y)$ (parallel to *every student*, except that the domain is the atoms of the plurality argument x), and apply it to the intended scope of the DP (6). A DP in (5) takes scope over (6) according to Charlow's (2020) $\star$ operator, which effectively amounts to applying (6) pointwise to each element in the set denoted by the DP, resulting in a set of Propositions, e.g., (7). We can then take the union of these Propositions (which can be seen as a generalized form of existential closure) to obtain a single Proposition P, i.e., any classical proposition that resolves at least one of the Propositions in (7) also resolves P. Therefore $Q > ?$ readings for numerals and *most* are semantically derivable.

(6) $D(\lambda t.[\![\text{what did t read?}]\!])$
$= \lambda x.\bigcap_{y:\mathbf{Atoms}(x)}\{\mathbf{read}(\mathbf{m})(y), \mathbf{read}(\mathbf{n})(y), \mathbf{read}(\mathbf{o})(y)\}^{\downarrow} \bullet (\forall y \exists z.\mathbf{read}(z)(y))$

(7) $[\![\text{What did two students read?}]\!] = [\![\emptyset_{\text{some}} \text{ two students}]\!] \star [\![(6)]\!]$
$\{\bigcap_{y \in \mathbf{Atoms}(x)}\{\mathbf{read}(\mathbf{m})(y), \mathbf{read}(\mathbf{n})(y), \mathbf{read}(\mathbf{o})(y)\}^{\downarrow} \bullet (\forall y \exists z.\mathbf{read}(z)(y)) \mid \mathbf{students}(x) \wedge \#x = 2\}$

However, there are two reasons why such $Q > ?$ readings are not always easily accessible and show a gradient. First, the union of (7) violates an independently motivated constraint on question meanings. According to Hoeks & Roelofsen (2019), a question meaning is defective if a maximal element is covered by a set of some other maximal elements, e.g. (8). This can be shown to be the case for the union of (7), which explains why the $Q > ?$ reading is marked.

(8) # Does Ann speak French, does she speak German, or does she not speak German?

Second, numerals and *most* tend to scope out of the DP and additionally apply negation to their scope to get a strengthened, upper-bounded reading. In particular, this strengthening process is required for *fewer than* because the meaning would otherwise be too weak (Buccola & Spector, 2016). However, as discussed above, negating a question would result in a contradiction. These two reasons explain why $Q > ?$ readings for numerals and *most* are not always easily accessible and why this is particularly so for *fewer than three*.

References

◦ Buccola, Brian & Benjamin Spector. 2016. Modified numerals and maximality. *L&P* ◦ Charlow, Simon. 2020. The scope of alternatives: indefiniteness and islands. *L&P*. ◦ Hoeks, Morwenna & Floris Roelofsen. 2019. Coordinating questions: The scope puzzle. *SALT 29*. ◦ van Gessel, Thom & Alexandre Cremers. 2020. Testing the distribution of pair-list questions with quantifiers. *SuB 25*.