Quantification into Non-Truth-Denoting Objects

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1. Introduction

Quantificational determiner phrases (QDPs) are standardly treated as generalized quantifiers of type $\langle et, t\rangle$. As exemplified below, they quantify into a truth-denoting (viz., t-type) expression and return another truth-denoting expression.

(1) Every boy watched *Hulk*.
[$_t$ every-boy λx_e [$_t$ x watched *Hulk*]]

(2) One of the boys watched *Hulk*.
[$_t$ one-of-the-boys λx_e [$_t$ x watched *Hulk*]]

However, some constructions containing QDPs yield interpretations that intuitively suggest the quantifier is quantifying into a non-truth-denoting object, such as a question or an entity.

1.1. Case 1: Quantification into a question

Wh-questions with a quantificational subject can allow for a 'quantification into a question' ('QiQ') reading. Depending on the quantificational force of the quantifier, a *wh*-question with a QiQ-reading may either require a pair-list answer, as in (3), or exhibit a choice flavor, as in (4). From here on, questions like (3a) and (4a) will be referred to as '∀-questions' and '∃-questions', respectively.

(3) a. Which movie did every boy watch?
'For every boy x: [tell me] which movie did x watch?' (Pair-list)
b. Andy watched *Ironman*, Billy watched *Spiderman*, Clark watched *Hulk*.

(4) a. Which movie did one of the boys watch?
'For one of the boys x: [tell me] which movie did x watch?' (Choice)
b. Andy watched *Ironman*.

However, questions are not truth-denoting, as it is nonsense to describe a question as being true or false. In classic theories, questions are defined as sets of propositions ($\langle st, t\rangle$), as in Hamblin-Karttunen semantics (Hamblin 1973; Karttunen 1977), as partitions of possible worlds ($\langle s, st\rangle$), following partition semantics (Groenxendijk and Stokhof 1984), or as predicates/properties ($\langle e, t\rangle$/$\langle e, st\rangle$), according to categorial approaches (Hausser and Zaefferer 1979; Hausser 1983; a.o.). Given these definitions, the LFs below, where a QDP directly quantifies into a question, result in a type-mismatch.

(5) a. * [every-boy λx_e [which movie did x watch ?]]
b. * [one-of-the-boys λx_e [which movie did x watch ?]]

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There is rich literature on the derivation of QiQ. I classify existing analyses into three groups based on their approach to resolving type-mismatch. The first strategy involves embedding the question within a truth-denoting constituent, allowing the QDP to quantify into it without causing a type-mismatch. For example, Karttunen (1977) and Krifka (2001) propose that quantification in QiQ is applied into a speech act, as illustrated in (6). (For a detailed review of this analysis, see Xiang 2023: Appendix A.)

(6) LF of (3a): [every-boy λx_e [I-ASK-YOU [which movie did x watch]]]

Alternatively, Fox (2012b) proposes an LF in which the universal subject in a $\forall$-question scopes over a t-type construction that expresses a prediction operation applied to a question (for further details, see section 2.1). The second strategy, implemented in inquisitive semantics (Ciardelli and Roelofsen 2018; Qing and Roelofsen 2022), assigns interrogatives and declaratives the same type $\langle st, t\rangle$ and aligns quantificational determiners with a corresponding type (viz., $\langle e, \langle stt, stt\rangle\rangle$). In this framework, quantification into a question operates no differently than quantification into a sentence, with regard to the mechanism of composition. The third approach introduces a special composition rule or type-shifting rule, such as converting a QDP into a witness set (Groenendijk and Stokhof 1984; Chierchia 1993; Dayal 1996; a.o.).

1.2. Case 2: Quantification into a DP

Beyond *wh*-questions, Bumford (2022) notes that certain complex DPs permit a ‘quantification into a DP’ (‘QiD’) reading. In example (7), the distributive QDP *each state* doesn’t quantify into a sentence; rather, it quantifies into the embedding inverse-linking DP, yielding a plural-entity denotation that can be selected by the collective predicate *be composed of.*

(7) The Senate is composed of [two representatives from each state].
   a. # ‘For each state x, the Senate is composed of two representatives from x.’
   b. ‘The Senate is composed of [two representatives from AZ, two representatives from state CA, ..., and two representatives from state FL].’

DPs are clearly not truth-denoting, which makes LF (8) subject to a type-mismatch. Additionally, it is puzzling how a DP structure involving distributivity can yield an interpretation that is compatible with collectivity.

(8) * [each-state λx_e [two representatives from x]]

To account for QiD, Bumford provides a polymorphic semantics for distributive QDPs, allowing them to quantify into various types of objects directly. For further details of Bumford 2022, see section 3.1.

With few exceptions (e.g., Fox 2012b), existing analyses of QiQ and QiD require substantial modifications to the theory of quantification, such as introducing new object types, implementing ad hoc composition rules, or altering the semantics of quantifiers. In contrast, this paper seeks to uniformly accounting for both QiQ and QiD within a unified framework, while preserving conventional assumptions about the semantics of quantifiers, questions, and DPs. In the following, I will start by presenting an analysis of QiQ developed from my earlier work (section 2) and then extend this analysis to QiD (section 3).

2. Quantification into a question

This section presents an account of QiQ developed in Xiang 2016, 2019, 2023, which integrates Fox’s (2012b) techniques for resolving the type-mismatch problem with a functionality-based framework (cf. Engdahl 1980, 1986; Chierchia 1993; Dayal 1996, 2016; Jacobson 1999; Sharvit 1999; a.o.). This account predicts the characteristics of QiQ readings and, in conjunction with independently motivated assumptions, explains the distributional constraints of QiQ readings and pair-list readings in questions.

2.1. Fox 2012a,b: Family-of-questions approach

Pair-list readings are not only available in ∀-questions like (3) but also in multiple-*wh* questions. Building on this connection, Fox (2012a,b) defines questions with a pair-list reading uniformly as families of questions, as illustrated in (9). He assumes that answering a family of questions amounts to answering each question in this family, which consequently introduces a pair-list effect.

$$\text{(9)}\quad \left.\begin{array}{ll}\text{a.} & [\![\textit{Which movie did every boy watch?}]\!] \\ \text{b.} & [\![\textit{Which boy watched which movie?}]\!]\end{array}\right\} = \left\{[\![\textit{Which movie did x watch?}]\!] \mid \mathit{boy}_{@}(x)\right\}$$

Regarding composition, Fox proposes different LFs for these two types of pair-list questions, which, however, result in the same semantics. Defining *wh*-phrases as existential quantifiers (cf. Karttunen 1977), Fox (2012a) assumes that in a pair-list multiple-*wh* question, the higher *wh*-phrase existentially quantifies into an identity operation Id applied to a covert variable (i.e., Q) and the embedded single-*wh* question (cf. Heim 1992), as illustrated in (10). Abstracting this variable Q over existential quantification yields a family of questions. LF (10) is read as 'the family of Q such that for some boy x, Q is equivalent to $[\![$*which movie did x watch?*$]\!]$'.

(10) Which boy watched which movie?
$[_{\text{(ii)}}\ \lambda Q$ [which-boy λx $[_{\text{(i)}}$ id(Q) [which movie did x watch]]]]
a. $[\![\text{(i)}]\!] = [Q = [\![\textit{which movie did x watch?}]\!]]$
b. $[\![\text{(ii)}]\!] = \lambda Q.\exists x[\mathit{boy}_{@}(x) \wedge Q = [\![\textit{which movie did x watch?}]\!]]$
$= \left\{[\![\textit{which movie did x watch?}]\!] \mid \mathit{boy}_{@}(x)\right\}$
c. $\text{Id} := \lambda\beta_{\tau}\lambda\alpha_{\tau}.\alpha = \beta$

Fox (2012b) derives pair-list readings of ∀-questions in two steps: (i) quantification into predication and (ii) (strong) minimization, as illustrated in (11). This LF is read as 'the minimal set **K** such that for every boy x, $[\![$*which movie did x watch?*$]\!]$ is a member of **K**', which is simply the set containing all and only the questions of the form '*which movie did boy-x watch?*'. The definition of minimality follows Pafel 1999: the minimal set is the unique set that is a subset of every relevant set, as in (11c).

(11) Which movie did every boy watch?
$[_{\text{(ii)}}\ \text{min}_{\mathcal{S}}\ \lambda\mathbf{K}\ [_{\text{(i)}}$ every-boy λx [**K** [which movie did x watch]]]]
a. $[\![\text{(i)}]\!] = \forall x \in \mathit{boy}_{@}[\mathbf{K}([\![\textit{which movie did x watch?}]\!])]$
b. $[\![\text{(ii)}]\!] = \left\{[\![\textit{which movie did x watch?}]\!] \mid \mathit{boy}_{@}(x)\right\}$
c. $\text{min}_{\mathcal{S}} := \lambda\alpha_{\langle\sigma,t\rangle}.\iota A_{\sigma}[A \in \alpha \wedge \forall B \in \alpha[A \subseteq B]]$

Fox's analysis upholds the conventional assumptions about quantifiers and composition theory (for a more detailed review, see Xiang 2023). However, it faces some empirical issues. First, unlike *wh*-questions, polar questions with a universal quantifier do not have a QiQ-reading (Chierchia 1993). For instance, the polar question in (12) is infelicitous because its only interpretation (12a), which inquires about the truth or falsity of a universal statement, has already been resolved in the given context.

(12) (Mutual knowledge: Some of the boys didn't watch *Spiderman*.)
\# Did every boy watch *Spiderman*?
a. Available reading: 'Is it true or false that every boy watched *Spiderman*?'
b. Unavailable reading: 'For every boy x, [tell me] did x watch *Spiderman*?'

If the QiQ-reading of a *wh*-question were derived from LF (13a), it would be difficult to explain why the pair-list-generating LF (13b) is not available for a polar question.

(13) a. [$\textsc{min}_S$ $\lambda\mathbf{K}$ [every-boy λx [**K** [which movie did x watch]]]] = (11)
b. * [$\textsc{min}_S$ $\lambda\mathbf{K}$ [every-boy λx [**K** [did x watch *Spiderman*]]]]

More generally, this contrast poses a challenge to any approach to QiQ that involves letting the quantifier quantify into a question-embedding constituent or the question itself. This includes the previously mentioned speech-act-embedding analysis (Karttunen 1977; Krifka 2001) and the inquisitive semantics analysis (Ciardelli and Roelofsen 2018; Qing and Roelofsen 2022).

Second, Fox's analysis of pair-list readings of ∀-questions doesn't extend to choice readings of ∃-questions. In contrast to (11), LF (14) is semantically deviant because there is no (strongly) minimal set among those that contain one sub-question of the form '*which movie did boy-x watch?*'.

(14) Which movie did one of the boys watch?
\# [$\textsc{min}_S$ $\lambda\mathbf{K}$ [one-of-the-boys λx [**K** [which movie did x watch]]]]
(The minimal set **K** such that for one boy x, $[\![$*which movie did x watch?*$]\!]$ is a member of **K**)

Finally, pair-list ∀-questions and their multiple-*wh* counterparts are not semantically equivalent—only pair-list ∀-questions exhibit a domain exhaustivity effect (Xiang 2016, 2019, 2023; contra Dayal 2002). For example, unlike (15a), (15b) is infelicitous. Intuitively, the ∀-question in (15b) presupposes that every relevant candidate will get one of three jobs, a presupposition that cannot be satisfied in the given context.

(15) (Mutual knowledge: 100 candidates are competing for three job openings.)
a. Guess which candidate will get which job.
b. \# Guess which job every candidate will get.

Although domain exhaustivity is not the primary focus of this paper, it served as the starting point for my approach to composing pair-list readings of questions (Xiang 2016, 2019, 2023) and will therefore be incorporated into the presented account.

*2.2. Composing non-*QiQ *readings*

∀-questions are ambiguous between individual readings, functional readings, and pair-list readings (Engdahl 1980, 1986). In example (16), the three readings correspond to answers naming an atomic movie, a function from entities to movies, and a list of boy-movie pairs, respectively. To establish the background assumptions on question semantics, the following will outline the derivation of the first two readings.

(16) Which movie did every boy watch?
a. 'Which movie y is s.t. every boy watched y?'
'*Spiderman.*' (Individual)
b. 'Which function **f** to atomic movies is s.t. every boy x_i watched $\mathbf{f}(x_i)$?'
'His$_i$ favorite superhero movie.' (Functional)
(Intended: 'Every boy$_i$ watched his$_i$ favorite superhero movie.')
c. 'For every boy x: [tell me] which movie did x watch?'
'Andy watched *Ironman*, Billy watched *Spiderman*, Clark watched *Hulk.*' (Pair-list)

The derivation of the individual reading is illustrated in (17). In LF (17a), the universal subject *every boy* undergoes standard QR, moving to the edge of IP, while the *wh*-object *which movie* undergoes standard *wh*-movement and binds a regular *e*-type trace. Composing this LF results in the question denotation (17b), which is a function mapping atomic movies to quantificational propositions.[1]

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[1] I assume that the root denotation of a question is a 'topical property' (Chierchia and Caponigro 2013), which maps a short answer to the corresponding propositional answer, and that *wh*-phrases act as function domain restrictors. The core analysis of this paper, however, is independent of these assumptions.

(17) Individual reading of ‘Which movie did every boy watch?’

a. $[_{\text{CP}}$ which-movie λy_e $[_{\text{IP}}$ every-boy λx_e $[_{\text{VP}}$ x watched y]]]

b. $[\![\text{CP}]\!] = \lambda y_e : \mathit{movie}_{@}(y).[\lambda w.\forall x[\mathit{boy}_w(x) \rightarrow \mathit{watch}_w(x, y)]]$

In the functional reading, the *wh*-phrase stands in a dependency relation with the quantifier (Engdahl 1980, 1986; Chierchia 1993; Dayal 1996, 2016; Jacobson 1999; Sharvit 1999; a.o.), which I refer to as a ‘*wh*-dependency’. Following the complex trace approach (Chierchia 1993), I assume that the *wh*-phrase leaves a complex functional trace, interpreted as $\mathbf{f}(x)$ where $\mathbf{f}$ is a functional $\langle e, e\rangle$-type variable and x an e-type variable, and that the subject *every boy* binds into this trace, as illustrated in (18a). The resulting denotation (18b) is a function that maps the intension of an entity-to-movie function to a proposition involving quantificational binding.

(18) Functional reading of ‘Which movie did every boy watch?’

a. $[_{\text{CP}}$ which-movie $\lambda \mathbf{f}_{\langle s,ee\rangle}$ $[_{\text{IP}}$ every-boy λx_e $[_{\text{VP}}$ x watched $\mathbf{f}(x)$]]]

b. $[\![\text{CP}]\!] = \lambda \mathbf{f}_{\langle s,ee\rangle} : \forall w'[\forall x \in \textsc{Dom}(\mathbf{f})(\mathbf{f}_{w'}(x)) \in \mathit{mov}_{w'}].[\lambda w.\forall x[\mathit{boy}_w(x) \rightarrow \mathit{watch}_w(x, \mathbf{f}_w(x))]]$

2.3. Deriving QIQ *readings*

2.3.1. Denotation

In line with functionality approaches (Engdahl 1980, 1986; Chierchia 1993; Dayal 1996, 2016), I assume that questions with a QIQ reading involve a *wh*-dependency. The root denotation of a pair-list ∀-question is exemplified in (19). It maps an entity-to-movie function to the ‘graph description’ of this function. In this denotation, the restriction on the range of the input function (i.e., $\mathbf{f}$ maps its inputs to atomic movies) is provided by the *wh*-phrase. The remainder of this denotation derives from the question nucleus and includes (i) a domain exhaustivity presupposition, which states that every boy is in the domain of $\mathbf{f}$, and (ii) the graph description of $\mathbf{f}$, namely, the conjunction of all propositions of the form ‘x *watched* $\mathbf{f}(x)$’ (abbreviated as $\psi^{\mathbf{f}}_x$) where x is a boy.

(19) $[\![$*Which movie did every boy watch?*$_{\text{QIQ}}]\!]$ ($\psi^{\mathbf{f}}_x$ abbreviates $\lambda w.\mathit{watch}_w(x, \mathbf{f}(x))$)

$= \lambda \mathbf{f}_{\langle e,e\rangle} : \forall x \in \textsc{Dom}(\mathbf{f})[\mathit{mov}_{@}(\mathbf{f}(x))] \wedge \forall x[\mathit{boy}_{@}(x) \rightarrow \psi^{\mathbf{f}}_x{\downarrow}]. \bigcap\{\psi^{\mathbf{f}}_x \mid \mathit{boy}_{@}(x)\}$

For a simple illustration, consider a context with three relevant boys b_1,b_2,b_3. As in (20a), for an input function $\mathbf{f}$ that maps each of the boys to a movie, the question denotation (19) maps this $\mathbf{f}$ to the conjunction of the three propositions of the form ‘*boy-x watched movie-*$\mathbf{f}(x)$’, which is therefore a pair-list answer. When domain exhaustivity is unsatisfied, namely, the input function $\mathbf{f}$ is undefined for some of the boys, the question denotation maps the input function to undefinedness, as in (20b).

(20) a. Domain exhaustivity satisfied: $\begin{bmatrix} b_1 \rightarrow m_1 \\ b_2 \rightarrow m_2 \\ b_3 \rightarrow m_3 \end{bmatrix} \rightarrow \bigcap \begin{Bmatrix} \lambda w.\mathit{watch}_w(b_1, m_1) \\ \lambda w.\mathit{watch}_w(b_2, m_2) \\ \lambda w.\mathit{watch}_w(b_3, m_3) \end{Bmatrix}$

b. Domain exhaustivity unsatisfied: $\begin{bmatrix} b_1 \rightarrow m_1 \\ b_2 \rightarrow m_2 \\ b_3 \rightarrow \textsc{Undefinedness} \end{bmatrix} \rightarrow \textsc{Undefinedness!}$

2.3.2. Composition

The nucleus of a pair-list ∀-question is composed in three steps, marked in the tree in Figure 1 in bold.

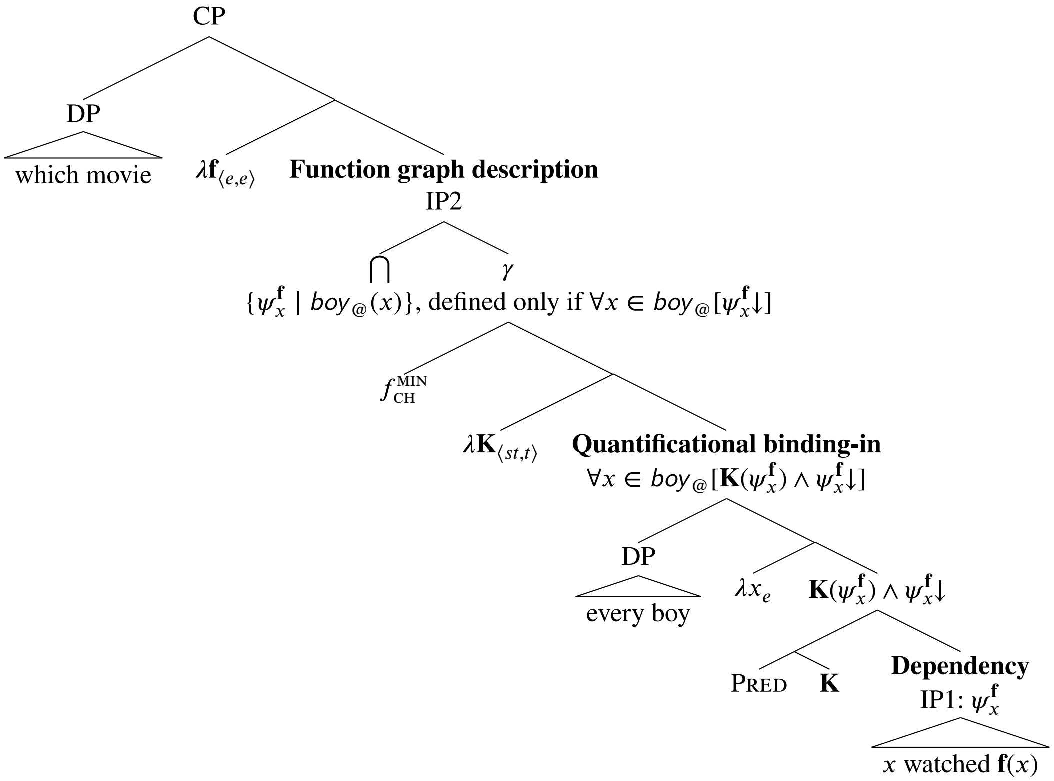

Figure 1: Composition of the QiQ-reading of a ∀-question

1. Form a 'dependency sentence'. In IP1, the trace of the universal subject is co-indexed with the argument of the functional trace of the *wh*-object, same as in the LF of a regular functional reading.

    (21) $[\![\text{IP1}]\!] = \lambda w.watched_w(x, \mathbf{f}(x))$, abbreviated as $\psi^{\mathbf{f}}_x$.

2. Apply quantificational binding across a predication operation. The universal subject *every boy* undergoes QR and binds into the functional trace of the *wh*-object. Compared to the derivation of a regular functional reading, a key difference that contributes to the QiQ effect is that here quantificational binding is applied across a predication operator PRED, not to the dependency sentence directly. The predication construction is of type *t*; it asserts that the dependency sentence denoted by IP1 is a member of the covert variable **K** as well as that this sentence is defined. Just like in Fox 2012b, applying quantification into a *t*-type predication construction is not subject to a type-mismatch.

    (22) PRED $:= \lambda \mathbf{K}_{\langle \tau,t \rangle} \lambda \beta_\tau . \mathbf{K}(\beta) \wedge \beta\downarrow$, where $\beta\downarrow$ is read as 'β is defined'.

3. Form a function graph description as the denotation of the entire question nucleus. This denotation is formed by extracting a minimal **K** set that satisfies the quantificational predication condition yielded at step 2, labeled as γ, and conjoining this minimal **K** set. In the considered ∀-question, the γ node has only one possible value, namely, the set consisting of all and only the propositions of the form '*boy-x watched* $\mathbf{f}(x)$'. The conjunction operator $\bigcap$ carries an existential presupposition, namely, that it cannot be applied to an empty set:

    (23) For any Q of type $\langle st, t \rangle$, $\bigcap Q = \lambda w.\forall p[p \in Q \rightarrow w \in p]$, defined only if $|Q| \geq 1$.

The domain exhaustivity effect of a ∀-question is derived by the second and third steps jointly. The quantificational predication condition directly asserts universal definedness, which, due to the existential presupposition of the $\bigcap$-operator, is passed up and turned into a domain exhaustivity presupposition.

2.3.3. Extending to a choice question

By assuming a weaker definition of minimization, the schema of composition assumed for pair-list readings of ∀-questions easily extends to choice readings of ∃-questions. I define a minimization operator $f^{\text{MIN}}_{\text{CH}}$, as in (24), which consists of a weak minimization operator MIN_W and a globally bound choice function variable f_{CH}. In contrast to the MIN_S-operator implemented in Fox's analysis, a set is considered minimal by the definition of MIN_W as long as it is not a proper subset of any relevant set.

(24) $f^{\text{MIN}}_{\text{CH}} := \lambda\alpha_{\langle\sigma,t\rangle}.f_{\text{CH}}(\text{MIN}_W(\alpha))$, where $\text{MIN}_W := \lambda\alpha_{\langle\sigma,t\rangle}.\{A_\sigma \mid A \in \alpha \wedge \neg\exists B \in \alpha[B \subset A]\}$

Compare the following two QiQ-generating LFs, which differ only in the quantificational force of the QDP subject. In the composition of the ∀-question (25), the composition at node γ yields the unique set containing all and only the dependency sentences of the form '*boy-x watched* $\mathbf{f}(x)$'. In contrast, when composing the ∃-question (26), node γ has multiple possible values, each of which is a singleton set containing exactly one such dependency sentence.

(25) Which movie did every boy watch? (Pair-list)

a. [... $\bigcap$ [$_\gamma$ $f^{\text{MIN}}_{\text{CH}}$ $\lambda\mathbf{K}$ [$_{\text{(ii)}}$ every-boy λx_e [Pred($\mathbf{K}$) [$_{\text{(i)}}$ x watched $\mathbf{f}(x)$]]]]]

b. $[\![\text{(i)}]\!] = \psi^{\mathbf{f}}_x$ ($\psi^{\mathbf{f}}_x$ abbreviates $\lambda w.watch_w(x, \mathbf{f}(x))$)

c. $[\![\text{(ii)}]\!] = \forall x[boy_@(x) \rightarrow \mathbf{K}(\psi^{\mathbf{f}}_x) \wedge \psi^{\mathbf{f}}_x{\downarrow}]$

d. $$[\![\gamma]\!] = \begin{cases} \{\psi^{\mathbf{f}}_x \mid \text{boy}_@(x)\} & \text{if } \forall x[boy_@(x) \rightarrow \psi^{\mathbf{f}}_x{\downarrow}] \\ \text{UNDEFINED} & \text{otherwise} \end{cases}$$

(26) Which movie did one of the boys watch? (Choice)

a. [... $\bigcap$ [$_\gamma$ $f^{\text{MIN}}_{\text{CH}}$ $\lambda\mathbf{K}$ [$_{\text{(ii)}}$ one-of-the-boys λx_e [Pred($\mathbf{K}$) [$_{\text{(i)}}$ x watched $\mathbf{f}(x)$]]]]]

b. $[\![\text{(i)}]\!] = \psi^{\mathbf{f}}_x$

c. $[\![\text{(ii)}]\!] = \exists x[boy_@(x) \wedge \mathbf{K}(\psi^{\mathbf{f}}_x) \wedge \psi^{\mathbf{f}}_x{\downarrow}]$

d. $$[\![\gamma]\!] = \begin{cases} \{\psi^{\mathbf{f}}_x\}, \text{ where } x \text{ is the chosen boy} & \text{if } \psi^{\mathbf{f}}_x{\downarrow} \\ \text{UNDEFINED} & \text{otherwise} \end{cases}$$

This analysis successfully predicts the characteristics of QiQ readings. In an ∃-question, unlike in a ∀-question, the QiQ-reading of a question has a choice flavor if and only if there are multiple minimal members among the sets that satisfy the quantificational predication condition. Additionally, this QiQ-reading is not a pair-list reading since all these minimal sets are singleton.

2.4. Distributional constraints

2.4.1. Distribution of QiQ *readings*

Unlike *wh*-questions, polar questions do not have a QiQ-reading. As previously mentioned, this constraint is not predicted by Fox 2012 or most of the other analyses discussed earlier.

(27) (Mutual knowledge: Some of the boys didn't watch *Spiderman*.) (Repeated from (12))
\# Did every boy watch *Spiderman*?

a. Available reading: 'Is it true or false that every boy watched *Spiderman*?'

b. Unavailable reading: 'For every boy x, [tell me] did x watch *Spiderman*?'

However, this contrast is successfully predicted by the presented analysis. Unlike Fox 2012b, I assume that the QDP subject in a QiQ-question quantifies into a constituent that embeds a dependency sentence rather than one that embeds a question. The pair-list effect only arises when the question nucleus involves a *wh*-dependency. As seen in (29), applying the proposed QiQ-generating LF schema to the polar question (27) does not result in a QiQ-reading; instead, it yields the same meaning as composing this question in the simplest way, as in (28): 'Is it true or false that every boy watched *Spiderman*?'

(28) $[_{\text{CP}}$ WHETHER $[_{\text{IP}}$ every-boy λx_e [x watched *Spiderman*]]]
  a. $[\![\text{IP}]\!] = \lambda w.\forall x \in boy_w[watch_w(x,s)]$
  b. $[\![\text{WHETHER}]\!] = \lambda p_{st}.\{p, \lambda w.\neg p(w)\}$
  c. $[\![\text{CP}]\!] = \lambda p_{st} : p \in \{\lambda w.\forall x \in boy_w[watch_w(x,s)], \lambda w.\neg\forall x \in boy_w[watch_w(x,s)]\}.p$

(29) $[_{\text{CP}}$ WHETHER $\bigcap$ $[_\gamma$ $f_{\text{CH}}^{\text{MIN}}$ $\lambda\mathbf{K}$ [every-boy λx_e [PRED($\mathbf{K}$) [x watched *Spiderman*]]]]]
  a. $\bigcap[\![\gamma]\!] = \bigcap\{\lambda w.watch_w(x,s) \mid boy_@(x)\} = \lambda w.\forall x \in boy_@[watch_w(x,s)]$
  b. $[\![\text{CP}]\!] = \lambda p_{st} : p \in \{\lambda w.\forall x \in boy_@[watch_w(x,s)], \lambda w.\neg\forall x \in boy_@[watch_w(x,s)]\}.p$

The distribution of QIQ readings is also constrained by the type of QDP. First, negative quantifiers (e.g., *no boy*, *none of the boys*) cannot participate in QIQ. My account readily predicts this constraint: composing *wh*-questions with a negative quantifier using the proposed QIQ-generating LF schema results in a deviant denotation, which maps any input to the conjunction of the empty set.

(30) Which movie did no boy watch? # [Silence]
  Unavailable QIQ-reading: ‘For no boy x: [tell me] which movie did x watch?’
  a. [... $\bigcap$ $[_\gamma$ $f_{\text{CH}}^{\text{MIN}}$ $\lambda\mathbf{K}$ [no-boy λx_e [PRED($\mathbf{K}$) [x watched $\mathbf{f}(x)$]]]]]
  b. $[\![\gamma]\!] = \emptyset$
  (viz., The minimal $\mathbf{K}$ set containing no proposition of the form ‘*boy-x watched* $\mathbf{f}(x)$’.)

Second, counting quantifiers (e.g., *at least/ exactly/ at most/ fewer than/ more than n boys*) cannot license QIQ, neither a pair-list reading nor a choice reading. This is because counting quantifiers are scopally unproductive (Szabolcsi 1997; Beghelli 1997). To derive a QIQ-reading, the quantificational subject must scope out of the IP; however, counting quantifiers cannot take such a wide scope and, therefore, do not participate in QIQ readings.

(31) Which movie did at least two boys watch?
  a. # Andy watched *Hulk*, Billy watched *Spiderman*. (✗ Pair-list)
  b. Andy and Billy watched *Hulk*.
    i. Unavailable (choice) reading: ‘Andy and Billy are two boys who both watched only *Hulk*.’
    ii. Available (individual) reading: ‘*Hulk* is the only movie watched by multiple boys, who are Andy and Billy. The other movies were watched by at most one boy.’

It is worth noting that decreasing counting quantifiers (e.g., *at most/ fewer than n boys*) are even less readily available for forming QIQ-interpretations compared to increasing and non-monotonic counting quantifiers. They are subject to semantic deviance, even when violations of scope rigidity are exempted.

2.4.2. Distribution of pair-list QIQ

Among the quantifiers that can participate in QIQ, only *every*- and *each*- phrases can license a pair-list reading for a matrix question (Srivastav 1991; Krifka 1991; Moltmann and Szabolcsi 1994; Szabolcsi 1997; Beghelli 1997; a.o.). Among the questions in (32), where a singular *wh*-object yields a uniqueness effect, only the two questions (32a,b) which contain an *every*- or *each*- subject are felicitous in a context that requires distributivity over uniqueness.

(32) *(Mutual knowledge: Every student voted for a different candidate.)*
Which candidate did ... vote for?
a. ... every student ... (*every* $\gg \iota$)
b. ... each student/ each of the students ... (*each* $\gg \iota$)
c. # ... two (of the) students ... ($\exists 2 \gg$ ~~EACH~~ $\gg \iota$)
d. # ... most (of the) students ... (*most* $\gg$ ~~EACH~~ $\gg \iota$)
e. # ... all (of) the students ... (*all* $\gg$ ~~EACH~~ $\gg \iota$)
f. # ... the students ... (*the*-$\mathrm{NP}_{\mathrm{PL}} \gg$ ~~EACH~~ $\gg \iota$)

For the questions in (32c–f), where the subject DP is non-distributive, applying the proposed LF schema yields a QIQ-reading that has no pair-list effect. Take (32c) as an example: assuming that the plural ∃-quantifier *two of the boys* ranges over the set of entities that are pluralities of two students, my analysis predicts that the question nucleus of (32c), structured as in (33), denotes an atomic proposition of the form 'x *voted for* $\mathbf{f}(x)$', where x is the plurality of two students chosen by the addressee.

(33) [... $\bigcap$ [$f^{\mathrm{MIN}}_{\mathrm{CH}}$ $\lambda\mathbf{K}$ [two-of-the-students λx_e [PRED($\mathbf{K}$) [x voted for $\mathbf{f}(x)$]]]]]

However, this explanation does not rule out the possibility of generating a pair-list reading through covert distributivity. The LFs below, where a covert distributor EACH is associated with the trace of the plural indefinite, result in a reading that calls for a pair-list answer.

(34) Which candidate did two of the students vote for? ($\exists 2 \gg$ ~~EACH~~ $\gg \iota$)
a. * ... [two-of-the-students$_@$ λX [X EACH λx [PRED($\mathbf{K}$) ($\lambda w.x$-vote-for$_w$-$\mathbf{f}(x)$)]]]
b. % ... [two-of-the-students$_@$ λX [PRED($\mathbf{K}$) ($\lambda w.$ X EACH λx (x-vote-for$_w$-$\mathbf{f}(x)$))]]

I argue that these LFs are unavailable due to an independently motivated constraint on covert distributivity: as illustrated in (35), unlike overt *each*, covert EACH cannot bind a covert variable (Spector 2004).[2]

(35) (Context: John and Peter live far from each other. There is a wild cat living in John's neighborhood, and another wild cat living in Peter's neighborhood.)
John and Peter have #(each) adopted the cat. Spector (2004: ex. 34)
a. [J-and-P *each* λn [x_n adopted [the $C(x_n)$ cat]]]
b. % [J-and-P EACH λn [x_n adopted [the $C(x_n)$ cat]]]

In contrast to the matrix question (32c), question-embeddings with a responsive predicate (e.g., *know*, *find out*, *be certain*) like (36a) allow a plural indefinite to license a pair-list reading (Szabolcsi 1997; Beghelli 1997). I derive this pair-list reading with the LF in (36b). In contrast to (34a,b), the formation of this LF is affected by the constraint on applying covert distributivity in binding: the interrogative complement of *know* has a simple individual reading, which involves no functional dependency.

(36) (Context: same as in (32).)
a. Susi knows [which candidate two of the students voted for]. (✓$\exists 2 \gg$ EACH $\gg \iota$)
b. [two-of-the-stdts$_@$ λx_e [Susi λz_e [x EACH λy_e [$_{\mathrm{VP}}$ z knows wh-candidate y voted for]]]]

---

[2] In addition to binding covert variables, this contrast is also observed with explicit binding:

(1) a. The boys$_i$ each$_j$ watched their$_{i/j}$ favorite movie.
b. The boys$_i$ (EACH$_j$) watched their$_{i/?j}$ favorite movie.

The proposed explanation for the lack of pair-list licensing effect of plural ∃-quantifiers in matrix questions also applies to other non-distributive DPs, such as *most/all (of the) students* and *the students*.[3]

2.4.3. Summary on distributional constraints

In short, only *wh*-questions with a distributive quantifier admits a pair-list QiQ reading. The reasons why other quantifiers do not participate in QiQ or license a pair-list reading vary. Negative quantifiers cannot participate in QiQ since they lead to semantic deviance. Counting quantifiers are excluded from QiQ due to their scope rigidity. Plural indefinites and definites, which are not distributive in lexicon, do not robustly license pair-list readings because of the markedness of binding with covert distributivity. Some embeddings are exempt from constraints on quantifier type because they involve only covert distributivity and no binding.

(37) a. Negative quantifiers: semantic deviance ($^{\#}$QiQ)
b. Counting quantifiers: scope rigidity (*QiQ)
c. Plural indefinites and definites: $^{\%}$binding with covert distributivity ($^{\%}$Pair-list)
d. Some embeddings: just covert distributivity, no binding (✓Pair-list)

This analysis predicts that the distribution of pair-list QiQ readings forms a gradient, from matrix *wh*-questions with a negative or decreasing quantifier, which are the least likely to have a pair-list reading, followed by those with a non-decreasing counting quantifier and those with a plural indefinite or definite, to *wh*-questions with an *each*/*every*-phrase, which can readily accept a pair-list reading.

This prediction aligns seamlessly with the experimental findings of van Gessel and Cremers (2021) on the distribution of pair-list readings for *wh*-questions with a quantificational subject. In their study, they examined two key factors: (i) environment type, finding that *wh*-embeddings with the rogative predicate *wonder* pattern with matrix *wh*-questions, in contrast to *wh*-embeddings with responsive predicates like *find out* and *be certain*; (ii) quantifier type, observing a gradient in the acceptability of matrix questions and *wonder*-sentences in pair-list scenarios, ranked as *every* ≫ *two* ≫ *most* ≫ *fewer than three* ≫ *no*. Both findings are well captured by the proposed analysis.

2.5. Interim summary

To sum up, the goal of this section has been to uniformly account for the QiQ readings in questions with a quantifier. I have presented an account with the following assumptions: (i) in the LF, the quantifier quantifies into the predication of a dependency sentence and binds into a functional trace left by the *wh*-phrase; (ii) the question nucleus of a QiQ-question denotes a function graph description, which is the conjunction of a minimal set of propositions that satisfies the quantificational predication condition. This analysis predicts the characteristics of QiQ readings in ∀-questions and ∃-questions.

This section has also accounted for the (seeming) unavailability of QiQ readings in polar questions and predicted a gradient distribution of pair-list QiQ readings that varies by quantifier type.

3. Quantification into a DP

This section is centered on the other non-truth-denoting category that allows for quantifying-in, namely, DP. Section 3.1 briefly introduces a polymorphic account of ‘quantification into a DP (QiD)’ by Bumford (2022), which is centered on DPs that embed a universal distributor (viz., *every*, *each*). Then I show that the analysis of QiQ presented in section 2 naturally extends to QiD (section 3.2) and captures the distributional constraints and characteristics of QiD readings (section 3.3).

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[3] Johnston (2019, 2023) discusses an interesting case where a definite plural licenses a pair-list reading. Xiang 2023 argues that this reading is not a QiQ-reading, but rather a functional reading involving *respective* distributivity.

3.1. Bumford (2022)

Bumford (2022) observes two types of DP constructions that allow for a QɪD interpretation, including inverse-linking constructions embedding a distributive DP, as in (38), and possessive expressions with a distributive possessor, as in (39). In both constructions, the distributor-embedding DP has a plurality-like interpretation and can be selected by a collective predicate.

(38) The committee is composed of ...
  a. ... two representatives from every/each city. (*every/each* $\gg \exists 2$)
  b. ... the mayor of every/each city. (*every/each* $\gg \iota\text{-NP}_{\text{SG}}$)
(39) a. [Each set's jobs] are now combined into a mega-job.
  b. An acrostic is a type of poem where [each line's first letter] spells out a word.

Additional examples below from Bumford 2022 show that DPs with a QɪD reading can be indefinite or definite, serve as a subject or an object, and are compatible with a range of collective predicates:

(40) a. School performance estimates combine [three years of data from each school] to provide an estimate of the expected percent of students proficient or advanced [...]
  b. During the next meeting you attend, add up [the hourly cost of every person in the room].
  c. But [the words of each inquiry] rattled and collided in my brain and spun into an unintelligible tangle.

To account for the QɪD interpretation in those distributor-embedding DPs, Bumford (2022) encodes a polymorphic conjunction into the lexicon of *every/each*, which has a boolean ($\bigwedge$) or non-boolean ($\bigoplus$) use varying by the type of the object that the distributor quantifies into. As in (41), this polymorphic semantics is formalized as an indexed conjunctive Π^{α}, where α can be a boolean or non-boolean type. Collectivity arises when a distributor quantifies into an entity (e) or a set of entities (S_e).

(41) $[\![every]\!] = \lambda P_{et}\lambda k.\Pi^{\alpha}\{k(x) \mid P(x)\}$, where
  a. $\Pi^{\alpha} = \bigwedge$, iff α is boolean type (t or $\langle\vec{\sigma}, t\rangle$)
  b. $\Pi^{\alpha} = \bigoplus$, iff $\alpha = e$ or $\alpha = \mathsf{S}_e$

Accordingly, in all the following, the *every*-phrase moves to the left edge of a TP/VP/DP and quantifies into this TP/VP/DP directly. The main distinction is that *every* has a boolean conjunction reading in (42a,b), where it quantifies into a t-type or $\langle e, t\rangle$-type expression, while a summation reading in (42c–e), where it quantifies into an entity or a set of entities.[4]

(42) a. Every boy watched *Spiderman*.
  $[_{::\,t}$ every-boy λx $[_{::\,t}$ x watched *Spiderman*]] (boolean conjunction)
  b. Spot chased every cat's tail.
  $[_{::\,t}$ Spot $[_{::\,\langle e,t\rangle}$ every-cat λx $[_{::\,\langle e,t\rangle}$ chased x's tail]] (boolean conjunction)
  c. two representatives of every state
  $[_{::\,\mathsf{S}_e}$ every-state λx $[_{::\,\mathsf{S}_e}$ two representatives of x]] (summation)
  d. the mayor of every city
  $[_{::\,e}$ every-city λx $[_{::\,e}$ the mayor of x]] (summation)
  e. Every sentence's first letter formed a word.
  $[_{::\,e}$ every-sentence λx $[_{::\,e}$ x's first letter]] (summation)

---

[4] Bumford (2022) treats indefinites as sets of entities and writes their semantic type as S_e, not as generalized quantifiers, which avoids assigning a boolean type (e.g., $\langle et, t\rangle$) to indefinites and under-generating a summation reading. Note that although $\langle e, t\rangle$ and S_e both are types for sets of entities, only the former is considered as a boolean type.

3.2. My proposal: quantification into predication

While keeping the standard boolean semantics of *every* and staying theory-neutral on the semantics of DPs, the analysis of QɪQ presented in section 2.3 easily extends to QɪD.

I treat indefinites standardly as generalized quantifiers and assume that a generalized quantifier is defined only if its domain of quantification is not empty. As illustrated in Figure 2 below, to derive the QɪD interpretation of an inverse-linking indefinite, the embedded distributor *every state* takes quantifier raising and quantifies into a predication operation applied to the embedding DP, giving rise to a universal predication condition. This condition also asserts that each state has at least two representatives, similar to the domain exhaustivity requirement of ∀-questions. Further, the same as the step of creating a function graph description in QɪQ, here applying minimization ($f_{\text{CH}}^{\text{MIN}}$) and conjunction (Aɴᴅ) returns the conjunction of a set of indefinites.

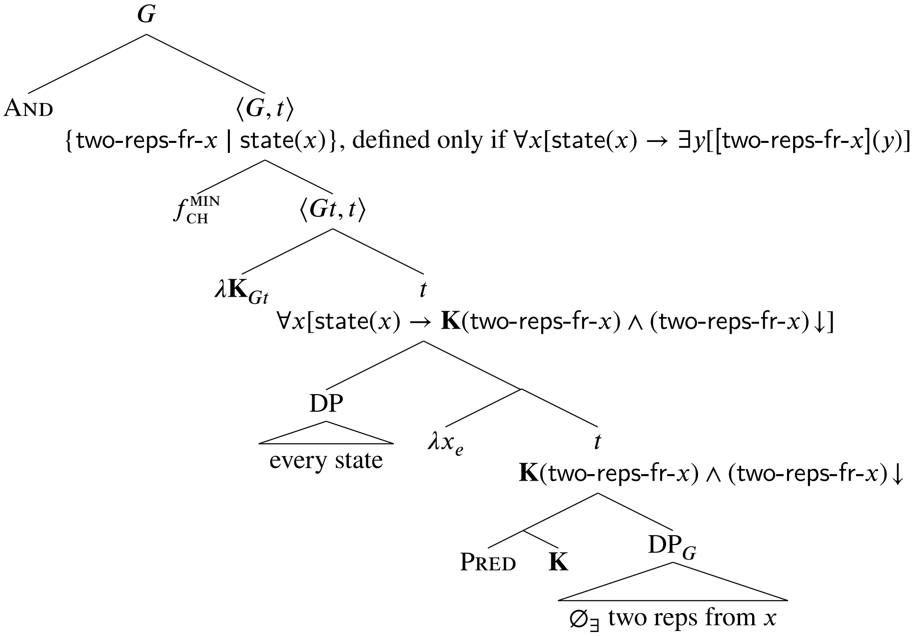

Figure 2: Composition of *two representatives from every state* (**G** abbreviates $\langle et, t\rangle$)

This LF schema also applies to a possessive DP, as exemplified in (43).

(43) every sentence's first letter

  a. [Aɴᴅ [$f_{\text{CH}}^{\text{MIN}}$ $\lambda\mathbf{K}$ [every-sentence λx [Pʀᴇᴅ(**K**) [x's first letter]]]]]

  b. Aɴᴅ$\{x\textsf{'s-first-letter} \mid \textsf{sentence}(x)\}$

The Aɴᴅ-operator, regardless of how it is defined, can be viewed as the covert counterpart of the English connective *and*, which is ambiguous between a distributive reading and a collective reading.[5,6]

(44) a. two representatives from state A <u>and</u> two representatives from state B

  b. sentence A's first letter <u>and</u> sentence B's first letter

---

[5] I leave it open how the distributive/boolean and collective/non-boolean readings of *and* are derived; they could be derived from two separate lexical entries (Link 1983) or uniformly (Champollion 2016b).

[6] The combination of quantification-into-predication and minimization is similar to Winter's (1996) collectivity operator C ($:= \lambda X \lambda Y.\exists Z[\textsc{min}(X)(Z) \wedge Y(Z)]$), which is coined to account for collective readings of conjunctions of singulars. E.g.,: $[\![\textit{John and Mary met}]\!] = [\mathsf{C}(j \sqcap m)](\textit{meet})$.

While Bumford 2022 encodes conjunction into the lexical semantics of *every* and *each*, my analysis assumes a covert conjunction operator AND in all cases, regardless of the type of the embedded quantifier. In the examples presented in Figure 2 and (43), the quantificational force of the quantifier only determines how many elements in the restrictor participates in forming a state-representative/ sentence-letter pair.

3.3. Predictions

The presented account makes similar predictions as Bumford's account regarding the distribution of QID readings in cases that involve a universal distributor. However, separating conjunction from the lexical semantics of *every/each*, my analysis uniformly applies to other quantifiers, with predictions analogous to what it predicts for QIQ. This section discusses these predictions.

3.3.1. Distributional constraints

QID exhibit similar distributional constraints on quantifier type as QIQ. First, negative quantifiers cannot participate in QID, as illustrated by the infelicity of (45a), in comparison to (45b). This constraint can be accounted for by the same explanation for the unavailability of QIQ readings in questions with a negative quantifier, that is, using a QID-generating LF to compose a DP that embeds a negative quantifier yields the conjunction of an empty set, which is semantically deviant.

(45) a. # This committee is made up of [representatives from no metropolitan city].
b. This committee has representatives from no metropolitan city.

Related to this deviance, negative quantifiers have a blocking effect to both QIQ and QID. In the (b)-examples below, in contrast to the well-formed (a)-examples, conjoining an *each*-phrase with a negative quantifier in an embedding position makes a QIQ/QID interpretation unavailable. In particular, question (46b) only admits a non-QIQ-reading, read as 'Which movie *x* is such that each boy and no teacher watched *x*?'; sentence (47b) sounds infelicitous, similar to (45a).

(46) a. Which movie did [each boy] watch? (✓QIQ)
b. Which movie did [each boy and no teacher] watch? (✗QIQ)

(47) This committee is made up of ...
a. [four representatives from [each metropolitan city]]. (✓QID)
b. # [four representatives from [each metropolitan city and no small city]]. (✗QID)

In Xiang 2023, I have proposed an explanation for the blocking effect in QIQ based on Efficiency. This explanation also applies to QID: composing (46b)/(47b) with a QIQ/QID-generating LF gives rise to a meaning equivalent to the QIQ/QID reading yielded by the simplification in (46a)/(47a), which violates Efficiency.

(48) **Efficiency** (Meyer 2013)
a. LF α is ill-formed if there is an LF β s.t. β is a simplification of α.
b. β is a simplification of α iff $[\![\alpha]\!] = [\![\beta]\!]$ and β can be derived from α by replacing nodes in α with their subconstituents.

Second, in analogy to the fact that only *wh*-questions with an *every/each*-subject admit a pair-list QIQ reading, only DPs that embed an *every/each*-phrase may have a pair-list QID reading. In (49b–d), embedding a non-distributive DP causes infelicity because the resulting inverse-linking DP only admits a cumulative reading, which contradicts a context that requires two of one-city-four-representatives pairs.

(49) (Mutual knowledge: The committee has eight members in total.)
The committee is made up of [four representatives from ...].
a. ... each of the two metropolitan cities
b. # ... the two metropolitan cities (*the*-$\text{NP}_{\text{PL}} \gg$ ~~EACH~~ $\gg \exists 4$)
c. # ... two (of the) cities ($\exists 2 \gg$ ~~EACH~~ $\gg \exists 4$)
d. # ... exactly two/ less than three cities (CQ-$\text{NP}_{\text{PL}} \gg$ ~~EACH~~ $\gg \exists 4$)

This distributional constraint is also supported by interactions with definite singulars. Example (50b), in contrast to the plural counterpart (50a), is infelicitous because it implies that multiple cities have the same mayor (cf. Hackl 2003). Embedding a distributive DP, however, the definite singular (50c) doesn't give rise to this contextually unlikely inference, since the embedded *every/each*-phrase can be interpreted as scoping above *the*, giving rise to a point-wise uniqueness inference.

(50) The committee is composed of ...
a. ... the mayors of two/all/most (of the) cities.
b. # ... the mayor of two/all/most (of the) cities. ($\exists 2$/*all*/*most* $\gg$ ~~EACH~~ $\gg \iota$-*mayor*)
c. ... the mayor of every/each city. (*every*/*each* $\gg \iota$-*mayor*)

3.3.2. Scope ambiguity of uniqueness

Wh-phrases with a singular *wh*-complement obligatorily trigger a uniqueness inference (Dayal 1996). For instance, the question 'Which student passed the exam?' presupposes that only one of the relevant students passed the exam. In questions with a quantificational subject and a singular *wh*-object, the uniqueness inference triggered by the *wh*-object can scope either below the quantificational subject, when the question has an individual reading, as in (51a) and (52a), or above it, when the question has a QIQ-reading, as in (51b) and (52b).

(51) Which school does every kid dream of?
a. (Every kid dreams of) Berkeley. (Individual)
$\iota \gg \forall$: 'There is only one school that is a dream school of every kid.'
b. Andy dreams of Arizona, Billy dreams of Berkeley, Cindy dreams of Caltech. (Pair-list)
$\forall \gg \iota$: 'Each kid has exactly one dream school.'

(52) Which gift did one of the students give to Mary?
a. A book. (Individual)
$\iota \gg \exists$: 'Only one gift was given to Mary by any of the students.'
b. Suzi gave a book to Mary. (Choice)
$\exists \gg \iota$: 'One of the students gave exactly one gift to Mary.'

Interestingly, the same ambiguity arises with definite singulars that embed a quantifier and with singular possessive phrases containing a quantificational possessor, as illustrated in (53) and (54).

(53) *the dream school of every kid*, *every kid's dream school*
a. 'Every kid dreams of the same school.' ($\iota \gg \forall$)
b. 'Each kid dreams of a (possibly different) school.' ($\forall \gg \iota$)

(54) *the gift from a student*, *one of the students' gift*
a. 'Only one gift was given by any of the students.' ($\iota \gg \exists$)
b. 'Some student gave exactly one gift.' ($\exists \gg \iota$)

I argue that the derivation of the wide-scope uniqueness reading parallels that of the individual reading of a ∀-question (given in (17)). In (55a), the embedded QDP *every kid* quantifies into a predication construction in which the NP-complement (i.e., *dream school of x*) acts as a predicate, and a covert variable (y) serves as the argument.[7] The narrow-scope uniqueness reading has an LF similar to that of the pair-list reading of a ∀-question. In (55b), *every kid* quantifies into a predication construction where the definite DP (or a larger constituent that embeds the DP) acts as the argument.

(55) *the dream school of every kid*

a. $\iota \gg \forall$ reading ($\approx$ individual reading of a ∀-question)
$[_{\text{DP}}$ the λy_e $[_{\text{(b)}}$ every-kid λx_e $[_{\text{(a)}}$ y $\textsc{Pred}$ $[_{\text{NP}}$ dream school of x]]]]

i. $[\![\text{(a)}]\!] = [\lambda d_e.\textit{dream-school}(x,d)](y) \wedge y{\downarrow} = \textit{dream-school}(x,y) \wedge y{\downarrow}$ t
ii. $[\![\text{(b)}]\!] = \forall x[\textit{kid}(x) \rightarrow \textit{dream-school}(x,y)]$ t
iii. $[\![\text{DP}]\!] = \iota y_e.\forall x[\textit{kid}(x) \rightarrow \textit{dream-school}(x,y)]$ e

b. $\forall \gg \iota$ reading: ($\approx$ pair-list reading of a ∀-question)
[$\textsc{And}$ [$f^{\text{MIN}}_{\text{CH}}$ $\lambda \mathbf{K}$ $[_{\text{(b)}}$ every-kid λx_e $[_{\text{(a)}}$ $\textsc{Pred}(\mathbf{K})$ $[_{\text{DP}}$ the dream school of x]]]]]

i. $[\![\text{(a)}]\!] = \mathbf{K}(\iota d_e.\textit{dream-school}(x,d)) \wedge [\iota d_e.\textit{dream-school}(x,d)]{\downarrow}$ t
ii. $[\![\text{(b)}]\!] = \forall x[\textit{kid}(x) \rightarrow \mathbf{K}(\iota d_e.\textit{dream-school}(x,d)) \wedge [\iota d_e.\textit{dream-school}(x,d)]{\downarrow}]$ t
iii. $\textsc{And}\ \{\iota d_e.\textit{dream-school}(x,d) \mid \textit{kid}(x)\}$,
defined only if $\forall x[\textit{kid}(x) \rightarrow \exists! d_e.\textit{dream-school}(x,d)]$

This analysis also extends to cases involving an embedded indefinite, illustrated as in (56). I argue that the wide-scope and narrow-scope uniqueness readings are derived analogously to the individual and choice readings of an ∃-question.[8]

(56) *the gift from a student*

a. $\iota \gg \exists$ reading: ($\approx$ individual reading of an ∃-question)
$[_{\text{DP}}$ the λy_e $[_{\text{(b)}}$ a-student λx_e $[_{\text{(a)}}$ y $\textsc{Pred}$ $[_{\text{NP}}$ gift from x]]]]

i. $[\![\text{(a)}]\!] = \textit{gift-from}(x,y) \wedge y{\downarrow}$ t
ii. $[\![\text{(b)}]\!] = \exists x[\textit{student}(x) \wedge \textit{gift-from}(x,y)]$ t
iii. $[\![\text{DP}]\!] = \iota y_e.\exists x[\textit{student}(x) \wedge \textit{gift-from}(x,y)]$ e

b. $\exists \gg \iota$ reading: ($\approx$ choice reading of an ∃-question)
[$\textsc{And}$ [$f^{\text{MIN}}_{\text{CH}}$ $\lambda \mathbf{K}$ $[_{\text{(b)}}$ a-student λx_e $[_{\text{(a)}}$ $\textsc{Pred}(\mathbf{K})$ $[_{\text{DP}}$ the gift from x]]]]]

i. $[\![\text{(a)}]\!] = \mathbf{K}(\iota d_e.\textit{gift-from}(x,d)) \wedge [\iota d_e.\textit{gift-from}(x,d)]{\downarrow}$ t
ii. $[\![\text{(b)}]\!] = \exists x[\textit{kid}(x) \wedge \mathbf{K}(\iota d_e.\textit{gift-from}(x,d)) \wedge [\iota d_e.\textit{gift-from}(x,d)]{\downarrow}]$ t
iii. $\textsc{And}\ \{\iota d_e.\textit{gift-from}(x,d)\}$, where x is the chosen student,
defined only if $\exists! d_e[\textit{gift-from}(x,d)]$, where x is the chosen student

It is worth noting that the existential force in the narrow-scope uniqueness reading (56b) comes from the existential closure of the choice function variable encoded within the $f^{\text{MIN}}_{\text{CH}}$-operator, not from the lexical semantics of the indefinite *a student*. This closure scopes globally above speech acts. Hence, the narrow-scope uniqueness reading can be obtained even if the indefinite takes an extremely local move and directly quantifies into the predication of its own trace, as in (57).

(57) [the [gift [from [$\textsc{And}$ [$f^{\text{MIN}}_{\text{CH}}$ $\lambda \mathbf{K}$ [a-student λx_e [$\textsc{Pred}(\mathbf{K})$ x]]]]]]]

---

[7] In (56a), I assume that the variable bound by *the* (viz., y) and the NP *gift from x* combine by functioning as arguments of a covert $\textsc{Pred}$-operator, following the convention that NPs, in contrast to VPs, do not actively combine with an e-type argument in syntax.

[8] The two readings in (56a) and (56b) correspond to what Barker (2005) refers to as the ‘strong’ and ‘weak’ readings of a possessive definite like *the student of a linguist*. Barker explains this strong-vs.-weak ambiguity by proposing that the determiner *the* can combine either with the complex NP *student of a linguist* or with the noun *student* alone.

3.3.3. A remaining puzzle: every as 'all the'

In sentence (58a), singular *every* doesn't atomically distribute into a definite plural, as each president has only one face. Intuitively, this *every* has a 'all (the)'-like interpretation like (58b), which takes the plural noun *faces* as a dependent plural.

(58) a. Just used AI to combine the faces of every single US President. (Bumford 2022: ex12a)
b. Just used AI to combine the faces of all the US President.

Similarly, singular *every* may occur inside the PP-modifier of a *joint*-type noun, as in (59), which shows that the embedded *every*-phrase has a collective interpretation.

(59) a. Implementing this will require [the joint effort of every single inhabitant of the planet].
b. Infection control is an output of [collective effort by every HCP].

My account of QID captures this 'all (the)'-like interpretation easily: this interpretation arises when the embedded *every*-phrase undergoes QID locally and quantifies into the predication of its own trace, as illustrated in (60).

(60) a. [the [faces [of [$_{\text{GDP}}$ AND [$f^{\text{MIN}}_{\text{CH}}$ $\lambda\mathbf{K}$ [every-US-president λx_e [PRED($\mathbf{K}$) x]]]]]]]
b. $[\![\text{GDP}]\!] = \text{AND}\ \{x \mid \textit{US-president}(x)\} \approx [\![\textit{all the US presidents}]\!]$

What yet remains puzzling is that the 'all (the)'-like reading of *every* has a limited distribution. Unlike *all (the)*, *every* doesn't license a plural dependent when appearing in an agent/subject position (Zweig 2008; Champollion 2010). In (61), the *every*-sentence is false since it implies that each safari participant saw more than one zebra. If the 'all (the)' interpretation of *every* were readily available, the contrast between (61a) and (61b) would be unexpected.

(61) (A cumulative scenario: Each safari participant saw at least one zebra, and at least two zebras were seen overall.)
a. All the safari participants saw zebras. [True]
b. Every safari participant saw zebras. [False]

Similarly, in contrast to (59a,b), sentences (62a,b) where a singular *every*-phrase serves as the agent of a collective predicate are infelicitous.

(62) a. Every single inhabitant of the planet made a (# joint) effort.
b. Every HCP made a (# collective) effort.

More broadly, the restricted distribution of the 'all (the)'-like reading of *every* is a variant of the well-known subject–object asymmetry problem of *every*: in an agent/subject position, *every* permits only a distributive reading, excluding collective or cumulative readings (Schein 1993; Kratzer 2003; Zweig 2008; Champollion 2010, 2016a; Brasoveanu 2013; Haslinger and Schmitt 2018; Chatain 2020, 2022; a.o.). Example (58a) presents a new challenge to this issue: the 'all (the)'-like reading of *every* must be derived locally—specifically, within the argument of the preposition *of*, and it remains puzzling how such a local derivation could be sensitive to subject–object contrasts, agent–non-agent distinctions, or c-command relations.

It should be made clear that Bumford's (2022) analysis may also predict this 'all (the)'-like interpretation of *every*: it is generated if the singular *every*-phrase takes a very short movement and quantifies into its *e*-type trace, as illustrated in (63).

(63) a. LF: ... [every-US-president λx_e x]
b. Meaning: $\bigoplus\{x \mid \textit{US-president}(x)\}$

However, judging (64c,d) ungrammatical, in contrast to (64a,b), Bumford rules out this LF by arguing that distributivity cannot be vacuous.[9]

(64) a. All the campers gathered around the fire.
b. The campers gathered around the fire.
c. % Every camper gathered around the fire.
d. * Each camper gathered around the fire.

In short, the generation of the 'all (the)'-like interpretation of *every* is two-fold. On one hand, this interpretation is necessary to account for cases like (58a) and (59); on the other hand, it must be constrained to prevent overgeneration, particularly when *every* appears in an agent/subject position. This issue requires further investigation.

4. Conclusion

The goal of this paper has been to uniformly account for quantification into a non-truth-denoting object. I argue that such quantification consists of three operations, namely, quantification into predication, minimization, and conjunction. In QiQ, quantifier quantifies into the predication of a dependency sentence; in QiD, quantifier quantifies into the predication of the embedding DP. In addition, *every* may obtain an 'all (the)'-like interpretation if an *every*-phrase quantifies into the predication of its own trace.

Combined with independently motivated assumptions, this analysis explains the distributional constraints of QiQ and QiD, as well as the distributional patterns of the corresponding pair-list readings.

Appendix

The following composition, where the quantifier quantifies into an inclusion (Incl) condition, yields results similar to those of the QiQ/QiD proposal presented in the main text. The Incl-relation is polymorphic; it denotes either generalized entailment or part-hood. (Defined-ness condition is omitted.) This method doesn't use a separate conjunction.

(65) *Which movie did every boy watch?* (Pair-list)
$[\text{ wh-movie } \lambda \mathbf{f}_{ee} \; [_\gamma \; f^{\text{MIN}}_{\text{CH}} \; \lambda p_{st} \; [_{(b)} \text{ every-boy } \lambda x_e \; [_{(a)} \textsc{Incl}(p) \; [\; x \text{ watched } \mathbf{f}(x) \;]]]]]$
a. $[\![(a)]\!] = [p \subseteq \lambda w.\mathit{watch}_w(x, \mathbf{f}(x))]$ t
b. $[\![(b)]\!] = \forall x \in \mathit{boy}_@[p \subseteq \lambda w.\mathit{watch}_w(x, \mathbf{f}(x))]$ t
c. $[\![\gamma]\!] = \bigcap\{\lambda w.\mathit{watch}_w(x, \mathbf{f}(x)) \mid \mathit{boy}_@(x)\}$ st
(The weakest proposition p such that for every boy x: $p \subseteq \lambda w.\mathit{watch}_w(x, \mathbf{f}(x))$)

(66) *the mayor of every city* (Collective)
$[_\gamma \; f^{\text{MIN}}_{\text{CH}} \; \lambda d_e \; [_{(b)} \text{ every-boy } \lambda x_e \; [_{(a)} \textsc{Incl}(d) \; [\text{ the mayor of } x \;]]]]$
a. $[\![(a)]\!] = [d \geq \iota y_e.\mathit{mayor}_w(x, y)]$ t
b. $[\![(b)]\!] = \forall x \in \mathit{city}_@[d \geq \iota y.\mathit{mayor}_w(x, y)]$ t
c. $[\![\gamma]\!] = \bigoplus\{\iota y_e.\mathit{mayor}_w(x, y)] \mid \mathit{city}_@(x)\}$ e
(The smallest d such that for every city x: the mayor of x is a part of d)

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[9] Judgment on the *every*-sentence (64c) varies in the literature on distributivity and collectivity.

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