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Determiners as predicates*

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Abstract Since Montague (1973), higher-order functions have formed the blueprint for analyzing determiner meanings in natural language, giving rise to the 'standard' relational treatment of Generalized Quantifier theory (Barwise & Cooper 1981; Keenan & Stavi 1986). The goal of this short paper is to begin sketching an alternative to Generalized Quantifier theory, in which determiners are treated as *predicates* of structured entities. In order to make sense of this idea, I build on recent work by Bledin (forthcoming), who suggests incorporating a notion of polarity into the domain of entities. The resulting account of determiner meanings is significantly more restrictive than the standard account—concretely, I demonstrate that non-conservative determiners cannot be expressed as predicates in the resulting system. Some additional applications of the resulting theory are explored, most prominently novel predictions concerning split and exceptional scope.

Keywords: quantification, determiners, conservativity, negation, numerals, scope

1 Introduction

In Generalized Quantifier (GQ) theory, natural language determiners are modeled as relations between sets of individuals (Barwise & Cooper 1981; Keenan & Stavi 1986, and many others). As is well known, the meaning space afforded by GQ-theoretic determiners far outstrips attested, Natural Language (NL) determiner meanings. An example of a GQ-theoretic determiner that has no known NL correlate is the so-called 'Härtig quantifier' given in (1). It simply expresses the (perfectly sensible) statement that the cardinality of the restrictor is the same as the cardinality of the scope.

(1) $I(A,B) \iff \#A = \#B$

Such gaps are thought to not be accidental, but correspond to substantive universals concerning what kinds of GQ-theoretic determiner meanings NL determiners may express. An extremely robust universal is that all NL determiners express *conservative* determiner meanings. The definition of conservativity is given in (2).

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(2) **Conservativity (def.):** A GQ-theoretic determiner R is *conservative* iff: $R(A,B) \iff R(A, A \cap B)$

It's easy to see that conservativity rules out the Härtig quantifier. Simply let $A = \{a\}; B = \{b\}$, where $a \neq b$. $I(A,B)$ is true, since the restrictor and scope sets are both singletons, but $I(A, A \cap B)$ is false; since A and B are disjoint their intersection is empty.

So, NL determiners may only express a subset of possible GQ-theoretic determiners. The widely adopted 'textbook' treatment of NL determiners integrates them into a compositional regime as higher-order functions (see, e.g., Heim & Kratzer 1998). This raises the question of why all NL determiners are conservative, given that lexical entries for non-conservative determiners are easily stateable.

The goal of this paper is to present an initial sketch of an alternative to the standard treatment of NL determiners. Briefly, I'll develop a semantic regime according to which determiners can be conceived as predicates of structured entities. Building on a recent proposal due to Bledin (forthcoming), this will necessitate integrating a notion of *polarity* into the domain of individuals. Once this is in place, the payoff will be that the meaning space afforded by the predicative treatment of determiners characterizes just the *conservative* GQ-theoretic determiners.

The compositional treatment of determiners I will ultimately advocate for bears a close family resemblance to the predicative treatment of numerals. In the next section, I will briefly summarize the predicative treatment of numerals, and walk through some problems that it gives rise to, given standard ontological assumptions. This will serve as an initial motivation to enrich the ontology with a notion of polarity, closely following Elliott (2025).

2 Numerals as predicates

2.1 Background

While bare numerals can of course be modeled as GQ-theoretic determiners, a decompositional alternative has been developed according to which bare numerals, at their core, are predicates of (plural) individuals (see, e.g., Bartsch 1973; Chierchia 1985; Landman 2003; Rothstein 2013, 2017, and many others) as in (3).[1]

(3) $[\![\text{three}]\!] = \lambda X \,.\, \#_{At} X = 3$

1 I am implicitly assuming, as is standard since Link (1983), that the domain of entities constitutes a complete atomic join semi-lattice. $\#_{At} X$ maps an entity X to the cardinality of its distinct atomic parts.

Numerals are taken to compose with plural NPs, which also denote predicates, as intersective modifiers, as in (4).[2]

(4) $[\![\text{three boys}]\!] = \lambda X\,.\,[\![\text{three}]\!]\,(X) \wedge [\![\text{boys}]\!]\,(X) = \lambda X\,.\#_{At}X = 3 \wedge^{*}\mathsf{boy}(X)$

In order to compose with a scope, (4) must be existentially raised (Winter 2001). There are various ways of implementing this—one way is to posit a silent existential determiner $\exists$.

(5) $[\![\exists]\!] = \lambda P\,.\,\lambda Q\,.\,\exists X, P(X) \wedge Q(X)$

An important advantage of this view over the classical GQ-theoretic approach to numerals is that it immediately explains the fact that numeral expressions may compose with *collective* predicates, as in (6).

(6) Three boys gathered.
$\Rightarrow \exists X, \#_{At}X = 3 \wedge^{*}\mathsf{boy}(X) \wedge \mathsf{gathered}(X)$

This view also explains the fact that numeral expressions may take distributive scope, much like other plural expressions. For example, (7) is judged true relative to a situation where boys b_1, b_2 are only singing, and b_3 is only dancing, and no other boys are singing or dancing. This reading follows from the availability of a covert distributivity operator *Dist*, which universally quantifies over atomic parts (Link 1987).

(7) Three boys are singing or dancing. *Dist* $> \vee$
[$\exists$ three boys] *Dist* [singing or dancing]
$\Rightarrow \exists X, \#_{At}X = 3, ^{*}\mathsf{boy}(X), \forall x \leq_{At} X, (\mathsf{sing}(x) \vee \mathsf{dance}(x))$

Although extremely successful in many respects, the predicative account of numerals faces some hurdles. Although certainly not fatal, taken together, these will serve as an initial motivation to enrich the domain of pluralities.

2.2 Problems for the predicative theory

2.2.1 Upper-bounded numerals

Note that, even though ‘three’ is taken to be a predicate true of pluralities with *exactly* three atomic parts, a statement such as “three boys sneezed” is still predicted to be true relative to a scenario in which four boys sneezed: If a predicate P is distributively true of a plurality X, it follows that P is distributively true of every $X' \leq X$.

2 For example, via Heim & Kratzer’s (1998) ‘Predicate Modification’ composition principle.

(8) Three boys sneezed. $\Rightarrow \exists X, \#_{At}X = 3, ^{*}\mathsf{boy}(X), \forall x \leq_{At} X, \mathsf{sneezed}(x)$

Attempting to extend this theory to upper-bounded modified numerals leads to immediate problems. A predicative entry for the upper-bounded numeral is given in (9).

(9) $[\![\text{less than three}]\!] = \lambda X\,.\,\#_{At}(X) < 3$

It's easy to see that (10) is in fact incorrectly predicted to be true relative to a scenario in which three boys sneezed. This is essentially because (10) is an existential statement—if, e.g., $b_1 \oplus b_2 \oplus b_3$ distributively sneezed, then from the definition of distributivity it follows that, e.g., $b_1 \oplus b_2$ sneezed, which constitutes a plurality with cardinality < 3. The sentence in (10) is therefore incorrectly predicted to be equivalent to "(at least) one boy sneezed". Existential quantification renders upper-bounds inert—this is often referred to as 'van Benthem's problem' (after van Benthem 1986).

(10) Less than three boys sneezed.
$\Rightarrow \exists X, \#X < 3, ^{*}\mathsf{boy}(X), \forall x \leq_{At} X, \mathsf{sneezed}(x)$

The literature has explored ways of addressing this issue, e.g., by positing a maximality operator in the LF of sentences with modified numerals (see, e.g., Buccola & Spector 2016). I do not wish to suggest that this approach isn't viable, but it's of course worth mentioning that the problem of upper bounds simply doesn't arise on a simple GQ-theoretic approach to determiners.[3]

2.2.2 Existential entailment and the problem of 'zero'

Assuming a standard Linkean approach to plurality (Link 1983), the extension of a plural NP is the *algebraic closure* of a set of atomic individuals. For example, the extension of 'boys' is written as $^{*}\mathsf{boy}$, which is a predicate true of (i) any atomic *boy* individual, (ii) any sum of atomic *boys*, and nothing else. Consider now the

3 Positing *maximality* in the semantics of modified numerals is not without its problems. Maximality operators give rise to complex scopal interactions, and it has been argued that this predicts unattested 'pseudo-cumulative' readings for sentences such as (i), and furthermore fails to derive the attested cumulative reading, which (roughly) says that the number of boys who like girls is *exactly three*, and the number of girls liked by boys is *exactly two*. See, e.g., Brasoveanu (2013), Charlow (2021) and Haslinger & Schmitt (2020) for detailed discussion, and especially Elliott (2025) for an account of cumulative readings using the framework developed in this paper.

(i) Exactly three boys like exactly two girls.

ramifications for upper-bounded numerals such as ‘less than three’ on the predicative view. (12) is predicted to be straightforwardly false relative to a scenario in which *no boys sneezed*. This is because the elements of ${}^{*}\mathsf{boy}$ with a cardinality of less than three are (i) atomic boy individuals, or (ii) sums made up of exactly two atomic boys. The sentence asserts that one such individual is (distributively) true of ‘sneezed’.

(11) $[\![\text{less than three}]\!] = \lambda X\,.\,\#X < 3$

(12) Less than three boys sneezed.
$\Rightarrow \exists X, \#X < 3, {}^{*}\mathsf{boy}(X), \forall x \leq_{At} X, \mathsf{sneezed}(x)$

The sentence in (12) is of course intuitively judged true in this scenario—Buccola & Spector (2016) call this the ‘existential entailment’ problem. There is a closely related problem, concerning the bare numeral ‘zero’. It is desirable to give a uniform treatment to the bare numeral ‘zero’ as a cardinality predicate, as in (13). This entry however has the unfortunate consequence of predicting any simple statement such as ‘zero boys sneezed’ to be trivially false, since given standard Linkean ontological assumptions, every individual has at least one atomic part (see Bylinina & Nouwen 2018 for discussion).

(13) $[\![\text{zero}]\!] = \lambda X\,.\,\#X = 0.$

Taken together, I’ll take the problem of upper bounds, existential entailment, and ‘zero’ as together suggesting that the standard Linkean plural ontology needs to be enriched. Of course, the literature has already addressed the aforementioned problems in a rather piecemeal fashion, but in the next section I’ll demonstrate that introducing a notion of *polarity* into the ontology of individuals allows for a simple and intuitive resolution, following Elliott (2025), while leaving the core of the predicative theory of numerals intact.

3 Polarity in the individual domain

The intuition that I’ll pursue in this section, following Bledin (forthcoming) (in spirit, although not in implementational detail) and Elliott (2025), is that the domain of individuals may be *polarized*, by associating each ordinary atomic individual with a ‘polar tag’. True-tagged, or ‘positive’ individuals are written as x^{+}, whereas false-tagged, or ‘negative’ individuals are written as x^{-}, as in (14). One way of conservatively formalizing this idea is to associate individuals with a single *bit* of information, i.e., a boolean value, as in (14).[4]

(14) **Polarized individuals (def.):** $x^{+} := (x, 1)$ $\quad\quad \forall x \in D_e$
$x^{-} := (x, 0)$

4 I’m grateful to Simon Charlow (p.c.) for suggesting this idiom.

In (15), I define a principle for applying a boolean function f to a polarized individual. Intuitively, the idea here is that f applies to 'not x' is true iff f applied to x is false.

(15) **Polarized functional application:** $f * x^+ := f(x) \qquad \forall f \in D_{et}, x \in D_e$
$f * x^- := \neg f(x)$

A crucial move will be to assume that the polarized domain has a rich part-whole structure (Bledin forthcoming)—this will be formalized by treating the polarized domain as an *atomic join semi-lattice*. In other words, '$a^+ \sqcup b^+ \sqcup c^-$' contains two positive individuals, and one negative individual (as atomic parts). There is no reason in principle why we could not take, e.g., $a^+ \sqcup a^-$, i.e., 'a and not a', however it will be necessary to filter out such cases. In order to do so, I define a notion of *coherence* (following Akiba 2009; Elliott 2025), the intuition being that *coherent* elements do not contain both x^+ and x^- as parts.

(16) **Coherence (def.):** X is *coherent* iff $\neg\exists x \in D$, s.t., $x^+ \leq_{At} X$ and $x^- \leq_{At} X$.

We may now define the *(coherent) polarized domain* $D_e^{\pm}$ as the coherent elements of the atomic join semilattice on polarized atoms. With this in mind, we can straightforwardly define an operator that allows an element of the polarized domain to compose with an ordinary predicate, by universally quantifying over the atomic parts (15). This is modeled after Link's distributivity operator.

(17) **Δ-operator (def):**
$\Delta(f) = \lambda X \in D_e^{\pm} . \forall x \leq_{At} X, f * x$

As a result, we can make sense of how to distributively predicate 'sneezed' of the group of a, b, and *not* c, (18).

(18) $\Delta([\![\text{sneezed}]\!])(a^+ \sqcup b^+ \sqcup c^-) \iff$ a and b sneezed, but c didn't sneeze.

Bledin (forthcoming) pursues the idea that NL coordinations such as "a, b and not c" denote groups of polarized individuals, in order to tackle problems in the semantics of collective coordinations. For the purposes of the current work, what will be crucial will be the idea that polarity is implicated in the semantics of Noun Phrases. Concretely, following Elliott (2025), I'll assume that the extension of the NP 'boy(s)' is true of *maximal* groups of polarized *boys*.[5] For the time being, as in GQ-theory, it will be convenient to gloss over the distinction between semantic singularity and semantic plurality. I'll return to this in §6.1.

5 Maximality wrt parthood is defined as follows:

(i) $Max_{\leq}(f) = \lambda X \in D_e^{\pm} . f(X) \wedge \forall X' \in D_e^{\pm}[f(X') \rightarrow X' \leq X]$

(19) $[\![\text{boy(s)}]\!] = Max_{\leq}(\lambda X \in D_e^{\pm} . \forall x^+, x^- \leq_{At} X, \mathsf{boy}(x))$

In order to see what this delivers, I'll walk through a concrete example. Let the ordinary atomic boys be b_1, b_2, b_3. We can now take the maximal elements of $D_e^{\pm}$, all of whose atomic parts are polarized boys. Since $D_e^{\pm}$ only contains coherent joins, there will be multiple such maxima, as illustrated in (20).

(20) $$[\![\text{boy(s)}]\!] = \left\{ \begin{array}{c} b_1^+ \sqcup b_2^+ \sqcup b_3^+, \\ b_1^+ \sqcup b_2^+ \sqcup b_3^-, b_1^+ \sqcup b_2^- \sqcup b_3^+, b_1^- \sqcup b_2^+ \sqcup b_3^+ \\ b_1^+ \sqcup b_2^- \sqcup b_3^-, b_1^- \sqcup b_2^+ \sqcup b_3^-, b_1^- \sqcup b_2^- \sqcup b_3^+ \\ b_1^- \sqcup b_2^- \sqcup b_3^- \end{array} \right\}$$

Note that the elements in the extension of 'boy(s)' each encode something about every ordinary *boy* individual. Concretely, for every ordinary *boy* b, each sum in (20) contains either b^+ or b^-. A useful metaphor to bear in mind is that each element of (20) says, for each boy, whether or not he has some yet-to-be-specified property.

In the following section, I'll first develop a semantics for numerals which exploits the rich structure afforded by polarization. I'll then show how the resulting system is in fact expressive enough to encompass NL determiners.

4 Determiners as predicates

4.1 Numerals revisited

The predicative theory of numerals can now be reconstructed in light of individual-level polarity. Given an element of $D_e^{\pm}$, it will be extremely useful to be able to pick out the individuals whose true-tagged counterparts are atomic parts of X (21a), the individuals whose false-tagged counterparts are atomic parts of X (21b), as well as the union of these two sets (21c). A demonstration is provided in (22). Note that, given coherence, it's a fact that $At^+(X)$ and $At^-(X)$ are always disjoint for any $X \in D_e^{\pm}$.

(21) **Positive and negative atoms (def.):** $\forall X \in D_e^{\pm}$,

a. $At^+(X) = \{x \in D_e \mid x^+ \leq_{At} X\}$

b. $At^-(X) = \{x \in D_e \mid x^- \leq_{At} X\}$

c. $At^{\pm}(X) = At^+(X) \cup At^-(X)$

(22) a. $At^+(a^+ \sqcup b^+ \sqcup c^-) = \{a, b\}$

b. $At^-(a^+ \sqcup b^+ \sqcup c^-) = \{c\}$

Numeral expressions place a cardinality constraint on $At^+(X)$. For reasons that will swiftly become apparent, in the polarized fragment it will be necessary to give bare numerals an *at least* semantics, as in (23). As in the classical predicative theory, bare numerals are assumed to compose with plural NPs as intersective modifiers. As before, let's take the atomic boys b_1, b_2, b_3. We can now observe the effect of intersectively modifying *boys* with the numeral in (25): any elements with less than two positive atomic parts are eliminated.

(23) $[\![\text{two}]\!] = \lambda X \in D_e^{\pm} \,.\, \#(At^+(X)) \geq 2$

(24) $[\![\text{two boys}]\!] = \lambda X \in D_e^{\pm} \,.\, \#(At^+(X)) \geq 2 \wedge [\![\text{boys}]\!]\,(X)$

(25) $$[\![\text{two boys}]\!] = \left\{ \begin{array}{c} b_1^+ \sqcup b_2^+ \sqcup b_3^+, \\ b_1^+ \sqcup b_2^+ \sqcup b_3^-, b_1^+ \sqcup b_2^- \sqcup b_3^+, b_1^- \sqcup b_2^+ \sqcup b_3^+ \\ \xcancel{b_1^+ \sqcup b_2^- \sqcup b_3^-}, \xcancel{b_1^- \sqcup b_2^+ \sqcup b_3^-}, \xcancel{b_1^- \sqcup b_2^- \sqcup b_3^+} \\ \xcancel{b_1^- \sqcup b_2^- \sqcup b_3^-} \end{array} \right\}$$

In line with the classical predicative theory of plurality, I'll assume that composition proceeds via the covert existential quantifier $\exists$, together with Δ-operator, in the case of distributive predicates (I revisit collective predication in §6.1). The resulting *at least* truth conditions essentially amount to a disjunctive statement of the form "either b_1, b_2, b_3 all sneezed, or b_1, b_2 but not b_3 sneezed, ..." etc.

(26) [$\exists$ [Two boys]] Δ sneezed.
$$\exists X, \#(At^+(X)) \geq 2, [\![\text{boys}]\!]\,(X), \forall x \in At^+(X), \mathsf{sneezed}(x), \\ \forall x \in At^-(X), \neg\mathsf{sneezed}(x)$$

Moving on to modified numerals, and specifically upper-bounded numerals—thanks to individual-level polarity, a predicative treatment is feasible without running into the problem of upper bounds, or existential entailment. The entries for 'exactly two' and 'less than three' are given in (27a) and (27b) respectively. As with bare numerals, modified numerals are simply predicates that place a cardinality constraint on positive atoms. In order to understand the predictions made, it is useful to consider the extensions relative to our concrete *boy* individuals $b_{1\ldots3}$, provided in (28). Note that, *exactly two* unlike bare *two*, is false of the wholly positive plurality, since it has three positive atoms—this reflects the upper-bound of the modified numeral. Note also that *less than three* is true of the wholly negative plurality—this reflects the lack of an existential entailment.

(27) a. $[\![\text{exactly two}]\!] = \lambda X \in D_e^{\pm} \,.\, \#(At^+(X)) = 2$

b. $[\![\text{less than three}]\!] = \lambda X \in D_e^{\pm} \,.\, \#(At^+(X)) < 3$

(28) a. $$[\![\text{exactly two boys}]\!] = \left\{ \begin{array}{c} \xcancel{b_1^+ \sqcup b_2^+ \sqcup b_3^+}, \\ b_1^+ \sqcup b_2^+ \sqcup b_3^-, b_1^+ \sqcup b_2^- \sqcup b_3^+, b_1^- \sqcup b_2^+ \sqcup b_3^+ \\ \xcancel{b_1^+ \sqcup b_2^- \sqcup b_3^-}, \xcancel{b_1^- \sqcup b_2^+ \sqcup b_3^-}, \xcancel{b_1^- \sqcup b_2^- \sqcup b_3^+} \\ \xcancel{b_1^- \sqcup b_2^- \sqcup b_3^-} \end{array} \right\}$$

$$\text{b. } [\![\text{less than three boys}]\!] = \left\{ \begin{array}{c} \cancel{b_1^+ \sqcup b_2^+ \sqcup b_3^+}, \\ b_1^+ \sqcup b_2^+ \sqcup b_3^-, b_1^+ \sqcup b_2^- \sqcup b_3^+, b_1^- \sqcup b_2^+ \sqcup b_3^+ \\ b_1^+ \sqcup b_2^- \sqcup b_3^-, b_1^- \sqcup b_2^+ \sqcup b_3^-, b_1^- \sqcup b_2^- \sqcup b_3^+ \\ b_1^- \sqcup b_2^- \sqcup b_3^- \end{array} \right\}$$

Strikingly, existential quantification neither gives rise to the problem or upper bounds nor existential entailment. Intuitively, this is because the pluralities given in (28), are more informative than on the classical view. They contain information both about which *boys* are true of the scope, and which *boys* are false of the scope; no maximality operator is necessary, because the pluralities in the extension of the DP already encode maximal information. The predicted truth-conditions for simple distributive statements are in fact identical to those obtained by a GQ-theoretic approach to numerals, as shown below.

(29) [$\exists$ [exactly two boys]] Δ sneezed.
$$\exists X, \#(At^+(X)) = 2, [\![\text{boys}]\!](X), \forall x \in At^+(X), \mathsf{sneezed}(x),$$
$$\forall x \in At^-(X), \neg\mathsf{sneezed}(x)$$
$$\Longleftrightarrow \#\{x \mid \mathsf{boy}(x), \mathsf{sneezed}(x)\} = 2$$

(30) [$\exists$ [Less than 3 boys]] Δ sneezed.
$$\exists X, \#(At^+(X)) < 3, X \in [\![\text{boys}]\!], \forall x \in At^+(X), \mathsf{sneezed}(x),$$
$$\forall x \in At^-(X), \neg\mathsf{sneezed}(x)$$
$$\Longleftrightarrow \#\{x \mid \mathsf{boy}(x), \mathsf{sneezed}(x)\} < 3$$

Before moving on to other quantificational determiners, note that it is easy to define ‘zero’ as a simple cardinality predicate, unlike on the classical view. The entry is given in (31)—it simply demands that there are no positive atoms. Applied to a set of maximal pluralities of polarized individuals, this will be true only of the wholly negative plurality. As the reader can verify, this predicts that “zero boys sneezed” is equivalent to “no boys sneezed”. Unlike other bare numerals, ‘zero’ must be given an *exactly* semantics; an *at least* semantics would be trivial. This can either be stipulated in the semantics of ‘zero’, or, following Bylinina & Nouwen (2018), derived as an (obligatory) implicature (see Elliott 2025 for further discussion). /

(31) $[\![\text{zero}]\!] = \lambda X \in D_e^{\pm} . \#(At^+(X)) = 0$

4.2 Beyond numerals

Other (plural) quantificational determiners may also be defined as simple predicates. The universal determiner ‘all’ is true of pluralities that have no negative atoms (32a). Applied to a set of maximal pluralities, this will only be true of the unique, *wholly positive* plurality, deriving universal force. The existential determiner ‘some’ encodes existential force by demanding that there be at least some positive atoms (32b). The negative determiners 'not all' and 'none' may both be defined decompositionally by an application predicate-level boolean negation (33).

(32) a. $[\![\text{all}]\!] = \lambda X \in D_e^{\pm} . At^-(X) = \emptyset$
b. $[\![\text{some}]\!] = \lambda X \in D_e^{\pm} . At^+(X) \neq \emptyset$

(33) a. $[\![\text{not all}]\!] = \lambda X \in D_e^{\pm} . \neg [\![\text{all}]\!] (X) = \lambda X \in D_e^{\pm} . At^-(X) \neq \emptyset$
b. $[\![\text{none}]\!] = \lambda X \in D_e^{\pm} . \neg [\![\text{some}]\!] (X) = \lambda X \in D_e^{\pm} . At^+(X) = \emptyset$

With determiners treated as predicates, composition must proceed via existential raising and the Δ-operator, much like with numerals. This is illustrated for the universal in (34). Given concrete boys $b_{1...3}$, *all* will only be true of the unique, wholly positive maximal group of polarized *boys*. Together with Δ, this straightforwardly derives universal truth-conditions.

(34) All boys sneezed.
[∃ [all boys]] Δ sneezed.
$\exists X, At^-(X) = \emptyset, [\![\text{boys}]\!] (X), \forall x \in At^+(X), \mathsf{sneezed}(x),$
$\forall x' \in At^-(X), \neg \mathsf{sneezed}(x')$
$\Rightarrow \forall x \in \{b_1, b_2, b_3\}, \mathsf{sneezed}(x)$

Moving on to a case that is typically thought to require the full expressive power of GQ-theory—perhaps surprisingly, proportional determiners may be defined as predicates in the current setting. Consider the case of proportional 'most', which is standardly defined as a GQ-theoretic determiner as in (35) (but see Hackl 2009 for an alternative).

(35) $\mathbf{most}(A, B) \iff \#(A \cap B) > \#(A - B)$

Recall that with individual-level polarity, groups encode restrictor individuals true of the scope, via positive atoms, and restrictor individuals false of the scope, via negative atoms. This means that 'most' may be given the predicative definition in (36), mirroring the GQ-theoretic entry. From an extensional perspective "most boys", is true of maximal *boy* groups where the positive atoms outweigh the negative atoms. Other proportional determiners such as "exactly half" may also be defined by imposing constraints on how $At^+(X)$ and $At^-(X)$ relate.

(36) $[\![\text{most}]\!] = \lambda X \in D_e^{\pm} . \#(At^+(X)) > \#(At^-(X))$

(37) $$[\![\text{most boys}]\!] = \left\{ \begin{array}{c} b_1^+ \sqcup b_2^+ \sqcup b_3^+, \\ b_1^+ \sqcup b_2^+ \sqcup b_3^-, b_1^+ \sqcup b_2^- \sqcup b_3^+, b_1^- \sqcup b_2^+ \sqcup b_3^+ \\ \xcancel{b_1^+ \sqcup b_2^- \sqcup b_3^-}, \xcancel{b_1^- \sqcup b_2^+ \sqcup b_3^-}, \xcancel{b_1^- \sqcup b_2^- \sqcup b_3^+} \\ \xcancel{b_1^- \sqcup b_2^- \sqcup b_3^-} \end{array} \right\}$$

This discussion naturally leads to the suspicion that GQ-theoretic determiners may be systematically mapped to their predicative counterparts. This turns out to be true (modulo the empty restrictor) but only for *conservative* determiners. In the next section, I turn to the relationship between GQ-theory, the predicative theory, and its ramifications for conservativity.

4.3 Conservativity and the predicative theory

In order to study the relationship between the predicative theory and GQ theory, I'll first establish a useful isomorphism. Given a domain of ordinary atomic individuals D, the structure afforded by $D_e^{\pm}$, given coherence, is isomorphic to the set of trivalent functions from individuals $\{f \mid f : D \mapsto \{1,0,\#\}\}$, minus the constant function $\lambda x \in D\,.\,\#$.[6] The individuals f maps to true, f^+, are 'positive', and the individuals f maps to false, f^-, are 'negative'. Functionality guarantees coherence. The correspondence is informally illustrated below:

(38) $a^+ \sqcup b^+ \sqcup c^- \approx [a \to 1, b \to 1, c \to 0, d \to \#, e \to \#, \ldots]$

Given n individuals in D, there are $3^n - 1$ such functions, which given the isomorphism corresponds exactly to the number of elements in $D_e^{\pm}$. Recall that, on the predicative theory, determiners are boolean functions from elements of $D_e^{\pm}$. From the functional perspective adopted in this section, e.g., 'all' is true of a function that maps no individual in its domain to 0.

(39) $[\![\text{all}]\!] = \lambda f \in D_e^{\pm}\,.\, f^- = \emptyset$

The predicative theory therefore allows for exactly $2^{3^n - 1}$ determiner denotations. For a domain with just 2 atomic individuals, this amounts to 256 possible determiner denotations. For a domain with just 3 atomic individuals, 67,108,864 possible determiner denotations.[7]

By way of contrast, given n individuals in D, there are 2^{4^n} GQ-theoretic determiners. For a domain with just 2 atomic individuals, there are already 65,536 possible determiner denotations; with 3 atomic individuals, there are roughly 10^{19} possible determiner denotations. In fact, only five individuals are necessary in order to outstrip the number of atoms in the universe. The predicative theory therefore clearly cuts down the number of possible determiner meanings exponentially.

6 I'm grateful to Amir Anvari (p.c.) for suggesting this perspective.

7 The factor of one in the exponent reflects the absence of an empty join in $D_e^{\pm}$. Conservative GQ-theoretic determiners number 2^{3^n} (Keenan & Stavi 1986; van Benthem 1986); predicates therefore correspond to equivalence classes of conservatives that agree everywhere except possibly on the empty restrictor (cf. fn. 9).

4.3.1 Mapping from determiners to predicates

In order to examine the relationship between the predicative account of determiners and the GQ-theoretic account, it will be useful to establish mapping principles to move back and forth between predicates and GQ-theoretic determiners.

Let *Det* be a GQ-theoretic determiner, i.e., a relation between sets of (ordinary) atomic individuals. *Det* may be mapped to a predicate via the mapping principle in (40).

(40) **Mapping from determiners to predicates:**
$P_{Det} := \lambda X \in D_e^{\pm} . Det(At^{+}(X) \cup At^{-}(X), At^{+}(X))$

The mapping principle is not meaning-preserving for *non-conservative* determiners. To demonstrate this, I'll adopt the isomorphism established in the previous section. On this isomorphic functional perspective, the effect of Δ on a scope set B is as in (41). $\Delta(B)$ is true of maximal joins qua boolean functions, if the individuals that f maps to true are elements of B, and the individuals f maps to false are not elements of B.[8]

(41) $\Delta(B) := \{ f \mid \forall x \in dom(f), f(x) \iff x \in B \}$

The truth-conditions predicted by (40) on the predicative theory are therefore as in (42). This can be simplified by replacing $f^{+} \cup f^{-}$ and $dom(f)$ with A.

(42) $\exists f \in Det(A_f), f \in \Delta(B)$
a. $\Rightarrow \exists f : A \mapsto \{1, 0\}, Det(f^{+} \cup f^{-}, f^{+}), \forall x \in dom(f), f(x) \iff x \in B$
b. $\Rightarrow \exists f : A \mapsto \{1, 0\}, Det(A, f^{+}), \forall x \in A, f(x) \iff x \in B$

Essentially, this says that there's a way of dividing A into two cells—a positive cell A^{+}, and a negative cell A^{-}, s.t. $Det(A, A^{+})$, and $A^{+} \subseteq B$, $A^{-} \cap B = \emptyset$. This means that A^{+} corresponds to *all* of the As that are Bs, i.e., $A \cap B$. (42b) therefore asserts that $Det(A, A \cap B)$ is true. For a conservative determiner, this mapping will obviously be meaning preserving, and for a non-conservative determiner, it will not be.[9]

To illustrate, consider an application of this mapping to the non-conservative determiner I. The mapping is not meaning preserving—in fact it returns a conservative determiner, equivalent to a universal quantifier on finite domains.

8 Here, I sloppily talk about the 'domain' of a trivalent function f as the elements of the domain that f does not map to #.

9 There is some additional nuance here: the mapping is insensitive to the value of *Det* at the empty restrictor. Throughout, the correspondence between predicates and conservative determiners should be understood modulo behavior at the empty restrictor. I take this to be benign—the empty restrictor case is standardly regarded as pragmatically degenerate or a presupposition failure.

(43) $\exists f : A \mapsto \{1,0\}, \#A = \#f^+, \forall x \in A, f(x) \iff x \in B$
$\Rightarrow \#A = \#(A \cap B)$

4.3.2 Mapping from predicates to determiners

Predicates of pluralities of polarized individuals can also be mapped back to GQ-theoretic determiners. Let P be such a predicate—the mapping principle is defined in (44).

(44) **Mapping from predicates to determiners:**
$P_{GQ}(A,B) \iff \exists f : A \mapsto \{1,0\}, P(f), \forall a \in A, f(a) \iff a \in B$

Consider, e.g., the predicate 'most', true of f iff $\#f^+ > \#f^-$. It's easy to see that this is equivalent to the standard GQ-theoretic definition of 'most'. Since the domain of f is the entirety of A, and f must *agree* with B, such an f exists iff the individuals in the restrictor true of the scope outweigh the individuals in the restrictor false of the scope, i.e., $\#(A \cap B) > \#(A - B)$.

(45) $\textbf{most}_{GQ}(A,B) \iff \exists f : A \mapsto \{1,0\}, \#f^+ > f^-, \forall a \in A, f(a) \iff a \in B$

More generally, if we take the functional isomorphism established in the previous section, the truth-conditions of any quantificational statement can be formulated in the following way, given an arbitrary restrictor set A, and scope B. N.b., that since determiners are restrictive modifiers, it's guaranteed that $Det(A_f) \subseteq A_f$

(46) $\exists f \in Det(A_f), \forall x \in Dom(f), f(x) \iff B(x)$

It's clear from this formulation that any variation in $B - A$ can never effect the resulting truth-conditions, because for any choice of f, if $f \in Det(A_f)$, then $Dom(f) = A$. To determine whether or not f and B *agree* on $Dom(f)$, we only need to look at $Dom(f) \cap B$, i.e., $A \cap B$. Any determiner expressible in this way must be conservative.

5 Existential and distributive scope

A key component of the predicative approach to determiners is the idea (inspired by the literature on numerals) that the contributions of existential raising and distributive quantification can be divorced from the semantic contribution of the determiner itself. For numerals, this decomposition is not only conceptually appealing but also empirically motivated, since the existential and distributive components of meaning exhibit different behavior. Consider, e.g., (47)—this has a salient reading which can be paraphrased as: *there are two relatives of mine X, s.t., if each of X die, I'll* *inherit a house* (Ruys 1992). What this kind of example is typically taken to show is that the existential component of the numeral can take exceptional scope out of the conditional antecedent, whereas the distributive component must be interpreted within the conditional antecedent. Indeed, (47) has no reading corresponding to distributive scope over the conditional, since distributive scope is strictly clause-bound.

(47) If two relatives of mine die, I'll inherit a house. ✓ $\exists >$ if..then $> Dist$
✗ $\exists > Dist >$ if..then

On the predicative theory of determiners, the semantic contribution of any determiner may be divorced from both its existential and 'distributive' scope. In principle, this predicts that the existential and distributive scope of any determiner may be 'split' by other operators, as in (47). This might seem especially concerning for, e.g., universal and negative determiners, which, unlike existentials and numerals, are known not to give rise to exceptional scope readings. Concretely, the examples in (48) do not have readings corresponding to the quantifier taking scope out of the conditional.

(48) a. If all relatives of mine die, I'll inherit a house. ✗ $\forall >$ if..then

b. If no relatives of mine die, I'll inherit a house. ✗ no $>$ if..then

Surprisingly, exceptional existential scope turns out to be completely innocuous for the case of 'all' and 'no'; this is fundamentally because, in case the restrictor is non-empty, DPs formed with 'all' and 'no' denote *singleton sets*, and existential quantification over a singleton set is effectively scopeless (Schwarzschild 2002).

In order to illustrate this surprising property of the theory, take a concrete case: let $r_{1..3}$ be *relatives of mine*. The DP 'all relatives of mine' is only true of the unique wholly-positive group $r_1^+ \sqcup r_2^+ \sqcup r_3^+$. The DP 'no relatives of mine' is only true of the unique wholly-negative group $r_1^- \sqcup r_2^- \sqcup r_3^-$. In other words, both DPs denote singleton sets. Now consider one possible LF for (48a), assuming that the DP can take exceptional existential scope outside of the conditional, as in (49).

(49) [$\exists$ all relatives] λX [if X Δ die, I'll inherit a house]
$\Rightarrow \exists X \in \{r_1^+ \sqcup r_2^+ \sqcup r_3^+\}$, if X Δ die, I'll inherit a house.
$\Rightarrow$ if $(r_1^+ \sqcup r_2^+ \sqcup r_3^+)$ Δ die, I'll inherit a house.

An existentially-quantified statement, with variable X ranging over a singleton set is equivalent to replacing all bound instances of X with the sole member of that set. The resulting reading does not correspond to the unattested one in (48a); rather, since quantificational force is tied to distributivity, the predicted reading is one on which universal quantification is evaluated within the scope of the conditional antecedent.[10] A parallel result can be established for 'no relatives of mine', which is left as an exercise for the reader.

For other determiners, this compositional regime leads to more intricate predictions. Consider e.g., modified numerals 'exactly two'. It is often assumed that modified numerals such as 'exactly two' don't give rise to exceptional scope readings (see, e.g., Cresti 1995: p. 13, Reinhart 1997: §6.4, Ruys & Spector 2017: §8), but it seems to me that the reading predicted by the predicative theory, with exceptional *existential* scope, is clearly available.

Imagine the following context: James is playing a variant of roulette involving two balls. The rules are simple: James can bet on any two numbers, and if the balls both land on the numbers James bet on, he wins. In any other scenario, James loses. Unbeknownst to James, the croupier has rigged the wheel, s.t., the balls are guaranteed to land on two pre-determined numbers. Relative to this context, I contend that (50) has a true reading.[11]

(50) If James bets on exactly two numbers, he'll win this round (I just don't know which two).

If this is right, the picture that emerges for the landscape of exceptional scope readings is interestingly different to other approaches on the market. The idea here is that exceptional scope is a property of *covert existential raising*, rather than of particular expressions (cf., e.g., Charlow 2014). Every quantificational DP is existentially raised, and therefore any such DP may take exceptional scope—however, whether or not this corresponds to exceptional quantificational force depends on the quantifier in question. The lack of a detectable exceptional scope reading for universals and negative indefinites (modulo transparent readings), is explained by the fact that they denote singletons, together with a syntactic restriction on insertion of the Δ-operator, which is in any case needed independently to account for attested split scope readings of numerals.

10 While exceptional existential is innocuous with respect to *quantificational force* for 'all/no relatives of mine', it may make a difference for whether the restrictor *relatives of mine* receives a *transparent* or *opaque* interpretation. A reasonable expectation based on the LF in (49) is that the restrictor is interpreted transparently, since it is evaluated outside of the conditional (at least, on a standard scope-based theory of intensionality; see von Fintel & Heim 2023 for an overview). This is fact arguably corresponds to the most salient reading of (48a).

On the assumption that the existential component can always give rise to exceptional scope, this provides an intriguing way of deriving a transparent interpretation of the restrictor, without inadvertently predicting unattested wide scope readings.

11 This judgment has been reinforced by consultation with ~ 10 native English speakers.

6 Extensions and open issues

6.1 Semantic plurality and collective predication

Despite starting from the intuition that determiners are simply predicates of pluralities, the present theory, much like classical GQ-theory, does not in its present state have sufficient resources to distinguish between semantically singular vs. plural DPs. Such a distinction is independently necessary in order to account for collective predication: collective predicates such as 'gather' require a semantically plural DP, as illustrated by the contrast between (51a) and (51b).

(51) a. #Some boy gathered.
b. Some boys gathered.

I'd like to tentatively suggest that in order to address this problem it is necessary to distinguish between atomic and non-atomic individuals, in the base domain from which the polarized domain is constructed. This can be implemented concretely as follows: (i) take the base domain to be closed under mereological sum-formation $\oplus$ (Link 1983), (ii) polarize pluralities drawn from the base domain, (iii) construct the polarized domain by taking *coherent* joins of polarized pluralities.

The resulting structure is expressive enough to distinguish between semantic singularity vs. plurality: we may assume that singular 'boy' draws its denotation from the groups made up of polarized *atoms*, whereas plural 'boys' draws its denotation from the groups made of polarized (potentially non-atomic) *pluralities*. Given just two atomic boys a, b, this is illustrated below in (52).

(52) a. $[\![\text{boy}_{\text{SG}}]\!] = \{\, a^+ \sqcup b^+, a^+ \sqcup b^-, a^- \sqcup b^+, a^- \sqcup b^- \,\}$

b. $$[\![\text{boy}_{\text{PL}}]\!] = \left\{ \begin{array}{c} a^+ \sqcup b^+ \sqcup (a \oplus b)^+, a^- \sqcup b^+ \sqcup (a \oplus b)^+, \\ a^+ \sqcup b^- \sqcup (a \oplus b)^+, a^+ \sqcup b^+ \sqcup (a \oplus b)^-, \\ a^- \sqcup b^- \sqcup (a \oplus b)^+, a^- \sqcup b^+ \sqcup (a \oplus b)^-, \\ a^+ \sqcup b^- \sqcup (a \oplus b)^- \\ a^- \oplus b^- \oplus (a \oplus b)^- \end{array} \right\}$$

This richer structure can immediately be exploited to account for the contrast in (51a), if we assume that a collective predicate such as 'gathered' is only ever true of non-atomic plural individuals. On this assumption, $\Delta([\![\text{gather}]\!])$ can never be true of any element in (52a), but it may be true of an element in (52b) (just in case, e.g., $a \oplus b$ gathered). Counter-intuitively, combining a plural quantifier with a collective predicate still must be mediated by the Δ operator, but Δ distributes over groups of polarized pluralities.[12]

12 We may want to consider eliminating atomic parts entirely from the denotation of 'boys', in case collective predicates are *undefined* for atomic individuals.

The plural perspective arguably requires us to rethink the semantics of, e.g., numeral expressions of the form 'n boys', which (if $n > 1$) are semantically plural and may compose with collective predicates. A tentative plural semantics for bare and modified numerals is given in (53a) and (53b) respectively. Informally, 'three' is true of a group which contain at least one positive atom, which has exactly three atomic parts. 'Exactly three' is true of groups with *exactly one* positive atom, where that positive atom has exactly three atomic parts.

(53) a. $[\![\text{three}_{\text{PL}}]\!] = \lambda X \in D_e^{\pm} \,.\, \exists x \in At^{+}(X), \#_{At} x = 3$

b. $[\![\text{exactly three}_{\text{PL}}]\!] = \lambda X \in D_e^{\pm} \,.\, \#(At^{+}(X)) = 1 \wedge \#_{At}(\iota x \in At^{+}(X)) = 3$

This semantics for numerals makes vivid the fact that shifting to a plural setting involves incorporating two 'layers' of part-whole structure—n.b., that $\#_{At}$ counts atomic parts of *inner* pluralities, which themselves may be elements of $At^{+}(X)$. The outer structure is implicated in the semantics of *quantification*, whereas the inner structure is implicated in the semantics of plural predication. Much as with GQ-theory, the singular predicative theory is expressive enough to define (modified) numerals, but to account for plural predication it is necessary to incorporate an additional layer of part-whole structure.[13] We leave a more thorough exploration of the extension to a plural setting to future work.

6.2 The connection with question semantics

There's an intuitive connection between the predicative semantics for determiners and Groenendijk & Stokhof's (1984) *partition semantics* for questions. Given a restrictor set A and a scope B Groenendijk & Stokhof (1984) define the semantic contribution of the question "who of A did B?" as a partition of logical space into cells of worlds which agree upon propositions of the form x *did* B, for $x \in A$. This can be achieved by first taking a *de re* Hamblin-Karttunen question denotation, as in (54) and derivatively defining an equivalence relation relative to a world of evaluation.

(54) $[\![\text{who of } A \text{ did } B]\!]^{w} = \{\, \{\, w' \mid x \in B_{w'} \,\} \mid x \in A_{w} \,\}$

(55) $w' \sim_{Q,w} w'' \iff \forall p \in [\![Q]\!]^{w}\, [w' \in p \iff w'' \in p]$

Given, e.g., $A = \{\, a, b \,\}$, the cells induced by (55) will correspond to the following propositions: (i) a, b both did B, (ii) a did B, b did not, (iii) b did B, a did not, and (iv) neither a nor b did B. There's a correspondence between cells in the induced

13 Ultimately, semantic plurality should also be implicated in the account of cumulative readings, pace Elliott (2025).

partition and maximal coherent joins of polarized atoms drawn from A, because each cell represents a choice as to whether elements of A are true or false (of the scope).

A partial answer to a question Q is one that eliminates at least one cell from the partition induced by Q. Similarly a non-trivial predicative determiner eliminates at least one function from the set of boolean functions on a set A. A stronger condition may be placed on answers—namely, a *relevance* requirement (Groenendijk & Stokhof 1984).[14] Informally, (56) demands that *relevant* answers to a question not provide any information that doesn't pertain exactly to the issue at hand.

(56) **Relevance (def.):** A proposition p is *relevant* wrt to a partition Q iff p is identical to a cell in Q, or a union of cells in Q.

At this point, I will conjecture that there is a connection between the notion of *relevance* and restrictions on determiner meanings. Concretely, if a GQ-theoretic determiner *Det* is realized as an NL determiner, then $Det(A,B)$ is *relevant* to the partition induced by "who of A did B"? All conservative determiner meanings are indeed relevant. Consider, e.g., 'exactly two'. The proposition that $\#(A \cap B) = 2$ is equivalent to the union of all cells in the partition induced by "who A did B?" where two elements of A did B, and the rest did not. For example, assume $A := \{a_1, a_2, a_3\}$. The proposition that $\#(A \cap B) = 2$ is equivalent to the union of the following cells: (i) a_1, a_2 but not a_3 did B, (ii) a_1, a_3 but not a_2 did B, (iii) a_2, a_3 but not a_1 did B.

For now, this is merely a hunch—a more thorough exploration of this conjecture will be deferred to future work.

7 Conclusion

In this paper, I've outlined a new perspective on the semantics of determiners, according to which they are treated as predicates of structured entities. Making sense of this view required attributing significantly more structure to the domain of entities than is typically assumed. In particular, I crucially incorporated a notion of polarity, following recent work by Bledin (forthcoming). From this perspective, we took a fresh look at well-worn questions: numeral semantics, the nature of the conservativity universal, and the ubiquity of exceptional scope phenomena. The predicative approach constitutes a radical departure from the standard account of determiner meanings, leaving a great many questions open. I've only been able to tentatively explore the consequences here, and a more thorough investigation must be deferred to future work.

14 The precise formulation of relevance I adopt in (56) is von Fintel & Heim's (2023: p. 156) *Relevance*$'$.

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