# 'Most people but not Bill': integrating sets, individuals and negation into a cognitively plausible account of noun phrase interpretation

An important motivation for Montague's work on quantification (Montague 1974) was to achieve uniformity with respect to predication across referential and quantificational subjects. This was attained by type raising all NPs to denote sets of sets. In this paper we argue for essentially the opposite move whereby all predication involves individuals or sets of individuals (for plurals).

Our motivation for this derives from (i) the need to attain *referential transparency*, a desideratum incorporating anaphoric and clarificational potential and co-verbal gesture; and (ii) from several key recent psycholinguistic results on processing generalized quantifiers (GQs). Since anaphoric expressions stand out in picking out a referent from the co-text, they are particularly suited for discovering antecedent denotations. Given that co-verbal gesture also has a kind of anaphoric relation to their affiliated speech, they provide a multimodal extension of the phoric principle. Psycholinguistic studies provide further evidence for the internal structure of quantified noun phrases in terms of their effect on processing in various contextual conditions. On our account formulated in Type Theory with Records (Cooper and Ginzburg 2015), NPs denote structured semantic objects as required by referential transparency that for extensional argument roles can either be referentially grounded (when coerced into dgb-params, see Figure 1) or existentially quantified away (when coerced into q-params, as exemplified in Figure 1); intensional readings arise via selection for the complex structured object. Our focus here is on how Boolean operations affect NPs, that is, how complex NPs are built using logical connectives like 'but', 'and' and 'not'.

Our starting point is an argument emanating from Purver and Ginzburg (2004). They show that clarificational potential provides data against higher order denotations (as postulated by GQs) in that answers to reprise fragment clarification requests always provide individuals or sets but not sets of sets. Hence, they argue in favour of a more transparent NP denotation in terms of *witness sets* (cf. Barwise and Cooper 1981).

We refine and generalize their proposal to all NPs. On our view the denotation of an NP is given in terms of the type in Figure 1. Here the maxset introduces a set-valued plurality, which is constituted out of individuals sharing a property given as value of c1 (the arrow type distributes this property (*Ppty*) over the elements of the maxset); the reference set (refset) and comp(lement)set partition the maxset, with the former providing a witness for the NP and the latter 'anti-witnesses'. $\theta$ is a contextual norm needed for capturing certain interpretations of quantifiers (van Benthem 1986), q-cond hosts the descriptive quantifier meaning (an example is given in Figure 2 below), and q-persp spells out the 'focus' of a quantified NP as being part of expectancy-driven GQ processing (Sanford, Dawydiak and Moxey 2007).

While in semantics in particular the compset received only a marginal and highly marked status (Nouwen 2003), we argue that it has a systematic place (besides compset anaphora) in the negation operation on NPs to explicate uses such as follows:

$$
\mathit{Quant} \mapsto \begin{bmatrix}
\text{dgb-params} : \begin{bmatrix} \theta : \mathbb{N} \end{bmatrix} \\
\text{q-params} : \begin{bmatrix}
\text{maxset} & : \mathit{Set}(\mathit{Ind}) \\
\text{c1} & : \overrightarrow{\mathit{Ppty}}(\text{maxset}) \\
\text{refset} & : \mathit{Set}(\mathit{Ind}) \\
\text{c2} & : \text{partition(refset,maxset)} \\
\text{compset} & : \mathit{Set}(\mathit{Ind}) \\
\text{c3} & : \text{rest(compset,refset,maxset)}
\end{bmatrix} \\
\text{q-cond} : \mathit{Rel}(\text{q-params.refset, q-params.compset}) \vee \mathit{Rel}(\text{refset},\theta) \\
\text{q-persp} : \text{refset}=\emptyset \vee \text{refset}\neq\emptyset \vee \text{none}
\end{bmatrix}
$$

Figure 1: Anatomy of a quantified noun phrase (type *Quant*).

(1) a. Jo: Who can solve the riddle? Bo: Not Bill.

b. Not all the boys left.

c. This view is shared by not a few scholars.

Since for the universal quantifier the inequivalence $\neg \mathit{all}.x(\phi)(\psi) \not\leftrightarrow \mathit{all}.x(\phi)(\neg\psi)$ holds, lexical decomposition (Sailer 2007) cannot be applied here. The same problem affects the account of Schmitt, Onea and Buch (2017). Therefore we introduce a *new negation operation* on nominal expressions, which is given in (2):

(2) **Not$_\mathbf{Q}$**

If record type $R$ is of type *Quant*. Then $\mathit{not}_\mathrm{Q}(R)$ results in a record type $R'$ of type *Quant* where

- all occurrences of 'refset' and 'compset' within $R$'s dgb-params or q-params fields are swapped in $R'$, and
- the relation symbol used in q-cond and q-persp of $R$ is reversed in $R'$ ($= \rightarrow \neq$, $\geq \rightarrow <$, $< \rightarrow >$, $> \rightarrow <$, $\leq \rightarrow >$, $\neq \rightarrow =$).

We show how this operation can enable both the right witnessing conditions for the examples above, as well as anaphora in cases such as the following, which have long been tricky for dynamic semantics (Fernando 1993):

(3) A: Go get a bike from the vélib station. B: Oh, but I don't see any bike that works there.

a. They are probably rented out.

b. It is probably rented out.

c. Where are they gone?

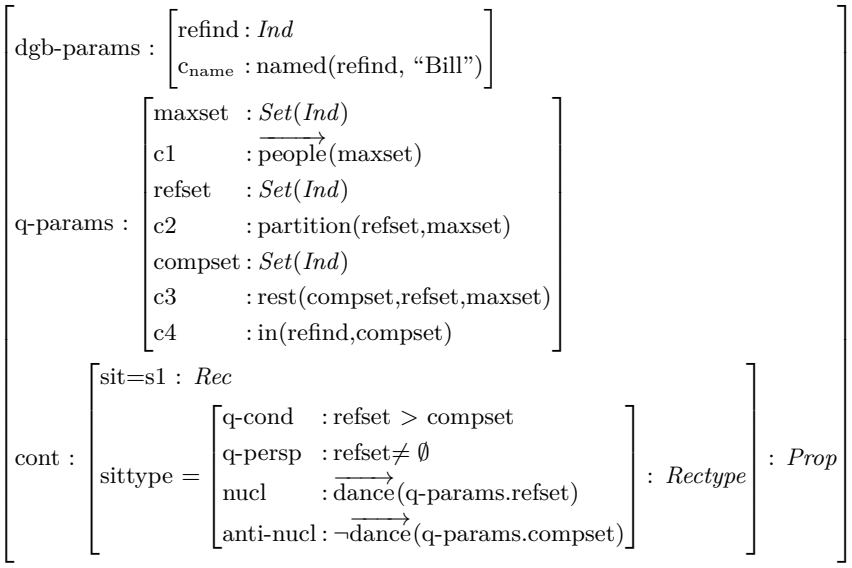


Figure 2: 'Most people but not Bill dance.'

We similarly show how this account extends to other Boolean operations even involving singular expressions like proper names as in Figure 2.

Our account is motivated by a variety of experimental evidence. This ranges from the extensive work on the refset/compset partition by Moxey, Sanford, Filik and colleagues (e.g., Moxey and Sanford 1986; Moxey, Sanford et al. 2004; Filik et al. 2011), which in particular shows that compset and maxset are not constructed as a fallback interpretation option, but have the same processing status as default antecedents have. It includes crucially experimental support for our account which assigns the QNP a completely "*in situ*", "internal" (in the sense of not incorporating a projected verbal argument) meaning from work by Urbach, DeLong and Kutas (2015), which indicates that, as with other meaning elements, QNPs are interpreted incrementally.

(*798 words*)

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