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On Some Examples of Chomsky's

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I understand the title of this volume, *Prospects for Meaning*, to subsume the topic of prospects for the *theory* of meaning. More specifically, I will be concerned with whether compositional, truth-conditional semantics embodies the central part of the explanation of how language functions as a vehicle of communication. My own view is that it does, provided the semantics in question is, in the usual jargon, *neo-Davidsonian*.[1] That is to say, typical assertions are taken to characterize states, processes, or events (henceforth just 'events'), with the various parts of speech identifying specific features or constituents of events in a fairly constrained way. In this paper I will consider some examples of Chomsky's which *prima facie* present difficulties for the compositional, truth-conditional approach, but I will argue that instead, the examples bring out some attractive features of the specifically neo-Davidsonian framework.

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[1] After (Davidson 1967). The canonical source for the 'neo' variation is (Parsons 1990).

1   TYPE-LOGICAL EVENT-SEMANTICS

One particularly appealing model of the composition of meanings is the *function-argument* model: when two meanings compose, one meaning is a function which takes the other as input, and the composed meaning is the result, or output, of this function-application. If two meanings cannot be composed, that may be because neither is a function whose domain of application includes the other.

The standard realization of this idea is in the *simple theory of types*, in which basic types of meaning, i (individual) and b (truth-value, 'boolean'), are posited; all other types of meaning are built up recursively by the rule that if t_1 and t_2 are types of meaning, there is a type of meaning denoted $t_1 \mapsto t_2$, or $t_1 t_2$ for short, namely, the type of functions from meanings of type t_1 to meanings of type t_2.

In *categorial grammar*, expressions are assigned syntactic categories that determine their potential for type-theoretic semantic composition. For example, (1a) below may have the semantic representation (1b), reflecting the syntactic and semantic classifications of (1a)'s constituent words and phrases given in (1c):

(1) a. Tom chased Jerry

    b. **(chased(jerry))(tom)**

    c. 'Tom': NP, i; 'chased': (NP\s)/(NP), $i(ib)$; 'Jerry': NP, i; 'chased Jerry': NP\s, ib; 'Tom chased Jerry': s, b

(1b) is in a type-theoretic language in which the order of application of functions to arguments is unambiguously indicated. The function **chased** applies to the individual **jerry** and produces the function **chased(jerry)**, which applies to the indi-

vidual **tom** to produce a truth-value. On the syntactic side, 'chased' merges with an appropriate sister expression on its right (indicated by '/'), that is, an NP, and forms the VP 'chased Jerry'; but 'VP' is not a basic syntactic category, rather, it abbreviates 'NP\S', an expression which merges with an appropriate sister expression on its left (indicated by '\'), again, an NP, to form an S. Note that without directionality, 'cat the' should be a meaningful phrase, since 'the cat' is. But 'the' is of category NP/N and cannot merge with what is on its left. This is a second way in which the meanings of two phrases may not be able to compose.

The semantic representations do not indicate the directionality of a word or phrase, so we cannot read the syntax off them. But in the other direction, those representations can be recovered from syntax by the rules that NP correlates with i, N with ib, S with b, and any syntactic category of the form A/B or B\A with the functional type t_1t_2, where t_1 is the type of expressions of category B and t_2 is the type of expressions of category A. So 'chased' is of category (NP\S)/(NP) because it looks right to merge with an NP and produces an expression such as 'chased Jerry'. 'Chased Jerry' is of category NP\S because it looks left to merge with an NP, say 'Tom', to produce a sentence. Correspondingly, the meaning of 'chased', which we variously write '⟦chased⟧' or '**chased**', is of type $i(ib)$, because it takes an input of type i, such as ⟦Jerry⟧, and produces a function of type ib, ⟦chased Jerry⟧, that takes an input of type i, such as ⟦Tom⟧, and produces an output of type b.

Notoriously, natural-language semantics based on the simple theory of types is hugely oversimplified, since only two sentence meanings, ⊤ and ⊥, are available.

However, one can modify the simple theory into a *hyperintensional* theory, in which *prop*, an unanalyzed type of sentence-meanings, replaces *b* (Thomason 1980; further elaboration in Muskens 2005). For instance, 'chased' in the hyperintensional theory is of type $i \mapsto (i \mapsto prop)$, since it maps an individual such as Jerry to a propositional function such as **chased(jerry)**, which maps the individual Tom to the proposition that Tom chased Jerry. This theory makes enough sentence meanings available, and it trades not offering an analysis of 'proposition' for not running up against the problems of grain that bedevil, for instance, the analysis of propositions as sets of possible worlds. But because the simple and the hyperintensional theory are close to isomorphic under interchange of *b* and *prop*, it is often adequate to formulate proposals in the simple theory, with the assurance that any extensionality objections can be met by moving to the hyperintensional theory without having to restructure the proposal.

The input-output arrow has a logic not unlike that of a substructural conditional logic. For given a meaning of type $t_1 \mapsto t_2$ and a meaning of type t_1, we obtain or 'infer' a meaning of type t_2 by functional application ($\mapsto$E); and if a meaning of type t_2 can be inferred from the hypothesis of a meaning of type t_1, then a meaning of type $t_1 \mapsto t_2$ may be inferred by functional abstraction ($\mapsto$I). The logic is substructural because of certain restrictions on $\mapsto$I; for a full account, see (van Benthem 1995, Chs. 2–4).

$\mapsto$E by itself suffices for the orthodox proof that (1b) is the semantics of (1a):

(2)

$$
\frac{\dfrac{\text{Tom}}{\text{NP}; \textbf{tom}: i} \text{Lexicon} \quad \dfrac{\dfrac{\text{chased}}{(\text{NP}\backslash\text{S})/\text{NP}; \textbf{chased}: i(ib)} \text{Lexicon} \quad \dfrac{\text{Jerry}}{\text{NP}; \textbf{jerry}: i} \text{Lexicon}}{(\text{NP}\backslash\text{S}); \textbf{chased(jerry)}: ib} \mapsto\text{E}}{\text{S}; \textbf{(chased(jerry))(tom)}: b} \mapsto\text{E}
$$

Wherever it is convenient to do so, we apply η-reduction, so **chased** rather than **λx.λy.chased(x)(y)** appears in (2). The lexicon provides both a syntactic category for the word, and, for its semantics, a constant of the type-theoretic language along with a type-label (which must be the one that can be read off the category label). The proof demonstrates both that 'Tom chased Jerry' is a sentence, since we derive s on the last row, and also that it has the semantics (1b), which is also derived on the last row. The rule $\mapsto$E that we are applying here applies to semantic types; but we could as well have cited rules of \E and /E.

The neo-Davidsonian semantics for (1a) is more involved than (1b), since it represents (1a) as meaning 'in the past, some event was a chase whose agent was Tom and whose theme was Jerry'. In other words, ignoring tense, we have

(3) a. Tom chased Jerry.

b. **(some)λe.chase(e) and agent(e)(tom) and theme(e)(jerry).**

The most obvious question raised by (3) is how (3b) is to be recovered from (3a). One possibility is that the procedure is indirect: first (1b) is derived – the 'atomic' semantics, in Parsons' terminology (Parsons 1990:8–9) – then a further analysis produces (3b), the 'subatomic' semantics. This route preserves a role for the familiar categorial syntax in deriving (1b). Alternatively, the subatomic semantics may

be derived directly from (3a), without reliance on (1b).

A direct-derivation account must be premised on a verb's lexical entry assigning it a property of events. This may be a complex property, as proposed in (Parsons 1995), with conjuncts for the thematic relations to events whose *relata* are obligatory NP-arguments to the verb. But this raises problems of distinguishing obligatory from non-obligatory arguments, which we can avoid if we take lexical entries to be as simple as possible. Thus for 'chase' we would just have **λe.chase(e)**. However, we may take it that an English-speaker who understands 'chase' knows that in any event of chasing there is a chaser and a chased, or an agent and a theme, and also knows that the subject and object NP's specify them. So we will assume that the input to interpretation is not the likes of the bare (3a), but rather a *theta-labeled* version:

(4) $|\text{Tom}|_{agent}$ chased $|\text{Jerry}|_{theme}$.

The labelling allows us to generate the likes of '**λe.agent(e)(tom)**' from '$|\text{Tom}|_{agent}$', as the following derivation illustrates:

(5)

$$
\begin{array}{c}
\dfrac{\mathbf{agent:}\ e(ib)\ [\mathbf{e:}\ e]^{(1)} \qquad |\text{Tom}|_{agent}}{\mathbf{agent(e):}\ ib \qquad\qquad |\mathbf{tom}|_{agent}\mathbf{:}\ i}\ {\scriptstyle\mapsto\text{E}}\ \ {\scriptstyle\text{Lx}}
\end{array}
$$

$$
\begin{array}{c}
\dfrac{\mathbf{theme:}\ e(ib)\ [\mathbf{e:}\ e]^{(2)} \qquad |\text{Jerry}|_{theme}}{\mathbf{theme(e):}\ ib \qquad\qquad |\mathbf{jerry}|_{theme}\mathbf{:}\ i}\ {\scriptstyle\mapsto\text{E}}\ \ {\scriptstyle\text{Lx}}
\end{array}
$$

$$\dfrac{\mathbf{agent(e)(tom):}\ b}{\mathbf{\lambda e.agent(e)(tom):}\ eb}\ {\scriptstyle\mapsto\text{I}\ (1)}$$

$$\dfrac{\text{chased}}{\mathbf{\lambda e.chase(e):}\ eb}\ {\scriptstyle\text{Lx}}$$

$$\dfrac{\mathbf{theme(e)(jerry):}\ b}{\mathbf{\lambda e.theme(e)(jerry):}\ eb}\ {\scriptstyle\mapsto\text{I}\ (2)}$$

$$\dfrac{\mathbf{\lambda e'.[(\lambda e.agent(e)(tom))(e')\ and\ (\lambda e.chase(e))(e')\ and\ (\lambda e.theme(e)(jerry))(e')]:}\ eb}{\mathbf{\lambda e.agent(e)(tom)\ and\ chase(e)\ and\ theme(e)(jerry):}\ eb}\ {\scriptstyle\beta,\alpha}$$

$$\dfrac{}{\mathbf{(some)\lambda e.agent(e)(tom)\ and\ chase(e)\ and\ theme(e)(jerry):}\ b}\ {\scriptstyle\exists}$$

A number of comments about (5) are in order:

(i) We have introduced a new type, *e*, which we will think of as a new primitive type, which generates new complex types in the standard way.

(ii) The step from **agent(e)(tom)** to **λe.agent(e)(tom)**, illustrates the use of $\mapsto$I: assuming an item of type *e*, we obtain an item of type $e \mapsto b$ from an item of type $e \mapsto (i \mapsto b)$ and an item of type *i*; *cp.* $p \to (q \to r), q \vdash p \to r$. The assumption is bracketed when it is discharged, and is co-indexed with the discharging use of $\mapsto$I.

(iii) We also need some extra-logical machinery. The presence of $|\text{NP}|_\theta$, where θ is a label for a thematic relation, permits the introduction of the constant for θ at a node on a path ascending from the node *n* where $[\![\text{NP}]\!]$ is input to the *ib* function. Exactly how one arranges this is partly a matter of aesthetics, but in derivations here, it will always be a two-node path, with a branch point at the lower node, as illustrated on the extreme top left of (5). When NP has semantic structure, the right branch from *n* will generally have more than two nodes (see below for the treatment of 'some mouse'). Note that the θ-label is erased when the *ib*-function derived from the θ-relation is applied to $[\![\text{NP}]\!]$. At the end of the derivation, I leave the leaf node with the constant for θ undischarged, though no doubt some other convention is possible.

(iv) The step labelled 'λ&', for 'lambda conjunction', is another piece of extra-logical apparatus, based on Parsons' non-logical rule of the same name (1995:651–2). A fixed verb, with its arguments and adjuncts, gives rise to an array of event-properties. As shown in (5), terms for these properties are applied to the same

event-term and the result is abstracted. β-reduction (lambda conversion) and α-reduction (change of variable) then produce the penultimate line of (5). Note that in (5), **and** is of type $b(bb)$ (i.e., it is the familiar sentential connective), but we write **p and q** rather than the official **(and(q))(p)**.

(v) The last step is Parsons' non-logical rule of *default existential quantification* (1995:652). This rule is *only* a default, as we shall see.

(vi) At the second last line of the derivation, we have three conjuncts in an order that reflects the word-order in (3a). But clearly, nothing turns on which order the conjuncts are presented in, so in the hyperintensional semantics, the same element of *prop* should result no matter what the order of the conjuncts.

Our final illustration simultaneously shows the treatments of non-sentential co-ordination, type-raising, and quantifier-raising, first at the atomic level, then at the sub-atomic:

(6) a. $|\text{Tom}|_{agent}$ chased and caught $|\text{a mouse}|_{theme}$.

b. **λP.P(tom)λx.a(mouse)λy.chased(y)(x) and caught(y)(x).**

c. **a(mouse)λy.(some)λe.agent(e)(tom) and chase(e) and theme(e)(y) and**

(some)λe. agent(e)(tom) and catch(e) and theme(e)(y).

(6b) is the reading of (6a) on which there is a mouse that Tom both chased and caught. In (6c) the chasing and the catching are different events (the very same chase might have ended with a fumble) and if 'chased' is intensional, then it is the relational reading that we aim to capture here.

The primary difference between (6a) and (6b) is that in (6b), **and** co-ordinates two expressions of sentential type (i.e., b), so **and** has its basic type $b(bb)$.[2] But in (6a), 'and' appears to co-ordinate two transitive verbs, expressions of type $i(ib)$; this 'and' has type $(i(ib))[(i(ib))(i(ib))]$. When **and** co-ordinates two expressions of type t, we may write it as **and**$_t$. So (6a) has **and**$_{i(ib)}$ while (6b) has **and**$_b$. To get from one to the other we use the polymorphic combinator $\mathbb{C}_{\&}$, which is defined for certain types t as input, and produces **and**$_t$ as output.[3] So in particular, $\mathbb{C}_{\&}(i(ib)) =$ **and**$_{i(ib)}$. The point is that we can define $\mathbb{C}_{\&}(t)$ for any appropriate t so that ultimately the behavior of such an **and**$_t$ is fixed by the behavior of **and**$_b$. The rule is

(7) a. $(\mathbb{C}_{\&}(t_1 t_2)(\mathbf{Y})^{(t_1 t_2)})(\mathbf{X})^{(t_1 t_2)} = (\mathbf{and}_{t_1 t_2}(\mathbf{Y}))(\mathbf{X}) = \lambda \mathbf{z}^{t_1}.(\mathbb{C}_{\&}(t_2)\mathbf{Y}(\mathbf{z}))(\mathbf{X}(\mathbf{z}))$

   b. $(\mathbb{C}_{\&}(b)(\mathbf{q}))(\mathbf{p}) = (\mathbf{and}_b(\mathbf{q}))(\mathbf{p})$

where (7b) is the base-case stipulation. So, by (7a) we have $(\mathbb{C}_{\&}(ib)(\mathbf{snored}))(\mathbf{slept})$ = $(\mathbf{and}_{ib}(\mathbf{snored}))(\mathbf{slept})$ = $\lambda \mathbf{x}^i.(\mathbb{C}_{\&}(b)(\mathbf{snored}(\mathbf{x})))(\mathbf{slept}(\mathbf{x}))$. By (7b) this in turn is $\lambda \mathbf{x}^i.(\mathbf{and}_b(\mathbf{snored}(\mathbf{x})))(\mathbf{slept}(\mathbf{x}))$. We refer to (7) as Simp(lification), and we continue to use postfix positioning of conjunction; for example, **slept and**$_{ib}$ **snored** rather than $(\mathbf{and}_{ib}(\mathbf{snored}))(\mathbf{slept})$.

The other special features of (6b) are (i) the quantifier-type semantics of 'Tom' and (ii) the raising of the terms for 'Tom' and 'some mouse' to have scope over the

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[2] An expression with free variables has the type that results when entities from the domains for the types of the variables are assigned to those variables. **chased(y)(x)** and **caught(y)(x)** each have type b because the output is a truth-value when entities from the domain of individuals are assigned to **x** and **y**.

[3] Here I follow (Carpenter 1997:180–1). The input types have to be *boolean*, that is, ones which produce the type b after all arguments have been consumed.

sentence **chased(y)(x) and caught(y)(x)**; in other words, we have type raising and quantifier raising. The type-raising we are employing takes an individual and produces a function from properties to truth-values, so we go from i to $(i \mapsto b) \mapsto b$ (this is known as the Montague Rule) and again there is a parallel between $\mapsto$ and $\rightarrow$, since $p \vdash (p \rightarrow q) \rightarrow q$. The derivation below of **λP.P(tom)** follows the natural proof of $p \vdash (p \rightarrow q) \rightarrow q$: we assume something of type $i \mapsto b$, use i and $i \mapsto b$ to obtain b, then discharge the assumption $i \mapsto b$ by lambda abstraction.

Quantifier raising is accomplished in two steps: after a QNP has been derived, it may be substituted by an individual variable **v**, and an expression of type b derived using **v**; a rule μ (for 'Moortgat') then allows abstraction on **v** and introduction of the QNP that was substituted (see Carpenter 1997:220–27).

The derivation of (6b) now follows. Here and in subsequent proofs, we use a double line to abbreviate a transition for which a sequence of steps is illustrated in previous examples or elsewhere in the current proof. The type of determiners, $(ib)((ib)b)$, is abbreviated as det, and the type of quantifiers, $(ib)b$, as q.

(8)

$$
\begin{array}{c}
\cfrac{
  \cfrac{
    \cfrac{[\textbf{P: } i b]^{(1)} \quad \cfrac{\text{Tom}}{\textbf{tom: } i}\, \text{Lx}}{\textbf{P(tom): } b}\,{\mapsto}\text{E}
  }{\textbf{λP.P(tom): } q}\,{\mapsto}\text{I}\,{}_1
}{[\textbf{x: } i]^{(3)}}\,\text{Sub}
\qquad
\cfrac{
  \cfrac{
    \cfrac{
      \text{chased} \quad \cfrac{\dfrac{\text{and} \qquad \text{caught}}{(\textbf{and}_{i(ib)}(\textbf{caught})): (i(ib))(i(ib))}}{ }
    }{\textbf{chased and}_{i(ib)}\textbf{ caught: } i(ib)}
  }{\textbf{λz.chased(z) and}_{ib}\textbf{ caught(z): } i(ib)}\,\text{Simp}
  \qquad
  \cfrac{
    \cfrac{\dfrac{\text{a}}{\textbf{a: } det}\,\text{Lx} \quad \dfrac{\text{mouse}}{\textbf{mouse: } ib}\,\text{Lx}}{\textbf{a(mouse): } q}\,{\mapsto}\text{E}
  }{[\textbf{y: } i]^{(2)}}\,\text{Sub}
}{\textbf{chased(y) and}_{ib}\textbf{ caught(y): } ib}\,{\mapsto}\text{E}
\end{array}
$$

$$
\cfrac{
\cfrac{
\cfrac{
\cfrac{\textbf{chased(y) and}_{ib}\textbf{ caught(y): } ib}{\textbf{λw.chased(y)(w) and}_{b}\textbf{ caught(y)(w): } ib}\,\text{Simp}
}{\textbf{chased(y)(x) and}_{b}\textbf{ caught(y)(x): } b}\,{\mapsto}\text{E}
}{\textbf{(a(mouse))λy.chased(y)(x) and}_{b}\textbf{ caught(y)(x): } b}\,\mu\,(2)
}{\textbf{λP.P(tom)λx.(a(mouse))λy.chased(y)(x) and}_{b}\textbf{ caught(y)(x): } b}\,\mu\,(3)
$$

Two applications of *β*-reduction to the last line of this derivation would distribute 'tom' through, resulting in **a(mouse)λy.chased(y)(tom) and$_b$ caught(y)(tom).**

We derive the subatomic semantics (6c) as follows, using *ag* for *agent* and *tm* for *theme:*

(9)

$$\cfrac{\cfrac{\cfrac{[|\mathbf{x}|_{ag}]^{(1)}}{\lambda e.ag(e)(x)} \quad \cfrac{\text{chased}}{\lambda e.chase(e)}\text{Lx} \quad \cfrac{[|\mathbf{z}|_{tm}]^{(2)}}{\lambda e.tm(e)(z)}}{(some)\lambda e.ag(e)(x) \text{ and } chase(e) \text{ and } tm(e)(z): b}}{\ \ }$$

(9) [|**x**|$_{ag}$]$^{(1)}$ chased   [|**z**|$_{tm}$]$^{(2)}$
                  — Lx
   λe.ag(e)(x)   **λe.chase(e)**   **λe.tm(e)(z)**

  (some)λe.ag(e)(x) and chase(e) and tm(e)(z): *b*   and   caught   a mouse
                        ↦I 1,2 — Lx
    λz.λx.(some)λe.ag(e)(x) and   **and**$_{i(ib)}$ **λz.λx.(some)λe.ag(e)(x)**   **a(**
     chase(e) and tm(e)(z): *i(ib)*   **and catch(e) and tm(e)(y)**   **mouse)**
                              Simp×2 —— Sub
Tom   **λz.λx.[(some)λe.ag(e)(x) and chase(e) and tm(e)(z)**   [**y**: *i*]$^{(3)}$
—— Lx   **and$_b$ (some)λe.ag(e)(x) and catch(e) and tm(e)(z)]**: *i(ib)*
tom: *i*   ↦E
    λx.∃λe.ag(e)(x) and chase(e) and tm(e)(y) and ∃λe.ag(e)(x) and catch(e) and tm(e)(y)
                                      ↦E
  ∃λe.ag(e)(tom) and chase(e) and tm(e)(y) and ∃λe.ag(e)(tom) and catch(e) and tm(e)(y)
                                    μ (3)
  a(mouse)λy.(some)λe.agent(e)(tom) and chase(e) and theme(e)(y) and
    (some)λe.agent(e)(tom) and catch(e) and theme(e)(y)

At the first step in (9), we obtain **λe.agent(e)(x)** from |**x**|$_{ag}$ in the same way as we obtained **λe.agent(e)(tom)** from |**tom**|$_{ag}$ in (5); *mutatis mutandis* for **λe.theme(e)(z)** and |**z**|$_{tm}$. The next step uses λ& and default existential quantification to obtain the proposition that *x* is an agent of a chasing of *z*. The assumptions |**x**|$_{ag}$ and |**z**|$_{tm}$ are then discharged by successive lambda abstractions, producing **λz.λx.(some) λe.agent(e)(x) and chase(e) and theme(e)(z)** as the interpretation of (6a)'s 'chased'. On the right of the proof we have suppressed the corresponding derivation of **λz.λx.(some)λe.agent(e)(x) and catch(e) and theme(e)(z)** as the interpretation of (6a)'s 'caught', which is achieved at the same line. Both these terms are of type *i*(*ib*), that of a transitive verb (fortunately, 'chased' and 'caught' *are* transitive

verbs) and so the meaning we need for (6a)'s 'and' is **and**$_{i(ib)}$. This is obtained by extracting **and**$_b$ from the lexicon and (not shown) applying $\mathbb{C}_{\&}(i(ib))$. Successive uses of Simp produce the desired $i(ib)$ term with separate event quantifiers but commonly bound agent variables and commonly bound theme variables. The proof finishes with this $i(ib)$ term consuming **y** then **tom**, then Moortgat's rule for quantifier-raising is applied.

Perhaps the reader will have noticed that while most semantic type information has been omitted from (9) (and **some** occasionally abbreviated ∃) simply to allow the proof to fit on the page, the syntactic category information is missing from (9) – and also (5) – for a different reason. It is not that the standard categories make no sense: we can still say, if we like, that 'chased' is of category (NP\s)/NP. But by going directly to subatomic semantics, we have dissolved the close relations between syntactic and semantic classification, so that a hand-in-hand derivation like (2) is no longer possible. One option here is just to accept that the proof that a given string is of category s proceeds entirely independently of the derivation of the string's meaning. Another is to drop the categorial syntax entirely and rely on phrase structure plus thematic labelling to screen out nonsense strings that threaten to acquire meanings in the framework. It is an interesting question how much service of this kind can be performed by the thematic requirements of, and options for, verbs. We already noted that though semantics can explain why some phrases lack meaning (there is a type mismatch both ways round), syntax is needed to prevent others being interpreted: either there is no type mismatch but

the order is wrong, or, though the types and order are correct, there is a category mismatch (*cf.* 'the sings', where the problem is that 'the' needs N to the left, not NP\s). However, I will not pursue this issue any further in this paper.

2 CHOMSKY'S EXAMPLES

Already in (Chomsky 1975) we find Chomsky expressing scepticism about truth-conditional semantics, on the basis of a range of examples which, he says, tend to show that 'even a principle of compositionality is suspect' (1975:31). Some of these examples are beyond the scope of this paper, but two pairs that are particularly interesting from the neo-Davidsonian perspective are (10) and (11) below:

(10) a. Poems are written by fools like Smith.

b. Mountains are climbed by fools like Jones.

(11) a. Beavers build dams.

b. Dams are built by beavers.

It is hard to see why there would be any structural differences in the semantics of (10a) and (10b), but (10a) requires *all* poems to be written by fools like Smith, whereas (10b) may be true even though there are unclimbed mountains. Chomsky doubts that these differences can be 'traced to structure' (1975:39); we might, for instance, restore a parallel with (10a) by substituting a creation verb in (10b) ('mountains are formed by cataclysms like this'). Apparently, the lexical meaning of the verb is playing a role that cannot be cashed out in terms of structural

effects.[4] In the case of (11), though passivization is meaning-preserving in simple cases ('Tom chased Jerry', 'Jerry was chased by Tom'), apparently (11a) can be true while (11b) is false.

But once we discern quantification over events, we can interpret the examples in (10) and (11) in a way that agrees with Chomsky's intuitions. For (10),

(12) a. Every poem has a fool like Smith as agent of its writing.

   b. **(every(poem))[λx.a((like(smith))(fool))**
       [λy.(the(λe.writing(e) and theme(e)(x)))[λe.agent(e)(y)]]].

   c. Every climbing of a mountain has a fool like Jones as agent.

   d. **every(λe.climbing(e) and some(mountain)[λx.theme(e)(x)])**
       [λe.a((like(jones))(fool))λy.agent(e)(y)].

In both (12b) and (12d), we use the syntax of *restricted quantifiers:* a determiner, in these cases, **every**, applies to a *range-restricting condition* (**poem** in (12b)) to produce a restricted quantifier of the general form *det*(*rr-cond*), which in turn is applied to a *scope* [...] of the required type. In (12b), **every** is of type (*ib*)((*ib*)*b*), while in (12d), it is of type (*eb*)((*eb*)*b*), as is **the** in (12b). In (12b), we say that every poem is such that the writing of which it is theme is such that a fool like Smith is its agent. **like(smith)** is the meaning of a complex extensional attributive adjective (type (*ib*)(*ib*)) which applies to nouns (type *ib*) to interpret first-order predicates such as 'fool like Smith'. The contrast between (10a) and (10b) emerges as a contrast in the restricting condition to which **every** is subject, simply **poem** in (12b)

[4] A similar theme is expanded on in (Johnson 2004).

but 'thing such that it is a climbing and some mountain is its theme' in (12d).

   We can capture the contrast between the examples in (11) with these analyses:

(13)   a.   Significantly many beavers are agents of dam-buildings.

       b.   **(s-many(beaver))[λx.(some(λe.building(e) and a(dam)[λy.theme(e)(y)])**
            [λx.agent(e)(x)]].[5]

       c.   Significantly many dams have beavers as agents of their building.

       d.   **(s-many(dam))[λx.(the(λe.building(e) and theme(e)(x)))**
            [λe.a(beaver)[λy.agent(e)(y)]].

(13)'s use of 'significantly many' (with proportional 'many') embodies a stop-gap proposal about how to provide a bare plural with a determiner in a use of the plural as a *generic*, though to keep things manageable here, the interpretations revert to the singular (unrealistically assuming distributive readings). One difficulty with generics is to decide exactly what quantification, if any, they are making: neither 'all' nor 'most' nor 'many' seems right, as examples like 'Dutchmen are good sailors' and 'mosquitoes spread malaria' show (only 5% of mosquitoes carry the virus).[6] The idea behind 'significantly' is that standards of significance – how many is *significantly* many? – can vary from context to context; the same effect would be obtained by using 'enough'. "Mosquitoes don't spread malaria" would then come out false because "significantly many/enough don't" means 'practically

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[5] I am ignoring one complication here, namely, that (11a) and (13a) would, I think, be true even if beavers have poor follow-through and are inclined to abandon their dam-building projects before any dam exists. The intensionality of creation verbs in the progressive is often noted, but characterizing sentences seem to have the same feature. However, I will not burden the reader at this point with the apparatus of (Forbes 2006:130–38) that would accommodate this complication.

[6] See (Pelletier and Asher 1997) for criticism of quantificational accounts of generics.

none do' in this case, and 5% is more than practically none. Perhaps 'significantly'
can even be made to capture the modal force of these examples (from Carlson and
Pelletier 1995:44, 81).[7]

Of course, it is all very well to trot out interpretations that have the truth-values
Chomsky proposes; the challenge is to describe a compositional, truth-condi-
tional, and non-*ad hoc* way of arriving at them. So we turn to that now, aiming to
extend the type-logical approach of Section 1 to these cases.[8]

3   FOCUS EFFECTS

The proposal we will try to implement is that the difference between the (a)-sent-
ences and the (b)-sentences in (10) and (11) has to do with different ways of
applying the *background/focus* (topic/comment, subject-matter/statement) dis-
tinction to them.[9] One way of imposing a background/focus distinction on a
statement is to take it to be the answer to a question – the focussed material is the
part that directly answers the question. For example, there are at least four differ-
ent ways of distinguishing background from focus in (10a), as the following

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[7] The modal force of 'mosquitoes spread malaria' can be made explicit by 'significantly many
mosquitoes spread malaria and it is in the nature of those mosquitoes to do so'. Thus an accidental
$\forall$-truth does not support a generic attribution, but at the same time, 'mosquitoes spread malaria'
would be false if it was in the nature of all to do so but none do, because of a vaccination program.
This tends to show that the generic is not being understood as contrastive with other insects. But
it is consistent with the modal force itself coming from the 'significantly', in which case the 'in the
nature of' conjunct need not be stated separately. See (Krifka *et al.* 1995) for a broad-ranging dis-
cussion of generics, and (Koslicki 1999) for the prospects of a unified treatment of the generic uses
of various categories of expression.

[8] For further elaboration of Chomskyan scepticism about truth-conditional semantics, see
(Pietroski 2003, 2005).

[9] Identifying these three distinctions is a substantial oversimplification; see (Partee 1991: 163–5).

question/answer pairs reveal (the fourth is rather marginal):

(14) a. How do poems come to exist? Poems *are written by fools like Smith.*

b. Who writes poems? Poems are written *by fools like Smith.*[10]

c. What do fools like Smith write? *Poems* are written by fools like Smith.

d. How do fools like Smith spend their time? *Poems are written* by fools like Smith.

The same focussing possibilities are available for (10b):

(15) a. What happens to mountains? Mountains *get climbed by fools like Jones.*

b. Who climbs mountains? Mountains are climbed *by fools like Jones.*

c. What do fools like Jones climb? *Mountains* are climbed by fools like Jones.

d. How do fools like Jones spend their time? *Mountains are climbed* by fools like Jones.

If we now suppose that the focus differences, especially the ones between the (a) and (b) sentences in (14) and (15), manifest themselves at the subatomic level as *structural* differences, then we have made a start on explaining how the difference between (10a) and (10b) can, after all, be traced to structure. For (10a) and (10b) do not give any clue about how the focus/background distinction applies to them. Chomsky's intuition that only (10a) is correctly paraphrased by prefixing 'all' may

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[10] In this example the question itself can be focussed in more than one way, for there is 'Who *writes* poems?' (as opposed to orally composing them) and 'Who writes *poems*?' These cases need an extension of the apparatus I propose in Section 4.

simply indicate that in the absence of other cues (in the "null context"), the focus displayed in (14a) is preferred for (10a), while the focus displayed in (15b) is preferred for (10b). If so, there is no semantic difference between (10a) and (10b), for they have the same range of readings discriminating background from focus; the difference would only have to do with which is preferred in the null context, and so would be pragmatic.

But why is there such a pragmatic difference, exactly? The use of the passive promotes either poems or poem-writings as the topic of (10a), and it is quite hard to distinguish the two cases:

(16) a. Every poem has a fool like Smith as agent of its writing.

b. Every poem-writing has a fool like Smith as agent.

(16a) would entail (16b) but for the possibility of the writing of a poem being abandoned before any poem exists. And given at most one writing *per* poem, (16b) would entail (16a) but for the possibility of a poem being entirely orally composed (or in some other way brought into existence). But (16a) and (16b) may be understood in such a way that (i) and (ii) are not the basis of potential counterexamples to equivalence. So defaulting to (16a) in the null context may just be a consequence of (16a)'s greater accessibility. By contrast, with no creation verb, (12c) and 'every mountain has a fool like Jones as agent of its climbing' are easily distinguished, and it requires some effort to get the topic to be mountains ((15a) is rather lame).[11] Another factor contributing to the preference for (16a) is also prag-

matic, namely, that if we think of 'Poems are written by fools like Smith' as an answer to 'How do poems come to exist?', Gricean mechanisms (see note 11) will create the implicature that there is no other way they come to exist, justifying 'all poems'. But even if nothing much else happens on mountains, there remains the option of being a mountain on which nothing happens, so 'all mountains' cannot be used. (There is no option of being a poem which doesn't exist.)

(10a), 'poems are written by…', and (11b), 'dams are built by beavers', are also comparable; indeed, Chomsky says (p. 39) that the most natural reading of (11b) takes 'dams' as 'all dams', as he interpreted 'poems' in (10a). Perhaps this is right, but I think there is also a generic reading, which states a not-necessarily-exceptionless characteristic of dams, and which is perhaps more useful for bringing out the core difference between (11a) and (11b). The availability of the generic reading may have to do with the existence of an option of being a dam that wasn't built, as Chomsky notes (p. 39) when he contrasts dams that are built with ones formed naturally by falling trees.

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[11] Chomsky (p. 39) considers the hypothesis that his passive examples all have an implicit 'only', as in 'mountains are climbed only by fools like Jones', and that 'we are saying something about all poems, mountains, dams'. [We would have the atomic semantics **every(mountain)λx.only(a fool like jones)λy.y climbs x**. This holds iff whenever a mountain is assigned to **x, y climbs x** is true only if a fool like Jones is assigned to **y** – **only** has type $((eb)b)((eb)b)$ in this case – so the statement neither entails nor presupposes that every mountain is climbed.] But when the verb is creative, Chomsky proposes, 'we understand further that the entities are formed in no other way'. However, this 'understanding' seems to be a *reading*. It is obtainable by replacing 'only by' with 'by and only by', but with compositionality in mind, it is not optimal to get different readings by positing different covert operators. There is also the worry that **only** does not belong in the *semantics* of these sentences, because it is just a conversational implicature – if the speaker thought other kinds of fool climbed mountains, the Maxim of Quantity would oblige him to say so. (See n.12 for more on **only.**)

4   FOCUS IN TYPE-LOGICAL EVENT SEMANTICS

If (10a) prefers the focus of (14a), and (10b) the one in (15b), how do we get from those readings to the different interpretations in (12)? Here we will employ the core idea of (Herburger 2000), where it is argued (p. 43) that there is an operation of *focal mapping*, which assigns background material to the restriction of the event quantifier and focussed material to its scope. In other words, and roughly speaking, the topic becomes the quantifier restriction and the comment its scope.

We need to specify exactly how we get this outcome in the derivational model of interpretation, beginning with a simple case, such as our initial example, (1a), 'Tom chased Jerry'. Our neo-Davidsonian semantics for (1a), given in (3b), **(some)λe.chase(e) and agent(e)(tom) and theme(e)(jerry)**, is, with its unrestricted **some**$^{(eb)b}$, suitable only for a use of (1a) with no focus/background contrast (Q: 'What happened here last night?'; A: 'Tom chased Jerry.'). But if (1a) were the answer to 'Who chased Jerry?', then 'Tom' would be focussed, as in (17a) below, requiring, on Herburger's theory, the interpretation 'some chasing of Jerry was by Tom', as given in (17b):

(17)   a. *Tom* chased Jerry

　　　b. **(some(λe.chase(e) and theme(e)(jerry)))[λe.agent(e)(tom)]**.[12]

[12] In this example, the focussing makes no difference to truth-conditions (compare (17b) and (3b)). That focus *does* have truth-conditional impact is illustrated by a well-known example due to Jackendoff, 'John only introduced Bill to Sue'. When 'only' immediately precedes a verb and its complements, there are usually multiple ambiguities over what **only** applies to. Apparently, 'only' and its argument can wrap around different stretches of the VP, so in Jackendoff's example, we cannot tell whether, say, 'only Bill' is wrapped around 'introduced' or 'only to Sue' is wrapped around 'introduced Bill'. These ambiguities are resolved by focus, normally marked by an intona-

To use this idea to meet the challenge of Chomsky's examples, we first have to show how we can derive (17b), starting with the same English sentence 'Tom chased Jerry' as in the original derivation (5). Fortunately, (5) is easily adjusted to produce (17b). On (5)'s fourth row, the constituents of the interpretation are available for combination into a truth-condition. λ-conjunction of all constituents is the only combination method we have used so far, but arguably, the phenomenon of focus calls for more flexibility: we should be able to apply separate λ-conjunctions to the focussed constituents and the background ones.

There is no mystery about the successful interpreter's knowledge of which constituents are focussed and which are background, since the question-answer contexts, or intonation, provide exactly that information. So expressions can be marked as focus or background without circularly assuming the interpretation of the statement they are part of. We can then apply one λ-conjunction to items marked F and another to items marked B, with the λ-conjunction of the latter group becoming, by default, the restricting condition of an existential event-

tion specifying the argument of 'only', as in (i) 'John only introduced *Bill* to Sue' *versus* (ii) 'John only introduced Bill to *Sue*'. And these have different truth-conditions. In fact, (iii) 'Bill' and 'Sue' may both be focussed (the only introduction John performed), (iv) 'introduced' may be the focus (he didn't arrange their marriage), (v) 'introduced Bill to Sue' may be the focus (the only thing he did), and no doubt there are other possibilities. For (i) we have the atomic semantics **(only(bill)) λx.introduce(to sue)(x)(john)**, while (iv) asks for a sub-atomic semantics, perhaps **(only(introduce)) λP.some(λe.agent(e)(j) and theme(e)(b) and goal(e)(s))[λe.P(e)]**. 'Only' is highly promiscuous, and can apply to adjectives, adverbs, determiners and quantifiers as well. An evaluation rule for (i) and (ii) is that if α is a constant of type i and ν a variable of that type, then **(only(α))λν.ϕ** is true iff: $[\![\phi]\!](\nu/x)$ is true (if and?) only if $x = [\![\alpha]\!]$. For (iii) we can use product types, or perhaps, as in (Krifka 1991), lists. But this is insufficiently general. For if John only introduced a *rich* man to Sue, and the man he introduced was sick, didn't he only introduce a sick man to Sue? But in that case a generalized version of our rule for (i) and (ii) would make both statements false, since both $[\![$**rich**$]\!]$ and $[\![$**sick**$]\!]$ satisfy the relevant open sentence. However, I think that a contextually-supplied domain restriction is all that is needed to fix this, not a more radical recasting of the semantics such as that in (Rooth 1992). See (Carpenter 1997:288) for two suggestions about what to restrict.

quantifier. In the following variant of (5), which produces (17b), we mark focus with italics and background with roman text:

(18)

$$\cfrac{\cfrac{\cfrac{\text{chased}}{\textbf{λe.chase(e)}: eb} \quad \cfrac{|Jerry|_{theme}}{\textbf{λe.theme(e)(jerry)}: b}}{\cfrac{\textbf{λe.chase(e) and theme(e)(jerry)}: eb}{\textbf{some(λe.chase(e) and theme(e)(jerry))}: (eb)b}\;\exists} \quad \cfrac{|Tom|_{agent}}{\textbf{λe.agent(e)(tom)}: eb}}{\textbf{(some(λe.chase(e) and theme(e)(jerry)))[λe.agent(e)(tom)]}: b}\;\mapsto\text{E}$$

As (18) shows, we are not employing an additional non-logical rule, focal mapping, but rather a liberalized version of λ-conjunction. Previously, λ-conjunction consolidated the event properties corresponding to a verb and all its arguments and adjuncts. But we now permit separate λ-conjunctions for focus properties and background properties. In (18), because the focus is a single property, only one λ-conjunction is required. But the one that is used, which produces **λe.chase(e) and theme(e)(jerry)** on the third row, is restricted to background properties. (However, focal mapping is present as a constraint, since we cannot apply default quantification to a conjunction of focussed properties.)

The bare-plurals examples show how a specific focus can produce a meaning specific to that focus. We consider (10b) in detail below, assuming the "natural" focus 'mountains are climbed *by fools like Jones*'. As already indicated, we follow Chomsky in ascribing universal force to these examples (see note 11) and in taking the agent specification to be exhaustive (perhaps as a consequence of the focus). The universal force is explained by (10b)'s being a "characterizing sentence" (Krifka *et al.* 1995:3), while the focus-background split determines what is charac-

terized, mountain-climbings in the case of (10b) and poems in the case of (10a).

'Mountains are climbed *by fools like Jones*' is synonymous with '*fools like Jones* climb mountains', where the focus is preserved, and (granted universal force) with 'every mountain-climbing is by a fool like Jones'. So neither passivization nor the use of plurals is essential to the meaning. In that case, a simplified derivation that produces (12d) as the meaning of (10b) is possible:

(19)

$$
\frac{
\dfrac{
\dfrac{|\text{mountains}|_{theme}}{\lambda e.\text{some}(\text{mountain})\lambda x.\text{theme}(e)(x)}
\quad
\dfrac{\text{are climbed}}{\lambda e.\text{climbing}(e)}\ \text{Lx}
}{\text{every}(\lambda e.\text{some}(\text{mountain})\lambda x.\text{theme}(e)(x)\ \text{and}\ \text{climbing}(e))}
\quad
\dfrac{
\dfrac{\dfrac{by}{agent}\ \text{Lx} \quad \dfrac{\textit{fools like Jones}}{a(like(j)(fool))}}{\dfrac{agent(e) \qquad\qquad x}{}}\ \text{Sub}
}{\lambda e.a(like(j)(fool))\lambda x.agent(e)(x)}
}{\text{every}(\lambda e.\text{some}(\text{mountain})\lambda x.\text{theme}(e)(x)\ \text{and}\ \text{climbing}(e))[\lambda e.a(like(j)(fool))\lambda x.agent(e)(x)]}\ \mapsto \text{E}
$$

At the fourth line, default existential quantification gives way to a universal, because we are generalizing over events of a certain sort. Also, 'fools like Jones' is not labelled 'agent', because the preposition 'by', in its sense here, expresses this concept (similarly, 'of' has a sense which expresses **theme** and 'with' has a sense which expresses **instrument**). Last, 'are climbed' does not really get its interpretation from the lexicon; some processing for 'be' + PAST PARTICIPLE is at work. But the details are not relevant here.[13]

There is a collective-distributive ambiguity in (10b), since a team of climbers may be said to climb a mountain without all the team's members climbing it, but

[13] They may be as simple as that participles get the same semantics as the main verb form, while auxiliary 'be' has no semantic effect (Parsons 1990:91–2). Alternatively, a participle may be of adjective type, with a meaning fixed by the verb (something is a climbed *F* iff it is an *F* which someone climbed). 'Be' then produces an appropriate predicate from the adjective; *cf.* Partee's account of 'be' in (Partee 1986), reprinted in (Partee 2004:213–5, 223–4).

it is only the distributive reading we aim to capture. In effect, the singular NP readings we give to the bare plurals in (19) presume distributivity. The equivalent of (12d) in which plurals are treated as such, would read: mountains are such that for every one of them, any climbing of it is such that fools like Jones are such that at least one of them is agent of that climbing.[14] Simply for illustrating the treatment of focus, it seems better to capitalize on the distributivity.[15]

   We turn now to the examples in (13), repeated here,

(13) a. Significantly many beavers are agents of dam-buildings.

     b. **(s-many(beaver))[λx.(some(λe.building(e) and a(dam)[λy.theme(e)(y)])**

         [λx.agent(e)(x)]].

     c. Significantly many dams have beavers as agents of their building.

     d. **(s-many(dam))[λx.(the(λe.building(e) and theme(e)(x)))**

         [λe.(a(beaver))[λy.agent(e)(y)]].

Chomsky's intuition that it could be that (11a), 'beavers build dams', is true while

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[14] In these terms, (10a) reads 'poems are such that for each of them, fools like Smith are such that one of them is agent of the writing of that poem'.

[15] Carpenter (1997:297–307) suggests that bare plurals are accompanied by a covert determiner, which for 'mountains' in our examples is presumably **all** (this allows for uniform treatment with cases where the determiner is explicit). Let **plu** be an operator such that given **mountain** of type *ib*, **plu(mountain)** is the subset of the powerset of mountains in which each set is of size ⩾ 2. Define the plural determiner **all** so that **all(plu(mountain))** takes (*ib*)*b* into *b*. Its complement is of the form 'every one of them is *F*', which Carpenter provides with an (*ib*)*b* semantics by defining a distributor I write '**devery**' that consumes, not **all(plu(mountain))**, but rather a term P^{ib} that would be substituted for it in a derivation. So we get **devery(P^{ib})**, for which we substitute a term x^i, and construct a sentence $\phi(x^i)$. An application of μ produces **devery(P)λx.ϕ(x)** and another use of μ results in **all(plu(mountain))λP.devery(P)λx.ϕ(x)**. The semantics requires that for this to be true, all sets in **plu(mountain)** make **devery(P)λx.ϕ(x)** true when assigned to **P**. The same derivation process within the **λx.ϕ(x)** will accommodate 'for every climbing of it, the/some fools like Jones are such that at least one of them is agent of that climbing'. The enthusiastic reader may wish to provide the unsimplified version of (19) to confirm that this nice piece of apparatus suffices.

(11b), 'dams are built by beavers', is false, appears to depend on letting focus shift rather than on reading 'dams' as a strict universal, 'all dams'. (11a) might be a correct response to the question 'what do beavers do that is distinctive of them?', which puts the focus on 'build dams'. (11b) might be an incorrect response to the question 'where do dams come from?'[16] But it sounds to my ear that if we treat (11b) as an awkwardly formulated response to 'what do beavers do that is distinctive of them?', that is, if we keep the focus on 'build dams', (11b) is true.

With focus having truth-conditional impact, allowing it to shift in passivization cannot be expected to be truth-preserving. And it is an immediate pay-off of Herburger's account of focus in the neo-Davidsonian framework that it pins down exactly what the semantic effect of the shift is and makes it easy to understand why equivalence is lost. For focus on 'build dams' puts 'beavers' into the restriction of the main quantifier and 'build dams' into its scope, while focus on 'built by beavers' makes 'dams' the quantifier restriction and puts 'built by beavers' into the quantifier scope. The contrast between (13b) and (13d) is therefore not altogether unlike that between a conditional and its converse.

As for deriving (13b) and (13d), no new issues arise, other than the adequacy, or otherwise, of 'significantly many'. So given focus on 'build dams' in 'beavers build dams', the semantics has 'λx.there's some dam building of which x is agent' as comment and beavers as topic. The semantics of the comment uses default existential quantification again.

[16] Incorrect because the proportion of dams not built by beavers is too high.

5 UNDERGENERATION AND OVERGENERATION

Semantic apparatus of the kind employed in this paper raises completeness and soundness questions: can we derive all the interpretations there are, and, can we derive some interpretations there aren't? We want the answers to be yes and no respectively. On the completeness side, the main challenge comes from cases where what is focused does not correspond to a λ-term to which λ-conjunction applies. For instance, perhaps an adjective is focussed. Intersective adjectives are easy, but we might instead focus an extensional attributive, as in

(21) A *large* beaver built this dam.

A large beaver is something that (i) is a beaver and (ii) is large for a beaver (we need (i) since (ii) by itself could be an argument against the thing in question being a beaver, as in 'too large for a beaver'). The way we handle this also has to work for cases such as 'no *large* beaver built this dam' and '*large* beavers build big dams'. Another challenge is that any proposal also has to work for intensional adjectives, since presumably the effect of adjective focus in a nominal is to be explained in a uniform way: focus is doing the same thing in (21) and 'an *alleged* thief removed the picture' (you made the allegation but I suspect he had permission).

These various constraints rule out many different proposals in which the adjective and the noun get separated. 'Large' and 'alleged' cannot meaningfully apply to an expression of type *i*, such as an individual variable, and in the intensional case any quantifier formed from a nominal involving 'thief' but not 'alleged' is likely to

be extensionally incorrect. It seems, then, that the first step is to apply λ-conjunction so that the entire λ-term that contains the adjective, **a(large(beaver))[λx. agent(e)(x)]** or **an(alleged(thief))[λx.agent(e)(x)]**, becomes the scope of the event quantifier.[17] But this is insufficient, since it does not distinguish between focus on 'large' *versus* focus on 'beaver' *versus* focus on 'large beaver'; *mutatis mutandis* for 'alleged thief'.

One solution to this problem is to suppose that *within* the topic, or *within* the comment, a subsidiary background/focus distinction can apply.[18] So taking 'a large beaver' in (21) as the argument to 'built this dam', we should be able to configure its interpretation in different ways, plausibly reflecting the discourse felicity of different prosodies.[19] The three intonations relevant to the interpretation are 'a *large beaver*', 'a *large* beaver' and 'a large *beaver*'. These suggest three different groupings of the words in the NP: 'a (large beaver)', 'a ((large) beaver)', and '(a large) beaver' respectively, where in the second we are thinking of 'a beaver' as constituting the background. These groupings in turn suggest how we might use type shifting to realize three distinct interpretations of the phrase, all of which work out to type (*ib*)*b*, and so can apply to **[λx.agent(e)(x)]**. Uniqueness is another question, but one trio which does the job is:

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[17] I am assuming that **an(alleged(thief))** is an expression of hyperintensional type-theory, in which **alleged** is of type $(i \mapsto prop)(i \mapsto prop)$.

[18] Krifka (1991:153) gives the following example of focus within the topic: "What did Bill's sisters do?––Bill's *youngest* sister kissed John".

[19] Here and in the rest of this paragraph I am borrowing ideas from (Steedman 2000:89–95).

(22) a. **a(large(beaver))[λx.agent(e)(x)]**

      b. **a(beaver(large))[λx.agent(e)(x)]**

      c. **(a(large))(beaver)[λx.agent(e)(x)]**.

In deriving (22c), the interpretation of 'a large beaver' still has to be of type $(ib)b$, and we can accomplish this if **a** is of the type of functions from $(ib)(ib)$ to $(ib)((ib)b)$. And the familiar determiner type, that is, the type of functions from properties to properties of properties – $(ib)((ib)b)$ – shifts to exactly this type *via* the principle

(23) $p \rightarrow q \vdash (r \rightarrow p) \rightarrow (r \rightarrow q)$

also known as the Geach Rule (see van Benthem 1995:26). For (22b), where we have taken **large** to be the argument of **beaver**, we use the Montague Rule $p \vdash (p \rightarrow q) \rightarrow q$ already encountered in the derivation of **λP.P(tom)** in (8). In this application, we shift **beaver** from the standard nominal type ib to a type which consumes adjectives, $(ib \mapsto ib) \mapsto ib$. **beaver(large)** is therefore of type ib, so if **a** is of its usual type $(ib)((ib)b)$, 'a *large* beaver' ends up being of type $(ib)b$ again.

These examples illustrate the flexibility of the framework, but may also raise the suspicion that it is *too* flexible. Perhaps we will end up with interpretations for the uninterpretable, like an example of Mark Liberman's reported in (Steedman 2000:92), 'Harry likes the *nuts* and bolts *approach*'. In this case the comment is not split across the λ-terms to which λ-conjunction applies (unlike Steedman's own case, *loc. cit.*, 'Three *mathematicians* in ten prefer *margarine*'), since 'the nuts

and bolts approach' expresses the theme of the state of liking. Hence an attempted derivation will not break down at focal mapping. But for Liberman's example, there does not seem to be a way of shifting types in the logic so that an intelligible topic/comment differentiation emerges *within* the theme and reflects the bizarre intonation. This is far from a soundness proof, but provides some reassurance that not just anything goes.

I conclude that the original examples Chomsky gave, or at least the four we have investigated, do not threaten the central role that compositional, truth-conditional semantics is commonly thought to have in the explanation of how language functions as a vehicle of communication. For the event-based, derivational semantics presented in this paper shows some promise of handling them acceptably, and this situation can only improve with the increasingly sophisticated understanding of such topics as generics and focus that, if the recent past is a guide, we can reasonably hope for.[20]

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[20] I thank Paul Pietroski for helpful discussion of Chomsky's examples.

Bibliography

Carlson, Gregory, and Francis Jeffry Pelletier, eds., 1995. *The Generic Book*. University of Chicago Press.

Carpenter, Bob. 1997. *Type-Logical Semantics*. The MIT Press.

Chomsky, Noam. 1975. Questions of Form and Interpretation. In *Essays on Form and Interpretation*, edited by N. Chomsky. North Holland.

Davidson, Donald. 1967. The Logical Form of Action Sentences. In *The Logic of Decision and Action*, edited by N. Rescher. University of Pittsburgh Press.

Forbes, Graeme. 2006. *Attitude Problems*. Oxford University Press.

Herburger, Elena. 2000. *What Counts: Focus and Quantification*. The MIT Press.

Johnson, Kent. 2004. Systematicity. *The Journal of Philosophy* 101:111–139.

Koslicki, Kathrin. 1999. Genericity and Logical Form. *Mind and Language* 14:441–467.

Krifka, Manfred. 1991. A Compositional Semantics for Multiple Focus Constructions. In *Proceedings from Semantics and Linguistic Theory I*, edited by S. Moore and A. Z. Weiner. Cornell University.

Krifka, Manfred, Francis Jeffry Pelletier, Gregory Carlson, Alice ter Meulen, Godehard Link, and Gennaro Chierchia. 1995. Genericity: an Introduction. In *The Generic Book*, edited by G. Carlson and F. J. Pelletier. University of Chicago Press.

Muskens, R. 2005. Sense and the Computation of Reference. *Linguistics and Philosophy* 28:473–504.

Parsons, Terence. 1990. *Events in the Semantics of English*. The MIT Press.

Parsons, Terence. 1995. Thematic Relations and Arguments. *Linguistic Inquiry* 55:663–679.

Partee, Barbara. 1986. Noun-Phrase Interpretation and Type-Shifting Principles. In *Studies on Discourse Representation Theory and the Theory of Generalized Quantifiers*, edited by J. Groenendijk, D. d. Jongh and M. Stokhof: Foris. Page references are to (Partee 2004).

Partee, Barbara. 1991. Topic, Focus and Quantification. In *Proceedings from Semantics and Linguistic Theory I*, edited by S. Moore and A. Z. Weiner. Cornell University.

Partee, Barbara, ed. 2004. *Compositionality in Formal Semantics: Selected Papers by Barbara Partee*. Basil Blackwell.

Pelletier, Francis Jeffry, and Nicholas Asher. 1997. Generics and Defaults. In *Handbook of Logic and Language*, edited by J. v. Benthem and A. T. Meulen. Elsevier and The MIT Press.

Pietroski, Paul. 2003. The Character of Natural Language Semantics. In *Epistemology of Language*, edited by A. Barber. Oxford University Press.

Pietroski, Paul. 2005. Meaning before Truth. In *Contextualism in Philosophy*, edited by G. Preyer and G. Peter. Oxford and New York: Oxford University Press.

Rooth, Mats. 1992. A Theory of Focus Interpretation. *Natural Language Semantics* 1:75–116.

Steedman, Mark. 2000. *The Syntactic Process*. The MIT Press.

Thomason, Richmond. 1980. A Model Theory for Propositional Attitudes. *Linguistics and Philosophy* 4:47–70.

van Benthem, Johan. 1995. *Language in Action*. The MIT Press.