

Graeme Forbes

Intensional Verbs in Event Semantics

1 HIDDEN INDEXICALS AND INTENSIONAL TRANSITIVES

This paper concerns how a hidden-indexical account of referential opacity can be implemented in a generally “neo-Davidsonian”, event-based approach to natural-language semantics. (Forbes 2006, Ch. 8) develops part of an answer, but only for the relatively tractable case of opacity in the complement position of intensional transitive (‘objectual attitude’) verbs. This leaves the harder problem of opacity in the complements of clausal (‘propositional attitude’) verbs still to be addressed.

The hidden indexical account of opacity presented here takes its inspiration from Quine’s ‘Giorgione’ case (Quine 1961:22):

- (1) a. Giorgione was so-called because of his size.
- b. Giorgione is Barbarelli.
- c. ∴ Barbarelli is so-called because of his size.

The inference is supposed to work by an application of Leibniz’s Law, or more formally, Identity Elimination (=E), but there is no threat to =E in (1)’s failure to preserve truth. In any application of a rule of inference there is always an implicit *no other changes* condition, built into the rule-schema by use of the same notation

for the linguistic context in the minor premise and the conclusion. The substitution performed in (1) violates this condition, indeed, it has a side-effect that is truth-condition-altering: the substitution causes the reference of 'so' to shift from 'Giorgione' (the name) in (1a) to 'Barbarelli' in (1c). So (1) is disqualified as a use of =E. Once this side-effect of the substitution is noted, it is easy enough to give a complete explanation of why (1c) is false even though (1a) is true, in terms of the potential (in this case, actual) irrelevance to one name of the reason why the other is bestowed; and *pace* Quine, this explanation does not lead us to posit anything deviant about either the semantic role of 'Giorgione' – it simply refers to the artist – or to the position of occurrence it occupies in (1a).

'So' can be treated as an indexical or demonstrative in the manner of (Kaplan 1989), its reference usually being under the intentional control of the speaker. So it is the shift in reference of a context-dependent expression that leads to the failure in (1). Of course, the context-dependent expression is overt in (1), but we may hypothesize that a substitution in the content-clause of a propositional attitude ascription goes astray for broadly the same reason, because of the presence of a *hidden* counterpart of 'so'; hence the nomenclature 'hidden indexical theory', first introduced in (Schiffer 1979). For example, in

- (2) a. Lois believes that Superman can fly
 b. Superman is Clark
 c. ∴ Lois believes that Clark can fly

the use of =E will be disqualified if there is an implicit 'so personified', or more

abstractly, ‘as such’, following ‘Superman’ in (2a), that is, if (2a) means

- (3) Lois believes that Superman, as such, can fly.

Here ‘such’ refers not to the name ‘Superman’, but by a kind of deferred ostension, through the name to something associated with it.

Of course, there is no need to deny that (2a) can also be understood in a way that legitimizes substitution, or in the standard jargon, that (2a) has a *transparent* reading. But where the orthodox account of the transparent reading would appeal to the idea of relative scoping possibilities for the attitude verb and the name, with the transparent reading being the one where the name is not within the scope of the verb, the account of transparency implied by hidden indexical semantics is simply the *absence* of hidden indexicals. This is to the advantage of the semantics, since names are scopally inert in other cases (e.g., with modal, tense and negation operators), and it is not straightforward to make them scopally active in attitude-ascriptions in a plausible way.

The same idea of an implicit ‘as such’ is applicable to cases that do not involve intensional verbs. Jennifer Saul has noted that in examples like

- (4) a. Clark entered the phone-booth and Superman emerged
 b. Superman has more success with women than Clark

we have an intuition of substitution-failure almost as strong as we have for (2a) (Saul 1997, 1999). A hidden indexical account is applicable even in the absence of an intensional verb, and (4a), for example, has a different literal meaning from

‘Superman entered the phone-booth and Clark emerged’ if both contain implicit “as such”s. We would be comparing (5) and (6) below:

(5) Clark, as such, entered the phone-booth and Superman, as such, emerged.

(6) Superman, as such, entered the phone-booth and Clark, as such, emerged.

However one spells out the details, these do seem to disagree over which *persona* is switched for which. And it is not only in philosophical examples that one comes across this phenomenon. The historian Orlando Figes writes, ‘Shostakovich always signalled his connections to the classical traditions of St. Petersburg, even if he was forced to live in Leningrad’.¹ Figes, one imagines, would be unhappy with an editor who interchanged the two names of the city.² Of course, statements like (5) and Figes’ remark have readings that permit substitution. And as before, hidden indexical semantics permits a simple characterization of a transparent reading, namely, as one with no hidden indexicals. Not only does this give a completely uniform account of ‘transparent/opaque’ across the range of cases, but it is quite difficult to see how the orthodox approach to the distinction in terms of scope would work for Saul’s examples.

These considerations bestow considerable appeal upon a hidden indexical account of referential opacity. But the appeal would quickly fade if it turned out

¹ *The New York Review of Books*, 10th June 2004, p. 14.

² Braun and Saul (2002:20) argue that when substitutions in Saul-type examples are resisted, that is because the judge is, for certain reasons, ignoring the identity. But when Figes rejects the emendation that Shostakovich was forced to live in St. Petersburg while signalling his connections to the classical traditions of Leningrad, on the grounds that it is *incorrect*, he is not in any sense *ignoring* the identity. For the rhetorical punch of his remark depends on the identity, something of which, as its author, he is well aware.

that there were serious obstacles in the way of incorporating ‘as such’ into a compositional semantics for attitude ascriptions and larger portions of the language containing them. Because of its ability to shed light on a wide range of problems, *neo-Davidsonian* semantics is an important test case.³ The central tenet of this approach is that verbs are predicates of events or states, and other parts of sentences, such as complements of and adjuncts to the verb, specify constituents of the event or state in question, and perhaps a special constituency relation they stand in to that event or state.⁴ Our question is how we should apply neo-Davidsonian compositional semantics to attitude ascriptions with hidden indexicals.

It is not difficult to see how this should go if the attitude ascriptions are *objectual* ones, ones made with an intensional transitive verb and an NP complement that is either a singular term or a quantified NP understood relationally. For instance, in the neo-Davidsonian theory, to say that Lex fears Superman is to say that there is a state of fear that Lex is *in* (Parsons 1995:644), or of which he is the *experiencer*, and Superman is the *theme* of that state. So we have the following analysis of the transparent reading (on which it follows that Lex fears Clark):

- (7) a. Lex fears Superman. (*transparent*)
 b. **(some) λ e.fear(e) and in(e)(lex) and theme(e)(superman).**

The formula in (7b) can be interpreted in a number of ways. It is best interpreted

³ A list of problems to which neo-Davidsonian semantics provides plausible solutions is given in (Forbes 2006:75). To this I would add problems about the semantics of ‘only’; see (Bonomi and Casalegno 1993).

⁴ Davidson’s original proposals are in (Davidson 1967), while the ‘neo’ variation is influentially formulated in (Parsons 1990).

in Thomason's 'intentional' or *hyperintensional* type-theory, less adequately in intensional type-theory, and even less adequately in the Simple Theory of Types.⁵ However, some of the problems that coextensiveness and cointensiveness give rise to do not trouble hidden indexical semantics, and others will be of no concern here, so for simplicity I will employ just a version of the Simple Theory of Types in which the basic types of *individual* and *boolean* are supplemented with basic types of *event* and *opacity inducers* (such as the *personae* invoked to explain the difference between (5) and (6)).⁶ Concomitantly, the account of opacity to be developed here is compatible with a variety of views about what propositions are: sets of possible worlds, Russellian complexes of objects and properties, or Fregean complexes of ways of thinking of objects and properties.⁷

The term **theme** has the semantic type of a function from events to functions from individuals to truth-values, in other words, its type, $e(ib)$, is that of a binary relation between events and individuals. **Theme** expresses a particular thematic relation in which an individual might stand to an event or state, that of being the theme of the event or state; other thematic relations include **agent**, **instrument**, **goal**, and, as we will argue below, **content**. o is the theme of an event or state e iff e is *of* o , in the correct sense of 'of' (Parsons 1995:640). So Superman is theme of

⁵ For hyperintensional logic see (Thomason 1980) and more recently (Muskens 2005).

⁶ Since shift in reference of the hidden indexical explains substitution-failure, there is no need for anything but the most straightforward reference-assignment to ordinary proper names, which are therefore of type i . But the hidden indexicals themselves refer to opacity inducers, and so are of type c .

⁷ The same formalism works for possible-worlds and Russellian propositions, and even for propositions-as-truth-values. But for the Fregean conception, significant modifications have to be made, and we will not pursue these in this paper. See further note 12.

Lex's state of fear because the latter state is one of fear *of* Superman. More substantially, the theme of an event or state is the thing that is affected by the event or state, in a suitably broad, sometimes rather 'light', sense of 'affected'. There is a use of 'get' that captures this: Superman gets feared, Jerry gets chased, Juliette gets loved, the winner gets congratulated.

If (7b) is the substitution-permitting semantics of (7a), then if the presence of a hidden 'as such' explains opacity, the likely candidate for the substitution-resisting semantics of 'Lex fears Superman' is (8b) below:

- (8) a. Lex fears Superman. (*opaque*)
 b. **(some) λ e.fear(e) and in(e)(lex) and as(such)((theme(e))(superman))**.

In this neo-Davidsonian analysis, fearing Superman as such becomes having a fear whose theme is Superman, as such: Superman *personified as* Superman, we might say in this case.

Some comments about the analysis:

(i) **Such** derives its value from context, and in the presumed context, the relevant contextual parameter is obtained by a deferred ostension routed through a word displayed on the page – one could draw an arrow from **such** to **superman** to make this explicit. But there seems to be no reason why a **such** could not get its value by deferred ostension from something identified by the speaker with a gesture. For example, a speaker might say 'Lex fears Clark as...' – here she gestures at a YouTube video of the Man of Steel in his Superman costume performing some superpowered deed – 'such'. This involves a linguistically overt 'such', but the same

attribution might be made with ‘Sure, Lex fears Clark’, with utterance of ‘Clark’ accompanied by gesturing at the video.

(ii) **Such** and **as** conspire together to produce substitution-resistance in (8b). By itself, the presence of **such** does not explain why substitution changes truth-condition, since **such** may refer to something *determined* by its anchor’s reference, so that reference-preserving substitution for the anchor would preserve the value of **such**. But **as** ensures, for the cases in question, that this is not so, in the same way it does in ‘disguised as Clark’. There is a quotational analysis of how ‘as’ induces substitution-resistance in the latter case, along the lines of “disguised in the attire associated with the name ‘Clark’”, but (Richard, p.c.) it is perhaps better to regard ‘as’ as one of the rare creators of non-quotational exceptions to Davidsonian semantic innocence.⁸ So in ‘disguised as Clark’, ‘Clark’ does not denote the person, but rather the opacity-inducer associated with the name, in this case a *persona*. So the whole phrase has a meaning something like ‘in the guise of the Clark *persona*’. Genuine reference-shift occurs, to one *persona* among others associated with the same person. **As** functions in the same way in (8b), so that **such** refers there to the Superman *persona*. Since the Man of Steel has at least two *personae*, we have the many-one relationship that accounts for substitution having a truth-condition-altering side-effect. Formally, **as** is of type $c(bb)$, from *personae* to unary truth-functions, and **as(such)** is a unary truth-function.

⁸ Davidson famously commented on Frege’s reference-shift semantics for attitude contexts that ‘if we could recover our pre-Fregean semantic innocence...it would seem to us plainly incredible that...words [in the content sentences of attitude attributions] mean anything different, or refer to anything else, than is their wont when they come in other environments’ (Davidson 1969:172).

(iii) If e_0 is a verifying state for (8b), then in the intended context, **as(such)** **((theme(e))(superman))** describes *the way in which* the Man of Steel is the theme of e_0 : *as* player of the Superman role, we might put it. In the same sense, a lawyer might be agent of a document-signing *as* Smith's representative, or *as* Jones' representative: the lawyer is agent of the signing, but in a special way, and even though Smith's representative *is* Jones' representative, being agent *as* Smith's representative is not the same thing as being agent *as* Jones' representative. For example, signing *as* Smith's representative imposes the obligations of the contract on Smith, not Jones, *mutatis mutandis* for signing *as* Jones' representative. Being the theme of Lex's fear *as* Superman, but not *as* Clark, has comparable consequences. For if Lex thinks it likely that Superman is nearby, then *ceteris paribus* he will become furtive, but not, *ceteris paribus*, if he only thinks it likely that Clark is nearby. So the crucial idea of a way of being the theme of an event or state seems perfectly intelligible. Then the (only) change **as(such)** ever makes is to produce a falsehood from a truth of the form **(theme(e))(t)** when the *persona* **such** refers to does not identify a way in which the individual **[t]** is theme of the event **[e]**.

2 PROPOSITIONAL ASCRIPTIONS

The question to which we now turn is how this treatment of opacity in complement position of intensional transitives is to be extended to a neo-Davidsonian semantics for opacity in propositional attitude ascriptions. The primary issues concern the thematic role of the proposition that is the content of the attitude,

and the handling of the hidden indexical.

The standard view of propositional attitude ascriptions is that they assert the holding of an attitude relation between a subject and a proposition, and the ascription's 'that'-clause, or *content* clause, denotes the proposition in question. Propositional attitude verbs are typically state verbs (though some are action verbs, like 'accept', 'assume', 'propose' and various inference verbs), so in a neo-Davidsonian analysis they will be predicates of states (like the **fear** of (8b)), and their syntactic subjects will be the experiencers of the states, that is, the individuals who are in those states. But there is good reason not to parallel (8b) by assigning the role of theme to the proposition. Most attitude verbs have both transitive and clausal forms; in categorial grammar, there would be two lexical entries, one for the clausal form, categorized as $(NP \setminus s)/s$, an expression that produces $NP \setminus s$ (verb phrase, VP for short) by concatenating with a sentence or sentential clause on its right; the other for the transitive form, categorized as VP/NP , an expression that produces a verb phrase by concatenating with a noun phrase on its right. **Theme** is appropriate only for the transitive form, as is shown by the contrast between clausal and transitive 'suspect' in the following examples:

- (9) a. Lois suspects that Clark can fly
 b. Lois suspects the proposition that Clark can fly.

In the movie *Superman II* Lois begins to suspect that Clark is Superman, so (9a) is true for a while in that story. But (9b) would not thereby be true: why would the proposition become an object of suspicion?⁹ That (9a) and (9b) have different

truth-values is, on the face of it, puzzling, since if the ‘that’-clause in (9a) stands for a proposition, it is surely the very same proposition as the description stands for in (9b). For this reason, some philosophers have concluded that content-clauses in clausal ascriptions do not stand for propositions (see Moltmann 2003:82–4; Pryor 2007:227–33). However, the difference in meaning between (9a) and (9b) would be equally well explained if the change from clausal to transitive attitude verb brought with it a change in the thematic roles the verb imposes on its arguments. With **theme** assigned by the transitive verb, the semantics of (9b) on a transparent reading are as follows:

- (10) a. Lois suspects the proposition that Clark can fly
 b. **(some) λ e.suspicion(e) and in(e)(lois) and (theme(e))(the(proposition that clark can fly))**.¹⁰

That **theme** is right for transitive ‘suspect’ is borne out by the prepositional criterion, since (10a) says that Lois’s state of suspicion is *of* the proposition. The ‘get’ criterion is in agreement, since (10a) says that the proposition gets suspected. And these are exactly the reasons that (10a) is so unlikely: suspicion is rarely of a proposition, and propositions rarely get suspected (outside of contexts where one speaks of, e.g., ‘the suspect premise’).

⁹ One can suspect the proposition that p to be true, but according to the standard syntactic account (see, e.g., Radford 1988:317–24) in ‘suspect t to be F ’ the constituent-bracketing is [[suspect][t to be F]], in which [t to be F] is a so-called ‘exceptional’ clause. So in ‘suspect t to be F ’ we have the clausal, not the transitive, form of ‘suspect’.

¹⁰ The details of the semantics of the description have no bearing on this paper, but if we want to treat content clauses as being of type b , and also see them as involved in modifying the noun ‘proposition’, one possibility is to analyze the description as ‘the proposition which is *that Clark can fly*’, or **the((which($\lambda p.p = that((can fly)(clark))))(proposition))$** .

The reasons why **theme** is right for transitive ‘suspect’ are equally reasons why it is wrong for clausal ‘suspect’, since of course (9a) does not say anything about suspicion *of* a proposition. The role of the content clause is, rather, to specify the content of the attitude state, exactly as the nomenclature suggests. So we need a thematic role **content** to formulate the transparent semantics of (9a):

- (11) a. Lois suspects that Clark can fly. (*transparent*)
 b. **(some) λ e.suspicion(e) and in(e)(lois) and (content(e))(that clark can fly).**

(10b) and (11b) can clearly differ in truth-value, since even if the proposition that Clark can fly is the *content* of a suspicion, it need not be the *theme*. We can also explain why (9a)’s failure to entail (9b) is consistent with the clause and the description standing for the same proposition: the substitution that produces (9b) from (9a) has the truth-condition-altering side-effect of changing the verb from its clausal form, which assigns the thematic role **content**, to its transitive form, which assigns the role **theme**. Therefore, the substitution is not a legal application of =E.¹¹

In deciding on (11b) as the transparent semantics of (11a), we have to part company with the Fregean conception of proposition as a complex of individual and general concepts, at least on the orthodox assumption that these concepts may be

¹¹ Other arguments for a thematic role **content** are given in (Pietroski 2005: §3.4), where it is used to pin down the difference between ‘Nora explained that Fido barked’ and ‘Nora explained the fact that Fido barked’. Moltmann (2003:88) also draws a distinction that is very close to the one drawn here between **content** and **theme**. For further discussion of the contrast in (9), see (Forbes 2008), where certain exceptions, or apparent exceptions, to the need for **content** are considered. These exceptions or apparent exceptions include inference verbs, and the state verbs ‘believe’ and ‘doubt’.

many-one related to what they are concepts *of*, together with our assumption that content clauses stand for propositions. For on these assumptions there is no guarantee that **that(clark can fly)** and **that(superman can fly)** stand for the same proposition, and so (11b) is not a *transparent* reading. Concomitantly, hidden indexicals referring to opacity-inducers appear to be otiose. Adjusting for this would take us rather far afield and requires, as a first step, a change of view about what content clauses stand for, so from this point on we have in mind just notions of proposition no more fine-grained than the Russellian one.¹²

Given (11b) as the transparent semantics of (11a), the semantics of the opaque reading is to be obtained by judicious insertion of **as(such)**. Just as the intensional transitive case used a notion of a way of being the theme of an event, we can employ an analogous conception of a way of being the content of a state. Formally, this leads to the following analysis of the opaque reading of (11a):

- (12) a. Lois suspects that Clark can fly. (*opaque*)
 b. **(some) λ e.suspicion(e) and in(e)(lois) and
 (as(such))((content(e))(that clark can fly)).**

Note that the hidden indexical operator **as(such)** is not (in any context) a constituent of the content of the suspicion, but rather, is part of the ascriber's 'commentary' on Lois's suspicion. As in (8a), **as(such)** is of type *bb*, the particular function

¹² See (Forbes 1996) for an analysis which combines hidden-indexical-generated opacity with the Fregean conception of proposition. Given the proposals in this paper for Russellian and coarser-grained notions of proposition, it's not difficult to see how to give a neo-Davidsonian cast to that analysis. A simpler version of the analysis is obtained if we follow (Marcus 1990) in letting the content of "propositional"-attitude states be given by states of affairs.

being determined by the expression to which **such** is linked in the context. If **such** gets its value from **clark** (the term), then **as(such)** would leave the truth-value of **(content(e))(that clark can fly)** undisturbed in the *Superman II* scenario, where Lois does suspect that Clark can fly. But in the semantics for ‘Lois suspects that Superman can fly’, **such** would get its value from **superman** in the intended context, and so **as(such)** would produce a falsehood from the truth **(content(e))(that superman can fly)**, since Lois does not suspect what she already knows she knows.

As with intensional transitives, the account of the transparent/opaque distinction prompted by (11b) and (12b) has nothing to do with variation in the scope of the attitude verb. It is, again, a matter of whether or not hidden indexicals are present. But it might be objected that, in the case of clausal verbs, the scope account of the distinction has more expressive capacity than the hidden indexical account. For instance, in ‘Lois suspects that Clark is Superman’ there appear to be four possibilities, with the wholly transparent reading coming out on an explicitly scoped paraphrase as ‘Clark is such that Superman is such that Lois suspects the former is the latter’, while ‘Clark is such that Lois suspects he is Superman’ would be a paraphrase of one of the three readings manifesting opacity. Using **as such**, how are we to distinguish these readings? A formulation in English with overt ‘as such’ making both name-occurrences opaque is ‘Lois suspects that Clark, as such, is Superman, as such’, which suggests that expressive power equivalent to the scopal account can be obtained by iterating **as such**. So we would have:

- (13) a. Lois suspects that Clark is Superman. (*doubly opaque*)
 b. **(some)** λe .**suspicion(e)** and **in(e)(lois)** and
(as(such))(as(such))(((content(e))(that clark is superman))).
-
- The diagram consists of two horizontal arrows. The first arrow starts under the lambda expression λe and points to the first **(as(such))** operator. The second arrow starts under the **(as(such))** operator and points to the **content(e)** function.

where we have made the context-dependencies explicit with linking arrows.¹³

These analyses make use of the idea of a state having a proposition as its content in a particular way. One gloss we can give on this, continuing the parallel with intensional transitives, attributes to the way in which the proposition is the content of the attitude-state the capacity to determine what kinds of interactions with other attitude states the given state can have. Suppose, for example, that Lois investigates everything she suspects. Then, if she suspects Clark is Superman, with her suspicion characterized as in (13b), she will investigate whether Clark is Superman, but not whether Clark is Clark (however, see Braun 2002 for a contrary account). When an individual with multiple *personae* is identified, and a propositional attitude about him is acquired, components of the proposition which is the content of the attitude-state can be marked with the *persona* that is active at the

¹³ Since the complement of a transitive verb can be a co-ordinated NP, the problem of expressive capacity in fact already arose for intensional transitives. Multiple uses of **as(such)** can accommodate the range of readings, so long as the semantics provides sentences for the operators to apply to. But if the co-ordinator is **or**, there are some complications. On one reading of 'seeks Clark or Superman' it follows from 'seeks Clark', and in this case it is likely that there is an elided 'seeks' preceding 'Superman', so we get two **theme** statements, each of which can be preceded by **as such**. On the more common reading, 'or' has conjunctive force: 'seeks Clark or Superman' implies that the search could succeed if Clark is found *and* that it could succeed if Superman is found, in the same way that '*a* or *b* could win' usually means '*a* could win *and* *b* could win'. This reading is notional, since there is no particular one of the "two" that is sought. On the account of notional readings in (Forbes 2006:77–84), in place of **theme** we use **char**, expressing a relation of *characterization* between quantifiers and events. So raising the compound NP to a quantifier, the wholly opaque reading of 'seeks Clark or Superman' gets the notional semantics **(as(such))(as(such))(char(e)($\lambda P.P(\text{clark})$ or $P(\text{superman})$))**, where the **such**'s link to the names in the manner of (13b).

point of identification, and these marks are subject to a matching requirement when attitudes combine to motivate action. The analyses presented here fit well with some account of cognitive mechanics along these lines.¹⁴

3 COMPOSITIONALITY

3.1 *Compositionality at the Atomic Level*

We have claimed to give the semantics of several English sentences by formulae of type theory that quantify over events. In order to justify the assumption that this is a *semantics*, we have to show how these formulae can be compositionally assigned to their associated sentences. For otherwise, all we have are regimentations of verbose paraphrases of the original English.

The formalism used here for compositional assignment of meanings is associative Lambek calculus (L^+). The purposes of language are semantic in nature, so an efficient relationship between syntax and semantics forged by the adaptive advan-

¹⁴ This account does not even involve reference to *modes of presentation*, and is therefore immune to the ‘mode of presentation problem’ of (Schiffer 1990). Schiffer argues that, granted certain constraints, there is nothing for modes of presentation to be. But the existence of *personae* can hardly be doubted – after all, the Man of Steel has two. However, I also believe that something more cognitive is available, if we exploit the dossier metaphor, on which names are labels of *loci* of organization of information or misinformation about an individual (the metaphor was introduced in Grice 1969; see Forbes 1990:536–45 for elaboration). But Schiffer would object to *any* candidate, it seems, on the grounds that it gives rise to the *meaning intention problem* (Schiffer 2000:22–4, 27–8). According to hidden indexical semantics, attitude ascribers are invoking entities over and above the standard referents of the words in content clauses. If so, they would surely have some awareness that they were doing this, which, Schiffer says, they in fact lack. However, I do not find this awareness principle very plausible. To buy a Superman outfit is not to buy a Clark outfit, and going to the party dressed as Superman is not going dressed as Clark. If Stellen says he is going dressed as Superman, he somehow invokes a way of dressing (a mode of self-presentation), perhaps by implicit quotation, perhaps by a Fregean reference-shift. But I think he is unlikely to be *aware* of this. ‘As’ can also figure in attitude ascriptions as a substitution-blocker (‘Lois failed to recognize Clark as Superman’). But ‘Clark’ is also opaque here. Yet all these case seem to be on a par as regards the subject’s (lack of) awareness of the semantic complexity.

tages of a language-faculty will be a close one, particularly as regards how syntax controls the composing of meanings. Lambek calculus is therefore a plausible basis on which to build a model of compositionality. We assume familiarity with the basics, but as a simple illustration, we derive the “atomic” meaning (no event quantification) of ‘Jerry hit Tom’. ‘Jerry’ and ‘Tom’ are of syntactic category NP, and ‘hit’ has the category $(NP \setminus S) / NP$, which means that it concatenates with an NP on its right, such as ‘Tom’, to produce an expression of category $NP \setminus S$, VP for short, such as ‘hit Tom’ (an intransitive verb like ‘sleep’ is also $NP \setminus S$).

Deriving the meaning of ‘Jerry hit Tom’ in L^+ consists in proving the following sequent: $Jerry \hat{\ } hit \hat{\ } Tom \Rightarrow \mathbf{(hit(tom))(jerry)}: s$. In this sequent, the “premise” is a term for the concatenation of ‘Jerry’ with ‘hit’ with ‘Tom’ (since the calculus is associative, the order in which the concatenations are made is immaterial). $\mathbf{(hit(tom))(jerry)}$ is the type-theoretic term obtained as the interpretation of $Jerry \hat{\ } hit \hat{\ } Tom$ by the derivation in (16) below, and s is its category according to that derivation. To construct the derivation we only need lexical entries for the three words, plus the two rules of the applicative fragment of L^+ . Lexical entries have the form $word \Rightarrow \mathbf{term}: \mathbf{CATEGORY}$, for example (suppressing some syntactic details), $hit \Rightarrow \mathbf{hit}: (NP \setminus S) / NP$, while the rules are:

- (14) Rule of /E: given $\tau_1 \Rightarrow \mathbf{t}_1: \alpha / \beta$ and $\tau_2 \Rightarrow \mathbf{t}_2: \beta$ at sister nodes,
 derive $\tau_1 \hat{\ } \tau_2 \Rightarrow \mathbf{t}_1(\mathbf{t}_2): \alpha$
- (15) Rule of \E: given $\tau_1 \Rightarrow \mathbf{t}_1: \beta \setminus \alpha$ and $\tau_2 \Rightarrow \mathbf{t}_2: \beta$ at sister nodes,
 derive $\tau_2 \hat{\ } \tau_1 \Rightarrow \mathbf{t}_1(\mathbf{t}_2): \alpha$

These rules have the character of $\rightarrow E$ (*modus ponens*) in natural deduction, and derivations are presented in natural-deduction-style tree format, where each node of the tree contains a full sequent (as opposed to a single formula).

(16) Show $Jerry \hat{\ } hit \hat{\ } Tom \Rightarrow \mathbf{(hit(tom))(jerry): s}$

$$\frac{\frac{Jerry \Rightarrow \mathbf{jerry: NP} \quad \frac{hit \Rightarrow \mathbf{hit: (NP \setminus s) / NP} \quad Tom \Rightarrow \mathbf{tom: NP}}{hit \hat{\ } Tom \Rightarrow \mathbf{hit(tom): NP \setminus s}} / E}{Jerry \hat{\ } hit \hat{\ } Tom \Rightarrow \mathbf{(hit(tom))(jerry): s}} \setminus E$$

The leaf nodes of the derivation contain sequents which are extracted from the lexicon, and the root node is the target sequent. Our aim now is to adapt this method to the neo-Davidsonian analyses developed in the foregoing.

3.2 Neo-Davidsonian compositionality

The derivation in (16) indicates that we face two major barriers to producing sequents with neo-Davidsonian terms on the left of \Rightarrow in place of conventional ones like $\mathbf{(hit(tom))(jerry)}$. For each term in a semantics derived in L^+ there must be some explicit or implicit element of the original English that is responsible for that term's presence. But nothing obvious in the original English of our examples corresponds either to the thematic role terms or to the conjunctions that combine role-assignment sentences, so where do they come from? Parsons (1995) has two suggestions about this which can be incorporated in our approach.

The first suggestion (p. 651) is that in its lexical entry, a verb is already conjoined with thematic-role assignments for its *arguments*. So for neo-Davidsonian deriva-

tions in L^+ , an entry like (17) would be typical for an extensional transitive:

$$(17) \textit{hit} \Rightarrow \lambda y. \lambda x. \lambda e. \textit{hit}(e) \textit{ and agent}(e)(x) \textit{ and theme}(e)(y): \textit{VP/NP}.^{15}$$

If the term in (17) is applied to **tom** and the result is applied to **jerry**, we get (almost) a derivation of the neo-Davidsonian semantics for ‘Jerry hit Tom’ that proceeds in the same way as the derivation in (16), with one use of /E followed by one use of \E. The reason for the ‘almost’ is that the final slash rule produces

$$(18) \textit{Jerry} \hat{\textit{hit}} \textit{Tom} \Rightarrow \lambda e. \textit{hit}(e) \textit{ and agent}(e)(\textit{jerry}) \textit{ and theme}(e)(\textit{tom}): s$$

so that the category s is interpreted by a property of events (being a hitting whose agent is Jerry and theme is Tom) rather than a truth-value. A step of ‘finalization’ is required to get a truth-value. One possibility is to change the category in (18) to some subcategory s' of s , so that \textit{VP} is $\textit{NP} \setminus s'$, and to conclude the derivation by applying a function of type $(eb)b$. Inspection of earlier examples shows that we were in effect presuming application of what Parsons calls *default existential quantification*, a function **some** of type $(eb)b$. This **some** might either be assigned a lexical entry $\varepsilon \Rightarrow \textit{some}: s/s'$, where ε is an empty string, or it might be introduced by application of a special rule $\delta\exists$, which is the route we will follow here. Other

¹⁵ In (Forbes 2006:85) I objected to this that it imposes the burden of distinguishing arguments from adjuncts and optional arguments from obligatory ones. But as far as the latter distinction is concerned, the categorial framework requires it anyway – in most cases, whether or not it’s obligatory that the *theme* role be filled is the same question as whether or not the syntactic category is one which looks right for \textit{NP} . There is a bias in favor of including a conjunct for **theme** in lexical entries, since it is not obvious where else it comes from. But then examples like *Where Satan destroys*, *God creates* are problematic. If we insist on a silent *something*, the objections in (Parsons 1995:659–60) will have to be addressed.

options for finalization are discussed in (Francez and Steedman 2006:399).

Lexical entries like (17) account for the appearance of **agent** and **theme** in our examples. Other terms for thematic roles can be introduced by prepositions expressing them. For example, in ‘Jerry hit Tom with the stick’, we interpret ‘with’ in its instrumental (‘using’) sense, as opposed to such senses as possession (‘boy with a scar on his forehead’), accompaniment (‘dog with its owner’), manner (‘entered with caution’) or involvement (‘won with your help’). An appropriate lexical entry for instrumental ‘with’ would be

$$(19) \textit{with}_{instr} \Rightarrow \lambda x. \lambda e. \textit{instrument}(e)(x): (\textit{VP} \setminus \textit{VP}) / \textit{NP}.$$

However, this is not the end of the matter. Lexical entries and special prepositions can account for the appearance of thematic role terms in semantic representations. But how is the *conjoining* of role-ascriptive subformulae into a conjunctive property of an event effected, if the conjunction is not built into the lexical entry of the main verb? Parsons’ second suggestion is that a semantic operation he calls *lambda conjunction* is at work (1995:651). Technically, if **f** and **g** are terms of type et_1 and et_2 respectively, for some types t_1 and t_2 , the lambda conjunction ($\lambda\&$) of **f** and **g** is the term $\lambda e. \mathbf{f}(e) \text{ and } \mathbf{g}(e)$. Suppose we want to combine the \textit{VP} ‘hit Tom’ and the \textit{VP} modifier ‘with the stick’ into the \textit{VP} ‘hit Tom with the stick’. It looks as if we can simply concatenate ‘hit Tom’ and ‘with the stick’ using $\setminus E$, since ‘with the stick’ would be of category $\textit{VP} \setminus \textit{VP}$ by (19). But as the discussion of (18) indicates, we are still using function application as the semantics of verb-

argument concatenation. And we cannot have a single way of merging of expressions, concatenation, with two different semantic interpretations, application and $\lambda\&$.

Independently of the issues we are discussing, there is good reason in categorial grammar to distinguish at least two ways of merging expressions, with concatenation being supplemented by *wrapping*. For example, the VP ‘ring John up’ is best seen as the result of wrapping a phrasal verb ‘ring up’ around ‘John’, and not, say, as the result of concatenating ‘ring’ and ‘John up’.¹⁶ Of course, there is an operational difference between concatenation and wrapping as modes of merging: juxtaposing *versus* surrounding. But nothing prevents the introduction of a mode of merging that we might call *conjoining*, symbolized ‘+’, whose difference from concatenation is only semantic, not operational. The idea is then to associate application with concatenation and conjoining with $\lambda\&$. $\tau_1 + \tau_2$ is produced, in one case, when τ_2 has a backwards-looking category $\beta \backslash \alpha$. The derivation E-rule is:

- (20) Rule of \backslash E: given $\tau_2 \Rightarrow \mathbf{t}_2; \beta \backslash \alpha$ and $\tau_1 \Rightarrow \mathbf{t}_1; \beta$ at sister nodes, where each \mathbf{t}_i is of some type *et*, derive $\tau_1 + \tau_2 \Rightarrow \lambda \mathbf{e.t}_1(\mathbf{e})$ and $\mathbf{t}_2(\mathbf{e}); \alpha$

We stipulate the term-identity $\tau_1 + \tau_2 = \tau_1 \hat{\ } \tau_2$, and assume a structural rule T= for replacing + with $\hat{\ }$.¹⁷ With these resources, we can finally construct some derivations for attitude ascriptions.

¹⁶ This example is from (Morrill 1995:198), whose treatment I would follow.

¹⁷ I have not formulated an I-rule for \backslash , since in the applications we want \backslash for, it is in an output category for an expression obtained from the lexicon or derived some other way. However, an I-rule is required for a logically adequate account of \backslash .

3.3 *Intensional transitives*

For (transparent) ‘seeks Superman’ we have the meaning $\lambda x.\lambda e.\mathbf{seeking}(e)$ and **agent(e)(x) and theme(e)(superman)** and the category VP , while for a prepositional phrase such as ‘with the telescope’ we have the meaning $\lambda e.\mathbf{instrument}(e)(\mathbf{the}(tel))$ and need the category $VP \parallel VP$ for $\lambda \&$; so we replace (19) with

$$(21) \text{with}_{instr} \Rightarrow \lambda x.\lambda e.\mathbf{instrument}(e)(x): (VP \parallel VP)/NP.$$

Let us take sequents for *seeks Superman* and *with the telescope* as given. Then we have the following VP -derivation for *seeks Superman with the telescope*:

$$(22) \text{Show } \textit{seeks Superman with the telescope} \Rightarrow$$

$\lambda x.\lambda e.\mathbf{seeking}(e)$ and **agent(e)(x) and theme(e)(superman) and instrument(e)(the(telescope)): VP**

$$\begin{array}{c}
 \begin{array}{cc}
 \textit{seeks Superman} \Rightarrow & \textit{with the telescope} \Rightarrow \\
 \lambda e.\lambda x.\mathbf{seek}(e) \text{ and } \mathbf{agent}(e)(x) \text{ and } \mathbf{theme}(e)(\mathbf{superman}): VP & \lambda e.\mathbf{instr}(e)(\mathbf{the}(tel))): VP \parallel VP
 \end{array} \\
 \hline
 \textit{seeks Superman} + \textit{with the telescope} \Rightarrow \\
 \lambda e'.(\lambda e.\lambda x.\mathbf{seek}(e) \text{ and } \mathbf{agent}(e)(x) \text{ and } \mathbf{theme}(e)(\mathbf{superman}))(e') \text{ and } (\lambda e.\mathbf{instr}(e)(\mathbf{the}(tel)))(e'): VP \\
 \hline
 \textit{seeks Superman} + \textit{with the telescope} \Rightarrow \\
 \lambda e.\lambda x.\mathbf{seek}(e) \text{ and } \mathbf{agent}(e)(x) \text{ and } \mathbf{theme}(e)(\mathbf{superman}) \text{ and } \mathbf{instrument}(e)(\mathbf{the}(tel))): VP \\
 \hline
 \textit{seeks Superman with the telescope} \Rightarrow \\
 \lambda e.\lambda x.\mathbf{seek}(e) \text{ and } \mathbf{agent}(e)(x) \text{ and } \mathbf{theme}(e)(\mathbf{superman}) \text{ and } \mathbf{instrument}(e)(\mathbf{the}(tel))): VP \\
 \hline
 \textit{seeks Superman with the telescope} \Rightarrow \\
 \lambda x.\lambda e.\mathbf{seek}(e) \text{ and } \mathbf{agent}(e)(x) \text{ and } \mathbf{theme}(e)(\mathbf{superman}) \text{ and } \mathbf{instrument}(e)(\mathbf{the}(tel))): VP
 \end{array}$$

$\parallel E$
 β
 $T=$
 $Perm$

Applying $\parallel E$ to the leaf nodes conjoins the terms for strings and lambda-conjoins their semantics. β -reduction then produces nearly the semantics we want, and the structural rule $T=$ redcribes the string as a pure concatenation. Finally, we allow ourselves to permute lambda operators in blocks freely, since the associated functional domains can be put in a meaning-preserving one-one correspondence

(see Carpenter 1997:48).

It remains to provide for opacity. When ‘Superman’ is not open to substitution in, say, ‘seeks Superman’, this is because of a silent ‘as such’. We argued in connection with (8a) that the semantic result is **as(such)((theme(e))(superman))**. *Prima facie*, this leads to a problem, for if *seeks* has a lexical entry like (17), there will be no way of inserting **as(such)** into the correct position once the derivation has started. The simplest way round this is to suppose that we are provided with two options for the *same* verb at the point of lexical extraction. For present purposes, we will just suppose that these two options are stipulated, but this is not generally satisfactory, in view of the need for iteration of **as(such)** (recall note 13). We really require recursive operations in the lexicon to assemble the lambda-term’s components, prefixing as many **as(such)**’s as desired. The details would take us rather far afield,¹⁸ so here we will simply grant ourselves the possibility of starting a derivation that is just like (22) except that the left leaf node has an **as(such)** and is arrived at as follows:

¹⁸ It’s reasonable to suppose that issues about the availability of **as(such)** should be settled at the level of the lexicon, since whether or not a verb supports opaque readings of some of its arguments is a matter of the sense of the verb. The contrast is illustrated by ‘seek’ and ‘need’, since the latter doesn’t allow opaque readings: if you need water, you need H₂O, and vice-versa. That is, ‘need’ is (intensional but) not hyperintensional, and opacity is a phenomenon of hyperintensionality. However, this argument ignores Saul’s examples, like ‘Clark entered the phone-booth and Superman left’. Whether we want a theoretical difference between hidden indexicals here and in attitude ascriptions is a question I leave for a future occasion. (A referee was sceptical of my claim that ‘need’ isn’t hyperintensional, offering ‘the world needs Superman/the world needs Clark’; I would say that the water/H₂O case establishes *prima facie* lack of hyperintensionality, and the Superman/Clark case is a Saul-style substitution-failure.)

$$\begin{array}{c}
\text{seeks} \Rightarrow \qquad \qquad \qquad \text{Superman} \Rightarrow \\
\lambda y. \lambda x. \lambda e. \text{seek}(e) \text{ and agent}(e)(x) \text{ and (as(such))}((\text{theme}(e))(y)): VP/NP \qquad \qquad \text{superman}: NP \\
\hline
\text{seeks} \hat{\ } \text{Superman} \Rightarrow \\
\lambda x. \lambda e. \text{seek}(e) \text{ and agent}(e)(x) \text{ and (as(such))}((\text{theme}(e))(\text{superman})): VP \qquad \text{Perm} \\
\hline
\text{seeks} \hat{\ } \text{Superman} \Rightarrow \\
\lambda e. \lambda x. \text{seek}(e) \text{ and agent}(e)(x) \text{ and (as(such))}((\text{theme}(e))(\text{superman})): VP
\end{array}$$

Notice that **such** is not nonsensically linking to a variable at the top left. **Such** is a context-dependent expression, and until a context is given, it is not linked to any particular expression. Whatever link is used to get a complete proposition for a sentence with **such**, is obtained extra-semantically.¹⁹

3.4 Clausal verbs

Because transitive ‘suspect’ and clausal ‘suspect’ have distinct ‘thematic grids’, each will need its own lexical entry, or family of entries. Focussing now on the clausal verb, we subcategorize sentences to classify content-clauses as *content sentences*, s_C . We then have the following entries for ‘that’ and clausal ‘suspect’:

- (23) a. *that* $\Rightarrow \lambda p.p: s_C/s$
b. *suspect* $\Rightarrow \lambda p. \lambda x. \lambda e. \text{suspicion}(e) \text{ and in}(e)(x) \text{ and content}(e)(p): VP/s_C$
c. *suspect* $\Rightarrow \lambda p. \lambda x. \lambda e. \text{suspicion}(e) \text{ and in}(e)(x) \text{ and as(such)(content}(e)(p)): VP/s_C$

(23b) is for a transparent content clause, and (23c) for one with a single opaque position. In (23b) and (23c), VP now abbreviates $NP \setminus s'$, where s' is semantically a property of events, as discussed in connection with (18), and an s is produced,

¹⁹ In suggesting that the **as(such)** in an opaque ascription is inserted from the lexicon by the ascriber, I am rejecting the view that it is something interpolated by an interpreter as the result of some ‘enrichment’ process of the kind argued for in, e.g., (Recanati 2003). But I don’t see any reason why a Recanati-friendly version of the present account could not be worked out.

semantically a truth-value, by application of $\delta\exists$. One derivation for ‘Lois suspects that Clark can fly’ with potentially opaque ‘Clark’ concludes as follows:

$$\begin{array}{c}
 \text{Clark} \hat{\wedge} \text{can} \hat{\wedge} \text{fly} \Rightarrow \lambda e'. (\text{can}(\text{fly}))(e') \\
 \text{and in}(e')(\text{clark}): s' \\
 \hline
 \text{Clark} \hat{\wedge} \text{can} \hat{\wedge} \text{fly} \Rightarrow (\text{some})\lambda e'. \\
 (\text{can}(\text{fly}))(e') \text{ and in}(e')(\text{clark}): s \\
 \hline
 \delta\exists \\
 \text{that} \Rightarrow \lambda p.p: s_c/s \\
 \hline
 \text{suspects} \Rightarrow \lambda p.\lambda x.\lambda e.\text{suspicion}(e) \\
 \text{and in}(e)(x) \text{ and as}(\text{such})(\text{content}(e)(p)): \text{VP}/s_c \\
 \hline
 \text{that} \hat{\wedge} \text{Clark} \hat{\wedge} \text{can} \hat{\wedge} \text{fly} \Rightarrow (\text{some})\lambda e'. \\
 (\text{can}(\text{fly}))(e') \text{ and in}(e')(\text{clark}): s_c \\
 \hline
 /E \\
 \text{suspects} \hat{\wedge} \text{that} \hat{\wedge} \text{Clark} \hat{\wedge} \text{can} \hat{\wedge} \text{fly} \Rightarrow \lambda x.\lambda e.\text{suspicion}(e) \text{ and in}(e)(x) \text{ and} \\
 \text{as}(\text{such})(\text{content}(e)((\text{some})\lambda e'. (\text{can}(\text{fly}))(e') \text{ and in}(e')(\text{clark}))) : \text{NP} \setminus s' \\
 \hline
 \text{Lois} \Rightarrow \text{lois}: \text{NP} \\
 \hline
 \backslash E \\
 \text{Lois} \hat{\wedge} \text{suspects} \hat{\wedge} \text{that} \hat{\wedge} \text{Clark} \hat{\wedge} \text{can} \hat{\wedge} \text{fly} \Rightarrow \lambda e.\text{suspicion}(e) \text{ and in}(e)(\text{lois}) \text{ and} \\
 \text{as}(\text{such})(\text{content}(e)((\text{some})\lambda e'. (\text{can}(\text{fly}))(e') \text{ and in}(e')(\text{clark}))) : s' \\
 \hline
 \delta\exists \\
 \text{Lois} \hat{\wedge} \text{suspects} \hat{\wedge} \text{that} \hat{\wedge} \text{Clark} \hat{\wedge} \text{can} \hat{\wedge} \text{fly} \Rightarrow (\text{some})\lambda e.\text{suspicion}(e) \text{ and in}(e)(\text{lois}) \text{ and} \\
 \text{as}(\text{such})(\text{content}(e)((\text{some})\lambda e'. (\text{can}(\text{fly}))(e') \text{ and in}(e')(\text{clark}))) : s
 \end{array}$$

$\delta\exists$ is used at top right because we want the content of the suspicion to be itself truth-evaluable. The derived semantics allows for ‘Clark’ to be opaque, though whether or not it *is* opaque will depend on how the context supplies the value for **such**, which could come from elsewhere in the discourse or from the non-linguistic environment.²⁰

²⁰ I have benefited from comments on earlier drafts of this material from George Bealer, Friederike Moltmann, Terence Parsons, Greg Ray, Mark Richard, Hans-Christian Schmitz, Magdalena Schwager, Zoltán Szabó and Ede Zimmerman. Thanks also to audiences at Frankfurt, Yale, and Wyoming for their input, and to an anonymous referee for a very useful report.

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