Chapter Two: Concatenation and Concatenates (23Nov07)

In this chapter, I provide a Conjunctivist account of semantic composition, drawing on the more detailed presentation in Pietroski (2005). On this view, every phrase in a Language is an expression of type <e, **t**>, formed by conjoining two expressions of type <e, **t**>. Along the way, and more extensively in chapter three, I offer some reasons for adopting this severely constrained conception of how meanings combine. But a prior task is to show that a Conjunctivist semantics is viable. And the aim is not *yet* to do semantics without truth values. It is to show how semanticists can eschew appeals to more permissive composition operations (e.g., function-application) and nonmonadic lexical meanings (e.g., functions from n-tuples of entities to truth values). Given a Conjunctivist semantics, formulated initially in truth-theoretic terms, we can then replace the idealization/pretense that sentences have truth conditions with the hypothesis that meanings are Conjunctivist concept construction instructions. But first things first.

The main thesis is that *combining* expressions always signifies predicate-conjunction. But thematic relations and existential closure are also semantically relevant. This preserves an adjunct/argument distinction: the lexical elements of ‘red ball’ are conjoinable in a way that the lexical elements of ‘stab Caesar’ are not. To a first approximation, the idea is that ‘red ball’ is the simple conjunction it appears to be, ‘Red(e) & Ball(e)’. But ‘stab Caesar’ is understood as a conjunction of two event predicates. The name ‘Caesar’ is itself a predicate of persons. But as such, it can be a constituent of the thematic predicate ‘∃e'[Caesar(e') & Patient(e, e')]’, which can be conjoined with ‘Stab(e)’. Not all monadic predicates are coherently conjoinable. Some apply to inanimate entities like balls; others apply to people, events, or things of other sorts. Indicating relations among such things requires a few “adapters” that get invoked by certain grammatical relations. These adapters create predicates of things that have participants from predicates of things that can be participants. In terms of *Begriffsplans*, given a monadic concept **C**, a thematic adapter is an instruction to create a complex concept: ∃e'[**C**(e') & **R**(e, e')]; where **R**(e, e') is a concept of some participation relation, and the existential/conjunctive concept applies to e iff e has a certain kind of participant that falls under **C**.[1]

This account of semantic composition turns out to be quite plausible, at least when cashed out in terms of concepts and instructions. But initially, one might think that Conjunctivism is hopeless, or that the requisite converters will be hopelessly *ad hoc*. How can each of the lexical items in (1) be plausibly understood as a monadic predicate conjoinable with others?

(1) Chris does not think that every ball Pat kicked is big

And given such examples, why think concatenation signifies a single operation across all constructions, much less the operation of conjoining monadic predicates? On the other hand, appealing to diverse operations leads to other difficulties. And given developments of Davidson’s (1967, 1985) work, it is now common to analyze a sentence like (2) as in (2a).[2]

(2) Plum stabbed Green quietly in the hall with a knife

(2a) ∃e[Agent(e, Plum) & PastStab(e) & Patient(e, Green) & Quiet(e) & In(e, the hall) & With(e, a knife)]

I think such analyses illustrate a more general pattern in human language. So in this chapter, I present a specific Conjunctivist theory that covers the usual textbook cases and more, within an explicitly truth-theoretic framework. But this is part of a larger Trojan Horse strategy: once Conjunctivism is in the door, it becomes less friendly to Truth Conditional Semantics.

1. Elementary Cases

It is hardly news that phrases like 'red ball', in which a noun is modified by an adjective, can be analysed as instances of predicate-conjunction. But this model extends to many cases that involve *recursion*. The phrase 'ball that Pat kicked' is understood as a conjunction of predicates, corresponding to the lexical noun and the relative clause, which applies to things Pat kicked. Adding 'red', to form 'red ball that Pat kicked', adds another conjunct. While 'big' introduces a complication discussed in chapter three—a big ant can be smaller than a tiny elephant—a big ant is still an ant that satisfies a condition on size.[3] Likewise, a big red ball that Pat kicked is a ball that satisfies three further conditions. So prima facie, the phrase 'big red ball that Pat kicked' invokes multiply a mode of Conjunctivist composition that 'red ball' invokes once. Other things equal, positing *one* recursive mode of semantic composition is better than positing two or more. This invites the hypothesis that *forming a phrase* signifies predicate-conjunction quite generally. And as reviewed below, this simple theory can account for a wide range of constructions.

1.1 Adverbs, Adnominals, and Arguments

Many adverbial modifiers seem to be predicate-conjoiners; see Davidson (1967), Taylor (1985), Parsons (1990). Sentences like (3-7) exhibit the indicated pattern of validity.

(3) Plum stabbed Green quickly with a knife
(4) Plum stabbed Green with a knife quickly
(5) Plum stabbed Green quickly
(6) Plum stabbed Green with a knife
(7) Plum stabbed Green

(3) ⟷ (4)
↓ ↓
(5) ⟶ (7) ⟵ (6)

But (5) and (6) do *not* jointly imply (3) or (4). Plum may have stabbed Green twice: once with a knife but slowly, and once with a fork quickly. This range of entailments and nonentailments can be explained by taking seriously paraphrases like (3a), partly formalized in (3b).

(3a) At least one stabbing of Green by Plum was done quickly and with a knife

(3b) $\exists e\{PastStabOfGreenByPlum(e) \;\&\; Quick(e) \;\&\; \exists e':Knife(e')[With(e, e')]\}$

On this view, adverbial modification is conjunctive, like the adnominal modification in 'red ball'. If something is a red ball, then something is red, and something is a ball. But the converse does not hold, since there may be two things: a red stick and a yellow ball. In general, if $\exists e[\Phi(e) \;\&\; \Psi(e)]$, then $\exists e[\Phi(e)]$ and $\exists e[\Psi(e)]$. But the converse inference is fallacious.

Of course, (3b) doesn't reveal any semantic structure within the first conjunct. So following Davidson (1967), one might adopt an analysis of (3) along the lines of (3c);

(3c) $\exists e\{PastStabOfBy(Plum, Green, e) \;\&\; Quick(e) \;\&\; \exists e':Knife(e')[With(e, e')]\}$

where 'PastStabOfBy(Plum, Green, e)' means that e was a stabbing of Green by Plum. Then (7) is analyzed as in (7a).

(7a) $\exists e[PastStabOfBy(Plum, Green, e)]$

But the constituents-as-conjuncts picture can be extended to tense and grammatical arguments, as indicated in (7b) and its formalization (7c), which is logically equivalent to (7d).[4]

(7b) There was a stab such that its Patient was Green, and its Agent was Plum

(7c) $\exists e[Past(e) \;\&\; Stab(e) \;\&\; Patient(e, Green) \;\&\; Agent(e, Plum)]$

(7d) $\exists e[Agent(e, Plum) \;\&\; Stab(e) \;\&\; Past(e) \;\&\; Patient(e, Green)]$

Each lexical item in (7) corresponds to a conjunct in (7d) that may also be associated with a participation relation. More specifically, one can say that action verbs and their grammatical arguments are all understood as conjoinable predicates of events. Then the semantic structure of (3)—the logical form of any proposition expressed with (3)—is as shown in (3d).

(3d) ∃e{Agent(e, Plum) & Stab(e) & Past(e) & Patient(e, Green) &
Quick(e) & ∃e':Knife(e')[With(e, e')]}

This hypothesis can be encoded in various ways, with the details depending on one's assumptions about grammatical structure. But for present purposes, let's depict the constituency structure of (7) as follows: [$Plum_D$ [$stabbed_V$ $Green_D$]]; where brackets indicate concatenation of expressions, and the subscripts indicate a distinction between designators and verbs. This leaves room for the hypothesis that proper names are complex expressions like [δ_D $Green_N$]; where the covert (and perhaps indexed) designator or determiner combines with a lexical proper noun. In chapter three, I follow Burge (197x) in arguing that some such hypothesis is needed to accommodate a wide range of facts concerning proper names. For now, we can be agnostic about this. But let's assume, standardly, that a complex expression inherits the label of exactly one constituent, and that combining a D with a N yields a D. Then the name 'Green' is a D, whether or not it is a *grammatically atomic* D; see CITATIONS. And let's assume that combining a V with a D yields a V: [$Plum_D$ [$stabbed_V$ $Green_D$]$_V$]$_V$.

This captures the idea that for purposes of concatenation, [$stabbed_V$ $Green_D$] is a V, like 'stabbed'. Similarly, [$Plum_D$ [$stabbed_V$ $Green_D$]$_V$] is a complex V. A more realistic depiction, [$past_T$ [$Plum_D$ [$stab_V$ $Green_D$]$_V$]$_V$]$_T$, treats tense as a functional element that combines with a complex V and then (transformationally) combines with the verb.[5] But let's ignore this complication, and indicate any further structure of (6) with angled brackets simply as follows: ⟨[$Plum_D$ [$stabbed_V$ $Green_D$]$_V$]$_V$⟩, pretending that 'stabbed' is a lexical item. This still distinguishes the complete sentence from the "grammatically saturated" V-phrase. And this distinction is wanted, since [$Plum_D$ [$stabbed_V$ $Green_D$]$_V$]$_V$ can be modified with adverbs like 'yesterday'. But the immediate task is to interpret [$Plum_D$ [$stabbed_V$ $Green_D$]$_V$]$_V$ as a conjunction of predicates.

Let 'Val(e, Σ, **A**)' mean that e is a value of expression Σ relative to an assignment **A** of values to any variables in Σ; see Tarski (1933), Higginbotham (1985), Larson and Segal (1995). We can easily formulate Conjunctivism in these terms.

Val(e, [Σ Σ'], **A**) iff Val(e, Σ, **A**) & Val(e, Σ', **A**)

Relative to any assignment **A**, e is a value of the phrase formed by concatenating Σ with Σ' iff e is a value of both concatenates. And we can formulate "axioms" like the following:

Val(e, $Green_D$, **A**) iff e = Green   for each index *i*, Val(e, *i*, **A**) iff e = **A***i*
Val(e, $Plum_D$, **A**) iff e = Plum   Val(e, $stabbed_V$, **A**) iff PastStab(e, **A**)

where in the metalanguage, 'Green' is a logically proper name for a certain gardener, 'Plum' is a label for a certain professor, '**A***i*' stands for whatever **A** assigns to the variable with index '*i*', and 'PastStab(e, **A**)' is an appropriate way of relativizing values of the tenseless verb $stab_V$. Alternatively, we can adopt a treatment of names like the one indicated below.[6]

Val(e, $Green_N$, **A**) iff e is properly called $Green_N$
for any index *i*, Val(e, δ_{Di}, A) iff Val(e, *i*, **A**); and so
Val(e, [δ_{Di} $Green_N$] A) iff (e = **A***i*) & e is properly called $Green_N$

But however names are associated with bearers, any such theory wrongly implies that e is a value of [$stabbed_V$ $Green_D$]$_V$ iff e was both a stab and a certain gardener—and that e is a value of [$Plum_D$ [$stabbed_V$ $Green_D$]$_V$]$_V$ iff e is both a certain professor and a value of [$stabbed_V$ $Green_D$]$_V$.

There is, however, an easy remedy. Conjunctivism permits grammatical arguments. And as we'll see, other views face analogous difficulties that call for remedies with worse side-effects.

The fact that [stabbed_V Green_D] is a V can be exploited to preserve the idea that concatenation signifies conjunction, even if stabbed_V and Green_D are not themselves coherently conjoinable. Conjunctivists can supplement their simple composition principle with an auxiliary hypothesis that is independently plausible: when a V combines with an D, thereby forming a complex V that will be interpreted conjunctively, the D is marked as an *argument of* the V; and for purposes of interpretation, the concatenates are the V and the D-as-marked. This hypothesis can be formally encoded in grammatical terms, by replacing [stabbed_V Green_D]$_V$ with [stabbed_V $\text{Green}_{D\Theta}$]$_V$; where 'Θ' is the relevant mark. But whatever the coding scheme, the idea is that 'stabbed Green' is not a mere concatenation of two expressions. It is a *phrase of the same grammatical type as* 'stabbed'. While 'stabbed' and 'Green' are certainly elements of this phrase, it is equally true that the phrasal constituents are the verb and its "subordinate sister."

This makes room for a distinction between the designator Green_D, independent of its grammatical relation to stabbed_V, and something more complex than the mere designator: Green_D-as-subordinate-sister-of-stabbed_V. Less cumbersomely, we can say that Green_D is "theta marked" by stabbed_V, which is therefore conjoined with $\text{Green}_{D\Theta}$ as opposed to Green_D.[7] One can say, rightly, that this is a purely formal distinction. Indeed, that is why the distinction can be exploited by a formal system constrained to treat concatenation as a sign of conjunction. If stabbed_V and Green_D are understood as expressions that cannot have a common semantic value, the event predicate and entity label cannot be coherently conjoined, not even if Green_D is interpreted as a predicate satisfiable by exactly one entity. But the designator need not be the *expression* that is conjoined with the verb. So far as interpretation is concerned, the expression conjoined/concatenated with stabbed_V may be $\text{Green}_{D\Theta}$, which is a product of the designator *and* its position in the phrase. While stabbed_V may be concatenated with Green_D "in syntax," the process of combining a verb with an argument may have secondary effects, like Θ-marking.

In which case, the input to interpretive processes can be [stabbed_V $\text{Green}_{D\Theta}$]$_V$, which can be construed conjunctively as the concatenation of stabbed_V with $\text{Green}_{D\Theta}$. The expression $\text{Green}_{D\Theta}$ can be interpreted as an event predicate—conjoinable with others—while Green_D is still interpreted as a label for a certain entity, who may be the Patient of a stabbing. This treats 'Θ' like the preposition 'of' in 'stabbing of Green': [stabbing_V [of_P Green_D]$_P$]$_V$. Though conversely, the preposition can be viewed as an overt signal for the relevant structural relation. But in any case, this leaves room for various interpretations of (the grammatical relation indicated by) 'Θ'.

One could treat the theta-mark as a direct sign of Patienthood, as suggested below.

$$\text{Val}(e, \Sigma_\Theta, \mathbf{A}) \text{ iff } \exists e'[\text{Val}(e', \Sigma, \mathbf{A}) \ \&\ \text{Patient}(e, e')]$$

This biconditional has consequences like the following.

$$\text{Val}(e, \text{Green}_{D\Theta}, \mathbf{A}) \text{ iff } \exists e'[\text{Val}(e', \text{Green}_D, \mathbf{A}) \ \&\ \text{Patient}(e, e')]\text{; or simplifying,}$$

$$\text{Val}(e, \text{Green}_{D\Theta}, \mathbf{A}) \text{ iff Patient}(e, \text{Green})$$

But it will be more useful to adopt a variant according to which the theta-mark indicates a more abstract relation—*being the "internal" participant of*—that predicates of different kinds can associate with various more specific participation relations. Consider the revised proposal below.

$$\text{Val}(e, \Sigma_\Theta, \mathbf{A}) \text{ iff } \exists e'[\text{Val}(e', \Sigma, \mathbf{A}) \ \&\ \text{Internal}(e, e')]$$

$$\text{Val}(e, \text{stabbed}_V, \mathbf{A}) \text{ iff Event}(e) \ \&\ \text{PastStab}(e, \mathbf{A})$$

$\text{Event}(e) \supset \forall e'[\text{Internal}(e, e') \equiv \text{Patient}(e, e')]$

$\text{Val}(e, \text{Green}_D, \mathbf{A}) \text{ iff Entity}(e) \;\&\; (e = \text{Green})$

It still follows that the internal participants of *events* are Patients.

$\text{Val}(e, [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V, \mathbf{A}) \text{ iff}$

$\text{Event}(e) \;\&\; \text{PastStab}(e, \mathbf{A}) \;\&\; \exists e'[\text{Val}(e', \text{Green}_D, \mathbf{A}) \;\&\; \text{Internal}(e, e')]$

And this biconditional can be simplified.

$\text{Val}(e, [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V, \mathbf{A}) \text{ iff Event}(e) \;\&\; \text{PastStab}(e, \mathbf{A}) \;\&\; \text{Patient}(e, \text{Green})$

We can make further distinctions, say by replacing ‘Event’ and ‘Patient’ with two or more pairs of technical notions that correspond to different kinds of event predicates.

${}^{\alpha}\text{Eventuality}(e) \supset \forall e'[\text{Internal}(e, e') \equiv {}^{\alpha}\text{Theme}(e, e')]$

${}^{\beta}\text{Eventuality}(e) \supset \forall e'[\text{Internal}(e, e') \equiv {}^{\beta}\text{Theme}(e, e')]$

But the more important point is that events are not the only things with participants.[8]

The values of some verbs, as in ‘Plum likes Green’, may be *states*; see Parsons (1990). And especially given examples like ‘The door was open because Plum opened it’, one might say that states have Objects with enduring properties, while events can have Patients (or Themes) that undergo changes. Perhaps events are changes of state, or as Higginbotham puts it, perhaps states are monotonous events. One might also say that some predicates have *ordered pairs* as values, even if transitive action verbs do not. I return to this empirical claim. But ordered pairs can certainly be described as things with internal participants. Consider the pair of expressions $<\text{stabbed}_V, \text{Green}_D>$, which can be identified with the set $\{\text{stabbed}_V, \{\text{stabbed}_V, \text{Green}_D\}\}$, in which Green_D is intuitively subordinate. This abstract entity has an internal participant—viz., the expression Green_D. Likewise, the ordered pair of entities <Plum, Green> has Green himself as its internal participant. And we can think about each event in which Green is stabbed as something that has Green as its internal participant. We can also say that Green is the internal participant of his death, even if such deaths have no external participants. This fits with independent reasons for treating ‘Green died’ as a transformation of $[\text{died}_V\ \text{Green}_{D\Theta}]_V$, in which the verb is an event predicate that takes Green_D as an internal argument.[9]

In short, we can regard events, states, and ordered pairs as species of a broader genus: things in which entities participate. We can invent a predicate satisfied by ordered pairs of the form <e, Green>. Likewise, there can be a predicate satisfied by anything that has Green as its internal participant. And we can hypothesize that $\text{Green}_{D\Theta}$ is such a predicate. In which case, if stabbed_V is a predicate of events whose internal participants are Patients, Conjunctivism implies that $[\text{stabbed}_V\ \text{Green}_{D\Theta}]$ is a predicate satisfied by e iff e was a stab whose Patient was Green.

Unlike died_V, stabbed_V can easily combine with two grammatical arguments. But the obvious proposal is that when $[\text{stabbed}_V\ \text{Green}_{D\Theta}]_V$ combines with Plum_D, forming a V-phrase that will be interpreted as a conjunction of predicates, Plum_D is marked as the argument of this phrase; where for purposes of interpretation, the concatenates are $[\text{stabbed}_V\ \text{Green}_{D\Theta}]_V$ and Plum_D-as-marked. Using ‘$\underline{\Theta}$’ as the relevant mark, the resulting expression is indicated below.

$[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V$

One can view ‘Θ’ as the mark of a lexical V, and ‘$\underline{\Theta}$’ as the mark of a complex V with a theta-marked constituent. Or put another way, Green_D is the argument of stabbed_V, while Plum_D is the argument of $[\text{stabbed}_V\ \text{Green}_{D\Theta}]_V$.[10] The requisite claims about events and ‘$\underline{\Theta}$’ are easily stated.

$\text{Event}(e) \supset \forall e[\text{External}(e, e') \equiv \text{Agent}(e, e')]$

$\text{Val}(e, \Sigma_{\underline{\Theta}}, \mathbf{A}) \text{ iff } \exists e'[\text{Val}(e', \Sigma, \mathbf{A}) \;\&\; \text{External}(e, e')]$

And this ensures an appropriate satisfaction condition for the complex expression.

$\text{Val}(e, [\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V, \mathbf{A})$ iff

$\text{Agent}(e, \text{Plum}) \ \&\ \text{PastStab}(e, \mathbf{A}) \ \&\ \text{Patient}(e, \text{Green})$

Adverbial modifers can be added at any point. Consider the following biconditionals.

$\text{Val}(e, \text{quickly}_A, \mathbf{A})$ iff $\text{Quick}(e)$

$\text{Val}(e, [\text{with a knife}]_A, \mathbf{A})$ iff $\exists e'{:}\text{Knife}(e')[\text{With}(e, e')]$

Given these satisfaction conditions, we get the desired Davidsonian result.

$\text{Val}(e, [[\text{Plum}_{D\underline{\Theta}}\ [[\text{stabbed}_V\ \text{Green}_{D\Theta}]_V\ [\text{with a knife}]_A]_V]_V\ \text{quickly}_A]_V, \mathbf{A})$ iff

$\text{Agent}(e, \text{Plum}) \ \&\ \text{PastStab}(e, \mathbf{A}) \ \&\ \text{Patient}(e, \text{Green}) \ \&$

$\exists e'{:}\text{Knife}(e')[\text{With}(e, e')] \ \&\ \text{Quick}(e)$

Combining a complex V with an adjunct creates another V, not a full *sentence*. Even a very complex V may be extendable with temporal adverbs like 'yesterday'. But at some point, composition comes to an end. Let's assume that at this point, perhaps associated with tense, a complex phrase is marked as complete: nothing more can be added to it; though it may still undergo transformations, or serve as a sentential constituent. Using angled brackets to indicate this special point in the construction of a sentence, (7) has the grammatical form shown in (7G).

(7) Plum stabbed Green

(7G) $\langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V\rangle$

1.2 Sentences, Negation, and Connectives

This invites an obvious thought about the significance of marking a phrase as complete. Let '$\top$' and '$\bot$' stand for the potential semantic values of sentences. Given the following axioms,

$\text{Val}(\top, \langle\Sigma\rangle, \mathbf{A})$ iff $\exists e[\text{Val}(e, \Sigma, \mathbf{A})]$

$\text{Val}(\bot, \langle\Sigma\rangle, \mathbf{A})$ iff $\neg\text{Val}(\top, \langle\Sigma\rangle, \mathbf{A})$

the *sentence* (7) has the value $\top$, relative to any assignment **A**, iff $\exists e[\text{Agent}(e, \text{Plum}) \ \&\ \text{PastStab}(e, \mathbf{A}) \ \&\ \text{Patient}(e, \text{Green})]$.

Given exactly two sentential values, as in classic truth-conditional semantics, Conjunctivists can go on to analyze sentential negation as a monadic predicate satisfied by and only by $\bot$. Suppose the grammatical structure of (8) is as shown in (8G),

(8) Plum didn't stab Green

(8G) $\langle[\ \text{NEG}\ \langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V\rangle]\rangle$

with NEG as a functional element that combines with a sentence to form an expression that can be marked as complete and subsequently interpreted as another sentence. This treats NEG, in effect, as a sentential adjunct. And consider the following description of what NEG means, recalling that 'e' ranges over all potential values of expressions, but that different monadic predicates can apply to different sorts of things: $\text{Val}(e, \text{NEG}, \mathbf{A})$ iff $e = \bot$. If concatenation signfies conjunction, then attaching NEG creates a conjunctive predicate.

$\text{Val}(e, [\text{NEG}\ \langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V\rangle], \mathbf{A})$ iff

$e = \bot \ \&\ \text{Val}(e, \langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V\rangle, \mathbf{A})$

And marking this complex predicate as a complete sentence indicates existential closure.

$\text{Val}(\top, \langle[\text{NEG}\ \langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V\rangle]\rangle, \mathbf{A})$ iff

$\exists e[e = \bot \ \&\ \text{Val}(e, \langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{Green}_{D\Theta}]_V]_V\rangle, \mathbf{A})]$

So as desired, (8) has the value $\top$ iff (7) has the value $\bot$. In section two of the initial chapter, I noted that this is fully in keeping with a Tarskian treatment of both predicates and sentences as expressions that have satisfaction conditions. One can define a negative predicate, of type $<\mathbf{t}, \mathbf{t}>$, for an invented language. And here, the point is that Conjunctivists can hypothesize that sentential negation (in Language) is such a predicate.

The moral of this trivial account is that NEG and stabbed_{V} can each be predicates, coherently conjoinable with others, without being coherently conjoinable with each other. The intervening existential closure allows for a predicate of truth values and a predicate of events to appear in the same (matrix) sentence, even though concatenation signifies conjunction. Likewise, given existential closure and thematic roles, a predicate of events and a predicate of entities like Green can appear in the same phrase, even though concatenation signifies conjunction. This is important, because Conjunctivists can deal with many apparent counterexamples by exploiting the two simple devices illustrated thus far: *marking* a grammatical argument, so that it can be interpreted as a predicate of "things" in which semantic values of the argument can "participate;" and marking a phrase (in which a grammatical predicate has combined with the requisite number of arguments) as complete, in a way that corresponds to *existential closure*.

As another illustration of how these devices can be combined, suppose that (9G) reflects the grammatical structure of (9), suppressing structure in embedded sentences for simplicity.

(9) Plum stabbed Green, or Peacocke shot Mustard

(9G) $\langle[\langle\text{Plum stabbed Green}\rangle_{\underline{\Theta}}$ [OR $\langle\text{Peacocke shot Mustard}\rangle_{\Theta}]]\rangle$

The idea is that OR takes two sentential arguments that are marked as such; see Larson and Segal (1995), whose account of sentential connectives and transitive verbs is almost Conjunctivist. Suppose the values of OR are ordered pairs of truth values: $<\top, \top>$, $<\top, \bot>$, and $<\bot, \top>$. Then we get the right result, given the little theory outlined thus far. Relative to any assignment **A**, (9G) has the value $\top$ iff at least one thing satisfies the following three conditions: its external participant is the value of ⟨Plum stabbed Green⟩; it is a value of OR; and its internal participant is the value of ⟨Peacocke shot Mustard⟩. Or put another way, some value of OR satisfies the first and third condition iff Plum stabbed Green or Peacocke shot Mustard.

1.3 Causatives

This account can be extended to mesh with the increasingly common idea that many transitive constructions are formed by combining a lexically intransitive verb with a transitivizing element that is covert in English. To take a much discussed example, one can hypothesize that 'Plum killed Green' has the following grammatical structure, in which the verb 'died' takes 'Green' as an (internal) argument and then combines with a verbal element *v*.

$[\text{Plum}_{D\underline{\Theta}}\ [[v\ \ \text{died}_{V}]_{v}\ [\ \_\_\ \text{Green}_{D\Theta}]_{V}]_{v}]_{v}$
|______|

Suppose that the lexical verb is interpreted in its final position, where it incorporates (in Baker's [1988] sense) with the covert element. Then a natural Conjunctivist thought is that in such a construction, died_{V} is understood as an argument of *v*, which introduces another kind of participation relation that one event can bear to another. Many theorists have appealed to casual and/or mereological relations to capture the intuition that a killing of Green by Plum starts with an action by Plum and ends with a death of Green.[11] My own preference is to encode such proposals as follows, where e' is a *Terminater* of e iff e is a *process* with e' as a final part.

$\text{Val}(e, [v\ \ \text{died}_{V}], \mathbf{A}) \text{ iff } \exists e'[\text{Terminater}(e, e') \ \&\ \text{Val}(e', \text{died}_{V}, \mathbf{A})]$

Details aside, the idea is that concatenating died_{V} with *v* creates a complex predicate of processes that end in deaths. In which case, e is a value of the complex *v*-phrase iff e is such a process with Plum and Green as external and internal participants. That is,

$$\text{Val}(e, [\text{Plum}_{\text{D}\underline{\Theta}}\ [[v\ \ \text{died}_{\text{V}}]_{v}\ [\ \_\_\ \text{Green}_{\text{D}\Theta}]_{\text{V}}]_{v}]_{v}, \mathbf{A})$$

if and only if the following triparite condition obtains.

$$\begin{aligned}&\exists e\{\exists e'[\text{Agent}(e, e') \ \&\ \text{Val}(e, \text{Plum}_{\text{D}}, \mathbf{A})] \ \&\\ &\quad \exists e'[\text{Terminater}(e, e') \ \&\ \text{Val}(e', \text{died}_{\text{V}}, \mathbf{A})] \ \&\\ &\quad \exists e'[\text{Patient}(e, e') \ \&\ \text{Val}(e, \text{Green}_{\text{D}}, \mathbf{A})]\}\end{aligned}$$

A wide class of verbs—including 'boil', 'melt', 'freeze', 'break, 'shatter', etc.—can appear with the same phonology in transitive or intransitive forms, with a characteristic and much discussed "causative" entailment pattern: if x V_T y, then y V_I. Such facts are easily explained, on this model, assuming that the internal participant of a process is the internal participant of any event that is a terminater of that process; cp. Tenny (199x).

Much ink to the contrary notwithstanding, this kind of semantic theory is compatible with Fodor's (199x, 200x) view, according to which verbs like 'kill' and 'boil_T' lexicalize *atomic* concepts; where by definition, such concepts have no parts that include any concept lexicalized with an intransitive verb (like 'die' or 'boil_I'), or any concept of termination (causation, or any part-whole relation). Spelling out this point requires a brief digression. But the moral is simple.

Conjunctivism is a thesis about semantic composition in Languages, not a thesis about prelexical concepts. So a Conjunctivist is free to hypothesize that 'kill' and 'die' lexicalize atomic concepts—perhaps KILL(X, Y) and DIE(X), or KILL(X, Y, E) and DIE(X, E). Speakers may know by nonlinguistic means that ∀x∀y[KILL(X, Y) ⊃ DIE(Y)]. But *pace* Fodor, this kind of conceptual atomism does not preclude a semantics according to which 'kill' is understood as a complex verb on the model above. Lexicalizing KILL and DIE may result in the acquisition of two independent event concepts, KILL(E) and DIE(E). Or lexicalization may lead to acquisition of structurally related event concepts, DIE(E) and ∃E'[TERMINATER(E, E') & DIE(E')]; where it is analytic that KILL(X, Y) ≡ ∃E{AGENT(E, X) & ∃E'[TERMINATER(E, E') & DIE(E')] & PATIENT(E, Y)}, but *not* because KILL(X, Y) is composite. As Frege taught us, and as discussed in chapter three, analysis can take the form of abstraction as opposed to decomposition. And if lexicalization *adds* to a stock of monadic concepts, speakers may end up having concepts of killing and death that are not logically independent, even if the lexicalized concepts KILL(X, Y) and DIE(X) are atomic. Speakers may acquire a linguistic way of knowing that ∀x∀y[KILL(X, Y) ⊃ DIE(Y)], via the linguistic knowledge that ∀x∀y{KILL(X, Y) ⊃ ∃E[KILL(E)]}.

Like Fodor (200x), who develops a line of thought pressed by Strawson (195x), I doubt that our many causal notions—pushing, pulling, breaking, boiling, etc.—are all *composite* and somehow "built up" from a common and underlying notion of causation. There are many ways of causing something. And I see no good reason for insisting that our many causal concepts share a constituent like CAUSE(E, F). Theorists, in a metaphysical or scientific mode, can abstract general notions of causation and classify diverse processes as changes of state brought on by a triggering event. And perhaps this mode of cognition is more "natural" for humans than many other scientific/metaphysical modes of thought. But this hardly shows that our concept of pushing and our concept of pulling share a constituent concept of causing.

Perhaps we have prelexical concepts of killing and (transitive) boiling that share a constituent causal/mereological notion; and perhaps not. As noted earlier, it is *very* hard to discern even the basic adicity properties of concepts. And as Fodor suggests, even adults may not have a concept of killing whose applicability logically implies a death. But this point can be pushed too far. In the many cases where a transitive and intransitive verb share their phonology, it seems rash to adopt (the hypothesis that children adopt) *ambiguity* hypotheses—according to which the apparent entailments are semantically accidental—especially since the posited covert element in English is overt in many other languages; see Pietroski (2005) for a review of relevant facts, drawing heavily on Baker (1988, 200x) and Pesetsky (200x). Given the conception of lexicalization urged here, one can say that whatever prelinguistic concept gets lexicalized with 'boil', children *end up with* a lexical item that polysemously linked to analytically related concepts: ∃E'[TERMINATER(E, E') & BOIL(E')], which applies to processes in which something gets boiled; and BOIL(E), which applies to briefer events in which something (changes state and) boils.

In short, lexicalization may be an abstractive process that *adds* structured concepts to a child's repertoire. This makes it possible to explain both the ubiquity of one-way entailments in Languages, and the failure of traditional decomposition hypotheses according to which the concepts we humans *lexicalize* have component analyses in terms of simpler concepts. I return to this point in chapter three. But let me return now to the main thread of this chapter: Conjunctivism, according to which concatenation uniformly signifies conjunction of monadic predicates, is much more defensible than one might think.

1.4 A Different Picture (for Comparison)

Recall that Davidson (1967) would have analyzed (5) along the lines of (5a).

(5) Plum stabbed Green quickly

(5a) ∃e[PastStabbingOfBy(Plum, Green, e) & Quick(e)]

Spelling out the first conjunct conjunctively, in terms of relations like *Agent-of* and *Patient-of*, is not required in order to diagnose certain adverb-reductions as conjunction-reductions. There are reasons, noted below, for adopting "thematically elaborated" logical forms like (5b);

(5b) ∃e[Agent(e, Plum) & PastStab(e) & Patient(e, Green) & Quick(e)]

see Pietroski (2005) for a review. Though one can go this far, as Davidson (1985) did, without saying that the ampersands reflect *concatenation* of a semantically *monadic* predicate with two arguments. Perhaps (5b) reflects a thematically structured *lexical* meaning of a semantically *ternary* verb combined with two arguments. This is, however, one way of formulating the issue.

Do the ampersands directly reflect the significance of concatenation, as opposed to an interaction of lexical meaning and nonconjunctive concatenation? We can also ask why there is no verb 'quabbed' such that 'Plum quabbed Green' is true iff ∃e[Agent(e, Plum) v PastStab(e) v Patient(e, Green)]? And why is there no adverb 'glickly' such that 'Plum stabbed Green glickly' would be true iff ∃e[PastStabOfBy(Plum, Green, e) v Quick(e)]? Is this because supralexical concatenation signfies conjunction, or because only certain kinds of lexical meanings can enter into semantic composition—or both, or neither? An increasingly common view is that with regard to simple cases of adjunction, combining one predicate with another does indeed signify predicate-conjunction; see Heim and Kratzer (1998). The disagreements tend to be about cases of predicate-argument combination. But it is worth considering the pure "Functionist" hypothesis that concatenation in a human language always signifies function-application, as in a Fregean *Begriffsschrift*, and as suggested by various developments of Montague (1970, 1973).

Functionism is often illustrated by supposing that a verb like 'stabbed' indicates a binary function, λy.λx.Stabbed(x, y), that maps entities to functions from entities to truth values. In which case, $[\text{stabbed}_V\ \text{Green}_D]_V$ indicates the function λx.Stabbed(x, Green); and

$[\text{Plum}_D\ [\text{stabbed}_V\ \text{Green}_D]_V]$ indicates truth iff Stabbed(Plum, Green). But event variables can be added. Suppose that 'stabbed' indicates the ternary function λy.λx.λe.PastStabbingOfBy(e, x, y), which maps entities to functions from entities to *functions from events to* truth values. Then $[\text{Plum}_D\ [\text{stabbed}_V\ \text{Green}_D]_V]_V$ indicates λe.PastStabOfBy(e, Plum, Green), which maps events to truth values. This maintains a distinction between sentences, which involve some kind of existential closure, and semantically monadic V-phrases. And this makes room for a Functionist account of adverbs, given an ancillary hypotheses needed to deal with a certain complication.

Suppose that 'quickly' indicates λe.Quick(e), which maps events to truth values. Neither λe.Quick(e) nor λe.PastStab(e, Plum, Green) maps the other to truth. Indeed, neither function is likely to be in the domain of the other. So $[[\text{Plum}_D\ [\text{stabbed}_V\ \text{Green}_D]_V]_V\ \text{quickly}_A]_V$ presents a difficulty for Functionism, at least initially, much as $[\text{Plum}_D\ [\text{stabbed}_V\ \text{Green}_D]_V]_V$ initially presents a difficulty for Conjunctivism.[12] Likewise, if the adjective 'red' and noun 'ball' indicate functions from entities to truth values—λx.Red(x) and λx.Ball(x)—neither maps the other to truth. So the noun phrase $[\text{red}_A\ \text{ball}_N]_N$ presents a prima facie difficulty for Functionism. But there is a familiar remedy: when one predicate is adjoined to another, one predicate indicates a "higher-order" function than it does when appearing by itself as a main predicate.

This suggestion can be encoded in many ways. But to make explicit the parallel with Conjunctivist treatments of arguments, let's mark the subordinate status of 'red' in 'red ball' as follows: $[\text{red}_{A\uparrow}\ \text{ball}_N]_N$. The idea is to distinguish the lexical adjective red_A from the adjunct $\text{red}_{A\uparrow}$, which will indicate a higher-order function. Let '$\|\Sigma\|$' stand for the Functionist value of the expression Σ, ignoring assignment variability for simplicity. And consider the hypotheses below.

$\|\text{red}_A\| = \lambda x.\text{Red}(x)$ $\quad\quad$ $\|\text{ball}_N\| = \lambda x.\text{Ball}(x)$

$\|\Sigma_\uparrow\| = \lambda F.\lambda x.\|\Sigma\|(x)\ \&\ F(x)$ $\quad\quad$ $\|\text{quickly}_A\| = \lambda e.\text{Quick}(e)$

Given the relevant consequences for 'red' and 'quickly' as adjuncts,

$\|\text{red}_{A\uparrow}\| = \lambda F.\lambda x.\|\text{red}_A\|(x)\ \&\ F(x) = \lambda F.\lambda x.\text{Red}(x)\ \&\ F(x)$

$\|\text{quickly}_{A\uparrow}\| = \lambda F.\lambda e.\|\text{quickly}_A\|(x)\ \&\ F(x) = \lambda F.\lambda e.\text{Quick}(e)\ \&\ F(e)$

Functionists can get their desired results: $\|\text{red}_{A\uparrow}\|(\|\text{ball}_N\|) = \lambda x.\text{Red}(x)\ \&\ \text{Ball}(x)$; and $\|\text{quickly}_{A\uparrow}\|(\|[\text{Plum}_D\ [\text{stabbed}_V\ \text{Green}_D]_V]\|) = \lambda e.\ \text{Quick}(e)\ \&\ \text{PastStabOfBy}(e, \text{Plum}, \text{Green})$. So one can maintain that concatenation signifies function-application, even for cases of adjunction, by hypothesizing a certain "type-shifting" significance for the grammatical relation between an adjunct and the predicate it modifies.

One can similarly maintain that concatenation signifies conjunction, even for cases of predicate-argument combination, by hypothesizing a certain "prepositional" significance for the grammatical relation between an argument and the predicate it saturates. Neither view is *ad hoc* or intrinsically simpler than the other. Though for several reasons, I find adjunct-adjustment less plausible overall than argument-adjustment; see Pietroski (2005), drawing on many authors. Adjuncts are recursive in ways that arguments are not. We have independent reasons for saying that thematic roles are associated with predicate-argument relations. Functionists still have to explain why human languages never exhibit certain lexical meanings: λy.λx.λe.Agent(e, x) v PastStab(e) v Patient(e, y); λz.λy.λx.Stabbed-With(x, y, z); etc. And the idea that every predicate corresponds to a function, a *set* of some sort, creates difficulties (related to vagueness and Russell's paradox) that Conjunctivists can avoid. Other reasons are discussed below.

In any case, semanticists are free to *supplement* a simple claim about the significance of concatenation with a hypothesis about the further significance of certain grammatical relations. And since adjuncts differ semantically from arguments, some such supplementation is required, unless we simply encode the difference with distinct composition principles. Though many theorists do just this; see Higginbotham (1985), Larson and Segal (1995), Heim and Kratzer (1998). For example, given a basically Functionist idiom, one can adopt the following axioms.

$\|[\Sigma_{pred}\ \Sigma_{arg}]\| = \|\Sigma_{pred}\|(\|\Sigma_{arg}\|)$ $\|[\Sigma_{pred}\ \Sigma_{ad}]\| = \lambda x.\|\Sigma_{pred}\|(x)\ \&\ \|\Sigma_{ad}\|(x)$

But if one such composition principle has a conjunctive character, and there is empirical pressure to replace 'PastStabOfBy(x, y, e)' with 'PastStab(e) & Agent(e, x) & Patient(e, y)', simplicity suggests that we explore the possibility of making do with a Conjunctivist composition principle.

2. Plural Variables

In §1.1, I assumed that each index has exactly one value relative to each assignment: Val(e, *i*, **A**) iff e = **A***i*. In which case,Val(e, $[\text{stabbed}_V\ \text{it}_{D1\Theta}]_V$, **A**) iff PastStab(e, **A**) & Patient(e, **A**1). But what about 'them'? We can use (10) to say that Green stabbed certain demonstrated turnips.

(10) Green stabbed them

And we can use (11) to report that Green and Plum *together* stabbed six turnips,

(11) They stabbed six turnips

without implying that either stabber stabbed six. There are at least two ways of accommodating plural expressions, and the one I adopt is less familiar among linguists. So comment is required.

2.1 Assigning Values to Variables

One approach begins with idea that *the* value of a plural designator is a *plural* entity—an entity with other entities as *elements*; see, e.g., Scha (1981), Link (1983, 1998), Schwarzschild (1996). Some such view may be required if each assignment of values to variables assigns exactly one value to each variable. But we can reject this singularist conception of assignments/variables, and let an assignment assign value*s* to a plural variable; see Boolos (1984). Instead of associating 'them' with a set of turnips, and 'they' with the set {Plum, Green}, we can associate 'them' with each of the demonstrated turnips and 'they' with each of the people demonstrated. This conception of value-assignments is less familiar but important for the Conjunctivist account of quantification in section three. So let me say a little more about it here.

Suppose we have a domain with exactly five "basic" entities: a, b, c, d, and e. Then the thirty-two possibilities for "things demonstrated" are shown below, where the first and "empty" cell corresponds to cases of demonstrating nothing.

—	a	b	ba	c	ca	cb	cba
d	da	db	dba	dc	dca	dcb	dcba
e	ea	eb	eba	ec	eca	ecb	ecba
ed	eda	edb	edba	edc	edca	edcb	edcba

Such a diagram, suggesting a lattice, can be viewed as a representation of thirty-one (non-null) entities: five singletons, and twenty-six plural entities. The idea is that each of the plural entities, which has two or more singletons as elements, can be *the* value of a plural variable relative to an assignment. But other construals of the diagram are possible. Consider the twelfth cell, indicated with 'dba'. Instead of thinking in terms of assigning the set {d, b, a} as the sole value of a given variable, we can think in terms of assigning exactly three entities—d, b, and a—to that variable.

To highlight this contrast, it may help to use binary numerals instead of letters, with our five entities numbered as follows: a, 1; b, 10; c, 100; d, 1000; and e, 10000.

00000	00001	00010	00011	00100	00101	00110	00111
01000	01001	01010	**01011**	01100	01101	01110	01111
10000	10001	10010	10011	10100	10101	10110	10111
11000	11001	11010	11011	11100	11101	11110	11111

The twelfth cell is indicated in bold. The numeral '01011' designates a number that is the sum of three entity correlates: 01011 = 1000 + 10 + 1. But in terms of using the lattice as a model for plural variables in a Language, there are at least two ways of thinking about the relation of '01011' to the three entities. Plural-entity theorists can say that the arithmetic relation models a mereological relation that each potential value of a plural variable bears to certain potential values of singular variables. From this perspective, '01011' corresponds to a plural entity, x_{pl}, such that an entity y is an element of x_{pl} iff y is identical with d, b, or a. There is, however, another way of thinking about the lattice. We can read '01011' as five answers to yes/no ($\top/\bot$) questions about whether a given assignment assigns a certain entity, perhaps among others, to a given variable: (e, $\bot$), (d, $\top$), (c, $\bot$), (b, $\top$), and (a, $\top$). From this second perspective, lattice-cell numerals indicate the possibilities for assigning *one or more* values to a variable.

There is nothing especially puzzling about assigning more than one value to a variable. Assigning exactly one entity to a singular variable, like 'it', is akin to an act of demonstrating that entity and nothing else. But likewise, an act of demonstrating several things is akin to assigning more than one entity to a plural variable. *Given* a particular semantic theory, one might insist that what we call an act of demonstrating several things is really an act of demonstrating a plural thing that has elements. But prima facie, this is a technical idea in need of empirical support. And there is much to be said in favor of the hypothesis that Languages regularly employ plural variables, each of which can have many values relative to an assignment.[13]

To formulate such hypotheses, we need some appropriate notation. So let 'X', unlike 'x', be a metalanguage variable that can be assigned *one or more* values. Then '∃X[...X...]' is to be understood *a la* Boolos: there are one or more things, the Xs, such that *they* satisfy the condition [...X...]; where the plural condition may or may not be such that *they* satisfy it iff *each of them* satisfies a corresponding singular condition. (Foreshadowing: some things are turnips iff each of them is a turnip, since 'turnip' is a distributive predicate; though some turnips can form a circle, or form circles, even if no one of them forms any circle.) Correlatively, let 'Xx' mean that x is one of the Xs. Intuitively, 'Xx' says that it_x is one of $them_X$; where this does not *mean* that it_x is an element of it_X, with 'it_X' having exactly one collectionish value relative to each assignment.

In particular, '$\exists X[\forall x(Xx \equiv Fx)]$' means that there are one or more things such that for each thing, it is one of them iff it is an F; where this does not *mean* that there is a set such that each thing is an element of that set iff that thing is an F. Boolos-style (pluralist) construals of capitalized variables differ from plural-entity (singularist) construals, in ways made vivid by Russellian examples like '$\exists X[\forall x(Xx \equiv x \notin x)]$'. Given ZF set theory, there is no *set* such that each thing is an element of that set iff that thing is nonselfelemental; but there are one or more things such that for each thing, it is one of them iff it is nonselfelemental. Let me stress the point: interpreting 'X' as a plural variable, ranging over whatever 'x' ranges over, *differs* from interpreting 'X' as a singular variable ranging over sets of things that 'x' ranges over.

Given a familiar model, the Boolos interpretation makes '$\exists X[\forall x(Xx \equiv x \notin x)]$' true, while a singularist interpretation makes '$\exists X[\forall x(Xx \equiv x \notin x)]$' false. So the interpretations differ, just as intuition suggests. A set with elements is *one* thing, while its elements are many. Assigning such a set as *the value* of a variable differs from assigning its elements as *the values* of the variable. Since the interpretations differ, semanticists make a theoretical choice when they use capitalized variables and adopt one interpretation instead of the other. And like any theoretical choice, this one should be evaluated in light of available evidence. It is an empirical question which if either choice is better for purposes of providing theories of meaning for Languages.

On the Boolos interpretation, $\exists X[\forall x(Xx \equiv Fx)]$ iff $\exists xFx$. Indeed, this biconditional is a logical truism: there are one or more Fs iff there is an F. In this sense, merely introducing a variable that can have more than one value relative to an assignment introduces nothing new. By contrast, on tshe plural-entity interpretation, 'X' ranges over things with elements; and so '$\exists X[\forall x(Xx \equiv Fx)]$' is equivalent to '$\exists s\forall x[(x \in s) \equiv Fx]$', which implies the existence of a set, in a way that '$\exists xFx$' does not. So given the plural-entity interpretation, it is not a truism that $\exists X[\forall x(Xx \equiv Fx)]$ iff $\exists xFx$. Intuitively, the former interpretation is less ontologically loaded. And in any case, theorists are free to adopt this interpretation of the metalanguage in which they formulate theories, including theories variables in Languages. As Boolos (1998, p.72) puts it, "We need not construe second-order quantifiers as ranging over anything other than the objects over which our first-order quantifiers range...a second-order quantifier needn't be taken to be a kind of first-order quantifier in disguise, having items of a special kind, collections in its range."

Given this option, theorists can use capitalized variables (interpreted in the way Boolos suggests) to hypothesize that in Languages, a plural variable is a Boolos-variable that can have many values relative to each assignment of values to variables. In providing semantic theories for Languages, *we theorists* can employ a metalanguage with genuinely plural variables, whose values are all among the things we quantify over when we use singular quantification—instead of employing a metalanguage with variables, each of which can have only value per assignment.[14] We can then hypothesize that plural variables in Languages work the same way. This permits quantification over collections: one can posit sets without taking them to be the only values of plural variables. The issue here concerns semantic typology, not ontology.

Nonetheless, plural variables make a difference. In particular, they allow for essentially plural predicates. Some things can *together* satisfy an essentially plural predicate even if no one thing can satisfy the predicate. Boolos (1984) offers, among others, the example 'rained down'; some rocks can rain down even if no thing can. Schein (1993) offers 'clustered'; some elms can be clustered in the middle of the forest even if no single thing can be clustered anywhere. And unsurprisingly, 'plural' is a plural predicate *par excellence*. Given some things, they are sure to be plural in way that no thing can be. So we can introduce a pair of restricted quantifiers, '$\exists X$:Plural(X)' and '$\exists X$:¬Plural(X)'; where the latter is equivalent to '$\exists x$', and $\exists X$:Plural(X)[$\forall x$:Xx(Fx)] iff $\exists x\exists y[Fx \,\&\, Fy \,\&\, x \neq y]$. By contrast, $\exists X$:¬Plural(X)[$\forall x$:Xx(Fx)] iff one or more things *such they are not more than one* are such that each of them is an F. So if $\exists X$:Plural(X)[$\forall x$:Xx(Fx)], then $\exists X$:¬Plural(X)[$\forall x$:Xx(Fx)].

This makes room for Conjunctivist theories according to which: Val(X, them_{D1}, **A**) iff $\forall x[Xx \equiv$ Assigns(**A**, x, 1)] & Plural(X); where 'Assigns(**A**, x, 1)' means that **A** assigns x, perhaps along with one or more other things, to the first variable. The idea is that some things are (together) values of them_{D1} relative to **A** iff they are the thing*s* that **A** assigns to the first index.

2.2 Plural Arguments

It is also plausible that Val(X, turnip_N, **A**) iff $\forall x$:Xx[Turnip(x)]. This biconditional is compatible with a lexical specification like '$\forall x$[Val(x, turnip_N, **A**) iff Turnip(x)]', according to which: given anything_x, it_x is a value of 'turnip' iff it_x is a turnip. But we can equally well describe the meaning of 'turnip' as follows: given any one or more things_X, they_X are values of 'turnip' iff each_x of them_X is a turnip. Conjunctivism is easily recast in these terms. One or more things are values of the phrase [Σ Σ'] iff each concatenate is such that those things are values of it.

Val(E, [Σ Σ'], **A**) iff Val(E, Σ, **A**) & Val(E, Σ', **A**)

So we can handle 'six' and 'six turnips' as follows, bearing in mind that the 's' in 'turnips' may mark agreement (as in 'zero/1.5/no turnips'), as opposed to intuitive plurality.

$\text{Val}(X, \text{six}_A, \mathbf{A})$ iff $\text{Six}(X)$

$\text{Val}(X, [\text{six}_A \text{ turnips}_N]_N\ \mathbf{A})$ iff $\text{Six}(X)\ \&\ \forall x{:}Xx[\text{Val}(x, \text{turnip}_N, \mathbf{A})]$

Relative to any assignment, some things are values of 'six turnips' iff they are six *and* each of them is a turnip. We can represent the nondistributive character of six_A as above, taking the absence of distribution on the right of 'iff' to be significant. Or we can mark the essentially plural character of the predicate, as in '$\text{Val}(X, \text{six}_A, \mathbf{A})$ iff $\text{SIX}(X)$'. No fewer than six things can be six in this sense. No one thing, not even a six-membered thing, can be a value of 'six turnips'.

We can now return to 'stabbed them'. If stabbed_V is a distributive event predicate, unlike rained_V, we can say that some things are values of stabbed_V iff each of them was a stab.

$\text{Val}(E, \text{stabbed}_V, \mathbf{A})$ iff $\forall e{:}Ee[\text{Event}(e)\ \&\ \text{PastStab}(e, \mathbf{A})]$

Conjunctivism tells us what to say next.

$\text{Val}(E, [\text{stabbed}_V \text{ them}_{D1\Theta}]_V, \mathbf{A})$ iff

$\forall e{:}Ee[\text{Event}(e)\ \&\ \text{PastStab}(e, \mathbf{A})]\ \&\ \text{Val}(E, \text{them}_{D1\Theta}, \mathbf{A})$

One or more things are values of the V-phrase relative to **A** iff: each of them was a stab relative to **A**; and they satisfy the condition imposed by $\text{them}_{D1\Theta}$ relative to **A**. At this point, we must tweak the earlier (singularist) characterization of how '**Θ**' influences interpretation. But instead of saying that *the* value of $\text{them}_{D1\Theta}$ relative to **A** is *the* internal participant of *an* event, we can say that the value*s* of $\text{them}_{D1\Theta}$ relative to **A** *are* the internal participant*s* of one or more events. And we want to say this, not just to preserve Conjunctivism, but because it is independently plausible.

Prima facie, (10) does not require any one event to be a stabbing of all the demonstranda.

(10) Green stabbed them

Green may have stabbed one turnip in the kitchen at dawn, another in hall at noon, and a third in the library at dusk. A theorist, bent on maintaining a singularist conception of variables, might insist that the truth of (10) *does* require a single plural-event with at least one element per thing stabbed. But this technical idea stands in need of clarification, via explicit mereology, and empirical support. By contrast, let 'Internal(E, X)' mean that the Xs are the internal participants of the Es. This can be spelled out in terms of 'Internal(e, x)' and first-order quantifiers.

$\text{Internal}(E, X)$ iff $\forall e{:}Ee\{\exists x{:}Xx[\text{Internal}(e, x)]\}\ \&\ \forall x{:}Xx\{\exists e{:}Ee[\text{Internal}(e, x)]\}$

That is, the Xs are the internal participants of the Es iff: each E has an X as its internal participant, and each X is the internal participant of an E; or equivalently, no E has an internal participant that is not an X, and no X fails to be the internal participant of an E. Given this generalization of the singular 'Internal(e, x)', to allow for plural variables, we can generalize the earlier specification of the semantic role of '**Θ**'. In place of a singular biconditional,

$\text{Val}(e, \Sigma_\Theta, \mathbf{A})$ iff $\exists x[\text{Val}(x, \Sigma, \mathbf{A})\ \&\ \text{Internal}(e, x)]$

we can offer a potentially plural variant by capitalizing.

$\text{Val}(E, \Sigma_\Theta, \mathbf{A})$ iff $\exists X[\text{Val}(X, \Sigma, \mathbf{A})\ \&\ \text{Internal}(E, X)]$

If expression Σ has exactly one value relative to **A**, this is a purely formal distinction. But if

$\text{Val}(X, \text{them}_{D1}, \mathbf{A})$ iff $\forall x\{Xx \equiv \text{Assigns}(\mathbf{A}, x, 1)\}\ \&\ \text{Plural}(X)$

then given that $\text{Val}(E, \text{them}_{D1\Theta}, \mathbf{A})$ iff $\exists X[\text{Val}(X, \text{them}_{D1}, \mathbf{A})\ \&\ \text{Internal}(E, X)]$, we get the consequence noted below.

$\text{Val}(E, [\text{stabbed}_V \text{ them}_{D1\Theta}]_V, \mathbf{A})$ iff $\forall e{:}Ee[\text{Event}(e)\ \&\ \text{PastStab}(e, \mathbf{A})]\ \&$

$\exists X\{\forall x[Xx \equiv \text{Assigns}(\mathbf{A}, x, 1)]\ \&\ \text{Plural}(X)\ \&\ \text{Internal}(E, X)\}$

One or more events are values of 'stabbed them' relative to **A** iff those events are such that: each of them was a stab (relative to **A**), and their internal participants were the things assigned by **A** to the plural variable. The condition imposed by stabbed_V is distributive, while the condition imposed by $\text{them}_{D1\Theta}$ is not. But this is compatible with Conjunctivism, which imposes no conditions apart from conjoinability on the conditions imposed by each concatenate. If it aids comprehension, '$\exists X\{\forall x[Xx \equiv \text{Assigns}(\mathbf{A}, x, 1)] \;\&\; \text{Plural}(X) \;\&\; \text{Internal}(E, X)\}$' can be replaced with '$\iota X{:}\text{Assigns}(\mathbf{A}, X, 1)[\text{Plural}(X) \;\&\; \text{Internal}(E, X)]$', using a potentially plural descriptor. But the idea, however encoded, is that one or more Es are values of the plural variable $\text{them}_{D1\Theta}$ iff the things assigned to the variable are the internal participants of those Es.[15]

Similarly, given the following biconditional,

$$\text{Val}(E, \Sigma_{\underline{\Theta}}, \mathbf{A}) \text{ iff } \exists X[\text{Val}(X, \Sigma, \mathbf{A}) \;\&\; \text{External}(E, X)]$$

we get the desired result for plural demonstrative subjects of transitive verbs.

$$\begin{aligned}&\text{Val}(E, [\text{They}_{D2\underline{\Theta}}\ [\text{stabbed}_V\ \text{them}_{D1\Theta}]_V]_V, \mathbf{A}) \text{ iff}\\ &\quad \iota X{:}\text{Assigns}(\mathbf{A}, X, 2)[\text{Plural}(X) \;\&\; \text{External}(E, X)] \;\&\\ &\quad\quad \forall e{:}Ee[\text{Event}(e) \;\&\; \text{PastStab}(e, \mathbf{A})] \;\&\\ &\quad \iota X{:}\text{Assigns}(\mathbf{A}, X, 1)[\text{Plural}(X) \;\&\; \text{Internal}(E, X)]\end{aligned}$$

This does not require that each value of the V-phrase be a composite thing, with events as parts, that has a plural-entity as its sole Agent and a plural-entity as its sole Patient. It says that one or more event*s*, which may have occurred at disparate times and places, are value*s* of the V-phrase relative to assignment **A** iff those events satisfy three conditions: their External participants (Agents) are the things that **A** assigns to the second variable; each of them was a stab; and their Internal participants (Patients) are the things that **A** assigns to the first variable.

It is significant, in this context, that collective readings do not imply cooperation; see Gillon (1987), Davies (1989), Higginbotham and Schein (1989), Schein (1993). If five professors wrote six papers, it may be that the five worked as a team to get six papers written. But each professor may have acted alone, with one author writing two papers. Or there may have been "semi-cooperation." Perhaps McKay and McBee coauthored three papers, and their rivals wrote the other three. Or perhaps Brown, Jones, and Smith wrote one paper, Jones, Smith and McKay wrote another, and so on. There are many ways for 'Five Xs wrote six Ys' to be true on a collective reading, even given the Xs and Ys, without *any* cooperative event involving all the Xs and Ys. This semantic indifference to cooperation is captured, easily and naturally, with a Conjunctivist theory that employs plural variables; cf. Gillon (1987).

On such a view, '$\exists E[\ldots E\ldots]$' means that *one or more* thing*s* are such that *they* satisfy the (perhaps complex) condition imposed. This should come as no surprise. As Ramsey (1927) noted, a sentence like 'Plum stabbed Green' implies *at least one* stabbing of Green by Plum, with no further semantic commitment concerning the number of stabbings; see also Taylor (1985) on 'gracefully ate the crisps'. And $[\text{stabbed}_V\ [\text{six}_A\ \text{turnips}_N]_{N\Theta}]_V$ poses no special difficulties, assuming that $\text{Val}(E, \Sigma_\Theta, \mathbf{A})$ iff $\exists X[\text{Val}(X, \Sigma, \mathbf{A}) \;\&\; \text{Internal}(E, X)]$.

$$\begin{aligned}&\text{Val}(E, [\text{six}_A\ \text{turnips}_N]_{N\Theta}, \mathbf{A}) \text{ iff } \exists X[\text{SIX}(X) \;\&\; \forall x{:}Xx[\text{Turnip}(x)] \;\&\; \text{Internal}(E, X)]\\ &\text{Val}(E, [\text{stabbed}_V\ [\text{six}_A\ \text{turnips}_N]_{N\Theta}]_V, \mathbf{A}) \text{ iff } \forall e{:}Ee[\text{Event}(e) \;\&\; \text{PastStab}(e, \mathbf{A})] \;\&\\ &\quad\quad \exists X[\text{SIX}(X) \;\&\; \forall x{:}Xx[\text{Turnip}(x)] \;\&\; \text{Internal}(E, X)]\end{aligned}$$

Relative to any assignment, some things are values of 'stabbed six turnips' iff: each of those things was a stab, and six turnips were the internal participants (Patients) of those things.

This captures the collective reading of (11).

(11) They stabbed six turnips

The demonstranda were the Agents of some events, each a stabbing, whose Patients were six turnips. The eventish entailments and nonentailments of (12) can also be captured,

(12) They stabbed six turnips with three knives on Monday

without saying that (14) implies *an* event with the following remarkable properties: its Agent was a plural entity whose elements were the demonstrated individuals; it was composed of some stabs; its Patient was a collection of six turnips; it was done with a collection of three knives; and it occurred (perhaps in a scattered fashion) on the relevant day. We also get, without hard work, the result that some things are values of 'stabbed turnips' iff: each of those things was a stab, and (some) turnips were the Patients of those things.[16]

So far, so good. But what about distributive readings of (11) and (12), according to which each of the demonstrated individuals stabbed six turnips? And what about the singular (13)?

(13) Plum stabbed every turnip

While this might seem to halt the Conjunctivist train, we already have the apparatus needed to analyze 'every' and 'every turnip' as monadic predicates conjoinable with others.

3. Quantifiers as Plural Predicates

In section one, I noted that things other than events can have internal and external participants, and that sentential connectives like 'or' can be treated as predicates satisfied by ordered pairs of truth values. In section two, I discussed the value of plural predicates and assignments that assign more than one value to a variable. In this section, I show how to combine these basic points in a less obvious way. Determiners can be treated as plural predicates satisfied by ordered pairs, each of which associates an entity with a truth value. In this sense, determiners can be treated as predicates of things that have internal and external participants, corresponding to the internal and external arguments of determiners. This does not require the claim that determiners indicate relations between sets. On the contrary, the proposal is that determiners do *not* indicate such relations. Rather, determiners are satisfied by pairs of the form <e, ⊤> and <e, ⊥>. This simple idea, to which Conjunctivists are more or less driven, leads to an attractive account of some otherwise puzzling features of determiners.

3.1 Frege-Pairs as Values of Determiners

Suppose the grammatical structure of (13) is as shown in (13G), ignoring for a moment the internal structure of the quantificational phrase.

(13G) $\langle[[\text{every turnip}]_1\ \langle \text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ t_{1\Theta}]_V]_V\rangle]\rangle$

Let me stress three aspects of this common hypothesis, which posits unsignaled transformations: 'every turnip' is displaced from its original position, as the internal argument of the verb, leaving an indexed trace; it recombines with the "open" sentence created by the displacement; and the resulting combination is a sentence.[17] Now let me elaborate (13G), indicating that 'every' is a determiner that takes a (singular) noun as its internal argument, and an open sentence as its external argument. And this time, let's ignore the internal structure of the embedded sentence.

(13G+) $\langle[[\text{every}_D\ \text{turnip}_{N\Delta}]_{D1}\ \langle \text{Plum stabbed } t_1\rangle_{\underline{\Delta}}]_D\rangle$

Arguments of 'every' are marked with 'Δ'/'$\underline{\Delta}$', instead of 'Θ'/'$\underline{\Theta}$', so as to not prejudge whether *being an argument of a determiner* differs semantically from *being an argument of a verb.*

Conjunctivism implies that relative to any assignment **A**, (13G+) gets the value ⊤ iff one or more things are such that they are values of both major constituents.

$$\exists E\{\text{Val}(E, [\text{every}_D\ \text{turnip}_{N\Delta}]_{D1}, \mathbf{A})\ \&\ \text{Val}(E, \langle \text{Plum stabbed } t_1\rangle_{\underline{\Delta}}, \mathbf{A})\}$$

But despite initial appearances, this specification of what (13) means has a perfectly coherent gloss that turns out to be theoretically attractive. The variable 'E', which can range over ordered pairs, can range over things of the form <⊤, e> and <⊥, e>; where e is any entity that could be the value of a (singular) variable like 't_1'. If Green and Plum are such entities, we have the ordered pairs $<\top, \text{Green}>$, $<\bot, \text{Green}>$, $<\top, \text{Plum}>$, and $<\bot, \text{Plum}>$; and given a potential value **A**1 of the variable 't_1', we have $<\top, \mathbf{A}1>$ and $<\bot, \mathbf{A}1>$. Call these abstracta, each of which has an entity as its internal participant and a sentential value as its external participant, *Frege-Pairs*.

We appealed to Frege-Pairs, in effect, by construing '01011' as a way of answering five questions about whether or not a certain entity was assigned, perhaps along with other entities, to a given variable. My suggestion now is that determiners are plural predicates satisfiable by Frege-Pairs. Initially, this might seem strange. But assuming at least one turnip, (13) is true iff there are some Frege-Pairs$_E$ such that: each of them$_E$ has $\top$ as its external participant; the turnips are their$_E$ internal participants; and each of them$_E$ has $\top$ as its external participant iff Plum stabbed its internal participant. We can encode this biconditional fact more formally.

$$\text{Val}(\top, \langle[[\text{every}_D\ \text{turnip}_{N\Delta}]_{D1}\ \langle\text{Plum stabbed}\ t_1\rangle_{\underline{\Delta}}]_D\rangle, \mathbf{A}) \text{ iff}$$
$$\exists E\{\forall e{:}Ee[\text{External}(e, \top)]\ \&\ \exists X{:}\forall x[Xx \equiv \text{Turnip}(x)]\{\text{Internal}(E, X)\}\ \&$$
$$\forall e{:}Ee\{\text{External}(e, \top) \equiv \exists x{:}\text{Internal}(e, x)[\text{Plum stabbed } x]\}\}$$

We can also adopt the following lexical specification for 'every',

$$\text{Val}(E, \text{every}_D, \mathbf{A}) \text{ iff } \forall e{:}Ee[\text{Frege-Pair}(e)\ \&\ \text{External}(e, \top)]$$

On this view, one or more things are values of 'every' iff each of them is of the form $<\top, x>$.

So *if* the two biconditionals below are consequences of plausible semantic principles,

$$\text{Val}(E, \text{turnip}_{N\Delta}, \mathbf{A}) \text{ iff } \exists X{:}\forall x[Xx \equiv \text{Turnip}(x)]\{\text{Internal}(E, X)\}$$
$$\text{Val}(E, \langle\text{Plum stabbed}\ t_1\rangle_{\underline{\Delta}}, \mathbf{A}) \text{ iff}$$
$$\forall e{:}Ee\{\text{External}(e, \top) \equiv \exists x{:}\text{Internal}(e, x)[\text{Plum stabbed } x]\}$$

then Conjunctivists can handle (13), by treating determiners and their arguments as conjoinable predicates that impose (plural) conditions on Frege-Pairs. In Pietroski (2005), I argue that such biconditionals do follow from independently plausible principles. Here, I present the gist.

In $\langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{it}_{D1\Theta}]_V]_V\rangle$, neither noun is marked as plural. We can specify values for singular arguments in various ways. But for present purposes, consider the following clauses.

$$\text{Val}(X, \text{Plum}_D, \mathbf{A}) \text{ iff } \forall x[Xx \equiv (x = \text{Plum})]$$
$$\text{Val}(X, \text{it}_{D1}, \mathbf{A}) \text{ iff } \forall x\{Xx \equiv \text{Assigns}(\mathbf{A}, x, 1)\}\ \&\ \neg\text{Plural}(X)$$

The corresponding result for $\langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{it}_{1\Theta}]_V]_V\rangle$ is below.

$$\text{Val}(\top, \langle[\text{Plum}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \text{it}_{1\Theta}]_V]_V\rangle, \mathbf{A}) \text{ iff}$$
$$\exists E\ \langle\exists X\{\forall x[Xx \equiv (x = \text{Plum})]\ \&\ \text{External}(E, X)\}\ \&\ \text{Val}(E, \text{stabbed}_V, \mathbf{A})\ \&$$
$$\exists X\{\forall x[Xx \equiv \text{Assigns}(\mathbf{A}, x, 1)]\ \&\ \neg\text{Plural}(X)\ \&\ \text{Internal}(E, X)\}\rangle$$

And this can be simplified, by letting '**A**1' signify *the* thing that **A** assigns to the first variable.

$$\text{Val}(\top, \langle\text{Plum stabbed it}_1\rangle, \mathbf{A}) \text{ iff Plum stabbed } \mathbf{A}1.$$

Assuming that traces of displaced D-phrases are relevantly like singular demonstratives,

$$\text{Val}(X, t_1, \mathbf{A}) \text{ iff } \forall x[Xx \equiv \text{Assigns}(\mathbf{A}, x, 1)]\ \&\ \neg\text{Plural}(X)$$

we get a similar result: $\text{Val}(\top, \langle\text{Plum stabbed } t_1\rangle, \mathbf{A})$ iff Plum stabbed **A**1.

As expected, the open *sentence* has a *sentential* value ($\top$ or $\bot$) relative to any assignment of a value to the variable. Given any assignment **A**, Tarski (1933) showed us how to think about a variant assignment **A'**—just like **A** except perhaps with regard to what **A** assigns to a certain index, say '1'—and the value of the open sentence relative to **A'**. A familiar move, at this point, is to introduce some trick for *reconstruing* the open sentence: as a predicate whose values are entities, like people and turnips; or as an abstract predicate whose values are sets.[18] As we'll see, Functionist reconstrual of the open sentence turns out to be unneeded and unwanted. But first, let's be clear that we *can* capture the relation between determiners and Frege-Pairs directly, without sets as intermediaries.

In [[every$_D$ turnip$_{N\Delta}$]$_{D1}$ $\langle$Plum stabbed $t_1\rangle_{\underline{\Delta}}$]$_D$, the open sentence is the external argument, while the noun is the internal argument of the determiner. Correspondingly, the external participant of a Frege-Pair is $\top$ or $\bot$, while the internal participant is an entity. With this in mind, consider again the three proposed biconditionals.

$$\text{Val}(E, \text{every}_D, \mathbf{A}) \text{ iff } \forall e{:}Ee[\text{Frege-Pair}(e) \;\&\; \text{External}(e, \top)]$$
$$\text{Val}(E, \text{turnip}_{N\Delta}, \mathbf{A}) \text{ iff } \exists X{:}\forall x[Xx \equiv \text{Turnip}(x)]\{\text{Internal}(E, X)\}$$
$$\text{Val}(E, \langle\text{Plum stabbed } t_1\rangle_{\underline{\Delta}}, \mathbf{A}) \text{ iff}$$
$$\forall e{:}Ee\{\text{External}(e, \top) \equiv \exists x{:}\text{Internal}(e, x)[\text{Plum stabbed } x]\}$$

Behind this formalism is a simple idea. Start with the turnips, and pair each with $\top$ or $\bot$. There will be many ways of doing this, since each turnip can be associated with either sentential value. (In the case at hand, each turnip might or might not have been stabbed by Plum.) Given any Frege-Pairs$_E$ that associate all and only the turnips with sentential values, they$_E$ are (nondistributively) values of turnip$_{N\Delta}$. Suppose there are exactly five turnips: a, b, c, d, e. Then three ways of associating the turnips with $\top$ or $\bot$ are indicated below.

$<\top, a>$ $<\top, b>$ $<\bot, c>$ $<\top, d>$ $<\bot, e>$
$<\bot, a>$ $<\bot, b>$ $<\top, c>$ $<\bot, d>$ $<\top, e>$
$<\top, a>$ $<\top, b>$ $<\top, c>$ $<\top, d>$ $<\top, e>$

The first five Frege-Pairs are (together) values of turnip$_{N\Delta}$, as are the next five, and the next five. But of these, only the last five Frege-Pairs are values of every$_D$.

There are many other ways of satisfying the condition imposed by every$_D$.

$<\top, a>$ $<\top, c>$ $<\top, e>$
$<\top, f>$
$<\top, a>$ $<\top, b>$ $<\top, d>$ $<\top, f>$ $<\top, g>$

But none of these are choices of Frege-Pairs that are also values of turnip$_{N\Delta}$. One or more things are values of turnip$_{N\Delta}$ iff they pair *all and only* the turnips with $\top$ or $\bot$. While turnip$_{N\Delta}$ doesn't care about which value a given turnip is paired with, turnip$_{N\Delta}$ does require that no turnip be omitted, and that no nonturnip be included. (This is what one expects the restrictor in a restricted quantifier to do.) By contrast, every$_D$ doesn't care about which entities are paired with values; it simply imposes the condition that each entity be paired with $\top$. The phrase [every$_D$ turnip$_{N\Delta}$] cares about *both* dimensions of Frege-Pairs. In our example, one or more things are values of this conjunctive predicate iff they are the following: $<\top, a>$, $<\top, b>$, $<\top, c>$, $<\top, d>$, and $<\top, e>$.

With regard to $\langle$Plum stabbed $t_1\rangle_{\underline{\Delta}}$, the idea is that this open-sentence-as-marked-by-a-D doesn't care about either dimension of Frege-Pairs *per se*. Rather, it imposes a condition on how entities can be paired with sentential values. More specifically, each value of $\langle$Plum stabbed $t_1\rangle_{\underline{\Delta}}$ conforms to the condition imposed by the open sentence: $\top$ iff Plum stabbed the entity in question; where for each Frege-Pair, the entity in question is its internal participant. (What else?) Many choices of turnipless Frege-Pairs are sure to be choices of Frege-Pairs that meet this requirement. Plum stabbed Green, or he didn't. So either $<\top$, Green$>$ or $<\bot$, Green$>$ is, all by itself, a value of $\langle$Plum stabbed $t_1\rangle_{\underline{\Delta}}$. And if Plum stabbed Green, but not Scarlet or White, then $<\top$, Green$>$ and $<\bot$, Scarlet$>$ and $<\bot$, White$>$ are together values of $\langle$Plum stabbed $t_1\rangle_{\underline{\Delta}}$. But the values of [every$_D$ turnip$_{N\Delta}$] are together values of $\langle$Plum stabbed $t_1\rangle_{\underline{\Delta}}$ iff Plum stabbed each turnip.

So we want to preserve the content, if not the form, of the corresponding biconditional.

$$\text{Val}(E, \langle\text{Plum stabbed } t_1\rangle_{\underline{\Delta}}, \mathbf{A}) \text{ iff}$$
$$\forall e{:}Ee\{\text{External}(e, \top) \equiv \exists x{:}\text{Internal}(e, x)[\text{Plum stabbed } x]\}$$

Given a variable and any assignment **A**, each Frege-Pair can be viewed as a recipe for creating a Tarski-variant **A'**: given <⊤, x> or <⊥, x>, replace whatever **A** assigns to the variable with x; see Pietroski (2005). So we can rewrite '∃x:Internal(e, x)[Plum stabbed x]' as follows.

$\exists\mathbf{A'}{:}\mathbf{A'} \approx_1 \mathbf{A}$[Internal(e, **A'1**) & Plum stabbed **A'1**]

And by replacing '<u>Δ</u>' with 'Δ*i*', where *i* is the index of the relevant determiner phrase, we can formulate a general principle; cf. Heim and Kratzer (1998).

for any index *i*, Val(E, $\langle \ldots \rangle_{\Delta i}$, **A**) iff

∀e:Ee{External(e, ⊤) ≡ $\exists\mathbf{A'}{:}\mathbf{A'} \approx_i \mathbf{A}$[Internal(e, **A'*i***) & Val(⊤, ⟨ ... ⟩, **A'**)]}

Given that the Es are Frege-Pairs, each of which has an internal element that *is* the thing assigned to the *i*th variable by some *i*-variant of **A**, we can rewrite the condition above.

for any index *i*, Val(E, $\langle \ldots \rangle_{\Delta i}$, **A**) iff

∀e:Ee{External(e, ⊤) ≡ $\exists\mathbf{A'}{:}\mathbf{A'} \approx_{e/i} \mathbf{A}$[Val(⊤, ⟨ ... ⟩, **A'**)]

Indeed, this may be a way of justifying appeal to Tarski-variants in a semantics for Languages governed by a Conjunctivist semantics. And however we encode such appeal, it provides the standard apparatus for accommodating cases involving multiple quantifiers, as in 'Most professors stabbed six turnips'; see Pietroski (2005). But here, I'll suppress these details, which reveal nothing new about a Conjunctivist semantics.

Ideally, one would like a still simpler general principle for external arguments of determiners. But the one below is too simple.

Val(E, $\langle \ldots \rangle_{\Delta i}$, **A**) iff ∃X[Val(X, ⟨ ... ⟩, **A**) & External(E, X)]

Drawing *no* distinction between 'Δ*i*' and '<u>Θ</u>' yields an unwanted result: relative to any assignment **A**, each value of $\langle\text{Plum stabbed } t_1\rangle_{\Delta 1}$ would have the *same* external participant (⊤ or ⊥), depending on whether or not Plum stabbed **A**1. But the Δ*i*/<u>Θ</u> distinction is due to indices, interpreted in terms of assignment-variants, which seem to be indispensible on any account of quantification. And my point is that the Tarskian tools, which do not require Functionism, are compatible with Conjunctivism—*not* that such tools are dispensible. We can, however, rewrite once more, since each Frege-Pair has ⊤ or ⊥ as its external participant.

Val(E, $\langle \ldots \rangle_{\Delta i}$, **A**) iff ∀e:Ee{External(e, $\exists\mathbf{A'}{:}\mathbf{A'} \approx_{e/i} \mathbf{A}$[Val(⊤, ⟨ ... ⟩, **A'**)])}

This says that one or more things_E are values of $\langle \ldots \rangle_{\Delta i}$ relative to **A** iff each_e of them_E is such that its_e external participant is (⊤ iff ⊤ is) the value of ⟨ ... ⟩ relative to the variant of **A** that replaces **A*i*** with its_e entity. This hypothesis about 'Δ_i'—or more precisely, about the significance of being an indexed argument of a determiner—is no more complex or *ad hoc* than extant alternatives.

The biconditional for $\text{turnip}_{N\Delta}$

Val(E, $\text{turnip}_{N\Delta}$, **A**) iff ∃X{∀x[Xx ≡ Turnip(x)] & Internal(E, X)}

suggests a hypothesis about 'Δ', the mark of a determiner's internal argument.

Val(E, Σ_Δ, **A**) iff ∃X{∀x[Xx ≡ Val(x, Σ, **A**)] & Internal(E, X)}

Relative to any assignment **A**, one or more things_E are values of Σ as Δ-marked iff (all and only) the values of Σ are (together) the internal participants of those_E things. The treatment of 'Θ'

Val(E, Σ_Θ, **A**) iff ∃X[Val(X, Σ, **A**) & Internal(E, X)]

was a little different. But this matters only for internal arguments like the bare plural 'turnips', with no independent element (like the index on $\text{them}_{\Theta 1}$) requiring that *all* values of the unmarked expression be internal participants of the relevant Es. So if the internal argument is somehow indexed, or otherwise forces "maximization," the Δ/Θ distinction is eliminable. In any case, the Conjunctivist hypothesis is natural enough: *the* turnips, and not merely some turnips, are the relevant internal participants when 'turnip' is the internal argument of a determiner.

Extending the proposal to other determiners, like 'some' and 'no', is easy.

$Val(E, some_D, \mathbf{A})$ iff $\forall e{:}Ee[\text{Frege-Pair}(e)]$ & $\exists e{:}Ee[\text{Internal}(e, \top)]$

$Val(E, no_D, \mathbf{A})$ iff $\forall e{:}Ee[\text{Frege-Pair}(e)]$ & $\neg\exists e{:}Ee[\text{Internal}(e, \top)]$

But even for 'most', recasting a generalized quantifier treatment is straightforward.

$Val(E, most_D, \mathbf{A})$ iff $\forall e{:}Ee[\text{Frege-Pair}(e)]$ & $\exists T\exists F\{\text{Outnumber}(T, F)$ & $\forall e[Te \equiv Ee$ & $\text{External}(e, \top)]$ & $\forall e[Fe \equiv Ee$ & $\text{External}(e, \bot)]\}$

It remains true that 'every', 'some', and 'no' are firstorderizable in a way that 'most' is not. But one can describe 'most' as a monadic predicate of Frege-Pairs, conjoinable with others, even if the condition imposed by this predicate is essentially second-order and nondistributive; see Pietroski (2005).[19] If numerals like 'six' can appear as displaced determiners, as in $\langle[[six_D\ turnips_{N\Delta}]_{D1}\ \langle Plum\ stabbed\ t_1\rangle_{\underline{\Delta}}]_D\rangle$, Conjunctivists can adopt corresponding proposals.

$Val(E, six_D, \mathbf{A})$ iff

$\forall e{:}Ee[\text{Frege-Pair}(e)]$ & $\exists E\{\text{Six}(E)$ & $\forall e[Ee \equiv Ee$ & $\text{External}(e, \top)]\}$

This captures a distributional reading of 'They stabbed six turnips', even though 'Six(E)' is an essentially plural predicate.

3.2 Quantifiers and Relative Clauses

In the rest of this section, I contrast this Conjunctivist treatment of determiners with the more familiar idea that determiners indicate (second-order) *relations* between monadic predicates, or *dyadic* functions of type <<e, **t**>, <<e, **t**>, **t**>>. From this Fregean perspective, developed by many theorists, a determiner indicates a relation that can be exhibited by (the extensions of) two predicates of type <e, **t**>. For example, one might say that in 'Every ball is red', 'every' indicates the subset relation. But such accounts face unpleasant questions that Conjunctivists can avoid.

Assuming that quantifiers raise, why does the external argument of a determiner seem to be *sentential*? And if the apparently sentential clause is understood as a complex expression of type <e, **t**>, like a relative clause, why can't the external argument of a determiner be such a clause? Note that 'Every tyrant who Brutus stabbed' has no reading according to which it is a complete sentence with any meaning like the following: every tyrant is such that Brutus stabbed him; every tyrant is one who Brutus stabbed; Brutus stabbed every tyrant. This is surprising if the external argument of 'every' is relevant like 'who Brutus stabbed'. Moreover, if determiners indicate *relations* between monadic predicates, why are these relations always conservative/intersective in the sense of Barwise and Cooper (1981), Higginbotham and May (1981)? I defer this last question to §3.3, and focus here on a simple thought: relative clauses are indeed of type <e, **t**>, but the external arguments of determiners are of type <**t**>; and we don't want a semantic theory that eviscerates this distinction by stipulating that external arguments of determiners are understood as expressions of the same type as relative clauses.

Since I have not yet offered an explicit treatment of relativization, in terms compatible with Conjunctivism, let me do so now. The idea is simple, Tarskian, and exploited in every treatment of relative clauses that I know of: an open sentence S, whose value is ⊤ or ⊥ relative to any assignment of values to variables, is converted into a monadic predicate that is satisfied by an entity e iff S has the value ⊤ when e is the value of the relevant variable. The details can be encoded in various ways. But let's suppose, pretty standardly, that the grammatical structure of 'tyrant who Brutus stabbed' is as follows.

$$[tyrant_N\ [who_{D1}\ [\varnothing_C\ \langle[Brutus_{D\underline{\Theta}}\ [stabbed_V\ \ t_{1\Theta}]_V]_V\rangle]_C]_C]_N$$

On this view, the indexed wh-expression has been displaced to the edge of a complementizer phrase (*cp*. 'the which that Brutus did stab') that combines with the noun. The displacement creates an open sentence, $\langle[\text{Brutus}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \ t_{1\Theta}]_V]_V\rangle$, whose value is $\top$ relative to any assignment **A** iff ∃e[Agent(e, Brutus) & PastStab(e) & Patient(e, **A1**)]. At this point, the usual strategy is to treat the covert complementizer as inert, and say that the indexed wh-expression is associated with an operation of lambda extraction: an assignment-relative specification of a truth value, ∃e[Agent(e, Brutus) & PastStab(e) & Patient(e, **A1**)], is mapped to an assignment-invariant function of type <e, **t**>, λx.∃e[Agent(e, Brutus) & PastStab(e) & Patient(e, x)]. But the appeal to functions and lambda abstraction is not essential. Indeed, it seems like overkill, given the appeal to assignment-relative specifications of truth values. A "pluralist Tarskian" option is available.

Consider the following principle,

$$\text{Val}(E, [\varnothing_C \langle ...\rangle], \mathbf{A}) \equiv \text{Val}(\top, \langle ...\rangle, \mathbf{A})$$

according to which some things are values of the complementizer phrase relative to **A** iff the embedded sentence is true relative to **A**. This just says that when a sentence is relativized, the resulting complementizer phrase is satisfied by everything or nothing, depending on whether or not the embedded sentence is true. This can be regarded as a syncategorematic axiom. Or it can be regarded as a kind of paratactic analysis of the covert determiner.[20]

for any phrase of the form $[\varnothing_C \langle ...\rangle]$,

$$\text{Val}(E, [\varnothing_C \langle ...\rangle], \mathbf{A}) \equiv \text{Val}(E, \varnothing_C, \mathbf{A}), \text{ and } \text{Val}(E, \varnothing_C, \mathbf{A}) \equiv \text{Val}(\top, \langle ...\rangle, \mathbf{A})$$

Either way, we get the following result.

$$\text{Val}(E, [\varnothing_C \langle[\text{Brutus}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \ t_{1\Theta}]_V]_V\rangle], \mathbf{A}) \equiv$$
$$\text{Val}(\top, \langle[\text{Brutus}_{D\underline{\Theta}}\ [\text{stabbed}_V\ \ t_{1\Theta}]_V]_V\rangle, \mathbf{A})$$

Relative to any assignment **A**, the complementizer phrase is satisfied by everything or nothing, depending on whether or not Brutus stabbed **A1**. For simplicity, assume that the relativizing pronoun is singular, and hence that Val(e, who_{D1}, **A**) iff e = **A1**. In which case, relative to any assignment **A**: if the embedded sentence is true, then e is value of *both* the complementizer phrase *and* the relativizing pronoun iff e = **A1**; and if the embedded sentence is true, then *nothing* is value of both the complementizer phrase and the relativizing pronoun.[21] So the desired analysis of the relativizing pronoun is obvious.

$$\text{Val}(E, [\text{who}_{Di}\ \ ..._C], \mathbf{A}) \equiv \text{for some } \mathbf{A'} \approx_i \mathbf{A}, \text{Val}(E, ..._C, \mathbf{A'})$$

This has the same effect as lambda abstraction. And this should come as no surprise. For while one can accommodate the linguistic facts by appeal to lambda abstraction, doing so requires appeal to assignment-variants. One way or another, an assignment-relative specification of a truth value gets mapped to an assignment-invariant function of type <e, **t**>, as indicated below.

$$\exists e[\text{Agent}(e, \text{Brutus}) \ \&\ \text{PastStab}(e) \ \&\ \text{Patient}(e, \mathbf{A1})]$$
$$\lambda x.\text{for some } \mathbf{A'} \approx_1 \mathbf{A}, \exists e[\text{Agent}(e, \text{Brutus}) \ \&\ \text{PastStab}(e) \ \&\ \text{Patient}(e, \mathbf{A'1})]$$

So the question is not whether we need appeal to assignment variants. On any extant account, we do.[22] But if relativizing pronouns combine with complementizer phrases, which can be viewed as predicates that apply either to nothing or to the value(s) of the relevant variable, then appeal to assignment-variants is *enough* to handle the semantics of relative clauses in conjunctivist terms. Appeal to lambda abstraction lets us encode such appeal in a way that identifies the meaning of a relative clause with a function of type <e, **t**>. But if relative clauses are adjuncts that combine conjunctively with nouns, and not even determiners have to be treated as function-indicators, it is not obvious that Functionism should be preserved. On the contrary, if the relative clause 'who Brutus stabbed' is satisfied by e iff Brutus stabbed e, then 'tyrant who Brutus stabbed' becomes a paradigm case for Conjunctivists.

Moreover, Conjunctivists can readily *distinguish* relative clauses from the open-sentence arguments of determiners. The former are predicates of entities like Caesar; and such predicates, created by displacing a relativizing pronoun, can appear as adjuncts to nouns. The latter are assignment-relative predicates of truth values, $\top$ or $\bot$, created by displacing a determiner that takes the resulting open sentence as its external argument. From this perspective, it is no surprise that external arguments of determiners like 'every' seem to be sentential; they *are* sentential. Likewise, it is no surprise that determiners cannot take relative clauses as external arguments. If the external arguments of determiners are predicates of truth values—satisfied by $\top$ or $\bot$, then relative clauses are not predicates of the right type to be external arguments of determiners

By invoking unnecessary formal apparatus, one *can* hypothesize that relative clauses and external arguments of determiners are semantically alike, despite evidence to the contrary. For one can say that displacement of relativizing pronouns *and* determiners triggers an operation of lambda extraction, which converts open sentences into expressions that indicate functions of type <e, **t**>. But prima facie, this hypothesis is motivated more by commitment to Functionism than to the need or desirability of providing such analyses of relativizing pronouns and determiners.

3.3 Explaining Conservativity

Let me turn now to the medieval observation, resuscitated by Barwise and Cooper (1991) and Higginbotham and May (1981), that biconditionals like the following are trivial.

(14) Every bottle fell iff every bottle is a bottle that fell
(15) Some bottles fell iff some bottles are bottles that fell
(16) No bottle fell iff no bottle is a bottle that fell
(17) Five bottles fell iff five bottles are bottles that fell
(18) The bottle fell iff the bottle is a bottle that fell
(19) More than three but fewer than seven bottles fell iff
more than three but fewer than seven bottles are bottles that fell
(20) Most bottles fell iff most bottles are bottles that fell

For each of these biconditionals, there is nothing puzzling about the fact that it is truistic. In each case, the specific meaning of the determiner ensures the corresponding instance of (21).

(21) [[Determiner Noun] Tensed-Predicate] iff
[[Determiner Noun] [(copula) [Noun that Tensed-Predicate]]]

Recapitulating a determiner's internal argument, as a restriction within the external argument, has no truth-conditional effect. But if determiners indicate second-order relations, one wants to know *why* Languages have no determiners that are counterexamples to (21).[23] Let me review this much discussed point, before saying how the proposed Conjunctivist account—according to which determiners do not indicate second-order relations—provides an easy explanation.

Following Frege (188x) and Montague (197x), one might represent the meanings of (22) and (23) as indicated below, with 'Includes' and 'Intersects' standing for set-theoretic relations.

(22) Every bottle fell (22a) Includes[{e:Fell(e)}, {e: Bottle(e)}]
(23) Some bottle fell (23a) Intersects[{e:Fell(e)},{e: Bottle(e)}]

One can rewrite (22a) and (23a) in terms of "generalized" quantifiers.

(22b) $|\{e: Bottle(e)\} - \{e: Fell(e)\}| = 0$
(23b) $|\{e: Bottle(e)\} \cap \{e: Fell(e)\}| > 0$

And this highlights facts worth noting. For any sets α and β, the following generalizations hold.

$\beta - \alpha = \beta - (\beta \cap \alpha)$ $\beta \cap \alpha = \beta \cap (\beta \cap \alpha)$
$|\beta - \alpha| = n$ iff $|\beta - (\beta \cap \alpha)| = n$ $|\beta \cap \alpha| = n$ iff $|\beta \cap (\beta \cap \alpha)| = n$

So trivially, (22b) and (23b) are truth conditionally equivalent to (22c) and (23c).

(22c) $|\{e: Bottle(e)\} - \{e: Bottle(e) \& Fell(e)\}| = 0$

(23c) $|\{e: Bottle(e)\} \cap \{e: Bottle(e) \& Fell(e)\}| > 0$

If 'every' and 'some' indicate inclusion and intersection, in this sense, then (22c) and (23c) arguably capture the truth conditions of (22d) and (23d).

(22d) Every bottle is a bottle that fell

(23d) Some bottle is a bottle that fell

In which case, (22) is true iff (22d) is, and (23) is true iff (23d) is.

In general, a relation $\mathbf{R}(\alpha, \beta)$ is said to be conservative iff for any sets α and β, $\mathbf{R}(\alpha, \beta) \equiv \mathbf{R}(\beta \cap \alpha, \beta)$. The metaphor is that for such relations, one can "conserve" effort in determining whether or not α bears **R** to β, by asking whether or not the more restricted set $\beta \cap \alpha$ bears **R** to β. In this sense, one can ignore any elements of the "external" set α that are not elements of the "internal" set β. For example, in determining the truth or falsity of (22), one can ignore any nonbottles—including any nonbottles that fell—and likewise for (23). So the determiners 'every' and 'some' are also said to be conservative. The following biconditionals, with copular elements ignored for simplicity, are truistic for any predicates *Int* and *Ext*.

[[every *Int*] *Ext*] iff [[every *Int*] [*Int* that *Ext*]]

[[some *Int*] *Ext*] iff [[some *Int*] [*Int* that *Ext*]]

Examples like (24-29) are usefully represented in these terms.

(24) Some bottles fell (24a) $|\{e: Bottle(e)\} \cap \{e: Fell(e)\}| > 1$

(25) No bottle fell (25a) $|\{e: Bottle(e)\} \cap \{e: Fell(e)\}| = 0$

(26) Five bottles fell (26a) $|\{e: Bottle(e)\} \cap \{e: Fell(e)\}| = 5$

(27) The bottle fell

(27a) $|\{e: Bottle(e)\}| = 1 \ \& \ |\{e: Bottle(e)\} \cap \{e: Fell(e)\}| > 0$

(28) More than three but fewer than seven bottles fell

(28a) $3 < |\{e: Bottle(e)\} \cap \{e: Fell(e)\}| > 7$

(29) Most bottles fell

(29a) $|\{e: Bottle(e)\} \cap \{e: Fell(e)\}| > |\{e: Bottle(e)\} - \{e: Fell(e)\}| > 0$

The set-theoretic relations corresponding to the quantificational expression are as follows.

plural some	$|\{e: Int(e) \cap \{e: Ext(e)\}| > 1$
no	$|\{e: Int(e) \cap \{e: Ext(e)\}| = 0$
(exactly) five	$|\{e: Int(e) \cap \{e: Ext(e)\}| = 5$
the	$|\{e: Int(e)\}| = 1 \ \& \ |\{e: Int(e) \cap \{e: Ext(e)\}| > 0$
between 3 and 7	$3 < |\{e: Int(e) \cap \{e: Ext(e)\}| > 7$
most	$|\{e: Int(e) \cap \{e: Ext(e)\}| > |\{e: Int(e) - \{e: Ext(e)\}|$

And in each case, the relation is conservative. Replacing '*Ext*(e)' with '*Int*(e) & *Ext*(e)'—that is, replacing the determiner's external argument with the conjunction of the determiner's internal and external arguments —cannot affect the truth of the whole. For example, (29a) says: the bottles that fell outnumber the bottles that didn't fall. And this is the case iff the bottles that are fallen bottles outnumber the bottles that are not fallen bottles.

This highlights the explanandum. We want to know *why* instances of (21) are always true, given that many set-theoretic relations are *not* conservative. Consider two simple examples.

identity	$\{e: Int(e)\} = \{e: Ext(e)\}$
equinumerosity	$|\{e: Int(e)\}| = |\{e: Ext(e)\}|$

It isn't generally true that $\{e: Int(e)\} = \{e: Ext(e)\}$ iff $\{e: Int(e)\} = \{e: Int(e) \ \& \ Ext(e)\}$, or that

$|\{e: Int(e)\}| = |\{e: Ext(e)\}|$ iff $|\{e: Int(e)\}| = |\{e: Int(e) \& Ext(e)\}|$. But one can imagine a language with determiner-like expressions, 'iden' and 'equi', that appear in sentences like (31) and (32).

(31) Iden bottles fell — (31a) $\{e: Bottle(e)\} = \{e: Fell(e)\}$

(32) Equi bottles fell — (32a) $|\{e: Bottle(e)\}| = |\{e: Fell(e)\}|$

In such a language, biconditionals like (33) and (34) could well be false.

(33) Iden bottles are bottles that fell

(33a) $\{e: Bottle(e)\} = \{e: Bottle(e) \& Fell(e)\}$

(34) Equi bottles are bottles that fell

(34a) $\{e: Bottle(e)\} = \{e: Bottle(e) \& Fell(e)\}$

But (31-34) could still be perfectly meaningful if the quantificational exepressions indicated relations exhibited by sets. And given the actual determiner 'most', one cannot claim that the relations corresponding to 'iden' and 'equi' are too complicated to be determiner meanings.

Moreover, while the relations corresponding to 'most' and 'the' are conservative, structurally similar relations are not.

the	$|\{e: Int(e)\}| = 1 \& |\{e: Int(e) \& Ext(e)\}| > 0$
gre	$|\{e: Ext(e)\}| = 1 \& |\{e: Int(e) \& Ext(e)\}| > 0$
most	$|\{e: Int(e) \& Ext(e)\}| > |\{e: Int(e) \& \neg Ext(e)\}|$
grost	$|\{e: Int(e) \& Ext(e)\}| > |\{e: Ext(e) \& \neg Int(e)\}|$

The only difference between (Russellian) 'the' and the invented expression 'gre' is that the latter would impose a cardinality restriction on its external argument, with the result that (35) and (36) would have the indicated and distinct truth conditions.

(35) Gre bottle fell

(35a) $|\{e: Fell(e)\}| = 1 \& |\{e: Fell(e) \& Bottle(e)\}| > 0$

(36) Gre bottle is a bottle that fell

(36a) $|\{e: Bottle(x) \& Fell(e)\}| = 1 \& |\{e: Bottle(e) \& Fell(e) \& Bottle(e)\}| > 0$

While (35) is true iff the only thing that fell is a bottle, (36) is true iff only one bottle fell. Likewise, the 'grost' is a nonconservative analog of 'most.

(37) Grost bottles fell

(37a) $|\{e: Fell(e) \& Bottle(e)\}| > |\{e: Fell(e) \& \neg Bottle(e)\}| > 0$

(38) Grost bottles are bottles that fell

(38a) $|\{e: Bottle(e) \& Fell(e) \& Bottle(e)\}| >$
$|\{e: Bottle(e) \& Fell(e) \& \neg Bottle(e)\}|$

While (37) is true iff the fallen bottles outnumber the fallen nonbottles, (38) is true iff the fallen bottles outnumber the fallen bottles that are not bottles; that is, (38) is true iff a bottle fell.[24]

In my view, this tells against the idea that conservative relations are somehow better suited to being determiner meanings. By any independent measure, the asymmetric conservative relations have nonconservative analogs that just as simple and computable; cf. Keenan and Stavi (198x). The facts seem to be telling us that determiners do not express genuine relations between sets, and that a determiner's external argument does *not* play the role of specifying an extension that is compared with the extension of the determiner's internal argument. This conception of determiners effectively requires a "filter" on the relations determiners can express, given the fact that elements of the "external" set are semantically germane only when they are also elements of the "internal" set. But absent independent motivation for appeal to some such filter, and the idea that external arguments of determiners specify *sets* as opposed to truth values, the search for such a filter seems to be motivated more by Functionism than by the facts concerning determiners. As

Barwise and Cooper (1981) put it, determiners "live on" their internal arguments. But if that is correct, why say that determiners indicate genuine second-order *relations*?

By contrast, if determiners are predicates of Frege-Pairs, it follows immediately that all instances of (21) will be truistic. On the proposed account, and assuming at least one ball, every ball is red iff one or more things_E satisfy a tripartite condition.

$$\forall e{:}Ee[\text{Frege-Pair}(e) \;\&\; \text{Internal}(e, \top)] \;\&\; \iota X{:}\text{Ball}(X)[\text{Internal}(E, X)] \;\&$$
$$\forall e{:}Ee\{\text{External}(e, \top) \equiv \exists x{:}\text{Internal}(e, x)[\text{Red}(x)]\}$$

Every ball is a ball that is red iff one or more things_E satisfy an equivalent condition.

$$\forall e{:}Ee[\text{Frege-Pair}(e) \;\&\; \text{Internal}(e, \top)] \;\&\; \iota X{:}\text{Ball}(x)[\text{Internal}(E, X)] \;\&$$
$$\forall e{:}Ee\{\text{External}(e, \top) \equiv \exists x{:}\text{Internal}(e, x)[\text{Ball}(x) \;\&\; \text{Red}(x)]\}$$

And the equivalence has nothing to do with the particular determiner. If the balls are the internal participants of some things_E, then each_e of those_E things is such that its_e internal participant is red iff its_e internal participant is a red ball.

That's it. From this perspective, the explanandum is not that determiners indicate second-order relations of a special (conservative) sort. The generalization—viz., that determiners yield trivial instances of (21)—follows trivially from the proposed Conjunctivist semantics for determiners. That is a point in favor of the proposed account, even if it makes the explanandum seem less exciting. The more interesting point, in my view, is that relative clauses and external arguments turn out to be alike in *not* invoking lambda-abstraction but *unlike* in following respect: relative clauses really are conjoinable with nouns, while the external arguments of determiners really are open sentences. Functionism leads to a different typology and unpleasant questions about (i) why relative clauses seem unlike external arguments of determiners, and (ii) why determiners always correspond to conservative relations. But so much the worse for Functionism.

Let me stress, however, that Conjunctivism leaves room for relational concepts in thought. Indeed, notions like *AgentOf* and *PatientOf* are presupposed. But to express a relational concept, a Conjunctivist semantics requires some formal device (like Θ-marking) for "spreading" the relationality across a phrase, in a way that allows each constituent to be interpreted as a predicate conjoinable with others. Likewise, our quantificational *concepts* are presumably relational. Though for just this reason, it is striking that many relations between predicates cannot be expressed with determiners. And in this regard it is worth noting that determiners are not the only words that can be used to indicate second-order relations. One can say that the fallen *include* the bottles, that the dogs *outnumber* the cats, and so on. But just as 'stab' does not itself express a first-order relation, on the eventish semantics proposed here, so 'every' does not itself express a second-order relation. Rather, given the grammatical contexts in which it appears, the determiner is interpreted as a predicate of Frege-Pairs.

Indeed, 'every' especially instructive in this respect, since the relation of inclusion has an obvious converse. Compare (39) with (40).

(39) $\{e{:}\ \text{Fell}(e)\} \supseteq \{e{:}\ \text{Bottle}(e)\}$ (39a) $\text{Includes}[\{e{:}\ \text{Fell}(e)\}, \{e{:}\ \text{Bottle}(e)\}]$

(40) $\{e{:}\ \text{Fell}(e)\} \subseteq \{e{:}\ \text{Bottle}(e)\}$ (40a) $\text{AreAmong}[\{e{:}\ \text{Fell}(e)\}, \{e{:}\ \text{Bottle}(e)\}]$

One can imagine a determiner 'ryev' such that [[Ryev bottles] fell] would have the truth condition shown in (40), and [[Ryev bottles] [are bottles that fell] would have the nonequivalent truth condition shown in (41).

(40) $\{e{:}\ \text{Bottle}(e) \;\&\; \text{Fell}(e)\} \subseteq \{e{:}\ \text{Fell}(e)\}$

Note that (41) is sure to be true: the bottles that fell must be among the things that fell; only bottles are bottles that fell. But (40) is the potentially false claim that the things that fell are among the bottles—i.e., *only* bottles fell. So the biconditional (42), paraphrased with (43), would be false whenever (40) is false.

(42) Ryev bottles fell iff ryev bottles are bottles that fell

(43) Only bottles fell iff only bottles are bottles that fell

A language with 'Ryev' would thus be a language with a determiner that indicates a nonconservative relation. But again, there is nothing conceptually wrong with such a language.

It is, therefore, quite interesting that 'only' is not a determiner. For these purposes, I take as given that 'only' is a kind of focus operator that can appear in contexts where a determiner cannot. (Note that 'only' can be inserted anywhere in 'Caesar thought that Brutus liked him', with differing focus/contrast meanings. See Herburger [200x, 200x] for discussion and analysis; see Pietroski [2005] for Conjunctivist implementation.) The interesting fact is that children, who encounter constructions like 'Only bottles fell', do not become adults who understand 'only' is a nonconservative determiner. Neither do children acquire any determiner *Det* such that '*Det* bottles fell' would mean that the fallen are among the bottles. This is puzzling if, but only if, children understand such constructions as claims of the form **R**(α, β), where α and β are sets corresponding to the external and internal arguments of the determiner. By contrast, given Conjunctivism, children are driven to understand determiners and determiner phrases as predicates of Frege-Pairs. In which case, 'Only bottles' cannot be a semantic constituent in (44),

(44) Only bottles fell

given that (44) is true iff: some bottles are the things—*all* the things, the *only* things—that fell.

So a child who presupposes Conjunctivism would be driven to an analysis according to which (44) is deceptively complex, as if 'bottles' was focused and 'fell' was like the plural relative clause 'things that fell'. In which case, children would treat (44) and (22) quite differently,

(22) Every bottle fell

even though (44) is true iff everything that fell is a bottle. If this is correct, and 'fell' in (22) is *not* understood as the entity predicate 'things that fell', that tells in favor of a Conjunctivist analysis.

3.4 Summary

Conjunctivists can get beyond 'red ball', dealing with 'Brutus stabbed Caesar' and 'Ceasar died or Brutus did not kill Caesar'. Conjunctivism accommodates plural constructions and relative clauses, quite easily, and it yields an account of determiners that helps explain some otherwise puzzling facts. So complex quantificational constructions like (44),

(44) Six gardeners saw every turnip that Brutus stabbed

which initially seem like poster cases for Functionism, actually provide evidence in favor of Conjunctivism. This makes Functionist accounts of 'red ball' seem even more strained theoretically. Of course, this doesn't yet show that Conjunctivism is correct. But in the next chapter, I review independent sources of evidence that closed class lexical items are all understood as monadic predicates.

Notes

[1] For the first part of this chapter, I always encode variables with 'e', to stress that I am not assuming distinct variable types for events (things that can have participants) and entities (things that can be participants). Though for logical forms with more than two variables, this becomes inconvenient. So later, I use 'x' instead of 'e''. But this has no theoretical significance.

[2] See Castañeda (1967), Carlson (1984), Taylor (1985), Higginbotham (1985), Parsons (1990), and for more recent developments, Higginbotham, Pianesi, and Varzi (2000), Rothstein (2004).

[3] Adam is a big ant iff: the ants are such that Adam is a big one (of them); i.e., Adam is an ant *and* a big one (cf. Kamp [1975], Higginbotham [1985]). I return to the plural in 'ants'.

[4] Davidson spelled the ternary predicate 'PastStabOfBy' differently, using 'Stabbed', but this is irrelevant to his theory. Like Parsons (1990), if not for his reasons, I countenance the possibility of stabs (a.k.a. stabbings) without stabbers and stabs without stabbees; see also Borer (2004). SOMETHING HERE ABOUT TENSE, citing Higginbotham and others

[5] Either by verb-raising or tense-lowering. See Pollack (1989) and Cinque (1999) for discussion of functional elements posited above the basic "V-shell" corresponding to the verb and its arguments. And given Chomsky's (1957) idea that phrases are (recursively) classified in terms of an "is a" relation, specified in terms of lexical classifications, the null hypothesis should be that [Plum_D [stabbed_V Green_D]$_V$] is a V.

[6] See Burge (1973), Katz (1994). Baker (2003) argues that all nouns are indexed. If proper names have proper nouns as constituents, and words of a spoken Language pair sounds with meanings, then to a first approximation: an entity e is properly called Green_N iff e is, in accord with relevant norms, summoned with the sound of that sound.

[7] See Gruber (1965), Fillmore (1968), Jackendoff (1972, 1987), Chomsky (1981), Higginbotham (1985). See Hornstein (2001) for a view that takes the idea of theta-*marking* quite seriously.

FURTHER REFERENCES ON ADJUNCTS, LABELING, and OPERATIONS:

Chametsky (199x), Hornstein and Nunes (forthcoming); Hornstein (forthcoming); Hornstein and Pietroski (forthcoming)

[8] Dowty (1979, 1991) introduces 'eventuality' in a related discussion, with different emphases; see also Baker (1997).

[9] See Burzio (1986), Belletti (1988). Whatever the grammatical structure of intransitive examples like 'I sang/dreamt/counted', there is a sense in which any singing/dreaming/counting is *of* something (a tune, a dream, some numbers). By contrast, a death (as opposed to a murder) need not be *by* something. See Hale and Keyser (1993), Tenny (1994). One shouldn't read too much into 'Theme': Themes are internal participants of potential values of event predicates. But in paradigmatic cases, the Theme of a event lets us "measure" the event in Tenny's sense: a stabbing of Green has occurred when Green is impacted in a certain way; a painting of the walls has occurred when the walls are suitably covered with paint; etc.

[10] Or perhaps Plum_D is the argument of a covert verb that combines with the intrinsically intransitive stabbed_V. See Williams (1981), Marantz (1984), Hale and Keyser (1993), Chomsky (1995), Kratzer (1996), Baker (2003). We could recode, as in Pietroski (2005), using '*ext-*' and '*int-*' to reflect external and internal arguments of the verb: [*ext*-Plum_D [stabbed_V *int*-Green_D]].

[11] Citations. A killing also exhibits a kind of unity that a mere cause-effect pair does not; see Fodor. But as will soon become clear, I am not proposing any analysis of the concept lexicalized with 'kill'.

[12] If the modification comes earlier, as in $[[\text{stabbed}_V\ \text{Green}_D]_V\ \text{quickly}_A]_V$, this is a further complication; see Kratzer (1996), Chung and Ladusaw (2003). Cases like 'There was a stabbing in the kitchen' and 'Plum kicked Green the ball' pose further difficulties; see also Borer (2004).

[13]... see Boolos (1998), Schein (1993, forthcoming), Higginbotham (1998), Pietroski (2003,

2005)

[14] I take no stand here on the utility of a Boolos-style interpretation for other projects. But one should not confuse empirical hypotheses, about natural languages and children who acquire them, with claims about how logicians should interpret all their second-order variables.

[15] See Schein (1993), which I draw on. In Pietroski (2005), I used a slightly different principle.

$$\text{Val}(E, \Sigma_{\Theta}, \mathbf{A}) \text{ iff } \exists X[\forall x\{Xx \equiv \text{Val}(x, \Sigma, \mathbf{A})\} \;\&\; \text{Internal}(E, X)]$$

This allowed for an easier unification with quantificational cases. But it generates technical questions I want to avoid here; and see note 14.

[16] Perhaps the "bare" plural object really combines with a covert element like 'some'. But this is not required; cf. Chierchia (1998). My thanks to Ivano Caponegro and Veneeta Dayal for discussion that helped me see a difficulty here for Pietroski (2005).

[17] See May (1985), Higginbotham and May (1981), and for discussion relevant to the labelling, Hornstein and Uriagereka (1999). Pietroski (2003) includes some Whiggish history.

[18] Frege (1892) spoke of Concepts and their Value-Ranges. See Pietroski (2005) for discussion in the context of questions about what distinguishes a sentence of *natural* language from a list.

[19] Though at least for finite domains, 'Outnumber(Y, N)' can be cashed out in terms of one-to-one correspondence: $\exists Z \exists x[Yx \;\&\; \forall z{:}Zz(Yz \;\&\; z \neq x) \;\&\; \text{OneToOne}(Z, N)]$.

[20] References to earlier work

[21] But the account works just as well for 'students who formed a circle' with 'who' as a plural pronoun that has more than one value relative to each assignment.

[22] Heim and Kratzer (199x) make this laudably explicit. Consider 'who$_2$ he$_1$ stabbed t$_2$', which must be associated (relative to **A**) with $\lambda x.\exists e[\text{Agent}(e, \mathbf{A1}) \;\&\; \text{PastStab}(e) \;\&\; \text{Patient}(e, x)]$, and not $\lambda x.\exists e[\text{Agent}(e, x) \;\&\; \text{PastStab}(e) \;\&\; \text{Patient}(e, \mathbf{A2})]$. As their treatment of indices reveals, the associating relative clauses with the right functions of type <e, **t**> requires appeal to assignment

variants to get the right abstraction on the right variable. And of course, similar points apply to constructions involving quantification with more than one variable; see Pietroski (2005) for discussion of the details

[23] See Barwise and Cooper (1981), Higginbotham and May (1981), and Herburger's (2001) discussion of 'only', which is not a determiner. The basic facts were known to medieval logicians.

[24] Compare the conservative 'fost': $|\{e: Int(e) \cap \{e: Ext(e)\}| < |\{e: Int(e) - \{e: Ext(e)\}|$

note to context restrictions, cite 'most' paper...Pietroski, Halberda, Lidz, Hunter.