

Underlying States and Time Travel

I begin by sketching a theory about the semantics of verbs in event sentences, and the evidence on which that theory is based. In the second section, I discuss the evidence for extending that theory to state sentences, including copulative sentences with adjectives and nouns; the evidence for this extension of the theory is not very good. In the third section, I discuss new evidence based on considerations of talk about time travel; that evidence is apparently quite good. I conclude with a problem about formulating default knowledge.

1. The Theory of Underlying Events for Event Sentences

The theory to be discussed is at least as old as Plato's *Sophist*. It is that verbs stand for kinds of events, and that several other parts of sentences contribute additional information about those events, sometimes standing for things that are related to the event in common ways. For example, in the sentence 'Brutus stabbed Caesar violently with a knife' the whole sentence asserts that an event of a certain kind occurred, the verb tells what kind of event it was (a stabbing), the tense on the verb tells when it occurred (sometime in the past), the subject indicates the agent of that stabbing, the direct object says who the object of the stabbing was, and the modifying phrases supply additional information about the event: that it was violent and that it was in the back. All told, this information can be summed up in this logical form for the sentence:

Brutus stabbed Caesar violently with a knife =

For some event *e*:

<i>e</i> is a stabbing	<verb>
<i>e</i> culminated in the past	<tense>
the agent of <i>e</i> is Brutus	<subject>
the object of <i>e</i> is Caesar	<direct object>
<i>e</i> was violent	<adverb modifier>
<i>e</i> was with a knife	<prepositional phrase>

In predicate calculus notation (which is optional), this is:

$\exists e: \text{Stabbing}(e) \ \& \ \text{Cul}(e, \text{past}) \ \& \ \text{Agent}(e, B) \ \& \ \text{Object}(e, C) \ \& \ \text{Violent}(e) \ \& \ \text{With}(e, \text{knife})$

The question naturally arises as to why anyone should attribute such a complex form to the sentence. It has an intuitive appeal, but does it yield any particular theoretical fruits or is it merely an engaging way to view things? In *Events in the Semantics for English*¹ I argued that such logical forms yield several important consequences. The main ones are summed up in the next two subsections. The remainder of this paper concerns extending the theory to state sentences.²

1.1 The Logic of Verb Modifiers in Event Sentences

The first piece of evidence for underlying quantification over events in event sentences stems from the logic of verb modifiers. It is a striking fact that of these sentences:

1. *Brutus stabbed Caesar violently with a knife*
- 2a. *Brutus stabbed Caesar violently*
- 2b. *Brutus stabbed Caesar with a knife*
3. *Brutus stabbed Caesar*

(1) entails either of (2a) or (2b), and either of these entails (3). Thus any modifier drop-off is valid, in any order. But equally important is the fact that the conjunction of (2a) and (2b) does not entail (1). If Brutus stabbed Caesar gently with a knife, and violently with an icepick, both (2a) and (2b) are true but (1) is not; there are two stabbings, each of which satisfies one of the sentences in (2), but neither of which satisfies (1). I call the first entailment MODIFIER DROPOFF and the second nonentailment MODIFIER NONCONJUNCTION. The logical forms proposed above satisfy both of these. Those forms are:

(1) For some e:
e is a stabbing,
the agent of e is Brutus,
the object of e is Caesar,
e is violent
e is with a knife

(2a) For some e:
e is a stabbing,
the agent of e is Brutus,
the object of e is Caesar,
e is violent

(2b) For some e:
e is a stabbing,
the agent of e is Brutus,
the object of e is Caesar,
e is with a knife

(3) For some e:
e is a stabbing,
the agent of e is Brutus,
the object of e is Caesar

Ordinary predicate logic then accounts for both MODIFIER DROPOFF and MODIFIER NONCONJUNCTION. That is, these logical forms are such that (1) entails both (2a) and (2b) in the predicate calculus, and these both entail (3). But there is no predicate calculus entailment of (1) by the conjunction of (2a) and (2b). Thus these forms validate the distinctive logic of verb modifiers, which is the first sort of evidence for the quantification over events.

1.2 Perception Statements for Event Sentences

The second sort of evidence has to do with the semantics of perception statements whose perception verbs take "small clauses." Examples are:

Mary saw Brutus stab Caesar.

Sam heard Mary shoot Bill.

Agatha felt the boat rock.

These are logically independent of similar constructions with the same verbs that take `that'-clauses:

Mary saw that Brutus stabbed Caesar.

Sam heard that Mary shot Bill.

Agatha felt that the boat rocked.

Thus, a different semantic treatment is necessary. If simple sentences routinely contain underlying quantifications over events, it is possible to attribute to the former constructions forms like these:

Mary saw Brutus stab Caesar =

there is an event of seeing
whose subject is Mary
and whose object is
a stabbing of Caesar by Brutus.

The advantage of these forms is that they validate equivalences such as the following:

Mary saw Brutus stab Caesar if and only if Mary saw a stabbing of Caesar by Brutus.

This provides a foundation for a robust set of other equivalences, such as:

Mary saw Brutus stab Caesar violently if and only if Mary saw a violent stabbing of Caesar by Brutus.

There must be some connection between the use of `violent' as an adjective of events and the use of `violently' as an adverb of event verbs; on the account in question these both contribute the same ingredient to logical form: a predicate true of events.

The point of this paper is not to engage in detailed assessment of the evidence just outlined. Instead, I take for granted that it is promising, and I ask whether there is similar evidence for attribution of underlying states in simple stative sentences. In section 2, I assess the evidence known to date, and in section 3, I argue that discourse about time travel provides better evidence.

2 Are There Underlying States for State Sentences?

In this section, I review evidence for underlying states in stative constructions: state verbs, adjectives, locative modifiers, and common nouns. For simplicity, I confine myself throughout to an examination of the logic of modifiers and of perception sentences.

2.1 Underlying States for State Verbs?

State verbs include verbs like the following:

John has a dog.
It resembles a small horse.
Mary believes it is friendly.

The question is whether these simple sentences have the simple forms attributed to them in logic texts, or whether they have more complicated forms analogous to those associated with simple sentences with event verbs. At issue is the contrast between these two kinds of form:

John has a dog:

NO UNDERLYING STATE: $\exists x: \text{Dog}(x) \ \& \ \text{Has}(j,x)$

UNDERLYING STATE: $\exists x: \text{Dog}(x) \ \& \ s[\text{Having}(s) \ \& \ \text{Object}(s,x) \ \& \ \text{In}(j,s)]$

2.1.1 The Logic of Modifiers with State Verbs

At first glance there is no evidence to be assessed for modifiers, since the kinds of modifiers that appear with event sentences (primarily, adverbials of manner, instrument, and similar ones) do not occur with state verbs. The following are not even grammatical:

**Brutus has a dog quietly*
**Brutus resembles a cat violently with a knife.*

There are a small number of cases in which the constructions occur with locatives, and in which there is some tendency to see a positive case for underlying states. Consider the following sentence with the stative reading of 'sit':

The TV sits on the desk by the lamp

This allows us to infer either of:

The TV sits on the desk
The TV sits by the lamp

and either of these allows the inference to:

The TV sits.

This MODIFIER DROPOFF is not relevant to the issue before us, since it is accounted for by either kind of form. E.g. we have:

Sits(TV) & On(TV,desk)
Sits(TV)

\exists s[Sitting(s) & Theme(s,TV) & On(s,desk)].
 \exists s[Sitting(s) & Theme(s,TV)].

But what about MODIFIER NONCONJUNCTION? The symbolization without underlying states falsifies this, while the one with underlying states satisfies it. The question is which is right. For example, is this a valid inference?

The TV sits on the desk
The TV sits by the lamp
— *The TV sits on the desk by the lamp*

Normally we would make such an inference without hesitation. But things are not completely clear. Imagine a TV set perched partly on a desk and partly on a table with a lamp on the table next to it. Is this situation a counterexample to this inference? If so, that is evidence for the underlying state form. If not, the general absence of such inferences would seem to favor the simpler form without underlying states. The data here are inconclusive.

2.1.2 Perceptual Idioms with State Verbs

With perception sentences, the situation is clear: the evidence does not occur. The following sentences are not grammatical:

**We watched her believe that snow is white.*
**We saw her resemble a unicorn.*

This is strange. Suppose that my pony resembles a unicorn, and that we find this out by looking and seeing. Why can't we then say that we saw her resemble a unicorn? If the underlying event form for perception sentences with event clauses were correct, the absence of such constructions for state sentences might have a simple explanation: there are no underlying states for state sentences.

2.2 Underlying States for Adjectives

When we turn to adjectives the issue is between these two sort of forms:

Mary is clever:

NO UNDERLYING STATES: Clever(m)
UNDERLYING STATES: \exists s: Cleverness(s) & In(m,s)

2.2.1 The Logic of Modifiers with Adjectives

Again, the relevant constructions mostly do not occur. We do not have sentences like:

**Mary is clever in Prague with a knife.*

There are a small class of sentences that do occur, and that seem to favor the underlying state view, examples like:

The board is coarsely grooved

These constructions favor the underlying state view because they obey the MODIFIER NONCONJUNCTION phenomenon; the following is not valid:

The board is coarsely grooved

The board is grooved along its edge

— *The board is coarsely grooved along its edge*

Suppose the board is coarsely grooved across one end, and finely grooved along its edge; the premises then can be true without the conclusion. The problem about these constructions is that they seem to occur only when the adjective is spelled like the past participle of a verb: 'grooved' is an example. The construction is thus quite restricted and special, and cries out for some special explanation;³ as a result it does not clearly provide strong support for the underlying states option.

2.2.2 Perceptual Idioms with Adjectival Phrases

Adjectives *do* occur in the relevant perception sentences, and the pattern from the event case seems to work fine:

She saw him naked:

There is an event of seeing
whose agent is her
and whose object is
a state of his being naked

If there is to be a good parallel, we also need to have an equivalence between these sentences and ones with explicit reference to states. These do occur, in examples such as:

She saw him naked if and only if she saw his nakedness.

The second clause here has an archaic ring to it, and not everyone accepts the equivalence. So this is provocative but inconclusive as evidence.

2.3 Underlying States for Locative Prepositional Phrases

With locatives the competing forms are:

Socrates is at the marketplace

NO UNDERLYING STATES: At(Soc,m)
UNDERLYING STATES: \exists s: s is a state of being-at &
m is the object of s & Soc is in s

2.3.1 The Logic of Modifiers: Locatives

As usual, both proposed forms satisfy the MODIFIER DROPOFF condition; they differ as to the MODIFIER NONCONJUNCTION condition. Which is right? In most cases it appears that the MODIFIER NONCONJUNCTION condition does *not* apply to these cases. The following kind of inference seems generally unproblematic:

Socrates is in the market
Socrates is under an awning
— *Socrates is in the market under an awning.*

There are a few counterexamples to this pattern; consider:⁴

IBM is in Paris
IBM is in a hilly region
— *IBM is in a hilly region in Paris*

But people generally have trouble with cases of this sort, feeling that there is something fishy going on. (In section 4, I will speculate about what this is.) Since the counterexamples are few in number and problematic in interpretation, they do not provide compelling evidence for the underlying state account.

2.3.2 Perceptual Idioms with Locatives

These perceptual idioms occur; we have e.g.:

Mary saw Socrates under an awning.

They provide moderate evidence for the underlying state account for copulative sentences with locatives.

2.4 Underlying States for Nouns

The competing analyses here are:

Socrates is a boy:
NO UNDERLYING STATES: Boy(Soc)
UNDERLYING STATES: \exists s: Boy(s) & In(s,Soc)

A key part of the assessment of these cases will be what happens when the nouns are modified in some way. I assume here a parallel with verbs, so that the competing analyses are ones like:

Socrates is a boy under 1.5 meters tall:
NO UNDERLYING STATES: Boy(Soc) & Under-1.5(Soc)
UNDERLYING STATES: \exists s: Boy(s) & Under-1.5(s) & In(Soc,s)

2.4.1 The Logic of Modifiers with Nouns

Again, both analyses obey the MODIFIER DROPOFF condition, and this seems to be borne out by the data (ignoring special cases such as 'former'). They differ with respect to the MODIFIER NONCONJUNCTION condition, and here the underlying state approach seems to be wrong. For arguments of this sort appear to be valid:

Socrates is a boy
Socrates is under 1.5 meters tall
— *Socrates is a boy under 1.5 meters tall*

If such inferences are valid, this provides strong evidence against the underlying state approach, which entails that they are invalid. (Below, I will suggest that in spite of appearances to the contrary, they are indeed invalid.)

2.4.2 Perceptual Idioms with Nouns

The relevant perceptual constructions do not occur with nouns:

**I saw her (be) a doctor*

This is consistent with the view that the underlying state view is wrong for nouns.

2.5 Summary

Based on the considerations reviewed above, it would appear that the underlying state analysis is not compelling for any kind of the constructions reviewed here, and is not even plausible for some (e.g. for nouns). There are a few outstanding problems that the underlying state analysis might solve, such as how to give a semantics for perception sentences with adjectival clauses, but for the most part the weight of evidence seems to go the other way. In the next section we look at some new evidence.

3 Considerations from Time Travel

Time travel raises a number of fascinating issues for philosophers. Is it possible? If not, why not? If so, what are its consequences? For want of a convincing proof that time travel is impossible, we are free to explore some conceptual puzzles that arise as soon as we contemplate its being carried out. These problems provide nice tests for our concepts of how the world operates. David Lewis has written about some of the problems that arise in cases of time travel, and I agree with his assessment that a world in which time travel takes place is, to us, very strange. Strange, but not impossible to conceive. And contemplation of cases of time travel can force us to clarify our theories about ordinary situations.

Consider a story in which time travel takes place, either by means of some marvelous application of scientific principles or by magic or supernatural means; the issues to be discussed don't depend on how it happens. Socrates, let us suppose, at age 18, engages in a discussion with Parmenides, the discussion that is portrayed in Plato's dialogue *Parmenides*. So we find Socrates, at high noon on the Ides of March, 452 BC, sitting outside the city walls talking with Parmenides. A month later, driven to distraction by the metaphysical conundrums of that conversation, he stumbles into a time warp, and travels back in time one year. He emerges from the time warp a year before he stumbled into it. He ponders his discussion with Parmenides for several months, and here he is again on the Ides of March, lying down in the marketplace, cursing the gods.

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                Socrates sitting
                  outside the
>-----          city walls          -----
                  talking with
                  Parmenides

                Socrates lying
----- in the marketplace ----->
                cursing the gods

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How are we to describe what takes place at noon on the Ides of March, 452 BC? Here are some of the things we want to say:

- Socrates is sitting outside the city walls.
- He is sitting outside the city walls talking to Parmenides.
- Socrates is lying in the marketplace.
- He is not lying in the marketplace talking to Parmenides.
- Socrates is not sitting in the marketplace.
- Socrates is Socrates.
- There is only one Socrates.
- Socrates is in two places at the same time

Let me focus for a moment on the next to last claim: there is only one Socrates. Obviously, people aware of Socrates in the marketplace and of Socrates outside the city walls, and unaware of the fact of time travel, would assume that these are two distinct but similar people, both named Socrates. But they would be wrong. There is only one person, Socrates. Recall that we are exploring the consequences of a hypothesis, and the hypothesis is that Socrates time-traveled, that is, Socrates entered a time warp and *he* emerged from it a year earlier. The hypothesis is not that some person very like Socrates emerged from the time warp a year earlier; the hypothesis is that *he* did. The hypothesis of time-travel entails that the very same person who entered the warp emerged from it at a time at which he already existed. And so, for a year, he overlapped himself in time.

So there is only one Socrates. But this claim seems easy to disprove. Since Socrates is sitting outside the city walls at noon on the Ides of March, he is sitting. Since he is lying in the marketplace, he is in the marketplace. Hence, at noon on that day he is sitting and he is in the marketplace; so he is sitting in the marketplace:

Socrates is sitting.
Socrates is in the marketplace.
— *Socrates is sitting in the marketplace.*

But that's absurd; for all we know, *nobody* is sitting in the marketplace at noon on the Ides of March. If time travel commits us to conclusions like this, it can't occur.

If this is a good argument, then the scenario we are discussing is impossible, and, by parity of reasoning, other cases are as well, and so time travel is impossible. Perhaps some person very like Socrates could emerge from a time machine, but *he* couldn't.

The other option, of course, is that the story under consideration is coherent, and we need a semantics that will avoid the appearance of incoherency. The underlying state semantics discussed in the previous section is just that. If the story is coherent, then it provides most of the missing evidence in favor of underlying states. I will review the points at issue in the order in which they were introduced above.

3.1.1 The Logic of Modifiers with State Verbs

Consider again an argument of this sort:

Socrates is sitting outside the city walls.
Socrates is lying in the marketplace.
— *Socrates is sitting in the marketplace.*

We can now see that this is invalid. And this invalidity is explained by the underlying state analysis. On this view, the first sentence entails that there is a sitting state that Socrates is in, and the second entails that there is an in-the-marketplace state that he is in. But the conclusion says that these are the *same* state; it says that there is a state that is both a sitting state and an in-the-marketplace state that he is in. So the conclusion says something beyond what is said in the premises.

For some state s : s is a state of sitting & Socrates is in s & s is a state of being outside the city walls.

For some state s : s is a state of lying & s is a state of being in the marketplace & Socrates is in s

For some state s : s is a state of sitting & s is a state of being in the marketplace & Socrates is in s

This inference is just like the inference involving Brutus stabbing Caesar; there may have been two stabbings in that case, and in this case there may be two different unrelated states that Socrates is in. Socrates is, in fact, simultaneously in these two different states:

State 1: sitting, outside the city walls, talking with Parmenides

State 2: lying, in the marketplace

We can't infer that he is sitting in the marketplace because there is no state having both of the properties: being a sitting state, and being an in-the-marketplace state. This form of analysis solves the apparent paradox we thought we were led into above.

(Here is where it is essential that there is only one Socrates. If there were two Socrates's, then one premise in the above argument would refer to one of them and the other premise to the other, and the argument would commit a fallacy of equivocation.)

For the remainder of the cases I will merely give the relevant example; the import of the example will be clear from the discussion above.

3.1.2 Perceptual Idioms with State Verbs

She saw him sitting in the marketplace.

These examples are grammatical and they need a semantical account. The underlying state theory provides one.

3.2.1 The Logic of Modifiers with Adjectives

The relevant constructions are still not grammatical, but there are some closely related ones that are grammatical, and that are explained by the underlying state analysis:

He is tall over here.

He is not tall over there.

(These could be handled instead by supposing that 'over here' and 'over there' create nonextensional contexts. I think that other hypotheses are more plausible,⁵ and these too work best with the underlying state approach.)

3.2.2 Perceptual Idioms with Adjectival Phrases

These constructions do occur with modals, and they seem to require something like the underlying state analysis:

Here you can see him tall, and there you can see him short.

3.3.1 The Logic of Modifiers: Locatives

The MODIFIER NONCONJUNCTION phenomenon occurs, and is evidence for the underlying state analysis. It explains why this argument is invalid:

Socrates is under an awning

Socrates is in the marketplace

— *Socrates is in the marketplace under an awning*

3.3.2 Perceptual Idioms with Locatives

The MODIFIER NONCONJUNCTION phenomenon affects these cases as well. The following is invalid:

She saw him under an awning.
She saw him in the marketplace.
— *She saw him under an awning in the marketplace.*

3.4.1 The Logic of Modifiers with Nouns

Suppose that Socrates was a boy under 1.5 meters tall talking to Parmenides, but that he was a man over 1.5 meters tall lying in the marketplace. Then this is clearly invalid:

Socrates is a boy under 1.5 meters tall
Socrates is a man over 1.5 meters tall
— *Socrates is a boy over 1.5 meters tall*

Likewise, our test inference for the modified nouns is invalid:

Socrates is a boy
Socrates is over 1.5 meters tall
— *Socrates is a boy over 1.5 meters tall*

3.4.2 Perceptual Idioms with Nouns

Again, the constructions occur awkwardly with modals, and seem to favor the underlying state analysis:

Here you can see him a boy, and there you can see him a man.

3.5 Summary

Considerations of how we describe what takes place in time travel stories suggest that there are underlying states in stative sentences involving state verbs, and copulative sentences with adjectives, locatives, and nouns.

4 A Problem of Default Information

If there are underlying states in simple state sentences, that leaves us with a problem. Inferences of the following sort are normally made, and are normally unproblematic:

Mary is at the desk
Mary is in the living room
— *Mary is at the desk in the living room*

She is a doctor
She is female
— *She is a female doctor*

Yet according to the proposed theory they are fallacious. Surely this needs some explanation. I suggest that such inferences are valid enthymemes. There is some background information that we normally presuppose, and that renders the inferences valid when conjoined with the premises. The problem is to identify what it is.

The information must include the fact that we are not dealing with a case of time travel. But this is much too special to provide a general solution. Perhaps the key lies in the idea that Socrates can be sitting and be in the marketplace without being sitting in the marketplace *because* he is in two places at once. *We* can't do that because we are not in two places at once. So perhaps the piece of background information is that the entities under discussion are not in two places at once:

TYPICAL DEFAULT ASSUMPTION:

The entities in question are not in two places at once.

This also meshes with part of the previous evidence discussed in section 2: the reason that IBM can be in Paris and also in a hilly region without being in a hilly region in Paris is that IBM *is* the sort of entity that can be in two places at once; indeed, in many places at once.

But what is the connection between not being in two places at once and the inferences in question? The following would do the trick:⁶

If x is not in two places at once, then if x is in state s_1 and x is in state s_2 , then $s_1=s_2$.

Whether this is plausible as an overall account is difficult to assess without additional evaluation.

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Notes

¹ Cambridge, M.I.T. Press, 1990; hereafter, ESE.

² I discussed the question of extending the theory to state sentences in ESE, and, earlier, in "Underlying States in the Semantical Analysis of English," *Proceedings of the Aristotelian Society* 88, 1987/88, 13-30. I have not been satisfied with the conclusions drawn in either of these earlier works.

³ As in ESE §12.7 we can imagine that the adjectives derive from the verbs by a somewhat regular process, and that the adverbs come along for the ride without there being any underlying states.

⁴ This example is due to Barry Schein.

⁵ See ESE §11.2 on frame adverbials.

⁶ Perhaps this is too strong when we turn our attention to discussion of mental phenomena. We may need a limitation on the states in question to physical states.