

Comments on Dynamic Semantics

Christopher Gauker

APA Central, April 21, 2007

- I. The project of dynamic semantics is to explicate the meaning of sentences as functions from information states to information states.
 - A. Alternatively, the project might be described as aiming to associate with each sentence a context-change potential.
 1. Actually, it's not always clear whether the thing to be updated is supposed to be an individual speaker's beliefs or is supposed to be the beliefs that the participants in a conversation in some sense share.
 2. I will alternate between calling the thing to be updated an *information state* and calling it a *context*, or *common ground*, depending on which body of literature I am alluding to.
 3. In either case, the thing to be updated is modeled as a set of possible worlds. More precisely, it is modelled as a set of *assignments* (in the model-theoretic sense) to the nonlogical primitive vocabulary items of the language.
 4. The meaning of a sentence is a function that takes a set of possible worlds (that is, assignments) and either reduces the set of assignments in some way or leaves it the same.
 - B. (Other definitions)
 1. We say that a sentence is *true* in an information state if and only the function on information states that the sentence expresses does not alter the information state. Alternatively, an information state *entails* a sentence or *supports* a sentence under this condition.
 2. We say that an argument is *valid* if and only if successive updates of the information state by the premises yields an information state in which the conclusion is true.

3. Although sentences are not thought of as expressing propositions in the classical sense, we will nonetheless have occasion to speak of propositions as sets of possible worlds, and will say that an information state, or context, *entails* a proposition if and only if the information state is a subset of the proposition.
- C. One thing we can ask is which pretheoretic conception of meaning this theory is supposed to elucidate.
1. We often think of meaning as that which a speaker expresses and that which a hearer grasps. Successful communication takes place when a hearer grasps the meaning the speaker expresses. But I am not sure that we can take “meaning” in this way and also define meaning as a function on information states.
 2. In any case, we might also say that meaning is what a person who understands a language understands *about* each sentence in the language. Meaning in this sense—what a speaker understands about a sentence—might plausibly be identified with a function on information states.
- D. The term “dynamic semantics” has a narrow sense and a broad sense.
1. What I have just defined is dynamic semantics in the narrow sense.
 2. The broader sense includes discourse representation theory, of the kind championed by Hans Kamp.
 3. I will use the term only in the narrow sense. It is dynamic semantics in this narrower sense that the speakers in this session have been talking about.
- II. Dynamic semantics seems to have its roots in thinking about anaphora and presupposition. More recently, it has been put to use in explicating logical connectives.
- A. Here is the main idea about anaphora.
1. We say things like this:

“A man came in. He was a surley brute.”

We expect the “he” in the second sentence to in some sense “pick up the reference” of the indefinite description in first sentence.

2. Here is how that phenomenon can be modeled in dynamic semantics.
 - a. The assignments that comprise an information state make assignments not only to constants but also to variables.
 - b. When the first sentence, “A man came in”, is accepted by the hearer, what happens is that a new variable is added to the domain of the assignments in the hearer’s information state, a certain object is assigned to that variable (the same one in each assignment), and then the information state is reduced to those assignments in which that object is in the extension of “came in”.
 - c. What the second sentence does is reduce the information state to those assignments in which the object assigned to the new variable is in the extension of “was a surley brute”.
 3. The credit for this idea goes to Groenendijk and Stokhof’s famous paper from 1991.
- B. Here is the main idea about presupposition. A presupposition is a precondition on update.
1. For example, if I say, “I have to pick up my sister at the airport”, my utterance presupposes that I have a sister, and what that means is that my utterance can update the context, or common ground, only if the context already entails the presupposed proposition that I have a sister.
 - a. If the context does entail that I have a sister, then the context can be updated with the information, regarding my sister, that I have to pick her up at the airport. That is, the sentence “I have to pick up my sister at the airport” can perform its update.

- b. If the context does not already entail that I have a sister, then conversation can proceed, but only by means of a side process called “accommodation”, in which the context is first updated with the information that I have a sister.
2. The primary source for this idea is a paper from 1974 by Lauri Karttunen. Karttunen’s idea got a significant boost from Irene Heim’s use of it in a paper in 1983 and in another one in 1992.
- C. Finally, it is claimed that in the context of dynamic semantics we can give a better account of the logical behavior of logical connectives such as “if . . . then . . .” and “might”.
 1. Here is an example: Supposedly, if I say “It’s going to rain,” but then a moment later, I say, “It might not rain,” I have in some sense contradicted my earlier statement.
 - a. Of course, these two sentences, “It’s going to rain” and “It might not rain”, are not inconsistent in classical modal logic. Rain in the actual world is not precluded by there being no rain in some merely possible world.
 - b. But intuitively, if I say, “It will rain” and then say, “It might not”, then my second utterance in some sense takes back what I first said.
 2. In the context of dynamic semantics, we can account for this fact as follows:
 - a. When I assert “It’s going to rain”, the information state is updated with the proposition that it will rain. That means that all worlds without rain are removed from the information state.
 - b. But when I say, “It might not rain”, that will be consistent with the information state only if there are some non-rain worlds in the information state. So it is not consistent if I have already eliminated all of the non-rain worlds.

3. The use of dynamic ideas to explicate logical connectives seems to originate in work by Groenendijk, Stokhof and Veltman in the early '90's. More recently, Thony Gillies and Kai von Fintel have been writing about conditionals from this point of view.
- D. I want to raise two sorts of doubt about dynamic semantics. First, I have some broad "philosophical questions". Second, I have doubts about the data.

III. Philosophical Doubts

- A. The first of my philosophical doubts concerns the nature of information states.
1. Again, information states are sets of assignments, which we can think of as possible worlds, and the set of worlds that an information state *is* can be thought of as the intersection of the propositions that an agent believes. So a person is in an information state just insofar as he or she believes some propositions.
 2. So what does it mean to say that a person believes a proposition?
 - a. Most people (not me, as it happens) will answer that a person believes a proposition only insofar as he or she contains some mental representations that bear some propositions.
 - b. Usually, these mental representations are conceived of on analogy to sentences.
 - i. On one view, they would be sentences in an innate language of thought.
 - ii. On another view, they would be sentences of spoken language, or some kind of deep structures of a kind that underlie the sentences of spoken language.
 3. If our account of the semantics of spoken natural language is that of dynamic semantics, then we will need a radically different kind of semantics for mental representation. We cannot say, without

inviting an infinite regress, that the meaning of a mental representation of the sort that realizes an information state is itself a function on information states.

4. It might be plausible that the semantics of mental representation is different from the semantics of spoken language in important respects.
 - a. One might plausibly maintain that mental representations do not contain anaphors. They might contain only “mental names”.
 - b. One might plausibly maintain that mental representations do not contain presuppositions. Perhaps every proposition expressed in our mental representations is expressed “explicitly”.
 - c. But I think it is quite doubtful that the logical connectives in our mental representations require an entirely different sort of semantics from the semantics of the logical connectives in spoken language.
- B. My second philosophical doubt concerns what we might call “the norms of discourse”.
 1. We should expect that we can use the concepts of semantic theory to formulate norms to which we should strive to adhere in speaking.
 2. Using the concepts of dynamic semantics we *can* certainly formulate *some* discourse norms.
 - a. In the framework of dynamic semantics we can define informativeness, thus: A sentence is informative on an occasion if and only if its utterance alters in some way the hearer’s information state.
 - b. And then we can say things like this:

“Utter a sentence only if doing so is informative for the hearer.”
 3. The trouble is that I do not see that in the context of dynamic semantics we can say anything quite like the following: Accept only those sentences that are true. Or: When someone utters a

sentence accept the proposition that it expresses in the context of utterance only if that proposition is true.

- a. The problem is that in dynamic semantics, sentences are not true, or true-in-a-context, and utterances of sentences do not express propositions.
- b. One could say, I suppose, that the corresponding norm of discourse is something like this: One should accept a sentence only if the resulting information state is true. The trouble with that formulation is that it is too demanding; it requires one to first make sure that the information state one starts with is true.

IV. I now turn to some doubts about some of the main motivations for the dynamic approach.

A. As for anaphora, the main problem for the dynamic approach is *forward anaphora*.

1. I might say something like this: “I don’t know if he has come yet, but someone was supposed to come and pick up the package for Chicago.”
2. In this case, the anaphoric pronoun “he” precedes the indefinite “someone” whose reference it in some sense picks up.
3. It seems that this phenomenon would be better accounted for on the supposition that a hearer listening to a discourse builds a “static” mental representation of a situation. When the hearer hears the first clause, “I don’t know if he has come yet,” he or she adds a representation containing an uninterpreted variable corresponding to the word “he”, which the hearer waits to interpret until he or she has heard some more of what is to come.

B. As for presupposition:

1. Again, the idea regarding presupposition is that a presupposition is a proposition that has to be already entailed by the context, or

common ground, if the sentence that bears the presupposition is to be allowed to perform an update.

- a. The trouble is that there is just not any sense in which update is really forbidden when the presupposition fails to be entailed by the common ground.
 - b. For example, if I say, “I have to pick up my sister at the airport” and you do not already know that I have a sister, then from what I say, you learn both that I have a sister and that I have to pick her up at the airport. The presupposition is informative.
 - c. The usual answer to this is that when a presupposition is not already entailed by the common ground, it can be “accommodated”.
 - i. But this answer undermines the theory of presupposition we began with.
 - ii. We cannot now say that a presupposition is a proposition that has to be entailed by the common ground if the sentence that bears it is to perform an update, because we allow the update to go through even if the common ground does not entail the presupposition, because the presupposition can be accommodated.
2. Further, I am not convinced that there is any work for this theory of presupposition to do. What Karttunen and Heim wanted it to do is solve the presupposition projection problem.
- a. For example, consider the following three sentences:
 - (a) John’s Jaguar is hidden.
 - (b) If John owns a Jaguar, then John’s Jaguar is hidden.
 - (c) If John’s Jaguar is hidden, then we will not see his Jaguar.Off hand, it seems that (a) presupposes that John has a Jaguar, (b) does not presuppose that, and (c) does again presuppose that.

- b. It seems that this pattern of presupposition is captured by the following theory:
- s admits “If P then Q” iff s admits P and s[P] admits Q.
 (“Admits” abbreviates “entails the presuppositions of”)
- i. s admits (a) only if s entails the proposition that John owns a Jaguar. But s admits (b) even if s does not entail the proposition that John owns a Jaguar, because s updated by the antecedent does entail that proposition. But s admits (c) only if s entails the proposition that John owns a Jaguar, because only in that case does s admit the antecedent.
 - ii. In sum, the presuppositions of the antecedent are projected onto the conditional as a whole, but whether the presuppositions of a consequent are projected onto the whole conditional depends on what the antecedent says.
- c. But I think this is an illusory achievement, because the phenomenon to be accounted for is not real. It’s just not true that the presuppositions of the antecedent are projected onto the conditional as a whole.
- i. Consider the following pair of sentences:
“John is contemplating buying a second car. If he uses his new car to drive to work, his daughter can use his old car to drive to her high school.”
 - ii. In this case, the conditional as whole does not presuppose that John has a new car, even though the antecedent, considered on its own, does presuppose that.
 - iii. As for (c), we may tend to “hear” that as presupposing that John has a Jaguar, but only because when we imagine a *typical* situation in which that sentence might be uttered, it is a situation in which John has a Jaguar.

C. Logical connectives

1. Recall that the behavior of the possibility connective “It might” was supposed to give us reason to adopt a dynamic semantics.
2. Actually, the full argument is that there is a kind of inconsistency that depends on the order in which things are said.
 - a. The following sequence is supposed to be inconsistent: $P, \Diamond\neg P$.
Once an information state is restricted to p-worlds, there are no non-p worlds in it.
 - b. However the following sequence is supposed to be just fine:
 $\Diamond P, \neg P$. The first sentence just affirms that there is a P-world in the information state. The second sentence then rules those out.
3. But I don't see here a reason to adopt dynamic semantics. While I agree that there is something inconsistent about the sequence $\langle P, \Diamond\neg P \rangle$, I think there is likewise something inconsistent about the sequence $\langle \Diamond P, \neg P \rangle$.
 - i. As I walk out of my house, I say to my wife, “It's going to rain”.
But then as I step outside I look up at the sky and say, “It might not rain”. It does seem as though, in saying “It might not rain”, I have *taken back* what I first said, namely, “It will rain”. So there is a kind of inconsistency in “It will rain” followed by “It might not rain”.
 - ii. But likewise: Suppose as I leave the house, I grab an umbrella, saying to my wife, “It might rain”. But then, as I leave the house, I look up at the sky and say, “Nah, it won't rain” and toss the umbrella back inside. Again, my second sentence amounts to taking back what I first said.
4. From this I infer that a semantics for natural language “It might” has to acknowledge that the *set* of sentences $\{P, \Diamond\neg P\}$ is inconsistent, not in a dynamic sense, but in a static sense.
5. Of course, we do not want to get the result that $P \models \neg\Diamond\neg P$,

i.e., $P \models \Box P$. So we need to reject the principle that if $\{P, Q\}$ is inconsistent then $P \models \neg Q$.

- a. But we can do that if we move to a three-valued semantics, which is what I would propose.
- b. So I think that the correct explanation of the data lies in adopting a three-valued semantics for the logic of natural language.

- V. In the past few years, Thony Gillies has been arguing that we can use the ideas of dynamic semantics to give an account of the meaning of “if”.
 - A. The main idea that emerges, as in his paper today, is that an indicative conditional is a “test” of a context. Conditionals do not add any information to what we had already. That is, they do not reduce the number of worlds in our context. But they tell us, in effect, whether we can keep our context or have to throw it out.
 - B. The updates performed by other kinds of sentences are specified as follows:

$$s[p] = \{w \in s \mid p \text{ is true at } w\} \text{ (} p \text{ atomic)}$$

$$s[\neg P] = s - s[P]$$

$$s[P \wedge Q] = s[P][Q]$$

$$s[P \vee Q] = s - ((s - s[P]) - s[Q])$$

The test performed by conditionals is as follows:

$$s[P > Q] = s \text{ if } s[P][Q] = s[P]; \emptyset \text{ otherwise.}$$

We say that P is true in s iff $s[P] = s$.

As a consequence of this, we have:

$$s[\neg(p > q)] = s \text{ if } \exists w \in s, p \text{ true at } w, q \text{ false at } w; \emptyset \text{ otherwise.}$$

In other words, the negation of a conditional is true in a context if and only if the conditional contains a counterexample.

We also have:

$$s[\neg(p > p)] = s[\Diamond p] = s \text{ if } \exists w \in s, p \text{ true at } w; \emptyset \text{ otherwise.}$$

Here I use lower case to indicate that the components do not themselves contain conditionals.

- C. This theory generates a logic with a lot of nice features. (It shares many of the distinctive features of the logic for indicatives that I defend in my own book on conditionals.)
1. For example, it has the result that Modus Tollens is valid for conditional-free substituends, but may be invalid for some substituends containing conditionals.
 2. $(p > q), \neg q / \neg p$ is valid for conditional-free substituends. If $\neg q$ is true in a context, so that q is false at every world in the context, then $(p > q)$ can only be vacuously true, so that p is false at every world in the context.
 3. $(p > (q > r)), \neg(q > r) / \neg p$ is not valid. $\neg p$ may fail to be true in the context (it may not support $\neg p$), because there may be a p -world in the context. Still if we update our information state with p , we may find that in the result r is true throughout the update with q , so that the first premise is true. And yet $(q > r)$ may be false in the original information state, if the information state contains a counterexample, so that the second premise is true.
 4. An intuitive counterexample: If a Republican wins, then if Reagan does not win, then Anderson will win. It is not the case that if Reagan does not win then Anderson will win. Therefore, a Republican will not win. That's the Modus Tollens version of McGee's purported counterexample to Modus Ponens.
- D. Unfortunately, this theory also has a patently wrong result. It validates the following argument form: $\diamond p, p > \neg(q > r) / \neg(q > r)$. Call this "Super Modus Ponens".
1. I take it that Super Modus Ponens is invalid. From the conditional premise we may derive the consequent only if we have another

premise at least as strong as the antecedent. But $\diamond p$ is of course not as strong as p .

2. But on Gillies's theory, this form of argument turns out to be valid. Suppose the premises are true in a context. So, by the first premise, there is a p -world in the context. So updating the context with p is not the empty set. But, by the second premise, there is a counterexample to $(q > r)$ in the result of updating with p . But that counterexample was present in the original context. So the conclusion is true in the context.
3. When I pointed out to Thony that his theory validates this argument, he replied that result was "good prediction" of his theory. I think he's plainly wrong about that.
- [4. At the meeting, Frank Veltman pointed out that the question can be reduced to this: Should $\diamond \neg(p > q)$ logically imply $\neg(p > q)$? Gillies's theory says yes. I say no.]

VI. [I did not have time to present the following material at the meeting.] Thony Gillies has also been arguing that the behavior of subjunctive conditionals gives us reason to adopt a dynamic semantics.

A. Compare:

Forward Sobel Sequence (OK):

1. If Albert had come to the party, then it would have been great.
2. If Albert and Betty had come to the party, then it would have been awful.

This seems fine.

Reverse Sobel Sequence (Not OK):

2. If Albert and Betty had come to the party, then it would have been awful.
1. If Albert had come to the party, then it would have been great.

There is something awkward about this second sequence. We feel that what the speaker must have meant to say was something like this: “If Albert had come to the party *and Betty hadn't*, then it would have been great”.

- B. On any theory of subjunctive conditionals according to which Strengthening of the Antecedent is invalid, we will have the result that sentences 1 and 2 are consistent.
 - 1. If Strengthening of the Antecedent is invalid, then from 1 we cannot derive the contradictory of 2, “If Albert and Betty had come to the party, then it would have been great”.
 - 2. But it remains to explain the oddity of the Reverse Sobel Sequence.
- C. Thony Gillies’s idea is that we can account for the asymmetry in a dynamic setting.
 - 1. Gillies proposes that subjunctive conditionals are strict conditionals that presuppose the possibility of their antecedents.
 - 2. When a subjunctive conditional “If had been p, then would have been q” is uttered, the context is altered to accommodate the possibility of the antecedent (which might mean that possibilities are added), and the conditional updates the context so that in the resulting context every p-world is a q-world.
 - 3. The Forward Sobel Sequence is OK, because initially the context might not contain an Albert-and-Betty-come world, and then when we expand the context to include one, we might be able to update so that all of the Albert-and-Betty-come worlds are party-awful worlds.
 - 4. But the Reverse Sobel Sequence is not OK, because once we accommodate the first conditional by adding Albert-and-Betty-come worlds, there is nothing more to do to accommodate the second conditional, so that once the context is updated by the first conditional, the second conditional is inconsistent with it.

D. I am not sure that this is an especially strong selling point for the dynamic approach to subjunctive conditionals, because we have the same asymmetry in the case of indicative conditionals.

1. If we rewrite the conditionals as indicatives, we find exactly the same asymmetry.

Forward Indicative Sobel Sequence (OK):

1. If Albert came to the party, then it was great.
2. If Albert and Betty came to the party, then it was awful.

Reverse Indicative Sobel Sequence (Not OK):

2. If Albert and Betty came the party, then it was awful.
 1. If Albert came to the party, then it was great.
2. Gillies's explanation of the subjunctive case is not available in the indicative case because, I claim, indicatives do not in the same way presuppose the possibility of their antecedents, and I think Thony agrees with that.
 3. On the contrary, if the antecedent has been ruled out, then on that basis we may infer that the conditional as a whole is true. Thus, the following argument, I claim, is valid:

I will meet you tomorrow.

If I do not meet you tomorrow, then dinosaurs rule the earth.

By contrast, the following argument, with a subjunctive conclusion, is not valid:

I will meet you tomorrow.

-----.

If I did not meet you tomorrow, then dinosaurs would rule the earth.

E. So I think we need a different explanation than Gillies's. I can't go into details, but the one I would favor rests on what I call *the principle of antecedent absorption*. This says that if we hear a sequence of two conditionals:

If p then q. If r then s.

then we tend to interpret the second one as if the antecedent of the first were part of the antecedent of the second, thus:

If p then q. If (p and) r then s.

This is a species of what is sometimes called "modal subordination".