

Two-Dimensional Semantics – the Basics

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‘Two-dimensional semantics’ denotes a family of semantic theories rooted in intensional semantics, held together by shared general ideas, yet divided by deep divergences in semantic aims and philosophical aspiration. 2d-theorists agree that our sentences’ truth-values vary with what the facts are, as well as with what the sentences mean. To model this twofold dependence of truth on fact and meaning, 2d-semantics assign our expressions intensions of more than one kind. The resulting formal framework, common to all 2d-semantics, distinguishes one dimension of actual worlds and primary intensions from a second dimension of counterfactual worlds and secondary intensions. (Hence *two-dimensionalism*.) These formal similarities often obscure the deep conceptual rifts between different interpretations of the 2d-framework. Kaplan interprets it to capture context-dependence, Stalnaker understands it to model meta-semantic facts, and Chalmers construes it to display the epistemic roots of meaning.

1. Intensional Semantics

Intensional semantics is anchored in five ideas. *First idea: meaning is representation*. The (literal) meaning of a sentence can be equated with how the sentence represents things as being. *Second idea: representational content equals truth-conditions*. How a sentence represents things as being is encapsulated in its truth-conditions. How ‘Pavarotti is famous’ represents things as being can be gauged from the situations the sentence is true in, i.e. that accord with how the sentence represents things as being. *Third idea: truth-conditions are truth-value-distributions over possible worlds*. Truth-conditions can be understood as assignments of truth-values across possible worlds. We can model the truth-conditions of ‘Pavarotti is famous’ by assigning the sentence the truth-value *true* in all possible worlds that accord with it, and the truth-value *false* in all that don’t. Here a *possible world* is taken to be a comprehensive counterfactual alternative to the way our actual world is. A possible world hence encapsulates a complete specification of all facts, and the space of possible worlds comprises a world for each possible counterfactual variation of our own. Some possible worlds, like those similar to ours save for the fact that Pavarotti isn’t famous (and whatever

may follow from it), will differ only slightly from our world. Other possible worlds, such as those with fundamentally different laws of nature, will deviate substantially from our actual world. *Fourth idea: extensions are compositional.* The truth-value of a sentence exhibiting a specific formal structure is determined by the reference of the descriptive terms it contains. ‘Pavarotti is famous’ is true in our world because the individual ‘Pavarotti’ designates a member of the set of objects the predicate ‘is famous’ applies to. Conversely, ‘Pavarotti is famous’ is false in a world where the individual ‘Pavarotti’ designates does not belong to the set of objects ‘is famous’ applies to there. The object a singular term designates, the set of objects a predicate applies to as well as the truth-value a sentence has are called the *extension* of the singular term, predicate, and sentence, respectively. Hence, the extension of a sentence in a possible world is determined by the extensions its constituent terms have in that world. *Fifth idea: intensions are compositional, too.* The truth-conditions of a sentence are determined by the extensions its constituent terms have across possible worlds. That ‘Pavarotti is famous’ has the truth-conditions it has results from the fact that ‘Pavarotti’ denotes an individual in every possible world, and that ‘is famous’ determines a (varying) set of object in every possible world. An assignment of extensions to all possible worlds – that is, a function $f: W \rightarrow E$ from possible worlds to extensions – is called an *intension*. Hence, the intensions of all sentences are determined by the intensions of the terms they contain.

These ideas yield a *semantical conclusion: (literal) meanings are intensions*. More carefully put, intensional semantics is driven by the idea that we can model the representational properties of our language by assigning intensions to terms and sentences. From this a significant *meta-semantical conclusion* follows: *meaning is intimately linked to modality (i.e. to possibility and necessity)*.

2. Kripkeanism

Kripke ([10] and [12]) relies on both conclusions to establish startling semantic consequences, and draw significant philosophical conclusions. In introducing a proper name or a natural kind term, we identify some *object* or *substance*. We might introduce ‘Hesperus’ as a name for the brightest star in our evening sky, or ‘gold’ as a designator for the chemical element most wedding rings around here are made of. Kripke argues that these very objects and samples *rather than the way we identify them* determine the terms’

intensions. Hence, 'Hesperus' denotes in any possible world the object that in *our* world is the brightest star in the evening sky, regardless of whether it plays the respective role in those counterfactual circumstances. Similarly, 'gold' denotes in a possible world the chemical element that is in *our* world used in wedding rings, regardless of whether it is so employed in that possible world. This model inspires Kripke's core semantic theses. For one: *some terms designate rigidly*. Proper names like 'Hesperus' and natural kind terms like 'gold' designate one and the same object or substance, respectively, across all possible worlds. Secondly, *many identity statements are necessarily true (if they are true at all)*. Since 'Hesperus' and 'Venus' both denote the object they denote here in all possible worlds, and since the brightest star in the evening sky happens to be Venus, 'Hesperus = Venus' is necessarily true, i.e. true in all possible worlds. Finally, *some necessary truths are a posteriori*. Since the chemical elements most wedding rings around here are made of happens to be the element with atomic number 79, 'Gold is the element with atomic number 79' is a necessary truth. Still, we had to do empirical research to determine the atomic number of the chemical element most weddings rings around here are made of. Hence 'Gold is the element with the atomic number 79' is a necessary truth *a posteriori*.

Kripke infers two profound philosophical principles from his semantic considerations. These mark a deep disagreement with philosophical tradition. For one, Kripke concludes that necessary truth and *a priori* knowledge do not coincide. *Pace* Kant, metaphysics is autonomous from epistemology. Secondly, Kripke concludes that the identifying knowledge a competent speaker associates with his terms *cannot be* what determines the reference and truth-conditions of his expressions. *Pace* Frege, semantics is autonomous from epistemology.

2. Two-Dimensional Semantics – the Key Ideas

Traditional intensional semantics assigns a sentence a single intension. This intension captures how the truth-value of the sentence depends on, and varies with, the respective facts. Its standard intension makes 'Pavarotti is famous' come out true for some world if the facts in that world accord with what the sentence says. 2d-semanticists draw our attention to another dependence. A sentence's truth-value also depends on, and varies with, what the sentence means. That 'Pavarotti is famous' is true in our world depends on the fact that the sentence expresses the proposition *that Pavarotti is fa-*

mous. 2d-semanticists agree that our semantics has to account for this twofold dependence of truth-value on meaning and fact, and they agree that we can capture both dependencies relying on the apparatus of worlds and intensions familiar from intensional semantics. We simply need to add the distinction between counterfactual and actual worlds, and we have to make use of the threefold distinction of kinds of intension this effects.

The twofold dependence noted is most pronounced in sentences containing indexicals such as ‘I’ or ‘now’. Whether ‘I am in *Milano*’ is true in some possible world depends on the facts in that world, and it depends on who utters this sentence in the first place. If Pavarotti utters it, the sentence is true in a possible world if in that world, Pavarotti is in Milan. If someone else uttered it, the sentence will have different truth-conditions. Put generally, the truth of an indexical sentence in some counterfactual world depends what is the case in that world, and it depends on what is the case in the actual situation, or the actual world, it is uttered in. This inspires a general way to analyse the twofold dependence noted. We can hold that whether a sentence is true in some counterfactual world depends on the facts, depicted by what is the case in that world, and it depends on what the sentence means, determined by what is the case in the actual world. The counterfactual and actual worlds set apart here are not different entities. What gets discriminated are two different roles the very same possible worlds can play (assuming that we specify for worlds considered as actual a centre consisting of a speaker, a place and a time).

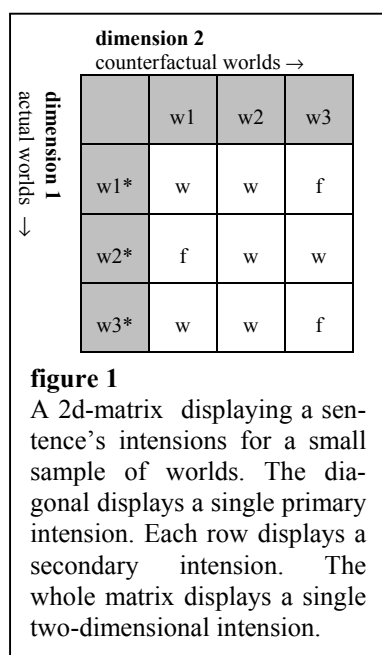
The distinction between counterfactual and actual worlds allows 2d-semanticists to distinguish three different kinds of intensions. An expression’s *primary intension* assigns it an extension in every *actual* world, determining a function $f: W_A \rightarrow E$ from actual worlds to extensions. An expression’s *secondary intension* assigns it an extension in every *counterfactual* world, determining a function $f: W_C \rightarrow E$ from counterfactuals worlds to extensions. An expressions *two-dimensional intension* assigns it for any actual world a secondary intension, determining a function $f: W_A \rightarrow (W_C \rightarrow E)$ from actual worlds to secondary extension that portrays how the expression’s primary and secondary intension interlock.

Assigning these different intensions to a sentence p allows 2d-semantics to capture the way p ’s truth-value varies with actual and counterfactual world. That in turn displays how it depends on fact and meaning. A plausible assignment of intensions to the sentence ‘I am in *Milano*’ is this: The primary intension of ‘I am in *Milano*’ yields varying extensions across ac-

tual worlds depending on who utters the sentence. This captures the dependence of the sentence’s meaning on who happens to utter it. The secondary intension yields varying extensions across counterfactual worlds depending on whether or not the one having uttered ‘I’ is in these counterfactual circumstances in Milan. This captures the dependence of the sentence’s truth on what the respective facts are. The 2d-intension combines these two, capturing for each actual world which secondary intension an utterance of ‘I am in *Milano*’ in this actual world effects.

The resulting formal structure (see figure 1), comprising two dimensions of worlds and three kinds of intensions, is common to all 2d-semanticists. 2d-semanticists agree that we can model all representational properties of our language by assigning primary, secondary and/or two-dimensional intensions to our terms and sentences. This consensus extends to the dimension of counterfactual worlds and secondary intensions. 2d-semanticists agree that this dimensions captures how an expression’s extension depends on the facts, and they take these worlds and intensions to be the possible worlds and standard intensions familiar from traditional intensional semantics. Most 2d-semanticists believe that Kripke’s claims concerning rigid designation and necessary truth are right about those. They agree that the secondary intension of ‘Hesperus’ picks out the same object in all counterfactual

worlds, and they acknowledge that ‘Gold is the element with atomic number 79’ is true in all counterfactual worlds. There is *no* consensus on the understanding of actual worlds and primary intensions. 2d-semanticists hold that this dimension captures how an expression’s extension depends on what it means. But they strongly disagree on the nature of this dependence. The paradigmatic interpretations put forth by Kaplan, Stalnaker, and Chalmers exhibit deep divergences in semantic aim and philosophical aspiration, and they yield different answers to the questions (1) ‘What are actual worlds?’ and (2) ‘What precisely do we need the apparatus of actual worlds and primary intensions for?’.



3. Kaplan: Actual Worlds as Contexts of Use

Kaplan's work on indexicals and demonstratives (see [8] and [9]) has done much to shape 2d-semantics. Adhering meticulously to the distinction between linguistic *tokens*, i.e. expressions occurring in contexts, and linguistic *types*, i.e. expressions apart from contexts, Kaplan detects a semantic asymmetry between indexical tokens and indexical types. Indexical tokens have reference but no descriptive meaning. Any utterance of 'I' in a context refers to an individual. This is what its meaning consists in, and this is all it contributes to the sentence it occurs in. Pavarotti's utterance 'I am in *Milano*' thus expresses a proposition about *him*, i.e. Pavarotti. Indexical types, on the other hand, have descriptive meaning but no reference. The type 'I' does not refer. It still has a descriptive meaning any competent speaker must know. This meaning consists in a conventionally assigned rule dictating that any utterance of 'I' refers to whoever produces the token in the respective context. Thus the sentence type 'I am in *Milano*' does not express a proposition. But having grasped its meaning, any speaker will know which proposition a token of this type expresses *if* it is uttered in a context.

Kaplan concludes that we must distinguish two kinds of meaning. Linguistic tokens have *contents*. The content of a term captures what it refers to, and the content of a sentence is the proposition it expresses. Linguistic types have *characters*. The character of an expression is a conventionally determined rule dictating which content a token of that expression expresses if it is uttered in a context. The characters of terms like 'grandmother' will assign all tokens the very same content. By contrast, the characters of indexicals and demonstratives will assign their tokens varying contents, depending on the respective contexts. It is this dependence of token meaning (or content) on type meaning (or character) cum context that Kaplan captures by means of a 2d-framework. He models contents as secondary intensions. The secondary intension of a sentence token specifies its truth-conditions and captures the proposition it expresses. Kaplan models characters as two-dimensional intensions. The two-dimensional intension of a sentence type specifies a secondary intension for each actual world, and thus captures how the proposition expressed by a token of that sentence varies with the context the token occurs in.

This yields a rigorous semantic interpretation of the 2d-framework. Kaplan's answer to (1) is straightforward: actual worlds are contexts, or possible occasions expressions can be used in. His answer to (2) voices a corre-

sponding idea: we need actual worlds and primary intensions to account for the context dependence of language. It is widely acknowledged that Kaplan's semantic theory yields a powerful intensional semantics for indexicals and demonstratives that fits our semantic intuitions, generates the correct modal truths, and that can be generalized to capture all kinds of context-dependence (see [11]). Kaplan's semantics moreover respects Kripke's semantics insights about rigid designation and necessary truth, given that these are taken to concern contents rather than characters, and it conforms to Kripke's philosophical principles. Kaplan consequently thinks of his 2d-theory as a conservative extension of Kripke's account.

4. Stalnaker: Actual Worlds as Means for Reinterpretation

The key to Stalnaker's influential use of 2d-means (see [13] and [14]) is his puzzle of informativity. Endorsing the following three claims, Stalnaker finds himself in a quandary: (i) Being necessarily true, the proposition expressed by 'Hesperus = Phosphorus' does not exclude any possibility. (ii) A sentence can be used to communicate contingent information about the world only if the proposition it conveys excludes some possibility. (iii) 'Hesperus = Phosphorus' can be used to communicate contingent information about the world. Stalnaker maintains that the ensuing inconsistency is merely apparent. In order to resolve the puzzle, he distinguishes the proposition *conveyed* with an informative use of 'Hesperus = Phosphorus' from the proposition *expressed* in that use. The latter is determined by the standard semantic rules for the sentence, and it is necessarily true. The former is inferred from the speaker's pragmatic communicative intentions, and it is contingent. Reinterpreting the speaker's utterance to convey this contingent proposition allows the hearer to make sense of his utterance.

Reinterpretation is a familiar pragmatic procedure. If the content of an utterance manifestly violates a conversational maxim, we assign it a different content by drawing on the speaker's communicative intentions. If Pavarotti asserts 'I am not famous', the apparent violation of the conversational maxim of truthfulness may motivate the hearer to understand him as expressing discontent with the evening's turnout. The same mechanism moves the hearer of 'Hesperus = Phosphorus' to reinterpret, for he notices that the standard proposition expressed by the sentence is ill-fit to convey information. The hearer reasons thus: (i) 'Hesperus' has been introduced as a name for the brightest star in the evening, and 'Phosphorus' has been introduced

as a name for the brightest star in the morning. (ii) The objects these introductions did yield depended on astronomical facts in our actual world. If the astronomical facts in the actual world had been relevantly different, ‘Hesperus’ and ‘Phosphorus’ would name two different object. (iii) What the speaker intends to convey is that our world is one where this is not so. He wants to convey that our world conforms to the proposition *that the brightest star in the evening = the brightest star in the morning*.

In reinterpretation, the hearer thus draws on his meta-semantic knowledge that the standard semantic meaning of some expression depend on features of our actual world. It is this dependence of semantic meaning on introductory procedure cum actual world that Stalnaker captures by means of a 2d-framework. He models standard semantic meanings as secondary intensions. Stalnaker models the propositions assigned in reinterpretation as primary intensions (that he calls, in line with figure 1, *diagonal propositions*). By displaying how an expression’s extension varies with the respective actual world, a primary intension captures how a term’s standard semantic meaning varies with the circumstances under which it is introduced.

This yields an austere meta-semantic interpretation of the 2d-framework. Stalnaker’s answer to (1) is straightforward: actual worlds are possible alternative environments we might have introduced our terms in. In his answer to (2), he distinguishes the subject matter of the 2d-framework from its employment: we need actual worlds and primary intensions to capture the actual-world-dependence of semantic meaning, and hence to describe meta-semantic facts; still we draw on it to make sense of otherwise incomprehensible utterances, and hence put it to a pragmatic use. Stalnaker thus uses a 2d-framework to model the meta-semantic *überbau* to our semantics and its pragmatic role, whereas Kaplan employs a 2d-framework to analyse the inner workings of our semantics. Stalnaker consequently holds that his interpretation supplements rather the conflicts with Kaplan’s account, just as he believes that his meta-semantics conforms to Kripke’s semantic insights, as well as to Kripke’s philosophical principles.

5. Chalmers: Actual Worlds as Epistemic Possibilities

Chalmers (see [1] to [4]) draws on two ideas. His one idea is that reference and truth are *scrutable*. Given a description of our world cast in neutral terms, a speaker can (in principle) *a priori* infer what her expressions refer to, and which of her sentences are true. From a description of the appear-

ance, make-up, and behaviour of chemical substances that makes no use of the term 'gold', she can *a priori* infer the truth of 'Gold is the chemical element with atomic number 79'. Chalmers other idea is that of *epistemic modality*. Epistemically possible hypotheses depict ways our world might be for all we can (in principle) know *a priori*, and a complete epistemic possibility depicts an epistemically possible world. For all we can know *a priori*, gold could be the chemical element with atomic number 55. A world in which this is true hence is an epistemic possibility. Chalmers merges these ideas in his thesis of *generalized scrutability*. Given a description of any epistemically possible world phrased in neutral terms, a competent speaker can (in principle) infer what her terms refer to in that world, and which of her sentences are true in that world. This ability reveals that speakers associate epistemic intensions – i.e. functions from epistemically possible worlds to extensions – with their terms and sentences. The epistemic intension associated with an expression is fundamental to the expression's significance. Firstly, it captures cognitive significance. If a term plays a cognitive role for a speaker at all, she associates an epistemic intensions with it that reveals what the term means for her. If 'Pavarotti' is significant to you at all, you will assign epistemic intensions to this terms; and if your efforts to identify its extensions in epistemically possible worlds pivots on whoever comes closest to be a brilliant though overweight Italian tenor, this captures what 'Pavarotti' mean for you. Secondly, the epistemic intension determines an extension in the actual world. For the actual world simply is the actualized epistemic possibility. Thirdly, the epistemic intension will ground the counterfactual intensions for all terms whose counterfactual intension depends on actual world extension. Say your epistemic intension makes you identify gold as the chemical element that most wedding rings are made of. Since around here it is the element with the atomic number 79 that plays this role, and given that 'gold' designates rigidly what it designates around here, 'Gold is the element with atomic number 79' comes out true in all counterfactual alternatives.

It is this dependence of truth and reference on our ability to determine extensions in epistemically possible worlds that Chalmers captures by means of a 2d-framework. Chalmers identifies primary intensions with epistemic intensions. By displaying how an expression's extension varies with the respective actual world, a primary intension captures how a term's actual extension varies with the respective epistemic possibility that is realized in our world. Chalmers' understands an expression's secondary intension to

capture its extension across counterfactual alternatives, and he employs two-dimensional intensions to model the dependence of secondary intensions on primary ones. His account embraces Kripke's semantic ideas of rigid designation and necessary truth, given that they are understood to concern secondary intensions, and he proposes an analysis of necessary *a posteriori* truths: a sentence is necessary *a posteriori* if it combines a necessary secondary intension with a contingent primary intension.

This yields a robustly epistemic interpretation of the 2d-framework. Chalmers' answer to (1) is unequivocal: actual worlds are epistemic possibilities. Chalmers' answer to (2) is similarly clear: we need the apparatus of actual worlds and primary intensions to capture the epistemic dependence of meaning. His epistemic 2d-account moves Chalmers to renounce both Kripkean principles. Chalmers maintains that Kant is right. There is a deep link between necessity and *a priori*, for a sentence is epistemically necessary if and only if it is *a priori*. Chalmers also holds that Frege is right. Semantics is indeed rooted in epistemology. For the identifying knowledge a competent speaker associates with her terms, as is revealed by the epistemic intension he associates with it, *precisely is* what determines the reference and truth-conditions of her expressions. Hence, metaphysics is not autonomous from epistemology. And neither is semantics.

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