

# Possible world semantics meets metaphysics

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## Abstract

Possible world semantics has been gradually fine-grained over the years. First, simple extensional semantics was fine-grained by relativizing it to worlds considered as counterfactual, thus generating standard possible-world semantics, which was later further fine-grained by relativizing it to worlds considered as actual, thus generating two-dimensional semantics. However, worlds considered as actual were only considered with respect to the empirical facts obtained in such worlds. This paper shows that no less of an important role is played by another feature of actual worlds, namely, the criteria of identity that obtain in such worlds.

**Key words:** Possible world semantics, reference, intension, criteria of identity

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## Introduction

A semantic theory should be able to account for sameness in meaning as well as for differences in meaning between expressions. Failing to do so indicates that the theory lacks the resources to capture some aspect of meaning, which invites a search for a better theory that does offer the required account. This paper is restricted to possible world semantics—a particularly powerful type of semantic theory, that has been extensively applied both inside and outside philosophy.<sup>1</sup> Accordingly, the discussion focuses on truth-conditional meaning.<sup>2</sup> Section 2 proposes a convenient way of reconstructing the development of possible world semantics, along the following lines: At a certain stage, we discover two terms that have the same semantic value<sup>3</sup> according to our present version of possible world semantics, yet have different designations relative to some index X. This indicates that there is a difference in meaning between the two terms (for no two terms can share the exact same meaning and yet differ in designation relative to some circumstances), and that this difference in meaning cannot be accounted for by our present version of possible world semantics (for according to that semantics, the two terms share the same semantic value). This is then solved by relativizing our possible world semantics to the index X, thus generating a finer-grained semantic theory. Later, we discover two *other* terms that have the same semantic value according to our *new* version of possible world semantics, yet have different designations relative to some *other* index, Y. And so on. Following this pattern, ‘simple extensional semantics’ was relativized to worlds considered as counterfactual, thereby generating the finer-grained ‘standard possible world semantics,’ which itself was later relativized to worlds considered as actual, thereby generating the yet finer-grained ‘two-dimensional (2D) semantics.’<sup>4</sup>

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<sup>1</sup> To be sure, there are semantic theories other than possible world semantics on offer. Of the various merits of possible world semantics that justify such a restricted discussion, one that particularly stands out is this theory’s ability to apply Tarskian model-theoretic tools (Menzel, 2023). For other merits of possible world semantics and the breadth of its application, see Perry (1998).

<sup>2</sup> Two terms have different truth-conditional meanings when there are circumstances relative to which the two have different designations.

<sup>3</sup> The semantic value of an expression is its contribution to the meaning of the complex expression of which it is a part.

<sup>4</sup> ‘Two-dimensional semantics’ refers here to the general semantic approach that uses two possible world parameters in order to characterize the truth-conditional meaning of expressions. Consequently, a. the discussion is not restricted to expressions of a specific kind (e.g., to

Worlds considered as actual—the domain that generated 2D-semantic—are standardly considered with respect to the *empirical facts* that obtain in such worlds (e.g., that in world W considered as actual, the last great philosopher of antiquity was Aristotle). However, it will be argued here that there is another feature of a world considered as actual, that is no less crucial for determining designation, namely, the *criteria of identity* that, in fact, obtain in such a world (e.g., that being the same person amounts to having the same psychological properties in that world).<sup>5</sup> Section 3 outlines a proposed richer version of 2D-semantic, in which each world considered as actual is described in terms of both the empirical facts *and* the criteria of identity that obtain in such a world. In section 4, this enriched version is put to a test, following the pattern described above: Is there a difference in meaning between terms that the present version of 2D-semantic cannot account for, but the proposed enriched 2D-semantic can? Two such terms are introduced, namely, terms that have the same 2D semantic value yet have different designations relative to some criteria of identity that obtain in the actual world. This indicates that there is a difference in meaning between the two terms, which cannot be accounted for by 2D-semantic. As in the previous cases, this is then solved by relativizing two-dimensional semantics to the relevant index, namely, to criteria of identity. Such relativization fine-grains the present dimension of worlds considered as actual, thus suggesting a finer-grained version of 2D-semantic. Section 5 addresses some possible objections, and section 6 concludes the discussion.

### The Evolution of Possible World Semantics

According to *simple extensional semantics*—also known as 0-dimensional (0D) semantics<sup>6</sup>—the semantic value of an expression is its extension. Now ‘H<sub>2</sub>O’ and ‘the watery stuff’ (i.e., the tasteless, odorless potable liquid that falls from the sky and flows in rivers, etc.)<sup>7</sup> have the same extension and, hence, the same semantic value according to this semantic theory. Yet the two terms have different designations relative to different *worlds considered as counterfactual*. For example, in a counterfactual world where the watery stuff is composed not of H<sub>2</sub>O molecules but rather of, say, XYZ molecules,<sup>8</sup> ‘the watery stuff’ designates that watery-XYZ stuff, whereas ‘H<sub>2</sub>O’ does not. By contrast, in a counterfactual world in which all collections of H<sub>2</sub>O molecules are not watery but rather, say, pink-solid,<sup>9</sup> ‘H<sub>2</sub>O’ designates this pink-solid H<sub>2</sub>O stuff whereas ‘the watery stuff’ does not. Table 1 below illustrates these designations.

	<b>W<sub>1</sub></b> <b>watery H<sub>2</sub>O</b>	<b>W<sub>2</sub></b> <b>watery XYZ</b>	<b>W<sub>3</sub></b> <b>pink solid H<sub>2</sub>O</b>	...
<b>‘H<sub>2</sub>O’</b>	+	-	+	
<b>‘The watery stuff’</b>	+	+	-	

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indexicals as in Kaplan (1989), or to modal quantifiers, as in Crossley and Humberstone (1977)); and, b. the discussion does not apply to non-semantic interpretations of the two-dimensional framework (e.g., Stalnaker’s (2004) ‘metasemantic’ interpretation).

<sup>5</sup> For reasons to be specified in section 3, it will be assumed here that, just like the empirical *facts* that obtain in an actual world, so are criteria of identity, an objective, mind-independent, feature of reality.

<sup>6</sup> Schroeter (2021, section 1.1).

<sup>7</sup> ‘The watery stuff’ is arguably not the best choice of a term to denote whatever has the actual manifest properties of H<sub>2</sub>O, yet we follow here the common practice, at least since Chalmers (1996: 57) and Jackson (1998: 49).

<sup>8</sup> Putnam (1973).

<sup>9</sup> Steward (1990).

Table 1: The designations of ‘H<sub>2</sub>O’ and of ‘the watery stuff’. ‘+’ indicates that the term on the left designates the stuff in the counterfactual world above; ‘-’ indicates that it doesn’t.

The difference in designation between the two terms indicates that they differ in meaning—for no two terms can share the same meaning and yet differ in designation. And since 0D-semantics assigns the two terms the same semantic value, 0D-semantics lacks the resources to account for this difference in meaning. This is solved by relativizing 0D-semantics to such worlds considered as counterfactual, thus arriving at a finer-grained possible world semantics—*standard possible world semantics*, or one-dimensional (1D) semantics. According to such 1D-semantics, the semantic value of a term is a function from worlds considered as counterfactual to extensions, or, in short, the term’s *intension*.<sup>10</sup> Since the intensions of ‘H<sub>2</sub>O’ and of ‘the watery stuff’ differ (as illustrated in Table 1), they have different semantic values according to 1D-semantics, and this accounts for their difference in meaning.

Now, consider the actualized term ‘the actual watery stuff,’ which is *stipulated* to designate, with respect to each counterfactual world W, the stuff that is watery in the actual world,<sup>11</sup> if it exists in W<sup>12</sup> (whether it is watery in W or not). Since the stuff that is watery in the actual world happens to be H<sub>2</sub>O, it follows that both ‘H<sub>2</sub>O’ and ‘the actual watery stuff’ designate H<sub>2</sub>O in every counterfactual world, as illustrated in Table 2 below.

	W <sub>1</sub> Watery H <sub>2</sub> O	W <sub>2</sub> watery XYZ	W <sub>3</sub> pink solid H <sub>2</sub> O	...
‘H <sub>2</sub> O’	+	-	+	
‘The actual watery stuff’	+	-	+	

Table 2: The designations of ‘H<sub>2</sub>O’ and of ‘the actual watery stuff’

Thus, both ‘H<sub>2</sub>O’ and ‘the actual watery stuff’ have the *same intension*, and hence, according to 1D-semantics, both have the same semantic value. Yet, although the two terms have the same intension relative to our actual world, they will have different intensions relative to other possible worlds *considered as actual*, e.g., relative to a world in which the *actual* watery stuff is composed of XYZ molecules. Relative to such a watery-XYZ world considered as actual, ‘the actual watery stuff’ will designate, with respect to every counterfactual world W, the XYZ stuff in W (bottom row in Table 3 below). By contrast, ‘H<sub>2</sub>O’ will continue to designate, with respect to every counterfactual world W, the H<sub>2</sub>O stuff in W (regardless of what world is considered as actual). Table 3 below illustrates these designations.

<sup>10</sup> Needless to say, other semantic theories that are not possible-world semantics, accounted for this difference in meaning in different ways. Notably, Frege used the notion of ‘sense’ to account for such differences. Yet, as stated above, this paper focuses exclusively on possible-world semantics (see footnote 1).

<sup>11</sup> Admittedly, the rigidity of natural kind terms like ‘water’ and ‘gold’ has been the subject of much debate, which is also relevant to actualized descriptions like ‘the actual watery stuff.’ (See Soames (2002), and LaPorte (2013), for elaborate discussions.)

<sup>12</sup> Indeed, this makes ‘the actual F,’ by definition, *persistently* (rather than *obstinately*) rigid. See Salmon (1982: 33-4).

	$W_1$ Watery H <sub>2</sub> O	$W_2$ watery XYZ	$W_3$ pink solid H <sub>2</sub> O	...
'H <sub>2</sub> O'	+	-	+	
'The actual watery stuff'	-	+	-	

Table 3: The designations of 'H<sub>2</sub>O' and of 'the actual watery stuff', relative to a watery-XYZ world considered as actual

This difference in designation indicates that there must be a difference in meaning between the two terms, and that this difference cannot be accounted for by 1D-semantics, for the two terms have the same 1D semantic value (as was illustrated in Table 2). This is solved by relativizing 1D-semantics to such *worlds considered as actual*, thus arriving at a yet finer-grained possible world semantics—*two dimensional (2D) semantics*—according to which the semantic value of a term is a *function from worlds considered as actual to intensions*, or, in short, the term's *2D-intension*.<sup>13</sup> Tables 4 and 5 below correspond to the 2D intensions of 'H<sub>2</sub>O' and of 'the actual watery stuff', respectively.

<i>Worlds considered as Counterfactual</i> \ <i>Worlds considered as actual</i>	$W_1$ Watery H <sub>2</sub> O	$W_2$ watery XYZ	$W_3$ pink solid H <sub>2</sub> O	...
Actual watery stuff is H <sub>2</sub> O	+	-	+	
Actual watery stuff is XYZ	+	-	+	
...				

Table 4: 2D matrix for the term 'H<sub>2</sub>O'

<i>Worlds considered as Counterfactual</i> \ <i>Worlds considered as actual</i>	$W_1$ Watery H <sub>2</sub> O	$W_2$ watery XYZ	$W_3$ pink solid H <sub>2</sub> O	...
Actual watery stuff is H <sub>2</sub> O	+	-	+	
Actual watery stuff is XYZ	-	+	-	
...				

Table 5: 2D matrix for the term 'the actual watery stuff'

<sup>13</sup> According to Schroeter (2021, section 3.4), 'A semantic interpretation of the 2D framework takes the 2D framework to specify a semantic value of an expression. Kaplan's theory of indexicals is a semantic interpretation of the framework, as are Jackson's and Chalmers' generalized 2D-semantics.' However, strictly speaking, Chalmers is talking of 'a complex semantic value involving both a primary and a secondary intension.' For Kaplan, the 2D intension is not the term's semantic value ('content') but rather the term's 'character'. So, in Kaplan's terminology, what accounts for the difference in meaning between two terms is not their different semantic values but rather their different *characters*. At any rate, the account for the difference in meaning between two terms is based on the difference in their 2D intensions (whether the semantic value is regarded as the 2D intension or a 1D intension that varies across different possibilities).

As can be clearly seen in Tables 4 and 5, ‘H<sub>2</sub>O’ and ‘the actual watery stuff’ have different 2D intensions (specifically, they differ in their second row), and hence, according to 2D-semantics, they have different semantic values, which provides an account for their difference in meaning.<sup>14</sup>

### Criteria of Identity and Intensions

As Table 5 indicates, designations vary relative to different worlds considered as actual. More specifically, designations vary relative to different *empirical facts* considered as actual, e.g., relative to different chemical compositions of the watery stuff, considered as actual. However, as we shall now see, designations vary not only relative to such different empirical facts considered as actual but also relative to different *criteria of identity* considered as actual.<sup>15</sup> Take the proper name ‘Aristotle’. Being a rigid designator, ‘Aristotle’ designates *the same person* in every counterfactual world. So, clearly, the designation of ‘Aristotle’ in counterfactual worlds, (i.e., ‘Aristotle’s *intension*’) depends on what *being-the-same-person* in fact amounts to, i.e., it depends on the actual criteria of (personal) identity. For example, consider a counterfactual world  $W_1$  in which a psychological duplicate of Aristotle exists with entirely different physical properties. Would that person in  $W_1$  be Aristotle? Does the name ‘Aristotle’ designate that person? Alternatively, consider another counterfactual world  $W_2$  in which a physical duplicate of Aristotle exists with entirely different psychological properties. Would that person in  $W_2$  be Aristotle? Does the name ‘Aristotle’ designate that person? According to (a simplified version of) psychological criteria of personal identity, A is the same person as B iff A and B share the same psychological properties.<sup>16</sup> Hence, relative to such a criterion of identity, ‘Aristotle’ designates the person in  $W_1$  but not the one in  $W_2$  (upper row in Table 6 below). By contrast, according to (a simplified version of) a bodily criterion of personal identity, A is the same person as B iff A and B share the same body.<sup>17</sup> So relative to such a bodily criterion, ‘Aristotle’ designates the person in  $W_2$  but not the one in  $W_1$  (second row in Table 6).

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<sup>14</sup> The construction of the 2D matrix in terms of ‘possible worlds considered as actual’ vs. ‘possible worlds considered as counterfactual’ is due to Davies and Humberstone (1980: 3). According to Chalmers (2006: 578), different versions of two-dimensional semantics refer to the two sets of possible worlds in different ways:

Intuitively, the worlds in the column on the left represent ways the actual world can turn out (these are sometimes thought of more precisely as possible contexts of utterances, and are sometimes thought of as epistemic possibilities), while the worlds across the top reflect counterfactual ways that a world could have been (these are sometimes thought of more precisely as possible circumstances of evaluation, and sometimes thought of as metaphysical possibilities). It is sometimes said that worlds on the left column (one world per row), making up the “first dimension” of the matrix, correspond to different worlds considered as actual; while the worlds in the top row (one world per column), making up the “second dimension” of the matrix, correspond to different worlds considered as counterfactual.

The distinction between context of utterance and circumstances of evaluation is due to Kaplan (1989); the distinction between epistemic and metaphysical possibilities’ is due to Chalmers and Jackson (2001).

<sup>15</sup> This point has been previously made in Pelman (2017). A similar point was also made in a different context in Pelman (2015)

<sup>16</sup> See for example Unger (2000).

<sup>17</sup> This is the physical version of the *somatic* view (most notably held by Thomson (1997)).

	$W_1$ Aristotle's mind + another body	$W_2$ Aristotle's body + another mind	...
<b>Psychological criterion of identity</b>	+	-	
<b>Bodily criterion of identity</b>	-	+	
...			

Table 6: The designations of 'Aristotle' relative to different criteria of identity

As Table 6 illustrates, the designation of proper names like 'Aristotle' varies relative to different criteria of identity.

A comment about objectivity is in order. Empirical facts that obtain in the world—e.g., that Aristotle was the last great philosopher of antiquity—are intuitively considered an *objective feature of reality*. The millennia-long philosophical ongoing debates concerning the criteria of identity pertaining to objects like ships, tables, statues, and especially persons, evidently indicate that such criteria are also considered an objective feature of reality.<sup>18</sup> Thus, for example, for all we know, the criterion for being the same ship *may* actually be its material constitution, or it may be its spatiotemporal continuity; likewise, for all we know, the criterion for being the same personal *may* be psychological, or it may be bodily. Following this long philosophical tradition, we shall also assume here that criteria of identity are an objective feature of reality.<sup>19</sup> Generally then, *both* features of worlds considered as actual—namely, the empirical facts as well as the criteria of identity that obtain in such worlds—will be considered here an objective feature of reality.

Let us see now how all this fits in the overall picture. We have just witnessed that the designation of 'Aristotle' in counterfactual worlds varies relative to different criteria of identity. What about the designation of 'the actual watery stuff' with which we have been concerned above? Like 'Aristotle,' this term too is a *rigid designator*, i.e., it is stipulated to designate, with respect to every counterfactual world  $W$ , *the same stuff* that it designates in the actual world, namely, the same stuff as the actual watery- $H_2O$  stuff. But what will that stuff be? Will 'the actual watery stuff' designate the watery-XYZ stuff in counterfactual  $W_2$ ? And what about the pink solid  $H_2O$  stuff in counterfactual  $W_3$ ?

Just like in the case of 'Aristotle', the answer depends, of course, on what *being the same* amounts to in this case. More specifically, it depends on the criteria of identity for stuffs.<sup>20</sup> According to a *material* criterion of identity, stuff  $A$  is identical to stuff  $B$  iff  $A$  and  $B$  share the same chemical composition. Thus, relative to such a material criterion of identity considered as actual, being the same as the watery- $H_2O$  stuff amounts to being composed of  $H_2O$  molecules, and hence 'the actual watery stuff' will designate the watery- $H_2O$  stuff in counterfactual  $W_1$  as well as the pink solid  $H_2O$  stuff in counterfactual  $W_3$ , but not the watery-XYZ stuff in counterfactual  $W_2$  (top row in Table 7 below).<sup>21</sup>

<sup>18</sup> For a recent survey of different views concerning the criteria of identity for objects, see Wasserman (2021).

<sup>19</sup> Accordingly, deciding who of the above two candidates *is* Aristotle cannot be solved by claiming that the *name* 'Aristotle' is simply *ambiguous* between 'the-same-body Aristotle' and 'the-same-psychological-properties Aristotle'. For the criterion of identity is assumed a feature of reality that determines designation, and not part of the *meaning* of the term; the proper name 'Aristotle' simply means *this* person.

<sup>20</sup> Pelman (2014)

<sup>21</sup> Indeed, we assume that just like criteria of identity are constant across different times, they are also constant across counterfactual worlds.

However, we may *consider* other criteria of identity as actual, e.g., that being identical to the watery-H<sub>2</sub>O stuff simply amounts to being watery (i.e., being drinkable, odourless, tasteless, etc.). Put more generally, we may consider that the actual criterion of identity is: *A* is the same stuff as *B* iff *A* and *B* share their *manifest*, or macroscopic, qualities (just like we considered as actual a world in which the chemical composition of the watery stuff was not H<sub>2</sub>O but rather XYZ).<sup>22</sup> Indeed, *for all we know*, this may, in fact, be the case in our actual world (just like in the case of Aristotle, for all we know, the criteria of personal identity may be material or manifest).<sup>23</sup> Now relative to such a manifest criterion of identity considered as actual, being the same as the watery-H<sub>2</sub>O stuff amounts to being watery, and hence ‘the actual watery stuff’ will designate the watery-H<sub>2</sub>O stuff in counterfactual W<sub>1</sub> and the watery-XYZ stuff in counterfactual W<sub>2</sub>, but not the pink solid H<sub>2</sub>O stuff in counterfactual W<sub>3</sub>, for it is not watery (row 2 in Table 7).<sup>24</sup>

<i>Worlds considered as counterfactual</i>	W <sub>1</sub> watery H <sub>2</sub> O	W <sub>2</sub> watery XYZ	W <sub>3</sub> pink solid H <sub>2</sub> O	...
<i>Criteria of identity</i>				
<b>Material criteria of identity</b>	+	-	+	
<b>Manifest criteria of identity</b>	+	+	-	
...				

Table 7: Designation of ‘the actual watery stuff’ relative to different criteria of identity

It turns out that the designation of rigid designators like ‘Aristotle’ or ‘the actual watery stuff’ varies not only relative to different empirical facts considered as actual (as was illustrated in Table 5), but also relative to different criteria of identity considered as actual (as is illustrated in Table 7). It thus follows that, within possible world semantics, an accurate description of an actual world should include not only the empirical facts obtaining in such a world, but also the criteria of identity that obtain in such a world. For example, when we list the relevant worlds that should be considered as actual with respect to the term ‘the actual watery stuff,’ we ought not to consider only two types of worlds (as is customarily done), namely, 1. Watery-H<sub>2</sub>O world and, 2. Watery-XYZ world, but rather four types of worlds, 1. Watery-H<sub>2</sub>O world with material criteria of identity; 2. Watery-XYZ world with material criteria of identity; 3. Watery-H<sub>2</sub>O world with manifest criteria of identity; and, 4. Watery-XYZ world with manifest criteria of identity. Table 8 below illustrates the designation of ‘the actual watery stuff’ relative to such a fine-grained description of actual worlds.

Specifically, relative to the watery-H<sub>2</sub>O world with material criteria of identity considered as actual (Row 1), ‘the actual watery stuff’ designates H<sub>2</sub>O, and hence it designates the watery H<sub>2</sub>O stuff in counterfactual world W<sub>1</sub> and the pink solid H<sub>2</sub>O stuff in counterfactual W<sub>3</sub>, but not the watery-XYZ stuff in counterfactual W<sub>2</sub>. However, relative to a watery-H<sub>2</sub>O world with manifest criteria of identity considered as actual (Row 3), this term will designate whatever is *watery*, and hence it will

<sup>22</sup> For a notable defense of ‘manifest’ criteria of identity with respect to objects, see Burke (1994).

<sup>23</sup> Note that science merely discovers the chemical composition of stuffs, yet science remains silent about whether such chemical compositions also serve as the *criterion of identity* for stuffs. This does not apply to empirical facts such as the fact that the actual watery stuff is composed of H<sub>2</sub>O molecules, which, although for all we know *a priori* may indeed be composed of XYZ molecules, by contrast, for all we know *a posteriori* may *not* be composed of anything but H<sub>2</sub>O molecules.

<sup>24</sup> This example was previously used in Pelman (2017).

designate the watery H<sub>2</sub>O stuff in W<sub>1</sub> as well as the watery-XYZ stuff in W<sub>2</sub>, but not the pink solid H<sub>2</sub>O stuff in W<sub>3</sub>. What about watery-XYZ worlds considered as actual? Relative to such an actual world with *material* criteria of identity (Row 2), this term will designate XYZ, and hence it will designate the watery-XYZ stuff in counterfactual world W<sub>2</sub>, but neither the watery H<sub>2</sub>O stuff in counterfactual W<sub>1</sub> nor the pink solid H<sub>2</sub>O stuff in counterfactual W<sub>3</sub>. Lastly, relative to an actual watery-XYZ world with *manifest* criteria of identity (Row 4), this term will designate whatever is watery, and hence it will designate the watery H<sub>2</sub>O stuff in W<sub>1</sub> as well as the watery-XYZ in W<sub>2</sub>, but not the pink solid H<sub>2</sub>O stuff in W<sub>3</sub>.

		<i>Worlds considered as counterfactual</i>			
		<i>W<sub>1</sub> watery H<sub>2</sub>O</i>	<i>W<sub>2</sub> watery XYZ</i>	<i>W<sub>3</sub> pink solid H<sub>2</sub>O</i>	<i>...</i>
<i>Worlds considered as actual</i>					
Material criteria of identity	Actual watery stuff is H <sub>2</sub> O	+	-	+	
	Actual watery stuff is XYZ	-	+	-	
Manifest criteria of identity	Actual watery stuff is H <sub>2</sub> O	+	+	-	
	Actual watery stuff is XYZ	+	+	-	
...	...				

Table 8: A fine-grained 2D matrix for ‘the actual watery stuff’

As Table 8 clearly illustrates, the designation of ‘the actual watery stuff’ is determined by *both* features of worlds considered as actual, namely, by the empirical facts that obtain in such worlds, together with the criteria of identity that obtain in such worlds.

Table 8, in fact, suggests a finer-grained version of 2D-semantics. Like in the present, coarser version of 2D-semantics, the semantic value of a term is a function from worlds considered as actual to intensions, yet now these worlds considered as actual are described in terms of both the empirical facts and the criteria of identity that obtain in such worlds. So, according to this finer-grained version, the semantic value of a term is simply its *finer-grained* 2D intension.

Now, recall that moving from 0D-semantics to 1D-semantics enabled us to account for differences in meaning that the former possible-world semantics couldn’t, e.g., between ‘H<sub>2</sub>O’ and ‘the watery stuff’. Similarly, moving from 1D-semantics to 2D-semantics enabled us to account for differences in meaning that 1D-semantics couldn’t account for, e.g., between ‘H<sub>2</sub>O’ and ‘the *actual* watery stuff’. It thus seems appropriate to put the proposed fine-grained version of 2D-semantics to a test by asking for some difference in meaning that the present (coarse) 2D-semantics cannot account for, yet the proposed fine-grained 2D-semantics can. The following section proposes such a case.

### Putting the Fine-grained 2D-semantics to a Test

Consider the term ‘the stuff that has the same chemical composition as the actual watery stuff.’ What would its traditional 2D intension be? Relative to a watery-H<sub>2</sub>O world considered as actual, the chemical composition of the actual watery stuff is H<sub>2</sub>O, and hence this term designates, with respect to every counterfactual world W, the stuff that is composed of H<sub>2</sub>O molecules in W (upper row in Table 9). By contrast, relative to a watery-XYZ world considered as actual, the chemical composition of the actual watery stuff is XYZ, and hence the same term will designate, with respect to every counterfactual world W, the stuff that is composed of XYZ molecules in W (second row in Table 9).



<i>Worlds considered as counterfactual</i>	$W_1$ watery H <sub>2</sub> O	$W_2$ watery XYZ	$W_3$ pink solid H <sub>2</sub> O	...
<i>Worlds considered as actual</i>				
<i>Actual watery stuff is H<sub>2</sub>O</i>	+	-	+	
<i>Actual watery stuff is XYZ</i>	-	+	-	
...				

Table 9: 2D matrix for ‘the stuff that has the same chemical composition as the actual watery stuff.’

But this 2D matrix of ‘the stuff that has the same chemical composition as the actual watery stuff’ is exactly identical to the 2D matrix of ‘the actual watery stuff’, which was illustrated in Table 5 above. It thus follows that both these terms have the same (traditional) 2D intension, and hence have the same semantic value according to (traditional) 2D semantics.

Yet, the two terms will have different *fine-grained* 2D intensions. We have already seen the fine-grained 2D intensions of ‘the actual watery stuff’ in Table 8 above. What about the new term, namely, ‘the stuff that has the same chemical composition as the actual watery stuff’? What would *its* fine-grained 2D intension be? Relative to all watery-H<sub>2</sub>O worlds considered as actual (rows 1 and 3 in Table 10 below), this term designates, with respect to each counterfactual world W, the stuff that is composed of H<sub>2</sub>O molecules in W, i.e., regardless of whether the criteria of identity are material (row 1) or manifest (row 3). Specifically, relative to both such worlds, this term designates the watery-H<sub>2</sub>O stuff in counterfactual  $W_1$  and the pink solid H<sub>2</sub>O stuff in counterfactual  $W_3$ , but not the watery-XYZ stuff in counterfactual  $W_2$ . Similarly, relative to watery-XYZ worlds considered as actual (rows 2 and 4), this term designates, with respect to each counterfactual world W, the stuff that is composed of XYZ molecules in W, again, regardless of whether the criteria of identity are material (row 2) or manifest (row 4). Specifically, relative to such worlds considered as actual, this term designates the watery-XYZ stuff in  $W_2$  but neither the watery H<sub>2</sub>O stuff in  $W_1$ , nor the pink-solid H<sub>2</sub>O stuff in  $W_3$ . In other words, unlike the fine-grained 2D intension of ‘the actual watery stuff’, which varies relative to different criteria of identity considered as actual, the fine-grained 2D intension of ‘the stuff that has the same chemical composition as the actual watery stuff’ is entirely indifferent to such variations.

<i>Worlds considered as counterfactual</i>		$W_1$ watery H <sub>2</sub> O	$W_2$ watery XYZ	$W_3$ pink solid H <sub>2</sub> O	...
<i>Worlds considered as actual</i>					
Material criteria of identity	Actual watery stuff is H <sub>2</sub> O	+	-	+	
	Actual watery stuff is XYZ	-	+	-	
Manifest criteria of identity	Actual watery stuff is H <sub>2</sub> O	+	-	+	
	Actual watery stuff is XYZ	-	+	-	
...	...				

Table 10: A fine-grained 2D matrix for ‘the stuff that has the same chemical composition as the actual watery stuff’

By comparing Tables 8 and 10, it is clear that ‘the actual watery stuff’ and ‘the stuff that has the same chemical composition as the actual watery stuff’ *differ* in their

designations (specifically, they differ in rows 3 and 4), which indicates that they must also differ in meaning. And this difference cannot be accounted for by (traditional) 2D-*semantics*, for, as we have seen, the two terms share the same (traditional) 2D intension and hence the same (traditional) 2D semantic value. Yet, as is evident in Tables 8 and 10, the two terms differ in their *fine-grained* 2D intensions, and hence, according to the proposed fine-grained 2D-*semantics*, they have different semantic values. And this provides an account for their difference in meaning. To conclude, the proposed fine-grained 2D-*semantics* can account for a difference in truth-conditional meaning that the present (traditional) 2D-*semantics* cannot. The proposed fine-grained version passes this test.

### Objections and Replies

One may object in the following way. Why include criteria-of-identity-considered-as-actual in our *semantic* theory, i.e., why consider them as part of the *semantics* of our language? Surely, people can understand the meaning of ‘the actual watery stuff’ without ever knowing whether the actual criterion for being identical to this stuff is material or manifest. So, criteria of identity cannot be part of the *meaning* of this term. Firstly, it should be noted that this charge equally applies to the other feature of worlds considered as actual, namely, to the empirical-facts-considered-as-actual—a feature that is at the heart of (traditional) 2D semantics. For surely, people in the Middle Ages could easily understand the meaning of ‘the actual watery stuff’ long before it was known that the actual watery stuff was composed of H<sub>2</sub>O molecules, and not of, say, XYZ molecules. So, following the same line of reasoning, this empirical fact, too, cannot be part of the *meaning* of the term—contrary to the contention of 2D semantics. The proper response to this latter charge—against empirical-facts-considered-as-actual being part of semantics—is that it is indeed true that to understand the meaning of ‘the actual watery stuff,’ one need not know the empirical fact *that* the actual world is the watery-H<sub>2</sub>O world (and not the watery-XYZ world). However, in order to fully understand the meaning of this term, and how it differs from the meaning of ‘H<sub>2</sub>O’, one *does* need to be able to tell what the term *would* designate relative to a watery-XYZ world *had* that world been actual. And this equally applies before and after the empirical discovery that the actual world was, *in fact*, an H<sub>2</sub>O-world. This warrants the inclusion of empirical-facts-considered-as-actual in our possible world semantics. By the same token, the response to the former charge—namely, that to understand the meaning of ‘the actual watery stuff,’ one need not know what the criterion of identity for stuffs actually is—is that although this is perfectly true, still, to fully understand the meaning of this term (and how it differs from the meaning of ‘the stuff that has the same chemical composition as the actual watery stuff’), one *does* need to be able to tell what this term *would* designate *had* the actual criterion been one or the other. Hence both features of actual worlds—empirical facts *and* criteria of identity alike—*are* parts of possible world semantics. And if one nevertheless insists on excluding criteria-of-identity-considered-as-actual on such grounds, one will also have to give up empirical-facts-considered-as-actual, and hence renounce 2D-*semantics* altogether.

Another objection may take the following form. Why care about how a term designates relative to different criteria of identity, when there is only one such criterion that *in fact* obtains? Why take into account designation relative to all those other criteria that are *not* actual?

Again, this exact charge equally applies to the empirical-facts-considered-as-actual, which are part and parcel of (traditional) 2D semantics: Why care about how a term designates relative to different facts considered as actual (e.g., why consider as actual a world in which the watery stuff is composed of XYZ molecules), when there is only one such relevant empirical fact that actually obtains, namely, that the actual watery

stuff is composed of H<sub>2</sub>O molecules? Why take into account designation relative to all those other empirical-facts-considered-as-actual? The response to this charge is that we do so in order to account for meanings and differences in meaning. Specifically, taking into account designation relative to different empirical-facts-considered-as-actual provides the resources to capture aspects of meaning that cannot be otherwise captured within standard possible world semantics; e.g., it enables us to account for the difference in meaning between 'H<sub>2</sub>O' and 'the actual watery stuff'. By the same token, taking into account designation relative to different criteria-of-identity-considered-as-actual provides us with the resources to capture aspects of meaning that cannot be otherwise captured within the framework of possible world semantics. And, again, if one nevertheless insists on excluding criteria of identity from possible world semantics on these grounds, one will also have to give up, on the same grounds, including empirical-facts-considered-as-actual, and hence renounce 2D-semantics altogether. Moreover, as opposed to the actual empirical composition of the watery stuff, which we *know* to be H<sub>2</sub>O molecules (but consider the *possibility* of it being XYZ molecules), we do not *know for certain* what the actual criterion of identity for stuffs is, namely, whether it is manifest or material.<sup>25</sup> Lastly, one may point to the fact that the terms 'the actual watery stuff' and 'the stuff that has the same chemical composition as the actual watery stuff' have very different *structures*, and hence the difference in meaning between the two terms can be straightforwardly accounted for by semantic compositionality ('Frege's Principle'), namely, the principle that the meaning of a syntactically complex expression is a function of the meanings of its syntactic parts and of how they are assembled. However, as stated at the outset of this paper, the present discussion is restricted exclusively to accounts of truth-conditional meaning within the framework of possible-world semantics. So, solutions such as compositionality remain outside the scope of the present discussion.

## Conclusion

According to possible world semantics, truth-conditional meaning is intension, i.e., a function from possible worlds to extensions. The guiding insight of 1D semantics was that intensions vary relative to worlds-considered-as-counterfactual, and hence possible world semantics should be relativized to worlds-considered-as-counterfactual. Such relativization also enables to account for differences in truth-conditional meaning that cannot be otherwise accounted for (within possible world semantics), e.g., between 'H<sub>2</sub>O' and 'the watery stuff.' The guiding insight of 2D semantics was that intensions vary relative to empirical-facts-considered-as-actual, and hence possible world semantics should be relativized to such facts, too. Such relativization enables to account for differences in truth-conditional meaning that cannot be otherwise accounted for within possible world semantics, e.g., between 'H<sub>2</sub>O' and 'the *actual* watery stuff.' The insight that guides this paper is that intensions also vary relative to criteria-of-identity-considered-as-actual, and hence, just like in the case of worlds-considered-as-counterfactual and of empirical-facts-considered-as-actual, so too in the case of criteria-of-identity-considered-as-actual, possible world semantics should be relativized to such criteria as well. It has been shown that this relativization too enables to account for differences in truth-conditional meaning that cannot be otherwise accounted for within possible world semantics, e.g., between 'the actual watery stuff' and 'the stuff that has the same chemical composition as the actual watery stuff.' Incorporating criteria-of-identity-considered-as-actual within possible world semantics fine-grains the (traditional) dimension of worlds-considered-as-actual, and as such offers a finer-grained, more powerful, version of 2D-semantics.

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<sup>25</sup> See footnote 23 above.

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