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Millikan on picturing and correspondence

(Millikan sobre figuración y correspondencia)

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Keywords

Ruth Millikan
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ABSTRACT: Ruth Millikan characterizes her account of truth as a pictorial theory inspired by Tractarian ideas of mapping and isomorphism. Given the well-known difficulties facing pictorial accounts of sentential truth, this characterization is puzzling. I argue that Millikan's account is best developed without requiring relations of structural resemblance between sentences and reality. Focusing on her notion of semantic mapping functions and her later distinction between projected and substitutional correspondence, I suggest that the relations relevant to sentential truth are best characterized in terms of systematic correlation rather than resemblance. While some representational systems may involve genuinely projective relations, Millikan's own treatment of natural-language sentences as governed primarily by substitutional rules points, despite her Tractarian rhetoric, toward a non-pictorial form of correspondence.

Palabras clave

Ruth Millikan
Teoría correspondentista de la verdad
Figuración
Isomorfismo
Teleosemántica
Verdad de las oraciones

RESUMEN: Ruth Millikan caracteriza su teoría de la verdad como una teoría pictórica inspirada en ideas tractarianas de mapeo e isomorfismo. Dadas las conocidas dificultades que enfrentan las teorías pictóricas de la verdad de las oraciones, esta caracterización resulta desconcertante. Sostengo que la teoría de Millikan puede elaborarse mejor sin exigir relaciones de semejanza estructural entre las oraciones y la realidad. Centrándome en su noción de funciones semánticas de mapeo y en su distinción posterior entre correspondencia proyectada y correspondencia sustitucional, sugiero que las relaciones relevantes para la verdad de las oraciones se caracterizan mejor en términos de correlación sistemática que de semejanza. Si bien algunos sistemas representacionales pueden involucrar relaciones genuinamente proyectivas, el propio tratamiento que Millikan da a las oraciones de los lenguajes naturales como gobernadas principalmente por reglas sustitucionales apunta, pese a su retórica tractariana, hacia una forma no pictórica de correspondencia.

Gako-hitzak

Ruth Millikan
Egiaren korrespondentziaren teoria
Figurazioa
Isomorfismoa
Teleosemantika
Esaldien egia

LABURPENA: Ruth Millikanek mapatzearen eta isomorfismoaren ideia traktarioetan inspiratutako teoria piktoriko gisa karakterizatzen du egiari buruzko bere teoria. Esaldien egiaren teoria piktorikoek dituzten zailtasun ezagunak kontuan hartuta, karakterizazio hori harrigarria da. Nik defendatzen dut Millikanen teoria hobeto garatzen dela esaldien eta errealitatearen arteko egiturazko antzekotasunaren beharrik gabe. Millikanen mapatze-funtzio semantikoen noziotik eta berak gerora korrespondentzia proiektatuaren eta ordezkoaren artean egindako bereizketatik abiatuta, proposatzen dut esaldien egiari dagozkion erlazio esanguratsuak hobeto karakterizatzen direla korrelazio sistematikoaren bidez, antzekotasunaren bidez baino. Irudikapen-sistema batzuetan erlazio benetan proiektiboak egon badaitezke ere, Millikanek mintzaira naturaletako esaldiei ematen dien tratamenduak berak, esaldiok nagusiki ordezkatze-arauek gobernatuak direla iritzirik, korrespondentzia-molde ez-piktoriko bat seinalatzen du, bere erretorika traktarista gorabehera.

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1. Introduction

The canonical version of the correspondence theory of truth has been largely abandoned for good reasons. This version relied on alleged relations of *resemblance* between truth-bearers and facts. One of the boldest attempts to clarify what such relations involved was perhaps Wittgenstein's *Tractatus Logico-Philosophicus* (1922)—where the correspondence relation was portrayed as involving (1) a relation of structural resemblance between a true sentence and a fact, and (2) referential relations between the words of the sentence and the components of the fact. The serious difficulties faced by this view have been widely discussed in the literature and account for why it has been largely abandoned. However, Tractarian themes have resurfaced in the literature. Sellars, for example, endorsed a picture theory according to which "the manner in which the names occur in the picture is a projection, in accordance with a fantastically complex system of rules of projection, of the manner in which the objects occur in the world" (1963, p. 215). More recently, Millikan has pursued, as she puts it, "the picturing themes from the *Tractatus* that were carried through in Sellars' discussions" (2005, p. 77). According to Millikan, "what makes a sentence true is that there is something in the world onto which it maps in accordance with certain mapping functions" (1984, p. 9). She clarifies that what she means by 'mapping' is, basically, "as Wittgenstein put it, 'picturing'" (2005, p. 63). "The value of a system of representation", she claims, "depends... on there being some kind of isomorphism... between the domain of the signs and the domain of their signifieds" (2004a, p. 84). Given the well-known problems faced by the pictorial account of sentential truth, these confident claims are puzzling. If taken strictly, Millikan's Tractarian rhetoric commits her to a problematic pictorial account of such truth; if assessed in terms of the work her semantic mapping functions are supposed to do, however, her account can be developed in terms of systematic correlation rather than resemblance. Millikan does not provide detailed mapping rules for sentences of any specific form, so it remains unclear whether her semantic mapping rules themselves require genuinely pictorial relations. In this paper, I argue that Millikan's pictorial presentation of her view is misleading, at least in this domain, and that the relevant relations are best characterized within the framework of a contemporary correlation-based account of truth. The relations between true representations and reality that a plausible development of Millikan's account requires are, at least for sentences and similarly structured representations, of the sort that follows from a Tarski-based characterization of the truth of a sentence in terms of its syntactic structure and the referential properties of its words, combined with a reductive account of reference in terms of substantive relations between words and parts of reality. Millikan's teleosemantic framework is one of the main contemporary contenders for explaining the nature of such substantive relations, by grounding the reference-determining links between representations and reality in the functions that representations have acquired through natural selection, learning, or cultural inheritance—an approach she explicitly applies to account for the referential properties of words. I will set aside other objections to Millikan's theory in order to focus exclusively on her claim that it involves picturing relations.

My argument is related to, but distinct from, objections raised by Godfrey-Smith (1996) and Shea (2013) concerning the explanatory role of isomorphism in Millikan's theory. Their discussions focus on relatively simple representational systems lacking the logico-syntactic structure of sentences—such as inner states representing mates or predators, or bee dances representing the location of nectar—rather than on sentential truth. Moreover, their concern is primarily that isomorphism is too liberal to do the work Millikan assigns to it. By contrast, my concern is that, for sentential truth, genuine structural resemblance would be too demanding, while a Tarski-based correlation account can do the needed work.

2. Correspondence, Picturing, and Correlation

This section is concerned with the nature of correspondence relations appealed to in accounts of truth, focusing on the contrast between correspondence understood as structural resemblance and correspondence understood as systematic correlation. What today is regarded as the canonical version of the correspondence view is the claim that a truth-bearer is true if and only if it *corresponds to a fact*. This idea was advanced in the early twentieth century by Moore, Russell and

Wittgenstein. The canonical view requires an ontology of facts. Moore, Russell and Wittgenstein argued that facts are entities in their own right, existing over and above the things that compose them. The basic idea is that facts are structured combinations of objects with properties or relations. For example, the fact that a certain tree is an oak allegedly consists of an object, the tree, combined with the property of being an oak (Moore, 1953, p. 311), while the fact that Desdemona loves Cassio allegedly is a "complex unity" of two objects, Desdemona and Cassio, connected by the loving relation which "binds [them] together" in a particular "order" (Russell, 1912, p. 128). The canonical view also needs an account of the correspondence relation. Wittgenstein and Russell proposed that a true sentence "pictures" or "mirrors" a fact in virtue of (1) the *referential* relations between its words and the constituents of the fact, and (2) a relation of *structural resemblance* or *isomorphism* between the sentence and the fact (Wittgenstein, 1922, 2.131 and 3.21; Russell, 1918/2010, pp. 24-25). For example, 'Socrates is wise' is true if there is a fact consisting of the object and property referred to by the name and predicate, respectively, which has what is taken to be the same monadic structure, Φx, as the sentence. Similarly, 'Napoleon hates Wellington' is true if there is a fact that has what is taken to be the same dyadic form as the sentence, Φxy, and which has Napoleon and Wellington and the hating relation as constituents.

While very influential in its time, the canonical version of correspondence faces serious difficulties. As Austin warned, the idea that portions of reality are *isomorphic* to the true sentences that represent them seems to commit "the error of reading back into the world the features of language" (1950, p. 119). Austin proposed that only correlations (not isomorphisms) between sentences and portions of reality are required for correspondence (1950, pp. 115-120). Moreover, it turns out that sentences are *not* isomorphic to what they represent, as Russell himself noticed:

> In the phrase "A is to the left of B," even if we treat "is-to-the-left-of" as one word, we have a fact consisting of *three* terms with a *triadic* relation, not two terms with a dyadic relation. The linguistic symbol for a relation is not itself a relation, but a term as solid as the other words of the sentence. (1919, p. 38)

The fact represented by a true sentence *'Rab'* allegedly is a unity of two objects, a and b, bound by a dyadic relation *R*. But the sentence is instead a unity of three words, *'R'*, *'a'* and *'b'*, bound by a triadic logico-syntactic relation. If there is such a thing as the fact that *Rab*, it is not isomorphic to the sentence *'Rab'*.

Given the serious problems faced by the canonical version of the correspondence theory, contemporary theorists have articulated a version of the view that relies neither on facts nor on resemblance relations. Instead, it relies on (1) an account of truth in terms of the logical structures of sentences and the referential properties of their parts—based on Tarski's (1944, 1956) influential work—coupled with (2) a reductive account of reference in terms of one or another kind of causal relation between words and objects—a combination which, Field (1972) argued, is necessary to provide a robust account of truth. While the canonical view regards correspondence as a resemblance-to-facts relation, the contemporary view treats correspondence as a correlation-to-objects relation.

Consider a simple sentence *'Kr'*. Following the procedure proposed by Tarski, we can specify the truth-conditions of *'Kr'* as follows:

> *'Kr'* is true ↔ $\exists x$(*'r' designates x* & *'K' applies to x*).

In plain English: *'Kr'* is true if and only if there is an object that the name *'r'* designates and the predicate *'K'* applies to. Notice that the truth-conditions of the sentence are characterized in terms of its structure and the referential relations—application and designation—between its component words and an object in the world. Sentential structure and referential relations were also components of the canonical view. But here "facts" and "structural resemblances" *play no role*. These are correlation-to-objects relations instead of resemblance-to-facts relations. Given the difficulties faced by the canonical view, related to "structural resemblance", this is a clear advantage.

Many authors have expressed skepticism about the existence of facts or states of affairs, and have instead favored object-based formulations of correspondence. While this is an important metaphysical issue, nothing in the present discussion turns on

whether correspondence is formulated in object-based or fact-based terms. The crucial contrast, for present purposes, is between correspondence understood as structural resemblance and correspondence understood as systematic correlation. Millikan herself endorses a fact- or state-of-affairs-based framework, but her account of truth can be developed without requiring resemblance relations. While Tarskian truth-rules are standardly formulated in object-based terms, an entirely parallel, non-pictorial formulation can be given in fact-based terms, as the rule *SP* discussed below illustrates. Conversely, a Millikanian who wished to avoid commitment to facts could equally adopt strictly object-based rules of the sort favored by Field (1972), without affecting the argument that follows. I contend that, despite its pictorial rhetoric, Millikan's account of truth is best developed without requiring relations of structural resemblance—at least for sentences and similarly structured representations—and can be reconstructed, in this domain, as invoking systematic correlation between representations and reality.

3. *Millikan's Pictorial Account and Teleology*

Millikan combines what she presents as a pictorial account of truth with a teleological account of the functions performed by representations. On her view, mapping relations or isomorphisms between representations and reality are the core features that make representations true, while representational mechanisms have functions acquired through natural selection, learning, or cultural inheritance that explain why representations are supposed, but may fail, to stand in those relations (Godfrey-Smith, 1996, pp. 184-185; Shea, 2013, p. 63). The same teleological framework is also meant to explain how the parts of representations acquire referential properties. Her naturalist account of reference is among the main contemporary candidates for reducing referential properties to substantial non-semantic relations. Earlier pictorial theories typically assumed referential links between words and worldly items without providing a naturalistic account of them. Millikan's view is complex and the role of picturing in her account is often overlooked, because most of the interest has been on her theory of reference.

Notable exceptions are Godfrey-Smith (1996) and Shea (2013), who are sympathetic to some aspects of Millikan's program but skeptical about the role of isomorphism in her account, at least as Millikan articulates it. Godfrey-Smith raises the general worry that *mapping* is too unconstrained to serve as a proto-semantic relation or substantive constraint antecedent to the teleological story. Shea develops a related point in terms of the multiplicity of possible isomorphisms: since many isomorphisms can be found between representations and represented affairs, isomorphism by itself cannot serve as an independent substantive constraint on content. For Shea, however, this is not an objection to Millikan's teleosemantics, since the relevant isomorphism can be *delivered* by the teleosemantic story rather than fixed independently of it. Their shared concern is that isomorphism is too liberal to play the independent explanatory role Millikan seems to assign to it (Godfrey-Smith, 1996, pp. 184-187; Shea, 2013, pp. 63-80).

My concern here is different. I am not concerned with whether the teleological part of the theory relies on an antecedent mapping relation or instead delivers the relevant mapping. My question is what sort of relation this mapping is supposed to involve. If it is understood as genuine structural resemblance, then it is too demanding for sentential truth; if it is understood as systematic pairing, then it is a form of correlation rather than picturing. Millikan intends her theory to apply to all sorts of representations, from human representations to the most basic cases of non-human representation. Whereas Godfrey-Smith and Shea focus primarily on simpler representational systems, I focus primarily on sentences of natural human languages, while drawing on non-sentential cases where they help to clarify the issues at stake.

4. *Mapping Rules and Correlation*

According to Millikan, sentences "correspond to states of affairs in accordance with semantic-mapping functions" (2005, p. 63). The notion of "function" here is the mathematical one (2005, p. 53), rather than the teleological no-

tion that she deploys in other parts of her theory. Semantic-mapping functions, she argues, are rules that determine the truth-conditions of sentences:

> The semantic-mapping function is given by rules according to which significant transformations of the sentence that conserve its syntactic form yield different truth- or satisfaction-conditions... 'It's raining' contrasts with 'It's snowing', 'It's hailing', 'It's sleeting', and so forth. All display the same syntactic form, the transformations that substitute 'snow', 'hail', and 'sleet' for 'rain' determining different satisfaction-conditions in a systematic way. (2005, pp. 63-64)

Substitutions of component parts of a sentence of a specific syntactic form, she claims, change its truth-conditions in a systematic way. So, for example, *'Fa'* can be transformed into *'Fb'*, *'Ga'*, *'Gb'*, etc., which have the same syntactic structure but represent different states of affairs. The difference regarding what portions of reality each of these sentences "maps" onto is determined exclusively by the different referential properties of their components. To the extent that mapping rules determine what states of affairs are represented by *transformations* of sentences of the *same* form—which is what Millikan suggests in the quoted passage—the "mapping" determined by these rules has nothing to do with the traditional notion of structural resemblance between sentences and facts. Of course, the mapping rules that determine the truth-conditions of *'Rab'* and its transformations—*'Rba'*, *'Scd'*, *'Sdc'*, etc.—will be different from those governing 'Fa' and its transformations. It is clear that Millikan thinks that mapping functions relate each sentence to a state of affairs that would make it true, and that this relation depends on (1) the syntactic structure of the sentence and (2) the referential properties of its words. These two features are shared by pictorial theories and by contemporary non-pictorial accounts of correspondence. The latter do not typically posit facts or states of affairs, but a variant of them may nonetheless do so without relying on picturing relations. The questions are whether Millikan's "mapping" rules are additionally *intended* to relate sentences to states of affairs that have the very same structures as the sentences, and whether this additional commitment is actually *required* by her account of truth-conditions in terms of "mapping" rules.

Millikan does not explicitly formulate mapping rules for sentences, so it is hard to assess whether her account requires specifically pictorial commitments. Consider the following candidate non-pictorial mapping rule for simple subject-predicate sentences:

> *SP: The sentence ⌜Φx⌝ is true if and only if the state of affairs in which the object referred to by ⌜x⌝ has the property referred to by ⌜Φ⌝ obtains.*

The rule *SP* is compatible with Millikan's claim that the *relata* of sentences are states of affairs and her professed Aristotelian realism about properties (1984, Chs. 15 and 16). Also, *SP* covers all the substitution instances of ⌜*Φx*⌝—i.e., *'Fa'*, *'Fb'*, *'Ga'*, etc.—assigning a specific state of affairs as the truth-maker for each instance. It yields in a *systematic way* the truth-conditions for all the *transformations* of *'Fa'*. Assuming that these corresponding states of affairs have the same ontological structure—that of an object having a monadic property—*SP pairs* or *correlates* sentences that have a specific syntactic structure with states of affairs that have a specific ontological structure. *SP* delivers what Millikan calls "a correspondence by a given rule or function between form and some structure in the world" (2005, p. 98). Everything that Millikan seems to require of a "semantic-mapping rule" is met by *SP*. The crucial point is that *SP* does not require the combination of a name with a monadic predicate to structurally resemble the combination of an object with a monadic property. If *SP* is the kind of "semantic-mapping rule" that Millikan has in mind, then hers is a correlation-based rather than a resemblance-based correspondence view. What is puzzling is Millikan's talk of "mapping" as a Tractarian form of "picturing" involving an "isomorphism" between representations and reality, which may suggest that she intends something stronger than a merely correlational rule such as *SP*. A correlation account may preserve talk of correspondence, but it does not need the stronger claim that representations picture what they represent.

5. *Bee Dances, Isomorphism and Projection*

Millikan's favorite example of representation is the figure-eight waggle dance made by honey bees to communicate to each other the location of nectar—which she often compares to human sentences. The ethologist von Frisch discovered that waggle dances communicate the location of nectar and that they do this by representing its direction and distance from the hive: the angle of the waggle dance with respect to the vertical axis of the hive represents the angle from the line between the hive and the Sun where nectar is located, while the duration of the dance represents how far away from the hive the nectar is (1953, Ch. 11). According to Millikan, the bee dance "is a tiny map" that "maps the location of nectar by a certain rule of projection" (2005, p. 83). "Variations in possible bee dances", she points out, "correspond one-to-one to variations in possible locations of nectar" and "the principle involved", she claims, "is mathematical isomorphism" (2005, p. 97). The way she describes how the "bee language"—as von Frisch called it—represents the location of nectar has a distinctly Tractarian flavor. It is striking that bee dances do represent the location of nectar by means of mathematical rules of projection. A waggle dance x represents the presence of nectar in direction y at distance z from the hive. There is a direct mathematical projection between the angle of x and the direction y, and another one between the duration of x and the distance z. Mathematical rules of projection determine the values of y and z. Whether this makes the whole dance "isomorphic" to the location of nectar is not so clear and I will not discuss it. But what is this supposed to tell us about representations in general and about human sentences in particular?

Bee dances are Millikan's favorite example because she thinks that they illustrate basic features of representations in general. Here is how she explains what "mapping functions" do in any system of representation: "Semantic mapping functions define isomorphisms between the set of possible signs in a certain sign domain and the set of their possible signifieds" (2004a, p. 49). This is meant to apply also to the linguistic and mental representations of human beings, although she warns that we should "expect the... mapping functions to be much more abstract" in the human case (2005, p. 102). Furthermore, she insists that she uses the term 'isomorphism' in "the abstract mathematical sense" (2004a, p. 84). In their pictorial period, Wittgenstein and Russell also intended true sentences to be isomorphic to facts only in an abstract sense. They intended only the underlying logical form of a true sentence to resemble the structure of what it represents, independently of its superficial structure which may be different. If this were the kind of abstract isomorphism that Millikan expects to obtain between true sentences and what they "map" onto, however, her theory would be undermined by the problem discovered by Russell: that a sentence *'Rab'* would represent a fact containing two objects united by a dyadic relation, while the sentence contains three words united by a triadic logico-syntactic relation. Despite her talk of "picturing", "mapping", "rules of projection" and "isomorphisms", however, Millikan does not say enough to determine whether, in the case of sentences, her mapping rules require genuine structural resemblance rather than merely systematic correlation, since she provides no explicit mapping rule for sentences of any particular form.

Recall Millikan's claim that, in human languages, the mapping rules systematically determine for different sentences different states of affairs as truth-makers (2005, pp. 63-64). This is compatible with a correlation-based view of correspondence. Recall her claim that mapping rules determine a correspondence between the form of a true sentence and some *structure* in the world (2005, p. 98). This claim also falls short of being genuinely pictorial. As I argued above, the rule *SP* I suggested would determine a correspondence between a sentence of the *form* $\ulcorner \Phi x \urcorner$ and a state of affairs with a specific structure—that of an object having a monadic property—regardless of whether the sentence's form matches that structure. This independence from structural resemblance is an advantage, since, as Russell showed, the sentence's form does not match the structure of the corresponding state of affairs.

With this in mind, consider the following passage, where Millikan hints at a way of understanding mapping rules for sentences and similarly structured representations that would not require their structural resemblance to facts:

> We can think of beliefs as... mental sentences... and think of... their truth makers... as determined by some sort of Tarskian mapping... Certain substitutions of sentence parts correspond to substitutions in aspects of world affairs mapped... That is, there is a functional isomorphism between

> the whole set of possible mental sentences... and the set of world affairs to which these sentences would correspond... (2004b, pp. 231-232)

This passage should be read with caution. Millikan speaks only of "some sort of Tarskian mapping", and she does not provide an explicit mapping rule for any sentence. Nor does she further develop this Tarskian suggestion here or elsewhere or explain whether such a rule would be non-pictorial or would instead somehow involve structural resemblance between sentences and facts. The passage is nevertheless revealing, because it gestures toward a way of developing mapping rules for sentential representations that would not require such resemblance. The rule *SP* I formulated above is a candidate development of this line of thought: a "sort of Tarskian mapping" for simple predicative sentences that is compatible with Millikan's realism about properties and structured states of affairs (or facts), while not requiring sentences to picture their truth-makers. Analogous rules would be required to cover other syntactic structures. What those rules would determine is a *systematic pairing* between possible sentences and the states of affairs that would make them true. This seems to be what Millikan in the passage calls—rather confusingly, in my opinion—a "functional isomorphism". Much, though not all, of Millikan's talk of isomorphism seems to concern this system-level pairing between possible representations and possible represenateds. Such a pairing may amount to systematic correlation rather than structural resemblance. In any case, system-level isomorphism does not by itself entail that individual sentences structurally resemble the states of affairs that make them true. Millikan's explicit appeal to Tractarian picturing nevertheless invites that stronger reading, which is why the issue remains unsettled. For a fact-based view of correspondence as correlation, what matters is that each sentence is paired by such rules with the state of affairs that would make it true. That is less than what a genuinely pictorial theory requires. Incidentally, notice that the set of all instances of what is now commonly called the "equivalence schema"—*'p'* is true ↔ *p*—also seems to provide a systematic pairing between sentences and what they represent (*'p'* is true ↔ *p*, *'q'* is true ↔ *q*, *'r'* is true ↔ r, etc.). But this "pairing" does *not* itself state a relation of correspondence.[1] A correlation-based *correspondence* theory requires the systematic pairing to be determined by substantial relations between sentences and truth-makers.

6. *Projected vs. Substitutional Correspondence*

All of this, however, leaves open the possibility that Millikan's talk of relations of "picturing" between sentences and their truth-makers may require actual structural resemblance. The issue is not settled by the fact that her mapping rules need not be read pictorially, since her Tractarian talk and her comparison between sentences and bee dances suggest that she may intend something stronger. However, Millikan's later distinction between "projected correspondence" and "substitutional correspondence" (2013, pp. 84-86) helps to clarify this issue. This distinction is introduced in response to an objection by Shea. I will provide some context before explaining the distinction and discussing what it shows about whether Millikan's account requires true sentences to structurally resemble states of affairs.

In his objection to Millikan's isomorphism requirement, Shea suggests an interesting hypothetical scenario. Suppose that the bee rules for representing distance were as follows: *1 waggle = 75 m*, *2 waggles = 300 m*, *3 waggles = 60 m*, *4 waggles = 150 m, etc.* (2013, p. 74). Of course, these are very different from the actual rules, discovered by von Frisch, relating bee dances to the distance of nectar. But in principle—while very unlikely—some species or subspecies of bee could have evolved to have dances which represent by Shea's rules, provided their foraging range was limited, so that a finite list

[1] As Douglas Patterson points out, many philosophers—notably Tarski (1944, pp. 342-343)—have held the view that instances of the schema "state correspondences between the sentences they mention and something else" (2003, p. 421). But instances of the schema do not state relations of correspondence, since they do not state any relations whatsoever: their basic form is *A* ↔ *B*, rather than *Rab*. Indeed, deflationists argue that there is no need to regard the word 'truth' as standing for a relational property because instances of the equivalence schema are all that is required to account for its meaning and utility (Field, 1994; Horwich, 1998).

of rules could be used to represent all the required distances. I will call these creatures "bees*". One of the features of Shea's bee* rules is that they are list-like: there is a different rule for each distance represented. Another feature is that the list is arbitrary: there is no general principle involved, such as more waggles representing more distance. The only principle is that each number of waggles represents a particular distance. Bee* dances are not "isomorphic" in any minimally strict sense of the word to the distance of nectar they represent. Yet, as Shea points out, his arbitrary rules seem to determine what qualifies as a "functional isomorphism" in Millikan's sense (2013, p. 75). As I indicated above, a systematic one-to-one pairing of representations with states of affairs seems indeed to be what she calls a "functional isomorphism". Shea's hypothetical bee* rules deliver such a pairing. The example echoes and supports Godfrey-Smith's objection that Millikan's notion of isomorphism is too liberal—that "nearly any relation can constitute a «mapping» in Millikan's theory" (1996, p. 185). Shea and Godfrey-Smith make these points in the context of discussing the relation between Millikan's isomorphism requirement and her teleological theory of content. As far as Shea is concerned, Millikan's teleosemantic theory has the resources to explain his hypothetical bee* rules in terms of evolutionarily grounded substantive relations.[2] He is not objecting to Millikan's teleosemantics. What Shea intends the example to show is that the isomorphism requirement does not play an independent substantive role in the theory.

Millikan draws the distinction between projected and substitutional correspondence in her response to Shea. The language of actual bees, she suggests, is a clear example of mapping by means of projected correspondence. There are mathematical functions or projection rules relating features of different bee dances to different locations of nectar. She offers the following illustration of what the rule for representing distance may look like: "For example: *add one waggle to the dance = add 1,000 yards to the distance of nectar*. If this equation applies to every possible bee dance, it describes a projected correspondence between dances and distances" (2013, p. 84). While also imaginary, this rule does capture the basic principle involved in actual bee dances: a longer dance represents a longer distance of nectar from the hive. About Shea's bee* rules, Millikan says: "Shea suggests for bee dances a list giving arbitrary correspondences between numbers of waggles and distances. This would be a list of correlated substitution transformations..." (2013, p. 84). Her point is that there is no mathematical equation or *projection* rule relating the number of waggles to the distance of nectar. Instead, she claims, there are *substitutional* rules that arbitrarily relate changes in the number of waggles to changes in the distance of nectar from the hive represented—e.g., replacing a two-waggle dance with a three-waggle dance transforms the distance represented from 300 m to 60 m (2013, pp. 84-85). Even though they are arbitrary, she acknowledges, bee* rules do determine a systematic one-to-one pairing of representations and what they represent (2013, p. 85). Setting aside the representation of direction, her claim is that a bee dance is true when it has a *projected correspondence* to the distance of nectar, while a bee* dance is true when it has a *substitutional correspondence* to the distance of nectar.[3]

Millikan further illustrates the distinction with another example where, she says, both kinds of correspondence are at play: a human-made map of a county where lines represent "the shape and placement of roads" and "different colors... represent different road surfaces, such as dirt, gravel, paved, and so forth" (2013, p. 86). This is basically a hybrid case where, if the map is accurate, the shape and placement of the lines have a projected correspondence to the actual shape and placement of the roads, while the colors of the lines have a substitutional correspondence to the actual surfaces of the roads.

Millikan's distinction can be reconstructed as a distinction between pictorial and non-pictorial forms of correspondence. Millikan herself, however, does not draw the contrast in these terms. On the contrary, she seems to regard projected and substitutional correspondences as two broad kinds of correspondence within the same framework of isomorphism (2013, pp. 83-84). Ryder *et al.* interpret her this way: "There is a *natural* isomorphism even when the correspondence is merely substitutional" (2013, p. 8). My suggestion is that this obscures an important distinction.

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[2] The list-like nature of bee* rules may raise concerns about whether they determine substantive correspondences, since deflationists offer precisely list-like characterizations which, they claim, involve no substantive relation. Presumably the reply to this concern is that the bee* dances are substantially related to locations of nectar by evolutionary history.

[3] Millikan now claims that the teleological part of her theory is what grounds any such correspondences on real relations (2013, pp. 82-83).

What Millikan calls a "projected correspondence" involves something close to structural resemblance or isomorphism between representation and reality, while what she calls a "substitutional correspondence" involves merely a correlation determined by some substantial relation other than projection. While this is partly a terminological issue, I see no point in applying the term 'isomorphism' to non-projective correspondences. This would be misleading, since it would obscure the standard distinction made in the literature on the nature of truth between correspondence as congruence, structural resemblance or isomorphism, on one hand, and correspondence as mere correlation, on the other (Kirkham, 1992). Once a theory admits both non-projective and projective correspondences, it is better characterized as a correlation theory, since it claims that the common feature of all true representations is that they are paired to their truthmakers by one or another substantive relation—projective relations being merely one such kind of relation that some representational systems (e.g., bee dances) may rely on.

7. Sentential Truth without Picturing

Now we can address Millikan's position regarding sentences in human languages. Drawing on her distinction between projected and substitutional correspondence, she says that "almost all of the correspondences found in natural language are substitutional" (2013, p. 84) and claims that "this is the main difference between simpler representations and the representations of human language" (2013, p. 86). I am skeptical about the second claim, to which I return briefly in the next section. But let me start by commenting on the first one. Millikan has repeatedly argued that what sets apart sentences from other representations is their syntactic structure: they have subject-predicate form and can be negated (1984, pp. 308-309). She has pointed out, for example, that "bee dances are not sentences, for they have no subject terms, and a rabbit's danger thumps are not sentences, for they never predicate of a time and place anything other than danger... [while] the alarm calls of vervet monkeys are not sentences because... [they] are never negated" (1993, p. 118). She has also previously characterized the "mapping" rules of sentences in mainly substitutional terms, as shown by some passages I have already quoted. Here is an earlier example: "In the case of *sentences* that map, the significant transformations... are mostly substitution transformations..." (1984, p. 108). However, only in her response to Shea does she explicitly distinguish substitutional rules from projective rules. This distinction provides resources for a non-pictorial reconstruction of her account of sentential truth. If almost all natural-language correspondences are substitutional rather than projected, then the truth of sentences need not involve anything like the projective correspondence of accurate bee dances. On the reconstruction I have been defending, the correspondence involved in sentential truth is therefore best characterized as correlation, rather than as congruence, structural resemblance or isomorphism. While Millikan herself does not present the distinction as a rejection of her earlier Tractarian rhetoric or commitments, the distinction helps show how her account of sentential truth can be developed without requiring true sentences to structurally resemble states of affairs.

8. Representation without Picturing

I close this paper with two critical remarks. The first is substantive and the second is terminological. My first remark is against Millikan's claim that the distinction between substitutional and projected correspondence is what sets apart human sentences from *simpler* representations. (I think that her syntax-based distinction is more appropriate, although we may find syntax also in non-human languages of thought: whether syntax is uniquely human is an empirical question.) Notice that *some* very sophisticated representations (e.g., computer-generated models) may rely at least partly on projection rules. More importantly, many simple non-human representations seem to have "substitutional" correspondences. Vervet monkey alarm calls are an obvious example: they are merely correlated with the presence of the appropriate predators when accurate. Indeed, plenty of extremely simple "detection" systems represent reality without relying on any projection

rules or mathematical isomorphisms. The trigger hairs of the Venus flytrap are a clear example, if they are treated as representational at all. These mechanisms would *only* represent—when successful—that an insect has landed, so there are neither projected nor substitutional "transformations" involved. The distinction does not apply across the board. It is likely that some *perceptual* representations do rely on some forms of isomorphism (Millikan, 2005, p. 102). But correspondence as correlation seems to be ubiquitous and not merely a sophisticated human phenomenon.

My second point is that once correspondence by means of mathematical isomorphism is no longer treated as a necessary condition for representational truth, there is no motivation for regarding true representations in general as picturing what they represent, or for using talk of "mapping" in anything stronger than the thin sense of systematic pairing. Perhaps bee dances and many other representations literally picture what they represent. But this cannot be true of representation in general. Consider simple human sentences like 'Socrates is wise' or 'Snow is white'. Saying that these sentences *picture* something seems clearly metaphorical. What could that possibly mean other than that they *represent* something? Talk of "mapping" may still be retained in the thin sense of systematic pairing, but it should not be confused with picturing.

9. Conclusion

In this paper I have argued that Millikan's "pictorial" account, if taken at face value, seems to require genuinely pictorial relations between sentences and the states of affairs that make them true. This is why her Tractarian rhetoric is puzzling: structural resemblance is too demanding for sentential truth, and Millikan does not provide detailed mapping rules showing how true sentences could picture their truth-makers. The work that her mapping rules are supposed to do, however, can be done by something less than picturing. As the rule *SP* suggested above illustrates, a mapping rule may systematically pair sentences with the states of affairs that make them true without requiring the former to structurally resemble the latter. Millikan's own work provides resources for this non-pictorial reconstruction: her earlier suggestion of "some sort of Tarskian mapping" (2004b, pp. 231-232) and her later distinction between projected and substitutional correspondence (2013, pp. 83-86) both point toward a correlation-based account of sentential truth. Millikan does not explicitly present these resources as a rejection of her Tractarian commitments; indeed, in later work she continues to present representation in explicitly Tractarian terms: "Representations 'picture' what they represent, just as Wittgenstein said in *Tractatus logico philosophicus*" (2024, p. 58). My conclusion is therefore not that Millikan officially abandons picturing, but that the most plausible development of her account of sentential truth is a correlation account based on substantive relations between sentences and reality.

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