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Research article

Scientific Representation – Metaphor's Terrain

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Abstract

Scientific maxims are often used to describe common behaviors without any pretense of a common cause. The maxim 'nature abhors a vacuum' can be used to describe the distribution of molecules in a vessel or the migrations of birds. These maxims can often be replaced with other expressions ('Brownian motion', 'flocking behavior') which can give better explanations when needed. In some cases, however, two seemingly disparate phenomena may have no better terms to account for them than provisional expressions. Perhaps this is because the phenomena in question are not as distant as they seem, or perhaps it is down to the fraught relationship between words and things. In the study of cooperation in biology, a great deal of research has been devoted to symbiotic relationships between plants and mycorrhizae fungi. The term used for how plants and fungi get together is 'recognition.' We would be inclined to say that this jargon is a pretty distant metaphor and should better rest on the more familiar biological maxim of 'lock and key' as analogy. I will forcefully argue that this inclination is wrong. I will also tentatively propose that the context of symbiosis has things to teach us about communication and metaphor, and maybe even ethics.

Keywords: Scientific representation; Theory of metaphor; Chemical recognition; Models; Ethics of communication; Biological cooperation

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Научная статья

Метафора и ее ландшафт в описании научного объекта

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Аннотация
Научные максимы часто используются для описания природных объектов без попытки объяснить общую причину, лежащую в основе их поведения. Например, максима “природа не терпит пустоты” может быть использована для описания распределения молекул в сосуде или миграции птиц. Эти максимы при необходимости часто можно заменить другими терминами (“броуновское движение”, “стадное поведение”), которые могут лучше объяснить явления, хотя имеют более ограниченное применение. С другой стороны, в некоторых случаях есть описания двух, казалось бы, несопоставимых феноменов, где нет лучших терминов, чем эвристические выражения. Возможно, это происходит потому, что рассматриваемые феномены на самом деле имеют скрытую причинную связь, или, возможно, из-за давно известных сложных отношений между языком и описываемыми явлениями. При изучении сотрудничества в биологии большое количество исследований было посвящено симбиотическим отношениям между растениями и микоризными грибами. Для описания взаимодействия растений и грибов используется термин “распознавание”. Обычно нам представляется, что такие термины – это метафора, весьма далекая от описываемых явлений, и ее следует заменить аналогом – более привычной биологической максимой “замок и ключ”. Мы же решительно докажем, что такое представление ошибочно, и также предположим, что феномен симбиоза может открыть новые аспекты таких явлений, как коммуникация, метафора, а возможно, даже этика.

Ключевые слова: Научное представление, Теория метафоры, Химическое распознавание; Модели; Этика коммуникации; Биологическое сотрудничество

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FAITHFUL REPRESENTATION

Arguably the best thing the Information Age has done for the philosophy of science is to give it a pass from the burdens of realism. Even heuristic models, such as Karl Popper's, were meant to flourish before a realistic background. When you can say that a scientific law is not a 'general representation of reality' but a 'transfer of information from one system to another' you think you are making progress. This requires shifting what we mean by representation. Science no longer engages in a pale, mathetic, reflection of the real but a transfer, or processing, from one medium to another. These terms: 'transfer', 'processing', 'medium' are used as if they were directly descriptive of a hermeneutical process and not themselves figures of speech; that is a supposition that we should not leave uncontested.

One path forward was contested by Gabriele Contessa (2007) when he distinguished between what he called 'denotation' and 'epistemic modeling.' In his example, the logotype of the London Underground denotes the London Underground and no more. But the map of the London Underground gives us a model by which we may make valid inferences about the referent (Contessa, 2007, p. 52). The map is engaging us in an act of 'surrogate reasoning' (after Sowyer, 1991) where the map is a vehicle that gets us to a target, which is the referent. We reason through the map toward the Underground. Now surrogate reasoning must exhibit a great deal of variety in use. A recipe is a surrogate for the procedure of baking a cake, as is the formula for turning iron into steel; but the formula for the cosmological constant or Maxwell's third theorem is a different kind of surrogate, though all of these use symbols, orders of operation, and require a behavior of matching terms and elements.

Other surrogates are much less tidy parents of reason. Contessa distinguishes between types of 'faithful representations.' A new Underground map is a faithful representation, an underground map from the 1930s is not. He says:

> In general, a vehicle is a *completely faithful representation* of a target if and only if the vehicle is an epistemic representation of the target and all of the valid inferences from the vehicle to the target are sound. It is a *partially faithful representation* of a target if and only if the vehicle is an epistemic representation of the target and some of the valid inferences from the vehicle to the target are sound. It is a *completely unfaithful epistemic* representation of a target if and only if the vehicle is an epistemic representation of the target and none of the valid inferences from the vehicle to the target are sound. A vehicle *misrepresents* (some aspects of) a target if the vehicle is an epistemic representation of the target and some of the valid inferences from the vehicle to the target are not sound. […] Unlike epistemic representation, faithful epistemic representation is a matter of degree. A representation can be more or less faithful to its target. The same vehicle can be a faithful representation of some aspects of the target and misrepresent other aspects. This seems to be the case with the old London Underground map. (Contessa, 2007, pp. 54–55)

Clearly Contessa has some knowledge of the London Underground. Someone who

does not know what a London or an Underground is might find themselves vexed trying to determine the faithfulness of any of their, or his, inferences. But we should not let ignorance be a guide. Take a person who is maximally knowledgeable about the London Underground, a London Underground historian. For this scholar, researching the state of the Underground in 1935, what invalid inferences might be drawn from the Underground map of 2025? Indeed, some of the inferences Contessa drew about the map in his article of 2007 would not be valid now. Let Contessa counter that the historian is not using the map in the way it was intended at any time. But then imagine a historical novelist who wants to give an accurate impression of how their protagonist would move between stations in the 1930s. In this case, the map could be used very much like it was in 2007. The presence of new stations and the absence of old ones are not the only weaknesses in Contessa's arguments. Clearly, his and most of the other scholarship related to scientific representation is not comparing information and information, but information and an ideal object: his Underground is clearly platonic. Maps do not need to be particularly verisimilar, in fact some maps (even Underground maps) are deliberately abstract to draw out the right features, or merely to show you it is a map. These features are isolated for a particular purpose: to identify the function of the representation and to lead you through the steps. Perhaps the term 'surrogate reasoning' is itself too mathetic, suggesting an externalization of internal mental ideas.

There is much about the whole debate surrounding scientific representation that could use a good whipping from the first part of Ludwig Wittgenstein's *Philosophical Investigations* (1953/1991), or any responsible theory of intention. If you use the logo of the Underground to find the Underground does the logo not have some epistemic purpose? Is a signifier the surrogate for the signified? If the most likely version of representation in the brain is correct, and all references are made up of neural networks, then any kind of denotation is a map and all references are surrogates. Maps clearly also have something to do with their practices around their use and not just their references.

As Anguel Stefanov says, much of the question during this period of the debate was about what 'modeling' means (2012, pp. 70–72). I would add that there is a parallel problem with what 'vehicle' means. This vehicle is a commuter vehicle, like the London Underground, that gets you from one place and back. But communication is a much more complex process. After Wittgenstein, it might be better to see modeling as an activity, a game, gesture, or ritual rather than a means of transport. There is a particular intention behind gestures and sets of rules. One can imagine these rules being learned as one learns to use maps, or being explained by things such as keys and legends. The boxes around the keys and legends on maps are like the boundaries of the ritual ground or the rope around the proscenium of the stage. One of the rules is an intuitive understanding of the levels of verisimilitude in a map. In order to be successful in communication the map must put across the intended grain of verisimilitude. The target is here the intention and not a presumed ideal object in reality. Again, 'vehicles', 'targets' like 'transfer', 'processing', 'medium' are terms that we presume have a direct connotation with little concern as to their own filial surrogacy or faithfulness. A set of dance steps may be part of a ritual intended to bring rain, or an elaborate code to open up a lock, or a praise to an exalted personage. Once we commit to connecting practices instead of levels of

verisimilitude, there are other, stranger correspondences afoot.

SCHOLIA

There is little to distinguish the kinds of reference we have in science from the hustle and bustle of semantics in everyday language. Consider the types of phrases common in medical diagnoses: '*rubor, calor, dolor, tumor*' – 'redness, heat, pain, swelling' is the classical definition of inflammation. The rhyme is an *aide-mémoire*. The diverse set of symptoms which some types of poisoning present has led to: 'Red as a beet, mad as a hatter, dry as a bone, hot as a hare, and full as a flask.'[1] These phrases help define a range of systems that might present themselves with other signs, or do not completely present themselves. The definition is a guidepost from the tradition. '*Rubor, calor…*' goes all the way back to the physician Celsus, a contemporary of Christ. There are still other devices that use *logical* shorthand instead of poetics. They are not meant to account for things as they are or as they actually happen, but they account for certain *blendings* that allow us to observe something else, especially when we want to determine a cause.[2] These are heuristic constructs but, unlike the literal verses from medical school, they are not meant to then lead to a more true etiological definition. They are provisional, but they are also permanent. The proper name for these phrases is '*axiomes vulgares*' but I would prefer the less precious term 'scholion.'[3]

Consider the phrase 'nature abhors a vacuum.' It accounts for nearly everything you might observe with respect to the dynamics of objects, but as a principle it does not explain anything. It is a story used to account for why something comes in the place of something else. There are many reasons why natural movement occurs – diffusion of gases, movement of electrons, foraging behavior of animals, the 'path of least resistance' (also a scholion). 'Nature abhors a vacuum' can account for any one of these, and others, too. There could be a distance opened up between a traveler and a crowd and a platform on the Underground. She walks because nature abhors a vacuum. A cavity opens up in the body because of a resected appendix. Nature's concupiscence filled the void with fluid. Who would say these things have the same cause, that the scale of the secretion of lymph is the same as the push in a narrative plot and the Brownian motion of particles? One could just as easily say: 'Things move around.' The scholion lets us end up with an explanation as a kind of myth. The myth makes life easier.

Sets of blended myths do not pose a problem so long as the scientist and philosopher know that they are provisional, heuristic way-stations from which we will

[1] Anticholinergic toxicity is the poisoning in question.

[2] Causal blending in both science and conventional language is examined in Fauconnier and Turner (2003, pp. 93–95). They consider the phrase 'my tax bill gets bigger every year!' A tax bill is not one thing that grows like an artichoke. We speak of many iterations of things in the same class over time as if they were one to illustrate their sequential change. Blending, compression, conflation are used to express a kind of causality – like the much-memed "March of Progress" (1965) illustration of an ape walking down a timeline to become a man.

[3] In the sense of a "condensed maxim or ancillary explanation" rather than in the narrow sense of "gloss or marginal note" (see Dickey, 2007, pp. 13–14).

move on. They are much more of a problem for those who see no need to ask why or have no sense of conceptual hygiene. Many disciplines, especially in the so-called 'narrative sciences' (geology, biology, economics), use scholia with seemingly no second thought. This may be because it is too provisionally difficult to give up the myth or because language makes it difficult to come up with concise expressions. These conflations thus make you think you are talking about one layer of relations – words and things – but you have slipped, blended, several layers of identity, causality, and representation together. And since this has to do with causes, this slippage operates like a kind of magic.

At their best in rhyme and reason, scholia are no more than verbal tools. No doctor thinks that '*rubor, calor*…' gives a faithful or comprehensive description to make an adequate contribution to pathology. Still these might be considered forms of surrogate reasoning and models of a kind.

'THE CAREER OF METAPHOR'

What might be needed is to parodize the terminology of Contessa, Stefanov, and others. The 'denotative' function follows the regular semantic pattern for natural language with all its highways and byways, and the 'surrogate' or 'constituitive' function involves the game, ritual, or gesture that uses a model. Among a number of the features to this art is the convention of learning and using levels of abstraction (see Floridi, 2008) or varying grains of intentional verisimilitude.

Interestingly, a test of validity can come when we try to switch these two elements, or practices – target and base, comparison and comparandum – with respect to the same object of investigation. In regard to a gesture, in naming a formula we have almost the same schematic processes as we would with naming a ritual or a dance: '$F = dp/dt$' > 'Newton's Second Law of Motion' and 'slow-slow-fast' > 'the fox trot.' But move from name to map and find that denotation demands the extraction of a script. If you choose the fox-trot, you have a number of plausible instances (not just tokens): 'slow-slow-fast,' a video, a series of numbered photographs, a step diagram. Any of these could reasonably be a valid representation. The same goes for Newton's Second Law. One of the ways to learn physics well is to solve these equations for yourself, go through all the steps. Now if you choose 'Nature abhors a vacuum,' you can give what might be the most fine-grained account – the formula for Brownian motion – but that does not cover anything like the whole scope of uses for this phrase in science (see Fodor, 1974). Unlike the diagnostic maxims mentioned above, many of the doctors of biology, economics, or urban planning that might use such a phrase would not be able to do much with the formula for Brownian motion, nor any of the models offered by their colleagues from other sciences. And this is not because 'Nature abhors…' is a more general term than an expression of Brownian motion; it is simply a less effective denotation that cannot be converted into a functional model. Unlike a good general classification, such a denotative marker might be a good shorthand term, nothing more. Functionality should trump verisimilitude, but the rules of mapping must pertain to the function.

As we extract 'models' from 'denotations' in Contessa's fashion, we see that analogies begin to look more and more like metaphors. For the last several decades,

cognitively aware theories of metaphor have moved away from a convention of metaphor as a 'deviation' from lexical reference. Around the time of Contessa (2007), Brian Bowdle and Dedre Gentner proposed a theory of the 'career of metaphor' based on experimentation (2005). Metaphor's career marks where broad and loose semantic mappings of association become gradually compressed into more fixed categories as the metaphor becomes more conventionalized. Bowdle and Gentner, note that neat Venn diagrams of matching and non-matching features do not allow for the expansion of a metaphor beyond already evident analogies that make them tidily, but uninformatively, conventional: "… metaphoric mappings often involve the projection of new forms of information from the base to the target" (2005, p. 194). A superimposition of homologous terms is not a functional metaphor. Psychology and cognitive science have demonstrated that metaphor's mappings are not just additional to expression, but essential to it.[4] What most determines the comparison seems to be the invocation of the terms themselves and not their relations. For example, even Bowdle and Gentner's examples set limits too firm for the multi-directionality of metaphorical terms. Taking the metaphor 'dew is a veil,' they note that certain common features to both target [= veil] and base [= dew] of a metaphor will necessarily enter into its interpretation:

> For example, both dew and veils are inanimate, and both are silent, but neither of these common properties seems relevant to the meaning of 'Dew is a veil.' A second criticism concerns the issue of asymmetry: Although the order in which two items are compared should not influence their degree of property overlap, metaphors often cannot be reversed or change their meaning […]. For example, whereas 'Dew is a veil' is a meaningful figurative statement, 'A veil is dew' seems nonsensical. (Bowdle and Gentner, 2005, p. 194)

Yet one could easily conjure a few mediocre lines of poetry to vitiate both these points:

> Silent,
> The veil is dew
> Dappling blossoming brides.

If metaphor has a career, its path must have some twists and turns of fortune. It seems the theorists of metaphor could use a lesson from the Surrealists, just as the philosophers of scientific representation could use one from Wittgenstein. The direction of what on juxtaposes does not matter, but it does matter which features one isolates by invoking them. In his highly neglected "Remarks on Frazer" Wittgenstein (2020) notes that one could take a set of myths and come up with any functional explanation for what they represent so long as the explanation harkens to some basic human element

[4]See Lakoff and Johnson, 2003, Ortony et al., 1985, Cooke and Bartha, 1992. As Iain McGilchrist notes, metaphorically, "The explicit is not more fully real than the implicit. It is merely the limit case of the implicit, with much of its vital meaning sheared off: narrowed down and 'finalized.' The literal is not more real than the metaphorical: it is merely the limit case of the metaphorical, in which the wealth of meaning is collapsed into a 1:1 correspondence for a useful, temporary, purpose" (McGilchrist, 2021, p. 17).

(Wittgenstein, 2020, § 11–13, pp, 38–42). The same could apply to the target and base of metaphors. Pull an element from the semantic field of one and the situation of juxtaposition itself will call forth associations with the other. As Bowdle and Gentner suggest above, metaphor relies on the disjunction of the partners in the juxtaposition ("new forms of information…") as much as – even more than – the similarity. Psycholinguists would say that exposure to disparate stimuli primes the functional networks that link commonalities while keeping disjunctive elements active or potentially active. A poem, or a ritual, or a work of theatre forms new contexts out of juxtapositions. The pairing works because the terms engage in asymmetrically disjunctive and dynamic engagement. The point is less to identify or denote and more to keep two points of conjuncture active: to keep them in play. This requires a sense of boundary, scale, and interaction. The selection of elements in a metaphor must both preserve the distance in the terms, accent it, and propose an improbable relation. A novel metaphor is then like a map.

REACTION AND 'LOCK AND KEY'

Any analogy or metaphor may thus serve as a potential model for surrogate reasoning. The extent and the manner in which they matheticize, graph, or map to one another stands between semantics, poetics, and the study of scientific representation. The function of analogies differs: some are better for explaining what you do, some are old heuristic habits that die hard. Some of them can be replaced by a more accurate set of expressions at the loss of generality. Among the principal terms in the lexicon of chemistry and biology is the word 'reaction.' From the 16th century, it had the sense in physics and nascent chemistry of an interaction between two bodies as indicated by the Latin '*re-agere'* ('to do back') designating the event of an interaction: sulphuric acid 'reacts with' silver to produce silver sulphate and oxygen gas. Over the course of the 19th century, reactions gained a highly formal language of representation, one that has only recently been enhanced by the advent of digital visual representation. These together would make the finest examples of surrogate reasoning. Moving out to biology, chemical reactions can be very highly conditioned and complex. Organisms need to do particular things at particular times to maintain the fundamental relationship between their insides and outsides (Mitchell, 1957). A photoreceptor in the eye or an insulin receptor in the liver is ready and waiting to respond to a necessary stimulus. The stimulus 'triggers' the response. Since receptors and stimuli are in such a tight relationship, a phrase is used to describe the triggering: 'lock and key.' As an analogy, it is almost ubiquitous. A lock is no good for anything but a key and a key for a lock and the expression of one matched to the other is a statement of unidirectional relationship and causality, quite like 'nature abhors…'. In some cases, the analogy works: DNA and RNA, ATP and ADP. Here, lock and key 'captures the model-relation well'.[5] But in many other references – no less ubiquitous – it is not. The purpose of insulin is not just to trigger receptors in the liver,

[5] Considering reverse transcription, 'button and hole' might be even more apt.

but to support the metabolism of glucose in general. That very fact explains why insulin needs to operate the trigger. It is a key, but also a door.

In his recent book, *How Life Works*, Philip Ball takes this lock and key scholion to task. He notes that the 1960s and 70s established a mechanistic conception of biochemistry, but that the malleable nature of proteins and their often unstructured reactions make a travesty of such a unidirectional model (Ball, 2023, pp. 158–159). Indeed, the computer-generated, three-dimensional crystal diagrams of proteins show how incredibly more complex their surfaces are than the classical, unidirectional chemical diagrams. And many proteins cannot be crystalized. The same can be said for the idea of 'chemical messengers.' Real messengers, on bicycles or on horses, deliver a message and then go home. Most of the time, however, biological messengers go to the recipient and eat the message and themselves, or deliver the message by being devoured by the recipient. The resulting reduction in the quantity of messengers results in the reduction of the message and the reaction of its recipient. And yet, 'locks and keys' as well as 'messengers' remain simultaneously persistent and ineffective representations.

I would venture that this predicament holds for two reasons: generalizing causes and semanticizing agents. Note that the processes taking place in 'lock and key' and 'messenger-message-recipient' are separate from their results. You put a key into a lock to get into something or somewhere – to get into elsewhere. The message likewise is a separate entity from the messenger and recipient. Perhaps we are proposing a model of words and things where this model of communication does not belong. We are inclined to separate the vehicles that convey the process from the process itself, as we would separate signifiers from the signified. Biology is more efficient. It does not require mediation. One would even prefer to say that biology is *prior*, it subsists in a world where mediation by naming processes is a useless application. Like Contessa's Underground, there are platonic ideas in these analogies that are hiding in plain sight.

This is especially the case when we digitize biological processes. Metaphors like 'genes are a language,' 'the brain is a computer' rely on the practice of marking biological processes with signs, manipulating the signs, and then imposing the nature of the representation and manipulation back onto the transcribed system. The same might be said for the phrase 'chemical recognition.' After all, 'recognize' is an even more anthropomorphic metaphor than language. Ball (2023) notes that chemical recognition is an essential term for the for the initiation of a process p. 154). Surely there could be something better.

RECOGNITION

If chemical reactions can give us the best examples of surrogate reasoning, the semantics of 'chemical recognition' should take mapping to a new level. I have not been able to arrive at a good historical account for how 'chemical recognition' emerges as a term in the biological literature and must hope that these reflections receive some more rigorous attention. The rub is contrasting 'reaction' with 'recognition' and a little play with these terms might tease some of the differences out. One would not consider, for example, the event of mixing silver with sulphuric acid as a moment of recognition

between silver and acid. This sounds a bit like Dido recognizing the fire. Recognition seems to require two independent entities who meet for an interaction and are in some way preserved, if altered, with the result. Chemical recognition means using a set of chemical reactions for each of the parties to do something else. Why then would we not speak of 'lock and key'? Ball's discussion suggests that 'recognition' refers to a set of interactions that take place at varied times and in varied ways. The two entities meet and the act of recognition is built into their interaction. For it to have significance, recognition must by itself be a separate process from the interaction and there must be some reason why it must stand apart. This reason can be that recognition triggers an internal process to one or either of the partners that is not exhausted in the course of the reaction but, so to speak, continues on. Thus the need to preserve individual integrity persists because the static and dynamic position of the relationship needs to be preserved. While there is a 'recognize' or 'do not recognize' binary to recognition, the 'accept' or 'deny' model of lock and key does not account for these other features.

With a little help from broader phenomenological reflection that would limit processes to behaviors, and by throwing the risk of anthropomorphism to the winds – since it already has been – recognition might require the following features:

a. Excitability = anxiety

To be recognized, something must be recognizable. This does not mean that it has to have a sensory capacity or a memory of prior acquaintances. The senses require that we cast a wide net and catch what we expect and what we do not expect, memory requires multiple stimuli and reinforcement. Recognition requires only the capacity to recognize. This capacity, however, is not static, like the capacity of a beaker. It is an expenditure of energy to await the stimulus of another. If A were always able to determine the advent of B, then there would be no need for recognition. The fact that A must invest energy in B, and B in A, to be able to recognize, means that each must invest energy in the recognition of the other or only to await the advent of the other. There is perhaps no better term than 'anxiety' for this dependency on what is awaited. If we are going to use 'recognition,' why not 'anxiety'? Perhaps such a term captures the importance of the investiture of energy expended in the synthesis of the membranes and appendages needed for recognition.

b. Preen and Peruse

The meeting then must be an event where each element can display its recognizable features. One of the more significant developments in recent genetic research has shown that the folding of proteins has an immense effect on how they are processed and synthesized. A great deal of the chemical environment around DNA and RNA is geared to manipulate the surfaces exposed to possible reactions. To recognize something you have to see enough of its features, to be recognized you have to display enough of these features. Unlike lock and key, chemical recognition requires a kind of choreography, like the dances of the 16th century that required participants to display the frills and attributes of their rank. If someone's crest were bunched up in their sleeves, how were you to know who they are? Each partner thus must preen before the other and then peruse the other so that recognition take place.

c. Engagement-non-engagement

If recognition *is* to take place, the previous elements must lead to this binary judgement of recognize or not-recognize. Here the lock and key model might be best applied: the pins and ridges are aligned and a third process can take place, the result of the recognition. However this resultant event can only take place on the basis of the prior two features, and it is only a part and not the whole of the process.

All these terms can be applied to the career of metaphor and, by extension, to some forms of representation. Every expression that requires surrogate reasoning must be designed around a particular level of abstraction that will make the expression functional. If we conceive of a formula as a type of expression that is meant to be solved, then the design of formulas builds in a set of anxieties about the quantities that are to be plugged into variables. Perhaps every element of a mappable representation involves an affordance of anxiety and expectancy about its application. As they are applied again and again, these affordances hone the elements of an expression to their most functional state.

This analysis has finally reversed the received epistemology of representation as mimetic. One first must recognize something by its cursory marks, then know it before you can make of it a faithful copy. Yet if recognition and representation are part of parallel processes, mimesis is already in the gestures of preen and peruse. One is reminded of the Indo-European root ‘mī’ from which the words mime, imitate, and measure come. If we limit ourselves to mapping behaviors and gestures, the range of correspondences becomes far more unfamiliar.

DECORATION = RECOGNITION

Anxiety, preening, perusing, engagement – these terms are far better suited to courtiers or birds than cell walls and long-chained molecules. Replacing verisimilitude with function and gesture, one cannot say that as models they are worse than ‘trigger’ or ‘unlock.’ Their surrogacy suits to the extent that what might be called a metaphor is also a model. If the test of suitability is functional and technical, there might be little real difference between the two.

Let us take an example which can either give the lie to the mapping or confirm it. In fact, like the career of metaphor, this example shall be not just an exercise in gesturing but a contribution to surrogate reasoning and modeling as hermeneutics.

As one might remember from school biology, many plants engage in symbiotic relationships with fungi. A broad class of fungi grow into the root systems of plants. The plants provide the fungi sugars while the fungi chemically bind nutrients to be digested by the plants. Explanations of symbiosis are full of teleological reasoning: Some fungi do good for plants and others infect them with disease. Defensive mechanisms must be in place for the right roots to match up with the right fungus. There is thus an affordance between the energy expended to make a more complex lock and key and the benefit of the relationship. The keys and locks of mycorrhizae fungi and plant structures have evolved into very complex and, by any stretch of the imagination, *baroque* structures of communication that ask, with 17 th century French diplomatic prolixity: ‘Am I right for you? Are you right for me?’ The technical term for these complex appendages on plants and fungi is ‘decoration’ and the process seems always to be called ‘recognition’ (e.g.,

Besserer et al., 2006, Rasmussen et al., 2016). The fungus and the molecules around the root structures recognize one another by decoration.

There seems to be nothing that distinguishes this recognition from that of a face, or a password – the assembly of correspondences which lead to an (electro-)chemical reaction, new physical information. And versions of this communication of surfaces can be seen throughout biological, including neurological, activity. Marching up from the roots to the tree to Newton sitting under the tree, there may be no observable difference between the baroque recognition of these symbionts and the far simpler recognition that takes place on the part of neurotransmitters. That is their capacity, and recognition their activity.

The teleology of symbiosis brings out a sense of agency in each of the partners, yet it only makes explicit processes which must be present in any recognition. Perhaps it is only the risk of impostors that makes prolixity absolutely necessary, but certainly decoration is a surface for 'preening and perusing.' Nevertheless, it is clearly also a product of the intensity of the exchange. Because mycorrhizae do not just engage with their symbionts from the outside but propagate deep into the hosting plant's root systems, we can say that the amount of decoration is directly proportional to the level of risk – you need more complex locks because you have more to lose. 'Complex enough' is a necessarily fuzzy category: complexity itself is an emergent phenomenon (one cannot move from simple to complex in one step), and there is not a certain level of complexity that would suit all possible keys and thwart all possible thieves: complexity in recognition is imbued with the anxiety of the possibility of recognition desired or undesired.

Beyond, or before, teleology, we might take a lesson from metaphor's career. As Bowdle and Gentner noted, metaphor functions just as much on the dissimilarity between its partners as on their similarity (Bowdle and Gentner, 2005, pp. 194). Whereas Jacobson and Groupe μ's work in the 1960s concentrated on metaphor as a deviation from lexical denotation, more recent theories of metaphor concentrate on overlapping fields of meaning which prompt one another in various mappings. The notion of lexical meaning is then like Contessa's platonic London Underground and deviation always tethered to it. In contrast, mental mapping, or network theory, might lead one to the sense that metaphor operates as a field of references with only weighted differences between target and base. This disregards the event of metaphor: that new metaphors are coined with a particular intention that can rearrange relations between target and base regardless of prior positions and proximities.

Eliminating the boundary between target and base in metaphor violates the rules of the exchange. The principles of game theory can fruitfully account for symbiotic behavior (see Nowak, 2006), but game-theoretical models cannot be built if there is no distinction between players. Perhaps the more empirical explanation of both mycorrhizae and metaphor is that the more overlap there is between the partners the more differences need to be maintained. Referring once again to the sphere of games and dances, the elaborate sleeves and fans of French or Japanese court culture were incorporated into gestures, theatre, and dance. The greater the inventory of possible gestures, the more need there was to have ordered structures to display them. The greater the number of points of contact, the more involved the preening and perusing.

Perhaps no less effective a metaphor for metaphor than the *career* of metaphor – a temporal illustration – is the *terrain* of metaphor – a spatial one. Poets vary the terrain of their targets and bases by massaging them with disjunctions. Semantic and imagistic expectancies (what in Indian aesthetics is called *akankshá*) are toyed with and manipulated in novel ways as the reader joins and disjoins elements of the verse. The distinction between the partners is maintained by rules of engagement: rhyme, metre, parallelism. Poets such as Keats or Bashō have strict patterns of juxtaposition, others such as Celan or e.e.cummings incorporate syntax and etymology. One can think of the metaphors in René Magritte's canvases: disjunctions are brought into greater relief by clean brushstrokes and mundane shadings of familiar objects in disjunctive settings. Similarities are toyed with along with deviations: preen and peruse. Like a map, metaphor shows a destination (dew→veil), and it presents the byways to that destination in its terms and conventions.

DIFFERENCE AND ETHICS

One might be persuaded that the real basis of interaction between partners is communication and that any theory of communication would naturally carry more surrogate weight than that of cooperation. One could say that lock and key communicate in order to open the door. But this is not always the case. The target and base of metaphorical relations are not communications with one another, but together form a communicative act. We have determined that a fundamental feature of chemical recognition over chemical messengers is that each of the partners maintain their integrity throughout the exchange. This is not always the case with chemical communication.

What does seem to be essential in cooperation, metaphor, and representation is a sense of the need for surface and difference. These two seem to be interdependent: the membrane around the cell, the root wall, the semantic field of a term or image, all depend on the surface marking the boundaries between partners as being the source of both anxiety and also preening/perusal. The duality is not just that of one boundary and membrane – x and $\sim x$ – but two boundaries and thus two internal states.

Our example of symbiotic decoration thus is an aid to understanding how meaning-making structures might work without denotation or signification, before what Iain McGilchrist calls the 'limit case' of the literal (McGilchrist, 2021, p. 17). But while we might easily dispense with denotation in favor of functional surrogacy, the position of intention is far more ambiguous. If it is helpful to anthropomorphize fungi with anxiety, there is no reason they should be denied their little intentions. The whole phenomenon of symbiosis relies on (at least) two partners, if we want to avoid applying teleology from outside the system, we have to conceive that the relations between partners carry their own intentions without some utilitarian intervention.

Perhaps it is at this point where the ultimate anthropomorphism needs to be indulged. While the study of biological cooperation has often tried to avoid any whiff of fundamental ethics, philosophers and theologians have not been able to resist (Almenberg et al., 2013). The more sensitive of them do not only attempt to prove the universality of morals, but also to investigate what these purely insentient agents might reveal about our

own ethical systems. The reverse might also be true. The need for two internal states and two decorated boundaries is a better analogy to an 'I/thou' relation than a relation of 'inside/outside' or '*x*/~*x*.' The position of radical ethics, given its classic expression by Emmanuel Levinas, is that the idea of the other is total, as he says, "an infinity" (Levinas, 1969, p. 51). This means that no presumptions of overarching purposes or internal states are valid. Boundaries, then, become everything, preening and perusing is duty. Indeed, adjusting for Jacques Derrida and Gilles Deleuze's critique of Levinas, we might see a decorative membrane, a baroque fold, as a better model of recognition than the face.

Finding an inherent ethical element in metaphor – in the maintenance of semantic integrity along with a terrain of informative disjunctions – might be of some use to aesthetics. The moral connotations of metaphor have always been read on the basis of intentions, often following a kind of sterile absolutism, and not on the fundamental models upon which associations are built. Such an approach might also help to relieve neuroethics of its deontological prejudices (see Trimble in Kopeikin and Nesteruk, 2024).

But is this all not a case of functional conflation? Is not the intention of surrogate reasoning to create precise, functional models that will allow us to propagate tokens or fulfill functional tasks? What precision can we gain from a morally structured fungus? After all, is the Deleuzian rhizome not intended to bring healthy, decentralized disorder? A hermeneutic in a theory of representation based not on verisimilitude but on functionality cannot help but arrive at sets of relations which jar, cajole, or dismay. Three simple arguments, one weaker and two stronger, support the relevance of such musings.

First the weaker: while symbiosis emerged as a concept early on in theories of evolution, it has always been seen more as an anomaly in comparison with competition and adaptation. Recent decades have shown, both through observation and theoretical modeling, that cooperation may be just as important to biology as competition. In fact, symbiosis with microorganisms is thought to have given plants the leg-up they needed to go from the sea to the land some 460 million years ago. This nicer kind of social Darwinism does not come from some marginal corner of biology, but from a set of dynamic principles foundational to life.

The first stronger point is that this theory of representation accounts for a number of similarly-structured processes that can resolve complex questions in a variety of ways and at several levels of abstraction. In order to use a cooperative theory of biology for the understanding of metaphor we do not have to argue that metaphor is more 'natural' than lexical denotation. In applications of metaphors to natural language, texts, or works of art, we only have to see how well the model works when it comes to giving a defensible explanation. Nor do we have to argue that there is a natural connection between neural networks and the career of metaphor, or participants in a game-theoretical model. But the virtue of applying such models is that they, like metaphors themselves, allow us to see structural connections where they might not have been seen before. Rather than inevitably taking a semiotic convention and applying it to biology, taking a biological phenomenon and applying it to semiotic conventions may bring out new models of functional significance. To the extent that life (at a certain scale) is always *better* than death, theories of living things are also inherently given a pass from the fact/value distinction. Using ethical principles to understand physical systems seems as anachronous as hanging a bull

for goring a man. However, such principles used in these terms are not normative but derive directly and intuitively from the natural behavior of two mutually distinctive agents primed for contact.

The second strong point seems paradoxical. The foundation for cooperation in biology is mutual benefit and this presumes either that each of the agents is aware of the benefit or that structures have emerged through natural selection to give advantage to those traits which lead to mutual benefit. Symbiosis carries its own purpose. As is well known, biology has a fraught relationship to teleology (see Hull, 1982), and biologists tend to qualify their teleological statements as heuristic scholia. But the sets of relations we have examined do not require an external purpose. Anxiety, preen and peruse, engagement can all be attributed to observable behaviors in the partners themselves. These are relations of surfaces and gestures and not of purposes and aims. At some level it is unhelpful to understand the relations between types of bean plants and types of smuts without mutual benefit: we may not be able to see some of the evolved features of these relations; and at some levels it is unhelpful to argue that a poet had no reason to fashion a particular metaphor. But in gestures and surfaces we have models for understanding relations at basic and empirical levels which we do not have when we must presume a cause or end.

There is clearly a virtue to positing models of scientific representation that do not give preference to the semiotic but that find application in the structures and behaviors around representational activity. That such disparate sets of applications arise could speak to the model's robustness and not its weakness.

RICHER TERMS = BETTER MODELS

Funny things happen when you relieve scientific models of the call to be mirrors of nature. After all, no model or map is ever considered to be equal to the territory it maps. Behaviors, practices, and traditions behind acts of scientific representation expose gestures, anticipation, and display. Some models persist for functional purposes: short-hand communication, diagnostics, but they do not serve to build functional models upon which new mappings can be built. Unexpectedly, metaphors do offer models that sometimes exhibit much more functionally applicable behavior. Comparable mapping gestures apply but, like formulas, they require a certain relationship between individual elements (or terms) to maintain the usefulness of the map.

This suggests that the gestures or games around mapping require a set of relations between partners, which further implies a radically ethical relation. Indeed, whereas the forms of cooperation we see in biology might be analogously applied to ethics as an example or lesson, a theory of representation which relies on mapping behaviors arrives at a set of necessary processes that pertain to recognition: the preparation, expectation, and invested energy of a meeting (anxiety), the full and extended presentation of recognizable features (preening and perusing), and the confirmation or denial of relations (engagement).

That metaphor, cooperation, molecular recognition, and scientific representation might exhibit comparable sets of gestures likely has to do with the interaction between

independent entities with varied internal states and complex patterns of interaction, as game and graphing theories would attest. A certain asymmetry in their states gives them their dynamism. The cooperative model takes these patterns to be a surface over which the process of recognition takes place. This means that the richer the surface, the more involved the set of relations, while ethics tells us these surfaces must only give a limited account of the internal states of each of the partners in the exchange. At a time when vast quantities of data can be milled by patently amoral actors, setting ethics at the fundament might reveal even richer surfaces.

Gross anthropomorphism or not, applying a theory of molecular communication to metaphor offers no more of a challenge to empiricism than saying that cells *are designed* to release hormones. A disciplined examination of the behavior of recognition without presuppositions as to its purpose implies that such relations have functional commonalities. Perhaps we use anthropomorphic terms for these relations because there are simply no better ones.

REFERENCES

Almenberg, J., Brooke, J. H., Clayton, P., Curtis, H. D., Dixon, T., Dreber, A., Fisher, J. C., Hall, N., Hauert, C., Hauser, M. D., Jackson, T. P., Johnson, D. D. P., Kosslyn, S. M., Lee, M., Lohmann, F., Porter, J., Pruss, A., Rota, M., & Schloss, J. P. (2013). *Evolution, Games, and God: The Principle of Cooperation*. (M. A. Nowak and S. Coakley, Eds.). Harvard University Press. https://doi.org/10.2307/j.ctvjnrscp

Ball, P. (2023). *How Life Works: A User's Guide to the New Biology*. University of Chicago Press.

Besserer, A., Puech-Pagès, V., Kiefer, P., Gomez-Roldan, V., Jauneau, A., Roy, S., Portais, J.-C., Roux, C., Bécard, G., & Séjalon-Delmas, N. (2006). Strigolactones Stimulate Arbuscular Mycorrhizal Fungi by Activating Mitochondria. *PLoS Biology*, *4*(7), e226. https://doi.org/10.1371/journal.pbio.0040226

Bowdle, B. F., & Gentner, D. (2005). The Career of Metaphor. *Psychological Review*, *112*(1), 193–216. https://doi.org/10.1037/0033-295X.112.1.193

Cooke, N. J., & Bartha, M. C. (1992). An Empirical Investigation of Psychological Metaphor. *Metaphor & Symbolic Activity*, *7*(3–4), 215–35. https://doi.org/10.1207/s15327868ms0703&4_7

Contessa, G. (2007). Scientific Representation, Interpretation, and Surrogative Reasoning. *Philosophy of Science*, *74*(1), 48–68. https://doi.org/10.1086/519478

Dickey, E. (2007). *Ancient Greek Scholarship: A Guide to Finding, Reading, and Understanding Scholia, Commentaries, Lexica, and Grammatical Treatises, from Their Beginnings to the Byzantine Period*. Oxford University Press.

Fauconnier, G. & Turner, M. (2003). *The Way We Think: Conceptual Blending and the Mind's Hidden Complexities*. Basic Books.

Floridi, L. (2008). The Method of Levels of Abstraction. *Minds and Machines*, *18*(3), 303–329. https://doi.org/10.1007/s11023-008-9113-7

Fodor, J. A. (1974). Special Sciences (Or: The Disunity of Science as a Working Hypothesis). *Synthese*, *28*(2), 97–115. https://doi.org/10.1007/BF00485230

Hull, D. L. (1982). Philosophy and Biology. In *La Philosophie Contemporaine / Contemporary Philosophy: Chroniques Nouvelles / A New Survey* (G. Fløistad, Ed.) (pp. 281–316). Springer Netherlands. https://doi.org/10.1007/978-94-010-9940-0_11

Kopeikin, K., & Nesteruk, A. V. (Eds.). (2024). *Consciousness and Matter: Mind, Brain, and Cosmos in the Dialogue Between Science and Theology*. Pickwick Publications.

Lakoff, G., & Johnson, M. (2003). *Metaphors We Live By*. University of Chicago Press.

Levinas, E. (1969). *Totality and Infinity: An Essay on Exteriority*. (A. Lingis, Trans.). Duquesne University Press.

McGilchrist, I. (2021). *The Matter with Things: Our Brains, Our Delusions and the Unmaking of the World*. Perspectiva Press.

Mitchell, P. (1957). The Origin of Life and the Formation and Organizing Functions of Natural Membranes. In A. I. Oparin, A. G. Pasynski, A. E. Braunstein, T. E. Pavlovskaya (Eds.), *Proceedings of the First International Symposium on the Origin of Life on the Earth* (pp. 229–234). Academy of Sciences.

Nowak, M. A. (2006). *Evolutionary Dynamics: Exploring the Equations of Life*. Belknap Press: An Imprint of Harvard University Press.

Ortony, A., Vondruska, R. J., Foss, M. A. & Jones, L. E. (1985). Salience, Similes, and the Asymmetry of Similarity. *Journal of Memory and Language, 24*(5), 569–94. https://doi.org/10.1016/0749-596X(85)90047-6.

Rasmussen, S. R., Füchtbauer, W., Novero, M., Volpe, V., Malkov, N., Genre, A., Bonfante, P., Stougaard, J. & Radutoiu, S. (2016). Intraradical Colonization by Arbuscular Mycorrhizal Fungi Triggers Induction of a Lipochitooligosaccharide Receptor. *Scientific Reports, 6*(1), 29733. https://doi.org/10.1038/srep29733

Stefanov, A. (2012). Theoretical Models as Representations. *Journal for General Philosophy of Science / Zeitschrift Für Allgemeine Wissenschaftstheorie, 43*(1), 67–76. https://doi.org/10.1007/s10838-012-9178-0

Swoyer, C. (1991). Structural Representation and Surrogative Reasoning. *Synthese, 87*(3), 449–508. https://doi.org/10.1007/BF00499820

Wittgenstein, L. (1991). *Philosophical Investigations: The German Text, with a Revised English Translation 50th Anniversary Commemorative Edition* G. E. M. Anscombe, and E. Anscombe, Eds.) [3rd ed.], (. Wiley-Blackwell. (Original work published 1953)

Wittgenstein, L. (2020). *The Mythology in Our Language: Remarks on Frazer's Golden Bough*. (G. da Col and S. Palmié, Eds.). HAU.

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