Beyond Mimesis and Convention: Representation in Art and Science, ed. Roman Frigg and Matthew Hunter, Dordrecht: Springer, 2010, 1-17; *Enrahonar*, 49, 2012, 68-89 (in Spanish, translated by Remei Capdevila).

Telling Instances

Catherine Z. Elgin

Abstract: Science is held to be the mirror of nature, while art imitates life. If so, representations in both disciplines should resemble their objects. Against such mimetic theories, I argue that exemplification rather than mere resemblance is crucial. I explicate exemplification – a referential relation of an exemplar to some of its features. Because exemplification is selective, an exemplar can diverge from its referent respects that are unexemplified. This is why an idealization, which is strictly false, can yield insight into the phenomena it concerns. Drawing on analogies with pictorial representations, I show how a model exemplifies features it shares with its target, highlights the significance of those features, and thereby yields an understanding of the target system.

Science, we are told, is (or at least aspires to be) a mirror of nature, while art imitates life. If so, both disciplines produce, or hope to produce, representations that reflect the way the mind-independent world is. Scientific representations are supposed to be complete, accurate, precise and distortion-free. Although artistic representations are granted more leeway, they too are supposed to resemble their subjects. Underlying these cliches is the widespread conviction that representations are intentional surrogates for, or replicas of, their objects. If so, a representation should resemble its referent.

This stereotype is false and misleading. It engenders unnecessary problems in the philosophy of science and the philosophy of art. It makes a mystery of the effectiveness of sketches, caricatures, scientific models, and representations with fictional subjects. Indeed, the stereotype strongly suggests that there is something intellectually suspect about such representations. Caricatures exaggerate and distort. Sketches simplify. Models may do all three. Many pictures and models flagrantly fail to match their referents.

Representations with fictional subjects have no hope of matching, since they have no referents to match. The same subject, real or fictive, can be represented by multiple, seemingly incongruous representations. These would be embarrassing admissions if representations were supposed to accurately reflect the facts.

Mimetic accounts of representation fail to do justice to our representational practices. Many seemingly powerful and effective representations turn out on a mimetic account to be at best flawed, at worst unintelligible. Nor is it clear why we should want to replicate reality. As Virginia Woolf allegedly said, 'Art is not a copy of the real world. One of the damn things is enough!'[1] To replicate reality would simply be to reproduce the blooming buzzing confusion that confronts us. What is the value in that? Our goal should be to make sense of things – to structure, synthesize, organize, and orient ourselves toward things in ways that serve our ends.

Nominalism is of no help with this task, for it is undiscriminating. According to nominalism, there are no natural kinds. Since, except for paradoxically self-referential cases, every collection of entities constitutes an extension, every two or more objects resemble each other in virtue of their joint membership in some extension. Thus mere resemblance cannot serve as a ground for representation, else everything would represent everything else. This is true but unhelpful. That there are no natural kinds tells us virtually nothing about how representations function.

---

[1] Nelson Goodman, *Languages of Art*, Indianapolis: Hackett, 1968, p. 3. Goodman was not able to find the original source for this quotation. Although a number of sources credit Woolf with it, I have found none that knows where in her work it is to be found.

The problem lies in the metaphor of the mirror and the ideal of replication. Neither art nor science is, can be, or ought to be, a mirror of nature. Rather, I will argue, effective representations in both disciplines embody and convey an *understanding* of their subjects. Since understanding is not mirroring, failures of mirroring need not be failures of understanding. Once we recognize the way science affords understanding, we see that the features that look like flaws under the mirroring account are actually virtues. A first step is to devise an account of scientific representations that shows how they figure in or contribute to understanding. It will turn out that an adequate account of scientific representation also affords insight into representation in the arts.

Representation

The term 'representation' is irritatingly imprecise. Pictures represent their subjects; graphs represent the data; politicians represent their constituents; representative samples represent whatever they are samples of. We can begin to regiment by restricting attention to cases where representation is a matter of denotation. Pictures, equations, graphs, charts, and maps represent their subjects by denoting them. They are representations *of* the things that they denote.[2] It is in this sense that scientific models represent their target systems: they denote them. But, as Bertrand Russell notes, not all

---

[2] This use of 'denote' is slightly tendentious, both because denotation is usually restricted to language and because even within language it is usually distinguished from predication. As I use the term, predicates and generic non-verbal representations denote the members of their extensions. See Catherine Z. Elgin, *With Reference to Reference*, Indianapolis: Hackett, 1983, pp. 19-35.

denoting symbols have denotata.[3] A picture that portrays a griffin, a map that maps the route to Mordor, a chart that records the heights of Hobbits, and a graph that plots the proportion of caloric in different substances are all representations, although they do not represent anything. To be a representation, a symbol need not itself denote, but it needs to be the sort of symbol that denotes. Griffin pictures are representations then because they are animal pictures, and some animal pictures denote animals. Middle Earth maps are representations because they are maps and some maps denote real locations. Hobbit height charts are representations because they are charts and some charts denote magnitudes of actual entities. Caloric proportion graphs are representations because they are graphs and some graphs denote relations among real substances. So whether a symbol is a representation is a question of what kind of symbol it is. Following Goodman, let us distinguish between representations *of p* and *p*-representations. If *s* is a representation *of p*, then *p* exists and *s* represents *p.* But *s* may be a *p*-representation even if there is no such thing as *p.*[4] Thus, there are griffin-pictures even though there are no griffins to depict. There is an ideal-gas-description even though there is no ideal gas to describe. There are also mixed cases. The class of dog-representations includes both factual and fictional representations. Factual dog-representations are representations of dogs; fictional dog-representations lack denotata.

Denoting symbols with null denotation may seem problematic. Occasionally philosophers object that in the absence of griffins, there is no basis for classifying some pictures as griffin pictures and refusing to so classify others. Such an objection supposes

---

[3] Bertrand Russell, 'On Denoting' *Logic and Knowledge,* New York: Capricorn, 1968, p. 41.

[4] Nelson Goodman, *Languages of Art*, Indianapolis: Hackett, 1968, pp. 21-26.

that the only basis for classifying representations is by appeal to an antecedent classification of their referents. This is just false. We readily classify pictures as landscapes without any acquaintance with the real estate – if any – that they represent. I suggest that each class of *p*-representations constitutes a small genre, a genre composed of all and only representations with a common ostensible subject matter. There is then a genre of griffin-representations and a genre of ideal-gas-representations. And we learn to classify representations as belonging to such genres as we study those representations and the fields of inquiry that devise and deploy them. This is no more mysterious than learning to recognize landscapes without comparing them to the terrain they ostensibly depict.

Some representations denote their ostensible objects. Others do not. Among those that do not, some – such as caloric-representations – simply fail to denote. They purport to denote something, but there is no such thing. They are therefore defective. Others, such as ideal-gas-representations are fictive. They do not purport to denote any real object. So their failure to denote is no defect. We know perfectly well that there is no such animal as a griffin, no such person as Othello, no such gas as the ideal gas. Nonetheless, we can provide detailed representations *as if* of each of them, argue about their characteristics, be right or wrong about what we say respecting them and, I contend, advance understanding by means of them.

Representation As

x is, or is not, a representation *of y* depending on what *x* denotes. And *x* is, or is not, a *z*-representation depending on its genre. This enables us to form a more complex mode of representation in which *x* represents *y as z.* In such a representation, symbol *x* is

a *z*-representation that as such denotes *y*. Caricature is a familiar case of representation-as. Winston Churchill is represented as a bulldog; George W. Bush is represented as a deer in the headlights. According to R. I. G. Hughes, representation-as is central to the way that models function in science.[5] This excellent idea needs elaboration.

Representation-of can be achieved by fiat. We simply stipulate: let *x* represent *y* and *x* thereby becomes a representation of *y*. This is what we do in baptizing an individual or a kind. It is also what we do in ad hoc illustrations as for example, when I say (with appropriate accompanying gestures), 'If that chair is Widener Library, and that desk is University Hall, then that window is Emerson Hall' in helping someone to visualize the layout of Harvard Yard. We could take any *p*-representation and stipulate that it represents any object. We might, for example point to a tree-picture and stipulate that it denotes the philosophy department. But our arbitrary stipulation does not bring it about that the tree-representation represents the philosophy department as a tree.

Should we say then that representation-as requires similarity? In that case, what blocks seemingly groundless and arbitrary cases of representation-as is the need for resemblance between the representation and the referent. But as Goodman, Suárez, and others argue, similarity does not establish a referential relationship.[6] Representation is an asymmetrical relation; similarity is symmetrical. Representation is irreflexive, similarity

---

[5] R. I. G. Hughes, 'Models and Representation,' *PSA 1996*, vol. 2, (Philosophy of Science Association), pp. S325-336.

[6] Goodman, *op. cit.*, p. 4; Mauricio Suárez, 'Scientific Representation: Against Similarity and Isomorphism,' *International Studies in the Philosophy of Science*, 17, 2003, pp. 225-243.

is reflexive. One might reply that this only shows that similarity is not sufficient for representation-as. Something else determines direction. Then it is the similarity between symbol and referent that brings it about that the referent is represented as whatever it is represented as. The problem is this: Via stipulation, we have seen, pretty much anything can represent pretty much anything else. So nothing beyond stipulation is required to bring it about that one thing represents another. But similarity is ubiquitous. This is the insight of nominalism. For any *x* and any *y, x* is somehow similar to *y.* Thus if all that is required for representation-as is denotation plus similarity, then for any *x* that represents *y, x* represents *y* as *x.* Every case of representation turns out to be a case of representation-as. In one way or another, the philosophy department is similar to a tree-picture, but it is still hard to see how that fact, combined with the stipulation that a tree-picture represents the department, could make it the case that the department is represented as a tree-picture, much less as a tree. Suppose we add that the similarity must obtain between the content of the *p*-representation and the denotation. Then for any *x-representation* and any *y*, if the *x-representation* denotes *y*, it represents *y* as *x.* In that case, a tree that represented the philosophy department would not represent it as a tree. But a tree-picture that represented the philosophy department would represent it as a tree.

The trouble is that contentful representations, as well as chairs and desks, can be used in ad hoc representations such as the one I gave earlier. If the portrait of the dean on the wall represents Widener Library, and the graph on the blackboard represents University Hall, then the map represents Emerson Hall. This does not make the dean's portrait represent Widener Library as the dean. Evidently, it takes more than being represented by a tree-picture to be represented as a tree. Some philosophy departments

can be represented as trees. But to bring about such representation-as is not to arbitrarily stipulate that a tree picture shall denote the department, even if we add a vague intimation that somehow or other the department is similar to a tree. The question is, what is effected by such a representation?

To explicate representation-as, Hughes discusses Sir Joshua Reynolds' painting, 'Mrs. Siddons as The Tragic Muse.' The painting denotes its subject and represents her as the tragic muse. How does it do so? It establishes Mrs. Siddons as its denotation. It might represent Mrs. Siddons, a person familiar to its original audience, in a style that that audience knows how to interpret. Then, without further cues, they could recognize that the picture is a picture of her. But the painted figure need not bear any particular resemblance to Mrs. Siddons. *We* readily take her as the subject even though we have no basis for comparison. (Indeed, we even take Picasso's word about the identities of the referents of his cubist portraits, even though the figures in them do not look like anyone on earth.) Captioning the picture as a portrait of Mrs. Siddons suffices to fix the reference. So a painting can be connected to its denotation by stipulation. The painting is a tragic-muse-picture. It is not a picture of the tragic muse, there being no such thing as the tragic muse. But it belongs to the same restricted genre as other tragic-muse-representations. To recognize it as a tragic-muse-picture is to recognize it as an instance of that genre. Similarly in scientific cases. A spring is represented as a harmonic oscillator just in case a harmonic-oscillator-representation as such denotes the spring. The harmonic-oscillator-representation involves idealization. So it is not strictly a representation *of* a harmonic oscillator, any more than the Reynolds is a picture *of* the tragic muse.

In both cases a representation that does not denote its ostensible subject is used to denote another subject. Since denotation can be effected by stipulation, there is no difficulty in seeing how this can be done. The difficulty comes in seeing why it is worth doing. What is gained by representing Mrs. Siddons as the tragic muse, or a spring as a harmonic oscillator, or in general by representing an existing object as something that does not in fact exist? The quick answer is that the representation affords epistemic access to features of the object that are otherwise difficult or impossible to discern. To make this out requires resort to another Goodmanian device – exemplification.

Exemplification

Consider a mundane case. Commercial paint companies provide sample cards that instantiate the colors of the paints they sell. The cards also instantiate innumerable other properties. They are a certain size, shape, age, and weight. They are at a certain distance from the Eiffel Tower. They are excellent bookmarks but poor insulators. And so on. Obviously, there is a difference between the colors and these other properties. Some of the properties the cards instantiate, such as their distance from the Eiffel Tower, are matters of complete indifference. Others, such as their size and shape, facilitate but do not figure in the cards' standard function. Under their standard interpretations, the cards serve exclusively as paint samples. They are mere instances of their other properties, but telling instances of their colors. A symbol that is a telling instance of a property exemplifies that property. It points up, highlights, displays or conveys the property. Since it both refers to and instantiates the property, it affords epistemic access to the property.[7]

---

[7] Goodman, *ibid.,* pp. 45-68 ; Catherine Z. Elgin, *Considered Judgment*, Princeton: Princeton University Press, 1996, pp. 171-183.

Because exemplification requires instantiation as well as reference, it cannot be achieved by stipulation. Only something that is colored dusky rose can exemplify that shade. Moreover, exemplification is selective. An exemplar can exemplify only some of its properties. It highlights those properties by marginalizing, downplaying, or overshadowing other properties it instantiates. It may exemplify a cluster of properties, as a fabric swatch exemplifies its colors, texture, pattern and weave. But it cannot exemplify all its properties. Moreover, an exemplar is selective in the degree of precision with which it exemplifies. A single splotch color that instantiates dusky rose, rose, and pink may exemplify any of these properties without exemplifying the others. Although the color properties it instantiates are nested, it does not exemplify every property in the nest. Exemplars are symbols that require interpretation.

Paint samples and fabric swatches belong to standardized, regimented exemplificational systems. But exemplification is not restricted to such systems. Any item can serve as an exemplar simply by being used as an example. So items that ordinarily are not symbols can come to function symbolically simply by serving as examples. A teacher might use one student's work as an example of what she wants (or does not want) her other students to do. Moreover, in principle, any exemplar can exemplify any property it instantiates, and any property that is instantiated can be exemplified.

But what is feasible in principle is not always straightforward in practice. Exemplification of a particular property is not always easy to achieve, for not every instance of a property affords an effective example of it. The roof of a crocodile's mouth is a distinctive shade of yellowish pink. Nevertheless, a paint company would be ill

advised to recommend that potential customers peer into a crocodile's mouth order to see that color. Crocodiles are so rare and so dangerous that any glimpse we get of the roof of one's mouth is unlikely to make the color manifest. We could not see it long enough or well enough and would be unlikely to attend to it carefully enough or survive long enough after our investigation to decide whether it was the color we want to paint the hall. It is far better to create a lasting, readily available, easily interpretable sample of the color – one whose function is precisely to make the color manifest. Such a sample should be stable, accessible, and have no properties that distract attention from the color. Effective samples and examples are carefully contrived to exhibit particular features. Factors that might otherwise predominate are omitted, bracketed, or muted. This is so, not only in commercial samples, but in examples of all kinds. Sometimes elaborate stage setting is required to bring about the exemplification of properties that are subtle, scarce, or tightly intertwined.

Scientific experiments are vehicles of exemplification. They do not purport to replicate what happens in the wild. Instead, they select, highlight, control and manipulate things so that features of interest are brought to the fore and their relevant characteristics and interactions made manifest. To ascertain whether water conducts electricity, one would not attempt to create an electrical current in a local lake, stream or bathtub. The liquid found in such places contains impurities. So a current detected in such a venue might be due to the electrical properties of the impurities, not those of water. By experimenting on distilled water, scientists bring it about that the conductivity of water is exemplified. But distilled water is nowhere to be found in nature.

Experiments are highly artificial.[8] They are not slices of nature, but contrivances often involving unnaturally pure samples tested under unnaturally extreme conditions. The rationale for resorting to such artifices is plain. A natural case is not always an exemplary case. A pure sample that is not to be found in nature, tested under extreme conditions that do not obtain in nature, may exemplify features that obtain but are not evident in nature. So by sidelining, marginalizing, or blocking the effects of confounding factors, experiments afford epistemic access to properties of interest.

Not all confounding factors are easily set aside. Some clusters of properties so tightly fuse that they cannot be prized apart. In such cases, we cannot devise a laboratory experiment to test one in the absence of the others. This is where idealizations enter. Factors that are inseparable in fact can be separated in fiction. Even though, for example, every actual swinging bob is subject to friction, we can represent an idealized pendulum that is not. We can then use that idealization in our thinking about pendulums, and (we hope) understand the movement of swinging bobs in terms of it. The question though is how something that does not occur in nature can afford any insight into what does. Here again, it pays to look to art.

Fiction

Like an experiment, a work of fiction selects and isolates, manipulating circumstances so that particular properties, patterns, and connections, as well as disparities and irregularities are brought to the fore. It may localize and isolate factors that underlie or are interwoven into everyday life or natural events, but that are apt to

[8] See Nancy Cartwright, 'Aristotelian Natures and Modern Experimental Method' *The Dappled World*, Cambridge: Cambridge University Press, pp. 77-104.

pass unnoticed because, other more prominent factors typically overshadow them. This is why Jane Austen maintained that 'three or four families in a country village is the very thing to work on.'[9] The relations among the three or four families are sufficiently complicated and the demands of village life sufficiently mundane that the story can exemplify something worth noting about ordinary life and the development of moral personality. By restricting her attention to three or four families, Austen in effect devises a tightly controlled thought experiment. Drastically limiting the factors that affect her protagonists enables her to elaborate the consequences of the relatively few that remain.

If our interests are cognitive though, it might seem that this detour through fiction is both unnecessary and unwise. Instead of resorting to fiction, wouldn't it be cognitively preferable to study three or four real families in a real country village? Probably not, if we want to glean the insights that Austen's novels afford. Even three or four families in a relatively isolated country village are affected by far too many factors for the social and moral trajectories that Austen's novels exemplify to be salient in their interactions. Too many forces impinge on them and too many descriptions are available for characterizing their interactions. Any such sociological study would be vulnerable to the charge that other, unexamined factors played a non-negligible role in the interactions studied, that other forces were significant. Austen evades that worry. She omits such factors from her account and in effect asks: Suppose we leave them out, then what would we see?

---

[9] Jane Austen, Letter to her niece, Anna Austen Lefroy, September 9, 1814, in *Letters of Jane Austen* Bradbourn Edition, www.pemberley.com/janeinfo/brablets.html Consulted May 4, 2005.

Similarly, the model pendulum omits friction and air resistance, allowing the scientist in effect to ask: Suppose we leave them out, then what would we see?

Models, like other fictions, can simplify, omitting confounding factors that would impede epistemic access to the properties of interest. They can abstract, paring away unnecessary and potentially confusing details. They can distort or exaggerate, highlighting significant aspects of the features they focus on. They can augment, introducing additional elements that focus attention on properties of interest. They can insulate, screening off effects that would otherwise dominate.

The question is how this is supposed to inform our understanding of reality. That Elizabeth Bennet and Mr. Darcy, who do not exist, are said to behave thus and so does not demonstrate anything about how real people really behave. That an idealized pendulum, which also does not exist, is said to behave thus and so does not demonstrate anything about how actual pendulums behave.

Let us return to the paint company's sample cards. Most people speak of them, and probably think of them as samples *of* paint – the sort of stuff you use to paint the porch. They are not. The cards are infused with inks or dyes of the same color as the paints whose colors they exemplify. It is a fiction that they are samples of paint. But since the sole function of such a card is to convey the paint color, the fiction is no lie. All that is needed is something that is the same color as the paint. A fiction thus conveys the property we are interested in because in the respect that matters, it is no different from an actual instance. The exemplars need not themselves be paint. Similarly in literary or scientific cases. If the sole objective is to exemplify particular properties, then in a suitable context, any symbol that exemplifies those properties will do. If a fiction

exemplifies the properties more clearly, simply, or effectively than a strictly factual representation, it is to be preferred to the factual representation.

Still there is a worry.[10] Many scientific models are not capable of instantiating the properties they apparently impute to their targets. If they cannot instantiate a range of properties, they cannot exemplify them. Suppose we model a pendulum as a simple harmonic oscillator. Since exemplification requires instantiation, if the model is to represent the pendulum as having a certain mass, the model must have that mass. But, not being a material object, the model does not have mass. So it cannot exemplify the mass of the pendulum. This is true. Strictly, the model does not exemplify mass. Rather it exemplifies an abstract mathematical property, the magnitude of the pendulum's mass. Where models are abstract, they exemplify abstract patterns, properties, and/or relations that may be instantiated by physical target systems. It does no harm to say that they exemplify physical magnitudes. But this is to speak loosely. Strictly speaking, they exemplify mathematical (or other abstract) properties that can be instantiated physically.

Both literary fictions and scientific models exemplify properties and afford epistemic access to them. By omitting or downplaying the significance of confounding factors (the Napoleonic wars in the case of *Pride and Prejudice*, intermolecular attraction in the ideal gas, friction in the model pendulum), they constitute a cognitive environment where certain aspects of their subjects stand out. They thereby facilitate recognition of those aspects and appreciation of their significance. They thus give us reason to take those aspects seriously elsewhere.

---

[10] I am grateful to an anonymous referee for pressing this point.

Of course this does not justify a straightforward extrapolation to reality. From the fact that Elizabeth Bennet was wrong to distrust Mr. Darcy, we cannot reasonably infer that young women in general are wrong to distrust their suitors, much less that any particular young woman is wrong to distrust any particular suitor. But the fiction exemplifies the grounds for distrust and the reasons those grounds may be misleading. Once we have seen them clearly there, we may be in a better position to recognize them in everyday situations. Nor can we reasonably infer from the fact that ideal gas molecules exhibit no mutual attraction, that neither do helium molecules. But the behavior ideal gas molecules exemplify in the model may enable us to recognize such behavior amidst the confounding factors that ordinarily obscure what is going on in actual gases.

Epistemic Access

Let us return to Reynolds' representation of Mrs. Siddons as the tragic muse. The tragic muse is a figure from Greek mythology who is supposed to inspire works of tragedy – works that present a sequence of events leading inexorably from a position of eminence to irrecoverable, unmitigated loss, thereby inspiring pity and terror.[11] A tragic muse representation portrays a figure capable of inspiring such works, one who exemplifies such features as nobility, seriousness, inevitability, and perhaps a somber dramaticality, along with a capacity to evoke pity and terror. To represent a person as the tragic muse is to represent her in such a way as to reveal or disclose such characteristics in her or to impute such characteristics to her.

---

[11] Aristotle, *Poetics* Book 6, lines 20-30. *Introduction to Aristotle* ed. Richard McKeon Chicago: University of Chicago Press, 1973, p. 677.

The ideal gas law is an equation ostensibly relating temperature, pressure, and volume in a gas. To satisfy that equation, a gas would have to consist of perfectly elastic spherical particles of negligible volume and exhibiting no mutual attraction. The law thus defines a model that mandates specific values for size, shape, elasticity, and attraction. With these parameters fixed, the interdependence of the values of temperature, pressure, and volume is exemplified. The law and the model it defines are fictions. There is no such gas. Nevertheless, the model advances our understanding of gas dynamics. It exemplifies a relation that is important, but hard to discern in the behavior of actual gases. Hughes maintains that the relation between a model and its target is representation-as. The model is a representation – a denoting symbol that has an ostensible subject and portrays its ostensible subject in such a way that certain features are exemplified. It represents its target (its denotatum) as exhibiting those features. So to represent helium as an ideal gas is to impute to it features that the ideal gas model exemplifies. By setting the parameters to zero, it in effect construes the actual size, shape, inelasticity, and mutual attraction of the molecules as negligible. Strictly, of course, in helium the values of those parameters are not zero. But the imputation allows for a representation that discloses regularities in the behavior of helium that a more faithful representation would obscure. The model then foregrounds the interdependence of temperature, pressure, and volume, making it and its consequences manifest.

Representing a philosophy department as a tree might exemplify the ways the commitments of the various members branch out of a common, solid, rooted tradition, and the way that the work of the graduate students further branches out from the work of their professors. It might intimate that some branches are flourishing while others are

stunted growths. It might even suggest the presence of a certain amount of dead wood. Representing the department as a tree then affords resources for thinking about it, its members and students, and their relation to the discipline in ways that we otherwise would not.

I said earlier that when *x* represents *y* as *z*, *x* is a *z*-representation that *as such* denotes *y*. We are now in a position to cash out the 'as such'. It is because *x* is a *z*-representation that *x* denotes *y* as it does. *x* does not merely denote *y* and happen to be a *z*-representation. Rather in being a *z*-representation, *x* exemplifies certain properties and imputes those properties or related ones to *y*. 'Or related ones' is crucial. A caricature that exaggerates the size of its subject's nose, need not impute an enormous nose to its subject. By exemplifying the size of the nose, it focuses attention, thereby orienting its audience to the way the subject's nose dominates his face or the way his nosiness dominates his character. The properties exemplified in the *z*-representation thus serve as a bridge that connects *x* to *y*. This enables *x* to provide an orientation to its target that affords epistemic access to the properties in question.

Of course there is no guarantee that the target has the features the model exemplifies, any more than there is any guarantee that a subject represented as the tragic muse has the features that a painting representing her as the tragic muse exemplifies. This is a question of fit.

A model may fit its target perfectly or loosely or not at all. Like any other case of representation-as, the target may have the features the model exemplifies. Then the function of the model is to make those features manifest and display their significance.

We may see the target system in a new and fruitful way by focusing on the features that the model draws attention to.

In other cases, the fit is looser. The model does not exactly fit the target. A target that does not instantiate the precise properties its model exemplifies may instantiate more generic properties that subsume the exemplified properties. If gas molecules are roughly spherical, reasonably elastic and far enough apart, then we may gain insight into their behavior by representing them as perfectly elastic spheres with no mutual attraction. Perhaps we will subsequently have to introduce correction factors to accommodate the divergence from the model. Perhaps not. It depends on what degree of precision we want or need. Sometimes, although the target does not quite instantiate the features exemplified in the model, it is not off by much. Where their divergence is negligible, the models, although not strictly true of the phenomena they denote, are true enough of them.[12] This may be because the models are approximately true, or because they diverge from truth in irrelevant respects, or because the range of cases for which they are not true is a range of cases we do not care about, as for example when the model is inaccurate at the limit. Where a model is true enough, we do not go wrong if we think of the phenomena as displaying the features that the model exemplifies. Obviously whether such a representation is true enough is a contextual question. A representation that is true enough for some purposes or in some respects is not true enough for or in others. This is no surprise. No one doubts that the accuracy of models is limited.

In other cases, of course, the model simply does not fit. In that case, the model affords little or no understanding of its target. Not everyone can be informatively

---

[12] See Catherine Z. Elgin, 'True Enough,' *Philosophical Issues*, 14 (2004), 113-131.

represented as the tragic muse. Nor can every object be informatively represented as a perfectly elastic sphere.

Earlier I dismissed resemblance as the vehicle of representation. I argued that exemplification is required instead. But for *x* to exemplify a property of *y*, *x* must share that property with *y.* So *x* and *y* must be alike in respect of that property. It might seem then that resemblance in particular respects is what is required to connect a representation with its referent.[13] There is a grain of truth here. If exemplification is the vehicle for representation-as, the representation and its object resemble one another in respect of the exemplified properties. But resemblance, even resemblance in a particular, relevant respect, is not enough, as the following tragic example shows.

On January 28, 1986, the space shuttle Challenger exploded because its O-rings failed due to cold weather. The previous day, engineers involved in designing the shuttle had warned NASA about that very danger. They faxed data to NASA to support their concern. The printouts contained complex descriptions conveying vast amounts of information about previous shuttle flights. They included measurements of launch temperatures for previous flights and measurements of six types of O-ring degradation after each flight. Had loss of elasticity been plotted against temperature, the danger would have been clear. The evidence that the O-rings were vulnerable in cold weather was contained in the data. But it was obscured by a melange of other information that was also included.[14] So although the requisite resemblance between model and target obtained, it was overshadowed in the way that a subtle irregularity in an elaborate

[13] This is the position Giere takes about the relation between a model and its target system. See *Science without Laws,* Chicago: University of Chicago Press, 1999.

tapestry might be. As it was presented, the data instantiated but did not exemplify the correlation between degradation of elasticity and temperature. They did not represent the O-rings as increasingly inelastic as the temperature dropped. Because the correlation between O-ring degradation and temperature was not perspicuous, the NASA decision makers did not see it. The launch took place, the shuttle exploded, and the astronauts died. When the goal of a representation is to afford understanding, its merely resembling the target in relevant respects is not sufficient. The representation must make the resemblance manifest.

Problems Evaded

The account I have sketched evades a number of controversies that have arisen in recent discussions of scientific models. Whether models are concrete or abstract makes no difference. A tinker toy model of a protein exemplifies a structure and represents its target as having that structure. An equation exemplifies a mathematical relation between temperature and pressure and represents its target as consisting of molecules whose temperatures and pressures are so related. Nor does it matter whether models are verbal or non-verbal. One could represent Mrs. Siddons as the tragic muse in a picture, as Reynolds did, or in a poem as Russell did.[15]

---

[14] Edward R. Tufte. *Visual and Statistical Thinking: Displays of Evidence for Making Decisions*, Cheshire, Connecticut: Graphics Press, 1997, pp. 17-31.

[15] W. Russell, 'The Tragic Muse: A Poem Addressed to Mrs. Siddons,' 1783. www.dulwichpicturegallery.org.uk/collection/search/display.aspx?im=252, Consulted January 12, 2006.

In all cases, models are contrived to exemplify particular features. Theoretical models are designed to realize the laws of a theory.[16] But we should not be too quick to think that they are therefore vacuously true. For by exemplifying features that follow from the realization of the laws, the models may enhance understanding of what the realization of the laws commits the theory to. They may, for example, show that any system that realizes the laws has certain other unsuspected properties as well. A model then can provide reasons to accept or reject the theory. Such a model is a mediator between the laws and the target system.[17] It in effect puts meat on the bare bones of the theory, makes manifest what its realization requires, and exemplifies properties that are capable of being instantiated in and may be found in the target system. In discussing theoretical models, we should be sensitive to the ambiguity of the word 'of'. Such a model is a model *of* a theory because it exemplifies the laws of the theory. It is a model *of* the target because it denotes the target. It thus stands in different referential relations to the two systems it mediates between.

Not all models are models of laws or theories. There are phenomenological models as well. These too exemplify features they ascribe to their target systems. They are streamlined, simplified representations that highlight those properties and exhibit their effects. The difference is that the features phenomenological models exemplify are not captured in laws.

---

[16] Ronald Giere, *op. cit.,* p. 92.

[17] Margaret Morrison and Mary S. Morgan. 'Models as Mediating Instruments,' *Models as Mediators,* ed, Mary S. Morgan and Margaret Morrison, Cambridge: Cambridge University Press, 1999, 10-38.

Data models regiment and streamline the data. They impose order on it, by smoothing curves, omitting outliers, grouping together readings that are to count as the same, and discriminating between readings that are to count as different. They thereby bring about the exemplification of patterns and discrepancies that are apt to be obscured in the raw data.

There is evidently no limit on what can be a target. It is commonplace that scientists rarely if ever test theoretical models or phenomenological models against raw data. At best, they test such models against data models. Only data models are apt to be tested against raw data. A theoretical model might take as its target a phenomenological model or a less abstract theoretical model.[18] Then its accuracy would be tested by whether the features it exemplifies are to be found in the representations that other model provides, and its adequacy would be tested by whether the features found are scientifically significant. We can and should insist that eventually models in empirical sciences answer to empirical facts. But there may be a multiplicity of intervening levels of representation between the model and the facts it answers to.

Because models depend on exemplification, they are selective. A model makes some features of its target manifest by overshadowing or ignoring others. So different models of the same target may make different features manifest. Where models are thought of as mirrors, this seems problematic. It is hard to see how the nucleus of an atom could be mirrored without distortion as a liquid drop and as a shell structure.[19] Since a single material object cannot be both fluid and rigid, there might seem to be something

[18] Suárez, 'Scientific Representation' *op. cit.,* p. 237.

[19] I owe this example to Roman Frigg.

wrong with our understanding of the domain if both models are admissible. But if what one model contends is that in some significant respects the nucleus behaves like a liquid drop, and another model contends that in some other significant respects it behaves as though it has a shell structure, there is in principle no problem. There is no reason why the same thing should not share some significant properties with liquid drops and other significant properties with rigid shells. It may be surprising that the same thing could have both sets of features, but there is no logical or conceptual difficulty. The models afford different perspectives on the same reality. And it is no surprise that different perspectives reveal different aspects of that reality. There is no perfect model[20] for the same reason that there is no perfect perspective. Every perspective, in revealing some things, inevitably obscures others.

Nothing in this account favors either scientific realism or anti-realism. One can be a realist about theoretical commitments, and take the success of the models to be evidence that there really are such things as, for example, charmed quarks. Or one can be an anti-realist and take the success of the models to be evidence only of the empirical adequacy of representations that involve charmed-quark-talk. Where models do not exactly fit the data, one can take an instrumentalist stance to their function. Or one can take a realist stance and say that the phenomena are a product of signal and noise, and that the models just eliminate the noise. I am not claiming that there are no real problems here, only that the cognitive functions of models that I have focused on do not favor either side of the debates.

Objectivity

[20] Paul Teller, 'Twilight of the Perfect Model Model,' *Erkenntnis* 55 (2001), 393-415.

The close affinity I find between scientific and artistic representations may heighten anxieties about the objectivity of science. I do not think this is a real problem, but I need to say a bit about objectivity to explain why.

We need to distinguish between objectivity and accuracy. A representation is accurate if things are the way it represents them to be. A hunch may be accurate. My wild guess that it is raining in Rome may be correct. But there is no reason to believe it, since it is entirely subjective and utterly ungrounded. A portrait portraying Aristotle as blue-eyed may be accurate. But there is no reason to think so, since we have no evidence of the color of Aristotle's eyes. An objective representation may be accurate or inaccurate. Its claim to objectivity turns not on its accuracy, but on its relation to reasons. A representation is objective to the extent that it admits of interpretations that are assessable by reference to intersubjectively available and evaluable reasons, where a reason is a consideration favoring a contention that the other members of the community cannot intellectually responsibly reject.[21]

In the first instance then objectivity attaches to interpretations. For it is interpretations that are (or are not) directly backed by reasons. To say that a representation is objective then is to say that it admits of objective interpretations.

---

[21] See T. M. Scanlon, *What We Owe to Each Other,* Cambridge, MA: Harvard University Press, 1998, pp. 72-75. I say 'assessible by reference to reasons' rather than 'supportable by reasons' because an objective judgment may not stand up. If I put forth my judgment as an objective judgment, submit it to a (real or hypothetical) jury of my peers, it is objective, even if my peers repudiate it.

Whether this is so depends on the norms governing the institutional framework within which it functions.

Where we are concerned with science, the relevant community is a scientific community. So scientific objectivity involves answerability to the standards of a scientific community. According to these standards, among the factors that make a scientific result objective are: belonging to a practice which regards each of its commitments as subject to revision or refinement on the basis of future findings; being grounded in evidence; being subject to confirmation by further testing; being corroborated or capable of being corroborated by other scientists; being consistent with other findings; and being delivered by methods that have been validated. And generating objective results is what makes a model or method objective.

My characterization of scientific objectivity is plainly schematic. What counts as evidence, and what counts as being duly answerable to evidence, and who counts as a member of the relevant community are not fixed in the firmament. Answers to such questions are worked out with the growth of a science and the refinement of its methodology. This is not the place to go into the details of such an account of objectivity.[22] What is important here is that to be duly answerable to evidence is not necessarily to be directly answerable to evidence. A representation may be abstract. Then it needs multiple levels of mediating symbols to bring it into contact with the facts. A representation may be indirect. It may involve idealizations, omissions, and/or distortions that have to be acknowledged and accommodated, if we are to understand how

[22] For the start of such an account see Israel Scheffler, 'Epistemology of Objectivity,' *Science and Subjectivity*, Indianapolis: Hackett, 1982, pp. 114-124.

it bears on the facts. But if it is objective, then evidence must bear on its acceptability and the appropriate scientific community must be in at least rough accord about what the evidence is (or would be) and how it bears or would bear on the representation's acceptability.

Since the same representation might be deployed by communities governed by different norms, a single representation be objective when functioning in one context and subjective when functioning in another. This result is welcome. Leonardo's scientific drawings are frequently exhibited in both science museums and art museums. When an illustration of a machine functions as a scientific representation, as it does in a science museum, features such as gear ratios are exemplified. When it functions as a work of art, as it does in an art museum, features like shading and delicacy of line are exemplified. The representation has all of the features each interpretation focuses on. But when interpreted against a background where different interests and values predominate, different features stand out.

A difference between art and science emerges from this characterization of objectivity. Aesthetic interpretations, unlike scientific ones, are endlessly contestable. There are relatively few reasons that no member of a community of connoisseurs could reasonably reject. A single work can bear multiple correct interpretations. Velázquez's *Infanta Margarita Teresa in Blue* is a portrait of the eight-year-old infanta. One interpretation might construe the work politically. The pose is regal; the accoutrements, opulent. But the infanta is trapped in an immobilizing gown, unable to move. She is completely unfree, nothing but a pawn in a political game. Foreign policy considerations dictate whom she will marry and when. On this interpretation, the portrait is not

unsympathetic to her plight, but the sympathy is entirely general. It applies to anyone fated to play such a role. Another interpretation is more personal. It focuses on the fact that, despite the accoutrements, it is a portrait of a little girl – a specific little girl. According to this interpretation, the painting exemplifies her fragility and the poignant tragedy inherent in her position. It notes the tenderness with which she is portrayed. The picture is not just a portrait of *an* infanta in the Spanish Court, but of a particular person – Infanta Margarita Teresa. The one interpretation looks outward, interpreting the portrait and its subject in light of dynastic politics. The other looks inward, inviting us to consider what the experience of this particular child might be. Arguably, both interpretations are correct. Each affords an understanding of the picture, its subject, and the forces of circumstance that constrict lives and fetter freedom. But because one is public and political while the other is private and personal, the understandings that emerge are different. A viewer in the grip of one might reasonably reject the perspective the other affords.

To say that there is no consensus about how to interpret works of art is not to say that reasons are inert. One can give reasons for one's interpretation, and both the reasons and the interpretation are open to public scrutiny.[23] Objectivity and subjectivity belong to a continuum. There is no sharp dividing line. So rather than asking whether an interpretation or a representation is objective, it is preferable to ask how objective (or subjective) it is. Typically some aspects of an interpretation of a work of art are backed by reasons that no members of a community of connoisseurs can reasonably reject. All, for example, are apt to agree that *Infanta Margarita Teresa in Blue* is a portrait of a little

[23] Immanuel Kant, *Critique of Judgment*. New York: Hafner, 1968, pp. 183-184.

girl. But to the extent that interpretations outrun the prospect of community consensus, to the extent that the reasons adduced to support them are contestable, they lack objectivity. The finest differences can make a difference to the interpretation of a work of art. Competent viewers discern, focus on, and weigh the significance of aspects of a work differently. So the reasons supporting an interpretation of a work of art are apt to be inconclusive.

The differences in objectivity suggest that the understandings we glean from the arts may be more tentative and tenuous than those we glean from science. There is far less agreement about the adequacy of the interpretations they generate. But all understanding is provisional and fallible. Even the most well established claim may be revised or rejected on the basis of further findings. So we should not repudiate the cognitive deliverances of art merely because they are tentative, controversial, and subject to revision.

I said that the outset that science and art embody understandings. An understanding is a grasp of a general body of information that is and manifests that it is responsive to reasons. It is a grasp that is grounded in fact, is duly answerable to evidence, and enables inference, argument, and perhaps action regarding the subject the understanding pertains to. This entails nothing about the way the body of information is encoded or conveyed. Whether symbols are qualitative or quantitative, factual or fictional, direct or oblique, they have the capacity to embody an understanding. To glean an understanding requires knowing how to interpret the symbols that embody it. So

although scientific models and fictional portrayals do not accurately mirror anything in the world, they are capable of figuring in an understanding of the world.[24]

Catherine Z. Elgin

Harvard University

[24] I would like to thank Israel Scheffler, Nancy Nersessian, John Hughes, the participants in the 2006 Workshop on Scientific Representation at the Universidad Complutense de Madrid, and two anonymous referees for helpful comments on earlier drafts of this paper.