

## 1 Introduction

Consider a particular neutrino. According to an *abundant* conception of properties this neutrino has a great many properties, including one corresponding to almost every predicate attributable to the neutrino. Among these abundant properties some are fairly straightforward. For example, the neutrino has half a unit of spin, and a tiny rest mass. Others are more complicated. For example, the neutrino has no electric charge, and is a member of the set {neutrinos and tigers}. Some of the abundant properties have only an apparently tenuous connection to the neutrino itself, such as being one of the things that I am thinking about right now, or having a name coined in 1933.

The proponent of sparseness acknowledges a distinction among properties such that there are important differences between those at the beginning and at the end of this list. Features of the former kind are privileged or elite, as an objective, worldly matter of fact. Among other things, the privileged properties are significant for predicting and explaining the neutrino's behavior, they account for objective similarities between the neutrino and other entities, and they account for the neutrino's causal powers. The features at the end of the list are not privileged in this way, and are unsuitable for these roles. To endorse this picture is to endorse the view that there are sparse properties - to endorse *sparseness*. To deny sparseness is to hold that there is no such worldly, objective distinction between properties.

Different approaches to sparseness vary on details such as what the privileging of sparse properties amounts to, whether it is a binary distinction or a spectrum, and on the background theory of properties more generally. But overall, commitment to sparseness amounts to this idea: that there is an objective, worldly privileging of certain properties over others which makes the privileged properties suited to play certain roles, and is responsible for their playing such roles. In this chapter I offer a brief, opinionated overview of sparseness. I begin by examining a set of problems that I call "problems of abundance", which generate canonical motivations for sparseness. I then survey some influential approaches to sparseness and the roles that they attribute to sparse properties, noting that on most approaches sparse properties are deeply

connected to inquiry. Finally I consider some problems for sparseness, focusing on the purported connections between sparseness and inquiry.

## **2 Motivating sparseness: problems of abundance**

Sparseness is, at first pass, a fairly intuitive notion. Those who prefer green to green-or-a-tiger, or think that the neutrino's having half a unit of spin is more significant than its being a thing I just thought of, will find sparseness appealing. However, often when philosophers endorse sparseness they do so not merely because of its intuitive appeal, but instead because of the problem-solving and system-building resources that sparseness offers. Here I will consider a set of problems that generate canonical motivations for sparseness. These ideas have a rich history going back to the ancient world, through manifestations in the medieval and early modern periods including the early modern interest in ideal languages (see Plato's *Phaedrus* in Cooper 1997, Dalgarno 1661 in Cram and Maat 2001, Wilkins 1668, and discussion in Eco 1995). However, here I will bypass much of that history and begin my overview in the aftermath of logical empiricism.

What I call "problems of abundance" are sceptical problems generated by the worry that some central aspect of thought and inquiry requires justification for honing in on one set of properties over another, but that this justification appears to be unavailable. Here I will consider three familiar examples – Nelson Goodman on induction, and W.V.O. Quine and Hilary Putnam on reference – but problems of abundance are prevalent, and appear in many different areas of philosophy.

In Goodman's new riddle of induction the same body of evidence – that all observed emeralds have been observed to be green – supports two distinct hypotheses: first, that all emeralds are green, and second that all emeralds are grue, where something is grue with respect to a future time  $t$  iff it is green and observed before  $t$ , or blue and observed after  $t$  (Goodman 1955:71-75). When inductive generalization performs as it should it ought to take us from observations about the greenness of emeralds to a generalization about the greenness of emeralds, rather than to a generalization about the grueness of emeralds, but this requires some justification for prioritizing green over grue. We of course prefer the green hypothesis as grue is a gerrymandered and unfamiliar predicate, but without some further justification for that preference selecting the green hypothesis over the grue seems objectionably arbitrary.

In Quine and Putnam's arguments for the indeterminacy of reference we see a similar structure. According to Quine's behaviorism meaning ought to be determined by behavior, but, he argues, behavior fails to determine meaning. For example, our behavior around the word "rabbit" does not hone in on "rabbit" over other options such as "undetached rabbit part" or "rabbit stage" (Quine 1960:51-56 and 1968:188-189). This leads Quine to the conclusion that meaning, and furthermore reference, are indeterminate (Quine 1968:191). Putnam pushes a similar worry further, showing that on some interpretations of the sentence "the cat sat on the mat" the word "cat" may refer to cherries and the word "mat" may refer to trees, without altering the truth-value of the sentence (Putnam 1981:32-35 and Appendix). Although the background and implications of these arguments are rich and complex, their significance here is that they both reveal a problem much like Goodman's. Determinate reference requires our words to hone in on certain features and to exclude others, but there is no apparent justification for or source of this honing-in.

Goodman, Quine, and Putnam adopted different responses to these problems. Goodman held that we select the green hypothesis over the grue because we have a history of projecting the predicate "green" (Goodman 1955:95). Quine held that there are no framework-independent facts about reference, and more generally about ontology (Quine 1968:200-212). Putnam considered a few options including the idea that there might be primitive metaphysical truths about reference, which he dismissed as a "magical theory of reference" (Putnam 1981:47). But this is the option closest to contemporary theories of sparseness, and the option David Lewis explicitly took up as a model for naturalness (Lewis 1984:228-229).

There are routes to sparseness beyond these sceptical problems of abundance. For example, David Armstrong was motivated to endorse a sparse theory of universals to explain genuine similarities between entities, and so endorsed versions of the One Over Many argument in cases where the cited similarities are genuine.<sup>1</sup> Others endorse sparseness as part of an intuitively appealing realist worldview (Sider 2011:18). However, the problems of abundance generate classic motivations for sparseness, and they illustrate much of the interesting work that sparseness can do. These problems reveal a theoretical need to privilege certain features over

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<sup>1</sup>Armstrong describes the One Over Many argument as "The argument to universals from the apparent existence of identities of nature between different particulars" (Armstrong 1978a:138). For Armstrong the need to explain similarities drives the One Over Many argument, and universals are well-placed to feature in explanations in part because of their causal significance.

others, on pain of facing a kind of scepticism about central aspects of thought and inquiry. According to proponents of sparseness the world itself provides that privilege, as a matter of primitive, unexplained metaphysical fact.

### 3 Roles and features

As we have seen, at the heart of a commitment to sparseness is the idea that there is an objective distinction among properties such that some are fit to play roles that others cannot. In this section I will consider some important features of sparseness, and some of the roles traditionally attributed to sparseness.

On all accounts, sparseness is objective. That is to say, if some property is sparse, or more sparse than some other, then this is a matter of objective fact (Lewis 1983:347; Sider 2011:5). The objectivity of sparseness acts as an explanatory backstop for questions about why sparse properties are appropriate for the roles attributed to them. For example, sparse properties feature in the laws of nature and in scientific explanations, they are the right classifications for inductive generalization, and they act as reference magnets. We might reasonably disagree about which properties are sparse, and this is an empirical question on most approaches. But once we have established that some property is sparse, there is no further question to ask about why it rightfully appears in our explanations and generalizations, or why it acts as a reference magnet. To be sparse just is to be the right kind of property for such roles, because sparse properties correspond to objective, worldly distinctions in reality. This idea is the source of familiar metaphors about sparseness, such as that sparse properties “carve at nature’s joints”, or that the “book of the world” is written in a language of sparse properties. Furthermore, the objectivity of sparseness has a causal aspect. For example, on Armstrong’s view, universals must perform genuine causal work, because otherwise they could not support scientific explanation or our scientific understanding of the world more generally (Armstrong 1978a:126-132). In addition to its objectivity, sparseness is also *absolute*. That is to say, if a property is sparse, it is sparse in all possible worlds (Lewis 1986:44, 60-1; see discussion in Brown and Wildman 2022, and Thompson 2016).

Two of the most central and influential contemporary approaches to sparseness are Lewis’s naturalness (and its descendant, Sider’s structure), and Armstrong’s universals (Lewis 1983; Sider 2011; Armstrong 1978a, Armstrong 1978b). They share the basic idea of sparseness

and many commitments about the roles played by sparseness, but there are significant differences between these approaches. First, the status of being a universal is not a matter of degree on Armstrong's view, whereas Lewis's naturalness and Theodore Sider's structure appear on a spectrum, such that there are degrees of naturalness, running from perfectly natural to highly non-natural. Second, the background view of properties is different. Lewis endorses an abundant, nominalist view of properties and Armstrong rejects this abundance, though he does endorse structural universals, such that some universals are built out of others.<sup>2</sup> Finally, although I group Sider with Lewis here, Sider extends his notion of sparseness beyond properties and into the logical domain, including quantifiers.

Let us now consider some canonical roles for and features of sparseness.

**Minimality.** Sparse properties form a minimal base for all other properties. Any instantiated property either is a sparse property, or else it is instantiated in virtue of certain sparse properties being instantiated.

**Similarity.** Sparse properties are the basis of objective similarity between entities. In so far as two entities are genuinely similar, this is because they share sparse properties.

**Causation.** Entities have the causal powers that they have in virtue of their sparse properties. Armstrong makes causal efficacy a criterion for universals, as without this universals would not feature in scientific explanations or contribute to scientific understanding.

**Laws.** Sparse properties feature in the laws of nature, either by their corresponding predicates appearing in the axioms of the Best System, as on Lewis's view, or by the laws themselves being relations between universals, as on Armstrong's view.

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<sup>2</sup>Here I understand "nominalism" as the view that there are no universals, rather than the view that there are no properties.

**Explanation.** Sparse properties feature in explanations, particularly scientific explanations. If we think of explanation as necessarily featuring laws then the connection between sparseness and explanation is mediated by the connection between laws and sparseness. Sider posits a connection between explanation and sparseness that is not necessarily mediated by the connection with laws, on which explanations are broadly speaking better the closer they get to a language of sparse properties. For Armstrong the causal role of universals accounts for their role in explanations.

**Reference.** Sparse properties act as reference magnets, in that, roughly speaking, they are more eligible referents than non-sparse properties. Sparseness thereby resolves the Putnam/Quine concerns about the indeterminacy of reference.

**Induction.** Sparseness provides a justification for selecting the green hypothesis over the grue hypothesis: an emerald is grue in virtue of its more sparse properties, and so our inductive reasoning should range over the more sparse properties.

**Fundamentality.** Sparse properties, as a minimal base for all other properties, are fundamental. This is reflected in the idea that sparse properties on most approaches are physical.

This is not an exhaustive list of roles and features, but most accounts of sparseness portray it as playing some version of these. Some further roles specific to Sider's extended notion of structure include that structure goes into logic, such that certain quantifiers are more structural than others (Sider 2011:85-104). Sider also holds that structure determines the substantivity or otherwise of debates (Sider 2011:44-66). In substantive debates each side must differ with respect to how effectively the rival views capture facts about structure, otherwise the debate is not a genuine, substantive disagreement.

A striking aspect of sparseness, evident from this list, is that so many of the roles for sparseness pertain to inquiry. I take inquiry to include activities such as forming lawlike generalizations, classifying phenomena, formulating explanations, formulating theories, and

engaging in inductive generalization. As we can see, proponents of sparseness believe that sparseness is central to all of these activities.

#### 4 Related notions

Sparseness is traditionally understood as pertaining to properties, such that it is a property of properties. But other, related notions play similar roles.

One is the *natural kind*. The natural kind realist, on a popular version, holds that there are worldly causal mechanisms that hold clusters of properties together, and that these property clusters are the natural kinds (Boyd 1999). The fact that there are such causal mechanisms accounts for the role of natural kinds in scientific theories, laws, and explanations, on the basis of the idea that part of what gives scientific inquiry its predictive power and explanatory success is the fact that it hones in on the kinds in this way, and so is guided by the causal structure of the world. On this view natural kinds play an equivalent role to sparse properties in that the structure of reality guides inquiry, when it goes well, to the correct classifications for explanation and generalization.

Another related notion is *essence*. On some versions of essentialism essences are abundant, such that anything that has individuation conditions has an essence, including Goodman's grue and other gerrymandered categories (Fine 1994; Correia 2006). On other versions of essentialism, however, essences are sparse, which reflects a privileged role for essences in inquiry that mirrors the privileged role of sparse properties in inquiry.<sup>3</sup>

#### 5 Challenges

With this overview of sparseness in hand, let us now consider some challenges to sparseness. Many reject the background realist picture behind sparseness simply because they reject realism, but some of the most interesting critical work on sparseness focuses on the combination of roles that sparseness is asked to play. In particular, Jonathan Schaffer and Cian Dorr & John Hawthorne have challenged the claim that sparseness can perform all of roles given above, and they have done so from a broadly realist-friendly background (Schaffer 2004; Dorr and

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<sup>3</sup> Lowe's view of metaphysics as "the science of essence" rests on the presumption that essences are sparse (Lowe 2018). Some endorse a sparse view of essence to fund a defense of modalism about essence against Finean counterexamples (Wildman 2013).

Hawthorne 2013). In this section I follow their lead of considering challenges to sparseness that do not depend on broader scepticism about realism, or about the possibility of metaphysics. In particular, I will focus on challenges to the purported connections between sparseness and inquiry, many of which are generated by concerns about the objectivity and absoluteness of sparseness.<sup>4</sup>

Let us begin by considering the relationship between the objectivity and absoluteness of sparseness and the connections between sparseness and inquiry. As discussed in Section 4, a property's status as sparse, or as more sparse than another, is determined entirely by the objective structure of reality. As such, sparseness is not affected by the features or interests of inquirers, by social or cultural context, or other potential sources of subjectivity. This is the realist aspect of sparseness, and it is of great significance to the work attributed to sparseness.<sup>5</sup> Much of that work involves connections between sparseness and inquiry, including central roles for sparseness in laws, explanations, and inductive generalization, and the objectivity of sparseness facilitates these connections. To illustrate, consider the role of sparseness in lawhood. Lewis and Armstrong are scientific realists, and the objectivity of sparseness grounds their realism. The predicates that appear in the axioms of Lewis's Best System correspond to perfectly natural properties, and on Armstrong's view laws just are relations between universals. On these views, part of what it is for a law to be a law is for it to identify objective connections between joint-carving classifications. Alternatively, consider the sparseness-based solution to Goodman's new riddle. The justification for choosing the green hypothesis over the grue hypothesis is that the world prefers it, and so sparseness offers a realist basis for generalizing over the more sparse classifications.<sup>6</sup> In each of these cases the objectivity of sparseness funds the connection between sparseness and inquiry, in that those connections obtain at least in part because sparseness is objective. Something similar applies to the absoluteness of sparseness, the fact that any sparse

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<sup>4</sup> There is much recent work on sparseness that deserves mention in a survey, but which space does not permit me to discuss here. For example, because sparseness is (typically) a property of properties it is naturally amenable to a higher-order treatment, and some authors are examining traditional issues about properties such as realism and abundance in a higher-order framework (Jones 2018, Jones in this volume; Liggins 2021; Skiba 2021).

<sup>5</sup> Sider discusses the objectivity of sparseness, in his case structure, and describes it as essential to the work performed by structure. "...joint-carving languages and beliefs are better. If structure is subjective, so is this betterness. This would be a disaster... If there is no sense in which the physical truths are objectively better than the scrambled truths, beyond the fact that they are propositions that we have happened to have expressed, then the postmodernist forces of darkness have won" (Sider 2011:65). Sparseness must also be objective to play any role in the determination of mental content (Lewis 1983: 370-377).

<sup>6</sup> As Lewis puts it, "...grue and bleen are inferior to the colours..." (Lewis 1986:61).



property is non-contingently sparse. The absoluteness of sparseness supports the role of sparse properties in inquiry because it gives the objectivity of sparseness a robust modal status.

These purported connections between sparseness and inquiry do not amount to a purely descriptive claim about how human beings in fact inquire, because (of course) people often explain, generalize, theorize and so on in highly non-sparse terms. Instead, these connections are based on a view of the nature and function of inquiry according to which the goal of inquiry is to get to the facts about the objective, absolute structure of reality. On this view, inquiry aims to get the facts right about the structure of reality, and as such, it is and should be guided by sparseness. If it is not so guided by sparseness, then it is worse as inquiry.

However, these purported connections between sparseness and inquiry face serious counterexamples. Many, though not all, of the problem cases are funded by the absence of the kind of objectivity and/or absoluteness characteristic of sparseness. In particular, cases in which the quality of inquiry is driven by more subjective or pragmatic considerations challenge the picture of sparseness as driving the quality of inquiry. Here I will consider two sources of examples: philosophy of science and inquiry into the social world.

### **5.1 Philosophy of science**

A first set of cases from philosophy of science are about fundamentality. On canonical views of sparseness the sparse properties are only fundamental physical properties. On the view of sparseness as driving the quality of inquiry, it follows that explanations, theories and so on in the non-physical sciences are worse *as* explanations and theories than those found in physics. Any case in which we legitimately explain, theorize, or generalize in less than fundamental terms presents a challenge to this view.

A number of authors have pressed this point. For example, Schaffer has argued that we should abandon the fundamentality aspect of traditional accounts of sparseness (Schaffer 2004). Jonathan Cohen and Craig Callender argue that any viable Best System Account of laws (BSA) must make room for non-fundamental special science laws. They propose an amended version of the BSA on which the predicates that appear in the laws are not necessarily perfectly natural but are instead a stipulated set of kinds, which may be selected for pragmatic reasons rather than their objective sparseness (Cohen & Callender 2009; see also Loewer 2021). These considerations also feature in traditional conversations about reductionism and nonreductionism

in philosophy of science, with many philosophers of science arguing that there are autonomous non-fundamental laws, explanations, theories, and classifications (such as Fodor 1974).

Proponents of sparseness have resources to push back against these concerns. If sparseness comes in degrees, then the proponent of sparseness can argue that non-fundamental sciences and non-fundamental inquiry more generally are not *perfectly* sparse but are *relatively* or *fairly* sparse, and that this status accounts for their legitimacy. Indeed, Sider uses this line of reasoning in his treatment of the legitimacy of inquiry into the nonfundamental sciences (Sider 2011:21-23). Another option is to simply deny the connection between sparseness and fundamentality, as Schaffer recommends (Schaffer 2004).

This issue about fundamentality need not be based on considerations about objectivity, as these cases might merely show that sparse properties are not necessarily fundamental. However, attempts to deal with this kind of problem often end up appealing to the idea that certain classifications are appropriate for inquiry for more pragmatic, practice-driven reasons (as in Cohen & Callender 2009; Loewer 2021), which indicates that considerations about objectivity drive some of these cases.

This leads to a second set of problem cases from philosophy of science, in which the classifications best for inquiry are best for reasons beyond sparseness. Here I will consider the case of inquiry involving idealizations.

The idea that scientific inquiry occasionally involves idealization is uncontroversial, and examples such as the frictionless plane and the perfectly rational agent are familiar. However, some philosophers of science argue that idealization is far more widespread than is standardly thought. For example, Angela Potochnik has described scientific idealization as “rampant”, “ineliminable”, and “unchecked”, arguing that idealization is a necessary and standard aspect of scientific inquiry (Potochnik 2017:23-61). The prospect of pervasive scientific idealization generates a challenge for proponents of sparseness. One significant area is laws. Potochnik argues that most laws are idealized, including physical laws such as the laws of gravitation (Potochnik 2017: 24-33). However, idealized laws do not summarize relations between joint-carving classifications, but instead relations between idealized classifications, which are arguably

non-sparse.<sup>7</sup> If we accept that scientific idealization is pervasive, then we must also accept that most laws are idealized, which challenges general connections between sparseness and the laws of nature.

These issues are complicated, and so only a summary of the potential challenges and responses can be given here. However, a proponent of sparseness could respond by arguing that rampant unchecked idealization is an artefact of our current, contingently limited conditions of inquiry, and that as we become more effective scientists, we will be able to abandon idealization. However, the pervasiveness of idealisation tells against this prediction. For this prediction to be accurate, we should expect idealization to be abandoned as we proceed towards more complete and sophisticated scientific inquiry, but historically this has not been the case. Another resource is to argue that idealization is a feature of representations of laws, rather than the laws themselves. However, if scientific inquiry works with the representations, then there remains a challenge to the purported connections between sparseness and scientific inquiry as it is actually practiced.

There are many other cases in which philosophers of science have argued that inquiry ranges over classifications rightfully selected for reasons other than sparseness. For example, some feminist philosophers of science have argued that the ideal of value-free science is misguided, and so that we should deliberately seek to place values into scientific practice, rather than attempt to eliminate them in pursuit of objectivity (Longino 1987). This includes the formulation of classifications, so on such views, the best scientific classifications may be best for normative reasons, rather than for their sparseness.

## 5.2 Social inquiry

A further source of problems for these purported connections between sparseness and inquiry is inquiry into social phenomena, where our explanations and generalizations often rightly range over highly non-natural classifications. I have discussed some examples of highly non-natural classifications in social inquiry in other work, including the case of the “six-pocket woman”, a local classification significant to the anthropology of money in Papua New Guinea, and mythical

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<sup>7</sup>This depends on the precise locus of the idealization. One could attribute idealized properties to entities, as I suggest here. Alternatively, one could posit idealized relations between non-idealized properties. A fully developed version of this challenge will have to consider a range of different targets for idealization.

classifications such as the racist controlling image of the “welfare queen” (Taylor 2016, 2020). Such classifications play a central role in social inquiry, yet are non-sparse. Furthermore, recently a number of authors have discussed the apparent non-sparseness of theories and classifications in social metaphysics, and implications for the substantivity or otherwise of social metaphysics (Barnes 2017; Sider 2017).

Rather than identify further cases here, it will be useful instead to consider the features of social inquiry that drive such problem cases, and so generate problems for the purported connections between sparseness and inquiry.

One potential source of non-sparseness in social inquiry is amelioration. In much social inquiry, particularly in more emancipatory branches of social metaphysics, theory choice is ameliorative in that it is driven at least in part by moral and political considerations. This feature plays a central role in debates about the metaphysics of gender, in which many participants hold that amelioration is a requirement for an adequate account of gender (Haslanger 2000; Jenkins 2016). This ameliorative aspect reflects a political tradition that takes the selection of views not only as a descriptive task but also as an action that can fund social change. However, moral and political considerations have little to do with sparseness, so theories selected for their ameliorative features are not selected for their sparseness.

A second source of non-sparseness, tied to amelioration, is the contingency of the social world. Social inquiry is responsive to highly contingent social conditions which, in so far as they are socially constructed, are subject to change through changes to human thought, talk, and action. Furthermore, much social inquiry is aimed not only at accurately describing social reality but also at providing tools to change social reality for the moral and political better. In so far as classification and generalization play any role in that process, social classifications cannot be sparse, because of the objectivity and absoluteness of sparseness.

### **5.3 Responses**

I have mentioned some straightforward responses that the proponent of sparseness can make to these challenges to the connections between sparseness and inquiry. They can deny the cases, and deny that the generalizations, theories, and explanations given in terms of non-sparse classifications really are better than their sparser counterparts. Alternatively, they can offer resources to handle the cases, such as degrees of naturalness or relative structure.

However, there are alternative, more radical responses to these problems. One route is to decouple sparseness from inquiry. That is to say, the proponent of sparseness can endorse the view that there are sparse properties while denying that sparse properties play any significant role with respect to inquiry. Shamik Dasgupta has recently argued for an approach along these lines, rejecting the connections between sparseness and inquiry that make sparse properties the right classifications for explanation, laws, induction, and so on (Dasgupta 2018). Further modifications to this kind of approach are available, such as endorsing connections between sparseness and some kinds of inquiry, but not others.

Another option is to develop tools that mirror the role of sparseness in inquiry but are more flexible than traditional sparseness, and are responsive to contingent, pragmatic, and normative factors. Two Taylors are salient here: Barry Taylor, and myself, Elanor Taylor. Barry Taylor's cosiness offers what he calls a "vegetarian alternative" to Lewisian naturalness on which the cosiness of a predicate is relative to a theory  $T$  and is determined by its position in the axiomatized formulation of  $T$  (Taylor 2006:109-124). My context-dependent naturalness (C-Naturalness) is intended to supplement commitment to Lewisian naturalness without over-extending the role of Lewisian naturalness in inquiry. A predicate is more C-Natural with respect to an activity when it displays a higher balance of salience and versatility with respect to that activity (Taylor 2016, Taylor 2020). These tools capture the idea that certain properties may be privileged over others with respect to inquiry, without understanding that privilege in objective, absolute terms.

## 6 Conclusion

In this chapter I have considered motivations for sparseness and for connecting sparseness to inquiry, and sketched some challenges to those connections. The traditional motivations for sparseness are rich and compelling, as are the reasons for connecting sparseness to inquiry. It is natural and appealing to think that inquiry, when functioning as it should, is guided by sparseness. However, as we have seen, often the actual business of inquiry is not so well-behaved.<sup>8</sup>

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