

The relationship between space and mutual interaction: Kant Contra Newton and Leibniz

James Messina

Department of Philosophy, University of Wisconsin–Madison, Madison, WI 53706, USA

ABSTRACT

Kant claims that we cannot cognize the mutual interaction of substances without their being in space; he also claims that we cannot cognize a ‘spatial community’ among substances without their being in mutual interaction. I situate these theses in their historical context and consider Kant’s reasons for accepting them. I argue that they rest on commitments regarding the metaphysical grounding of, first, the possibility of mutual interaction among substances-as-appearances and, second, the actuality of specific distance-relations among such substances. By illuminating these commitments, I shed light on Kant’s metaphysics of space and its relation to Newton and Leibniz’s views.

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1. Introduction

In the Third Analogy of the first *Critique*, Kant explores the conditions for cognizing that a set of substances have states that exist simultaneously, e.g. one substance’s being green while another is red.¹ The conditions for such cognition are captured by Kant’s so-called ‘principle of community’, which is formulated in the B-edition of the *Critique* as follows: ‘All substances, insofar as they can be perceived in space as coexistent, are in thoroughgoing mutual interaction’ (B256).² By *thoroughgoing mutual interaction*, or thoroughgoing community, Kant means a state of affairs in which all the members of a set of substances reciprocally causally influence one another, such that each brings about a change of state in the others, e.g. a change in momentum. A paradigm case of thoroughgoing mutual interaction is the sort of interaction between all existing bodies prescribed by Newton’s law of universal gravitation (Friedman 1992, 39).³ Thoroughgoing mutual interaction is equally central to Leibniz’s physics and

CONTACT James Messina  jmessina@wisc.edu

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metaphysics,⁴ though in Leibniz's case, it does not involve real causal influence among substances.

Of late, progress has been made in understanding Kant's arguments for the principle of community.⁵ However, an important aspect of the Third Analogy along with the closely related General Note on the System of Principles has not yet received satisfying treatment: Kant's account of the relationship between *space* and *mutual interaction*. Kant commits himself to two substantive claims in particular whose justification, relation to one another, and underlying metaphysics have not been adequately illuminated. First, he claims that there can be no cognition of mutual interaction among substances without those substances' being in space (B292–293).⁶ Call this Thesis 1. Second, Kant claims that we can't cognize substances' being in what he calls a 'spatial community' – by which I take it he means a state of affairs where they actually stand in specific distance-relations to one another – without their being in mutual interaction (A213/B260). Call this Thesis 2. The substances Kant has in mind in Theses 1 and 2 are substances-as-appearances (i.e. phenomenal substances) since these are the only substances of which we can have cognition.

What are Kant's reasons for endorsing these theses? I will argue that Theses 1 and 2, despite being claims about the conditions for certain kinds of *cognition*, rest on metaphysical claims about space and mutual interaction, in particular (what we might call) metaphysical grounding claims.⁷ Underlying Thesis 1 is the claim that being in space is what metaphysically grounds the *possibility* of substances-as-appearances' having distance-relations (as well as other distinctively spatial properties), and in turn metaphysically grounds the *possibility* of their standing in relations of mutual interaction to one another. Underlying Thesis 2 is the claim that substances-as-appearances' *actually* standing in specific relations of mutual interaction is what metaphysically grounds their *actually* standing in specific distance-relations to one another.

The difference in modality in these metaphysical claims turns out to be crucial for understanding how they do not run afoul of the asymmetry of metaphysical grounding. As we will see, their significance and meaning are best understood against the backdrop of Leibniz and Newton's views. By understanding the grounding claims and how they fit together, we don't simply shed light on Theses 1 and 2; we also gain an understanding of an interesting, under-explored dimension of Kant's metaphysics of space. As an additional benefit, we help acquit a powerful recent reading of Kant's main argument for the principle of community in the Third Analogy of an objection that has been made against it.⁸

In Section 2, I provide the historical background for my discussion. In Sections 3 and 4, I investigate Kant's reasons for endorsing Theses 1 and 2, respectively, and explain how Kant's views bear on the questions discussed in Section 2. In Section 5, I conclude.

2. The historical context

There is widespread recognition that Kant's claim that space is subjective rather than an objective feature of things-in-themselves pits him against both Newton and Leibniz. From Kant's standpoint, the latter are united in taking space to be a feature of things-in-themselves.⁹ However, there has been much less attention to the ways in which Kant saw his specific views about the relationship between space and mutual interaction as contrasting with the Newtonian and Leibnizian accounts of that relationship. As will emerge, from Kant's standpoint, the Newtonian and Leibnizian accounts deliver very different answers to the following questions: (1) What role does being in space play in grounding the fact that substances mutually interact? (2) What role does the mutual interaction of substances play in grounding the fact that they stand in distance-relations to one another? Kant's *Auseinandersetzung* with Leibniz on these points is explicit at various points in the *Critique* (e.g. in the General Note on the System of Principles). Though Kant does not explicitly engage with the Newtonian position in the *Analytic of Principles*, given his engagement with it in other texts considered here, it is plausible that Kant's account of the relationship between space and mutual interaction in the *Critique* is meant to be an alternative to the Newtonian view.

Let's consider how a Newtonian might answer the first question. For Newton, space is a necessary condition on being. Any substance that exists must necessarily be in space.¹⁰ Since substances cannot mutually interact – e.g. by exercising attractive force on one another – without existing, it follows that all mutual interaction without exception must take place in space. A fortiori, all mutual interaction among substances that *we can cognize* requires that the mutually interacting substances be in space. Newton is thus committed to a version of Kant's Thesis 1.

Can anything further be said about why mutual interaction, for Newton, must take place in space? The pre-Critical Kant seems to think so. As he describes Newton's position in the *Inaugural Dissertation* [ID] (1770), space is not merely a necessary condition of mutual interaction: it is sufficient to ensure the possibility of thoroughgoing mutual interaction among all existing corporeal substances:

They [i.e. the Newtonians] treat them [i.e. space and time]¹¹ as primitive conditions which are already given in themselves, and, in virtue of which to be sure, and independently of any other principle, it would not only be possible but also necessary that a number of things should be mutually related to one another (AA 2:391)¹²

Kant here treats the manifest modal fact that all corporeal substances that exist *can* interact with one another as a fact in need of explanation. As he understands Newton, being in space is that in virtue of which it is possible for all existing corporeal substances (which are necessarily all in the same space) to interact with one another. To deploy a helpful technical phrase, not used by Kant himself, we could say that he thinks that being in space for Newton *metaphysically*

grounds the possibility of thoroughgoing mutual interaction among corporeal substances.¹³ Given that corporeal substances are in space, it is *ipso facto possible* for those substances to mutually interact. As we will see, with a few qualifications, the Critical Kant agrees with Newton about this.

But in the ID Kant also ascribes claims to Newton about space and mutual interaction that Kant rejects. Kant takes Newton to hold that being in space explains not just the possibility of mutual interaction among corporeal substances but also its necessity ('it would not only be possible *but also necessary* that a number of things should be mutually related to one another' [AA 2:391; my emphasis]). Just as it is a manifest modal truth that corporeal substances in space *can* interact, it is a manifest modal truth that they *must* interact. We do not think that it just happens to be the case, as a contingent matter, that corporeal substances all influence each others' states. There is a law that says all corporeal substances in space *have to* interact and indeed do so in specific ways, exercising specific amounts of force on one another. This law is itself in need of explanation. Space, as Kant reads Newton, provides the requisite explanation: it metaphysically grounds the necessity of all existing corporeal substances' interacting in specific ways.¹⁴ As Kant writes later in the ID:

For, since whatever things exist are, in their [i.e. the Newtonians'] opinion, necessarily somewhere, it appears superfluous to them to enquire why these same things are present to one another in a fixed manner. For this, it seems to them, would be determined in itself by the entirety of space, which includes all things. (AA 2:406–407)

As I understand this passage, for substances to be present to one another 'in a fixed manner' is for each pair of corporeal substances to actually be in some specific distance-relation to one another and to actually exercise some specific quantity of force on one another (e.g. gravitational attraction).¹⁵ For the 'entirety of space' to determine this mutual interaction is for being in space to be the metaphysical ground of the law according to which corporeal substances must mutually interact in specific ways.

This claim is one that Kant considers and criticizes in later work. For example, in the *Metaphysics L1* lecture transcripts, from the mid-1770s, he discusses the position that 'things *must* stand in interaction <in commercio> with one another simply because they are in one space' (AA 28:213; my emphasis). Kant then goes on to give his opinion on the matter a few sentences later:

To maintain this connection of substances without any ground, merely because they are there, is that which the Wolffian philosophy called physical influence Space would clearly laugh at us if we were to ask it such; it would say: that is already so, that must already be so, but in itself it is not necessary. (AA 28:213)

What Kant describes as risible is the same position ascribed to Newton in the ID.

There is textual evidence that supports the – independently plausible – view that Kant did not suddenly change his mind about the correctness of this Newtonian view between the mid-1770s and the publication of the first *Critique*

(1781).¹⁶ First, the Newtonian view is plausibly taken to be the intended foil for Kant's own claim in *Prolegomena* §38 that 'space is something so uniform, and so indeterminate with respect to all specific properties, that certainly no one will look for a stock of natural laws within it' (AA 4:322). As we have seen, in the ID, Kant reads Newton as holding that space is the source of the law of nature according to which existing corporeal substances must interact. In *Prolegomena* §38, Kant is, among other things, denying this.¹⁷ The Newtonian view is also plausibly the intended foil for a remark in the Antinomies, where Kant rejects a position according to which 'space, as something subsisting in itself' determines the 'reality' of the 'relation' among things (A431/B459, discussed further in Sections 3 and 4).

Let's consider why Kant reads Newton as holding that being in space determines corporeal substances to mutually interact since this rather abstract metaphysical thesis is not one that Newton explicitly commits himself to. Part of the answer lies in the details of Newton's account of absolute space. For Newton, space is an all-encompassing, container-like entity made up of infinitely many parts, called absolute places. Absolute places are entities that endure through time, exist whether or not there are bodies in space, and have positions relative to one another, defined in part by their specific distance-relations (Newton 1999, 408–410). All corporeal substances that exist must exist in some absolute place or other and automatically inherit the specific distance-relations and positions of the absolute places that they occupy (see Earman 1989, 10–12). In this sense, space 'determines' (recall Kant's word 'determined' in the ID [AA 2:406–7]) the distances and absolute motions of the bodies in it. For Newton, as Kant understands him, it is in virtue of their being in space that corporeal substances actually do stand in a specific set of distance-relations. As we will see below, Kant parts ways with Newton here.

If one allows that being in space determines corporeal substances to stand in specific distance-relations to one another, then it would also make sense that it determines them to actually stand in specific dynamical relations with one another. At the same time, the latter fact does not obviously follow from the former fact: distance-relations and dynamical relations are, after all, different.

However, there are some considerations that further support a reading of Newton whereby being in space plays both roles. First, there is the fact that, for Newton, all of the corporeal substances that are in space also happen to be such that they must interact and vice versa: the co-extensionality of things in space and things in necessary mutual interaction is a reason for thinking that the former provides the metaphysical explanation for the latter. Second, there is Newton's notorious 'sensorium of God' doctrine: space is God's way of being simultaneously present to, and acting on, the entirety of his creation (Newton 2004, 130, 138). This association of space with God's presence and activity fits well with the idea that space is the source of the law whereby everything in it must be dynamically present to everything else.

Let's return to the questions raised above. What role does Kant see space playing in mutual interaction for Newton? Being in space is the metaphysical ground of various modal facts regarding mutual interaction: first, that it is *possible* for corporeal substances to mutually interact; second, that they *actually* do (and indeed, *must*) interact in specific ways (i.e. exercise specific amounts of force on one another). Kant only speaks of a one-way dependence-relation when describing the Newtonian position. This makes sense, for the Newtonian position does not appear to leave any room for the mutual interaction of substances to play a role in metaphysically grounding the facts that corporeal substances can, do, and must stand in specific distance-relations to one another. On the contrary, for Newton, it is corporeal substances' being in space that metaphysically grounds the facts that they can, do, and must have specific dynamical and distance-relations to one another.

What about Leibniz's answers to these questions? According to a standard reading of Leibniz's philosophy, one which Kant himself subscribes to in the *Critique*, the fundamental structure of reality consists of un-extended, windowless, mind-like, simple substances: monads. Though monads do not really act on one another – each is fully causally responsible for its own states and changes of state – the monads that belong to a common world exercise an ideal influence on each other. This ideal influence consists in the fact that each internally induced change in one monad is harmoniously coordinated with similar changes in all the other monads. On Leibniz's behalf, Kant describes this coordination, which is the result of God's divine decree, as a *community of substances* (A274–5/B331). As for space, it consists of spatial relations among bodies, relations which have their ultimate basis in the ideal community that obtains among their underlying monads. This is what Kant is getting at when he says that 'Leibniz thought of space as a certain order in the community of substances' (A275/B331).

This reading of the Leibnizian philosophy has fairly clear implications for the two questions above. In contrast to Newton, being in space does not metaphysically ground the possibility, actuality, or necessity that bodies interact in specific ways. Space cannot play this role since it consists of spatial relations among bodies that are themselves ultimately determined by relations of (ideal) mutual causal influence among the corresponding monads. From Kant's standpoint, it is precisely because Leibniz cannot appeal to being in space to explain the possibility of community that he abandons real community for ideal community, explaining the possibility of ideal community in terms of God's ability to co-actualize monads whose states change in conformity with each other: '[Leibniz's] principle of the possible community of substances among themselves had ... to be predetermined harmony' (A274/B331). As for the necessity of this (ideal) mutual interaction, the fact that any monads that exist must be in pre-established harmony, this is a hypothetical (rather than absolute metaphysical) necessity, resting on God's preference for the best.

Thus, as Kant reads them, Newton and Leibniz have diametrically opposed views about the relationship between space and mutual interaction. For Newton, being in space metaphysically grounds the possibility, actuality, and necessity of bodies standing in specific distance and dynamical relations to one another. For Leibniz, spatial and dynamical relations among bodies are metaphysically grounded in their corresponding substances' ideal mutual interaction; the possibility, actuality, and necessity of this, in turn, are grounded in God's will. With this historical context in place, I turn to Kant's views on (what I called above) Thesis 1 and Thesis 2. As we will see, these claims rest on an account of the relationship between space and mutual interaction that is an interesting alternative to the Newtonian and Leibnizian views.

3. Kant's reasons for endorsing Thesis 1

The task of this section is to get clear on Kant's underlying reasons for accepting Thesis 1: any mutual interaction that we can cognize – which for Kant means mutual interaction among *substances-as-appearances* – requires that the substances be in space. Thesis 1 has received fairly little attention in the literature.¹⁸ As we will see, the search for Kant's ultimate reasons for endorsing it quickly leads off the beaten path of Kant's theory of cognition and into the thickets of Kant's surprisingly sophisticated metaphysics of space. From this vantage point, the differences between Kant's account of space and mutual interaction and those of Leibniz and Newton will emerge more clearly.

The central thesis of the Third Analogy is that substances have to be in mutual interaction if we are to cognize that they are simultaneous (B256). In other words, the category of mutual interaction must be instantiated by things 'out there' in the world whenever we cognize that their states are simultaneous. I take it Kant also means to be making the claim that we must have *cognition* of mutual interaction – that is, we must apply the category of mutual interaction in a way that yields cognition – when we cognize simultaneity. Kant holds moreover that we can have no such cognition unless the objects we are applying the category of mutual interaction to are in space (Thesis 1). That he thinks this is evident from remarks he makes in the General Note, as well as from the fact that he explicitly builds in reference to space in the B-edition formulation of the principle of community.

Why does Kant think that cognizing mutual interaction requires space? One might initially think that the Schematism Chapter holds the key to the answer. The guiding idea of the Schematism Chapter is that for the categories to be given a 'significance' (A147/B186) or meaning that is more than merely logical, they have to be schematized in terms of some sensory states of affairs. The schema for a given category is in effect a description of the specific sensory circumstances in which the category applies. Categories can only be used to cognize objects insofar as they have been schematized. This might suggest that space

is required for cognizing mutual interaction because space gives significance to the category of mutual interaction. However, this is not Kant's view. In the Schematism Chapter, Kant claims that the schemata for the categories involve only temporal features. The schema for the category of mutual interaction is 'the simultaneity of the determinations of the one [substance] with those of the other' (A144/B183). No mention is made here of space. Thus, it is not the requirement that cognition involve a meaningful (schematized) category that, in the case of cognition of mutual interaction, gives rise to the demand that the substances in question be in space.

The beginning of a solution to the puzzle lies in an easy-to-overlook aspect of Kant's theory of cognition. Cognition, for Kant, does not merely require the application of a schematized category to an object given in intuition; it further requires the application of a category whose *objective reality* has been established. According to Kant, a category has objective reality iff it is really possible for it to be instantiated by the object (or objects) of cognition (e.g. A223/B270 and B291).¹⁹

Apparently, the mere fact that a category has been schematized (that is, given some sort of meaning) does not guarantee even the *real possibility* that anything in the world answers to it, let alone the possibility that the particular objects one is applying it to instantiate it. But without having some sort of guarantee that the category *could* be instantiated, Kant thinks, even efforts to apply a schematized category to an object given in empirical intuition would fall short of cognition – since, for all one knew, there might be some metaphysical impossibility in the object's instantiation of the category. If a category-involving judgment about objects of intuition is to amount to cognition, then we need some guarantee that it is metaphysically possible for the objects to which we are applying it to instantiate that category.

But what could provide the requisite guarantee? Surely it could not be any of the categories since it is these whose possible instantiation is in question. This leaves it up to *intuition* to ensure the possibility of the category's being instantiated. Rather than allowing that the intuition in question could be one with temporal content alone, as is the case with inner intuitions, Kant claims that it must be an intuition with spatial content, an outer intuition:

[I]n order to understand the possibility of things in accordance with the categories, and thus to establish the objective reality of the latter, we do not need merely intuitions, but always outer intuitions. (B291)

What is interesting for our purposes is Kant's claim that the intuition of space is what guarantees for us the objective reality of the category of *community*. Kant asserts:

... [T]he possibility of the category of community is not to be comprehended at all through mere reason, and thus it is not possible to have insight into the objective reality of this concept without intuition, and indeed outer intuition in space. (B292)

At this point, it is natural to wonder why inner intuitions (intuitions that simply have *time* as their form) do not suffice. The answer is that Kant shares what he takes to be Newton's view that substances' being in space metaphysically grounds the possibility of their mutual interaction. In a remark he inserted into his copy of the first *Critique*, he says that 'space makes community possible' and that 'space is the *phaenomenon* of possible community' (AA 23:31–32; *Nachträge* [1780's]). Similar characterizations of space occur elsewhere.²⁰ In the General Note, he adds an additional qualification: space does this in a way that we can 'readily grasp':

But we can readily grasp the possibility of community (of substances as appearances) if we represent them in space, thus in outer intuition. For this already contains in itself a priori formal outer relations as conditions of the possibility of the real (in effect and countereffect, thus in community). (B293)

My suggestion is that we read this as follows. The reason that we can't cognize mutual interaction unless the mutually interacting substances are *in space* is that their being in space metaphysically grounds (in a manner intelligible to us) the possibility of their mutual interaction. The (spatial) substances in question are substances-as-appearances rather than noumenal substances. It is precisely because the noumenal substances that underlie my mind and my body are not both in space that the possibility of their community is 'not comprehensible' and thus not cognizable (AA 23:31–32).

It might seem curious that Kant precludes time playing this role. After all, all substances whose mutual interaction we can cognize (substances-as-appearances) are also in time. Kant's talk of 'a priori formal outer relations' contained in space 'as conditions of the possibility of the real' provides an important clue (B293). I take it the a priori formal outer relations mentioned here include *distance-relations* (among other things), while the 'real relations' are dynamic relations of mutual interaction. My suggestion is that being in space metaphysically grounds the possibility of the mutual interaction of substances-as-appearances *by metaphysically grounding the possibility of their having distance-relations and other distinctively spatial properties*. For Kant, the space of which we have a pure intuition is intrinsically Euclidean in its geometry and metric.²¹ It can be said to 'contain' within it as possibilities all the various distance-relations and geometric properties (e.g. shapes and angles) consistent with its Euclidean character. In virtue of being given in this space, it is possible for spatial substances to stand in the sorts of distance-relations and have the sorts of geometric properties permitted by Euclidean space. Moreover, in virtue of being in space, it is *impossible* for spatial substances to have any non-Euclidean relations or properties. Their being in space guarantees the applicability to them of Euclidean geometry and that their distance-relations will conform to the Euclidean metric. This last point means, e.g., that the distances between substances in space are constrained by the Pythagorean Theorem.

As we will see below, though, Kant unlike Newton does not think that space determines which of the possible, specific distance-relations and properties consistent with it are *realized* by its occupants, or even whether any of the possible, specific relations and properties consistent with it are realized at all.

But first: How is the appeal to possible relations and properties contained in space supposed to ground the possibility of the mutual interaction of substances-as-appearances? As I understand Kant, the distinctively spatial relations and properties contained within space as possibilities ground the possibility of mutual dynamic relations in a way that temporal relations and properties, like simultaneity, cannot. Here's why. Mutual interaction, insofar as we can cognize it, involves substances' reciprocally exercising forces on one another. These forces have specific quantities that (1) can change even while the intrinsic properties of the relata remain the same and (2) are equal and opposite. While it is true that all cognizable mutual interaction involves substances that stand in the relation of simultaneity, this relation does not allow us to understand why mutual interaction should have either of these properties. It can't explain (1) because simultaneity does not admit of different degrees: all simultaneously existing substances are equally simultaneous. It can't explain (2) since there is no apparent way to derive Newton's Third Law from the mere relation of simultaneity.

By contrast, distance-relations and other spatial properties do allow us to explain and make sense of (1) and (2). With regard to (1), distance obviously does admit of degrees, and we have no trouble understanding that changes in quantity of distance correspond to changes in the quantity of force that two masses of fixed magnitude exert on one another. It is intuitive that two objects placed in close proximity will influence each other more than they would if they were placed at a considerable distance.

With regard to (2), Kant's remarks in a 1791 letter to Hellwag are instructive. Elaborating on his proof of Newton's Third Law in the *Metaphysical Foundations*, he writes that 'in space and its properties alone' lies the '*sole sufficient ground*' of the law of action and reaction (AA 11:247). He says further that this law:

... rests on the relation of active powers in space in general, which relation is necessarily reciprocally opposed to one another [*wechselfeitig einander entgegengesetzt*], because space does not make possible one-sided but rather always reciprocal relations, thus also changes of the same. (AA 11:246)²²

Changes in distance are reciprocal: if X moves 3 feet from Y in 10 seconds, then necessarily Y moves 3 feet from X in those 10 seconds. This fact is not very interesting. But a more interesting fact follows when this reciprocity is taken in conjunction with the notion of a center of mass, understood as a spatial point that necessarily always maintains proportionately the same relative distances to the masses of which it is the center. The fact is this: when you have a mass A and a mass B, and A has mv relative to the center of mass of A and B, then necessarily B has an equal and opposite mv relative to that same center of mass. Kant thinks that because A and B's mv relative to the center of mass is equal and

opposite, the same will be true of any changes in *mv* that come about through their mutual exercise of forces (e.g. in collision). Thus, the forces will necessarily be equal and opposite. Notice that the fact that A and B's *mv* relative to the center of mass is necessarily equal and opposite follows from the very notion of a center of mass (which is itself defined using spatial notions) and from the reciprocal character of distance-relations. Kant's point is that it is only by appealing to the distinctive sorts of possible relations and properties contained in space that the necessary equality of action and reaction in mutual interaction is explained. There is no way of carrying out a similar sort of derivation of the equality of action and reaction in terms of purely temporal notions. I think this is what Kant is getting at when he says that 'in space and its properties alone' lies the '*sole sufficient ground*' of the law of action and reaction (AA 11:247; my emphasis).²³

I have been claiming that Kant thinks that substances-as-appearances' being in space metaphysically grounds the possibility of their mutual interaction by grounding the possibility of their having distance-relations and other distinctively spatial properties. Moreover, I have asserted that the space in which substances-as-appearances are given has an intrinsic Euclidean metric to which they must conform. This might sound very close to the Newtonian view; however, there are two crucial differences. First, for Newton, space makes it possible for bodies to stand in specific distance-relations by containing parts – absolute places – which themselves instantiate every specific distance-relation that it would be possible for bodies to stand in (cf. Earman [1989, 10–12]). There are no possible specific distance-relations that are not already realized by some pair of absolute places. Newton has an analogous view of geometric properties. Absolute space makes it possible for the occupants of space to have various Euclidean shapes because these shapes are already realized by its parts (Newton 2004, 22).

Second, as we saw above, absolute space for Newton is what determines that bodies actually do have some specific distance-relations to one another (and not simply that this is *possible*). In virtue of being in absolute space, any given pair of existing bodies automatically and in virtue of that very fact instantiate some specific distance-relation. E.g., if the absolute places that they occupy are 4 feet apart, the occupying bodies are *ipso facto* themselves actually 4 feet apart. In this respect, for Newton, substances' being in space grounds not just the possibility but the *actuality* (and, indeed, necessity) of their having specific distance-relations to each other.

Kant rejects this picture. First, for Kant, pure space does not contain possible distance-relations by containing parts that realize, or instantiate, such relations. As I read Kant, the possible (Euclidean) distance-relations contained in space are contained within it as un-instantiated possibilities. The same is true, I think, for all the various geometric shapes consistent with Euclidean geometry; they are not, as they are for Newton, already *realized* by the parts of pure space.

I find textual evidence that Kant departs from Newton here in the remark from *Prolegomena* §38 (mentioned earlier) that ‘space is indeterminate with respect to all specific properties’ (AA 4:322). Such a position is consistent with the claim that, in virtue of being in space, spatial substances must conform to a Euclidean distance metric.

Second, Kant denies that being in space is what determines which out of all the possible Euclidean distance-relations gets realized by its occupants. For a set of substances to be in space metaphysically grounds the fact, according to Kant, that they *can* have specific distance-relations to one another. However, it does not ground the fact that they *actually do* have any specific distance-relations. (This is consistent with thinking that whenever substances are in space, they always do actually have specific distance-relations to one another. One fact can imply another without also being its metaphysical ground.²⁴) While Newton takes it to be superfluous to seek for anything beyond space to explain why the things in it actually instantiate specific distance-relations, Kant thinks that being in space is not itself what is responsible for the fact that there are actually specific distances between spatial substances. This fits with a further difference from Newton that we noted earlier: while Newton holds that their being in space determines substances to stand in specific relations of mutual interaction, Kant holds that substances’ being in space merely makes their mutual interaction *possible*. Space does not, as it were, *force* the substances in it to actually exercise specific quantities of force on one another.

I find evidence that Kant rejects Newton’s view that space determines substances to actually stand in specific distance-relations in a remark from the *Antinomies* (mentioned earlier):

Thus space taken absolutely (simply by itself) alone cannot occur as something determining the existence of things, because it is not an object at all, but only the form of possible objects. Thus things, as appearances, do determine space, i.e. among all its possible predicates (magnitude and *relation*) they make it the case that this or that one belongs to reality; but space, as something subsisting in itself, cannot conversely determine the reality of things in regard to magnitude and shape, because it is nothing real in itself. (A431/B459; my emphasis)

In contrast to Newton, Kant says that ‘things, as appearances ... do determine space, among all its possible predicates.’ Kant’s talk of ‘possible predicates’ in the passage can be understood to refer to the distance-relations and other spatial properties²⁵ contained in pure space as un-instantiated possibilities. In Section 4, I offer a proposal about how to understand the manner in which appearances determine that some subset of specific distance-relations gets realized.

I have argued that Kant’s acceptance of Thesis 1 rests on the following grounding claim: substances-as-appearances’ being in space metaphysically grounds the *possibility* of their having distance-relations and other distinctively spatial properties, and in turn the *possibility* of their mutual interaction. Kant and Newton agree on this anti-Leibnizian point, though as we have seen, they

disagree about whether it is being in space that determines bodies to *actually* stand in specific spatial and dynamical relations to one another. A further difference is also noteworthy. Unlike Newton, Kant does not hold that being in space is the only thing that can metaphysically ground the possibility of community among substances. Indeed, Kant *cannot* since he allows for mutual interaction among non-spatial *noumenal* substances – such as the noumenal substances corresponding to my mind and my body (AA 23:31–32; *Nachträge* [1780's]). At least with respect to noumenal substances, Kant is in principle open to Leibniz's suggestion that God is the relevant metaphysical ground of the possibility of *their* mutual interaction. However, we don't have any insight into the way this divine grounding would work, and for this reason, we could never *cognize* such noumenal interaction.

4. Kant's reasons for endorsing Thesis 2

Let's turn to Thesis 2, the claim that cognition of substances' being in a 'communio spatii' (spatial community) entails that those substances are in mutual interaction (A213/B260). By a spatial community, Kant does not mean substances' being in space. Instead, I think he means a state of affairs where substances actually stand in specific distance-relations to one another. Thus, it is a state of affairs in which some specific set of distance-relations is realized.

Thesis 2 has received a fair bit of attention in the literature. However, there is no consensus about Kant's reasons for endorsing it.²⁶ Some commentators take it to be the result of an illegitimate slide between two very different senses of 'mutual determination,' one involving space (e.g. when we say that the position of an object is determined by its spatial relations to others) and another involving reciprocal causal relations (e.g. Strawson [1966, 140]). Other, more charitable commentators interpret the claim differently²⁷ and attempt to find a reputable argument on its behalf (e.g. Guyer [1987, 274–275]).²⁸ But so far, to my knowledge, no commentator has provided an explanation of the justification of Thesis 2 that is at once reputable, consistent with the text of the Third Analogy, and compatible with Kant's other commitments: particularly, the grounding thesis that I ascribed to Kant above.

Why does Kant think that it is impossible for us to cognize that substances-as-appearances actually have specific distance-relations to one another without those substances being in dynamical relations to one another? Let me start with an initial point about the term 'cognition.' As numerous commentators have pointed out, Kant allows for 'false cognition.' E.g., an optical illusion might lead me to judge that the table is 4 feet away when really it is 40 feet away, and my judgment might still count as Kantian cognition. However, Kant does not think that cognition can be false in a systematic way (cf. Watkins [2005, 214n–215n]). I make sense of this as follows: while it is possible to misapply our concepts in particular circumstances in ways that still amount to cognition, this presupposes

that there are true affirmative judgments involving those concepts (or, perhaps, relevantly similar ones) that can be made about the world in other circumstances. A consequence of this is that cognition of a very general proposition like 'there are substances that actually have specific distance-relations to another' cannot be false. If such a judgment were false and yet still cognition, it would have to be the case that this judgment, or a relevantly similar judgment, could be true if made in other circumstances (perhaps not involving optical illusion). But if it were false, there would be no circumstances in which such a judgment could be truly made.²⁹

Now, I understand the cognition involved in Kant's Thesis 2 to be cognition of precisely this general proposition. As such, if we cognize it, it must be true; its being true is a condition on our cognizing it. This points toward a possible way of understanding why mutual interaction is necessary for cognition of spatial community. Perhaps what metaphysically grounds the fact that a set of substances-as-appearances are in spatial community is that the substances actually stand in specific relations of mutual interaction (i.e. they actually exercise some specific amounts of force on another). If this is right, then since we can't cognize that there is spatial community unless there truly is spatial community, actual mutual interaction is necessary for cognition of spatial community. In short: Thesis 2 follows from the claim that substances-as-appearances' actually being in mutual interaction metaphysically grounds their actually having specific distance-relations (which is just what a spatial community amounts to).

This interpretation of Thesis 2 is similar in spirit to Watkins' interpretation of the Third Analogy's main claim that mutual interaction is required for cognition of the *simultaneity of substances* (2005, 219–227). Watkins argues that substances-as-appearances are simultaneous in virtue of the metaphysically more basic fact that they mutually interact (2005, 201). We might put the point by saying that mutual interaction metaphysically grounds the simultaneity of such substances. This is why we can't cognize their simultaneity without their being in mutual interaction. Andrew Chignell and Derk Pereboom have recently objected to Watkins' reading that if Kant were to hold that temporal relations (like simultaneity) are ontologically constituted by the mutual interaction of substances, then given similarities between spatial and temporal relations, Kant ought also to hold that spatial relations like distance are so constituted. They find the consequent implausible and so reject the antecedent (Chignell and Pereboom 2010, 580–81). However, if my proposed interpretation is correct, then Kant holds a version of the consequent, with the caveat that what is constituted is not spatial relations simpliciter, but rather the actuality of spatial relations (specifically, distance-relations). Thus, Watkins need not deny the analogy between temporal and spatial relations.

It is important to note that my proposed interpretation and Watkins' are fully compatible with transcendental idealism. One can allow that substances-as-appearances' being in mutual interaction metaphysically grounds their being

simultaneous (Watkins' claim) and actually having specific distance-relations to one another (my claim), while also allowing that (1) substances-as-appearances are only *spatial and temporal* in virtue of the constitution of our sensibility, and (2) substances-as-appearances are only *substances that are in mutual interaction* in virtue of our so conceptualizing them.

But what reason is there to think that Kant holds this grounding thesis? Kant thinks that for a substance to have a place is for it to be positioned relative to other substances, that is for it to actually have specific distance-relations to them.³⁰ Significantly, in a number of pre-Critical texts, Kant makes actual mutual interaction a condition of substances' having places.

For when we analyze the concept of what we call place, we find that it suggests the actions of substances on each other. (AA 1:20–21; *Living Forces* [1747])

The being of a thing in a place can be so expressed: place is the ground of something, which means as much as: to be in a place is to act externally [*äußerlich*] in certain relations. (AA 17:453; R4199 [1769–1770])

Pure space is merely the potential relation (*die potentiale relation*) and is represented prior to things but not as something actual ... [H]owever, absolute space, as something against which [*als wogegen*] created things stand in actual relation, is impossible. For no substance is present somewhere without acting (*irgendwo gegenwärtig, ohne zu wirken*) and indeed externally; in absolute space, however, there are no correlates [*correlate*]. (AA 17:578; R4512 [early 1770's])

These texts support the idea that, for the pre-Critical Kant, what metaphysically grounds substances' being in places – that is, their actually having specific distance-relations to one another – is their actual mutual interaction.

But what about the Critical Kant? I am unaware of any textual evidence that indicates that Kant suddenly decided to reject this long-held grounding thesis in the years right before the *Critique*, nor do I see philosophical commitments that would require him to reject it (like transcendental idealism). On the contrary, the Critical Kant's continued acceptance of the grounding claim makes sense of the remark in the Antinomies that 'things, as appearances, do determine space, i.e. among all its possible predicates (magnitude and relation) they make it the case that this or that one belongs to reality' (A431/B459). The language here – particularly the word 'determine' – suggests that appearances' *acting* in some way is what makes it the case that some possible relations are realized.³¹ This is what we would expect Kant to say if he holds that what grounds the fact that substances actually have specific distance-relations to one another is that they actually act on one another in specific ways. Furthermore, as we will see, the Critical Kant has philosophical commitments about substances and their accidents that justify his acceptance of this grounding claim. Thus, we have good reason to think that the Critical Kant accepts it. Since it would actually justify Thesis 2, it is reasonable to think it is operating in the background of the Third Analogy.

Before we look more closely at Kant's reasons for endorsing the grounding claim, let's consider the relationship between it and the grounding claim underlying Thesis 1. One might initially worry that the conjunction of these two grounding claims is inconsistent with the asymmetric character of metaphysical grounding: a state of affairs or thing cannot itself be grounded in the very state of affairs or thing that it grounds. As a result, any of the following conjunctions would be metaphysically untoward:

[C1] Substances-as-appearances' being in mutual interaction is what metaphysically grounds their being in a spatial community, and what metaphysically grounds their being in a spatial community is their being in mutual interaction.

[C2] Being in space metaphysically grounds substances-as-appearances' being in mutual interaction, and substances-as-appearances' being in mutual interaction metaphysically grounds their being in space.

[C3] Being in space metaphysically grounds the possibility of substances-as-appearances' being in mutual interaction, and the possibility of substances-as-appearances' being in mutual interaction metaphysically grounds their being in space.

However, the Critical Kant is not committed to any of these. Instead, he holds

[C4] Being in space metaphysically grounds the possibility of substances-as-appearances' being in mutual interaction, and substances-as-appearances' being in mutual interaction metaphysically grounds their being in a spatial community – i.e. their actually having specific distance-relations to one another.

What makes C4 metaphysically kosher is, first, that the grounding claims involve different modalities (possibility vs. actuality) and, second, that they refer, respectively, to substances' being in space and substances' being in a spatial community. It is not the case that one-and-the-same state of affairs or thing is metaphysically grounded in the same state of affairs or thing that it grounds. It is in virtue of being in space that it is possible for substances-as-appearances to be in dynamic community. However, it is not their being in space that grounds the fact that they actually do interact. For Kant, what makes it *possible* for substances to interact is that they are in space. But it is in virtue of actually mutually interacting in specific ways (i.e. exercising some specific amounts of force) that they actually have some specific distance-relations to each other.³²

One might worry that being in space is supposed to ground the possibility of mutual interaction by grounding distance-relations, but distance-relations are supposed to be grounded in mutual interaction. But the violation of the asymmetry of metaphysical grounding is again merely apparent. As I argued in Section 3, being in space grounds the *possibility* of substances' having distance-relations by containing within it merely possible, un-instantiated relations. By grounding the possibility of such relations, being in space grounds the possibility of mutual interaction. This is consistent with it being the case that what grounds the fact that every pair of substances *actually* stand in some specific distance-relation is the fact that they actually interact in some specific way.

But why would the Critical Kant accept this last claim? The first step to appreciating Kant's reasons is remembering that he rejects the Newtonian account according to which being in space does the grounding. Kant thus needs another metaphysical explanation for why it is that any pair of substances in space actually stands in some specific distance-relation. That their actually interacting in specific ways provides the requisite explanation makes a lot of sense, given assumptions that the Critical Kant makes about substances and their accidents.

First, all substances have causal powers (or forces) as part of their natures (B204/B249). This is an assumption that Kant shares in common with Leibniz (1989, 158–160) and Newton (2004, 21). Second, any accidents or states that exist in a substance exist in virtue of its exercising its own causal powers.³³ While a substance cannot bring about changes of state – e.g. changes in its momentum – all on its own, all of the accidents that actually inhere in it owe their actuality to the exercise of its distinctive powers. This assumption has been dubbed the principle of active inherence (PAI) (see Thorpe [2011]). The rationale behind PAI is that if the fact that a substance actually has a given accident is not grounded in the causally active nature of that substance, then there is no basis for saying that the accident in question actually inheres in the substance. An opponent of PAI would need to give some alternative criterion of the inherence of an accident in a substance; it is not obvious what this would be.

Now, accidents like distance are *relations*; as such, the distance of *X* relative to *Y* inheres as much in *X* as it does in *Y*. Given this fact, PAI entails that the existence of a specific distance-relation must have a basis in the exercise of the causal powers of both *X* and *Y*. Furthermore, as we saw earlier, distance is a reciprocal relation: substance *X* cannot change its distance relative to the center of mass of *X* and *Y* during time *t* without *Y* proportionately changing its distance relative to that center of mass during *t*. Given that distance is a reciprocal relation, PAI implies that the existence of specific distance-relations among spatial substances is due to their reciprocally exercising their forces on one another. What makes it so that spatial substances *X* and *Y* are actually some specific distance apart is, then, their actually interacting in specific ways: their exercising specific amounts of force on one another. By contrast, on the Newtonian view (as Kant understands it), the metaphysical ground for the fact that every pair of spatial substances actually exert some specific amount of force on one another at each moment is the fact that they actually stand in some specific distance-relation at each moment. As for why they actually stand in some specific distance-relation at each moment, this is simply due to their being in (absolute) space. Kant's view turns the Newtonian position on its head.

Before concluding this section, something needs to be said about whether and how Kant can reconcile his grounding claim with the apparent fact that the amount of force (e.g. attractive force) a pair of substances actually exert on one another at a given moment is influenced by the actual distance they are apart, and so it would seem dependent on it. Consider the law of universal gravitation,

which says that the amount of attractive force two masses exert on one another is inversely proportional to the square of their distance. Kant is in a delicate position here, though there are at least two possible strategies that he might pursue. One very radical strategy would be to deny that the specific amount of force two spatial substances exert on one another at a given moment is truly metaphysically dependent on the specific amount of distance between them at that moment. The law of universal gravitation, it might be claimed, describes a relation between quantities without itself revealing which are the ones whose actuality is metaphysically basic. In fact, so the radical strategy runs, the basic quantity is the actual amount of attractive force; facts about the actual quantity of distance between a pair of substances at a given moment are metaphysically derivative on more basic facts about the actual quantity of attractive force they exert on one another (along with facts about the quantities of their masses and the value of the gravitational constant).

A more concessive strategy would allow that quantities of distance do indeed influence quantities of force and are in turn influenced by them: substances move closer or farther depending on the net quantities of force exercised on them. However, it might be claimed, this is consistent with the grounding claim above. The existence of particular quantities of distance between substances is not what metaphysically grounds the fact that at each moment in time they actually do (and indeed must) exercise *some specific quantity or other* of force (e.g. attractive force). Changes in specific quantity of distance cause changes in the specific quantity of force exerted and vice versa, but that substances actually exercise some specific quantities or other of force(s) in the first place is not metaphysically accounted for by their being some specific distances apart. To claim otherwise would be to endorse the paradoxical position that their existing accidental relations force them to actually exercise the forces characteristic of their substantial natures. On the contrary, what metaphysically grounds spatial substances' actually being some specific distance or other apart at each moment in time is the metaphysically more basic fact that that they actually (and indeed, must) exercise their characteristic forces to some specific degree or other at each moment.

5. Conclusion

I have considered Kant's reasons for endorsing Theses 1 and 2, claims which Kant commits himself to in the Third Analogy and General Note. I have argued that these theses rest on an account of the relationship between space and mutual interaction. Thesis 1 rests on the claim that substances-as-appearances' being in space metaphysically grounds the possibility of those substances' being in mutual interaction. It is for this reason that there can be no cognition of mutual interaction among substances without those substances' being in space, which is what Thesis 1 says.

Thesis 2 rests on the claim that substances-as-appearances' actually standing in specific relations of mutual interaction metaphysically grounds their being in spatial community – that is, their actually having some specific distance-relations to one another. It is for this reason that there is no cognition of spatial community without those substances' actually interacting, which is what Thesis 2 says. Kant departs fundamentally from Newton on this point, whom he takes to hold that space determines existing substances to both be in spatial community and to be in mutual interaction. This left Kant needing to give an alternate metaphysical explanation for why substances *actually* have specific distances to one another. PAI is what provides the rationale for the grounding claim underlying Thesis 2.

One final question: What if anything, for Kant, metaphysically grounds the fact that substances-as-appearances *actually* (not possibly!) exercise some specific amounts of force on one another? My thesis in this paper does not stand or fall with my giving any answer, but let me suggest one: the ground lies in the very natures of these substances, which is to be causally active.

Notes

1. References to the first *Critique* are given according to the pagination of the first (A) and second (B) editions. References to other works by Kant are by volume and page number in the Academy edition (cited as AA). Translations of Kant's writings are from the Cambridge Translation of the Works of Immanuel Kant, with the exceptions of Kant's *Reflexionen*, *Nachträge*, and *Correspondence*, where the translations are my own.
2. I focus on Kant's account in the second edition of the *Critique*. The second edition is generally more insistent than the first on the crucial role of space and motion in the application of the categories. For a discussion of some of the changes in the second edition and their relation to the *Metaphysical Foundations*, see Förster (2012, 66–74) and Friedman (2013, 1–11).
3. Note that this is not the only case of mutual interaction for Kant; the concept offered in the Third Analogy is more general.
4. E.g., 'Every individual created substance exerts physical action and passion on all the others' (Leibniz 1989, 33).
5. One particularly noteworthy advance is Watkins' (2005, 219–227) proposal that Kant's argument relies on the idea that, without coexisting substances' standing in mutual interaction, it would not be cognizable that they have coexistent states because the mutual interaction of substances is constitutive of substances' having coexistent states.
6. I explain in Section 3 why I take Kant's remarks in B292–293 to show commitment to Thesis 1.
7. I use the technical phrase 'metaphysical grounding' here in the following sense: it is an irreflexive, asymmetric, transitive relation distinct from causality such that if A metaphysically grounds a state of affairs or fact B, then (1) B obtains in virtue of A, (2) A explains why B obtains, and (3) A is ontologically prior to B. 'A's' can be either states of affairs, facts, or entities. Where A's and B's are states of affairs or facts, they include a modal status: e.g. substances' *being* in mutual interaction or

substances' *possibly* being in mutual interaction. This account of metaphysical grounding draws on aspects of some influential contemporary accounts. See Fine (2012) and Rosen (2010).

8. Namely, the interpretation in Watkins (2005), which has recently been criticized by Chignell and Pereboom (2010). The truth of my interpretation, however, does not presuppose the truth of Watkins.'
9. For a recent discussion, see Friedman (2013, 11–17).
10. As Newton puts the point in *De Gravitatione*, 'Space is an affection of being just as being. No being exists or can exist which is not related to space in some way' (Newton 2004, 25).
11. Kant here speaks of space *and* time. It is significant, though, that when he returns to the issue a few pages later, talk of time drops out (e.g. at AA 2:406–7).
12. One might initially think that Kant means to be talking here only of spatial relations, not dynamic relations. However, when this passage is read in conjunction with a related remark a few pages later in the ID, there can be no doubt that he means also to be talking of dynamical relations: 'Those who take space and time for some real and absolutely necessary bond, as it were, linking all possible substances and states, do not think that anything further is required in order to understand how a certain originary relation, *as the fundamental condition of possible influences ...* should belong to a plurality of existing things' (AA 2:406; my emphasis).
13. See footnote 7 for the meaning of 'metaphysical grounding.'
14. Interestingly, Kant's reading of Newton here agrees with the reading of Newton in Brading (2013).
15. When Kant speaks of things being 'present' to one another, he generally means causally present to one another: e.g. AA 1:483; *New Elucidation* [1755].
16. This is not to deny that aspects of Kant's *positive* position on lots of issues – including mutual interaction – might have shifted around during this time. But it is not plausible that he would have suddenly changed his mind on this *negative* position, deciding that the Newtonian view is completely right after all. For one thing, the Newtonian view invokes absolute space, which Kant continuously rejects from the 1770s onward. Moreover, a common thread during Kant's period of philosophical experimentation is the belief that a radical break from his predecessors is necessary.
17. *Prolegomena* §38 contains a discussion of the law of universal gravitation, which is a paradigm case of mutual interaction. This makes it hard to resist the conclusion that the law of mutual interaction is foremost in Kant's mind as one of the 'natural laws' in question. For such a reading, see Messina (*forthcoming*). It might be objected here that there are passages that suggest that Kant thinks that space is the metaphysical ground of the necessity of mutual interaction: e.g. AA 17:579; R4515 (1770's), AA 29:865 and AA 29:868; *Metaphysics Mrongovius Lectures* (1782–3). However, I think the right way to read such claims is in light of what Kant says at AA 28:213; *L1 Metaphysics Lectures* (mid-1770s): if substances actually stand in specific distance-relations to each other, then this entails they are in mutual interaction ('that is already so, that must already be so ...'). However, their actually being in specific distance-relations is not itself what determines the substances to mutually interact in specific ways. As I will argue, Kant holds that the actual mutual interaction of substances-as-appearances is the metaphysical ground of their actually having specific distance-relations to one another. Given the irreflexivity of grounding, he cannot claim that their actually having specific distance-relations in turn grounds their actually being in mutual interaction.
18. For three exceptions, see Buchdahl (1969, 577–579), Friedman (1992, 38–39), and Morrison (1998, 266–268).

19. The possibility at issue here is what Kant calls *real possibility*. For discussion, see Chignell (2009).
20. E.g., AA 28:325; *L1 Metaphysics Lectures* (mid 1770s) and AA 2:414; *Inaugural Dissertation*.
21. Thanks to referees for pushing me on this.
22. Cf. AA 18:321; R5662 (1788–1790).
23. A referee has asked me to explain how distance-relations help in a case where there is heat exchange between two bodies in contact, such that one gets colder while the other gets hotter. However, it is not fully clear to me that Kant would count this as an instance of mutual interaction. For Kant, the paradigm cases of mutual interaction are cases of collision and gravitation.
24. See note 17 in this regard.
25. In addition to specific distance-relations, Kant is also talking about specific sizes and shapes.
26. Kant's explicit explanation in the Third Analogy is cryptic and has the appearance of an illustration rather than a justification.
27. Morrison (1998, 269), e.g., claims that 'mutual interaction means, for Kant, a mutual determination of position.' Thus, on her view, Kant is not guilty of the illegitimate slide mentioned above. But pace Morrison, Kant must take mutual interaction to have a more general meaning than spatial relatedness (otherwise, he could not talk of noumenal entities being in community).
28. As Guyer understands Kant's argument for Thesis 2, Kant is claiming that judgments about the spatial positions of substances depend for their justification on judgments about the mutual interaction of those substances. One problem with Guyer's reading is that he fails to adequately explain why the one sort of judgment depends on the other sort of judgment.
29. Even if one does not accept my particular explanation for why cognition of such a general proposition must be true for Kant, I think it still plausible that Kant is using the term 'cognition' in the Analogies in a strong sense to mean what we call knowledge.
30. E.g., 'Place [Ort] is determinate position, i.e., relation to other things in space' (AA 29:839–40; *Metaphysics Mrongovius Lectures* [1782–83]).
31. I am focusing here on Kant's account of *distance-relations*. I leave it open how to understand the grounding of the actuality of specific *sizes and shapes* – though I am attracted to the idea that actual relations of mutual interaction also perform this job.
32. It might be objected: since actuality entails possibility, actual mutual interaction must also metaphysically ground the possibility of distance-relations by grounding their actuality. But this objection presupposes that entailment relations and relations of metaphysical grounding are the same thing; they are not.
33. See, e.g., AA 29:823; *Metaphysics Mrongovius Lectures* [1782–3]: 'substance acts, insofar as it contains not merely the ground of the accidents, but rather also determines the existence of the accidents; or substance, insofar as its accidents inhere, is in act, and it acts insofar as it is the ground of the actuality of the accidents.'

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Notes on contributors

James Messina received his PhD in philosophy from UCSD in 2011. He is currently an assistant professor in the philosophy department at UW-Madison. He works on Kant, early modern philosophy, and German Idealism.

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