



Kant and Newton on the a priori necessity of geometry

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ABSTRACT

In the Transcendental Aesthetic, Kant explicitly rejects Newton's absolutist position that space is an actually existing thing; however, Kant also concedes that the absolutist successfully preserves the a priori necessity that characterizes our geometrical knowledge of space. My goal in this paper is to explore why the absolutist can explain the a priori necessity of geometry by turning to Newton's *De Gravitatione*, an unpublished text in which Newton addresses the essential features associated with our representation of space and the relationship between our geometrical investigation of space and our knowledge of the form of space that is a part of the natural order. Attention to Newton's account of space in *De Gravitatione* offers insight into the sense in which absolutist space is a priori and reveals why, in the Aesthetic, Kant could concede a priori geometrical knowledge to his absolutist opponent. What I highlight in particular is that, by Kant's standards, Newton employs the very constructive method of mathematics that secures the a priori necessity of geometry, even though, as an absolutist, and as emphasized in the arguments of the Aesthetic, Newton fails to provide a metaphysics of space that explains the success of his mathematical method.

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1. Introduction

Kant's general goal in the Transcendental Aesthetic is to establish that space and time are a priori (pure) forms of intuition, which serve as conditions for the possibility of having empirical intuitions, that is, of experiencing any objects at all. Insofar as space and time are established as necessary components of all human experience, they are presented in the Aesthetic as empirically real, yet insofar as they are claimed to attach only to the "subjective constitution of our minds" (and not to things in themselves), space and time are also rendered transcendently ideal. Kant famously forwards this metaphysics of space and time as an improvement over the absolutism associated with Newton and the relationism associated with Leibniz.¹ Indeed, as Kant initially

questions what space and time are, he offers their positions as the only alternatives to be considered:

Now what are space and time? Are they actual entities? Are they only determinations or relations of things, yet ones that would pertain to them even if they were not intuited, or are they relations that only attach to the form of intuition alone, and thus to the subjective constitution of our minds, without which these predicates could not be ascribed to any thing at all? (A23/B37–8)²

Given Kant's goal to show that his characterization of space and time improves upon the characterizations offered by absolutists and relationists, it is quite natural and remains quite common to read the arguments offered in the Aesthetic as arguments intended

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¹ There is no explicit reference to Newton or to Leibniz in Kant's discussion of absolutism and relationism. The only mention of either of them in the Aesthetic comes in §8, where Kant criticizes the logical distinction between sensibility and intellect associated with the "Leibnizian-Wolffian philosophy" (A44/B62). Nonetheless, that Newton and Leibniz are Kant's primary targets in his discussion of space and time has never been a matter of scholarly dispute, primarily because of Kant's engagement with Newton's and Leibniz's positions on space and time in his pre-Critical works. See, for instance, the detailed discussions in Friedman (1992) and Laywine (1993). Hatfield (2006) offers a broader view of the absolutist and relationist positions to which Kant was reacting and also considers the positions of Descartes, Wolff, and Crusius.

² Unless otherwise noted, all references to the First Critique are taken from Kant (1999) and follow the standard A/B pagination, which refers to the first (1781) and second (1787) editions, respectively.

to undermine the positions taken by his opponents. Kant's treatment of space, which will be my focus throughout this paper, lends support to this sort of reading; however, in regard to the absolutist position, an interpretive problem remains.

Consider first the relationist position, according to which our representation of space is a concept that expresses the possible relations between actually existing things. To put it in the terms of the Aesthetic, the relationist relies on the alleged priority of our experience with essentially non-spatial entities such that to represent space is to represent a concept that expresses the "determinations or relations of things, yet ones that would pertain to [these things] even if they were not intuited." One of the major failings Kant associates with this account of space is its inability to explain the a priori necessity of geometry: since the relationist concept of space is derived from experience, the geometrical investigation of space ultimately rests on empirical, a posteriori grounds, and as a result, geometrical knowledge is rendered contingent rather than necessary. In §7 of the Aesthetic, where the relationists are branded "metaphysicians of nature," Kant puts the problem they face as follows:

they must dispute the validity or at least the apodictic certainty of *a priori* mathematical doctrines in regard to real things (e.g., in space), since this certainty does not occur *a posteriori*, and on this view the *a priori* concepts of space and time are only creatures of the imagination, the origin of which must really be sought in experience, out of whose abstracted relations imagination has made something that, to be sure, contains what is general in them but that cannot occur without the restrictions that nature has attached to them. (A40/B57)

Kant's main point here is that since the relations that define space are, for the relationists, abstracted from and thus contingent on our experience with bodies, the alleged truths of geometry are subject to empirical disconfirmation.

Given the absolutist's claim that space is an actually existing thing that subsists in nature, one might well expect that the charge above would also be leveled against the absolutist. For, assuming that our geometrical and idealized representation of space is not innate, which is Newton's position, the space investigated by the absolutist in geometry is a form of space gleaned from experience such that our knowledge of space in some way depends upon our interaction with nature. As such, it would seem that these "mathematical investigators of nature," just as the "metaphysicians of nature," would have an apparent difficulty explaining the a priori necessity Kant takes to be characteristic of geometry. However, as Lisa Shabel's (2005, 2010) recent treatments of the Aesthetic nicely bring to light, this peculiar challenge to absolutism is curiously absent from Kant's discussion. In fact, Kant concedes that the absolutist can explain our a priori geometrical cognition of space and can also explain the applicability of geometry to appearances (i.e., to objects as they are presented to us in the course of human experience). Where they falter is in extending their geometrical knowledge too far and applying geometrical truths to things in themselves and, specifically, to a form of space that is taken to be an actual, transcendentally real and self-subsisting thing. As Kant puts the point, the "mathematical investigators of nature" "succeed in opening the field of appearances for mathematical assertions. However, they themselves become very confused through precisely these conditions if the understanding would go

beyond this field" of appearances, presumably, to the field of objects that stand outside the domain of human cognition (A40/B57).

Kant's concession that the absolutist can explain our a priori cognition of space invites some reflection on just how Kant understands the form of space that is the subject matter of the absolutist's geometrical investigations. On the face of it, it seems that for Kant to consistently claim, on the one hand, that the necessity of geometry is tied to the a priori status of space (as he does in the Aesthetic and other texts from the Critical period) and, on the other, that the "mathematical investigators of nature" can explain the necessity of geometrical cognition, he must accept that the space investigated by the absolutist in geometry is a priori in some significant way. That is, in order for Kant to maintain that the absolutist can generate geometrical propositions that are neither "empirical or judgments of experience, nor inferred from them" (B41), he must admit that the absolutist's representation of geometrical space is not, as the relationist representation of space, a creature of the imagination whose properties depend on our experience of objects. In light of these concerns, Shabel (2005) suggests that Descartes might in fact serve as a better representative of the "mathematical investigators of nature" targeted in the Aesthetic. The suggestion makes good sense, since for Descartes, our representation of space is innate and hence a priori and is also identified with the material bodies of the external, natural world. Thus, on the Cartesian view, the a priori geometrical cognition of space is not tainted by experience and, additionally, geometrical truths faithfully map on to the bodies and space of experience (cf. Shabel, 2005, p. 38). Shabel's proposal is illuminating, insofar as it grants important insight into Kant's relationship to one of his key predecessors in natural philosophy;³ however, we are still left to wonder how Newton himself, who is by all standard accounts the chief representative of the absolutism targeted in the Aesthetic, can meet the demands of a priori geometrical cognition that Kant sets forth in his Critical philosophy.⁴

This is the interpretive problem on which I focus in what follows, and I address it by appealing to Newton's now famous *De Gravitatione*, an unpublished text in which Newton details (1) the essential features associated with our representation of space, (2) the relationship between space and the bodies situated in space, and (3) the relationship between our geometrical investigation of space and our knowledge of the form of space that is a part of the natural order.⁵ Though Kant was, of course, entirely unfamiliar with this text, attention to Newton's account of space in *De Gravitatione* offers insight into the sense in which absolutist space is a priori and reveals why, in the Aesthetic, Kant could concede a priori geometrical knowledge to his absolutist opponent. These issues will be the focus of Sections 2 and 3 below. In Section 4, I put Newton's account of geometrical reasoning into conversation with the arguments forwarded in the First Critique and in the *Prolegomena* (1783) and aim to show that there are important affinities between Newton's and Kant's approach to geometrical cognition, and to the practice of geometry, that lend further insight into how, by Kant's own standards, Newton can maintain the a priori necessity of geometrical knowledge. What I highlight in particular is that while Newton remains committed to the priority of experience over geometry—to the claim that we cannot geometrically investigate the features of space, or even have a geometrical representation of space, until we first encounter spatially-located empirical objects—he relies on the very methods for constructing geometrical, a priori spatial

³ Though I don't think the suggestion is without potential problems. See Note 10 below.

⁴ Shabel (2005) briefly considers Newton's characterization of geometrical cognition, but she doesn't elaborate on the sense in which Newton's absolutist space is a priori, an issue that I think requires further attention if we are to understand precisely why, for Kant, Newton can maintain the a priori status of geometrical knowledge.

⁵ The fuller title of *De Gravitatione* is "On the Gravity and Equilibrium of Fluids." There has been significant controversy about the dating of this undated manuscript (see Janiak's Introduction to Newton, 2004, p. xviii, Note 14). The precise date of composition is not crucial to the arguments I make below; I simply rely on the assumption (which is embraced by all commentators) that *De Gravitatione* was penned by Newton prior to the first (1687) edition *Principia mathematica*.

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